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Bone marrow exploitation in Crete: continuity or fracture? The evidence from Building 101, Room 1 in the North-Eastern Complex of Phaistos

ABSTRACT

Bone marrow exploitation is an attested practice in Aegean Prehistory, but little evidence is known for Phaistos hill. This contribution aims to explore new data on bone marrow related activities on the north-eastern slopes of Phaistos hill during the Prepalatial period, exploring evidence of continuity and fractures between the latest Prepalatial and the Palatial period, when social changes are well attested in Aegean societies. Focused on the so called “North-Eastern Complex” of Phaistos Palace, the excavation activities led by the University of Catania and the Ca’ Foscari University of Venice between 2013 and 2017 have revealed an interesting faunal assemblage, dated to the final phases of the Prepalatial period, characterized by fractured and fragmented bones of sheep, goats and cattle inside a small sounding in Building 101, Room 1. The evidence highlighted by fracture and fragmentation patterns along with taphonomic ones suggests bone marrow exploitation. A taphonomic study focusing on fragmentation patterns and Fracture Freshness Index estimation was applied to the assemblages in order to reconstruct the extraction technique and use of marrow. Through the integration of bones and pottery data, and comparisons with archaeological and ethnographical sources, it has been possible to define the archaeological assemblage as a waste deposit, and to identify it as the results of communitarian episodes of consumption of food and drink. The analysis has also shown that food consumption is a conservative tradition even during times of social change, which highlights continuity in the bone marrow exploitation in the context of enlarged feasting episodes in both the Prepalatial and Palatial periods.

KEYWORDS: Faunal remains, bone marrow, fragmentation patterns, taphonomic analysis, conspicuous consumption, Early Minoan, Prepalatial Phaistos, North-Eastern Complex

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INTRODUCTION

Bone marrow is the soft tissue found in the medullary cavity of long bones and the lower jaw, characterised by a high lipidic component (50%), particularly rich in fatty acid (Eaton et al. 1998, 13). Animal size, age and nutritional conditions are the elements determining the quantity and quality of bone marrow. The older and larger an animal is, the more cost effective marrow extraction activities are, resulting in higher fragmentation of the bones (Isaakidou 2004, 196-197).

The practice of bone marrow extraction is attested as early as the Pliocene (3.39 Ma) (McPherron et al. 2010) and the Early Paleolithic (2.5-0.2 Ma), when there is evidence for storage as well as for consumption (Assaf et. al 2020), indicating that bone marrow extraction had a role in the human diet.

Ethnographically, bone marrow extraction is well attested as source of animal fat and protein in case of food scarcity, but also for other purposes, e.g. as fuel for lighting (Burch 1972), for the waterproofing of skins and for the treatment of bow strings (Binford 1978), and for tanning (Levin and Potapov 1964).

The preferred skeletal parts for marrow extraction are long limb bones (humerus, radius, femur, tibia), then metapodials and lastly the jaw, generally attested when food shortage is particularly severe (Outram 1998).

According to ethnographical sources, bone marrow extraction is performed by means of various techniques: bones can be cracked raw or, more often, they can be heated to soften the marrow, which can then be poured, scooped or poked out (Binford 1981, 148). Heating is generally done by placing the bones directly on fire, which make them easier to break or, more rarely, by boiling. The bone is then broken by percussion using stone tools or knife handles (Outram 1998).

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ARCHAEOLOGICAL CONTEXT

During the 2013 fieldwork season, led in the North-Eastern Complex of the Palace (Figs. 1-2) by the University of Catania directed by P. Militello under the aegis of the Italian School of Athens, two Pre-Palatial levels rich in pottery and faunal remains were uncovered under Building 101 (sondage D) (Militello, Buscemi 2015, 269-270). The trench was 120x90 cm, located along the southern wall of compartment 1 (Fig. 3) (Militello, Buscemi 2015, 269).

Under the superficial level, two strata (UUS 102 and 103) were identified, characterised by a considerable amount of Prepalatial pottery. Study of the pottery deposit and faunal remains enabled us to date the two strata to the final moment of the Prepalatial period (Messina 2018), between EM III and the MM IA (Phaistos VIII-IX phases, according to the Prepalatial sequence; Todaro 2013). The two levels were cut by stratigraphical unit 104, as can be seen in the north-south section (Fig. 4), the foundation trench for a Proto-Palatial wall (UM 104) (Militello, Buscemi 2015, 270), and by a modern cut for conservation works (Militello, Buscemi 2015, 270).

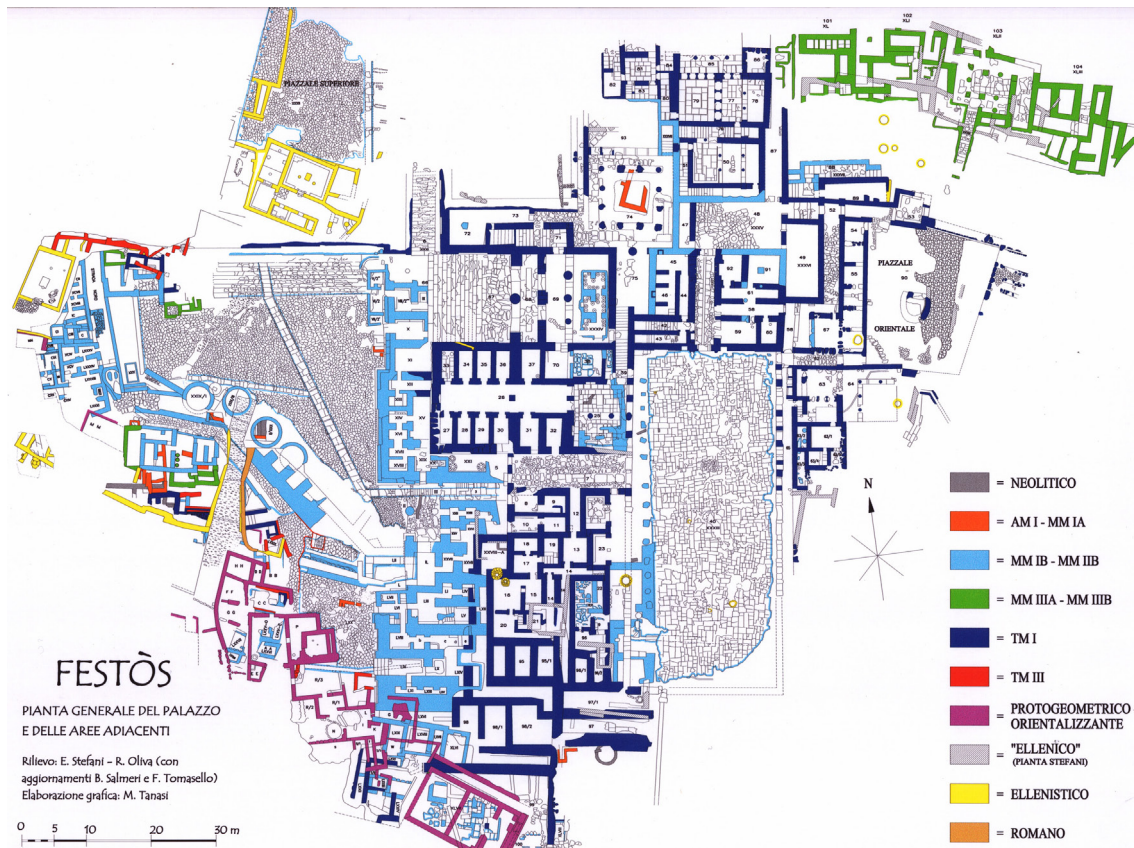


Fig. 1. Phaistos Palace. Planimetry (La Rosa 2010, p. 586, fig. 44.1).

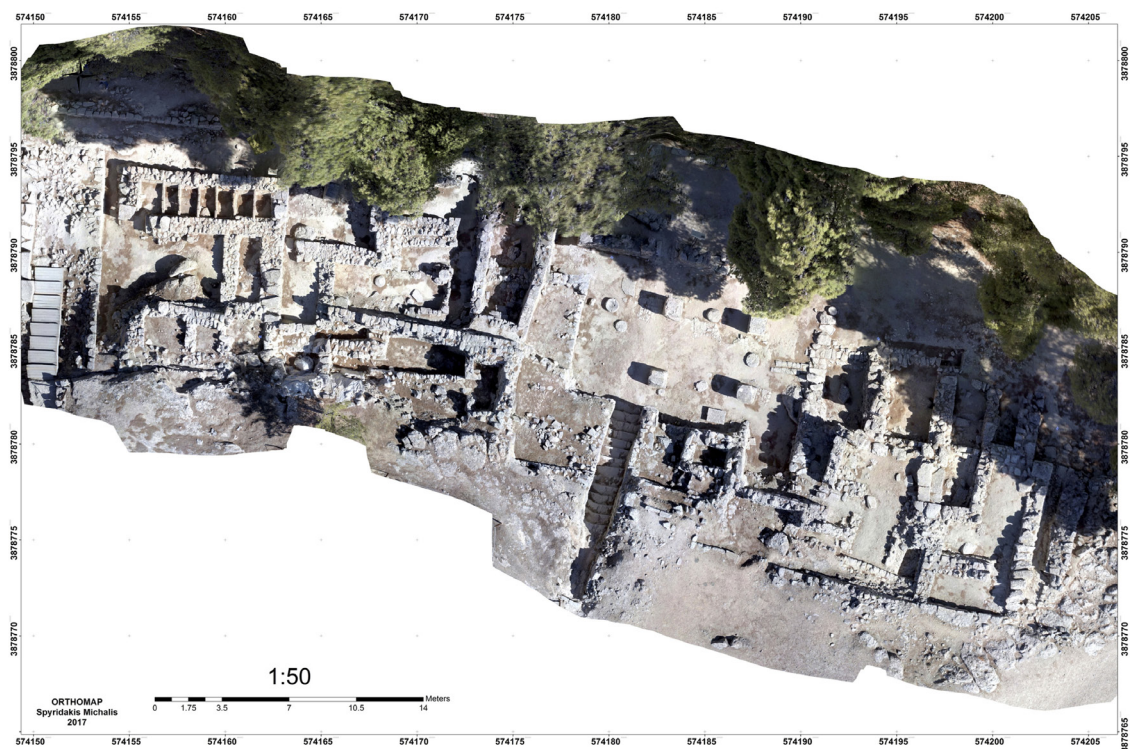


Fig. 2. Phaistos. Aerophotogrammetry of the North Eastern Complex (M. Spiridakis, F. Buscemi, M. Figuera). ©Archivi SAIA, V/384.

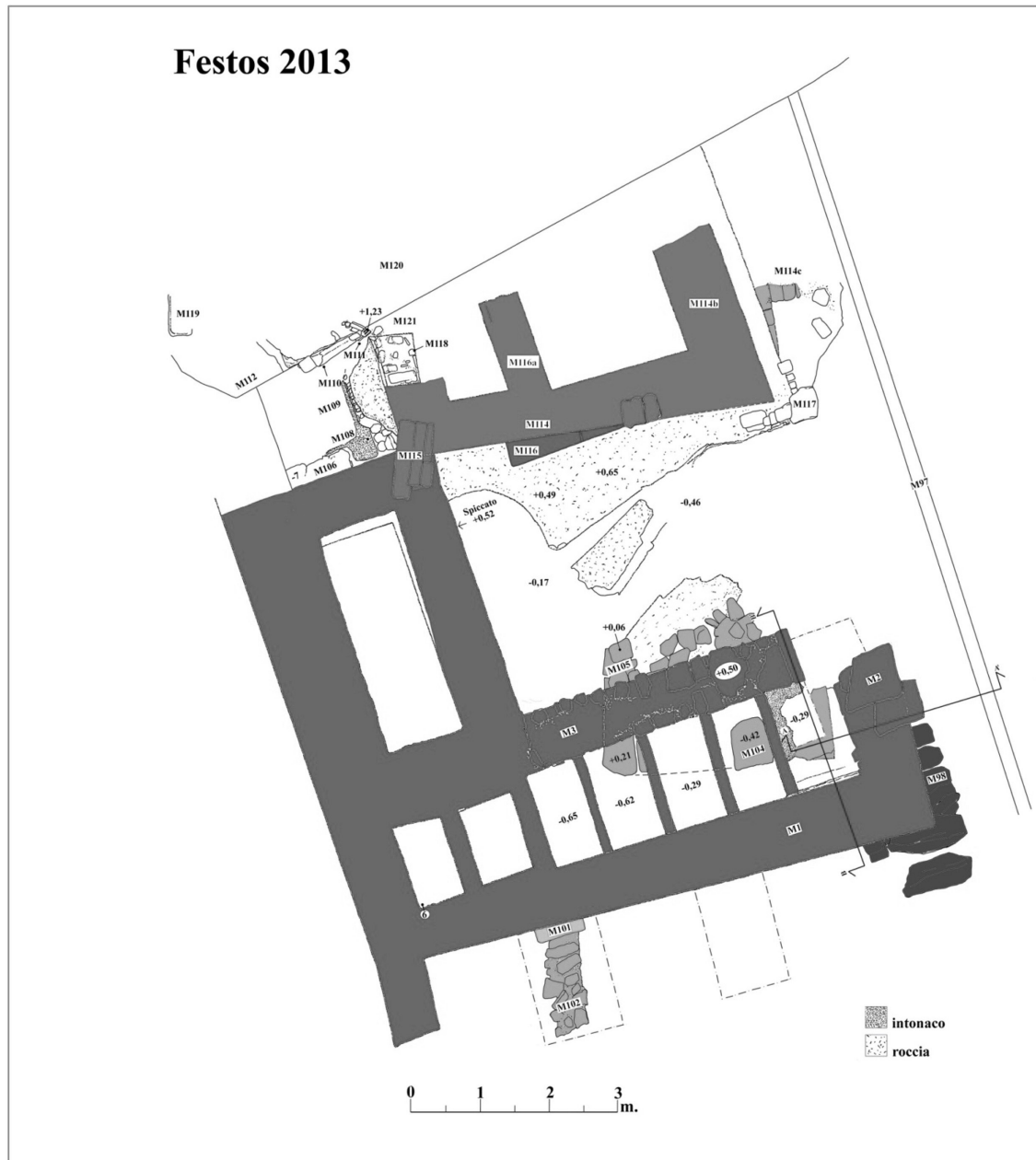


Fig. 3. Phaistos. Building 101-1. Planimetry. ©Archivi SAIA, NIG 8871.

According to the integrated analysis of pottery and faunal remains, both deposits can be interpreted as waste that was quickly buried without being exposed for a long period (Messina 2018; Messina and Platania in press).

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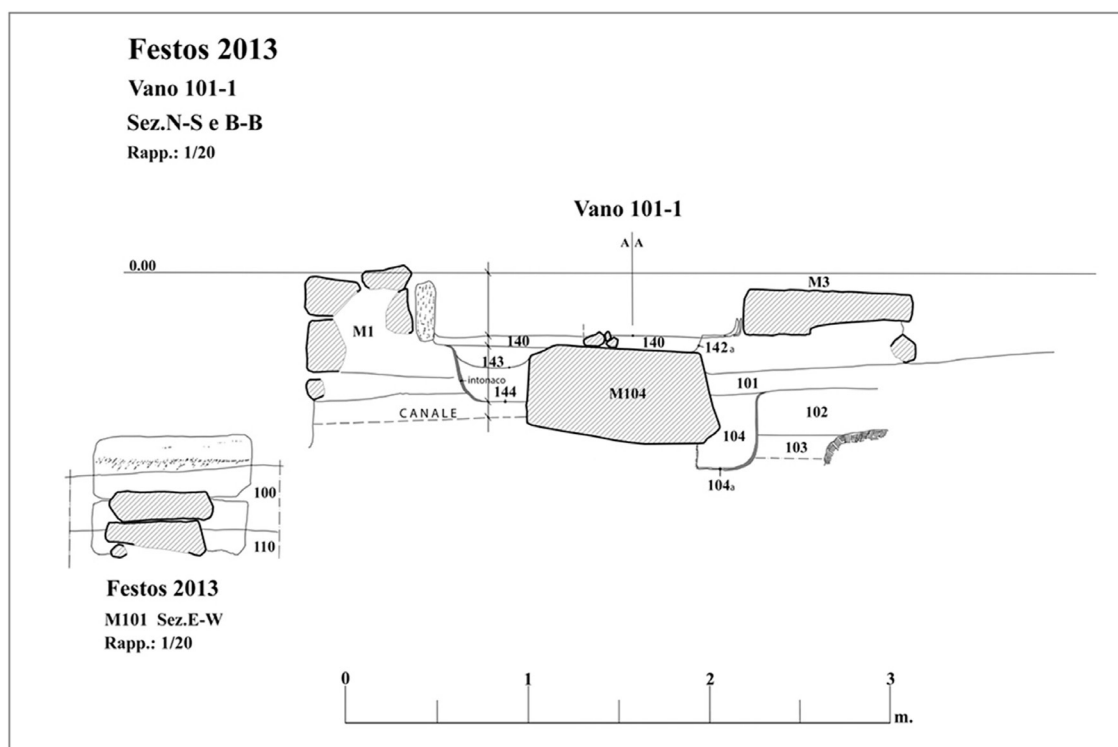


Fig. 4. Phaistos. Building 101-1. Sounding D-E, N-S Section. ©Archivi SAIA, NIG 8870.

MATERIAL AND METHODS

In order to investigate the possibility of marrow extraction activities in the faunal assemblages recovered from Room 1 in Building 101 of the North-Eastern Complex, a comprehensive zooarchaeological analysis was performed, integrating study of the animal bones with the associated pottery deposits, in order to assess bone marrow extraction activities and gain a better understanding of the archaeological context.

Zooarchaeological analysis was carried out using an osteological atlas (Barone 2015; France 2009; 2017; Schmid 1972), and a small comparative collection available at the site. Standard data were recorded on the identified species, anatomical elements, age, and sex (Messina and Platania in press). However, taphonomic analysis was the focus of the applied methodology, as it enables the identification of pre- and post-depositional taphonomic changes and hence the assessment of anthropogenic traces produced during the nutritional phase of carcass use, percussion marks, and fragmentation patterns.

The faunal assemblage from US 102-103 of sounding D is composed of 225 bones fragments in varying states of preservation; it was possible to identify the main domestic taxa attested in the area of the Phaistos Palace in previous reports (Wilkins 1996, 241-261; 2003, 85-90; Masala 2009, 97-103): *Ovis aries*, *Capra hircus*, *Bos Taurus*, *Sus scrofa* and *Canis lupus familiaris*, with the caprovine being the most represented species in both assemblages in terms of NR and MNI (Fig. 5).

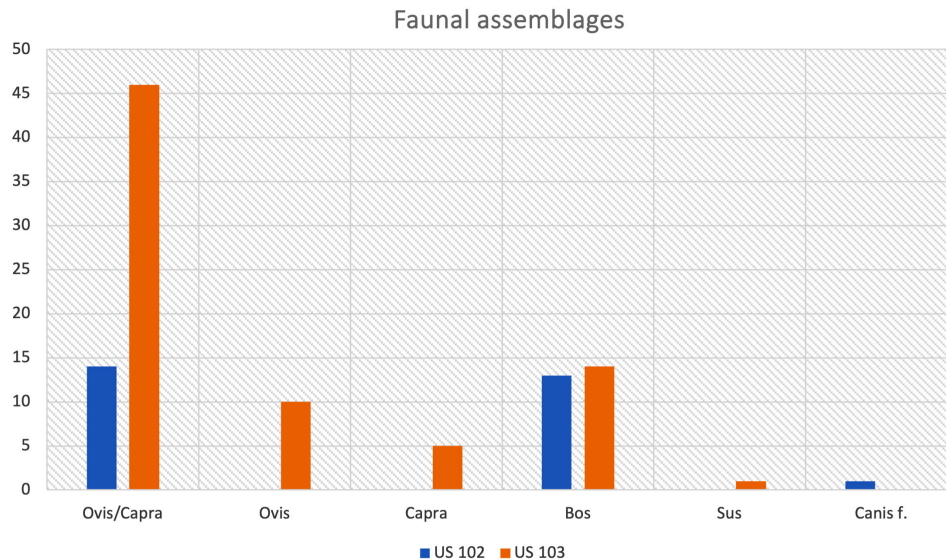


Fig. 5. NR of the identified taxa.

Taphonomic analysis was performed on the entire assemblages, including the undetermined fragments. Considering the significant number of non-taxonomically identifiable remains in both assemblages (54%), all fragments were classified by size and weight and subjected to taphonomic analysis in order to investigate the nature of the fractures using the Fracture Freshness Index (FFI, Outram 2001). The analysis process was undertaken using a 40× magnification hand lens.

A wide range of biotic and abiotic traces have been recorded, including weathering, gnawing, trampling, and root marks (Ferdandez-Jalvo, Andrews 2016); in addition, interesting information emerges from the observation of anthropogenic damage: cut marks, burning, and intentional bone breakage. For the identification of cut marks and related butchering activities the previous work of Binford (1981) and Lyman (1987) were consulted. Burning damage is observed here in terms of presence/absence, its recognition mainly being based on identified colour changes using Munsell soil charts; the data was correlated to the sequence given by Shipman et al. (1984) to evaluate the temperature of exposition.

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FRACTURE FRESHNESS INDEX EVALUATION

Observation of fracture pattern is considered a key factor in identifying marrow extraction (Outram 2001) because of its informative value in recognizing fresh fractures produced during or immediately after butchering activities, especially for accessing bone marrow or alternatively for making bone tools. For our analysis Outram's method was selected and applied to evaluate FFI (Outram 2001).

The method considers all osteological remains, including indeterminate and very small fragments usually excluded from zooarchaeological analysis (Outram 2001, 403-404). The advantage

of this method is the ability to quickly identify levels of fresh or non-fresh fracture within an assemblage as a whole, considering that the average result rather than the interpretation of individual specimens is critical for interpreting the assemblage in terms of marrow exploitation (Outram 2001, 407).

The first stage of the methodology is to separate the fragments by type: diaphyseal shaft; appendicular bones; axial bones; whole and partial bones, mandibular bones, and teeth; the second stage involves further division into size classes from <20 mm to 100 mm and subsequent recording of the weight of each fragment. To evaluate the FFI, fractures on the elements were analysed taking into account three critical factors: fracture outline; angle of fracture of the cortical surface; fracture edge texture. A score from 0 to 6 was assigned: 0 corresponds to fresh fractures and 6 to dry and mineralized (Outram 1998, 2001).

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RESULTS

The faunal assemblage from stratigraphic units 102-103 consists of 225 fragments, 48 from US 102 and 177 from US 103. Analysis of specimen composition in terms of the representation of anatomical body parts shows a high frequency of appendicular bones, especially in caprovines; whole specimens belong only to small bones, while the number of shaft fragments is significantly high and the number of axial bones very low (Figs. 6-7); the high percentage of diaphysis fragments is of interest in relation to marrow exploitation.

The data from the taphonomic analysis made it possible to identify various types of anthropogenic activities on the osteological remains: cut marks were detected in 6% of the bones of the US 103 assemblages, particularly chop marks on the shoulder, jaw, and tarsal

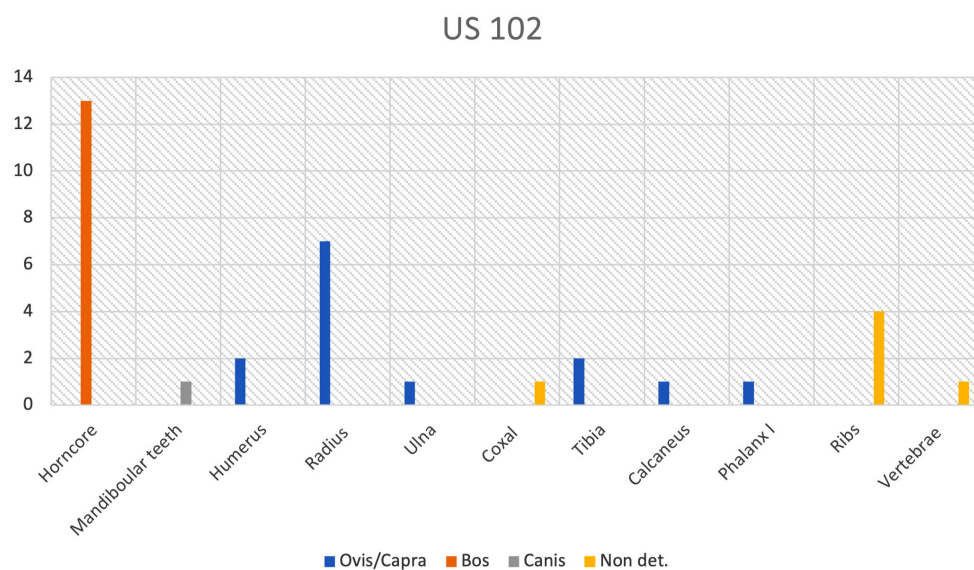


Fig. 6. Anatomical distribution of identified taxa remains (US 102).

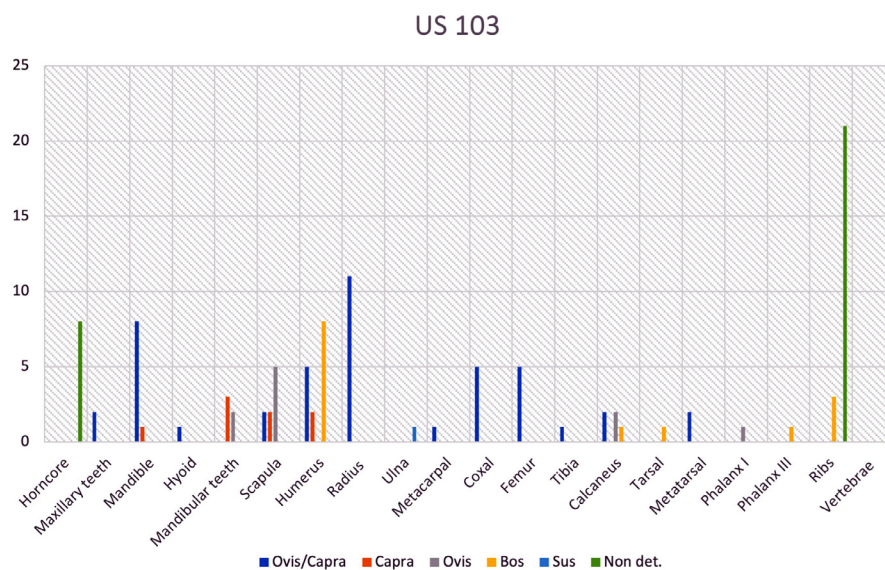


Fig. 7. Anatomical distribution of identified taxa remains (US 103).

bones, appearing to be the result of disarticulation of the carcass or a portion of it; linear marks generated by scraping the flesh from the bone were detected mainly in the limb bones.

Both assemblages show changes in the coloration of the bone surface, which takes on yellowish-red and reddish-brown tones, homogeneous in a few cases and mottled in several, attributable to episodes of burning. According to Shipman *et al.* (1984), the estimated temperature of exposition should not exceed 525 degrees and is compatible with cooking activities.

Based on two different estimation methods (number of fragments and weight (Figs.8-11), fracture pattern analyses yield similar results for both assemblages (US 102-US 103).

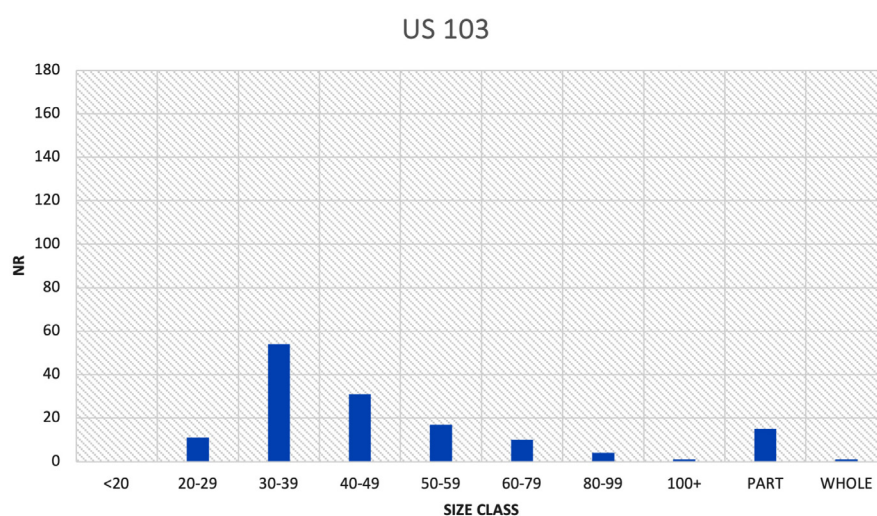


Fig. 8. The proportions of the various bone types in different size classes, as quantified by number (US 103).

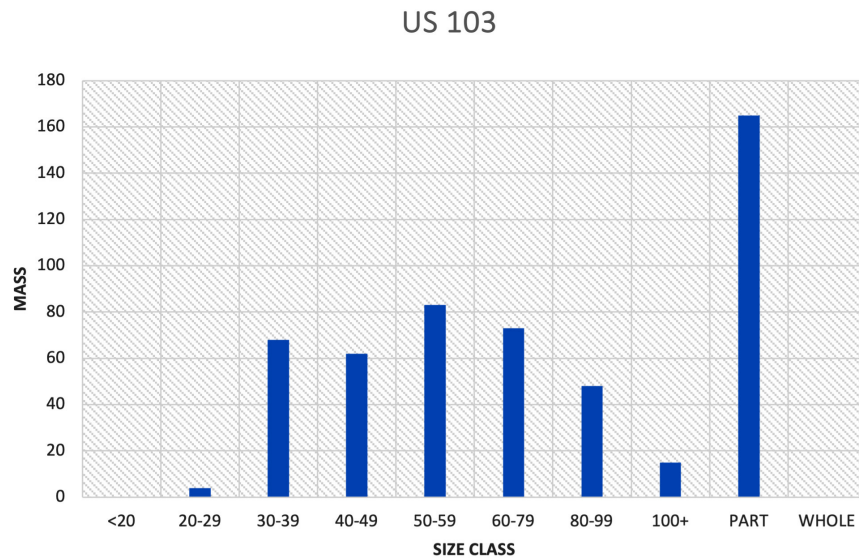


Fig. 9. The proportions of fragments in different size classes, as quantified by mass (US 103).

The FFI shows a range of distribution between 0 and 4, with most scores close to 0, demonstrating the clear preponderance of fresh fractures (Fig. 12-13), as well as the majority of small fragments (between 20 and 60-79 mm) coming from the appendicular bones and shaft (Figs. 14-15), especially in the US 102 assemblage (Fig. 15)

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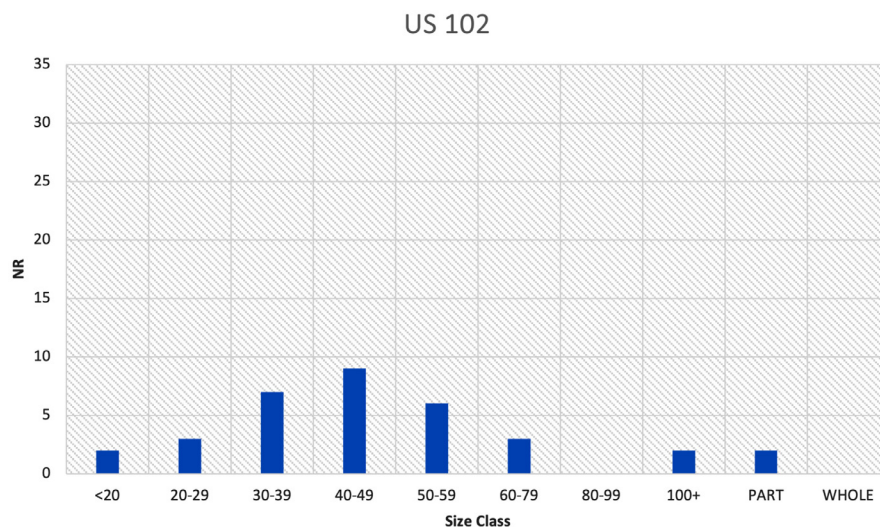


Fig. 10. The proportions of the various bone types in different size classes, as quantified by number (US 102).

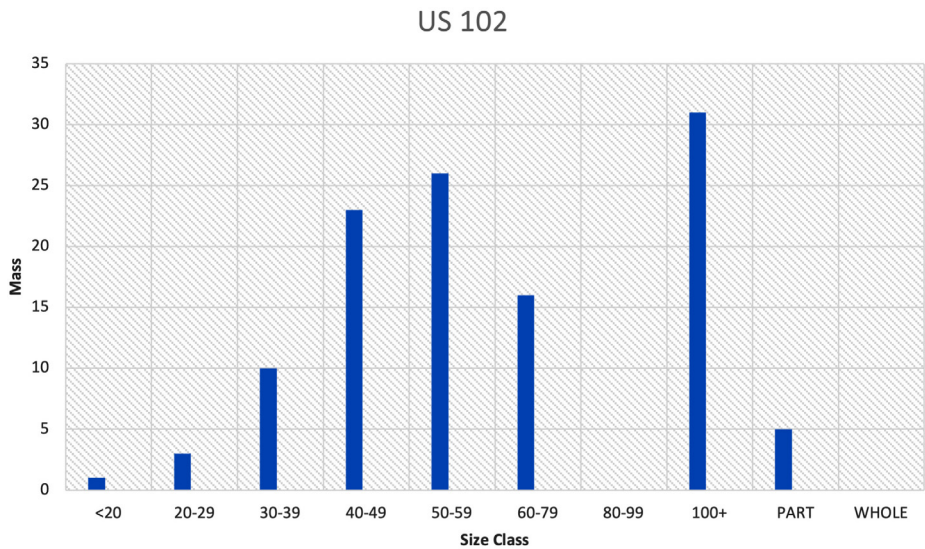


Fig. 11. The proportions of fragments in different size classes, as quantified by mass (US 102).

DISCUSSION

Application of the FFI method in this context allowed us to identify the practice of marrow extraction. Moreover, it was possible to outline some useful elements for the reconstruction of the extraction technique; finally, the interpretation of these data in the light of the other archaeological evidence, mainly from the ceramic materials (Messina 2018; Messina and Platania in press), enabled us to hypothesize that marrow may have been used in this particular archaeological context.

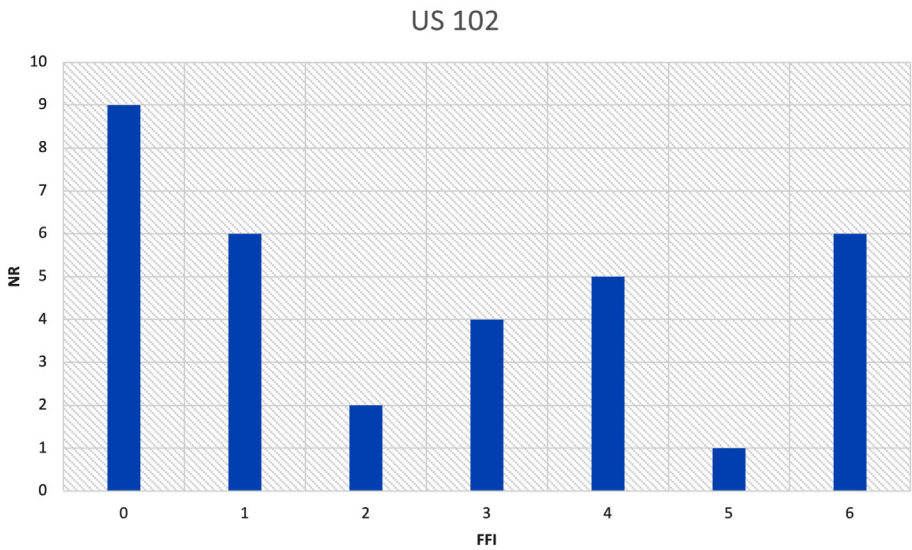


Fig. 12. A histogram of the number of fragments assigned different FFI scores (US 102).

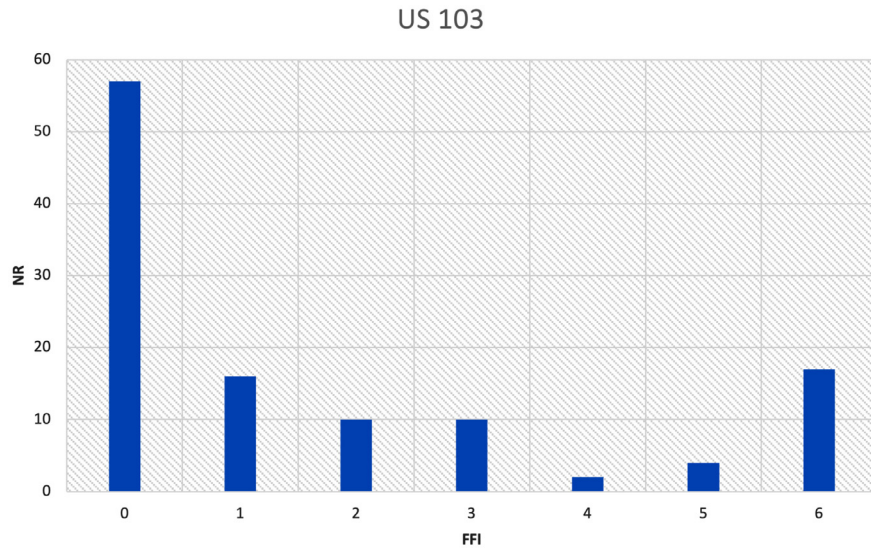


Fig. 13. A histogram of the number of fragments assigned different FFI scores (US 103).

The FFI score close to 0 in both assemblages indicates a clear preponderance of fresh fractures, mainly located on particularly marrow-rich bones (limb bones, such as humerus, femur, radius, tibia) of caprovines, while the presence of conchoid scars and percussion notches indicates the application of percussion to gain access to the marrow (Fig. 16). Moreover, the presence of splinters of reduced dimensions (between 2 and 10 cm) (Fig. 17), suggests that the extraction technique required exposing the bones to an open flame prior to percussion, as demonstrated by experimental results (Càceres *et al.* 2002, 477). This hypothesis is also supported by the overall diffusion of burning traces on bone surfaces.

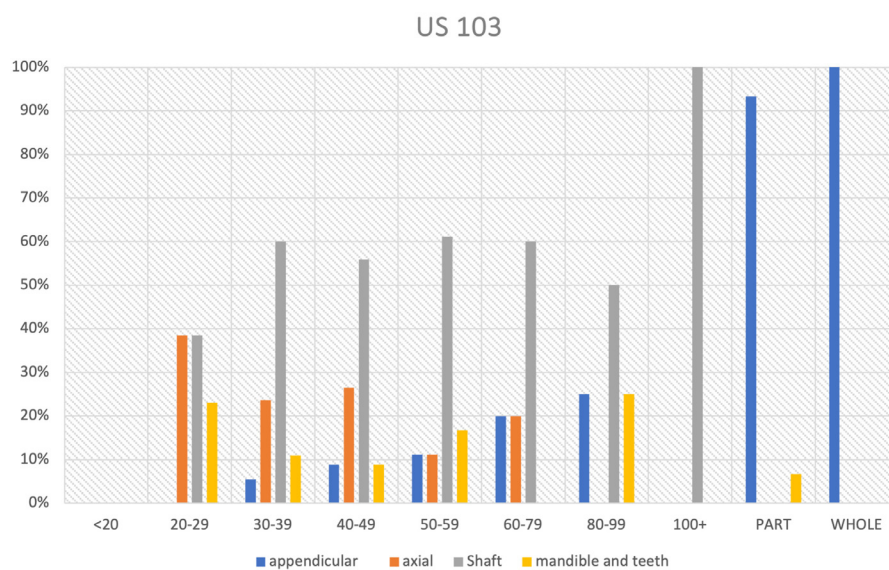


Fig. 14. The proportions of the various bone types in different size classes, as quantified by number (US 102).

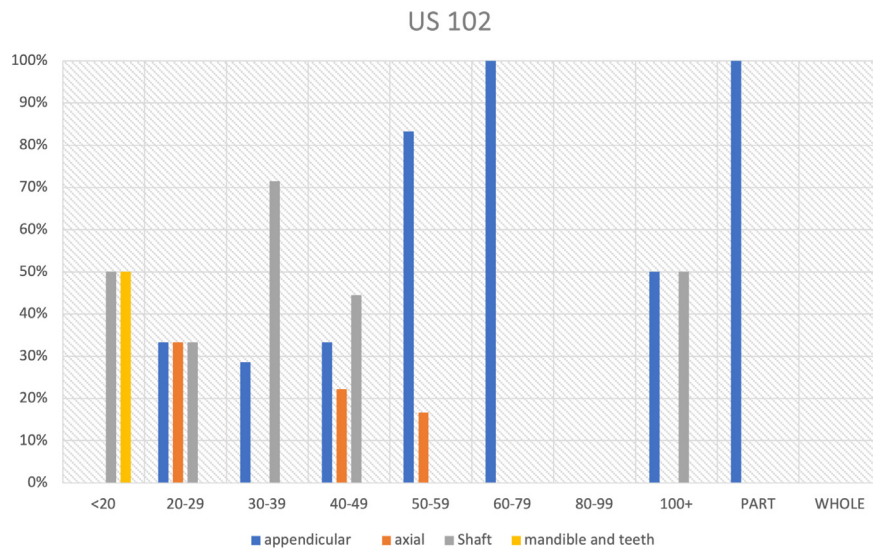


Fig. 15. The proportions of the various bone types in different size classes, as quantified by number (US 103).

The integration of archaeozoological and pottery data seems to indicate marrow exploitation for alimentary purposes in a consumption context. The complex appears consistent with a context of food and drink consumption, also indicated by the presence of cooking pots. The two strata show some differences in terms of composition and, therefore, functional interpretation. Stratigraphical unit 102 is characterised by a greater presence of consumption vessels (shallow bowls and *skoutelia*) in a better state of preservation.

Painted jars are more numerous and more complete, only being represented in US 103 by spouts. Dark-on-light saucers are also more numerous in US 102 (9) than in US 103 (4), with large sections of the body preserved, whereas in US 103 only rims are present.



Fig. 16. Sheep/goat fractured humeri from US 103.



Fig. 17. Diaphysis splinters of small size (between 2 and 10 cm) from US 103.

Skoutelia are another feature differentiating the two units: there are 127 sherds in US 102, and 96 in US 103. Moreover, the number of sherds between 60 and 30% preserved is higher in US 102, whereas in US 103 there are no *skoutelia* more than 60% preserved.

By contrast, a higher number of containing vessels characterises US 103: 4 stamnoi in US 103 versus 1 in US 102; 4 deep bowls against 3 in US 102, and a higher number of very fragmentary plain pottery (68 sherds against 42 in US 103).

The lower deposit (103), including more vessels for containing, plain ware and cooking ware, is likely related to food preparation. The consumption of bones may well be related with the extraction of marrow probably for alimentary purpose; in this phase, butchery activities include carcass dismembering and defleshing. Instead, the upper deposit (US 102) provided evidence for the actual moment of consumption: a higher number of conical cups and fine tableware (DoL and LoD), best preserved, while only scrape marks were identified.

Considering the overall context data discussed analytically in Messina and Platania (in press), it is also possible to hypothesize that two phases were linked with episodes of communal consumption on the northeastern slopes, integrating the system proposed for the first time by Todaro (2009: 334-352; 201, 2013a, 2013b, 2020) for the northern and southwestern slopes of Phaistos hill in EM II-III, when the hilltop was used as an open-air gathering place for communal ceremonies based on the consumption of food and drink.

Evidence for bone marrow exploitation for alimentary purposes is attested at different sites in mainland Greece and Crete from the Early Neolithic to the Bronze Age (Halstead, Isaakidou 2011, 95; Hamilakis, Sherratt 2012, 190-191).

In the Early Neolithic, marrow extraction from long-bone shafts of cattle and from sheep/goat phalanges is well attested at the open-air site of Revenia-Korinou (Isaakidou et al. 2018, 121), in a consumption context. The method employed for extraction being intentional fragmentation often after preparatory heating (Isaakidou et al. 2018, 120), exactly as in the context of Room 101 in the northeastern complex at Phaistos.

Fragmentation analysis of the faunal remains from Knossos conducted by V. Isaakidou hypothesizes, based on the available data, that marrow extraction was practiced at the site in the Late Neolithic, Early Minoan (EM I-III), and MM IA-Palatial periods (Isaakidou 2004, 202). Bovine long bones and metapodials, in particular, were widely used in the FN context rather than in the EM and MMIA, when fragmentation of goat and pig bones was also well attested. Also, in this context bone marrow was extracted for alimentary purposes.

However, the closest comparison to the deposit in Room 101 at Phaistos is offered by the LM IA deposit at Nopigeia Drapanias, where the use of marrow in a conspicuous consumption context is confirmed by the zooarchaeological and archeological record, in particular by the presence of broken cattle metapodia which have a hole drilled at the proximal end to extract the marrow (Hamilakis, Sherratt 2012, 190-191), a practice already found in a LN deposit at Knossos (Isaakidou 2004, 198).

Review of the abovementioned case study shows some common elements and some discrepancies with the Phaistos deposit. The similarities mainly concern the methods used to

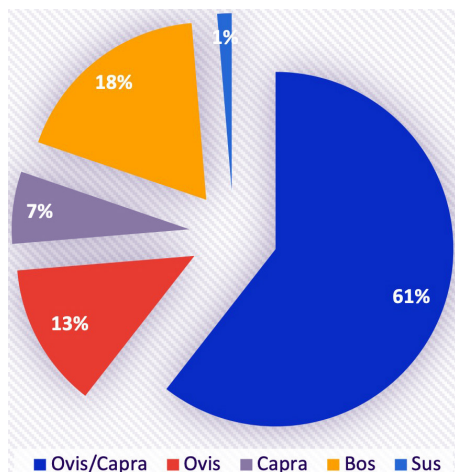


Fig. 18. Percentage distribution of the remains of identified taxa from UUSS 102-103.

obtain the marrow from bones and its use. Intentional fragmentation was coupled with the use of fire to make the bone more malleable and the marrow more liquid, which was found both at Revenia-Korinou and in the Phaistos deposit. All the contexts, moreover, were related to the consumption and/or preparation of food, so it is possible to infer that the marrow was exploited for food purposes, and thanks to the examples of Nopigeia Drapanias and Phaistos it is possible to assume that this was also consumed in episodes of conspicuous consumption.

The main difference between the context of Phaistos and the others mentioned concerns the high frequency of sheep/goat long bones fragmented for marrow extraction, which differ from the preponderance of cattle bones used for the same purpose at the other sites. In the case of Phaistos, caprovine bones represent a significant majority of bone assemblages from both deposits, and cattle remains represent only 18% of the faunal assemblage (Fig. 18). Thus, a selection of species can be inferred, which may result from several factors. Considering the low incidence of trampling and gnawing, the selection cannot be attributed to post-depositional taphonomic factors (Messina and Platania in press), which would have affected the bones of smaller animals to a greater extent. It may instead reflect breeding practices and thus the greater availability of sheep and goats in the area (Platania 2016, 188; Masala 2009, 97-103), or a cultural choice related to taste preferences, or it could be due to technical reasons such as easier marrow extraction from smaller animals.

A comparison of the available data shows that technological and resource exploitation choices show strong continuity through all the periods analyzed, highlighting the strong traditional value of food, being the alimentary habitus linked intimately with personal identity (Hastorf, 2017, 237).

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CONCLUSIONS

Bone marrow exploitation is attested in Crete and the Mainland in Pre-and-Protohistory, as indicated by the abovementioned archaeological contexts and new data from Prepalatial Phaistos.

Evidence from taphonomic studies of faunal remains has shown that the common technological choice for extracting marrow from bones was fragmentation; in the case of Phaistos, this was

achieved by percussion after heating the bones over an open flame to soften the marrow. The use of fire for this purpose is attested from the Early Neolithic by the zooarchaeological record in Revenia-Korinou, though unfortunately the available data for the other sites do not suffice to suggest this was the only practice in use. This is comparable to what emerges from the ethnographic record; in contrast, the practice of perforating the proximal diaphysis of the metapodia of cattle for extracting marrow content, attested at both Knossos in the FN and Nopigeia Drapanias in LM IA, does not seem to find immediate comparisons in ethnographic sources.

Among the uses testified by ethnographic data, use of marrow for alimentary purposes is the only one attested by available archaeological and zooarchaeological data considered here. Ethnographically, bone marrow extraction is well attested as source of animal fat and protein in case of food scarcity; the archaeological data from the deposit of Phaistos and Nopigeia Drapanias seems to outline that its exploitation has a broader significance, in light of its use in episodes of conspicuous consumption. Feasting events, indeed, according to Todaro (2013b, 10), are the reflection of a specific ritual and of the ceremonial function of Phaistos hill in EM, particularly EM IIA. It could be argued that the activities performed during these events, like pottery production (Todaro 2009), or bone marrow extraction, assumed a ritual significance beyond daily practices. The data indicate that in the context of communitarian feasts, too, where large amounts of meat were consumed, animal fats were exploited to the full, suggesting that these episodes were opportunities to take up fat reserves, or, on the other hands, that marrow consumption had a cultural meaning. The integration of archaeozoological data and pottery, including cooking vessels and tableware, seems to confirm marrow exploitation for alimentary purposes in a consumption context. Moreover, the presence of a consistent number of conical cups (at least 170), and of at least 12 individuals (9 caprovines, 1 cattle and 1 pig) (Messina and Platania, in press), may indicate that the consumption was extended to an enlarged group of people (also considering the small size of the trench).

Finally, thanks to the new data from Phaistos it was possible to add further elements to reconstruct the diffusion of this practice in the latest phases of the Prepalatial period, especially in conspicuous consumption contexts.

Comparison with other contexts distributed over time from EN to LM IA also showed that significative changes cannot be highlighted in the use and technological aspects related to marrow consumption between the Neolithic, Prepalatial, and Palatial periods. This may mean that food consumption traditions were maintained over time, notwithstanding the rise of the Palaces.

The continuity of marrow consumption during conspicuous consumption episodes, and thus the ritual significance of the practice, even in the Protopalatial period, is not fully confirmed by the available data. A Protopalatial deposit of faunal remains from Room IL at Phaistos (Caloi 2012, currently under investigation) seems to indicate a different pattern of fragmentation and anatomical composition of the sample, not compatible with marrow extraction. Further analysis is therefore underway, involving the application of the methodology used in this work to obtain further evidence to demonstrate the continuity or breakdown of this practice.

From a topographical perspective, fractures are nonetheless evident in the functional destination of the area between the Pre-and-Protopalatial period. The integrated analysis of pottery and faunal remains provided the evidence for the interpretation of the area at the end of the Prepalatial period: the good preservation of the ceramic sherds and the low degree of weathering on bones suggest that the material was quickly buried and covered, without being exposed for a long period (Messina and Platania in press). Moreover, the coherence of the internal composition of the pottery and faunal remains, the low evidence of trampling and the presence of gnawing marks point out that the deposits cannot be understood as a construction fill for terrace and buildings, as those testified elsewhere in the Phaistos hill (Todaro 2013). On the contrary, the assemblages can be considered as a structured deposit of discarded waste materials. A change in the use of the area can be seen in MM IB, when a long wall with large blocks was first constructed in the north, followed by the edification of monumental Building 101, destroyed by earthquake in MM IIB (Militello, Buscemi, 2015, 291), and, finally, in MM III A-B and in LM I, by the other buildings in the monumental North-Eastern Complex (Girella, 2010).

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