

New stratigraphic and taphonomic data from the late Pleistocene deposits of the San Teodoro Cave (North-Eastern Sicily, Italy)

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Abstract

In previous excavations at the San Teodoro Cave (North-Eastern Sicily) the Authors distinguished an upper Late Glacial sedimentary unit (Unit A) and a lower sedimentary unit (Unit B) containing Upper Pleistocene endemic mammal remains. New data collected during 2002 and 2003 excavations come from a trench located on the eastern side of the cave at a distance of 30-34 m from the entrance. In the new trench the composition and taphonomic characters of the faunal assemblage of the Unit B deposits are similar to those recognized in 1998 in a trench located on the eastern side of the cave at a distance of 9-13 m from the entrance. The Unit B contains a highly diversified assemblage of vertebrates, invertebrates and vegetal remains. Damages on bones and abundant coprolites testify to intense hyena activity. Complete and undamaged remains of elephant and deer are actually a novelty from a taphonomic point of view. A new sterile sedimentary unit (Unit C) has been brought to light. The characters of the new sedimentary Unit C suggest a correlation with the older lacustrine deposits located at the base of the vertical cliffs where the San Teodoro cave is located.

Keywords: Pleistocene, mammals, cave deposits, stratigraphy, insularity, Sicily.

Introduction

This paper deals with the new data collected in the San Teodoro cave during 2002 and 2003 excavations. Previous excavations were carried in 1998 (Bonfiglio et al. 1999, 2001); they followed the older excavations carried by Anca (1860), Vaufrey (1928, 1929), Tricomi (1938), Maviglia (1941, 1942), Graziosi (1943, 1947), Graziosi and Maviglia (1946) (Fig. 1).

The San Teodoro Cave is large (about 60 m long, 20 m wide and up to 20 m high), opens in Jurassic limestone and has a relatively small entrance at the altitude of 150 m a.s.l. and a total surface of more

than 1.000 sq. m. The longer axis is oriented according to a NNW-SSE fault system (Robillard 1975).

In previous excavations the Authors distinguished an upper Late Glacial sedimentary unit, containing human feeding remains (mammal bones) associated with late Upper Palaeolithic (Epigravettian) stone artifacts, and a lower sedimentary unit (Unit B; Bonfiglio et al. 2001) containing Upper Pleistocene endemic mammals. Within the prehistoric deposit two successive cultural phases have been identified (Vigliardi 1968, 1989), which are also known in other Sicilian prehistoric sites where they have been dated from

14.000 to 11.000 y BP (radiocarbon dating; Martini 1997).

In the San Teodoro Cave the first, and so far still unique, Palaeolithic burials of Sicily have been also found, which have been referred by the authors to the oldest human occupation phase of the cave. Skulls and exceptionally complete and preserved articulated skeletons of at least seven humans, which have been buried in the clayey sands and

gravels of the lower stratigraphic unit, have been recovered (Graziosi 1947; Fabbri 1989, 1993).

Even though the San Teodoro Cave has been the object of intense episodes of human occupation from the upper Palaeolithic to present, it still preserves a consistent part of the older, natural deposits which contain Pleistocene mammals. The 1998 excavations were devoted to the reconstruction of the stratigraphy of cave deposits

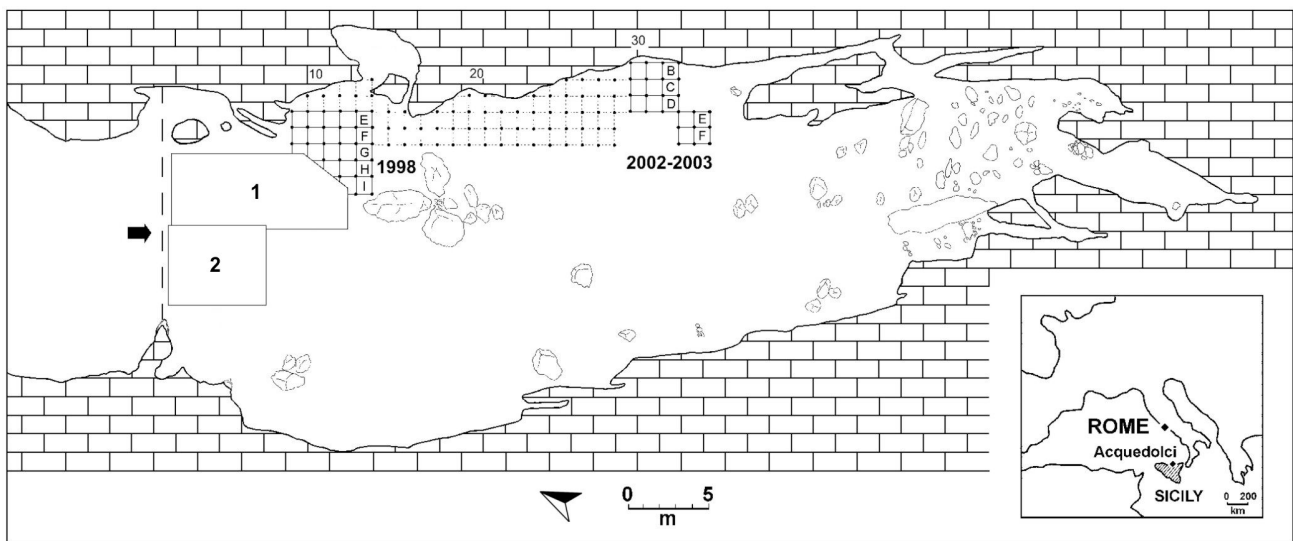


Fig. 1. Plan of the S. Teodoro Cave: the 1998 (sq. E-I/9-13) and the 2002-2003 trenches (sq. A-B-C-D-E-F/30-34) are indicated. The arrow indicates the cave entrance. 1, Location and probable extension of the trench excavated by Maviglia (1941) and by Graziosi (1947); 2, Probable location of the trench excavated by Anca (1860) (modified after Bonfiglio et al. 2001).

and to a better knowledge of the faunal assemblages, especially the older one. The results of the 1998 excavations gave new information on the history of Pleistocene mammal populations of the island and provide original taphonomic aspects not only for Sicily, but also for the Italian Peninsula (Bonfiglio et al. 1999, 2001).

The investigated Unit B is made of clayey sands and gravels which contain a highly diversified assemblage of vertebrates, invertebrates (molluscs) and vegetal remains. The large mammal assemblage which contains elephant (*Elephas mnaidriensis*), wild ox (*Bos primigenius siciliae*), deer (*Cervus elaphus siciliae*), wild boar (*Sus scrofa*), wolf (*Canis lupus*), hyena (*Crocuta crocuta spelaea*), fox (*Vulpes vulpes*), with the equid (*Equus hydruntinus*) and the associated small mammals taxa (*Microtus (Terricola) ex gr. savii*, *Apodemus cf. sylvaticus*,

Erinaceus cf. europaeus and *Crocidura cf. sicula*) has been attributed to a new faunal complex in the Pleistocene of Sicily. It contains some endemic taxa surviving from the previous faunal complex associated with non-endemic taxa (*Equus hydruntinus*, *Microtus (Terricola) ex gr. savii*, *Erinaceus cf. europaeus*) (Bonfiglio et al. 2001).

The material resulting from washed samples of sediment consists of a large number of mammal bones and hyena coprolite fragments, small vertebrates (rodents, insectivores, bats, birds, amphibians and reptiles), small gastropods and seeds. The numerous and diverse evidences of cave occupation by spotted hyena populations is actually the most prominent taphonomic feature of this deposit. The evidence consists of several *Crocuta* skeletal elements (skull, teeth, limb bones), an impressive quantity of coprolites, and of ubiquitous

traces of crushing, gnawing, chewing and digestion that have been detected on almost all the large mammal remains (Bonfiglio et al. 1999, 2001). These taphonomic characters have been found so far only in a few cave deposits of the Italian peninsula ("Grotta dei Moscerini", Stiner 1990-91; "Buca della Iena", Pitti and Tozzi 1971; Stiner 1990-91; "Grotta Guattari", Piperno and Giacobini 1990-1991; Stiner 1990-91; "Tana delle iene", Giaccio and Coppola 2000) and are actually a novelty for insular environments.

Pollen spectra from samples of coprolites from the Unit B show the existence of a main vegetation formation dominated by grass and with moderate arboreal taxa (*Artemisia*, *Ephedra*) and lower percentages of pollen of mesophilous taxa (i.e. *Quercus*, *Betula*, *Abies*, *Alnus*, *Pistacia*) and depicted a glacial landscape (Yll et al., in press).

Geochemical and radiometric dating are not available for the deposits of the San Teodoro cave; the dispersal to Sicily of the ground vole, which has a fossorial habit, and of horses, that prefer open landscapes, might imply that a fully exposed connection (a temporary land bridge related to eustatic lowstand) had formed, perhaps more than once during the last glaciation (Bonfiglio et al. 2002).

2002-2003 excavations

During 1998 excavations a grid of squares (side 1 m) identified by surface co-ordinates (numbers and cap letters) have been superimposed on the cave floor, starting from the entrance. Square numbers start from the entrance (n. 1) and proceeds towards the inner part of the cave. Letters start from M, indicating squares immediately eastward of the major axis set at the centre of the cave and N for squares immediately westwards. The excavation trench has been located on the eastern side of the cave on a square surface of 25 sq. m (co-ordinates 9-13 and E-I).

The 2002/2003 trench has been located on the inner eastern side of the cave on a square surface of about 13 sq. m (co-ordinates 30-32/A-D and 33-34/E-F) (Fig. 1) in order to verify the extension of evidence of occupation by spotted hyena populations in the inner part of the cave, far from the entrance.

The new data concern the stratigraphic sequence of the cave deposits and the composition and tapho-

nomic characters of the faunal assemblage.

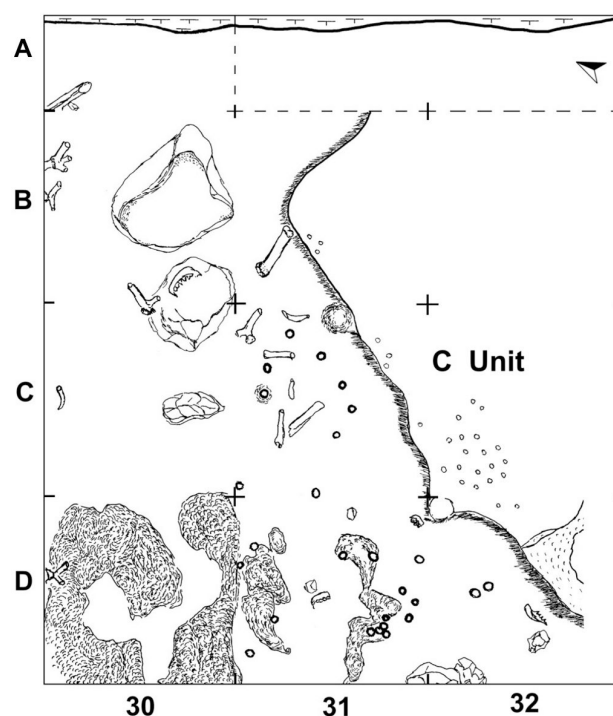


Fig. 2. Plan of the 2002-2003 trench (squares 30-32/A-D, cut 6). The limit between Unit C and the fossiliferous Unit B is indicated. Circles in the Unit C indicate the pisoliths-like elements. Large carbonatic fragments and concreted areas contained in the Unit B are also indicated. The dotted line delimits not excavated area close to the eastern wall of the cave.

Stratigraphic data (L. Bonfiglio)

In the 2002/2003 trench sediments of Unit B are again made of clayey sands and gravels and contain several carbonic concretion levels, which often incorporate fossil remains.

In the Southern area of the trench (squares 32B/C/D, and part of squares 31B and 31C) a unit of clayey sands and gravels (Unit C in this paper) has been detected which does not contain any trace of fossil remains (Fig. 2). Lithology of the Unit C is fairly uniform along all the investigated depth (1 m). The sediment is yellowish-brown and contains mineral particles of the same litotypes as the Unit B, which were carried by vadose flow and washed into the cave from the sedimentary cover of an older terrace overlying the roof of the cave (Coglitore 2002). In the Unit C numerous white-yellowish pisoliths-like elements are scattered. The non-

crystalline structure, the phosphatic composition and the dimension of the elements (diameter 1-4 cm) suggest that these particles have originated in a vadose level located above a water table inside the cave.

A subvertical and quite irregular surface separates the fossiliferous Unit B from the sterile Unit C and suggests that an erosional phase cut the sterile deposit unit before the deposition of Unit B.

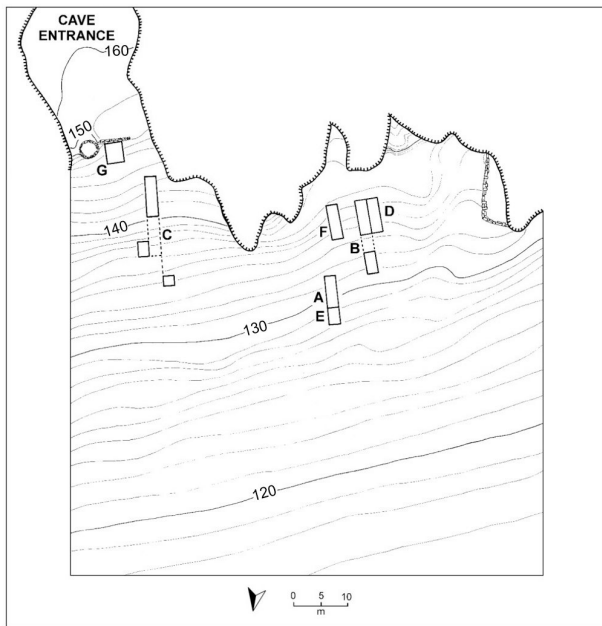


Fig. 3. Topography of the lacustrine deposits located at the base of the carbonatic massif where the S. Teodoro cave opens and location of the trenches. The numbers indicate the heights above sea level (modified after Bonfiglio, 1987).

Discussion

The age and the precise environmental significance of this new sedimentary unit is to be clarified with the deepening of the trench.

The excavations inside the cave follow extensive stratigraphical investigations and excavations carried out during the years 1982 -1987 at the base of the high vertical cliffs of the carbonic massif in which the San Teodoro Cave opens. Seven trenches have been excavated (Fig. 3). This field survey brought to light late Middle Pleistocene lacustrine deposits containing mostly bones of *Hippopotamus pentlandi*, the endemic sicilian hippo, associated with scarce and fragmentary bones of *Elephas* sp.,

Cervus siciliae, *Ursus* cf. *arctos*, *Canis lupus*, *Testudo* cf. *hermanni* and birds (Bonfiglio 1992, 1995).

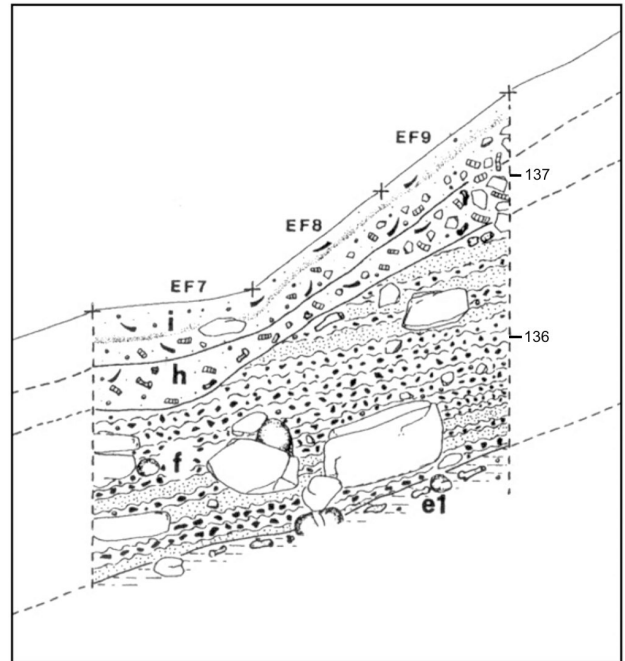


Fig. 4. N-S section of trench C, squares E-F/7-9. e1, Lacustrine deposits; f, Bone breccia; h/i, Reworked levels. The numbers indicate the heights above sea level (modified after Bonfiglio, 1987).

Taphonomic characters suggest an autochthonous bone assemblage (Bonfiglio 1995). The gravels and silty laminated lacustrine deposits with vertebrate remains overlie beach gravels and a wave-cut platform located at 131 m a.s.l. The vertebrate bearing deposits, the abrasion platform and the beach gravels are in turn cut by the younger Tyrrhenian abrasion platform which is extended northward of the lacustrine basin and presents its inner margin at the altitude of 105 m a.s.l. (Bonfiglio 1992). In the trench C, which is located outside the entrance of the cave, the lacustrine deposits extend up to the height of 142 m a.s.l. and they are overlain by a bone breccia (Fig. 4) which is made up prevalently by fragments of bones of *Hippopotamus pentlandi* coming from the erosion of the highest portion of the lacustrine deposits, subsequent to its drying and probably previous to its cutting by Eutyrrhenian marine cycle (Bonfiglio 1987).

When a lacustrine basin existed the water table

and the overlying vadose level may have extend inside the cave.

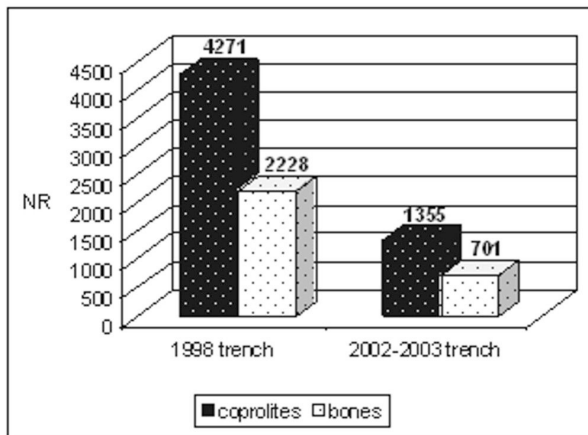


Fig. 5. Distribution of bones and coprolites in the 1998 and 2002-2003 trenches.

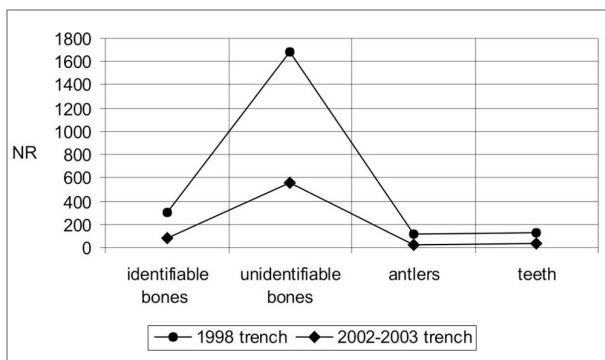


Fig. 6. Composition of large mammal remains in the 1998 and 2002-2003 trenches.

The lacustrine deposits and the Unit C inside the cave may have been cut by the same erosional phase, in response to the lowering of regional base levels due to uplift characterizing North-Eastern Sicily in the late Middle Pleistocene.

Faunistic and taphonomic data (G. Mangano)

The excavations of 1998 and 2002/2003 trenches involved the Unit B. Quantitative data concerning the 2002/2003 trench are compared with those concerning the 1998 trench, partially published (Marra and Bonfiglio 2002) and reviewed on this occasion.

A total number of 2.929 large mammals remains and 5.626 hyena coprolites have been collected (Fig.

5). The bones/coprolites ratio is about 1:2 in both the trenches. A relationship between the number of collected remains and the volume of investigated sediments has been observed. In the 1998 trench, 4.271 coprolites and 1.355 bones remains have been collected from about 15 cu. m of excavated sediments; in the 2002/2003 trench, 2.228 coprolites and 701 bones remains have been found in about 5 cu. m of sediments. The number of collected remains appears proportionate to the volume of excavated sediments. The ratio of the 1998 trench remains to 2002/2003 trench ones is 3:1.

Also in the 2002/2003 trench almost all the skeletal remains are fragmentary, not articulated and horizontally and vertically scattered without preferential orientation. A very large number of them are represented by unidentifiable bone splinters and about half of the anatomically and taxonomically identifiable remains are represented by isolated teeth and fragments of antlers (Fig. 6).

The herbivores are represented by *Cervus elaphus siciliae*, which is the most abundant species, followed by *Equus hydruntinus*, *Elephas mnaidriensis*, *Bos primigenius siciliae* and *Sus scrofa*.

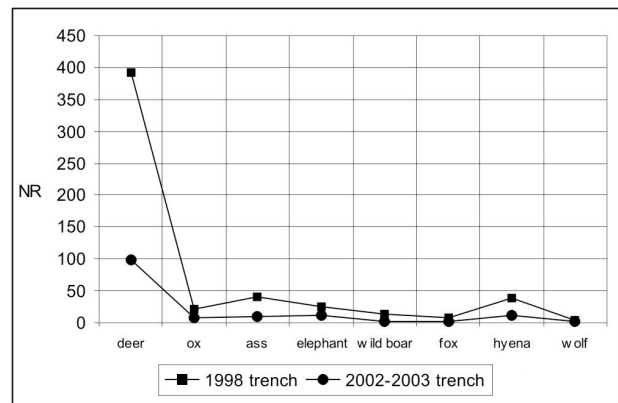


Fig. 7. Taxonomic distribution of skeletal remains in the 1998 and 2002-2003 trenches.

The carnivores are almost exclusively represented by *Crocota crocota spelaea*, with very scarce remains of *Vulpes vulpes* and *Canis lupus* (Fig. 7).

The skeletal part composition is characterized by the absolute predominance of teeth and antlers, with few vertebrae and ribs, few limb bones and many podial bones, metapodial bones and phalanges

belonging to the herbivores, and prevailing teeth and cranial remains belonging to hyenas (Fig. 8).

Almost all the large mammal bones show the typical damages produced by hyena activity, such as strong fragmentation, ragged edges, tooth grooves, tooth pits, digestion traces and scooping out of cancellous bone (Brain 1981; Bunn 1983; Sutcliffe 1970).

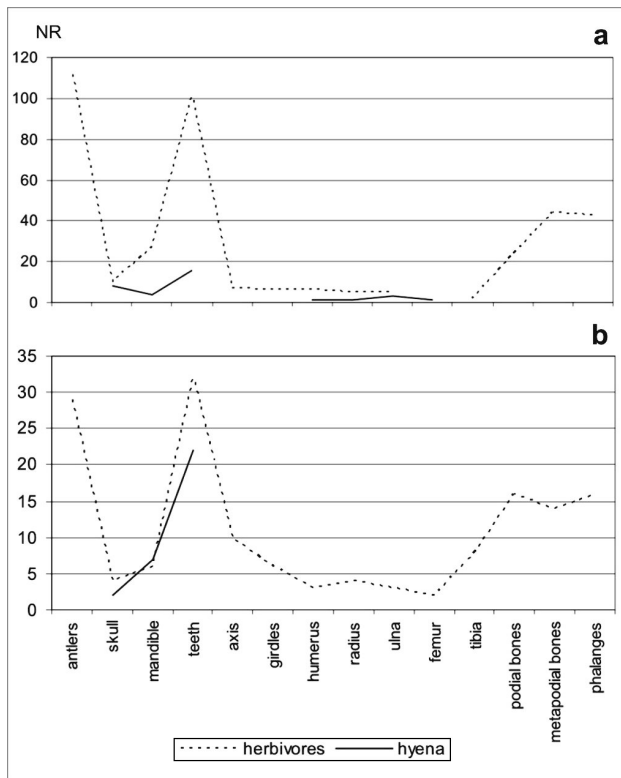


Fig. 8. Anatomic distribution of herbivores and hyena remains in the 1998 trench (a) and 2002-2003 trench (b).

New taphonomic features, different from those previously recognized, come from the 2002/2003 trench. Undamaged and complete large bones (tibiae, ribs, pelvis, scapula) of elephant (*Elephas mnaidriensis*) (Fig. 9) have been recovered accumulated on the eastern side of the trench, nearby the cave wall. In the squares 32-33/E-F two complete right shed antlers of deer (*Cervus elaphus siciliae*), different in size and side by side arranged, have been recovered (Fig. 10); their surface shows teeth grooves which cannot be ascribed for certain to hyenas.

Discussion

Taphonomic data indicate that the fossil bone assemblage has been collected by hyenas inhabiting the cave. The skeletal part composition, the herbivore/carnivore ratio and the bone/coprolite ratio of the San Teodoro cave bone assemblage have many similarities with other continental Pleistocene hyena dens (Fosse 1997; Fosse et al. 1998; Piperno and Giacobini 1990-1991).



Fig. 9. Tibia and ribs of *Elephas mnaidriensis* recovered in the 2002-2003 trench (sq. 30A).

The body part representation of bone assemblages in recent hyena dens (Behrensmeier and Dechant Boaz 1980; Brain 1981) as well as in Pleistocene hyena dens (Piperno and Giacobini 1990-1991; Fosse et al. 1998) shows a higher frequency of post-cranial elements and a lower frequency of vertebrae and ribs belonging to herbivores, while hyena is mainly represented by cranial bones.

The presence of droppings in modern hyena dens and of coprolites in fossil hyena dens is usual (Fosse 1997; Piperno and Giacobini 1990-1991; Sutcliffe 1970), but in recent hyena dens bone fragments and droppings are mainly located in the daylight zone near the entrance (Sutcliffe 1970).

Data from 2002-2003 trench suggest that all the sectors of the cave were frequented by hyenas without difference in the distribution of remains. The San Teodoro cave is confirmed as a very large Pleistocene hyena den.

The presence of complete and undamaged large bones represents a taphonomic novelty in the San Teodoro cave fossil assemblage and could suggest that the hyena is not the only collecting agent of the faunal remains.

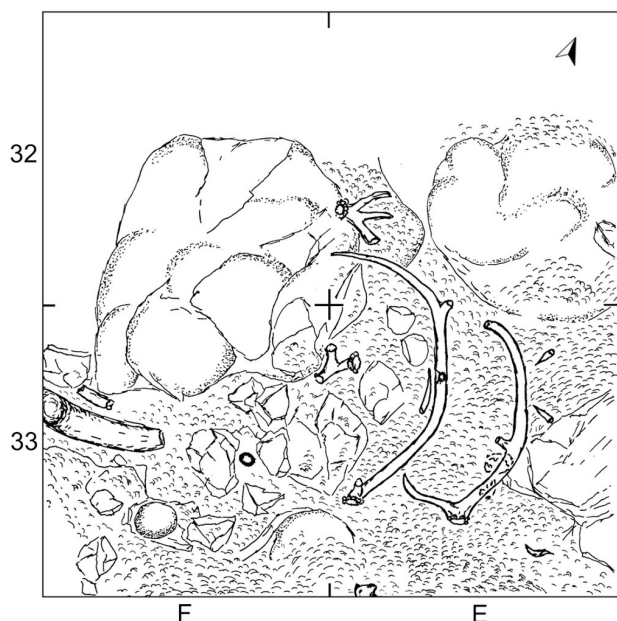


Fig. 10. Plan of the 32-33/E-F squares (2002-2003 trench) showing the location of two complete shed antlers of *Cervus elaphus siciliae*.

Conclusions

1 - During the 2002-2003 excavations inside the San Teodoro cave a new sterile sedimentary unit has been recognised (Unit C) older than the previously recognized fossiliferous sedimentary Units A and B.

2 - In the late Middle Pleistocene, before the deposition of the Upper Pleistocene Unit B, the Unit C has been cut by an erosional phase, probably the same which cut the lacustrine deposits located in the steep slope between the high vertical cliffs where the San Teodoro cave is located and the widest terrace extending northward.

3 - The cave is confirmed as a very large hyena den and the spotted hyena is confirmed as the main collecting agent of the skeletal elements of the Unit B. Nevertheless, some taphonomic characters show that probably the spotted hyena was not the only collecting agent of the faunal remains.

4 - New data show that the Pleistocene history of the San Teodoro cave is more complicated than previously thought and that the cave still preserves numerous evidences of the Upper Pleistocene evolution of Sicily.

Acknowledgments

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Riassunto

[Nuovi dati stratigrafici e tafonomici sui depositi tardopleistocenici della Grotta di S. Teodoro (Sicilia nord-orientale)]

Dalle precedenti ricerche risulta che nella Grotta di S. Teodoro sono presenti due unità stratigrafiche, delle quali la superiore, di età Tardiglaciale, contiene manufatti litici del tardo Paleolitico Superiore (Epigravettiano) associati a resti di pasto rappresentati da elementi scheletrici di mammiferi non endemici appartenenti al Complesso di Castello, il più recente dei complessi faunistici a vertebrati del Pleistocene della Sicilia. L'unità inferiore, costituita da argille e sabbie, contiene resti di mammiferi endemici.

Nel 1998 sono stati condotti scavi su di un'area di circa 12 mq., ubicata presso l'ingresso della grotta (a 9-13 m dall'ingresso). È stata indagata solo l'unità inferiore (Unità B) che è costituita da sabbie e ghiaie argillose contenenti un'associazione ben diversificata di vertebrati (elefante, idruntino, bue, cervo, cinghiale, iena, volpe, topo, arvicola, toporagno, riccio, pipistrelli, uccelli, rettili) invertebrati (molluschi) e resti vegetali. Per la presenza di frequenti danni sulle ossa e di abbondanti coproliti, che testimoniano una massiccia frequentazione dalla grotta da parte di popolazioni di iene, la grotta è stata identificata come una grande tana di iene mentre l'associazione faunistica presente è stata attribuita a un nuovo complesso faunistico del

Pleistocene della Sicilia (Complesso Faunistico "Grotta S. Teodoro-Pianetti").

I nuovi dati qui esposti provengono dall'esplosione di una nuova trincea scavata nelle campagne del 2002 e del 2003, ed ubicata sempre sul lato orientale della grotta a una distanza di 30-34 m dall'ingresso. La composizione dell'associazione faunistica e i caratteri tafonomici del deposito sono assai simili a quelli già messi in luce nel 1998 ma la presenza di due palchi di cervo e di resti scheletrici di elefante interi e non danneggiati costituiscono una novità dal punto di vista tafonomico, di cui non si è trovata ancora una spiegazione.

Lungo la parete orientale della grotta, infine, è stata messa in luce una nuova unità sedimentaria, sempre costituita da sabbie e argille sabbiose, ma completamente sterile. Il contatto tra le argille sabbiose fossilifere dell'Unità B e questa unità (Unità C in questa nota) è subverticale e indica che essa è stata interessata da una fase erosiva precedente la deposizione dell'unità sedimentaria B. I caratteri dell'Unità C suggeriscono una correlazione con i più vecchi depositi lacustri a *Hippopotamus pentlandi* messi in luce sul ripido talus ubicato tra le pareti subverticali del massiccio carbonatico, sulle quali si apre la grotta di S. Teodoro, e l'ampio terrazzo che si estende verso Nord.