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Article

The raptors in the Mesolithic at the Grotta del Santuario della Madonna at Praia a Mare (Cosenza, Italy)

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Key words

- Calabria
- Southern Italy
- Falconiformes
- Strigiformes
- taphonomy
- human-raptor relationship

Parole chiave

- Calabria
- Italia meridionale
- Falconiformes
- Strigiformes
- tafonomia
- rapporto uomo-rapaci.

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Summary

Grotta del Santuario della Madonna at Praia a Mare, located in Northern Calabria, was continuously occupied from the Upper Paleolithic until the Middle Ages. Over 1,200 bird bones belonging to 50 species were found in the Mesolithic layer I. The rocky species are prevalent, mainly because of the high frequency of rock dove. Woodland and aquatic birds are also well represented. One of the features of this avian assemblage is the abundance of raptor remains (Falconiformes and Strigiformes). Previous taphonomic analyses on Paleolithic and Mesolithic aquatic bird bones (including also some diurnal raptors) evidenced many anthropic marks produced during carcass dismemberment and meat cooking for consumption. In order to continue and improve the study of the Mesolithic bird exploitation in this cave, further taphonomic investigations have been carried out on the raptor bones. The presence of a large number of anthropic traces (cut marks, impacts, polishes, peelings, arrachement, fractures, burning) allows hypothesizing that some of these birds were included in the diet of Mesolithic hunters-gatherers; furthermore, they were also captured in order to use the bones and the feathers for ornamental and/or symbolic purposes.

Riassunto

Grotta del Santuario della Madonna di Praia a Mare, localizzata nella Calabria settentrionale, è stata occupata continuativamente dal Paleolitico superiore fino al Medio Evo. Oltre 1.200 ossa appartenenti a 50 specie di uccelli provengono dal livello I del Mesolitico. Le specie che frequentano le pareti rocciose e falesie sono predominanti soprattutto per l'alto numero di resti di piccione selvatico. Gli uccelli dei boschi e acquatici sono ben rappresentati. Una delle caratteristiche del complesso ornitico è la presenza di molte specie di rapaci (Falconiformes e Strigiformes). Precedenti analisi tafonomiche condotte sulle ossa degli uccelli acquatici dagli strati paleolitici e mesolitici (tra i quali anche alcuni rapaci diurni) hanno evidenziato molte tracce antropiche prodotte durante il depezzamento della carcassa e la cottura della carne per consumarla. Al fine di continuare ed approfondire lo studio delle modalità di sfruttamento degli uccelli del Mesolitico di questa grotta sono state effettuate ulteriori indagini tafonomiche sulle ossa dei rapaci. La presenza di un gran numero di tracce antropiche (strie, impatti, politure, peeling, arrachement, fratture, combustioni) permette di ipotizzare che alcuni di questi uccelli siano stati inclusi nella dieta dei cacciatori-raccoglitori mesolitici oltre ad esser stati catturati per utilizzarne le ossa e le piume a scopo ornamentale e/o simbolico.

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Introduction

Since ancient times until the present days, raptors have always affected human imagination. Consider, for example, the role played in mythologies and in many religions of early civilizations in the Old World (Egyptians, Greeks, Romans), but also among the native Americans and the Incas. A symbolic value, strictly related to the myth of the foundation of the *Urbs*, was even assigned to the vulture remains recovered in the sacrificial deposit of the *Niger Lapis* in the area of the *Comitium* in the Roman Forum (Blanc & Blanc 1958). Human-raptor relationship presents numerous facets, that are difficult to understand only at a material level; however, some ethnographic examples show varied and complex uses of these animals by modern populations that may provide important clues for the archaeozoological interpretation. For example, specific vulture organs or portions were used for therapeutic purposes in Africa and in Israel, while in India and in Pakistan their meat was consumed (Dendaletche 1988). During the last few years, some archaeozoological researches tried to identify the earliest evidences of interactions between raptors and hunters-gatherers in order to understand the way these birds were acquired and exploited. In Italy and in Europe, the earliest evidences of anthropic traces on raptor bones date back to the Middle Paleolithic (and therefore *H. neanderthalensis*) and reveal human behaviors that may have also had a symbolic character. In fact the traces are localized on particular anatomical portions: wing and talon (Fiore *et al.* 2004a; Peresani *et al.* 2011; Morin & Laroulandie 2012; Romandini *et al.* 2014). The interest in the raptor wings is documented also in the early Gravettian of Grotta Paglicci where stone tool cut marks have been detected on humeri of cinereous vulture (*Aegypius monachus*) and kestrel (*Falco tinnunculus*) (Tagliacozzo & Gala 2004). It is only in the final Epigravettian, at Grotta Romanelli, that we find the largest number of information on the butchery and cooking techniques used for eagles, hawks, and owls; however, their exploitation only for alimentary purposes is not sure. In fact anthropic traces may indicate the use of these birds also for other purposes (procurement of feathers and down?) (Cassoli & Tagliacozzo 1997; Cassoli *et al.* 2003; Gala & Tagliacozzo 2010).

At Grotta della Madonna, one of the most important sites in Southern Italy, there are numerous raptor bones, in both the Upper Paleolithic and the Mesolithic levels. Therefore a research project was launched in order to clarify the way raptor carcasses were exploited.

This paper presents the results of the analyses carried out on the bones of 11 species of diurnal and nocturnal raptors found in the Mesolithic level of this large cave (about 40x50 m wide and 15 m high) opening on a cliff at about 500 m from the modern coastline (Fig. 1). The excavations, carried out by the Istituto Italiano di Paleontologia Umana of Rome (1957 - 1970), revealed an impressive archaeological deposit, over 8 m thick, characterized by several layers

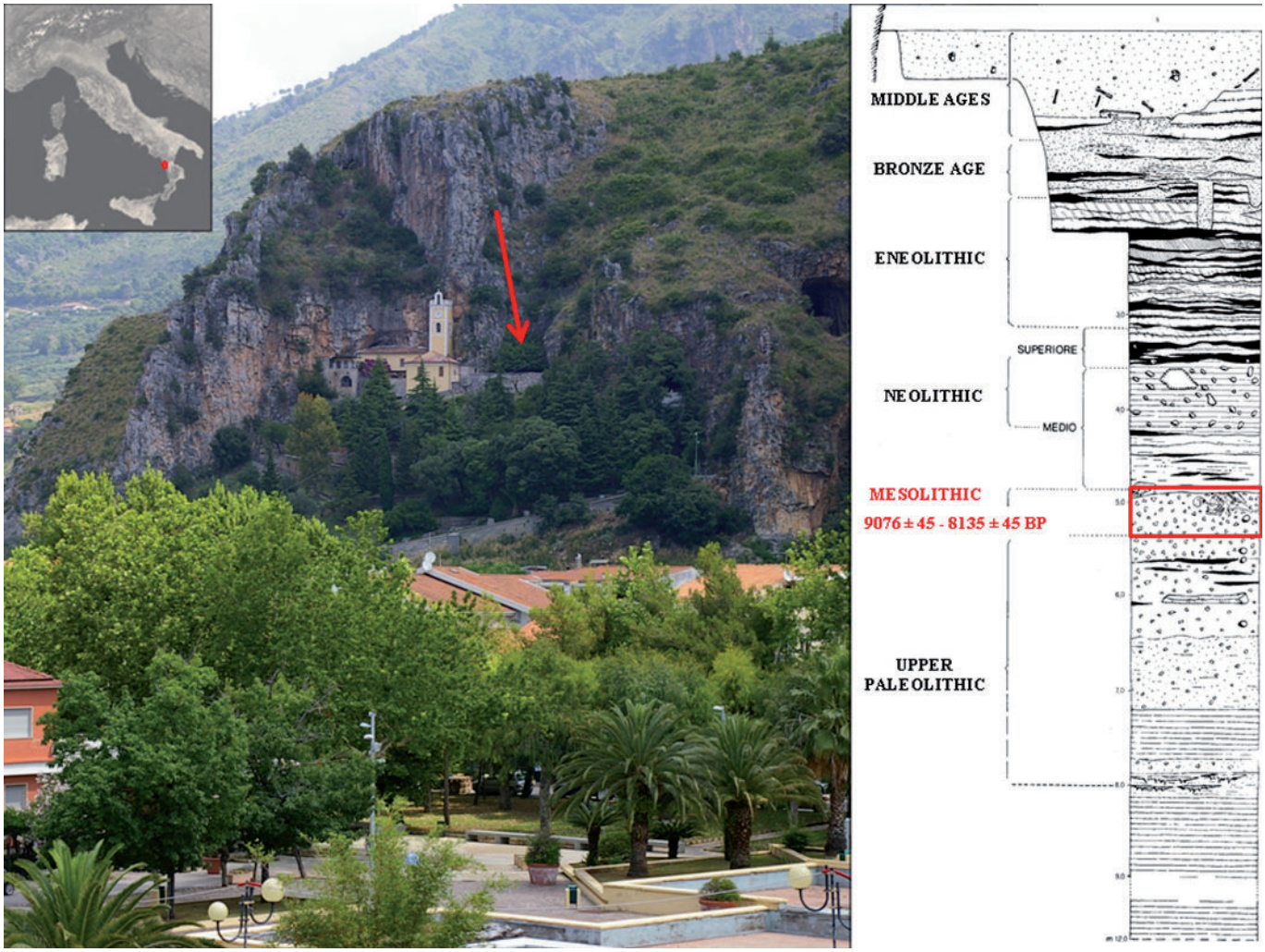

Fig. 1 *- Location of Grotta della Madonna in the southern Italian Peninsula; cave view (photo I. Fiore) and stratigraphic profile with Mesolithic layer I (cuts 42-47) based on Cardini 1972. / Localizzazione di Grotta della Madonna nella penisola italiana; vista della grotta (foto I. Fiore) e sezione stratigrafica con il livello I Mesolitico (tagli 42-47) da Cardini 1972.*

related to the human occupation of the cave, from the late phases of the Upper Paleolithic until the Middle Ages (Blanc & Cardini 1957, 1961; Cardini 1972). The Upper Paleolithic level "L" with final Epigravettian industry provided dates by 14C between 12,100±150 and 9,020±125 BP (Alessio *et al.* 1966, 1967).

Starting in 2002 the Soprintendenza al Museo Nazionale Preistorico Etnografico L. Pigorini carried out new excavations (test trench 4x5 m) corresponding to about 5.5 m of anthropic deposit of the Holocene period, down to the Mesolithic frequentation.

The new excavations provided new chronological data for the site, applying the radiocarbon method (AMS) to different Mesolithic cuts and structures. The new dates (from 8,350-8,220 cal. BC to 7,200- 7,040 cal. BC) indicate an intense frequentation of the cave between the end of the 10th and the entire 9th millennium BP (see Tagliacozzo *et al*. this volume). The data obtained from the lithic production indicate the presence of an Early Mesolithic assemblage, with very low microlithic component, similar to other industries from Central and Southern Italy, known as Undifferentiated Epipaleolithic.

The bone remains analyzed in this study come from the Mesolithic layer I (cuts 42-47) of the excavations by Cardini. The faunal sample includes over 12,000 remains, about 7,000 of which could be identified. Mammal bones are the most frequent, followed by birds, testudinates, amphibians and fishes. Among the mammals, wild boar is the most frequently hunted species, followed by cervids (red and roe deer). Small mammals (hare and dormouse) and carnivores are also present. The analysis of the bone remains showed the presence of several butchering marks and combustion traces, indicating the capture and the consumption of a wide range of animal species (Fiore *et al.* 2004b, 2004c).

Method

The raptor bones analyzed in this paper had been previously selected by P. F. Cassoli who also identified most of the bird assemblage. The revision of the materials was carried out using the osteological collections of the Laboratorio di Paleontologia del Quaternario e Archeozoologia of the Museo Nazionale Preistorico Etnografico "L. Pigorini" and of the Istituto Italiano di Paleontologia Umana.

The remains were quantified employing the most common methods: NISP (Number of Identified Specimens) and MNI (Minimum Number of Individuals); this latter has been calculated by cut. The Minimum Number of Element (MNE) was not calculated because there were only few specimens for each species, distributed in different cuts, therefore the MNE overlapped with the NISP. Measurements have been taken following von den Driesch (1976). The taxonomic sequence and the nomenclature are based on "La lista CISO-COI degli uccelli italiani" (Fracasso *et al.* 2009). The anatomical terms follow Baumel & Witmer (1993) and the data regarding the present distribution, behavior and ecology have been obtained mainly from Brichetti (2002). Microscopic analyses of the bird bone surfaces were carried out using a Nikon 1000 stereomicroscope with a magnification range of 15x-35x. For each bone pre- and post-depositional modifications have been described according to criteria established in the taphonomic literature for mammals and particularly for birds (Binford 1981; Lyman 1994; Fisher 1995; Cassoli & Tagliacozzo 1997; Laroulandie 2000; Serjeantson 2009). The category "impact mark" includes traces of different nature produced by percussion fracturing. For assigning some traces of dubious interpretation a "Homo/Other" category has been created.

Results

Over 1,200 bird bones belonging to 50 different species were found in the Mesolithic layer I (Tab. 1). The rocky species are prevalent, mainly because of the high frequency of rock dove (*Columba livia*). Gruiformes and Passeriformes are also well represented. The proximity of a large delta allowed the capture of several aquatic birds, particularly the coot (*Fulica atra*) and many species of Anseriformes, including the mallard (*Anas platyrhynchos*) which is the prevalent species among them. The analysis of water bird bone remains evidenced many anthropic marks (cuts, impacts, scrapings and localized burnings) suggesting that these birds were exploited for human consumption (Gala & Tagliacozzo 2004).

Raptors of Grotta della Madonna

One of the features of the Paleo-Mesolithic avian assemblage of Grotta della Madonna is the large number of remains and the abundance of species belonging to diurnal and nocturnal raptors (Tab. 1). In the Paleolithic level there were remains of 10 species of Accipitridae and 3 species of Falconidae among the diurnal raptors, and 5 species of Strigidae among the nocturnal birds of prey, both representing about the 4% of the NISP of the total sample. In the Mesolithic level a significant decrease in the number of species of diurnal raptors was observed: only 5 species of Accipitridae and 1 of Falconidae were recorded; while the number of species of Strigiformes remained unchanged, although the species composition varied (1 of Tytonidae and 4 of Strigidae). In this level the raptors (NISP 27) represent more than 2% of the total avian assemblage.

In the Mesolithic level it was possible to observe the absence, among the Accipitridae, of the honey buzzard (*Pernis apivorus*), of the marsh harrier (*Circus aeruginosus*), of the hen harrier (*C. cyaneus*), of the sparrowhawk (*Accipiter nisus*), and particularly of the cinereous vulture (*Aegypius monachus*). Among the Falconidae, the lesser kestrel (*Falco naumanni*) and the hobby (*F. subbuteo*) are missing. As far as the nocturnal raptors are concerned, the short-eared owl (*Asio flammeus*) was not found, replaced by the barn owl (*Tyto alba*) that is absent in the Paleolithic level.

Distribution and behavior of raptors in the Mesolithic level at Grotta della Madonna

Falconiformes
Accipitridae

White-tailed eagle (*Haliaeetus albicilla*). Right distal humerus.

This species is found in northern Europe and Asia, may reach a length of 70-90 cm and a wingspan of 200-240 cm. It is common on the seacoast, especially in wooded areas, in wetlands and estuaries. It feeds on fish and several mammals and occasionally eats carrions. Currently, the Mediterranean population is almost extinct.

Pallid harrier (*Circus macrourus*). Right distal radius.

This migratory bird breeds in southeastern Europe and central Asia, and winters in the Mediterranean area. It is a medium-sized raptor, has a wingspan of 95-110 cm and a length of 40-48 cm. It is present mostly in open plains, marshes and heathlands.

Goshawk (*Accipiter gentilis*). Left incomplete coracoid and left medio-proximal femur.

This sedentary species is a medium-sized bird of prey, has a wingspan of 135-165 cm and a length of 48-62 cm. It hunts mainly squirrels, hares, small mammals and various birds. The prey is attacked and killed using the talons. The carcasses are eaten on the ground or on the lower branches of the trees. It is present mainly in woodlands, but may also adapt to Mediterranean scrub areas.

Buzzard (*Buteo buteo*). Left distal radius.

The range of this species covers most of Europe. It is a medium-sized raptor measuring between 51 and 57 cm in length and with a wingspan of 113-128 cm. It lives in forests and wooded areas, but usually hunts in open areas, eating small mammals and sometimes carrions. It nests in trees, but also on rock walls.

Tab. 1 *- Grotta della Madonna. Number of Identified Specimens (NISP) of birds from the Upper Paleolithic (Layer L) and the Mesolithic (Layer I). / Numero resti (NR) degli uccelli del Paleolitico superiore (Livello L) e Mesolitico (Livello I).*

TAXA	UPPER PALEOLITHIC (LEVEL L)		MESOLITHIC (LEVEL I)							
	TOTAL		CUTS						TOTAL	
	NISP	%	47	46	45	44	43	42	NISP	%
Anseriformes Anatidae										
Cygnus cygnus	18	0,24								
Anser fabalis	3	0,04								
Anser albifrons	24	0,32		1					1	0,1
Anser anser	3	0,04								
Tadorna tadorna	4	0,05	1						1	0,1
Anas penelope	5	0,07		1					1	0,1
Anas strepera	8	0,11								
Anas platyrhynchos	265	3,55	11	2	4		1		18	1,5
Anas acuta	38	0,51		1			1	2	4	0,3
Anas querquedula	3	0,04								
Netta rufina	16	0,21								
Aythya ferina	88	1,18	4	1		2	1		8	0,6
Aythya nyroca	22	0,30		1		1			2	0,2
Aythya fuligula	76	1,02	6	4	3		1		14	1,1
Somateria mollissima	3	0,04								
Bucephala clangula	3	0,04								
Mergus serrator	7	0,09	1						1	0,1
Mergus merganser	7	0,09								
Tot. Anseriformes	**593**	**7,95**	**23**	**11**	**7**	**3**	**4**	**2**	**50**	**4,0**
Galliformes Tetraonidae										
Lagopus mutus	1	0,01								
Tetrao tetrix	1	0,01								
Phasianidae										
Alectoris graeca	8	0,11								
Perdix perdix	19	0,25								
Coturnix coturnix	6	0,08		1	6	10	8	4	29	2,3
Tot. Galliformes	**35**	**0,47**		**1**	**6**	**10**	**8**	**4**	**29**	**2,3**
Gaviiformes Gaviidae										
Gavia stellata	5	0,07								
Gavia arctica	15	0,20	2						2	0,2
Tot. Gaviiformes	**20**	**0,27**	**2**						**2**	**0,2**
Procellariiformes Procellariidae										
Calonectris diomedea	3	0,04								
Podiceps cristatus	13	0,17	1	1	1				3	0,2
Podiceps nigricollis	8	0,11				2			2	0,2
Tot. Procellariiformes	**24**	**0,32**	**1**	**1**	**1**	**2**			**5**	**0,4**
Pelecaniformes Phalacrocoracidae										
Phalacrocorax carbo	**4**	**0,05**	**1**					**1**	**2**	**0,2**

Tab. 1 - *Continued. / Continua.*

TAXA	UPPER PALEOLITHIC (LEVEL L)		MESOLITHIC (LEVEL I)							
	TOTAL		CUTS						TOTAL	
	NISP	%	47	46	45	44	43	42	NISP	%
Ciconiiformes Ardeidae										
Botaurus stellaris	**11**	**0,15**		**1**					**1**	**0,1**
Podicipediformes Podicipedidae										
Tachybaptus ruficollis	**12**	**0,16**		**1**		**1**	**1**		**3**	**0,2**
Falconiformes Accipitridae										
Pernis apivorus	1	0,01								
Haliaeetus albicilla	1	0,01			1				1	0,1
Aegypius monachus	6	0,08								
Circus aeruginosus	3	0,04								
Circus cyaneus	22	0,30								
Circus macrourus	4	0,05				1			1	0,1
Accipiter gentilis	9	0,12			1		1		2	0,2
Accipiter nisus	1	0,01								
Buteo buteo	7	0,09		1					1	0,1
Aquila chrysaetos	71	0,95					1		1	0,1
Falconidae										
Falco naumanni	3	0,04								
Falco tinnunculus	3	0,04			1	1			2	0,2
Falco subbuteo	3	0,04								
Tot. Falconiformes	**134**	**1,80**		**1**	**3**	**2**	**2**		**8**	**0,6**
Gruiformes Rallidae										
Rallus aquaticus	1	0,01								
Crex crex	2	0,03								
Gallinula chloropus	2	0,03	1				1		2	0,2
Fulica atra	273	3,66	41	31	14	17	9	2	114	9,2
Gruidae										
Grus grus	30	0,40			1				1	0,1
Otididae										
Tetrax tetrax	685	9,19	5						5	0,4
Otis tarda	25	0,34								
Tot. Gruiformes	**1018**	**13,66**	**47**	**31**	**15**	**17**	**10**	**2**	**122**	**9,9**
Charadriiformes Scolopacidae										
Scolopax rusticola	8	0,11								
Laridae										
Larus canus	1	0,01								
Tot. Charadriiformes	**9**	**0,12**								
Pterocliformes Pteroclidae										
Pterocles orientalis	**1**	**0,01**								
Columbiformes Columbidae										
Columba livia	4569	61,29	219	200	166	134	45	33	797	64,4
Columba oenas	382	5,12	14	16	11	10	2		53	4,3
Columba palumbus	47	0,63	6	6	3	5		2	22	1,8
Streptopelia turtur	4	0,05		1			1		2	0,2
Tot. Columbiformes	**5002**	**67,10**	**239**	**223**	**180**	**149**	**48**	**35**	**874**	**70,7**

Tab. 1 - *Continued. / Continua.*

TAXA	UPPER PALEOLITHIC (LEVEL L)		MESOLITHIC (LEVEL I)							
	TOTAL		CUTS						TOTAL	
	NISP	%	47	46	45	44	43	42	NISP	%
Cuculiformes Cuculidae										
Cuculus canorus					**1**				**1**	**0,1**
Strigiformes Tytonidae										
Tyto alba					1		1		2	0,2
Strigidae										
Otus scops	1	0,01			3		1		4	0,3
Bubo bubo	11	0,15	1		1	1			3	0,2
Athene noctua	13	0,17		1	1				2	0,2
Strix aluco	100	1,34	2	4		1		1	8	0,6
Strix sp.	25	0,34								
Asio flammeus	2	0,03								
Tot. Strigiformes	**152**	**2,04**	**3**	**5**	**6**	**2**	**2**	**1**	**19**	**1,5**
Coraciiformes Coraciidae										
Coracias garrulus	**1**	**0,01**	**1**					**1**	**2**	**0,2**
Piciformes Picidae										
Picus viridis	**5**	**0,07**								
Passeriformes Alaudidae										
Melanocoripha calandra	3	0,04								
Hirundinidae										
Ptyonoprogne rupestris	23	0,31	3	2		2	1	2	10	0,8
Turdidae										
Turdus merula	114	1,53	12	10		6	10	4	42	3,4
Turdus pilaris	23	0,31			7	4	3	1	15	1,2
Turdus iliacus	61	0,82	5	7		4	4		20	1,6
Turdus viscivorus	24	0,32		2		3	4		9	0,7
Oriolidae										
Oriolus oriolus	1	0,01		1					1	0,1
Corvidae										
Garrulus glandarius	38	0,51	4	1	2	2	2	2	13	1,1
Pyrrhocorax graculus	38	0,51								
Pyrrhocorax pyrrhocorax	6	0,08								
Corvus monedula	8	0,11								
Corvus frugilegus	12	0,16	1						1	0,1
Corvus corone	37	0,50								
Corvus corax	39	0,52	1						1	0,1
Fringillidae										
Fringilla coelebs	7	0,09		3		2		1	6	0,5
Emberizidae										
Miliaria calandra								1	1	0,1
Tot. Passeriformes	**434**	**5,82**	**26**	**26**	**9**	**23**	**24**	**11**	**119**	**9,6**
TOTAL	**7455**	**100**	**343**	**301**	**228**	**209**	**99**	**57**	**1237**	**100**

Golden eagle (*Aquila chrysaetos*). Incomplete pelvis.

This species is currently widespread in the mountainous areas throughout Eurasia. It is a large bird of prey with a length of 75-88 cm and a wingspan of 204-220 cm. It nests in cliffs, but frequents a wide range of open spaces or with sparse trees, where it mostly hunts mammals (rodents and lagomorphs) and birds (Galliformes) and, in winter, it also feeds on carrions.

Falconidae

Kestrel (*Falco tinnunculus*). Left coracoid and right distal ulna.

This is one of the most common small sized raptor in Europe, it measures 32-35 cm from head to tail and has 71-80 cm of wingspan. It tolerates a wide range of habitats, mainly rock faces, and hunts mice, other rodents, small birds and insects in open country.

Strigiformes

Tytonidae

Barn owl (*Tyto alba*). Right ulna and right carpometacarpus.

This species is widespread over all continents, it is mostly non-migratory, nocturnal or crepuscular. Its length is 33-35 cm with a wingspan of 83-93 cm. It is present in open country areas and hunts voles, mice, moles, but also amphibians and insects, mainly at the edge of the woods.

Strigidae

Scops owl (*Otus scops*). Left distal humerus, left carpometacarpus, left proximal carpometacarpus and left tarsometatarsus.

After the Eurasian pygmy owl (*Glaucidium passerinum*) this is the smallest European nocturnal raptor: length 19-20 cm, wingspan 53-63 cm. It is a migratory bird that winters in wooded or shrubby savannahs in sub-Saharan Africa. Some southern Italy populations, however, are non-migratory. It nests in caves, in rock cavities or in tree holes. It hunts mainly insects, to a lesser extent, birds and toads, and only rarely small mammals. It prefers open habitats, sometimes arid.

Eagle-owl (*Bubo bubo*). Right ulna shaft and 2 foot phalanges.

This is the largest owl species with a wingspan of 160-188 cm and a length of 60-75 cm. It nests in the trunks of trees or in rock crevices and lives mainly in rocky terrain forests. It hunts, at sunrise and sunset, mostly small mammals (rodents and lagomorphs), but also fox-sized preys. It kills also other birds, including other raptors and Galliformes.

Little owl (*Athene noctua*). 2 right distal humeri.

This species is widespread throughout the Northern Hemisphere; in Italy it is a very common bird. It is a typical nocturnal bird of prey and may be active also at sunrise and sunset. It is about 21-23 cm long and has a wingspan of 54-58 cm. It nests in small cavities between the rocks or in trees. It feeds on small vertebrates and large insects. It prefers poorly tree-lined hilly areas, but may adapt to different environments.

Tawny owl (*Strix aluco*). Left quadratum, right coracoid shaft, left medio-distal coracoid, left distal humerus, left radius shaft, incomplete pelvis, left medio-proximal femur, right tarsometatarsus shaft

This is a medium-sized owl (length 37-39 cm, wingspan 94-104 cm) widespread throughout Italy. It is closely related to forest habitat, but it also adapts to open environments and breeds in cavities of different type both on isolated trees and on rocky faces. It is specifically nocturnal, but it is also active at sunset when caring for its offspring. It feeds mainly on small mammals, but also birds, amphibians and invertebrates.

Raptor bones in the Mesolithic level at Grotta della Madonna

The raptors are represented by a minimum number of specimens varying from 1 (for 4 species), up to 8 remains (tawny owl) for an estimated total of 22 individuals (Tab. 2). Adult specimens predominate in the assemblage, but 2 juvenile bones of golden eagle and tawny owl were also identified (7%).

The sex of one individual of tawny owl was determined from the medullary bone in a radius shaft; this is therefore a female who died during the hatching period that lasts up to 29 days, once a year, between March and June.

The skeletal element distribution (Tab. 3 and appendix) shows more wing bones (humerus, ulna and radius) and coracoids. The number of leg bones is very low, in fact there are only 1 femur of goshawk, 1 femur of tawny owl, 2 tarsometatarsi of scops owl and tawny owl and 2 foot phalanges of eagle-owl. This latter bird is represented also by an ulna, and since the three bones come from different Mesolithic cuts, it was not possible to attribute them to a single individual. In any case it is undeniable that these are all particular elements belonging to the wing and to the distal limbs. No other posterior phalanges have been found in the Mesolithic raptor sample.

Taphonomic analyses

Most of the long bones are fragmented (NISP 22) and only some of them are complete (NISP 5).

The bone specimens are well preserved and only in a few cases are eroded by soil, root action or affected by abrasion (30%) (Tab. 4). The taphonomic analysis evidenced several types of traces, some of them (8 bones, 33%) surely referable to humans (cut marks, impact marks, polishes, peelings, *arrachement*). In addition many combustion traces have been detected on 19 bones (79% of the modified remains); in some cases they cover the whole surface (2 NISP) or a large portion of the bone (5 NISP), in others they are localizes mainly on the long bone epiphyses (12 NISP).

Other traces are instead of more difficult attribution (gnawing

Tab. 2 *- Grotta della Madonna. Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) of raptors from the Mesolithic (Layer I). / Numero resti (NR) e Numero Minimo degli Individui (NMI) dei rapaci del Mesolitico (Livello I).*

MESOLITHIC (LEVEL I) / *TAXA*	NISP	%	MNI	%
FALCONIFORMES				
Accipitridae				
White-tailed eagle (*Haliaeetus albicilla*)	1	*3,70*	1	*4,55*
Pallid harrier (*Circus macrourus*)	1	*3,70*	1	*4,55*
Goshawk (*Accipiter gentilis*)	2	*7,41*	2	*9,09*
Buzzard (*Buteo buteo*)	1	*3,70*	1	*4,55*
Golden eagle (*Aquila chrysaetos*)	1	*3,70*	1	*4,55*
Falconidae				
Kestrel (*Falco tinnunculus*)	2	*7,41*	2	*9,09*
STRIGIFORMES				
Tytonidae				
Barn owl (*Tyto alba*)	2	*7,41*	2	*9,09*
Strigidae				
Scops owl (*Otus scops*)	4	*14,81*	2	*9,09*
Eagle-owl (*Bubo bubo*)	3	*11,11*	3	*13,64*
Little owl (*Athene noctua*)	2	*7,41*	2	*9,09*
Tawny owl (*Strix aluco*)	8	*29,63*	5	*22,73*
TOTAL	**27**	***100***	**22**	***100***

Tab. 3 *- Grotta della Madonna. Skeletal part representation of raptor remains. Head: CRA (skull, mandible, maxilla, quadrate). Axial: VER (Vertebra), RIB, STE (Sternum), PEL (Pelvis, synsacrum, notarium). Shoulder girdle: FUR (Furcula), COR (Coracoid), SCA (Scapula). Wing: HUM (Humerus), ULN (Ulna), RAD (Radius), CAR (Carpometacarpus) CRP (Carpal), W.P (Wing Phalanx). Hindlimb: FEM (Femur), TIB (Tibiotarsus), FIB (Fibula), TAR (Tarsometatarsus), MET (Metatarsal), F.P (Foot Phalanx). / Rappresentazione scheletrica dei rapaci. CRA (cranio, mandibola, mascella, osso quadrato). VER (Vertebra), RIB (Costa), STE (Sternum), PEL (Pelvis, synsacrum, notarium). FUR (Furcula), COR (Coracoide), SCA (Scapola). HUM (Omero), ULN (Ulna), RAD (Radio), CAR (Carpometacarpo) CRP (Carpale), W.P (Falange alare). FEM (Femore), TIB (Tibiotarso), FIB (Fibula), TAR (Tarsometatarso), MET (Metatarsale), F.P (Falange posteriore).*

	HEAD	AXIAL				SHOULDER GIRDLE			WING						HINDLIMB						TOTAL	
TAXA	CRA	VER	RIB	STE	PEL	FUR	COR	SCA	HUM	ULN	RAD	CAR	CRP	W.P	FEM	TIB	FIB	TAR	MET	F.P	NISP	%
White-tailed eagle (*Haliaeetus albicilla*)									1												**1**	***3,7***
Golden eagle (*Aquila chrysaetos*)					1																**1**	***3,7***
Eagle-owl (*Bubo bubo*)										1										2	**3**	***11,1***
Total large sized raptors					**1**				**1**											**2**	**5**	***18,5***
Pallid harrier (*Circus macrourus*)											1										**1**	***3,7***
Goshawk (*Accipiter gentilis*)							1								1						**2**	***7,4***
Buzzard (*Buteo buteo*)											1										**1**	***3,7***
Barn owl (*Tyto alba*)										1		1									**2**	***7,4***
Tawny owl (*Strix aluco*)	1				1		2		1		1				1			1			**8**	***29,6***
Total medium sized raptors	**1**				**1**		**3**		**1**	**1**	**3**	**1**			**2**			**1**			14	***51,9***
Kestrel (*Falco tinnuculus*)							1			1											**2**	***7,4***
Scops owl (*Otus scops*)									1			2						1			**4**	***14,8***
Little owl (*Athene noctua*)									2												**2**	***7,4***
Total small sized raptors							**1**		**3**	**1**		**2**						**1**			**8**	***29,6***
TOTAL RAPTORS	**1**				**2**		**4**		**5**	**2**	**3**	**3**			**2**			**2**		**2**	***27***	***100***
% TOTAL RAPTORS	***3,7***				***7,4***		***14,8***		***18,5***	***7,4***	***11,1***	***11,1***			***7,4***			***7,4***		***7,4***		

and fresh bone fractures). As regards tooth marks (gnawing), these were observed on 13 bones (54 % of the modified remains): coracoids, wing elements (humerus, ulna, radius, carpometacarpus) and pelvis. Punctures (on 11 bones, 85 % of the gnawed remains) and scoring (on 6 bones, 46 % of the gnawed remains) are the most abundant, but crenulated edges (on 4 bones, 31 % of the gnawed remains) were also recorded. Except for 2 cases (coracoid of tawny owl and carpometacarpus of barn owl) all the other gnawed bones showed other kinds of human damage on the same specimen, cut mark (3 NISP), peeling (6 NISP), *arrachement* (1 NISP), fracture (5 NISP) and localized burning (8 NISP).

Among the large raptors, at least 3 groups of cut marks, 2 impact marks and 2 peeling traces are present on the two faces of the distal humerus of a white-tailed eagle. Two sub-parallel *striae* transverse to the bone axis are visible on the distal diaphysis (Fig. 2.3), while many transverse cuts, deep, more or less short and rectilinear, are present close to the *processus supracondilaris dorsalis* (Fig. 2.6). The fracture edge shows signs of polish, peeling and possible functional removals (Fig. 2.4-5). Furthermore, a combustion trace is also evident on the *condylus dorsalis*. It is therefore possible that the different actions, with and without a lithic tool, were aimed at the disarticulation of the humerus from the forearm, in order to consume the meat that was covering it. Another purpose was to use the bone since this specimen probably represent an expedient tool.

Striae of variable size and orientation are located above the *foramen ilium ischiadicum* of the pelvis of a young individual of golden eagle: two long, deep and longitudinal *striae*, one of which is interrupted, and two other groups of short, repeated and transverse marks (Fig. 3.2-3). This area is affected also by combustion traces and crenulated edges, while on the *ileum* there are at least 5 punctures (Fig. 3.4). Other single short, deep and transverse cuts on the synsacrum are associated to peeling on the same face of the bone (Fig. 4). The different butchering activities were aimed at the disarticulation of the pelvis from the femur, probably before cooking and consumption .

Traces of lithic tool divided into two groups of short, superficial

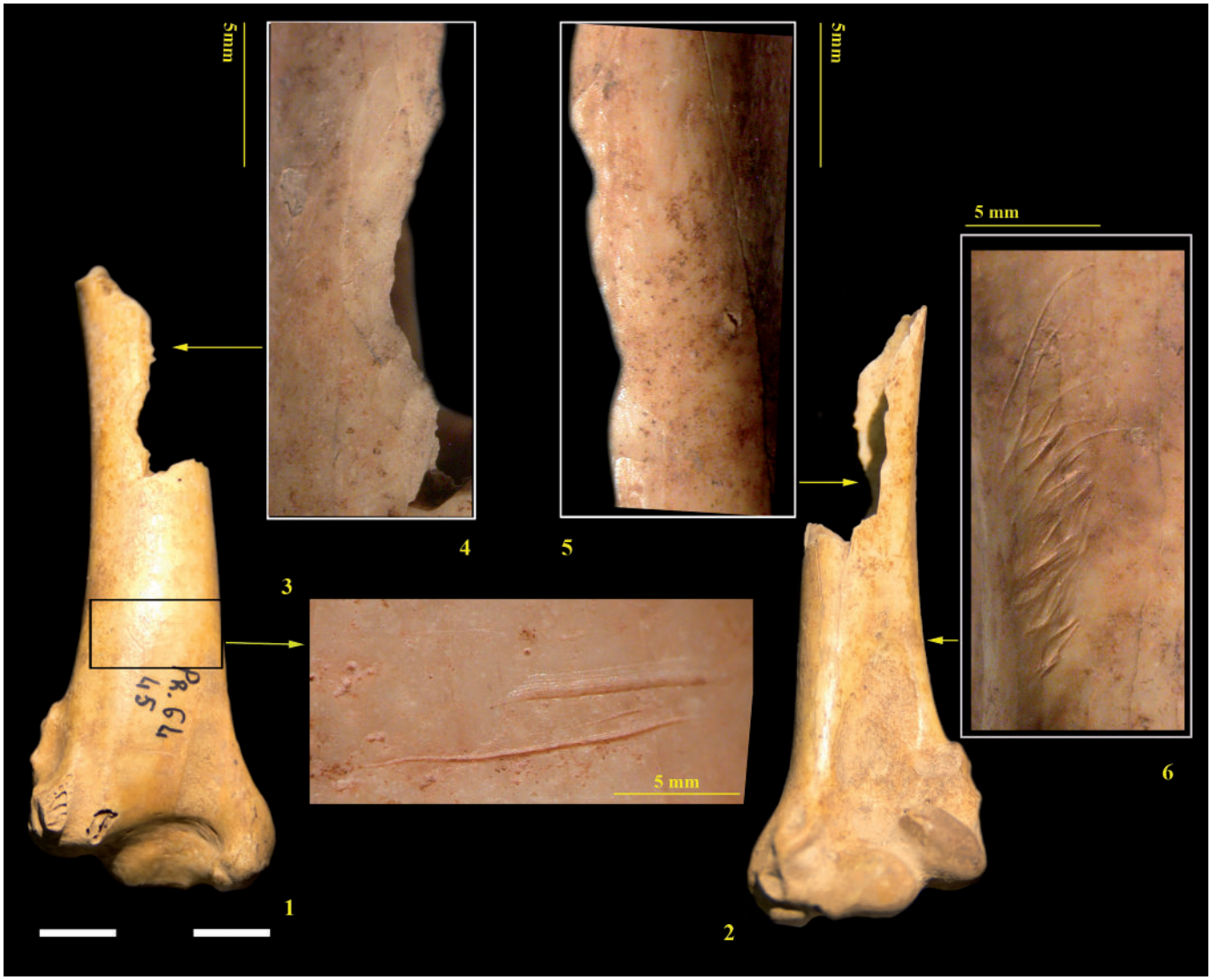

Fig. 2 *- 1-2 Distal humerus of white-tailed eagle (Haliaeetus albicilla), caudal and cranial views. 3 Cut marks. 4-5 Detail of impact mark and fracture edge with signs of polish and removals. 6 Detail of cut marks. / 1-2 Omero distale di aquila di mare (Haliaeetus albicilla) viste caudale e craniale. 3 Strie da strumento litico. 4-5 Particolari dell'impatto e del margine di frattura con tracce di politure e distacchi. 6 Particolare dei tagli.*

and transverse marks have been observed on the diaphysis of the ulna of the eagle-owl. On the distal diaphysis there are *arrachement,* peeling and crenulated edge, while on the proximal end there are a fresh bone fracture and a combustion trace. On the whole the observed traces suggest that human exploitation may be related to disarticulation and filleting of the wing, as well as to cooking and consumption.

A fresh bone fracture is also visible on the proximal end of an eagle owl talon, while combustion traces cover the whole surface of a medio-distal posterior phalanx. The burning traces are in general relatively light, but become more intense close to the proximal fracture edge suggesting a localized combustion.

As far as the medium sized birds are concerned, among the diurnal birds of prey the distal radii of buzzard and pallid harrier from two different Mesolithic cuts, (46 and 44) present fresh bone fractures. In the case of the buzzard radius, there are also other macro- and micro- traces (cut mark, impact, polish, peeling) (Fig. 5). Three groups of *striae*, mostly short, deep, repeated and oblique, depart from the dorsal face and continue to the ventral face; an impact is present on the diaphysis; a localized combustion trace was detected on the dorsal face of the distal portion of the diaphysis; peeling traces were found on the dorsal face of the distal end. Furthermore, the bone diaphysis is affected by a puncture on the cranial face. All these modifications on such a small fragment evidence a particular interest in a portion that may have been used as a tool; such interpretation is also supported by the polished appearance of the bone and by the rounded tip. However, it seems, as in the case of the humerus of white-tailed eagle, that this pointed object represents an expedient tool.

Human modifications are also visible on the coracoid and on the femur of two individuals of goshawk from two different cuts. The whole surface of the coracoid is burnt and presents also a proximal peeling and bi-lateral gnaw marks (puncture, scores and crenulated edge) on the distal portion over the *processus lateralis*.

On the femur, combustion traces are more evident on the proximal portion (the prolonged exposure to fire or coals produced also a break) where there is also a wide fracture edge, but are localized also on the distal portion of the bone, always close to an intentional fracture. It is therefore possible to hypothesize that for this bird no lithic tools were employed, but small portions were disarticulated, such as the coracoid from the shoulder girdle or the femur form the pelvis and the tibiotarsus, probably after cooking (as indicated by the

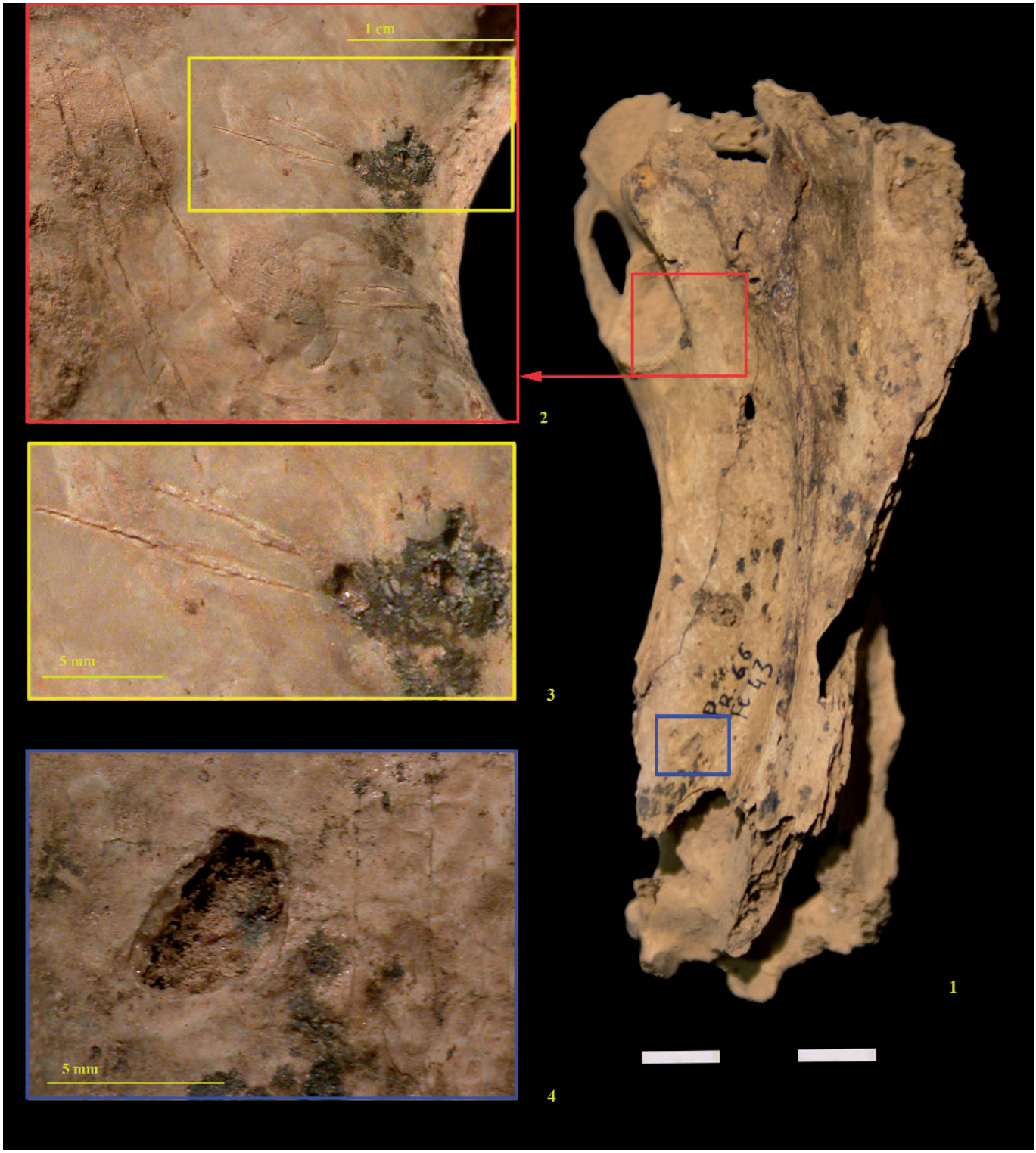

Fig. 3 - 1 Pelvis of golden eagle (Aquila chrysaetos), lateral view. 2-3 Cut marks. 4 Puncture. / 1 Pelvis di aquila reale (Aquila chrysaetos) vista laterale. 2-3 Strie da strumento litico. 4 Puncture.

traces on the femur) and then consumed (as suggested by gnawing on the distal coracoid).

The biological agent that gnawed the carpometacarpus of barn owl producing 2 bilateral punctures on the *processus extensorius* is not clear.

Of the 8 bones of tawny owl, only the caudal face of the proximal diaphysis of the femur shows many marks suggesting the use of a lithic tool: 2 long *striae*, superficial and transverse were identified below the trochanter, and further down many other *striae*, shorter, repeated and oblique, but also transverse to the bone axis, are present (Fig. 6). The distal portion of the same specimen had been removed and a fresh bone fracture is present on the diaphysis.

The distal portion of the humerus is fractured as well, however it presents, besides a slight burning trace on the diaphysis, a hole close to the *condylus dorsalis* and evidences of gnawing on the caudal face. Such gnawing traces present features that are different from

those produced by carnivores and other animals, and may therefore be probably attributed to human chewing.

Other gnaw marks are visible on the proximal portion of a coracoid of a young individual and a clear puncture is evident on the *lamina infracristalis ilii,* close to the acetabular cavity of the pelvis (see eagle pelvis).

On the pelvis there are also several combustion traces of variable intensity and extension on the 4 faces of the bone and peeling traces on the *crista iliaca obliqua*.

Other very intense traces of burning have been observed on the two ends of a coracoid, without the epiphyses, while a bending fracture, associated to peeling, has been identified also on the proximal diaphysis of a completely burnt tarsometatarsus.

Among the small sized raptors, the coracoid of a kestrel shows scores on dorsal and ventral faces of both ends of the bone, a puncture on the distal end and a slight proximal combustion.

The ulna of the other individual shows a fracture and scores on the diaphysis and a burned *condylus dorsalis ulnae*. It is difficult to attribute these traces to a specific predator, but it is possible to note that the gnawing on the distal end of the coracoid is comparable to the one on the goshawk coracoid.

Other bilateral punctures are visible on the distal humerus of a scops owl, presenting also a fracture and a slight burning on the *condylus dorsalis*.

A light punctiform burning trace is present on the dorsal face of the proximal diaphysis of a tarsometatarsus of the same species.

A widespread, but more intense, combustion was observed on the distal end on an almost complete carpometacarpus of scops owl that, in the same area, presents also some scores, transverse to the long axis of the bone. Other traces of peeling are visible on the proximal end below the *processus extensorius* that is partially absent (removed?).

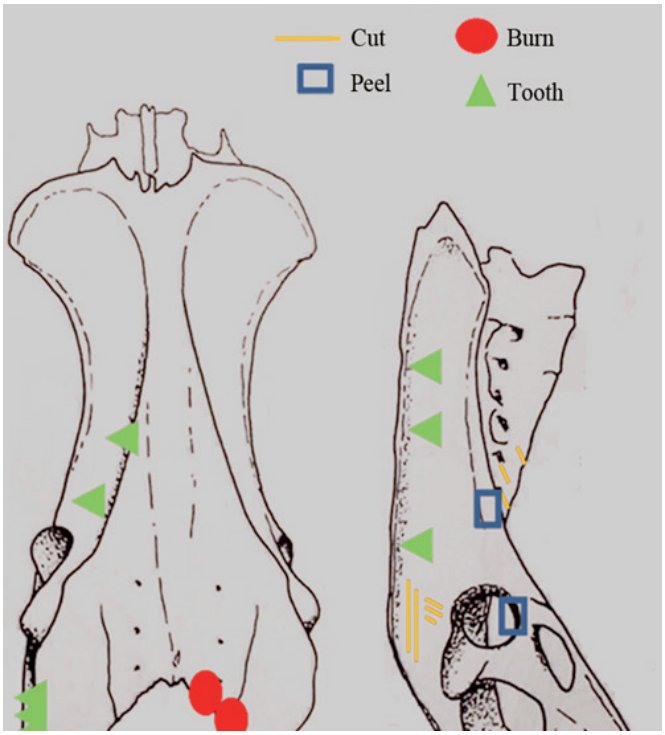

Fig. 4 *- Summary of the anthropic traces identified on Pelvis of golden eagle (Aquila chrysaetos) (drawing modified from Cohen Serjeantson 1996). / Riepilogo delle tracce antropiche individuate sul pelvis di aquila reale (Aquila chrysaetos) (disegno modificato da Cohen Serjeantson 1996).*

Tab. 4 *- Grotta della Madonna. Modifications on raptor remains. Some bones show several types of modifications. CUT: cut-marks. Imp: impact marks. POL: polish; PEEL: peeling. ARRACH: arrachement. FRA: fresh bone fracture. Burn: burning traces. TOOTH: tooth marks. E/R/T: Erosive action/Root/Trampling. / Modificazioni delle ossa dei rapaci. Alcuni reperti presentano vari tipi di modificazioni. CUT: cut-marks. Imp: impatti. POL: politure; PEEL: peeling. ARRACH: arrachement. FRA: fratture da osso fresco. BURN: combustioni. TOOTH: rosicature. E/R/T: tracce di erosione/Radici/Abrasioni.*

	TOTAL WITH MODIFICATION		HUMAN MODIFICATION					HUMAN/OTHER			OTHER
TAXA	NISP	%	CUT	IMP	POL	PEEL	ARRACH	FRA	BURN	TOOTH	E/R/T
White-tailed eagle (*Haliaeetus albicilla*)	1	*4,2*	1	1	1	1			1		3
Golden eagle (*Aquila chrysaetos*)	1	*4,2*	1			1			1	1	
Eagle-owl (*Bubo bubo*)	3	*12,5*	1			1	1	3	3	1	1
Total large sized raptors	**5**	***20,8***	**3**	**1**	**1**	**3**	**1**	**3**	**5**	**2**	**4**
Pallid harrier (*Circus macrourus*)	1	*4,2*						1			
Goshawk (*Accipiter gentilis*)	2	*8,3*				1		1	2	1	
Buzzard (*Buteo buteo*)	1	*4,2*	1	1	1	1			1	1	1
Barn owl (*Tyto alba*)	1	*4,2*								1	2
Tawny owl (*Strix aluco*)	6	*25,0*	1			2		3	5	3	
Total medium sized raptors	**11**	***45,8***	**2**	**1**	**1**	**4**		**5**	**8**	**6**	**3**
Kestrel (*Falco tinnunculus*)	2	*8,3*						1	2	2	
Scops owl (*Otus scops*)	4	*16,7*				1		2	3	2	
Little owl (*Athene noctua*)	2	*8,3*						2	1	1	
Total small sized raptors	**8**	***33,3***				**1**		**5**	**6**	5	
TOTAL RAPTORS	**24**	***100***	**5**	**2**	**2**	**8**	**1**	**13**	**19**	**13**	**7**
% TOTAL RAPTORS			***20,8***	***8,3***	***8,3***	***33,3***	***4,2***	***54,2***	***79,2***	***54,2***	***29,2***

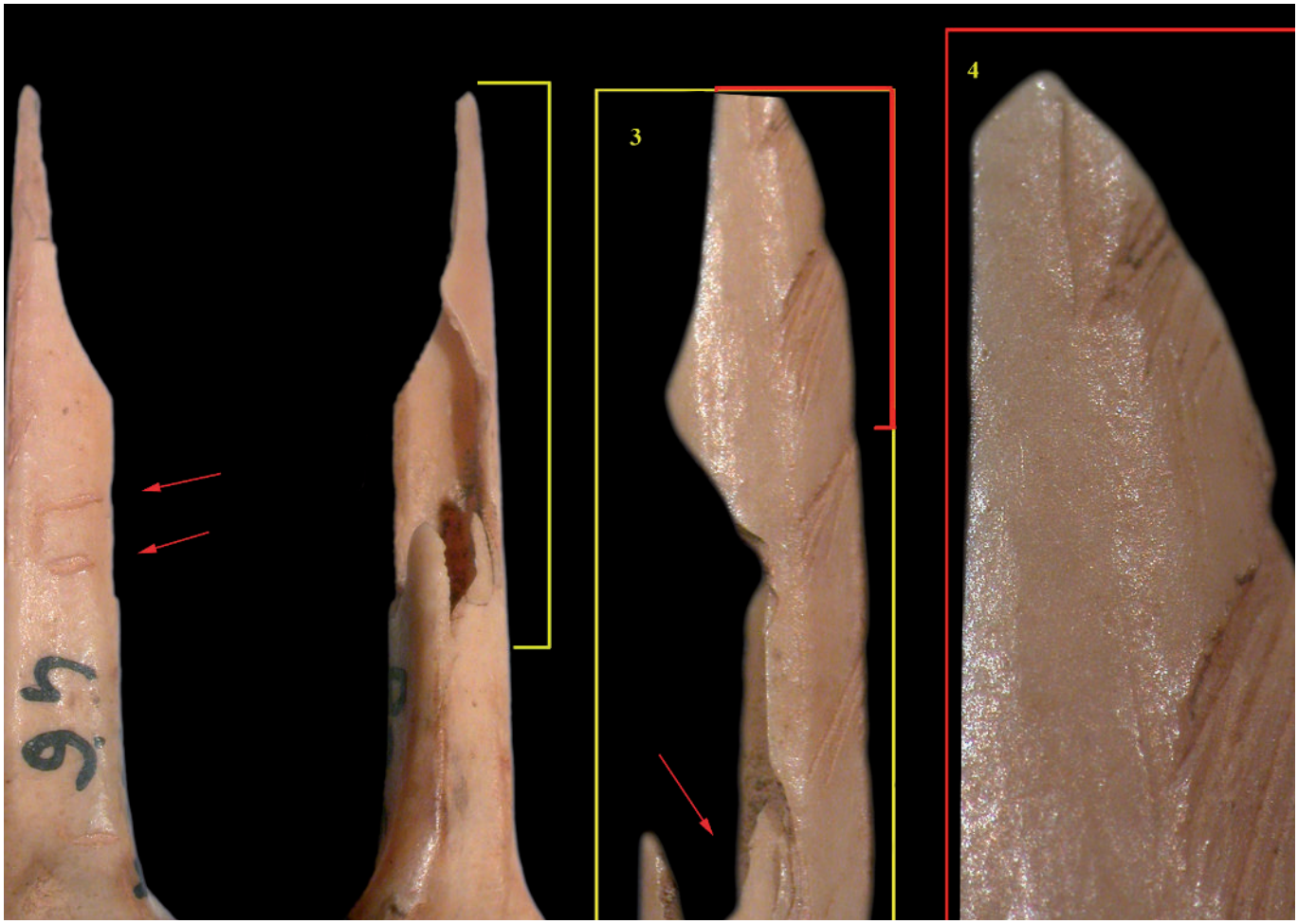

Fig. 5 - 1-2 Distal radius of buzzard (Buteo buteo), dorsal and ventral views. 3 Group of cut marks on the edge of the bone, impact mark, fracture and edge with signs of polish. 4 Detail of cut marks and rounded tip. / 1-2 Radio distale di poiana (Buteo buteo) viste dorsale e ventrale. 3 Gruppo di strie da strumento litico sul margine dell'osso, impatto, frattura e margine con tracce di politure. 4 Particolare dei tagli e della punta arrotondata.

A fracture is evident on the diaphysis of another proximal carpometacarpus, but, considering the small dimensions and the absence of other traces, it is very difficult to suggest an interpretation. On the other 3 specimens of scops owl it is possible to note that the localized combustion traces are in 2 cases associated to gnawing and there are no criteria to exclude that humans contributed to the accumulation of these remains.

Similarly the fractures on the 2 distal humeri of little owl, placed at different cuts along the diaphysis and the presence of a bilateral gnaw mark on the longest fragment and of a puncture on the caudal face do not provide further clues. However, it is true that only two humeri belonging to two different individuals, but of the same side (right) and of the same portion (distal), have been attributed to this bird; they also present the same fracture typology as well as punctures in the same position on the caudal face. Therefore, although with some doubts, it is possible to hypothesize some kind of intentionality in the actions and attribute such awareness to humans.

Discussion and conclusions

The majority of raptor remains in the Mesolithic level of Grotta della Madonna suggests the presence nearby of woodlands and forests, but also of large clearings where these birds could hunt. The cliff where the cave is located and the cave itself may have been used for nesting by some of the species identified in the sample (buzzard, golden eagle scops owl, little owl).

The presence of bones of small vertebrates (that are in small number) may indicate the use of some areas of the cave as a roost, thus explaining the accumulation of pellets.

The taphonomic analysis did not reveal digested bones, therefore it is possible to exclude the capture of small birds of prey by larger raptors. On the examined bones there were no sure traces related to carnivore action, except dubious gnaw marks on two bones of barn owl and tawny owl. The other 11 gnawed bones represent 46% of all the modified bones, and since they all present other kinds of human damage, it is not possible to exclude that most of these specimens were altered by human chew marks. These mostly occurred on humerus (3), coracoid (2), ulna (2), pelvis (2), carpometacarpus (1) and radius (1). Comparing the punctures with experimental traces produced during the consumption of a hare, analogies in size (about 5 mm) and shape (ovoid but with one rectangular edge and crushing of cortical bone) have been observed with at least one of the punctures on the pelvis of golden eagle.

Although part of the bird remains may not be of anthropic origin, for example, the juvenile elements of tawny owl, that are birds nesting in the cave, probably represent animals that died of natural causes, it is possible that humans may have been the main agent for the introduction of raptor carcasses in the cave. The identification of human modifications (cut marks, impact marks, polishes, peelings and *arrachement*) on large (white-tailed eagle, golden eagle, eagle-owl) and medium sized raptors (buzzard, tawny owl) may con-

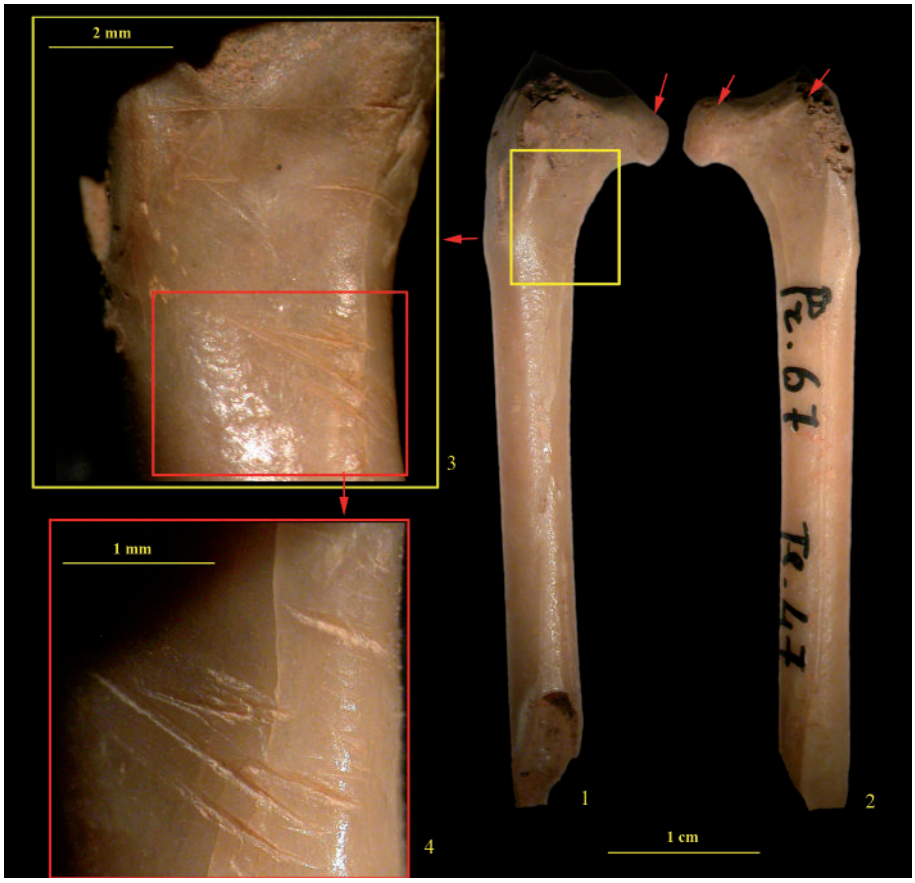

Fig. 6 - 1-2 Proximal femur of tawny owl (Strix aluco), caudal and cranial views. 3 Group of cut marks. 4 Detail. / 1-2 Femore prossimale di allocco (Strix aluco), viste caudale e craniale. 3 Gruppo di strie da strumento litico. 4 Particolare.

firm this hypothesis. Mainly traces referable to carcass portioning have been identified: disarticulation of the wings from the shoulder girdle (coracoid of goshawk), of wing portions (humerus of white-tailed eagle, scops owl, tawny owl and little owl, radius of buzzard and perhaps pallid harrier, ulna of eagle-owl and kestrel, carpometacarpus of scops owl), of the femur from the pelvis (golden eagle and tawny owl). Filleting traces have been evidenced on the ulna of eagle-owl; a particular interest in wings is indicated by the impacts and the signs of polish on the humerus of white-tailed eagle and the radius of buzzard.

In addition, localized combustion traces on long bone epiphyses, coracoid, pelvis and foot phalanges of diurnal (white-tailed eagle, goshawk, kestrel) and nocturnal (scops owl, tawny owl and eagle-owl) birds of prey, indicate the intentional division of the carcasses into small portions. It is possible that all these traces may reflect the consumption of some raptors.

However, the analysis of the anatomical regions highlights the complete absence of skulls, vertebrae and, above all, bones of the pectoral girdle (sternum, furcula, scapula) that provide the largest amount of edible meat in birds. In contrast, the wing bones appear to be particularly abundant (humerus, ulna, radius and carpometacarpus), suggesting a particular interest in this part of the body or, most likely, in the raptor remiges, possibly for ornamental purposes. Such interest, however, has already been described in the case of Middle Paleolithic sites in several European countries (Peresani *et al.* 2011).

In the second step of the research project the taphonomic study of the raptor remains from the Upper Paleolithic layer L of this cave will be completed and the results of the two layers will be compared providing a more comprehensive description of the human-raptor relationship over a period of 4000 years.

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Appendix *- Measurements (in mm) of raptor bones after Von den Driesch (1976): GL (greatest length), Bd (breadth distal end), Bp (breadth proximal end), Dp (proximal depth), Dd (distal depth), Dip (diameter of the proximal end), Did (diameter of the distal end), DiA (Diameter of the acetabulum), LV (Length along the vertebrae), Sc (smallest breadth of the corpus). Ad= adult; juv = juvenile /* ***Appendice*** *- Misure (in mm) delle ossa dei rapaci da Von den Driesch (1976): GL (lunghezza massima), Bd (larghezza distale), Bp (larghezza prossimale), Dp (spessore prossimale), Dd (spessore distale), Dip (diametro prossimale), Did (diametro distale), DiA (diametro dell'acetabulum), LV (lunghezza vertebrae), Sc (larghezza minima del corpo dell'osso). Ad= adulto; juv = giovanile.saetos)*

TAXA	ELEMENT	MEASUREMENT	AGE
White-tailed eagle (*Haliaeetus albicilla*)	Right distal humerus	Bd = 30.8	Ad
Pallid harrier (*Circus macrourus*)	Right distal radius	Bd = 6.4	Ad
Buzzard (*Buteo buteo*)	Left distal radius	Bd = 8.3	Ad
Golden eagle (*Aquila chrysaetos*)	Incomplete pelvis	LV = 11.2; DiA=16.6	Ad
Kestrel (*Falco tinnunculus*)	right distal ulna	Did = 5.9	Ad
Barn owl (*Tyto alba*)	Right ulna	GL = 93.9 Bp = 7.8 Dp = 8.1 Sc = 3.8 Did = 7	Ad
Barn owl (*Tyto alba*)	Right carpometacarpus	GL = 43.6 Bp = 9.2 Did = 7.1	Ad
Scops owl (*Otus scops*)	Left distal humerus	Bd = 7.8	Ad
Scops owl (*Otus scops*)	Left carpometacarpus	GL = 23.8;	Ad
Scops owl (*Otus scops*)	Left proximal carpometacarpus	Bp = 5.9	Ad
Scops owl (*Otus scops*)	Left tarsometatarsus	GL = 26.4 Bp = 5.6 Sc = 3 Bd = 5.7	Ad
Little owl (*Athene noctua*)	Right distal humerus	Bd = 9.1	Juv
Little owl (*Athene noctua*)	Right distal humerus	Bd = 9.9	Ad