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A taphonomic signature for quolls in the Australian archaeological record

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ABSTRACT

Australian archaeofaunal assemblages are often heavily fragmented by taphonomic agents whose identity or origins are frequently difficult to discern. This study explores whether the fragmentation and accumulation of bone by carnivorous marsupial quolls may be distinguished from that produced by humans. Analyses of 140 scats obtained from captive feeding trials and wild populations of three quoll species (*Dasyurus maculatus*, *Dasyurus viverrinus* and *Dasyurus hallucatus*) indicates that damage to bones by quolls may be identified through a combination of the median length of bone specimens and observations of specific types of damage to the bone surface. Our results demonstrate that bone consumed by *D. viverrinus* and *D. hallucatus* is highly unlikely to be confused with human-accumulated assemblages due to low dietary overlap and the very small bone fragment size produced by both quoll species. Bone accumulations of the larger *D. maculatus* species, however, may be incorrectly attributed to humans due to the consumption of medium-large mammals by both humans and quolls, and the larger size of bone fragments produced by *D. maculatus*. Although fragments as large as 25 mm were recovered from wild *D. maculatus* scats, the median length of scat-bone fragments for *D. maculatus* falls between ~8.30–10.40 mm. This is significantly different statistically to the median fragment length (11.90 mm) of bone in scats of the Tasmanian devil, *Sarcophilus harrisii*, as reported by Caroline Northwood (1990). Scats from wild *D. maculatus* indicate that polish and pitting are the most common forms of surface damage to bone, with more than 25% of specimens displaying these marks. Punctures and tooth drag marks are far rarer, with only 5% of bone specimens exhibiting this kind of damage. In light of these results, we advocate for detailed observation of the surface of bone specimens, along with obtaining specimen lengths, in order to distinguish quoll accumulated bone in archaeofaunal assemblages.

1. Introduction

Fragmentation of skeletal elements in archaeological deposits may be a product of a variety of processes, including the activities of bone consuming scavengers, the cultural and consumption practices of people, burning, trampling and pressure from sediment overburden. In archaeology, taphonomy is defined as the processes that affect an assemblage and consist of the activities that resulted in the deposition of bone and how they may have been subsequently modified during burial and recovery (Reitz and Wing, 2008). In differentiating these processes, careful attention to taphonomic markers must be undertaken.

Heavily fragmented bone assemblages are a common occurrence in Australian contexts, particularly in the northern half of the continent (Gould, 1996; Manne and Veth, 2015; O'Connor et al., 1998; Shine et al., 2013). The causes for this fragmentation are not always understood and this may be partly attributed to an inability to clearly identify and differentiate between the various agents contributing to fragmentation. In this paper we attempt to provide useful, distinguishing features of bone accumulated by marsupial carnivore quolls, in order to assist in differentiating these deposits from archaeofaunal ones.

Although the presence of quolls in the Australian archaeological record is known (Dortch, 1979; Huchet, 1990; Lundelius, 1966; Pearson et al., 2001; Walshe, 1994) there is currently no clear taphonomic signature to specifically distinguish their contributions to bone assemblages from other predators, including human activities. Archaeologists have previously conducted taphonomic analyses of bone accumulations in Australia attributed to the Dingo (*Canis lupus dingo*) (David, 1984; Fillios et al., 2010b; Huchet, 1990; Solomon and David, 1990), the Tasmanian devil (*Sarcophilus harrisii*) (Marshall and Cosgrove, 1990; Northwood, 1990; Walshe, 1994, 1999) and owls (*Tyto alba*; *Ninox boobook*; *Tyto novaehollandiae*) (Garvey, 1999; Marshall, 1986). Despite evidence for some overlap with prey consumed by people, however, quolls remain largely unconsidered as potential bone accumulators by archaeologists (but see Northwood, 1990).

Quolls form a key component of the marsupial carnivore cohort in Australia. As members of the genus *Dasyurus* quolls are related to Tasmanian devils (*S. harrisii*) in the phylogenic tribe *Dasyurini*. There are four extant species of quoll in Australia ranging in body size between 0.3 and 7 kg (Table 1) (Black, 2013; Dela Cruz, 2002; Fahey and Kinder, 2001; Leung, 2002; Strahan, 2004; Verjinski, 2013). Sexual

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Table 1
Comparative body mass ranges for five species of dasyurid.

Dasyurid species	Body mass range (gm)
S. harrisii	4000–12,000 Fahey and Kinder (2001)
D. maculatus	1800–7000 Verjinski (2013)
D. viverrinus	600–1550 Dela Cruz (2002)
D. geoffroii	900–1300 Leung (2002)
D. hallucatus	300–900 Black (2013)

size dimorphism is significant in all four species of quoll (Cooper and Withers, 2010). In Tasmania for example, Jones (1997) finds a 56% sexually dimorphic difference in body mass for *Sarcophilus laniarius* and *D. viverrinus* and a 94% difference for *D. maculatus*. Size difference within species also occurs geographically: on the Australian mainland *D. maculatus* are larger than those in Tasmania, while the opposite is true for *D. viverrinus*, which are larger in Tasmania than on the mainland (Jones, 1997). Populations and current geographic distributions of all quoll species (Fig. 1) have diminished considerably since European settlement of Australia (Strahan, 2004).

Quolls den in a variety of structures including earth burrows, rock crevices, hollow logs, caves, tree hollows, termite mounds and the burrows of other animals (Belcher et al., 2007; Triggs, 2004). Rather than defecate in their dens, quolls habitually leave their scats at familiar and conspicuous latrine sites. Prominent locations are commonly used as latrine sites, such as large boulders or bedrock with flat, horizontal surfaces (Kruuk and Jarman, 1995), ridge tops and hills (Triggs, 2004), or more contemporarily, on roads (Burnett, 2001). As quolls do not defecate in their dens, locations such as rock shelters and caves containing quoll scats should be considered latrine sites, not dens. This behaviour is relevant to archaeological sites and bone accumulations in rock shelters and caves, where occupation of these locations by humans may occur either before or after use as latrines by quolls.

Dasyurids exhibit a biting and cutting dentition, with pointed upper and lower incisors, prominent upper and lower canines, blade-like premolars and four pairs of lower and upper molars tipped with sharp, shearing cusps (Strahan, 2004). Werdelin (1986) observes that although their carnassial forms differ, the masticatory geometry of *S. harrisii* is adapted similarly to hyaenas and for the same purpose: the cracking and consumption of bone. This bone crunching capacity gives osteophagous species access to a dietary niche largely inaccessible to flesh eaters (Van Valkenburgh, 1988). *D. maculatus*, *S. harrisii* and an extinct dasyurid from the late Pliocene, *Glaucodon ballaratensis*, share the capacity for high levels of bone consumption via a documented marsupial structural phylogeny (Archer, 1976; Archer and Bartholomai, 1978). Archer (1976) notes that the difference in the dentition of *S. harrisii* and *D. maculatus* is one of degree within the dasyuridae. *S. harrisii* have the greatest bite force, not only among dasyurids, but of any extant mammal yet studied (Wroe et al., 2005). Although its cheek-tooth cusps are not as large as those of *S. harrisii* (Attard et al., 2011), the powerful bite and robust cranium of *D. maculatus* enable this dasyurid to crush the skulls of its prey (Buchmann and Guiler, 1977; Ewer, 1969). The measure of bite force normalised for body mass indicates relative prey size (Wroe et al., 2005). Furthermore, Procrustes and Principal Components (PCs) analyses of bite force, which may provide meaningful predictors of feeding ecology, are found to be similar for *D. maculatus* and *S. harrisii* (Wroe and Milne,

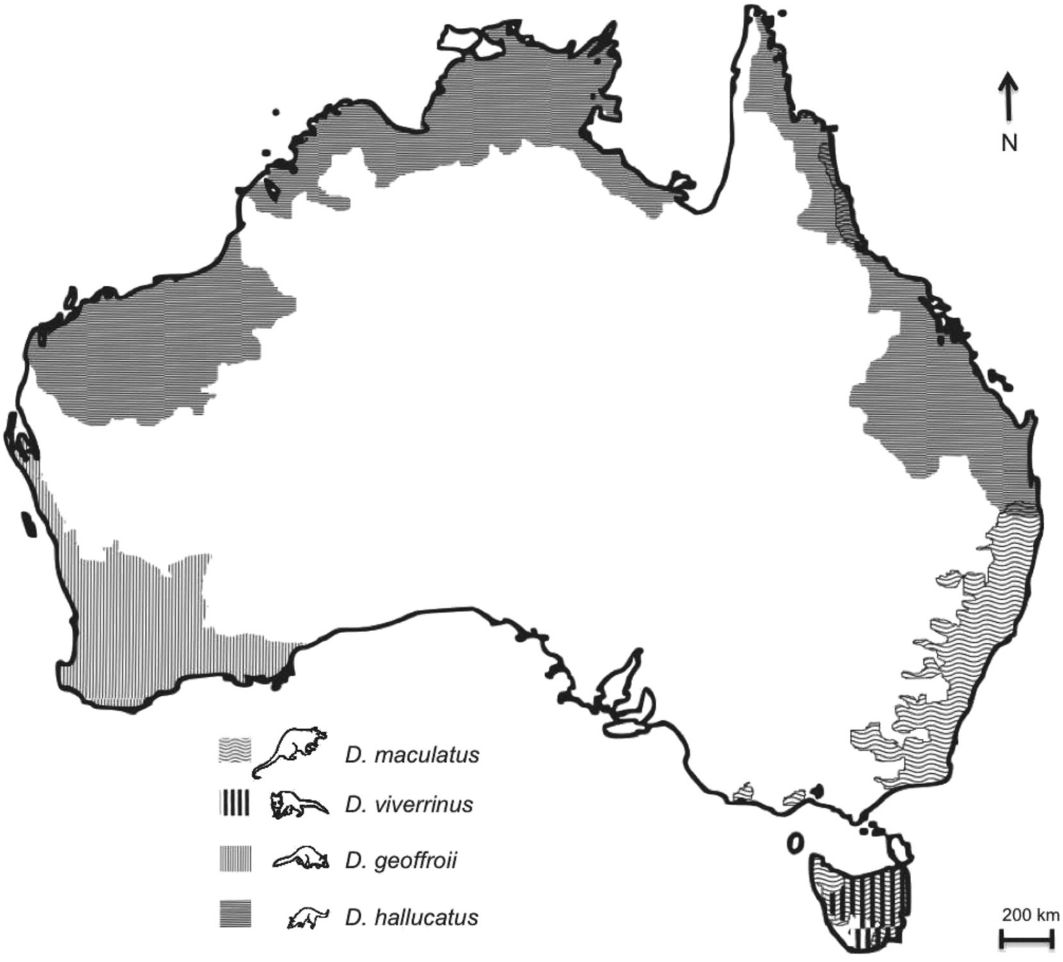

Fig. 1. Distribution of quoll species in Australia.

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