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CAVA MURACCI: A NEW MIDDLE-UPPER PALAEOLITHIC SITE IN WEST-CENTRAL ITALY

Maurizio Gatta[1], Mario F. Rolfo[2]

[1] University of York, Department of Archaeology, King's Manor, Exhibition Square, York YO1 7EP, UK
[2] Department of History, Culture and Society, University of Rome 'Tor Vergata', Via Columbia 1, Rome 00163, Italy

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Corresponding author: Maurizio Gatta (maurizio.gatta@york.ac.uk)

ABSTRACT

Comprehensive studies of Palaeolithic sites and the application of modern analytical techniques are still incredibly rare in coastal central Italy. In this paper, we present the Middle-Upper Palaeolithic cave deposits excavated in the travertine quarry of Cava Muracci (Cisterna di Latina, central Italy) and summary describe the multidisciplinary approach carried out on findings discovered therein. A large faunal assemblage, fossil faeces (coprolites) and a small lithic collection have been examined along with reliable dating analyses for the interpretation of the context. The site proved to be extensively frequented by cave hyena (Crocuta crocuta spelaea) between 34–44 ka BP, with a marginal human presence also attested. This study demonstrates that a holistic approach is crucial for enhancing our understanding of the archaeological context of the area, previously interpreted using studies of fauna or lithic industries alone. The evidence gathered from Cava Muracci and the results from their study provide a valuable reference database from which to draw upon for future investigations.

KEYWORDS: Cave Hyena (Crocuta crocuta spelaea), Central Mediterranean, Late Pleistocene, MIS 3, Fauna, Coprolites, Pontinian industry.

1. INTRODUCTION

The first studies on the prehistory of Latium region (central Italy) derive from the pioneering research of local enthusiasts of the first half of the nineteenth century, when the first assemblages of Palaeolithic lithic industry were collected. Afterwards, G.M. Bleicher, L. Ceselli, M.S. De Rossi, F. Indes, R. Meli, G. Ponzi and G. Pinza carried out regular investigations in the second half of the nineteenth century, focusing exclusively on the identification and collection of abundant surface lithic deposits (Bleicher, 1865-66; Ceselli, 1866; De Rossi, 1867; Indés, 1875; Meli, 1884; Pinza, 1905; Ponzi, 1865-66 a-b, 1870). During the late 1930's a new impetus was provided by A.C. Blanc, who discovered a series of surface lithic deposits throughout the entire coastal area between the Tiber river (Rome) and the Circeo promontory. Blanc's techno-typological studies allowed him to identify a local Mousterian culture, with unique features, that he defined as "Pontinian" (1937).

In 1939, the discovery of Neanderthal remains at the Guattari Cave in the Monte Circeo opened a new phase of research (Blanc, 1939a, 1939b, 1940, 1957; Blanc and Segre, 1953). Extensive excavations of natural caves in the Circeo (i.e. Grotta Guattari, Grotta del Fossellone e Grotta Barbara) (Blanc, 1937, 1938, 1939c, 1954) and Gaeta (i.e. Grotta Dei Moscerini and Grotta Sant'Agostino) (Blanc and Segre, 1947; Tozzi, 1970) were carried out over the next few decades. The prehistoric knowledge of the area was enriched by stratigraphic data, chronological backgrounds and large faunal assemblages. In addition to systematic surface surveys (Ceruleo and Zei 1984; La Rosa 2004; Voorrips et al. 1983) and extensive contributions on the Pontinian culture (Bietti et al., 1989; Bietti and Grimaldi, 1993, 1996; Kuhn, 1995), the late 1900s brought new research directions such as population dynamics of Middle-Upper Palaeolithic (Mussi and Zampetti 1987) and the first studies on fauna recovered in the Circeo's caves (Alhaique and Tagliacozzo, 2000; Stiner, 1990-91; 1991a, 1991b, 1991c, 1994).

At present, studies on the prehistory of the Pontine Plain are affected by several problems. Firstly, dates from Circeo's cave sites (Schwarcz et al., 1991a; Schwarcz et al., 1991b), show some inconsistencies with the archaeological data, therefore new ones should be produced using modern techniques. Secondly, studies of lithic industries need to be reviewed as most of them, excepting those of Grotta Breuil (Grimaldi and Santaniello, 2014 and references therein), were produced in the mid-90s (Bietti and Grimaldi, 1993, 1996; Kuhn, 1995) using chrono-typological observations which now need to be integrated with modern approaches. Similarly, new faunal assemblages were not added to the literature since the early 90s, with only some recent revisions of the existing material having been presented by Alhaique et al. (1998a-b; 2007) and Farina (2011). Thirdly, and most importantly, the existing studies are mostly confined to lithic and faunal finds. Multidisciplinary approaches and the exploitation of other resources, such as pollen and geological data aimed at improving the knowledge of the territory, are completely missing.

In the last decade, multidisciplinary approaches (Gatta et al., 2016a; Rolfo et al., 2007; Tafuri et al., 2015) have been applied to improve the understanding of the local framework and to allow dissemination of scientific data so far only known regionally. This study stresses the need for new stratigraphic investigations and the ongoing research at Cisterna di Latina aims to represent a first step in this direction.

2. GEOGRAPHICAL SETTING

The Latium region is located in the west-central Italy, bounded by the Apennine Mountains to the east and the Tyrrhenian Sea to the west. It is characterised by lithological and geomorphological diversity associated with a wide variety of natural environments, ranging from coastal dunes and river valleys to volcanic cones and karst plateaus.

The archaeological site of Cava Muracci (hereafter CM) is located in the coastal area of this complex geological framework, the Pontine Plain. The plain is located about 100 m a.s.l. and occupies a 50km long stretch of the Tyrrhenian coast, extending for 17-25 km inland towards the Lepini Mountains (De Santis et al., 1975).

This area has undergone radical changes during its history, due to both natural and anthropological reasons, deeply affecting the preservation of archaeological sites in its territory. The topographic and geological history of the Pontine Plain is relatively well known, having been examined several times in recent decades (Sevink at al., 1991). The hydrogeology of the plain, particularly complex and thoroughly studied by many scientists (Camponeschi and Nolasco, 1983; Capelli et al., 2004; De Vito, 1977; Manfredini, 1977; Marinucci et al., 2006), has an important role in this study. Firstly, the Pontine Plain and CM area were subject to flooding and swamping until the mid-1900s, when reclamation work altered the region's drainage (Almagià, 1935; De Santis et al., 1975). Secondly, the extremely active hydrogeology caused extensive outcropping of travertine formations in the region. In the North-East, it produced a vast expanse of quaternary travertine situated on the furthest foothills of the Vulcano Laziale up to the

base of the Lepine Mountains. Several quarries have been opened, abandoned and re-opened here since the Roman times. During the quarry works, relevant archaeological discoveries have been documented in this area (e.g. Finocchietto and Cotronia quarries) since the mid-1900s (Segre and Ascenzi, 1956).

3. ARCHAEOLOGICAL BACKGROUND

3.1. *Cava Muracci (Latium, central Italy)*

The travertine quarry "Cava Muracci" (GPS: 41°35'53.4 "N 12°51'23.4" E) in Cisterna di Latina (Latina) (Fig. 1) is of great interest in the area. In 1956, extraction activities brought to light a cave with a scattered Holocene deposit, containing fauna, stone tools and prehistoric human remains (Segre and Ascenzi, 1956). The cave was then destroyed by quarrying in the following years. Simultaneously, small caves filled by Pleistocene soil, fossil fauna and lithic industry attributed to the Upper Palaeolithic were also discovered. However, in the early 1990s, a local enthusiast recovered further human and animal remains along the northern side of the quarry (Area 1, Fig. 2a), within a conical slit of the travertine (Angle and Germano, 2003). The most important of these was the discovery of a Middle-Late Neolithic adult male skull (3620–3590 14C BP), placed on top of a tortoise shell, perhaps suggestive of a voluntary ritual deposition. However, due to the risk of the travertine collapsing, further investigations were not carried out at this time.

In 2012, seven natural karst deposits rich in archaeological remains, whose sizes range from a few meter pockets to proper caves, were discovered during surveys in the area (Gatta et al., 2015, 2016b; Fig. 2a).

In a geo-morphological framework similar to those of 1956, the initial recovery of archaeological finds was immediately carried out to protect the material from quarrying and/or exposure to climatic stress. Abundant faunal remains were collected along with coprolites and rare lithic industry. Surveys and collection of findings along new quarry faces continue to the present day.

3.2. *The excavation of "Area 3"*

Among the seven areas where archaeological remains were found, one, in particular, stood out due to the high quantity of remains and the well-preserved deposit. Area 3 (Fig. 2a) is a limestone cave placed about three meters above the lower floor level of the quarry and was seriously damaged by travertine extraction which occurred about three decades ago (according to the quarry owner). Subsequent to the surveys, once archaeological significance was identified, an accurate stratigraphic excavation of the area was carried out between 2012 and 2016.

The archaeological deposit was mostly intact, while the front part had slipped, forming an altered and sloping slide arriving at the floor level 3 m below. The first phase involved the excavation of the unaltered in situ cave deposit. Unfortunately, the destruction of the cave was so advanced that its original morphology and extent is impossible to determine. At the start of the excavation, only a 6m-long wall and part of the ceiling of the original cave were left, conferring to the site the morphology of a rock-shelter. In order to acquire as much useful information as possible, stratigraphic investigation of the site commenced where the Pleistocene surface was best preserved, in an area measuring c. 20m². The cave was almost completely obstructed by continental alluvial deposits, however seven stratigraphic levels have been recognised (see Fig. 2b):

- SU 7: This layer, about 20 cm thick, is the modern upper walking surface, composed of mixed material but mainly soil and gravel, with which the quarry is paved.
- SU 8: Is the 40-to-80 cm thick travertine ceiling of the cave, hidden below the modern surface. Part of it has been removed for safety reasons during the excavation.
- SU 11: This consists of a 45-to-100 cm thick highly consolidated red-brown clay soil with rare reworked volcanic products from the neighbouring Vulcano Laziale (see SU13). It also incorporated small calcareous conglomerates and clasts which are ruins of the cave. This stratigraphic unit contained abundant large mammal and small vertebrate remains, coprolites and rare lithic industries.
- SU 12: Is a very compact 20-to-40 cm thick layer of reddish brown clay, containing a large number of clasts that separates the level from the above SU11 and a greater number of volcanic products. Abundant small vertebrates and few lithic industries were present, while large faunal remains and coprolites were absent.
- SU 13: A homogeneous greyish green layer of highly consolidated volcanic tephra and pyroclastic products. This sterile layer attests to the eruptive phase of the Vulcano Laziale complex dating at 70±2 ka (Gatta et al., in press a).
- SU 14: Consists of a 50-to-100 cm thick very solid reddish paleosol. The presence of light patina of manganese is widespread, perhaps being evidence of a recurrent presence of water. Extremely rare lithic and bone remains were also found.
- SU 15: This bottom layer is made of calcareous encrustation and travertine with a strong presence of manganese patinas. It represents the natural floor of the cave.

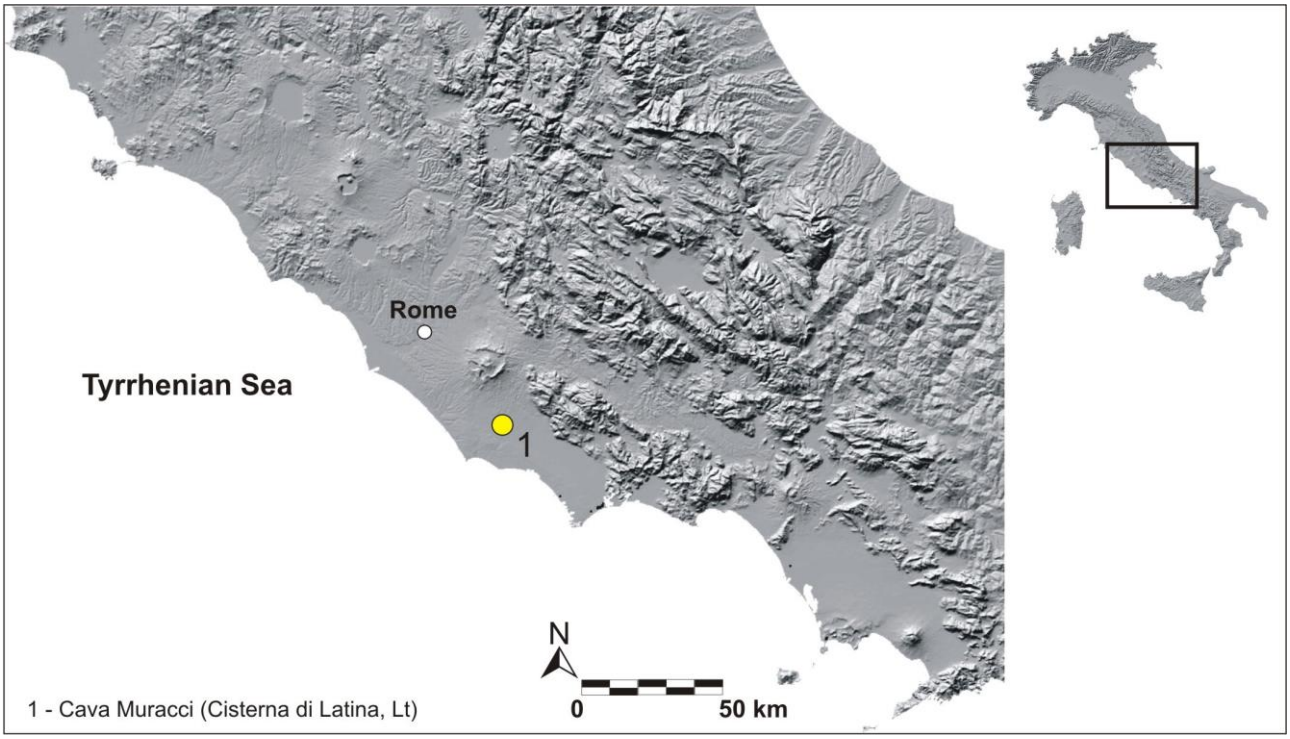

Figure 1. Location of Cava Muracci site, Cisterna di Latina.

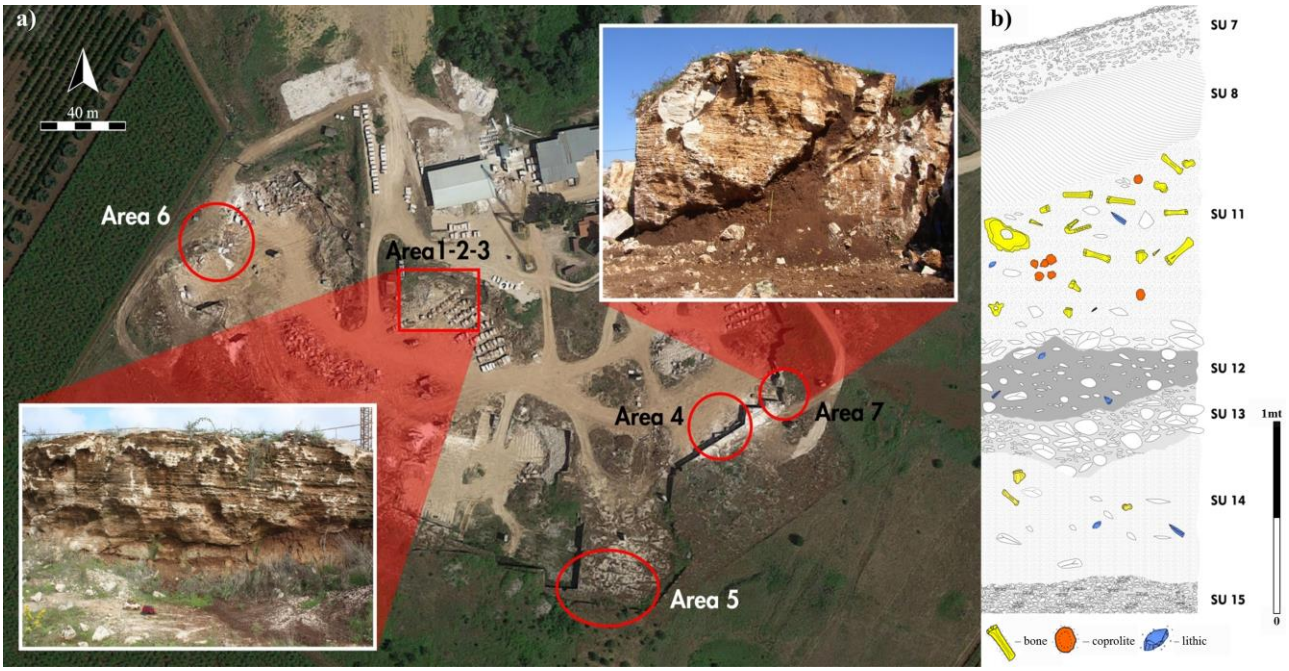

Figure 2. a) Satellite image and photos showing the investigated areas in Cava Muracci. b) Stratigraphy of Area 3 from Cava Muracci (from Gatta and Rolfo, 2015).

SU11 proved to be the main archaeological site level. Fauna was present in various states of preservation, from intact to fragmentary. From this paleosol approximately two-third of the whole identified fauna from CM has been collected, together with coprolites and lithics.

In the early stages of the surveys, the site was interpreted as filled by a natural chimney or vertical access over an indefinite period of time. However, new features were soon noticed. Several carnivore mandibles were visible on the surface layer, whilst on many of the other animal remains evident gnawing marks were visible. It became clear that the deposition of the remains was not accidental but rather the result of carnivore activity. Nevertheless, the potential for human frequentation remained linked only to the presence of a small lithic collection.

At the same time the investigation of the slope was carried out, which proved to be particularly rich of findings. This slope seems to have been formed by exposure and weathering, ultimately causing the collapse of part of the upper layer (SU11) and the artefacts contained within. This hypothesis is confirmed by the study of the deposit:

1. The archaeological remains (i.e. bone remains, lithic industry and coprolites) are the same found in SU11, although distribution patterns are completely absent in the slope, while climatic markers (i.e. patinas and cracks) are evident.
2. The soil of the slope, although disturbed by climatic stress, shows the same geo-morphological characteristics (i.e. colour, texture and composition) of SU11.

3.3. *The chronology of Cava Muracci site*

In order to define the chronological framework of CM, a large number of dates have been produced (Table 1), although many difficulties occurred. The first radiocarbon date was carried out by the Beta Analytic (USA) on three bone samples from SU11 but failed due to lack of collagen. Collagen is highly sensitive to preservation environments and while the high dissolution of travertine and minerals within the deposit allowed for exceptional bone fossilisation, it had a destructive role on their organic components.

An attempt was therefore made with the Uranium-Thorium method, despite a well-known difficulty of this method in contexts rich in calcium carbonates such as CM, on three different findings from the SU11. These yielded abnormally young and therefore unreliable dates. Tephrochronological analyses of the volcanic layer SU13 were therefore carried out to provide a *terminus ante quem* of the overlying SU11. It successfully correlated the SU 13 to the Albano Unit 3 dating to 69 ka (Gatta et al., in press a), providing a first chronological constraint.

Finally, further radiocarbon dating was recently undertaken on bone fragments and coprolites and successfully analysed, despite poor preservation of collagen prevented the use of Ultra Filtration preparation method. Four bones from Area 3 and Area 7 of CM yielded consistent ages ranging between 34,810–44,054 cal BP (Table 1). This chronological range matches with the palaeoenvironmental indications provided by the study of pollen from coprolites (Gatta et al., 2016b) and by the faunal taxa identified. Vice versa, the two coprolites produced ages between 19292–22378 cal BP which are substantially younger than the above-mentioned ages. Considering that the coprolite ages are incompatible with the faunal assemblage and a general unreliability of 14C on coprolites has already been documented (Bon, 2012; Diedrich, 2012, p. 372), we are inclined to consider the dates from coprolites as completely unreliable (Gatta et al., 2016b).

Table 1. Results of AMS radiocarbon dating from Cava Muracci.

Specimen	Laboratory No.	14C age yr BP	Calibrated age yr BP*
Area 3	LTL15758A	39417±450	44054-42523
Area 7	LTL15759A	35231±350	40658-38945
Area 3	LTL15760A	36885±350	42054-40804
Area 3	ETH-66210	31339±168	35638-34810
Coprolite Area 3	ETH-66212	16141±42	19640-19292
Coprolite Area 3	ETH-66213	18313±51	22378-21952

4. MATERIALS AND METHODS

4.1. *Palaeoecological remains*

A total of >100 coprolites has been collected from areas 3, 4 and 7 of CM. The colour varies from pale yellow to light brown on the external surface with yellow-white shades internally. The diameter of the pellets varies between 15–85 mm, with a weight between a few grams and over two hundred grams. Macroscopic analysis showed the presence of medium to small fragments of partially digested bones (Fig. 3) typical of few large carnivores during the Late Pleistocene (Diedrich, 2014). Surfaces of almost all the samples were quite solid and compact with no cracks and with an internal structure which is porous and granular-like, because of the shrinking caused by dehydration which started immediately after the deposition of faeces. The preservation of coprolites seems to be significantly related to the depositional environment. The high calcium carbonate values of both karst caves have triggered a strong mineralisation of organic material, allowing for solid fossilisation. During the excavations, the majority of coprolites were found as isolated ele-

ments, albeit close to each other. However, longer segments composed of several pellets have been found, confirming that fossilisation must have occurred fairly quickly with minimum or no post-depositional disturbance. The analogous morphology and fossilisation of all coprolites, albeit from different areas of the quarry, suggest deposition by the same species within a similar time span. The identification of coprolites and their attribution was made according to their morphology and size.

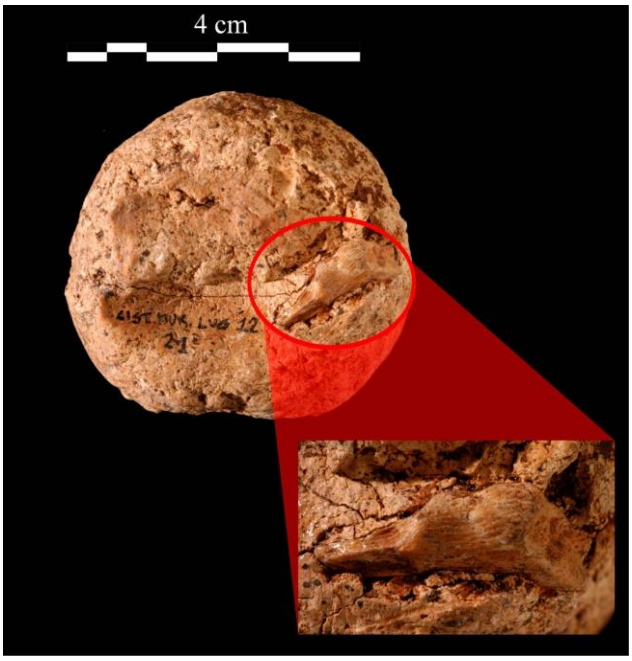

Figure 3. Cave hyena coprolite with digested bone.

4.2. *Archaeozoological collection*

The study of the fauna from Area 3 involved 1346 macro-remains and several hundred of small vertebrates (Gatta et al., in press b), currently stored at the Laboratory of Prehistory of the University of Rome Tor Vergata. A total of 656 macro-remains (48.7% of total) and 49 small vertebrates' remains were taxonomically classified and taphonomically studied. Despite the excellent bone fossilisation, about 690 macro-remains (51.3% of total), presented a high fragmentation rate as the result of carnivore activity. The indeterminate material includes bone fragments, whose size ranges between 1–10 cm. For this reason, these were not morphologically attributable to any taxon.

Findings were found over all of the quarry but were mostly concentrated in the excavation Area 3 (Fig. 4). A find number was assigned to each bone, which was recorded with x, y and z coordinates within a 1x1m excavation grid system. The soil was fully sieved with a 2 mm mesh in the field to ensure that microfauna was also collected. The preservation is extremely variable. Short and long bones are found both intact and fragmented ranging from 1 cm to a few decimetres in size. The texture and patina are also variable, especially among those recovered deep into the archaeological layers and those found on the surface, long exposed to severe local climate factors such as warm summers and prolonged winter rains.

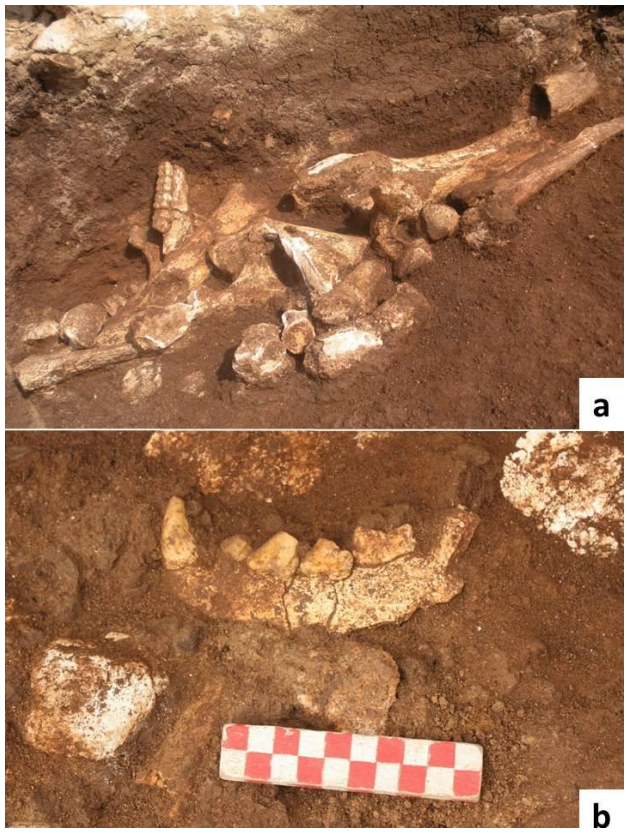

Figure 4. a) Bone distribution in SU11 (Area 3); b) Focus on a cave hyena mandible.

4.3. *The Lithic assemblage*

The lithics analysed were modest in quantity and were particularly concentrated in "Area 3" of the site. The morpho-technical study was performed by naked eye or with a support of low-power magnification (10–20X). Each lithic was oriented and documented according to Inizan et al. (1995) and assigned to specific typological categories. For each item several descriptive attributes were recorded: technology, typology, raw material quality, colour and patina, butt and bulb morphology, blank morphology, cortex presence, damage and wear traces, knapping quality, retouch type and size. Technological and typological assignments were based on Bordes' (1961) and Bietti's typology (1977). These typologies proved to be the most appropriate to the local Pontinian industries. Preliminary trace wear analysis on flints was considered necessary to clarify taphonomic activities.

The collection is composed of 61 pieces: 23 retouched tools, 37 flakes and 1 residual core. The most frequent tools are scrapers on blanks shaped like a "slice of tangerine" (cfr. Blanc, 1937). The number of retouched tools is slightly over 38% of the total assemblage. This is a rather high percentage, assuming that many flakes could also be used without retouching. A possible explanation of this occurrence could be the transport in the area of many finished tools and only a few cores. This approach may be explained by the inland location of CM, in comparison to the already known coastal sites, and therefore by the greater distance from raw material sources. The presence of cortex flakes and a residual core suggest that every step of the chaîne opératoire was carried out in the area.

The main feature of the assemblage is the generally small size of pebbles (microlithic or hypermicrolithic), with only three specimens of larger size – still within 5.2cm – due to the small size of the raw material. The percentage of cortex on blanks is high, in accordance with the industry found elsewhere in the coastal area. The raw material, as is often documented for the lithic industries of the Pontine Plain, is obtained by processing fossil beach pebbles, which are characterised by a wide variety of rock types. The use of any exotic raw materials is not attested. The presence of impact traces produced by natural secondary deposition, typical of raw material from coastal beaches and river beds, are visible at a macroscopic level on most of the analysed artefacts. The flint consistency is compact with a fine to medium grain and rare occurrence of coarser textures and radiolarites is observed. The colours range from white to grey and pale yellow, with substantial differences in the shades even within the same specimen.

5. RESULTS AND DISCUSSION

The Cava Muracci travertine quarry was archaeologically investigated between 2012 and 2016. Seven areas containing faunal remains, coprolites and stone industries were identified. The site was reliably attributed to a time span of the Late Pleistocene between 34–44 ka approximately (Table 1).

Despite the severe damage to the deposits caused by quarrying, a comprehensive study and an interpretation of these was still possible. Particular attention has been given to Area 3, the most preserved, which returned the highest number of findings. Based on the remaining section of the cave and comparison with numerous other sections along the quarry, it can be stated that Area 3 was a large natural travertine cave with at least one access, probably vertical, in the travertine ceiling (SU8).

The morphological study of coprolites permitted to classify them as cave hyena faeces, according to the morphological types proposed by Diedrich (2012) (Fig. 5a). The hard and compact preservation of faeces, triggered by the high number of ingested bones and subsequent phosphate composition (Larkin et al., 2000), allowed us to recognise seven shapes of pellets (Fig. 5b).

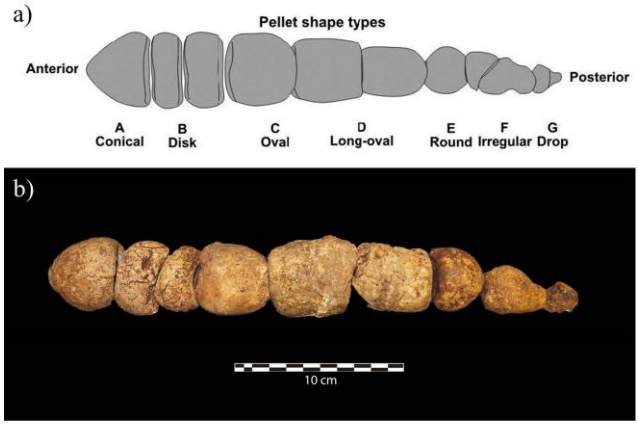

Figure 5. a) Hyena faeces aggregate and pellet terminology from Diedrich (2012); b) Cave hyena aggregate (reconstructed) from Area 3 at Cava Muracci (Latina, central Italy).

The quality of bone preservation permitted the identification of at least twelve macromammals (i.e. *Lepus* sp., *Mustela nivalis*, *Canis lupus*, *Meles meles*, *Crocuta crocuta spelaea*, *Equus ferus*, *Stephanorhinus hemitoechus*, *Sus scrofa*, *Capreolus capreolus*, *Cervus elaphus*, *Dama dama*, *Bos primigenius*) together with fifteen micro-, avi- and ichthyo- species (i.e. Osteichthyes indet., *Bufo bufo*, *Bufotes* gr. *B. viridis*, *Rana* (s.l.) sp., *Podarcis* sp., *Anguis veronensis*, *Natrix natrix*, *Hierophis viridiflavus*, *Aves* sp., *Arvicola amphibious*, *Microtus (Terricola) savii*, *Microtus (Microtus) arvalis*, *Myodes glareolus, Apodemus* cf. *A. sylvaticus*, *Glis glis*) from SU 11 and SU12 of Area 3 (Gatta et al., in press b).

The numerous remains of cave hyena found in the SU11, belonging to specimens of all ages (Fig. 6), together to the high percentage of remains displaying gnaw marks (Fig. 7b) and the identification of coprolites, permitted to interpret the SU11 of Area 3 as a den of the carnivore. Moreover, hyenas use faeces to mark their territory (Diedrich, 2014) and the joint discovery of few coprolite pellets in SU11 indicates a deposition in situ of faeces. This interpretation is also supported by the large number of shed cervid antlers (Fig. 7a) and the discovery of regurgitated bone fragments partially digested (Fig. 7c), both evidence typical of the Pleistocene hyena (Diedrich, 2012, 2014; Stiner, 1994).

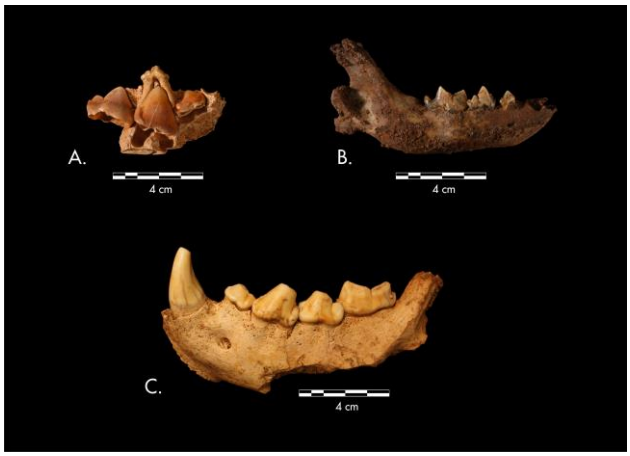

Figure 6. Fragmented cave hyena mandibles from SU11 of Area 3: A) Juvenile individual; B) Juvenile individual; C) Adult individual.

Figure 7. a) Shed antlers of Cervus elaphus from SU11 with conspicuous gnaw marks; b) Radius and Ulna of Bos primigenius with significant chewing of both epiphysis; c) Partially digested and regurgitated bone fragment from SU11.

Although it is clear that the majority of the faunal deposit in Area 3 represents primary deposition by hyenas, it is still possible that water transported additional elements. This is particularly relevant regarding the presence of lithic industries from different chronocultural phases within the SU11 (Fig. 8). This assemblage can be divided into two groups basing on the type of retouching: the larger one, where simple and scalariform retouch predominates, belongs to the Pontinian culture (e.g. local Mousterian), and was present throughout the Middle Palaeolithic (SU14, SU12) and during the hyena occupation (SU11). The second group is composed of two end-scrapers on marine pebbles with laminar retouch, attributed to the Aurignacian culture basing on comparisons with local lithic collections (Mussi et al., 2002; Vitagliano and Piperno, 1990-1991). These implements were found on the surface of SU11 and would have been deposited in a period contemporaneous and/or subsequent to the carnivore activity but prior to the sealing of the cave. Such a reconstruction is confirmed by preliminary trace wear observations (V. García-Díaz, pers. comm.), which suggest that the industries were not in a primary deposition, having been transported there from nearby.

The water must also have carried the rare fauna of SU14, which do not feature gnawing marks or other taphonomic evidence.

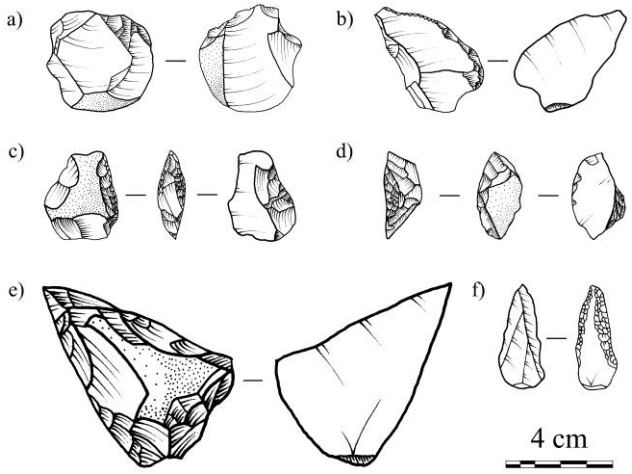

Figure 8. Lithic industries from SU11 (Area 3): a) Residual core b) Pontinian transverse scraper c) Pontinian straight scraper d) Aurignacian carenated point e) Pontinian transverse scraper f) Aurignacian Levallois point.

Area 4 and Area 6 had similar deposits to Area 3. A large part of the deposits containing animal remains was eroded away by the weathering but hundreds of bones were collected and reflect the same species and taphonomy of Area 3. The presence itself of the hyena, attested by bones and coprolites, leads us to consider these as natural ravines inhabited by the carnivore. Other collection areas (i.e. 1; 2; 5; 6) instead, can be considered as natural caves and pockets, filled with debris and the rare finds found, solely by water flooding that transported material from the surrounding surface area. These conclusions are based on the sporadic nature of the findings, the absolute absence of gnawing marks and the mixture of Middle and Upper Palaeolithic lithic industries in the same layers.

The multidisciplinary approach used in this study is even more important than the interpretation itself,

as both excavation and analysis methods not available in the past were used:
- Ten coprolites, selected among those recovered in the hyena level (SU11) of Area 3 at CM, were processed for pollen analysis (Gatta et al., 2016b). Pollen from coprolites is known for its potentiality to return accurate local environment reconstructions (Argant and Dimitrijevic, 2007; Djamali et al., 2011; González-Sampériz et al., 2003; Scott et al., 2003), despite that, coprolites from CM are the first analysed for pollen purposes in central Italy (Gatta et al., 2016b). Results provided new insights into the vegetation of the Late Pleistocene central Italy and indicate that a mosaic environment surrounded CM: open lowlands dominated by steppe and grassland vegetation alternating to hilly areas covered by Mediterranean and mesophilous woods while mesophilous and thermophilous trees were probably present along the coastline and main rivers (Gatta et al., 2016b).
- The faunal assemblage of CM is one of the largest from the inland of the Pontine Plain. Its excavation, which took place over seventy years after the discovery of the neighbouring cave deposits of Monte Circeo, shed light on the wild life and the environment in this area (Gatta et al., in press b). In particular, the discovery of a teeth of *S. hemitoechus* from SU11 dating to 42 054–40 804 cal. BP represents the latest occurrence of this species in Italy (Pandolfi et al., 2017).
- The technology of the lithic industries discovered seems consistent in all of the investigated areas and, from a morpho-typological point of view, this material does not show any particular difference from other industries of the Pontine Plain, including the raw material originating in both cases from the fossil beaches of the coast. However, the use-wear analysis is a tool still poorly exploited in this region, particularly for Palaeolithic industries, but is useful for highlighting attributes of an item which are otherwise invisible. The use-wear analyses of implements from SU11 of Area 3 demonstrated the role of water as the main agent of lithic accumulation. This result is extremely important to define the human role in the history of this site. People frequented the surrounding plains rather than the caves. Moreover, this interpretation is supported by the absence of cut marks on bone remains.

6. CONCLUSION

Cava Muracci is fully described for the first time in this paper. The new evidence from the site provides new information towards the prehistoric knowledge of the Pontine Plain, for which stratigraphic excavations and reliable dates were previously lacking. Moreover, its location around 22 km from the shoreline offers a new archaeological perspective of the inland area, since research was formerly concentrated along the coast.

During Late Pleistocene, the North-East Pontine Plain was characterised by widespread underground travertine caves and pockets now occasionally unearthed by diffuse quarrying. The holistic approach presented in this study allowed for the interpretation of seven archaeological data-rich cave deposits near Cisterna di Latina, central Italy. Three deposits were demonstrated to be hyena dens while others seem to be naturally filled by alluvial deposits. The absence of cut marks on bone remains excludes a human role in the bone accumulations. One the one hand, the abrasion of the lithic artefacts compatible with water transport returned by use-wear analysis suggests humans did not attend the caves investigated but, on the other hand, the transport of implements demonstrate a previously unknown human presence in the surrounding environments of Cava Muracci during the Middle and Upper Palaeolithic.

The importance of CM is highlighted by the advanced analyses on the findings discovered, some of which have never been realised before in the region: (i) Pollen analysis of coprolites proved to be a successful indicator for local vegetation reconstruction. (ii) Tephrochronological analysis proved to be a valid tool to provide a suitable constraint for volcanic archaeological contexts where other dating material may not be available. (iii) Lithic trace wear analysis returned fundamental taphonomic information for the correct interpretation of the human role at the site.

In a broader perspective, the multidisciplinary approach adopted and evidence discussed here can be considered as a reference for future site investigations and provide a valuable database for other disciplines such as palaeoecology, archaeozoology and geology. On the other hand, the successful application of new analytical techniques shows that a revision of the contexts investigated in the past is also necessary to improve our knowledge of prehistory of Latium region.

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