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SHEPHERDS AND CAVES IN THE KARST OF ISTRIA (CROATIA)

Abstract - Geoarchaeological and archaeozoological studies have been applied to the study of the post-Mesolithic sequence of Pupićina Cave (Istria, Croatia), producing high quality results about the use of the site, and showing that a strict integration of these two methods can greatly improve the general understanding of the archaeological context. The use of the cave was mostly pastoral with a markedly seasonal pattern of use from the Middle Neolithic onwards; seasonality may have been less strong only in the Late Neolithic. Mostly ovicaprines, but also cattle and pigs were stabled/penned inside the cave; good evidences of limited domestic activities can also be observed.

Key words - Geoarchaeology, zooarchaeology, agropastoral caves, Neolithic, Istria, Croatia.

Riassunto - *Pastori e grotte nel carso dell'Istria (Croazia).* La geoarcheologia e l'archeozoologia sono state applicate allo studio della sequenza post-mesolitica della Pupićina Peć (Grotta Pupićina, Istria, Croazia) ottenendo ottimi risultati circa l'uso del sito, e dimostrando che la stretta integrazione di questi due metodi può migliorare notevolmente la comprensione del contesto archeologico. L'uso della grotta è stato prevalentemente agropastorale e con forte stagionalità dal Neolitico medio in avanti, mentre questa può essere stata meno marcata durante il tardo Neolitico. Nella grotta sono stati stabulati prevalentemente ovicaprini, ma anche bovini e maiali, e sono state individuate modeste tracce di attività domestiche.

Parole chiave - geoarcheologia, zooarcheologia, grotte agropastorali, Neolitico, Istria, Croazia.

INTRODUCTION

In recent years we have developed powerful methods for analysing past shepherds and their herds. Geoarchaeologists have become ever better at isolating the animal contribution to sediment and site formation. Likewise, zooarchaeologists study animal mortality and bone modification to examine the temporal and spatial dimensions of animal use. Too often, however, the results of these efforts are presented separately to different audiences, with little integration and synthesis.
Our interest here is to use geoarchaeological and zooarchaeological data to understand how past shepherds used Pupićina Cave, a karstic cave from Istria, Croatia. In particular, did they pen their flocks in caves? How else were they using caves, and how (and why!) did these activities change over time?

J.-É. Brochier's model (J.-É. Brochier, 2002; J.-É. Brochier *et al.*, 1999) of caves as a *habitat bérgerie* or a *grotte-bérgerie*, though considered as too schematic and simplistic by the same Author, provides a useful tool for examining our data. In the former case, one expects caves to have had along and/or intense periods of occupation, with the living space shared by flocks and people. Caves in this case would have been only loosely complementary to open-air villages. In the case of the *grotte-bérgerie*, caves were only used for short, ephemeral occupations, and the space was primarily used for penning flocks. The cave's relationship to open-air villages was also different, with strong complementarity between these different kinds of site.

THE PUPIĆINA CAVE

Pupićina Cave is situated in the lower reaches of Vela draga canyon in northeastern Istria, Croatia (Fig. 1). The cave is funnel shaped; the southeast-facing entrance is about 20 m wide and 8 m high (Fig. 2). Excavations from 1995-1998 exposed 33 m^2 of an estimated 190 m^2 of archaeological deposits preserved in the cave (Miracle & Forenbaher, in press a).
Pupićina Cave was episodically used from the late glacial period to the present. Here we focus on the later prehistoric sequence from the cave.

STRATIGRAPHY

The lithological units included in horizons I, H, and G contain (Fig. 3) Middle to Late Neolithic cultural remains with occupation starting in the mid 6th Millennium BC and ending about 1,100 years later (Tab. 1; Miracle, 1997; Miracle & Forenbaher, in press b). The shape and size of Neolithic pots suggests a variety of food preparation, cooking and communal serving of food; very few of the Middle Neolithic vessels are individual-portion sized (Forenbaher *et al.*, 2004). Long-distance interaction during the Neolithic, as reflected in lithic raw materials and to a lesser extent ceramic imports, increased with the passage of time.
The stratigraphy, ceramic assemblages, and radiocarbon dates show a 2,500-year gap in the sequence between the Late Neolithic and the Middle Bronze Age. The latter is found only in pits dug into the northern and

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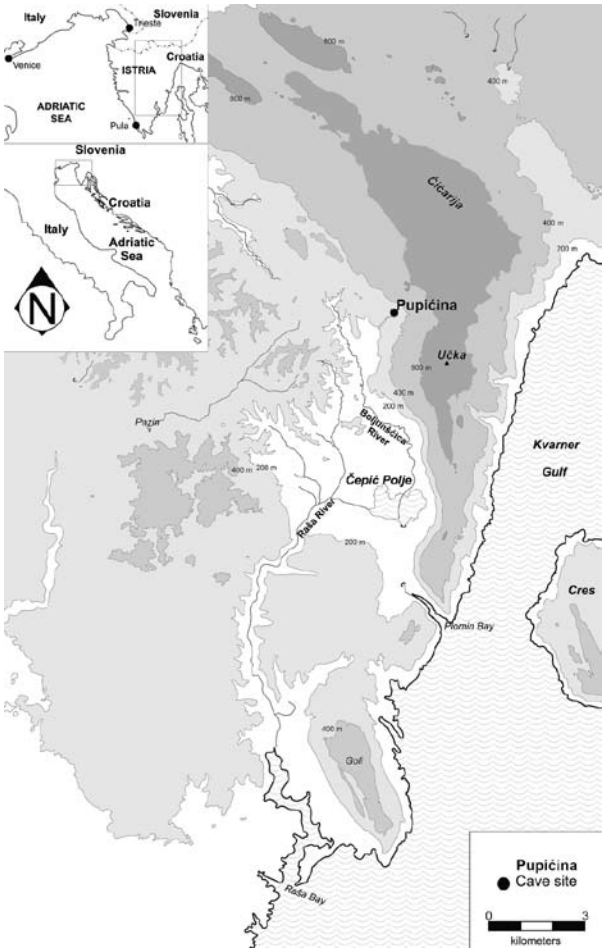

Fig. 1 - Pupićina Cave: location map.

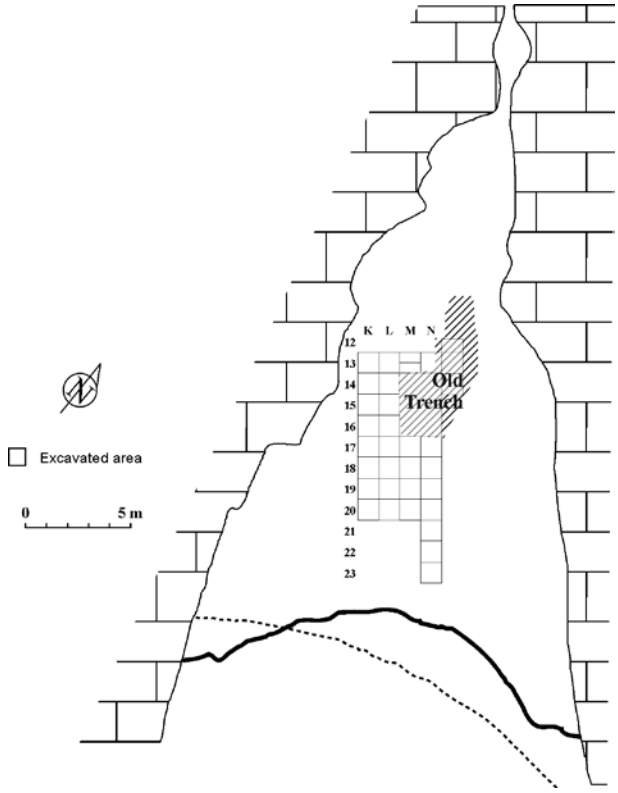

Fig. 2 - Pupićina Cave: plan.

eastern portions of the excavated area. These pits were dug during the Bronze Age and backfilled with roughly contemporaneous occupation debris.
There is a clear disconformity in the stratigraphy between the Bronze and Iron Age occupations at the site. The duration of this gap lies between 500-1,500 years. A few Roman sherds were found only in mixed and surface deposits of Horizon A.

Sediment types

Two main sediment *facies* were recognised during excavation; *subfacies* were observed through a polarising microscope in transmitted, reflected and reflected UV/blue fluorescence light; the descriptive criteria follow the standard indicated by Bullock *et al.* (1985) and Stoops (2003).

Layer-cake *facies*

This *facies* is peculiar for its distinctive black-and-white layered aspect. Couples of blackish and whitish layers or lenses are cyclically organised in finely interfingered stacks that can be up 1 m thick and somewhat domed – the whole feature resembles a finely layered «heap», or a «layer cake» (Fig. 3, 4). The layers and lenses are thin (2-3 to 8-10 cm) if compared to their extension. The limits are always sharp and plain or slightly undulating. Black horizons are always the bottom elements of the couples
The black levels are thinner then the white ones, and in some cases can also be discontinuous. Their structure is fine granular, rather loose and porous. Conversely, the whitish horizons are more compact, mottled by minor differences in texture, colour and porosity.
The grain-size is sandy silt loam to sandy loam; the skeleton is rather rare, made up of sparse angular limestone pebbles.
At microscopic scale, the black levels are mainly made up of coarse vegetal remains at various degrees of charring; cell and tissue structures of the original plant organs are well preserved, *i.e.* mostly of leaves, twigs and young wood.
The second main component are brownish aggregates of partially burned fibrous coprolites, up to about 1-2 cm large. The fibres are made up of connected opal phytoliths and of partially charred organic matter, 5-20 µm thick and up to 1-2 mm long. Their size and spatial organisation depend on the shape of the aggregates:

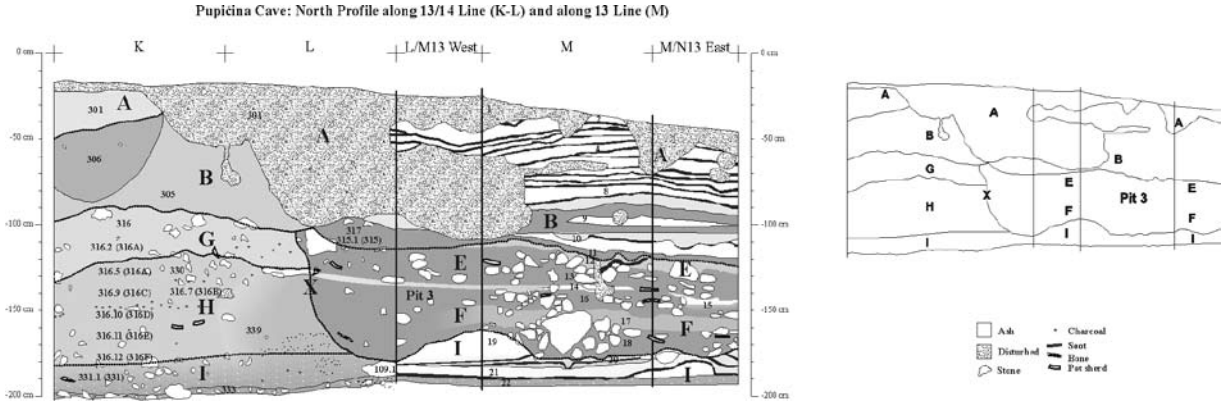

Fig. 3 - Pupićina Cave: profile drawing along 13/14 line (K-L) and 13 line (M).

Tab. 1 - Dates of occupation and sedimentation rates from the Neolithic to the present at Pupićina Cave. Lower and upper boundaries calculated using OxCal v. 3.8 (Bronk Ramsey, 1995, 2001) on calibrated radiocarbon dates (one from Horizon B; two from Horizons E + F; one from Horizon G; two from Horizon H, two from Horizon I) and estimated from stylistic attributions (Horizon A). Radiocarbon dates calibrated using the INTCAL98 calibration curve (Stuiver *et al*., 1998).

	Cal years AD/BC				
Horizon	**Lower boundary**	**Upper boundary**	**Duration (years)**	**Thickness (cm)**	**Sedimentation rate (cm/100 y)**
A (Roman to Present)	*ca.* 1	AD 400	400	5	1.3
B + C (Iron Age)	950	225	725	76	10.5
E + F (Middle Bronze Age)	1775	1410	365	35	9.6
G (Late Neolithic)	4535	4175	360	35	9.7
H (Middle Neolithic)	5480	5025	455	49	10.8
I (Middle Neolithic)	5655	5530	125	17	13.6

short fibres are randomly compressed within subspherical (sheep/goat) coprolites, while the longer ones occur in wavy bundles within elongated droppings that can be attributed to cattle (Macphail *et al*., 1997) or possibly to goats.
Spherulites (Canti, 1997, 1998) and ash (Canti, 2003) are present, even if rather rare. The latter occurs as very fine carbonate material, and sometimes as micrite aggregates pseudomorphic on oxalate crystals.
The whitish/greyish layers include three main microscopic sub*facies*:

1. The granular one is made up of the above described fibrous coprolites, but these are here thoroughly burned, whitish and subtransparent, and include common faecal spherulites clustered in small areas. Spherulites, phytoliths and amorphous organic matter, embedded in a fine micromass of micritic ash, fill up the interaggregate spaces.
2. The layered vughy sub*facies* is spongy (Pl. 7a, 7b), due to the occurrence of prolate or subplanar vughs within layers that resemble the homogeneous *facies* (*v. infra*). These vughs usually have homogeneous size and shape within a layer, and are interbedded with thin laminae of parallel-oriented phytoliths.
3. The finely layered sub*facies* is a fine lamination of 60-80 to 2,000-3,000 μm thick beds made up almost only of opal phytoliths, regularly alternating with layers of mixed phytoliths, amorphous organic matter, fine quartz grains, spherulites and micrite (Pl. 7c, 7d). It is noteworthy that this sub*facies* occurs sometimes also within units made up of homogeneous *facies* deposits.

Homogeneous *facies*

The homogeneous brown colour and the massive or sometimes well developed prismatic structure are the most evident characteristics at eye-scale (Fig. 3); the matrix is silty clay loam, embedding unsorted angular limestone gravel.
The lithological units are roughly tabular, few centimetres up to 1.5 m thick, bounded by sharp to clear, plain or slightly undulating limits. Isolated couples of black-and-white layers may sometimes occur.
The microstructure is massive also at microscopic scale, with small vughs or sometimes channels and chambers.
The bulk of the sediment is made up of unconnected phytoliths and faecal spherulites; randomly arranged,

Fig. 4 - «Layer cake» *facies*. Profile along 13 line (M-square in Fig. 3).

and never organised in higher level features (Pl. 7e, 7f). These components usually occur in the same percentage and only in some cases the spherulites prevail over the phytoliths.
The amorphous organic matter is very common, occurring mostly in fine silt-size chips and larger fragments that in some cases still preserve remains of vegetal cell structures. Charcoal often occurs, usually in fine fragments. Ash is present in variable quantity, mostly as micrite aggregates pseudomorphic on oxalate crystals and as very fine carbonate material.

Interpretation of the sediments

These *facies* indicate that the Pupićina cave sediments are made up of sheep/goat and probably also cattle dung, more or less thoroughly burned. Actualistic studies have shown the strict resemblance between the fabrics of these sediments and of the deposits originated by the penning of these animals.
This is sound evidence that the cave was frequented by domesticated herbivores, as in all the other sites where these deposits were observed (Courty *et al.*, 1992; Boschian, 1997; Macphail *et al.*, 1997; J.-L. Brochier *et al.*, 1999; Boschian & Montagnari-Kokelj, 2000; Iaconis, 2002).
Each couple of black-and-white levels is the result of the burning of a layer of herbivore droppings and some leaves and twigs, probably young branches, that may have been fodder (Haas *et al.*, 1998; Karg, 1998; Nisbet, 1997). The rhythmical aspect of this *facies* suggests some sort of cyclical burning of the dung, which was probably lit when it had partially dried up, some time after the cave had been abandoned.
Litter and dung were rather compact because of trampling, and also probably humid, therefore burned slowly because oxygenation was poor, particularly in the bottom part, so that the organics were charred giving the horizon a dark colour. Conversely, the whitish colour indicates that the organic components were thoroughly ashed in the upper horizon.
The meaning of the homogeneous *facies* is less clear, as no good actualistic examples are available at present. The basic components are the same as in the layer-cake *facies*, but they are here almost completely unorganised: complex pedofeatures like coprolites are absent or extremely rare. As suggested by J.-É. Brochier (2002), also this *facies* derives from herbivore dung, but through its slow mineralisation without burning. The reasons why the sediment was homogenised are still not clear, even if it is likely that reworking and trampling induced the de-organisation of the sediment components. This hypothesis is also supported by the occurrence of such *facies* also inside the Bronze Age pit, whose infilling is made up of reworked sediment. The occurrence of wood ash pseudomorphs also suggests that the products of some domestic activities are included in this sediment.
As to the finely layered *facies*, they do not resemble those interpreted by J.-É. Brochier (2000) as cattle droppings (as also supported by the general scarcity of remains of these animals at Pupićina), but probably show that some litter/fodder of herbs was laid in some specific areas inside the cave, as also suggested by the same Author.
In all cases, these sediments involve the use of the cave for stabling domesticated herbivores.
Layer-cake and homogeneous *facies* usually occur together within the same chrono-cultural horizons and at the same depth; only the relatively thin horizon G is made up only of homogeneous sediments. If observed along vertical cuts, the shapes of the side terminations of the lenses indicate non-erosional lateral limits. Finally, short-range and inside-context conjoins of potsherds and bones also suggest moderate reworking of the sediments. As a consequence, the *facies* should be considered as moderately reworked sedimentary and/or diagenetic environments, organised in a complex framework of patches. The extreme fragmentation and small size of the layer-cake units show that these cannot correspond to areas of forced penning, also because the evidence of wattle and fences is extremely scanty.
Layer-cake sediments occur mostly in the eastern and inner parts of Pupićina, often interfingered with thin layers of homogeneous or (more frequently) laminated *facies*. The homogeneous *facies* is apparently better represented in the southwestern and western parts of the cave, in horizons B, G, H and I, that are here remarkably thick. The thick layers of homogeneous facies are apparently unique to Pupićina Cave and the Trieste Karst caves; likewise at these sites the layer-cake units are organised in «heaps» and «decks» whose size is relatively small if compared to the cave area (Boschian & Montagnari-Kokelj, 2000). Conversely, in other caves of the Italian peninsula like Arene Candide (Courty *et al.*, 1992; Macphail *et al.*, 1997; Maggi, 1997: 18) or Grotta dei Piccioni and Grotta S. Angelo (Iaconis, 2002) these deposits are much wider and cover most of the cave surface.

ZOOARCHAEOLOGY

Pupićina Cave contains a total of 14,933 faunal remains weighing 31.7 kg; 5,604 fragments were identified to body part and/or taxon. The Neolithic to present layers at Pupićina Cave are dominated by remains of domestic animals (Miracle & Pugsley, in press; Miracle, in press).

Sheep and rare goat are the most common taxa; they dominate the Middle Neolithic assemblages (*ca*. 85% of NISP), decrease somewhat in frequency during the Late Neolithic and MBA (*ca*. 53-70% of NISP), and increase again during the Iron Age (*ca*. 80% of NISP).

Cattle make up only about 4-9% of NISP in the Middle Neolithic. Their frequency increases to around 12% of NISP in the Late Neolithic and Bronze Age horizons before falling back to *ca*. 5% of NISP in the Iron Age.

Pig/wild boar increase in frequency from about 2% on NISP in the Middle Neolithic (mostly wild boar) to about 17-27% of NISP in the MBA (mostly pig). The frequency of pig/boar remains drops back to *ca*. 5% of NISP in the Iron Age. Wild taxa (mostly red deer and roe deer) never make up more than 10% of NISP.

The faunal composition provides a clear picture of the animals brought to the cave. How can we distinguish between those animals brought to the site on the hoof as opposed to the others carried in as carcasses, joints of meat, and so forth? Furthermore, for those animals brought to the site alive, were they penned there? Evidence of animal penning is provided by shed or exfoliated deciduous teeth. Although it is impossible to be sure from the morphology of a tooth itself whether it was shed by a living animal or present in the mouth of a sub-adult animal killed just prior to the tooth being shed, when shed deciduous teeth are present in great numbers we can be confident that most of them were dropped from an animal's mouth or passed through its gut if swallowed.

Sheep/goat shed milk teeth are present throughout the sequence (Tab. 2). They are particularly frequent in Horizons I and E + F, and account for almost 60% of the sheep/goat teeth in Horizon B + C. They are somewhat less frequent in Horizons G and H. There would appear to have been considerable variation in the use of Pupićina as an animal pen over time. The presence of shed milk teeth and of reworked ovicaprid dung in Pit 3 from the Middle Bronze Age (Horizons E + F) indicates that refuse from a variety of contexts, including floor sweepings, was deposited in the pit; the sheep/goat would not have been actually penned within the pit itself, but later on they provided new dung to build up a thin layer that sealed the content of the pit.

In Table 3 we have calculated the sheep/goat MNI represented by shed deciduous teeth, comparing them, by horizon, for sub-adults with erupting permanent cheek

Tab. 2 - Frequency of shed deciduous teeth at Pupićina cave. The percent is calculated relative to all teeth for each species in a given horizon. Horizons E and F combined owing to small sample sizes.

Horizon	***Bos taurus*** **NISP (%)**	***Sus scrofa*** **NISP (%)**	***Ovis/Capra*** **NISP (%)**	**Total NISP (%)**
Mixed Roman (A)	1 (50.0)		14 (48.3)	15 (42.9)
Iron Age (B + C)			45 (66.2)	45 (60.0)
Middle Bronze Age (E + F)	2 (66.7)		13 (31.8)	15 (23.1)
Late Neolithic (G)			15 (10.2)	15 (8.2)
Middle Neolithic (H)		4 (33.3)	66 (9.9)	70 (9.5)
Middle Neolithic (I)			38 (19.5)	38 (18.1)
Total	3 (3.0)	4 (6.5)	191 (16.7)	198 (15.2)

Tab. 3 - Sheep and goat MNI based on shed deciduous (exfoliated) teeth («living» adults) and ageable dentitions from dead sub-adults and adults (age stages after Payne, 1973). Horizons E and F combined owing to small sample sizes.

Horizon	**MNI**	**MNI**	**MNI**
	Exfoliated teeth	**Sub-Adult (C/D, D, D/E)**	**Adult (E-I)**
Mixed Roman (A)	4	0	1
Iron Age (B + C)	10	2	0
Middle Bronze Age (E + F)	3	0	2
Late Neolithic (G)	4	2	6
Middle Neolithic (H)	14	5	10
Middle Neolithic (I)	9	0	4
Total	44	9	23

teeth and adult animals that had already shed milk teeth. The MNI represented by shed deciduous teeth is in all horizons much greater than that for sub-adults (Tab. 3). Hence the majority of these teeth were shed by living animals rather than coming from dentitions of slaughtered sub-adult animals. Furthermore, with the exception of Horizon G, «living» adults represented by shed deciduous teeth are better represented than dead ones (Tab. 3). This pattern is particularly strong for Horizons I and B + C.

Sheep and goat were penned at Pupićina during every significant period of human use. This penning decreased in importance from the Early Neolithic to Late Neolithic, only to become very important again in the Iron Age.

Only a very few shed cattle teeth are present. The first evidence of shed cattle teeth comes from the Bronze Age (Horizons E + F); there is also a shed tooth from Horizon A. None of the remaining cattle remains from these Horizons are aged as sub-adults; these teeth were probably shed by living animals. These teeth thus provide some evidence of cattle penning at Pupićina during the Bronze Age and later episodes of occupation at the cave. The fill of Pit 3 in Horizons E + F in this case must come from sweepings from other contexts within the cave; cattle could not have been penned in Pit 3! Likewise, shed pig milk teeth are present in Horizon H. Although these teeth could have come from a single animal, there are no sub-adult dentitions from which these teeth could have come. These shed deciduous teeth thus provide some evidence of people keeping a few pigs at Pupićina during the Middle Neolithic. It seems highly unlikely that these kept pigs would have been wild. Thus the shed deciduous teeth provide indirect evidence for domestic pig already in Horizon H (Tab. 2). We conclude from these data that domestic cattle were occasionally kept at the site at least by the Middle Bronze Age, while domestic pig were periodically penned at the site already in the Middle Neolithic. Cattle and pig, however, appear to have been stabled at Pupićina much less frequently than sheep and goat.

Discussion

We integrate these different lines of evidence in Table 4. The earliest «Neolithic» visitors to Pupićina relied almost exclusively on herds of domestic sheep and goats; hunting played almost no role in subsistence. These first shepherds penned and stabled their flocks in the cave, and there is nothing «transitional» about animal use during the earliest Neolithic occupations at Pupićina. These early shepherds had detailed and intimate knowledge of their herds; they both relied on them for food and sustenance, and lived with them. Faunal evidence (Miracle & Pugsley, in press) shows that Pupićina's Middle Neolithic shepherds were most active at the cave during the spring. On a number of occasions they burned the animal dung and rubbish that had accumulated at the site. We suspect that shepherds «cleaned» the site at the end of one or more seasons/years of occupation by firing dung at the end of the summer – after dung had dried. In some parts of the cave dung was completely burned, forming large lenses of ash, whereas in other parts of the cave the dung was only partially burned or not burned at all.

Pupićina, however, was more than an animal pen during the Middle Neolithic, and in fact, the Middle Neolithic occupation of Pupićina does not fit perfectly either of J.-É. Brochier's (1991, 1999) models (Tab. 5). The data suggesting an *habitat bérgerie* are as follows:

– evidence of penning animals (burnt and unburnt animal dung, shed deciduous teeth);
– diverse human activities (lithic reduction and production, wide range of ceramic forms, «special» ceramics);
– relatively high density of occupation refuse (Miracle & Forenbaher, in press b);
– human habitation features (hearths).

The human use of Pupićina Cave changed dramatically in the Late Neolithic. There is no evidence of hearths or other combustion features from anywhere in the site, and the frequency of wood charcoal in the sediment drops significantly from the Middle Neolithic. Dung from domestic animals was either periodically removed from the site, perhaps to fertilise nearby fields, or it was no longer burned. We favour the latter interpretation, supported by the exclusive occurrence of homogeneous (unburned?) deposits, and the implication that the rate of dung accumulation was relatively slow. Direct evidence from soil micromorphology shows that animal dung was an important constituent of Late Neolithic sediment, while indirect evidence of penned animals and their dung comes from shed deciduous teeth. At the same time, the frequency of disposal of domestic refuse drops significantly from the Middle Neolithic to the Late Neolithic (Miracle & Forenbaher, in press b); coupled with the lack of hearths, we think that shepherds (as opposed to their flocks) only rarely stayed at Pupićina Cave, and did not need to reduce the volume of their animals' dung by burning. The Late Neolithic occupation at Pupićina is closer to J.-É. Brochier's *grotte-bérgerie* than *habitat bérgerie* (Tab. 5). Occupation appears to have been ephemeral, and the cave was used mostly by flocks.

The Middle Bronze Age pits appear to have been filled with a mixture of stabling and occupational refuse. The Bronze Age use of animals at Pupićina is a continuation of patterns established during the Late Neolithic. People came to the site at different seasons to pen flocks of domestic sheep, hunt wild game, and occasionally butcher a sub-adult sheep, cow, and/or pig. In contrast to a fairly stereotypic approach to animals during the Middle Neolithic, Late Neolithic and Bronze Age people's uses (and attitudes?) to animals were more diverse and situationally flexible. The high density of ceramics is less an indicator of occupation intensity than the provisioning of the site (Forenbaher *et al.*, 2004). Thus the Bronze Age occupation at Pupićina has characteristics of both a *habitat bérgerie* and a «grotte bergerie».

After another period of abandonment and/or sediment removal from the cave, in the Iron Age thick layers of animal dung accumulated from the repeated use of

the cave as a pen for domestic flocks. This dung was frequently burned, perhaps at the end of a seasonal occupation. There is almost no evidence of human occupation. Shepherds appear to have either brought their flocks to the cave for short periods of time or made their own camps outside of the cave. Iron Age cave use at Pupićina fits very well expectations of a *grotte-bérgerie* (Tab. 5).

CONCLUSION

Summing up, it may be concluded that the use of Pupićina Cave was mostly pastoral from the Middle Neolithic onwards, with a markedly seasonal pattern of use throughout the sequence; the only well documented period when the seasonality may have been less strong is the Late Neolithic. The Bronze Age use of the cave is enigmatic, but the available data suggest that the cave was frequented and used as a stable. Within the pastoral framework, it can be inferred that the cave was mostly used to stable domestic animals; however, good evidences of domestic activities can be observed, though apparently these were limited in space and time. All of these considerations point to a use of the cave that can be compared in some way to the *grottes bergeries* of the French Chasséen culture; nevertheless, the differences that can be observed between the agropastoral systems to which the latter belong and the archaeological evidence from Pupićina Cave and Istria urge us to draw new models that can fit better the situation of the Northern Adriatic region.

Tab. 4 - Summary of Pupićina stratigraphy.

Horizon	**Date**	**Occupation intensity**	**Stabling evidence**
Roman (A)	1st-4th century AD	Sporadic use	Sheep and cattle? Penned in other parts of the cave
Iron Age (B + C)	1st millennium BC	Low-intensity or occasional use	Frequent sheep penning in cave
Hiatus	Late 2nd millennium BC	Abandoned and/or sediment removed during Iron Age	
Middle Bronze Age (E + F)	Middle part of 2nd millennium BC	Concentrated disposal of ceramics in pits, lithics no longer used	Sheep and cattle? Penned in other parts of the cave
Hiatus	Final 5th to early 2nd millennium BC	Abandoned (scarce evidence of a few sporadic visits) and/or sediment removed during Iron Age	
Late Neolithic (G)	Middle to late 5th millennium BC	Sporadic occupation?; decreased density of lithics, domination of imported raw materials and prismatic blade technology	Dung not burned, sheep less frequently penned in cave
Middle Neolithic (H)	Second half of 6th millennium BC	Relatively intensive occupation, decreasing frequency of lithics, increasing frequency of ceramics and animal bone	Dung burned, sheep and pig? Penned in cave
Middle Neolithic (I)	Around 5500 BC	Relatively intensive occupation, high frequency of lithics made on local raw materials and wood charcoal	Dung burned, sheep penned in cave
Hiatus	*ca*. 8000-5500 BC	Abandoned	

Tab. 5 - Caves as pens and as homes, from J.-É. Brochier (1991) and J.-É. Brochier *et al*., (1999).

Habitat bérgerie	**Grotte-bérgerie**
Long and/or intense periods of occupation	Short and/or ephemeral occupation
Living space shared by flocks and people	Space used only by flocks
Sites only loosely complementary to open-air villages	Seasonal transhumance with strong complementarity to open-air villages.

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