FOSSIL OCCURRENCES OF CERCARTETUS NANUS (MARSUPIALIA: BURRAMYIDAE) IN SOUTH AUSTRALIA

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Summary

This study documents the known prehistoric distribution of the eastern pygmy-possum Cercartetus nanus in South Australia. This is based on 10 caves (Bat Cave, Cathedral Cave, Comaum Forest Cave, Haystall Cave, Henschke Fossil Cave, Kilsbys Hole, Robertson Cave, Sleeping Cave, Victoria Fossil Cave, and Wet Cave) and one rockshelter deposit (Narcurrer Shelter) all from the south-east of South Australia. Comparison of prehistoric and modern distribution records for C. nanus suggest a recent northward range contraction. The oldest fossil C. nanus are from Cathedral Cave where dates as old as 279,000 years have been established. The bone assemblages were reported to be the result of natural pitfall death-traps or from predatory species such as owls and mammalian carnivores depositing prey remains in caves.

KEY WORDS: Cercartetus nanus, Burramyidae, fossil, caves.

Introduction

The eastern pygmy-possum Cercartetus nanus is a small marsupial which reaches its western range limit in the lower south-east of South Australia (SA), and in this State it is currently classed as ‘Vulnerable’ under Schedule 8 of the National Parks and Wildlife Act 1972 (van Weenen & Harris 2006). The species also occurs in Victoria, New South Wales, Queensland and Tasmania, but its conservation status varies throughout this range. Certainly, much less is known of C. nanus populations in SA compared with the eastern states, and at present even basic data on C. nanus distribution and life history in SA are lacking. This study contributes some information on C. nanus palaeodistribution in SA, and builds upon the work of Harris & Goldingay (2005) and Harris & Garvey (in press). The aims were to: (1) map the point occurrences of fossil and sub-fossil C. nanus; (2) relate these localities to its modern distribution in SA; (3) document the reported ages for the fossil material; and (4) identify the agent/s reportedly involved in their accumulation.

Methods

A literature search was conducted to obtain fossil records of C. nanus in SA (e.g. Reed & Bourne 2000). Enquiries were also made with the Wonambi Fossil Centre at Naracoorte, the South Australian Museum (SAM) and Museum Victoria (MV). Site co-ordinates were determined using the Geoscience Australia online place-name search, and by correspondence with Cave Exploration Group South Australia Inc. (CEGSA) and Cave Divers Association of Australia Inc. (CDAA). Reliable modern records of C. nanus were sourced from van Weenen & Harris (submitted).

Results

As far as is presently known, fossil and sub-fossil C. nanus have been reported from 10 caves and one rockshelter deposit in SA (Table 1). At Victoria Fossil Cave at the Naracoorte Caves National Park World Heritage Site, there are several discrete chambers, and C. nanus has been found in one known as ‘Grant Hall’ as well as the main ‘Fossil Chamber’ (Reed & Bourne 2000). Several other separate caves within the Oligocene-Miocene limestone formation at Naracoorte have also yielded C. nanus, including Bat Cave, Cathedral Cave, Haystall Cave, Robertson Cave and Wet Cave (Table 1).
Table 1. Location of Cercartetus nanus remains in South Australian Holocene and Late Pleistocene cave deposits. Code = Alphanumeric identification system assigned to caves by the Cave Exploration Group of South Australia (CEGSA). MV = Museum Victoria. Origin: MS= Mammal Scat, OP= Owl Pellet, PF= Pitfall. ka = thousand years. A dash (-) indicates that the data are unknown or not available.

| Site Name          | Code   | Origin | Age       | Latitude | Longitude | Sources                                  |
|--------------------|--------|--------|-----------|----------|----------|------------------------------------------|
| Sleeping Cave      | 5L-2   | -      | -         | 38°00'S  | 140°57'E | B. Thompson (MV) pers. comm.; G. Pilkington (CEGSA) pers. comm. |
| Bat Cave           | 5U-2   | PF     | -         | 37°02'S  | 140°47'E | Reed & Bourne 2000; Tidemann 1967; Smith 1971 |
| Haystall Cave      | 5U-23  | -      | -         | 37°05'S  | 140°49'E | Reed & Bourne 2000; Smith 1971             |
| Comaum Forest Cave | 5U-118 | -      | -         | 37°11'S  | 140°54'E | Reed & Bourne 2000; Tidemann 1967; Smith 1971 |
| Robertson Cave     | 5U-17, 18, 19 | PF, OP | 8 to 31 ka | 37°05'S  | 140°50'E | Reed & Bourne 2000; McDowell 2001; Tidemann 1967; Smith 1971 |
| Wet Cave           | 5U-10, 11 | PF, OP | 0.7 to >45 ka | 37°02'S  | 140°47'E | Reed & Bourne 2000; McDowell 2001; Tidemann 1967; Smith 1971 |
| Henschke Fossil Cave | 5U-91, 97 | PF, OP, MS | 32 to 40 ka | 36°58'S  | 140°46'E | Pledge 1990; Barrie 1997; Reed & Bourne 2000; Smith 1971; Wells et al. 1984; Moriarty et al. 2000; Reed & Bourne 2000; Brown & Wells 2000; Moriarty et al. 2000; Reed & Bourne 2000 |
| Victoria Fossil Cave | 5U-1 | PF, MS | 213 to 206 ka | 37°02'S  | 140°48'E | Reed & Bourne 2000; Smith 1971; Wells et al. 1984; Moriarty et al. 2000; Reed & Bourne 2000; Brown & Wells 2000; Moriarty et al. 2000; Reed & Bourne 2000 |
| Cathedral Cave     | 5U-12, 13 | PF, OP | 159 to 279 ka | 37°02'S  | 140°47'E | Reed & Bourne 2000; G. Medlin pers. comm. |
| Kilsbys Hole       | 5L-46  | PF     | -         | 37°53'S  | 140°40'E | Reed & Bourne 2000; G. Medlin pers. comm. |
| Narcurre Shelter   | L195   | OP, MS | <2 ka     | 38°00'S  | 140°55'E | Barker 1987; B. Barker pers. comm.; K. Mott pers. comm. |

Other fossil C. nanus sites include Henschke Fossil Cave on the outskirts of Naracoorte, Comaum Forest Cave west of Comaum, Narcurre Shelter north-west of the border town of Nelson, and Kilsbys Hole near Mount Gambier (Figure 1). The Kilsbys Hole C. nanus was listed as a tentative identification by Reed & Bourne (2000). However, Graham Medlin (SAM) recently re-examined this specimen and confirmed that it is C. nanus (pers. comm. 11 October 2005). An ‘unnamed cave’ that also yielded C. nanus occurs ‘on a limestone cliff on the western side of Glenelg River, near Donovan’s Landing’ (MV collections database). Graham Pilkington (CEGSA) suggested that it may be the 60 m long cave which is numbered by CEGSA as L2 (‘Sleeping Cave’), and recorded by them as ‘1.5 km north of Donovan’s Landing on the western side of the Glenelg River’ (pers. comm. 15 March 2005). Nonetheless, it was cautioned that there are many small cavities in these cliffs that CEGSA have not documented as ‘caves’, and it is possible that the collection was made from one of these. Tidemann (1967) noted that C. nanus fossils were found at Yallum Cave, near Penola, but it is apparent that this was incorrect since an ‘errata slip’ later published with the *South Australian Naturalist* indicated that this species was not found there.

Bone deposits retrieved from the identified sites were reported to be the result of natural pitfall death-traps and/or accumulations produced by predatory species (Table 1). The youngest deposit is reported to be <2 ka (ka = thousand years) (Narcurre Shelter) and the oldest is 159 to 279 ka (Cathedral Cave). There are also 6 deposits that are currently undated. The modern and prehistoric range of C. nanus in SA is not entirely coincident. Three fossil sites (Kilsbys Hole, Sleeping Cave and Narcurre Shelter) lie considerably south of the known modern range for this species in SA (Figure 1). The nearest modern records to Kilsbys Hole are at Millicent and Reedy Creek Conservation Park (43 and 76 km distant, respectively).
Figure 1. Fossil and modern records of *Cercartetus nanus* in South Australia.

**Discussion**

At most sites, multiple modes of accumulation were reportedly involved. For example, Victoria Fossil Cave was a pitfall trap for large vertebrates, but the bones of smaller animals are believed to have been brought in by mammalian or avian predators (Smith 1971, 1972; Wells et al. 1984). Similarly, Cathedral Cave was a pitfall trap primarily, although a small amount of bone was attributed to an avian predator (Brown & Wells 2000). However, in the literature reviewed there was no information regarding the mode of accumulation for small mammal bones retrieved from Haystall Cave, Comaum Forest Cave, or Sleeping Cave. Despite this, it is likely that predatory species and/or pitfalls were accumulating agents at these sites also.

For the site believed to be Sleeping Cave, apart from *C. nanus* there are only murids (*Rattus culmorum, R. fuscipes, R. lutreolus*) and small dasyurids (*Sminthopsis crassicaudata, S. leucopus*...
and *S. murina* recorded on the MV database. However, this may not be a complete list because not all of the collection is on the database at this point (Bronwyn Thompson pers. comm. 11 May 2005). Notwithstanding this, the deposit appears to be comprised entirely of small mammals, which might suggest a prey assemblage rather than pitfall assemblage. However, the identity of the predator involved at this site is unknown.

For Victoria Fossil Cave, a skewed adult age structure for burramyids, small dasyurids and petaurids was found (Smith 1971, 1972), and this tends to support the contention that a selective predatory accumulator was involved (Wells *et al.* 1984). Remains of masked owl *Tyto novaehollandiae* were found at this site (Van Tets & Smith 1974), and it is therefore likely that this owl was responsible for at least some of that immense deposit. However, it remains entirely possible that more than one owl species was involved during the long period of deposition of the small vertebrate bone in Victoria Fossil Cave. That is, barn owl *T. alba*, sooty owl *T. tenebricosa*, barking owl *Ninox connivens* and/or southern boobook *N. novaeseelandiae* may have been involved to varying degrees as these owl species occur in SA, utilise caves, and are known to prey on *C. nanus* (see Harris & Goldingay 2005; Harris & Garvey submitted) and other small vertebrates (Higgins 1999). The powerful owl *N. strenua* also occurs in SA, but is unlikely to have contributed to the assemblages as it rarely roosts in caves (Higgins 1999).

For Robertson and Wet Cave, McDowell (2001) suggested the involvement of a predatory accumulator because most (>80%) of the mammal bones were of species with a mean body mass of ≤300g, and the larger (1000-1500g) species present were almost exclusively juveniles and sub-adults. A mammalian carnivore was thought unlikely to have contributed to any significant extent because most bones were largely intact and lacked evidence of digestive erosion. Considering the types and size range of mammals represented, McDowell (2001) proposed that *T. alba* was probably the main predator contributing to the assemblages at both these sites, although it was noted that *T. novaehollandiae* may also have contributed. Remains of *T. alba* were recovered from both excavation sites, which add confidence to McDowell’s hypothesis. It was thought unlikely that the *N. novaeseelandiae* was an accumulating agent because of its ‘primarily insectivorous’ diet. However, this species does take vertebrates on occasion, and *C. nanus* is recorded as part of its contemporary diet (Green *et al.* 1986). Hence, *N. novaeseelandiae* is a possible accumulator of small vertebrates in Robertson Cave. Furthermore, *N. novaeseelandiae* was present in Robertson Cave during McDowell’s excavation. Notwithstanding this, it is very unlikely that this species was a significant contributor because of its generally non-vertebrate diet.

A number of mammalian carnivores were found in certain deposits. For example, at Cathedral Cave, two quoll species were found (*Dasyurus viverrinus* and *D. maculatus*; both now extinct in SA), Tasmanian devil *Sarcophilus harrisii* (now extinct on mainland Australia), as well as the much larger thylacine *Thylacinus cynocephalus* and marsupial lion *Thylacoleo carnifex* (both entirely extinct). The latter two predators can be immediately eliminated as likely accumulators of *C. nanus* on the basis that they are unlikely to hunt diminutive prey (see also Smith 1972; Wells *et al.* 1984). However, the other listed predatory mammals could be responsible for at least some vertebrate bone (including remains of *C. nanus*) recovered from Cathedral Cave and other sites (see also Harris and Goldingay 2005; Harris and Garvey submitted).

The 11 sites referred to comprise the fossil record currently known for *C. nanus* in SA. All of the sites are restricted to the south-east of the State, and there is no evidence available that *C. nanus* has ever inhabited the far northern or western areas of SA. However, there is a bias because the occurrence of fossil *C. nanus* is dependent on the presence of suitable caves, and the south-east province is particularly unusual for its extensive limestone substrates and karst development. Further study should involve examination of palynological evidence and other records (see also McDowell 2001) to determine what influence changes in Quaternary vegetation and climate may have had on the distribution of *C. nanus*. Despite limitations in the data available, it appears that *C. nanus* has suffered a northward range contraction in SA. This is apparent because of the occurrence of fossils at Kilsbys Hole, Sleeping Cave and Narcerrer Shelter and the absence of modern records.
near the south-east tip of SA (Figure 1). It is unlikely that modern \textit{C. nanus} populations are present but so far undetected at the south-east tip because of the widespread habitat clearance in that area since European settlement. This is despite the presence of fossil and modern records of \textit{C. nanus} just over the border in the far south-west of Victoria (Harris and Goldingay 2005).

New fossil sites for \textit{C. nanus} may well be found in the future as there are at least 570 caves known in the south-east of SA (Reed and Bourne 2000), and many of these are likely to contain mammal bone, but are yet to be subjected to excavation. New excavations are likely to add to the emerging picture of \textit{C. nanus} fossil history. The occurrence of \textit{C. nanus} at \textasciitilde{}279 ka at Cathedral Cave is particularly significant. These fossils are considerably older than those known from Victoria (Pyramids Cave \textasciitilde{}33 ka) (Harris and Goldingay 2005) and Tasmania (Warreen \textasciitilde{}25 ka) (Harris and Garvey submitted), and have implications for future palaeobiogeographical understanding of this species.

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