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The subfossil fauna of Goat Cave and Prostate Pit Cave, Mundrabilla Station, Nullarbor Plain, Western Australia

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ABSTRACT – The Nullarbor Plain of southern Australia contains a vast karst system, with thousands of caves recording remains of the original fauna before European modification of the Australian landscape and biota. The Nullarbor region records the highest rate of mammal extinction in Australia. We report the results of an expedition to the Nullarbor Plain, with surface collections from Goat and Prostate Pit caves. Goat Cave preserved 25 mammal, six bird, six reptile and three snail taxa and had incredibly well preserved, fully furred, mummified Common Brush-tailed Possums and a Chuditch. Prostate Pit Cave preserved 20 mammal, one bird, seven reptile and four snail taxa. Accumulation of remains in Goat Cave was predominantly due to predation from Australian Masked Owls, while remains in Prostate Pit Cave were accumulated mainly by Dingoes and pitfall trapping. We also report cave use by brushtail possums and Dingoes, and a collection, transport, and preservation methodology for fragile soft-bodied, furred, cave mummies.

KEYWORDS: mammals, birds, reptiles, snails, owl roost, Dingo den

INTRODUCTION

The Nullarbor Plain is a vast plain in southern Australia, extending across the southern border of South Australia and Western Australia. It is the world's largest exposed karst terrain, with a vast system of shallow caves beneath the arid surface (Woodhead et al. 2019). The Nullarbor caves have been accumulating faunal remains since the middle Pleistocene, when the Nullarbor Plain was covered in open woodland with records of arboreal species, including tree kangaroos (Prideaux et al. 2007; Prideaux and Warburton 2008, 2009). By the late Pleistocene the woodland had retreated, and the fauna changed over many climatic cycles (Lundelius 1963; Lundelius and Turnbull 1973, 1975, 1978, 1981, 1982, 1984, 1989, 1999; Lundelius et al. 2025).

A biological survey of the Nullarbor region in 1984 showed that the diversity of fauna had been declining, with several species becoming extinct in the last 100 years (Boscacci et al. 1987). This was also shown by a review of the subfossil record accumulated in caves in the region, demonstrating that many species recorded from the cave floors were no longer extant on the Nullarbor Plain (Baynes 1987). The decline is attributed to two major events. First by diseases in the late 19th century claiming some species, including brushtail possums, possibly one of them being toxoplasmosis spread by feral Cats (*Felis catus*; Richards and Short 1996). The other reason is the arrival of foxes in 1917 that predated many medium-sized species such as the bilby, bandicoots, bettongs (Richards and Short 1996). Both exotic species were aided by the establishment of bores to provide water for the Transcontinental Railway.

Goat Cave (6N-0745) is located on Mundrabilla Station on the Nullarbor Plain, on Mirning Country (Figure 1). It was first surveyed and mapped by Max Meth, Ray Gibbons and Ken Boland in 1996, with only the entrance chamber and some side passages known at the time (MacLucas 1996). In 2023, a party of cavers, including Alan Pryke, Megan Pryke, Bert De Waele and Brett Wiltshire, made a significant discovery (De Waele et al. 2023). They found multiple mammal remains beyond the entrance series of chambers, of brushtail possums that were fully furred. While this part of the cave was slowly uncovered over multiple

trips over multiple years (2021–25) by multiple teams of people, the 2023 discovery was the one that identified Goat Cave as a significant site (De Waele et al. 2023). The discovery was reported to the Western Australian Museum (WAM), which after seeing the incredible preservation of the brushtail possums, decided to undertake an expedition to the Nullarbor Plain to recover those specimens.

Prostate Pit Cave (6N-1369), also on Mundrabilla Station (Figure 1), was first recorded by Plane Caving members David 'Max' Hall, Judy Shaw and Phil McGuigan in April 1995 (Poulter 2020). It was named by the late Lindsay Hatcher to honour a friend who was suffering from prostate problems at the time. Some specimens were collected by Lindsay Hatcher from the cave, including skulls of Tasmanian Devil (*Sarcophilus harrisii*), Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*) and Western Grey Kangaroo (*Macropus fuliginosus*), which were donated to WAM after his passing. The cave is well-known to cavers who visit it to see stegamites, gypsum and halite columns, and calcite decorations. It also contains unique invertebrates, including cave spiders in the genus *Troglodiplura* (Poulter 2020). Nothing has been reported to date of its vertebrate remains.

Herein we report the findings of the 2025 expedition to Goat Cave and Prostate Pit Cave on the Nullarbor Plain. We present the collection of terrestrial vertebrate and mollusc specimens, some interpretation of how the caves were used by animals in the area, and what species were there until extirpation after the arrival of Europeans in Australia.

MATERIALS AND METHODS

FIELDWORK

Fieldwork to recover vertebrate remains was undertaken between the 20th and 28th of April 2025. Three days of works was undertaken at Goat Cave, and two days at Prostate Pit Cave. Opportunistic collection of live fauna (invertebrates and reptiles) was also conducted in the cave dolines and surrounding area with the assistance of a cultural monitor.

RECOVERY OF MUMMIFIED SPECIMENS

The mummified remains were photographed on a previous expedition, but their structural integrity was unknown to the collection team as they were not touched or moved by the cavers. Each mummified

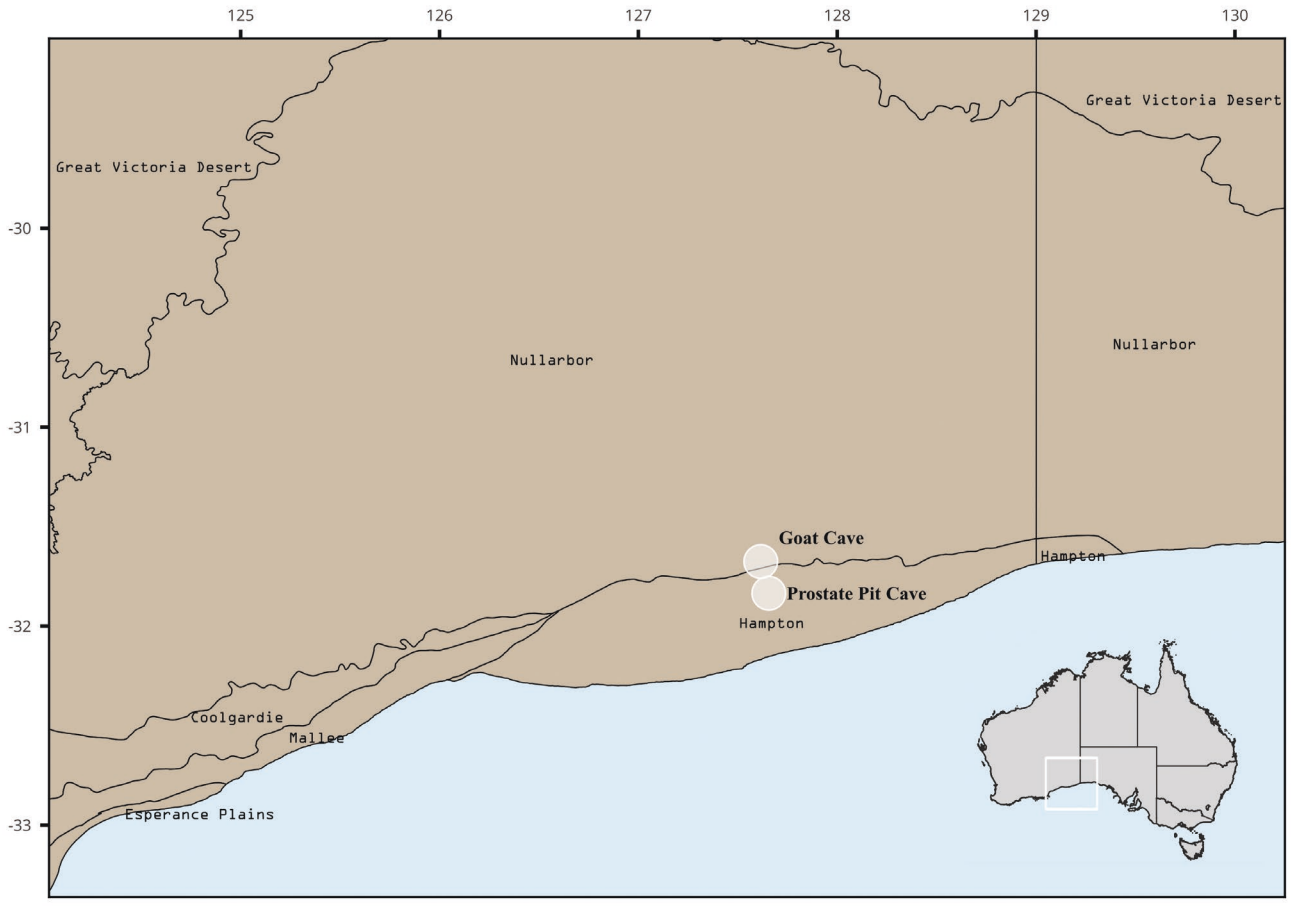

FIGURE 1 General location of Goat and Prostate Pit caves on the Nullarbor Plain, Mirning Country, Western Australia.

FIGURE 2 Recovery of the mummified specimens.

animal was mapped to the nearest cave survey marker, photographed, measured, and probed for overall preservation integrity and pliability on day one in Goat Cave. External measurements for the specimens marked for retrieval were used to precut rectangular pieces of 3 mm white foam board for mounting. Each mounting board also had corner braces and a lid, and two pieces of 10 mm dowel rod, flat-packed into a labelled, 150 µm thick, clear polyethylene 'mining sample' bag, for final assembly with cloth tape in the cave (Figure 2). Flat packing allowed for easier transport of materials into the cave. Each mummy was slid onto the flat mounting board and pinned into place with fine stainless steel entomological pins to prevent movement in any direction. After pinning, the corner braces and lid were added to the mounting board to prevent compression, and the wooden dowel rods positioned diagonally across the lid and base to prevent twisting. The mining bag was slid over the 'boxed' mummy and taped shut, with corners folded, flattened, and taped to prevent snagging. The bag prevented dust incursion and fluctuations in humidity as the specimen was transported through the cave. A cloth tape handle was added to the lid of the box for passing the package one-handed through cave crevices.

All mummified remains in their sealed packages were then packed into a padded Pelicase in the entrance cavern of Goat Cave which was filled with packing peanuts to minimise movement during transport back to the vehicle and during return to Perth.

COLLECTION OF SUBFOSSILS

Collection of subfossil material was only from the cave floor surface, by hand, with natural and LED headtorch light. Surface density of subfossil material was localised to patches within the entrance chamber of both caves, positioned beneath suitable owl roost location or within the range of pitfall trappings. As all collections were made by hand, the smallest vertebrate remains (disarticulated anurans, passerines, geckos and small skinks) are likely to be under-represented.

IDENTIFICATION OF SUBFOSSILS

Taxonomy follows the WAM Taxonomic Checklist (https://visit.museum.wa.gov.au/collections/terrestrial-zoology/checklist-terrestrial-vertebrate-fauna-WA). All subfossils were first sorted into major taxonomic groups: mammals, birds, reptiles and molluscs. Then they were identified to order or family. Using WAM collections, comparative specimens were used to identify to the lowest taxonomic rank possible, subspecies for some of them (e.g. *Chaeropus ecaudatus occidentalis*), or morphotype for osteologically cryptic taxa (e.g. Agamidae morphotype 1). Examples of each taxon identified are shown in Figures 3–10.

The mummified specimens of *Amphibolurus norrisi* and *Pseudonaja affinis* were identified using preserved external morphological characters reported by Storr et al. (1983), Storr et al. (2002) and Cogger (2018).

RESULTS

GOAT CAVE

Entrance chamber

Subfossils collected in the entrance chamber consisted of 25 mammal, six bird, five reptile and three snail taxa (Table 1). The number of identified specimens (NISP) of mammals is 422. The bulk of the bones are likely prey remains accumulated by predators such as Australian Masked Owl (*Tyto novaehollandiae*), Dingo (*Canis familiaris*), Red Fox (*Vulpes vulpes*) and feral Cat, all of which have remains also collected in the cave. One intact, mummified, Mallee Dragon Lizard (*Amphibolurus norrisi*) was found underneath a ledge outside of the reach of sunlight suggesting the individual may have been unable to climb out of the cave once cold, effectively pit-trapped within a few metres of the cave opening.

The absence of diplodactylid or gekkonid geckos in the surface material is unexpected, but most likely due to size biases as they are smaller vertebrates than others collected (snout-vent lengths usually <50 mm).

A specimen of Nullarbor Marbled Gecko (*Christinus alexanderi*, WAM R182378) was collected from within 50 m of the mouth of Goat Cave during this expedition, and a Tree Dtella (*Gehyra variegata*, WAM R182379) vouchered from the camp site ~800 m from the cave. Carphodactylid gecko material attributed to Southern Barking Gecko (*Underwoodisaurus milii*) was relatively abundant in the entrance chambers of both Prostate Pit and Goat caves and a live specimen was found basking on a rock pile outside Goat Cave (WAM R182377). Most of the fossils attributed to the family Agamidae could not be further refined due to a lack of comparative osteological material and the lack of morphological variation between species detectable from isolated or incomplete elements (see Ramm et al. 2024).

Snake and Possum Chamber

One chamber contains both a snake skeleton and a possum skeleton (hence the name of the chamber). The snake skeleton namesake for this chamber is a partially mummified adult Dugite (*Pseudonaja affinis*). The head was found wedged between loose limestone boulders and collected for identification purposes. The mummified body remains in-situ to preserve the context of the chamber name and as a landmark for cavers.

Beyond the entrance series

Deep into the cave tunnels, remains of nine brushtail possums were found on the cave floor surface. Some were incredibly well preserved, being fully furred and one having a blood-stained nose (Figure 11A), while others were completely skeletonised on a thin cushion or ring of fur. All specimens were identified as juveniles, due to their small size, and their teeth showing deciduous premolars still present or the M4/m4 not erupted. Scent trails (urine stains) and possum scats were found on the path in multiple areas of the cave, showing that possums were regularly using the cave. A very small Chuditch (*Dasyurus geoffroii*) approximately 32 cm in length from head to tail tip and 12 cm in width, was also found mummified (Figure 11B), with only the right forepaw fully skeletonised. A mummified microbat was also mapped and photographed, then left in place as it was too fragile to move.

PROSTATE PIT CAVE

Entrance chamber

Subfossils collected in the entrance chamber consisted of 18 mammal, one bird, seven reptile and four snail taxa (Table 1). The number of identified specimens (NISP) of mammals is 72. Skeletal remains of Tasmanian Devils and Southern Hairy-nosed Wombats had previously been recovered from this cave, but it is not clear if they were collected from the entrance or further inside the cave. Possum urine on one of the devil skulls suggests that it was collected further into the cave. There was no evidence of Australian Masked Owl in the cave, and the prey size was biased toward larger animals, lacking the usual abundance of small rodents and small dasyurids which are typical of owl diets. As a result, the accumulation of bones is likely from mammalian predators such as Dingo and Red Fox whose remains were found in the cave.

Dingo den

A set of chambers with a very low ceiling, named the 'ossuary' by cavers, was littered with large macropod bones (Figure 12A). There were fewer remains from other mammals such as Rabbit (*Oryctolagus cuniculus*), bandicoots and brushtail possums, and only one reptile represented by one large agamid dentary. The prey species and the way bones were broken suggest that this area of the cave was used by Dingoes to feed (the prey size rules out foxes as the main contributor). Several locations in the chamber had an accumulation of bones in front of depressions in the cave floor, that appeared to be dug by Dingoes to rest in. We believe this is the first time this behaviour is reported. Along the back walls of the chambers, brushtail possum scats were found in stacks (Figure 12B). This suggests that possums would come into the chamber and follow the edge of the chamber, rather than going through the middle, perhaps to avoid becoming a Dingo meal. They would likely feed from carcasses left by Dingoes or perhaps steal some of the carcasses (see section on brushtail possum den). No Dingo scat was found within the Dingo den chambers. However, immediately outside the Dingo den chambers, there was a large raised platform with several Dingo scats on it, which we suspect was used as a latrine.

Brushtail possum den

In a chamber that was topographically higher than the Dingo den, the floor was covered in brushtail possum scats, with a few small carcasses, mostly Rabbit remains, present amongst the scats (Figure 13A). This chamber is interpreted as being a brushtail possum den, with scavenged remains that they potentially stole from other predators (proximity suggests the Dingo den). This chamber is connected to another much larger room by a tunnel with trails of possum scats, this room had multiple trails of scats going in various directions within it (Figure 13B). It is interpreted here that the scats were used as scent trails in the dark for the possums to find their way to various resting spots within the chamber. One resting spot was a large speleothem covered in possum urine (Figure 13C). These two chambers and the Dingo den were the only place in the Prostate Pit Cave that large amounts of possum scats were found, suggesting that brushtail possums fed in the same area that they also used as latrines (contrary to the Dingoes).

TABLE 1 Species and specimen list of the subfossils recovered from Goat Cave and Prostate Pit Cave with Western Australian Museum registration numbers. † † = extinct; † = locally extinct.

Taxon	Goat Cave	Prostate Pit Cave
MAMMALIA		
Order: Monotremata		
Tachyglossus aculeatus (Short-beaked Echidna)	-	M65630
Order: Dasyuromorphia		
Antechinomys sp. † (kultarr)	M65640	M65639
Dasycercus archeri † † (Southern Mulgara)	M65638	-
Dasycercus cristicauda † † (Crest-tailed Mulgara)	M65636	-
Dasyurus geoffroii † (Western Quoll/Chuditch)	M65637, M65692	M65632
Sarcophilus harrisii † (Tasmanian Devil)	-	04.2.403-404, 2024.3.1
Sminthopsis dolichura (Little Long-tailed Dunnart)	M65635	M65634
Order: Peramelemorphia		
Chaeropus ecaudatus occidentalis † † (Pig-footed Bandicoot)	M65612, M65613	-
Macrotis lagotis † (Greater Bilby)	M65614	-
Perameles myosuros † † (Marl)	M65610	M65625
Perameles papillon † † (Nullarbor Barred Bandicoot)	M65609	M65627
Order: Diprotodontia		
Bettongia haoucharae † †	-	M65633
Bettongia lesueur † (Burrowing Bettong/Boodie)	M65615	M65621
Lagorchestes hirsutus hirsutus † (Rufous Hare-wallaby)	-	M65626
Lasiorhinus latifrons (Southern Hairy-nosed Wombat)	M65607	04.2.405-406,
Macropus fuliginosus melanops (Western Grey Kangaroo)	M65605	M65618, 04.2.407-410, 2024.3.2-3, M65643
Onychogalea lunata † † (Crescent Nail-tailed Wallaby)	M65616	M65628
Osphranter rufus (Red Kangaroo)	-	M65622
Trichosurus vulpecula † (Common Brush-tailed Possum)	M65611, M65690, M65691	M65620, M65623, M65624
Order: Rodentia		
Leporillus apicalis † † (Lesser Stick-nest Rat)	M65647	M65644
Leporillus conditor † (Greater Stick-nest Rat)	M65646	-
Notomys sp. indet. (Hopping mouse)	M65648	-
Pseudomys australis † (Plains Mouse)	M65649	-
Pseudomys bolami (Bolam's Mouse)	M65650	M65645
Rattus villosissimus † (Long-haired Rat)	M65651	-
Order: Lagomorpha		
Oryctolagus cuniculus (Rabbit)	M65606	M65631
Order: Chiroptera		
Chalinolobus gouldii (Gould's Wattled Bat)	-	Observed live
Chalinolobus morio (Chocolate Wattled Bat)	M65617	-

Taxon	Goat Cave	Prostate Pit Cave
Order: Carnivora		
Canis familiaris (Dingo)	M65604	M65629
Felis catus (domestic/feral Cat)	M65641	-
Vulpes vulpes (Red Fox)	M65608	M65619, M65642
Mammal species total	**25**	**20**
AVES		
Order: Strigiformes		
Tyto novaehollandiae (Australian Masked Owl)	A52933	-
Order: Passeriformes		
Hirundo neoxena (Welcome Swallow)	A52952, A52953	A52934
Artamus cinereus (Black-faced Woodswallow)	A52978	-
Cinclosoma alisteri (Nullarbor Quail-thrush)	A52979	-
Gavicalis virescens (Singing Honeyeater)	A52980	-
Melanodryas cucullata (Hooded Robin)	A52981	-
Bird species total	**6**	**1**
REPTILIA		
Order: Squamata		
Family: Agamidae		
Amphibolurus norrisi (Mallee Dragon Lizard)	R182390	-
Agamidae indet.	R182399	R182397
Agamidae morphotype 1	-	R182396
Agamidae morphotype 2	-	R182395
Family: Carphodactylidae		
Underwoodisaurus milii (Southern Barking Gecko)	R181028	R182394
Family: Scincidae		
Liopholis sp. (skink)	R181030	-
Tiliqua rugosa (Bobtail)	R181029	R181031
Family: Elapidae		
Pseudonaja affinis (Dugite)	R160413	-
Family: Pythonidae		
cf. *Morelia* sp. indet. (python)	-	R152532
Family: Varanidae		
Varanus sp. indet. (goanna)	-	R182393
Reptile species total	**6**	**7**
MOLLUSCA		
Order: Stylommatophora		
Bothriembryon barretti	S27695	S27690
Basedowena elfina	S27696	S27691
Sinumelon nullarboricum	S27694	-
Westralaoma sp. indet.	-	S27693
Pupoides adelaidae	-	S27692
Snail species total	**3**	**4**

FIGURE 3 Monotreme and dasyurid specimens identified in Goat and Prostate Pit caves: A) *Tachyglossus aculeatus* (M65630), scat; B–C) *Antechinomys* sp. (M65640), left dentary; D–E) *Dasyurus geoffroii* (M65632), right dentary; F–G) *Dasycercus archeri* (M65638), left dentary; H–I) *Dasycercus cristicauda* (M65636), skull; J–K) *Sminthopsis dolichura* (M65635), left dentary; L–M) *Sarcophilus harrisii* (04.2.404), skull. Scale = 10 mm.

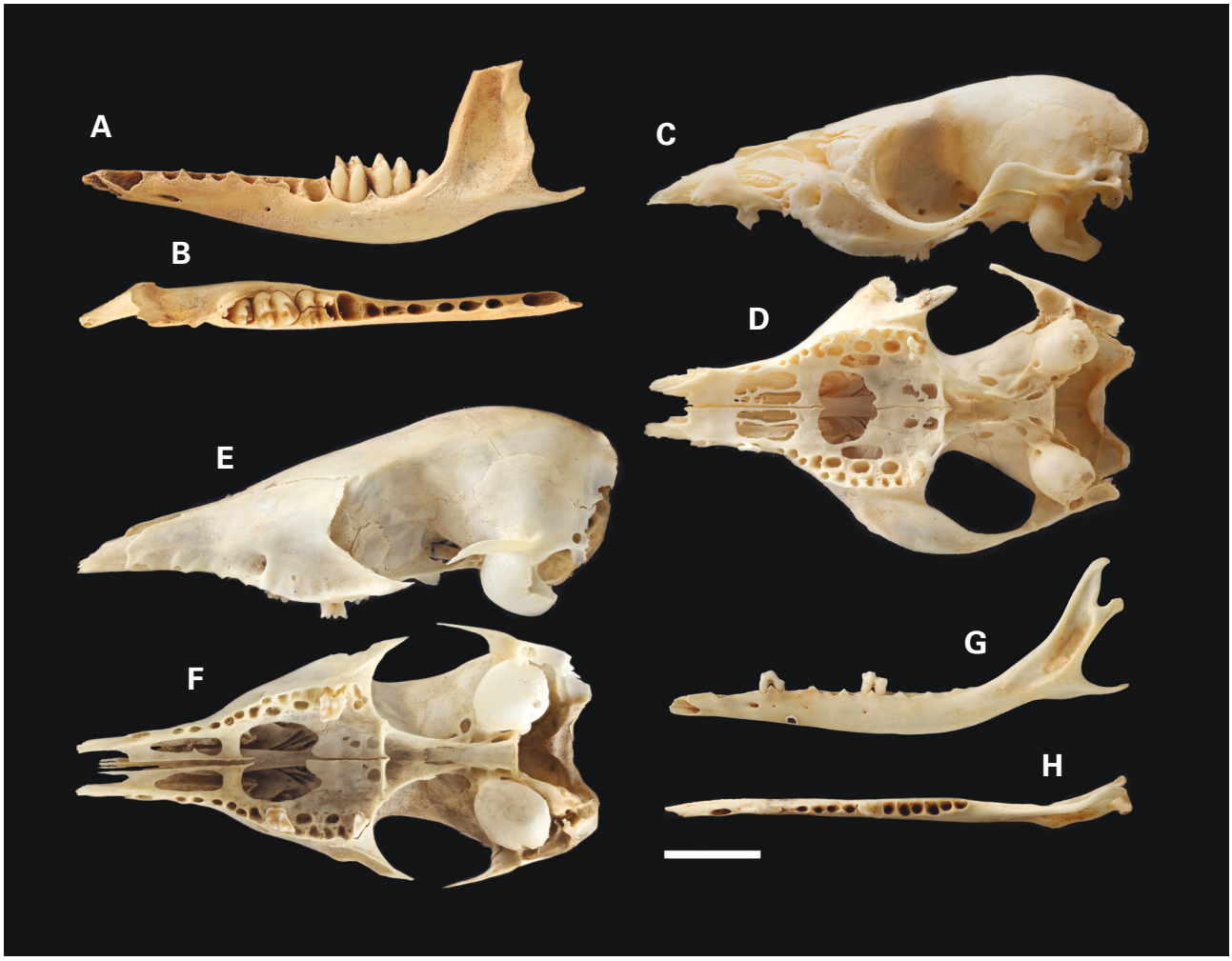

FIGURE 4 Peramelemorphian specimens identified in Goat and Prostate Pit caves: A–B) *Macrotis lagotis* (M65614), left dentary; C–D) *Chaeropus ecaudatus occidentalis* (M65612), skull; E–F) *Perameles papillon* (M65609), skull; G–H) *Perameles myosuros* (M65610), left dentary. Scale = 10 mm.

DISCUSSION

FAUNAL DIVERSITY IN GOAT AND PROSTATE PIT CAVE

Considering how little time was spent collecting subfossil remains from the cave floors, the diversity recorded in both caves is high, with 39 taxa recorded from Goat Cave (Goat Cave NISP = 422) and 32 taxa recorded from Prostate Pit Cave (Prostate Pit Cave NISP = 72) (Table 1). While the bird and reptile faunas are very much an under-representation of the diversity that exists outside the cave today, the mammal fauna is close to that reported previously (Boscacci et al., 1987; Baynes 1987). Of the original native mammals (~54 species; Boscacci et al. 1987; Baynes 1987), 15 taxa, previously reported as part of the original fauna, are missing from our dataset: four dasyurids (*Phascogale calura, Sminthopis gilberti, S. ooldea, S. crassicaudata*), one pygmy possum (*Cercartetus concinnus*), one bandicoot (*Isoodon fusciventer*), four rodents (*Pseudomys desertor, P. gouldii, Notomys mitchellii, N. alexis*) and five bats (*Austronomus australis, Nyctophilus major tor, N. geoffroyi, Scotorepens balstoni, Vespadelus regulus*). All of these are small taxa that could have been easily missed during the collection of bones but some of those might not occur at all locally as both caves are near the escarpment where the vegetation is more wooded, and some of those taxa would only occur in the more arid parts of the Nullarbor Plain further north (e.g. both *S. ooldea* and *N. alexis* are desert species and unlikely to have occurred near these caves) or in the more forested vegetation further south. Also, note that we do have *Notomys* on our list (Table 1), but the species could not be identified. Of the introduced mammals, the House Mouse (*Mus musculus*) was not detected, perhaps for similar reasons to the small native mammals. Mundrabilla station is currently a cattle station, so *Bos primigenius taurus* is still present, but other domestic mammals such as Goats (*Capra aegagrus hircus*), Sheep (*Ovis aries*) and Horses (*Equus ferus caballus*) are no longer kept on the property. Feral Camels (*Camelus dromedarius*) still occur in the northern part of the station.

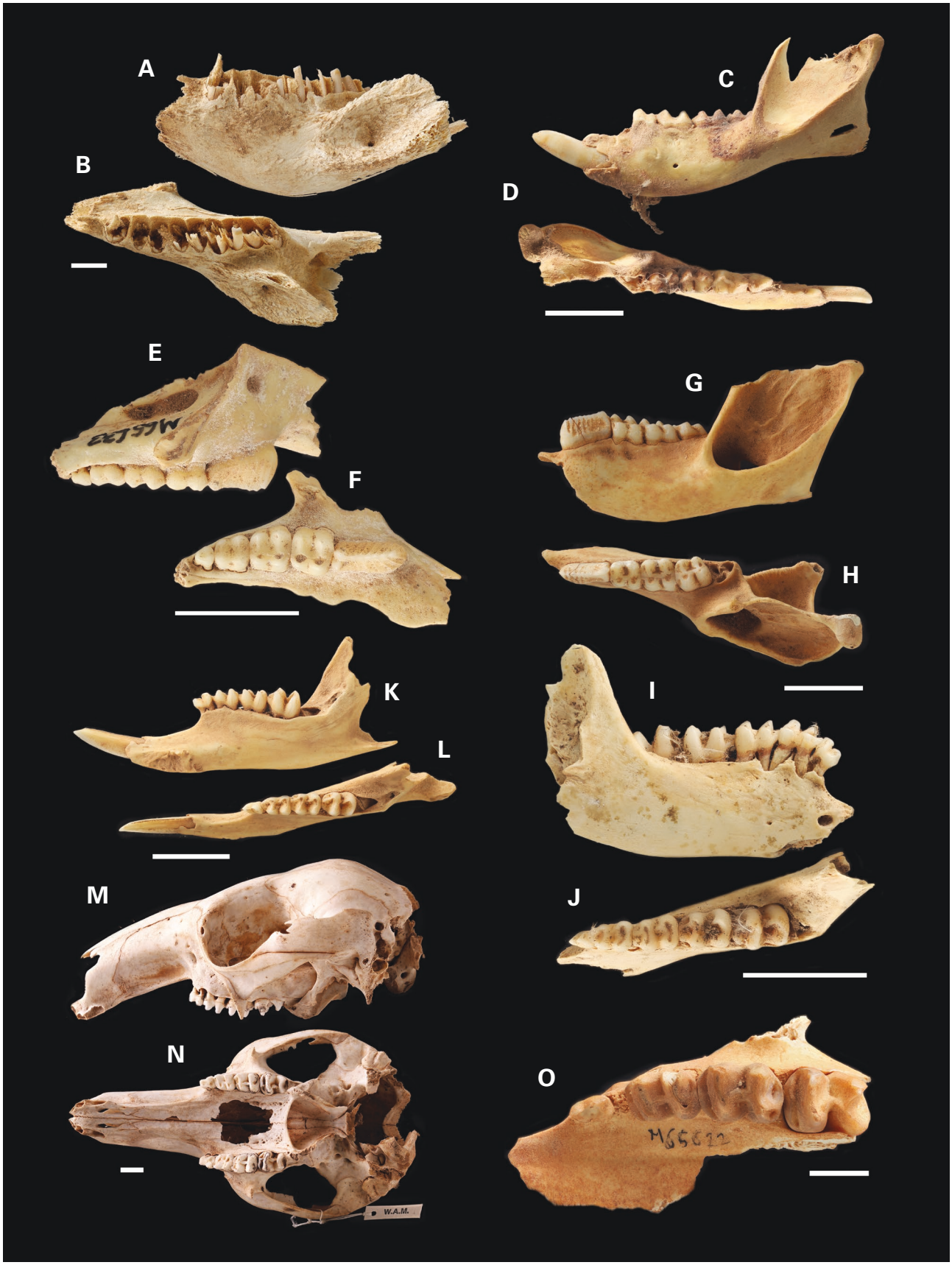

FIGURE 5 Diprotodontian specimens identified in Goat and Prostate Pit caves: A–B) *Lasiorhinus latifrons* (M65607), left dentary; C–D) *Trichosurus vulpecula* (M65623), left dentary; E–F) *Bettongia haoucharae* (M65633), right maxilla; G–H) *Bettongia lesueur* (M65621), left dentary; I–J) *Onychogalea lunata* (M65616), right dentary; K–L) *Lagorchestes hirsutus hirsutus* (M65626), right dentary; M–N) *Macropus fuliginosus melanops* (M65618), skull; O) *Osphranter rufus* (M65622), left maxilla. Scale = 10 mm.

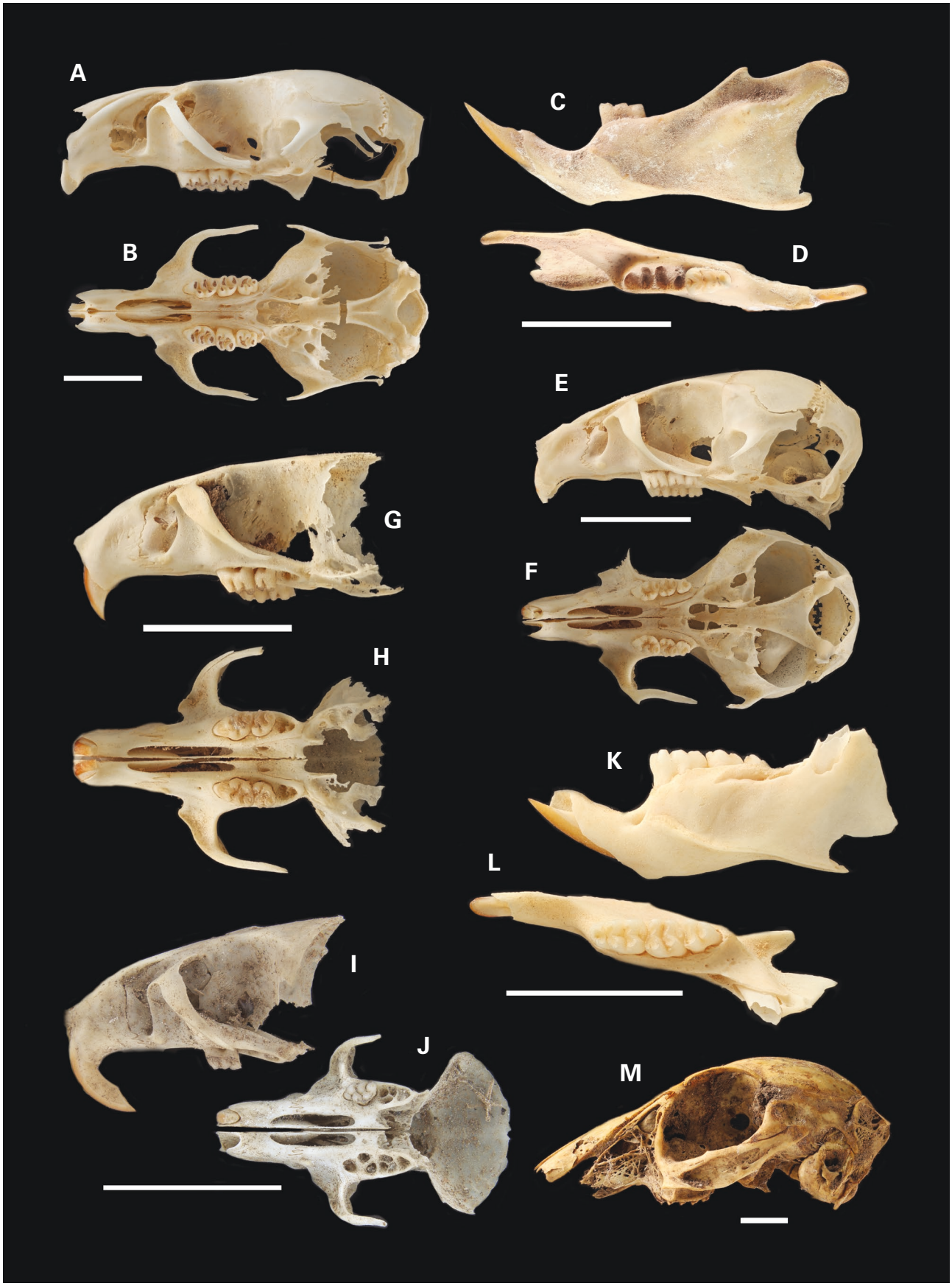

FIGURE 6 Rodent and lagomorph specimens identified in Goat and Prostate Pit caves: A–B) *Leporillus conditor* (M65646), skull; C–D) *Leporillus apicalis* (M65644), right dentary; E–F) *Notomys* sp. indet. (M65648), skull; G–H) *Pseudomys australis* (M65649), skull; I–J) *Pseudomys bolami* (M65650), skull; K–L) *Rattus villosissimus* (M65651), left dentary; M) *Oryctolagus cuniculus* (M65606), skull. Scale = 10 mm.

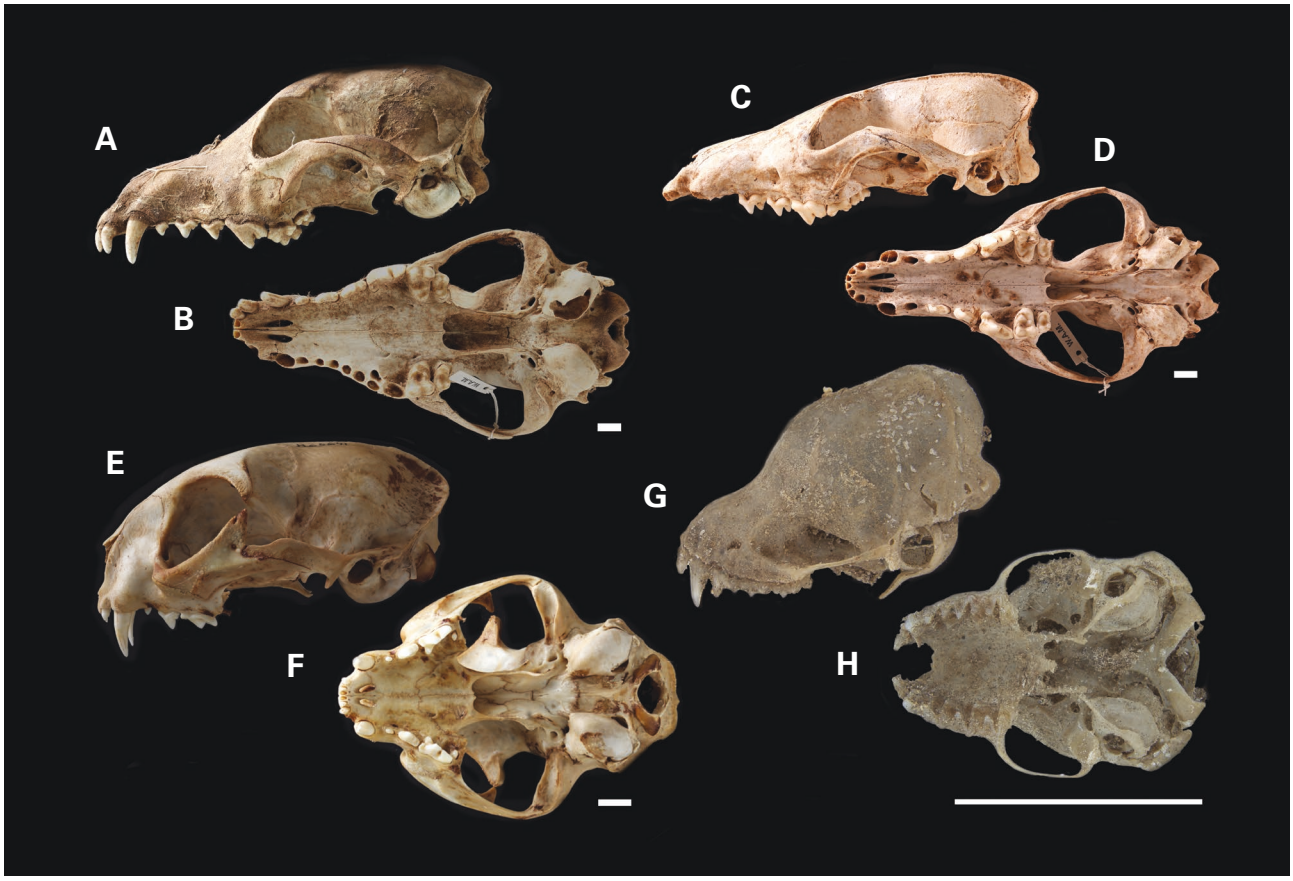

FIGURE 7 Carnivoran and chiropteran specimens identified in Goat and Prostate Pit caves: A–B) *Canis familiaris* (M65606), skull; C–D) *Vulpes vulpes* (M65619), skull; E—F) *Felis catus* (M65641), skull; G–H) *Chalinolobus morio* (M65617), skull. Scale = 10 mm.

FIGURE 8 Bird specimens identified in Goat and Prostate Pit caves: A) *Tyto novaehollandiae* (A52933), skull; B) *Hirundo neoxena* (A52953), mummified specimen; C) *Artamus cinereus* (A52978), skull; D) *Cinclosoma alisteri* (A52979), skull; E) *Gavicalis virescens* (A52980), skull; F) *Melanodryas cucullata* (A52981), skull. Scale = 10 mm.

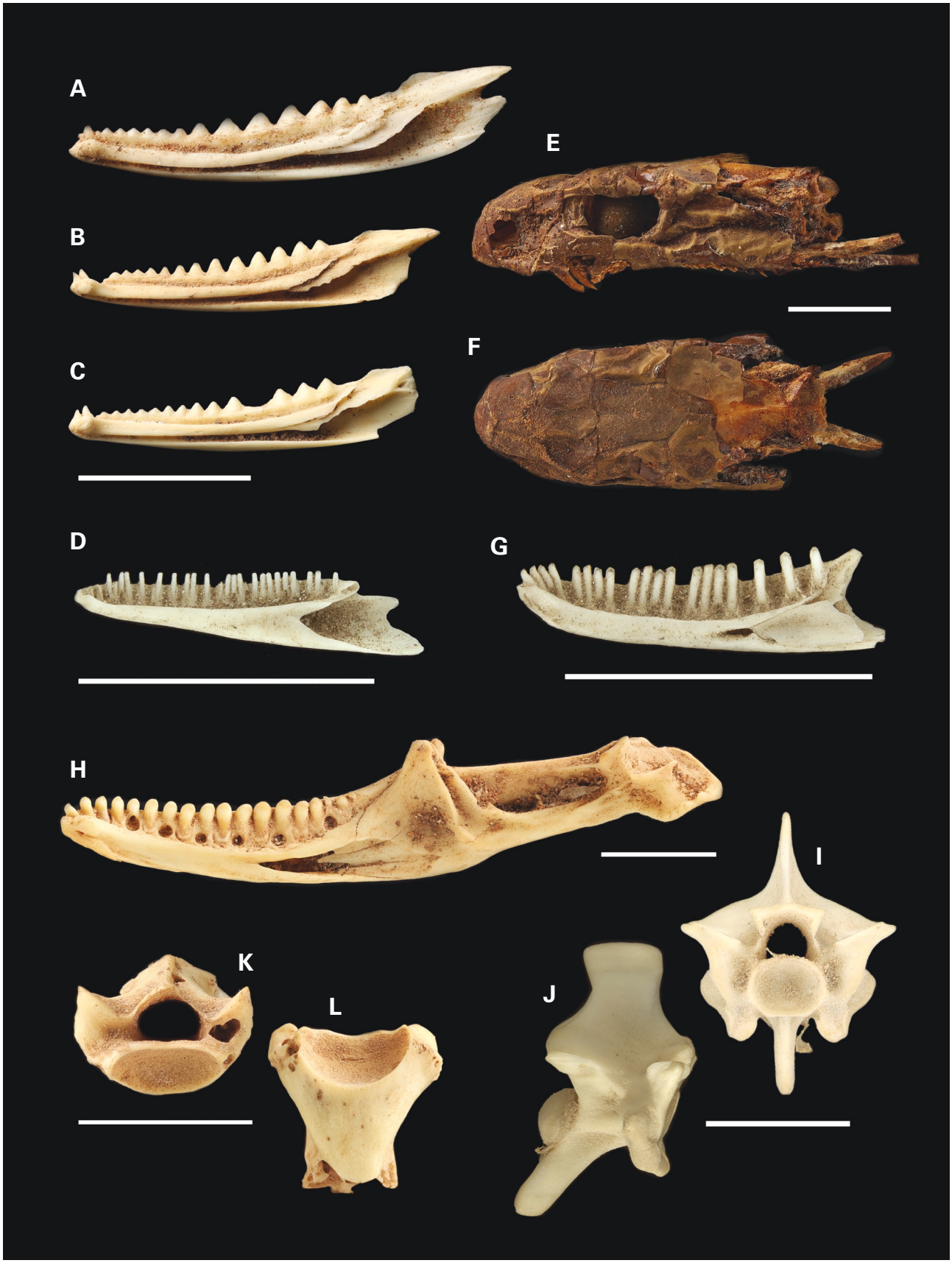

FIGURE 9 Reptile morphotype specimens identified in Goat and Prostate Pit caves; A) Agamidae indet. (R182399), right dentary; B) Agamidae morphotype 1 (R182396), right dentary; C) Agamidae morphotype 2 (R182395), right dentary; D) *Underwoodisaurus milii* (R181028), right dentary; E–F) *Pseudonaja affinis* (R160413), mummified skull; G) *Liopholis* sp. (R181030), right dentary; H) *Tiliqua rugosa* (R181029), right mandible; I–J) cf. *Morelia* sp. (R152532), vertebra; K–L) *Varanus* sp. (R182393), vertebra. Scale = 10 mm (except G–H = 5 mm).

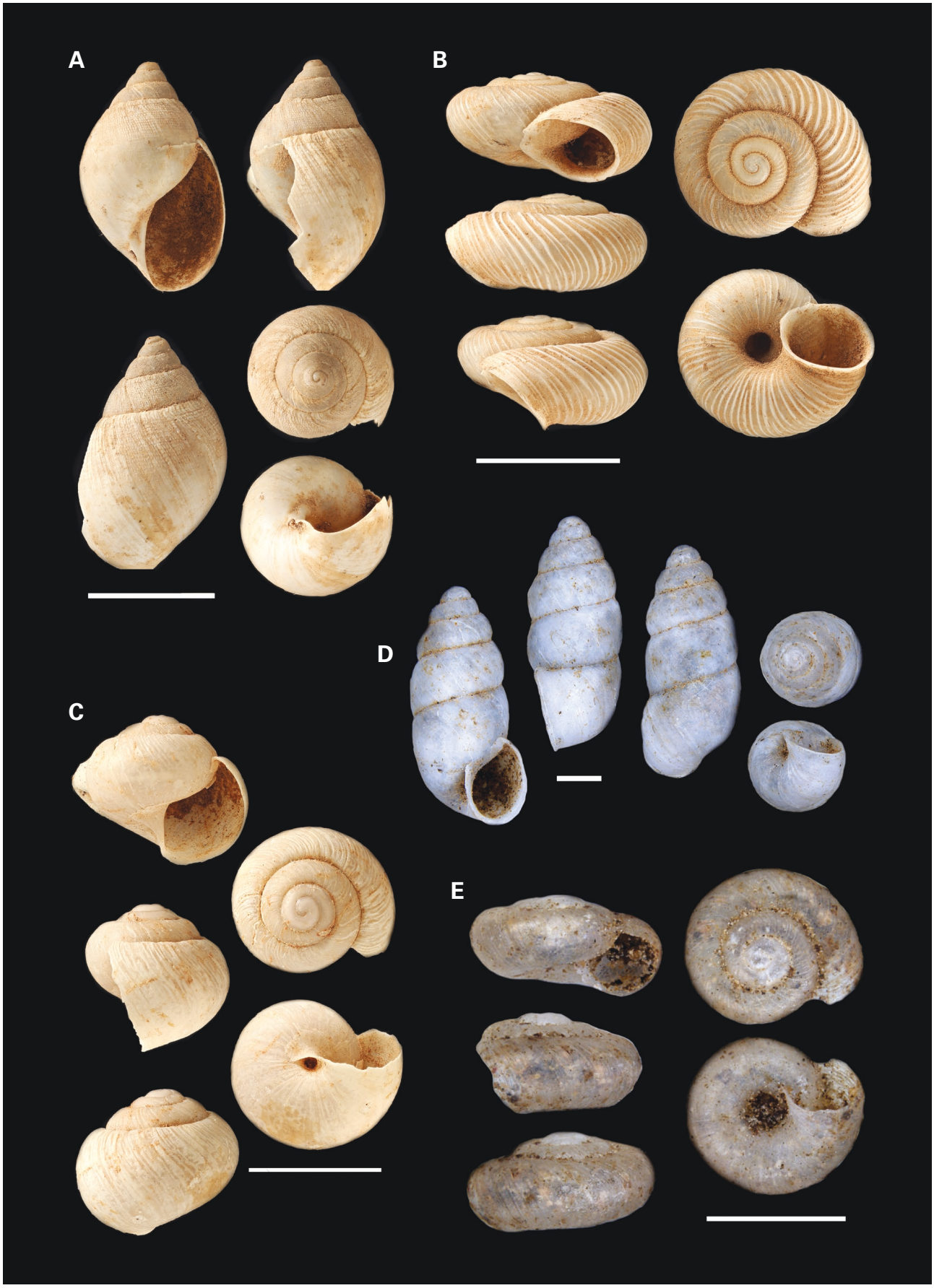

FIGURE 10 Gastropod mollusc specimens identified in Goat and Prostate Pit caves: A) *Bothriembryon barretti* (S27690); B) *Basedowena elfina* (S27691); C) *Sinumelon nullarboricum* (S27694); D) *Pupoides adelaidae* (S27692); E) *Westralaoma* sp. (S27693);. Scale = 10 mm (except D–E = 1 mm).

FIGURE 11 Mummified specimens found in the deep tunnels of Goat Cave: A) Common Brush-tailed Possum (*Trichosurus vulpecula*); B) Chuditch (*Dasyurus geoffroii*).

FIGURE 12 Dingo den in Prostate Pit Cave: A) main chamber showing macropod bone remains in stacks on cave floor; B) possum scats located on the outer edges of the Dingo den.

FIGURE 13 Brushtail possum den in Prostate Pit Cave: A) first small chamber showing thousands of possum scats on cave floor and carcasses; B) possum scats trail in second larger chamber; C) possum urine staining cave decoration.

We have recorded a total of 8 extinct and 9 locally extinct mammal species (Table 1). Some of the extinct species have been revised since the original survey (Boscacci et al. 1987; Baynes 1987; McKenzie et al. 1987). In the order Peramelemorphia, the Nullarbor Barred Bandicoot *Perameles papillon* (previously *Perameles bougainville notina* in Boscacci et al. 1987) and the Marl *Perameles myosuros* (previously *Perameles bougainville* in Boscacci et al. 1987) were both revised by Travouillon and Phillips (2018) and identified as distinct taxa. The Pig-footed Bandicoot subspecies *Chaeropus ecaudatus occidentalis* was also reinstated by Travouillon et al. (2019). In the order Dasyuromorphia, a new mulgara was recognised by Newman-Martin et al. (2023), *Dasycercus archeri,* which was previously misidentified by Lundelius and Turnbull (1978) as *Dasyuroides*. Also, the kultarr, *Antechinomys laniger*, has been revised and no longer occurs in Western Australia. Instead, the newly described *Antechinomys auritus* occurs in the arid zone of WA, and there is another undescribed *Antechinomys* that occurs in the wheatbelt and on the Nullarbor of WA (Dodd et al. 2025). In the order Diprotodontia, a new bettong *Bettongia haoucharae* (referred to as *B. penicillata* by Baynes 1987) has also recently been described by Newman-Martin et al. (2025).

We recorded a total of 10 reptile taxa from Goat Cave and Prostrate Pit Cave. Prior to 1900 only two reptiles (*Varanus gouldi* and *Rhinoplocephalus bicolor*) were collected by Australian museums from the Nullarbor Plain (Atlas of Living Australia 2025). Very little was known of the herpetofauna until 1914 when W.B. Alexander made small collections from stations along Eyre Highway, and until the 1950s museums were only receiving specimens collected ad hoc by members of the public (Storr et al. 1981). Evidently, the original herpetofauna of this part of Australia was not well-documented before the impact of introduced predators, Rabbits, or extensive sheep and cattle grazing.

Surface collecting of skeletal remains from natural pitfall traps and predator accumulations might be the only means by which we can determine the pre-European reptile fauna from this remote region of Australia. Mead et al. (2008) reported three *Pygopus* dentaries in mid-Holocene deposits from Webbs Cave (6N-132; 5,200 to 4,160 cal. BP) and Wombat Cave (5N-264; undated) on the Nullarbor. Two species of legless geckos (*Pygopus)* are known from the extant fauna of the Nullarbor IBRA region, the Common Scaly-Foot (*Pygopus lepidopodus)* and Western Hooded Scaly-Foot (*P. nigriceps*; McKenzie et al. 1987; Atlas of Living Australia 2025). The absence of pygopodid remains from this investigation is not unexpected, as only the three dentaries were recorded from the large sample of thousands of reptile bones sorted by Mead et al. (2008). Present knowledge of reptile osteology prevents identification of most groups to species-level determinations, but with the expanding application of ancient DNA (see Scarsbrook et al. 2023), the remains collected from caves can be further refined in years to come.

Identification of the mummified remains allow for direct comparisons of the herpetofaunal subfossil record to modern survey efforts. Harold and Hanlon's survey (Storr et al. 1981) of the herpetofauna of the Great Australian Bite in 1979 referred to both Mallee Heath Dragons and Dugites as relatively common in coastal areas with mallee or heath. McKenzie et al. (1987) recorded Dugites, Western Brown Snakes (*P. nuchalis*, now *P. mengdeni*) and Peninsula Brown Snake (*P. textilis* now *P. inframaculata*) along the southern escarpment of the Nullarbor and on Roe Plain in 1984 (figure 56, p. 182). Goat Cave is located approximately midway between their southern records of *P. affinis* at Madura and *P. mengdeni* at Eucla. The same survey also records *Amphibolurus norrisi* (previously *A. muricatus*) in the same region.

Dugites are moderately large elapids with broad habitat preferences and a large distribution spanning south-western Australia and the Great Australian Bight to the Eyre Peninsula. While they are expected to occur in Holocene deposits throughout this range, no published record of their fossil occurrence is known. Holocene agamid material from Kangaroo Island was referred to *Amphibolurus norrisi* (Gray et al. 2017), and WAM R182390 from Goat Cave represents the only other fossil record for this species to date. Overall, the reptile diversity of the Nullarbor Plain is underrepresented in the surface deposits, as records within 10 km of the cave locations include at least 15 species while the IBRA region has 115 species listed (Atlas of Living Australia, 2025).

Six species of birds were recorded in total. Welcome Swallows (*Hirundo neoxena*) were the only species present in both caves, as they were actively using the cave entrances to nest. The Australian Masked Owl was likely the main accumulator of bones in Goat Cave. All other birds found were small local birds that may have been predated, as they are all similar in size.

All five taxa of snail recorded during this survey are semi-arid taxa with widespread distributions (Stanisic et al. 2018) and represent a high percentage of extant surface taxa found in the region. Most of the recorded species live at or near the surface among leaf litter, except for the rock-dwelling *Basedowena.* Cave entrances and near surface systems would be a refuge for Nullarbor snails during hot, dry periods, providing dependable shade, moisture and litter.

TAPHONOMY

In both caves, bones would have been accumulated by a mixture of pitfall trapping and accumulation from bones left by predators and owl pellets. There is a

noticeable difference in fauna between the two caves, with Prostate Pit Cave missing many small mammals (e.g. fewer rodents) and small birds, due to a difference in the predator presence between caves. The shape of the entrance of Prostate Pit Cave, with a low flat roof with very few places to perch doesn't encourage owls to use the cave. As a result, the fauna represented is composed of larger species, as it would have been biased by the prey size preference of mammalian predators, such as Dingoes. Goat Cave doesn't seem to have any size bias in its fauna, which includes taxa of all sizes. The entrance of Goat Cave is very large with a domed roof and many large boulders that owls could use to perch. Two species of owl, Barn Owl (*Tyto javanica*) and Australian Masked Owl (McAllan 1997) may live in the region. Both species could have used the caves at some point in time, but we only recovered bones from Australian Masked Owls, providing evidence that at least this species was present in the cave and contributing to the accumulation of bones of the smaller taxa.

The herpetofauna recorded from the opportunistic collecting of surface material is biased towards groups that have remains large enough to be noticed by the naked eye when disarticulated. This excludes many of the smaller skinks, smallest geckos (most gekkonids, and diplodactylids), pygopodids, and blind snakes. Owls as accumulators prefer mammalian prey, resorting to small crepuscular/nocturnal lizards only in times of drought (McDowell and Medlin 2009). Therefore, geckos are typically under-represented in owl roost deposits if small mammalian prey are in abundance. Diurnal predators such as small raptors (kestrels, kites) are more likely to collect reptiles that are active and exposed in the hottest parts of the day – dragons and small monitor lizards. Typically, when larger lizards (*Pogona*, *Varanus*, or *Tiliqua*) are taken by predatory birds the animal is 'unzipped' ventrally and the brain accessed from beneath the chin (KMT pers. obvs.), leaving the body mostly intact and in-situ rather than being transported, partially digested and pelletised. Therefore, the presence of these animals in cave deposits is most likely to be from pit trapping or mammalian accumulators.

CAVE USE, NESTING AND DEN BEHAVIOUR

Upon entering both Goat and Prostate Pit caves, it was very apparent that Welcome Swallows use the cave entrance, as they constantly flew in and out of the caves and were seen tending to their nests built in the cave roof. It is well known that this species uses caves in that manner (Tarburton 1986). As mentioned previously, Australian Masked Owls did occupy Goat Cave at some point in the past but have likely gone locally extinct as a result of fewer prey species available, with many mammalian species now extinct on the Nullarbor Plain (McKenzie et al. 2023).

Denning behaviour in Dingoes is poorly understood, with very few studies in existence (Smith and Vague 2016). Dingoes using caves to den has been reported anecdotally, without a detailed study of behaviour and use within caves (Corbett 2025). Here, we recorded in Prostate Pit Cave, how Dingoes used particular cave chambers to feed, through the accumulation of large prey attributed to Dingoes. The same chamber was used to rest, evidenced by shallow depressions without bones thought to be excavated by Dingoes to lie in, with piles of bones accumulated next to them. We also reported that Dingoes used an adjacent cave chamber as a latrine, evidenced by several Dingo scats found near each other in one area of the cave. Skulls of Tasmanian Devils were also found in the Prostate Pit Cave. As they were collected previously by cavers, we do not know where exactly in the cave they were collected. As a result, it is not possible to understand if Tasmanian Devils also used the cave as a den before going extinct locally, or if they were prey of Dingoes.

Both Goat Cave and Prostate Pit Cave showed evidence of brushtail possum use, although this was far more pronounced in Prostate Pit Cave. In both caves, scent trails and scats were present, suggesting that they may have served as shelters for brushtail possums after the loss of trees on the Nullarbor reduced the availability of shelter. While brushtail possums primarily shelter in tree hollows, they are known to use alternative shelters where trees are absent, including rock crevices and caves (Butler 1970).

In Prostate Pit Cave, evidence suggested that brushtail possums were scavenging carcasses, likely sourced from the nearby Dingo den, and transporting them back to their own den area. Brushtail possums are omnivorous and have been documented to opportunistically feed on carrion (Cruz et al. 2012). The presence of Rabbit remains in both the brushtail possum and Dingo dens further indicates that brushtail possums persisted in this region of the Nullarbor after European settlement, when Rabbits were first introduced.

FUTURE WORK

We have collected samples from seven brushtail possum specimens and the single Chuditch found in the deep tunnels of Goat Cave with the aim to undertake sequencing of their DNA in an ancient DNA lab at Curtin University. This should help resolve the genetic affinity of the Nullarbor Brushtail Possum and Chuditch (Middleton et al. 2025). The same samples will be subsampled and sent to ANSTO for radiocarbon dating, to understand the timing of the death of the specimens in the cave, perhaps helping to understand when and why they died the way they did. Invertebrates other than snails were also collected in the cave, mainly insects and arachnids, which will be studied by colleagues at Adelaide University and the WA Museum.

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