Il Quaternario IT ISSN 039-3356
Italian Journal of Quaternary Sciences
***24** (1), 2011- 113-119*

THE ARGALI (*OVIS AMMON ANTIQUA*) FROM THE MAGLIANA AREA (ROME)

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ABSTRACT: Rozzi R., Palombo M.R. & Barbieri M., *The argali (*Ovis ammon antiqua*) from the Magliana area (Rome)*.
During the Middle Pleistocene, the fossil subspecies was widespread from Georgia to Portugal, though it is scantily recorded in local faunal assemblages of Southern Europe. Its occurrence in a few Late Pleistocene sites needs to be confirmed. In Italy, the subspecies is recorded in the late Galerian fauna of Visogliano (MIS 13 - 10) as well as in the Magliana area, where an incomplete skull was found at the beginning of the last century. Although the precise location where this specimen was found is unknown, on the basis of the results of the geochemical analysis performed on a small amount of sediment, sampled from the filling of the inner cavities of the horn-cores, and considering the stratigraphy of the area, the hypothesis that the skull comes from the deposits of the PG4 sequence (MIS14 *partim* - MIS13) cannot be ruled out. This hypothetical remark would confirm the occurrence in Italy of the argali in late Galerian faunas. The dimensions of *Ovis ammon antiqua* from the Magliana area fit well within the range of variability of the larger specimens, likely males, found at La Caune de L'Arago (France) (MIS 14-12), from which the Italian specimen differs in having less twisted and more dorso-ventrally curved horn-cores.

RIASSUNTO: Rozzi R., Palombo M.R. & Barbieri M., L'argali (*Ovis ammon antiqua*) della Magliana (Roma).
Durante il Pleistocene medio, la sottospecie fossile di argali è diffusa dalla Georgia al Portogallo ma è piuttosto rara nei giacimenti dell'Europa meridionale, mentre la sua presenza in alcuni siti del Pleistocene superiore deve essere confermata. In Italia questa sottospecie è segnalata nella fauna tardo galeriana di Visogliano (MIS 13 - 10) e nell'area della Magliana, dove, agli inizi del secolo scorso, fu rinvenuto un cranio incompleto. Sebbene il luogo esatto del ritrovamento di questo esemplare non sia noto, in base ai risultati delle analisi geochimiche effettuate sul sedimento ancora presente nei cavicchi ossei e tenendo conto dell'assetto geologico stratigrafico dell'area, non si può escludere che il cranio provenga dai depositi della sequenza PG4 (MIS14 partim - *MIS13). Questo ipotetico riferimento confermerebbe la presenza in Italia dell'argali in faune del tardo galeriano. Le dimensioni di* Ovis ammon antiqua *della Magliana rientrano nel campo di variabilità degli esemplari, presumibilmente maschi, de La Caune de L'Arago (Francia) (MIS 14-12), dai quali l'esemplare in studio, tuttavia, si differenzia per una minore torsione e una più accentuata curvatura dorso-ventrale dei cavicchi ossei.*

Key Words: argali, *Ovis ammon antiqua*, early Middle Pleistocene, Magliana, Italy,

Parole-chiave: argali, Ovis ammon antiqua*, Pleistocene medio inferiore, Magliana, Italia.*

1. INTRODUCTION

A *Ovis* species, possibly similar to *Ovis ammon*, is first reported in Europe in the Early Pleistocene of Bulgaria (*Ovis* sp., Slivnitsa, SPASSOV & CRÉGUT-BONNOURE, 1999; CRÉGUT-BONNOURE, 2005; 2007), while *Ovis ammon antiqua* was undoubtedly present in local faunal assemblages of the Middle and, possibly, Late Pleistocene (CRÉGUT-BONNOURE, 2005; 2007).

In Italy, the subspecies is reported in the late Galerian fauna of Visogliano (MIS 13 - 10, ABBAZZI *et al.*, 2000; FALGUERES *et al.*, 2008) as well as in the Magliana area (Fig. 1), where an incomplete skull was found at the beginning of the last century (PORTIS, 1917). The exact geographical location as well as the precise stratigraphical position of the latter specimen is uncertain.

The aim of this paper is twofold: 1) to provide a further morphological description of the specimen retrieved in the Magliana area; 2) to hypothesize its stratigraphical position comparing the information included in Portis' paper (PORTIS, 1917) with geological evidence from the area as well as on the basis of new geochemical data. Since *Ovis ammon antiqua* is extremely rare in Italian local faunal assemblages, a better knowledge of this specimen is useful to further detail the fossil record of the peninsula and to enhance our data on the spreading of this subspecies in southern Europe.

2. THE PUZZLING QUESTION OF THE STRATIGRAPHICAL CONTEXT: GEOCHEMICAL INFERENCES

In 1917, Portis described an incomplete skull of *Ovis ammon antiqua* (Fig. 2) that was retrieved in the Magliana area by a building worker and brought to the "Regio Istituto Geologico Universitario" of Rome by U. Rellini. Although Portis did not know exactly where this specimen was found, after a detailed analysis of the deposits cropping out at "Santa Passera", "del Truglio", "delle Piche", "dell'Infernaccio", "della Muratella" and "del Merlo" hills, he assumed the argali might have been retrieved from deposits overlaying the "Pozzolane grigie" (also called "Pozzolanelle", KARNER *et al*., 2001). If Portis' hypothesis was correct, the incomplete skull of *Ovis ammon antiqua* would have been younger than

these volcanic deposits, deriving from the explosive activity of the Alban Hills volcanism, which are dated at357 ± 2 ka (KARNER *et al*., 2001). This would imply the presence of the argali in the central Italy during MIS 10 if not at the beginning of the late Middle Pleistocene. Therefore, we have to suppose that sediments where the skull was buried in belong to a sequence not older than the PG5, but whose deposits are scantly or not present in the Fosso della Magliana area (MILLI, 1997; MILLI *et al,* 2008 and references therein).

Outcrops of "Pozzolane grigie" are actually scanty in the Magliana area, where volcanic deposits cropping out more frequently are those of the "Santa Cecilia Formation" (including two volcanic levels dated at 614 ± 15 ka and 605 ± 11 ka, KARNER & RENNE, 1998; KARNER *et al*., 2001; FUNICIELLO & GIORDANO, 2008). Moreover occasional outcrops of "Tufo Pisolitico" have been reported, which have been dated at 561 ± 1 ka (KARNER & RENNE, 1998; KARNER *et al*., 2001). Small clasts of these products, as well as volcanoclastic materials related to Sabatini activity, are contained in a few levels of the youngest high-frequency depositional sequences (PG3 and PG4), cropping out in the Magliana area (MILLI, 1997), which are characterized by upper shoreface deposits (PG3) and lacustrine-lagoonal deposits (PG4) (see MILLI, 1997; MILLI *et al*., 2008). In the study area, the sequences PG0, PG1 and PG2, which are older than the beginning of the Alban Hills volcanic activity, also outcrop in a number of quarry cuts. These sequences are mainly composed of fluvial and beach deposits.

Therefore, to clarify the stratigraphical position of the Magliana specimen, the first step was to analyse a small amount of sediment, sampled from the fillings of the inner cavities of the horn-cores, aiming to check whether its origin was continental or marine. Unfortunately no palaeontological content was found to support either of the two hypotheses.

Accordingly, geochemical analyses were performed in order to verify the presence of volcanic particles in the sediment. A representative portion of each sample was finely powdered using an agate mortar and used for chemical analysis.

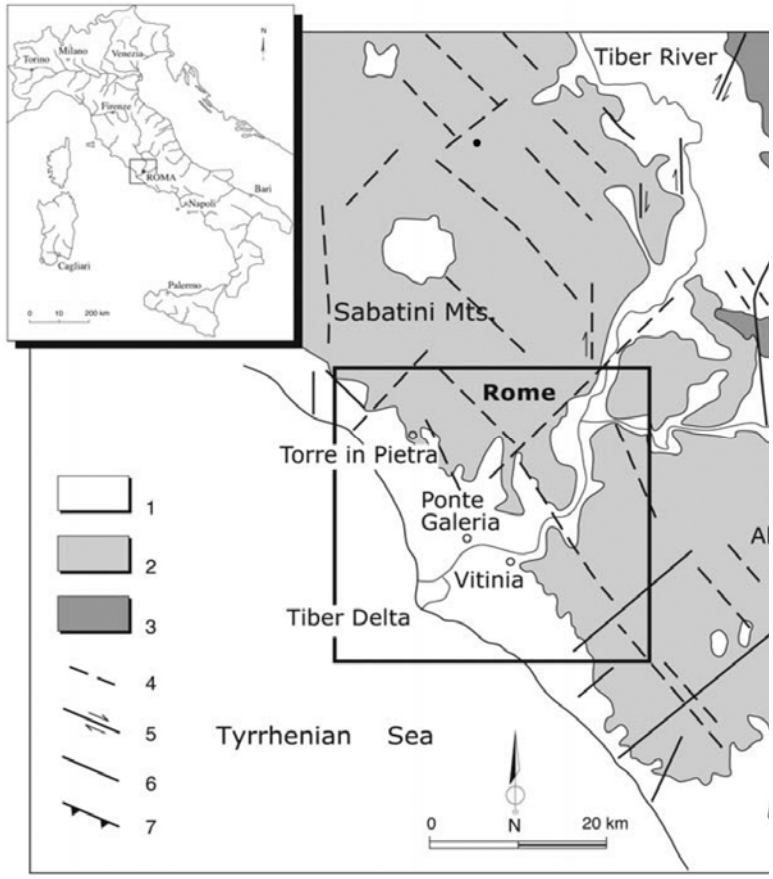

Fig. 1 - Geological sketch of the Thyrrhenian margin, Central Italy. 1) Messinian to Holocene sedimentary deposits; 2) Pliocene-Pleistocene lavas and volcanoclastic deposits; 3) Meso-Cenozoic sedimentary deposits; 4) main buried faults; 5) strike-slip faults; 6) normal faults; 7) major thrusts. The black square indicates the study area (modified after MILLI *et al.*, 2008).

Schema geologico del margine tirrenico, Italia centrale. 1) depositi sedimentari dal Messiniano all'Olocene; 2) lave e depositi vulcanoclastici del Pliocene-Pleistocene; 3) depositi sedimentari del Meso-Cenozoico; 4) principali faglie sepolte; 5) faglie trascorrenti; 6) faglie normali; 7) sovrascorrimenti principali. Il riquadro in nero indica l'area in studio (modificato da MILLI et al., 2008).

Analyses of metals were carried out using inductively coupled plasma mass spectrometer (ICP-MS) after acid total digestion (HF, HNO_3). Analytical blanks were run in the same way as the samples and concentrations were determined using standard solutions prepared in the same matrix. Results are expressed in mg/Kg (Tab. 1), except for Fe and Al, whose concentrations are expressed in percentage. The accuracy and precision of our results were checked by analysing sediment reference material.

Li	Be	B	Na	Mg	Al %	K	Ca	V	Cr	Mn	Fe %	Co
10,5	22,4	26,8	188,7	194,1	0,3	2.082,00	37,9	73	22,1	25	1,3	1,9
Ni	**Cu**	**Zn**	**As**	**Rb**	**Sr**	**Mo**	**Cd**	**Ba**	**W**	**Tl**	**Pb**	**U**
7,9	5,6	17,4	10,2	1,1	3,6	0,1	0	10,7	2,2	0,3	6,5	1,3

Tab. 1 - Concentrations of trace elements expressed in mg/Kg (except for Al and Fe, whose concentrations are expressed in percentage) and carried out using inductively coupled plasma mass spectrometer (ICP-MS).

Concentrazioni di elementi in traccia espresse in mg/Kg (tranne che per l'Al e il Fe le cui concentrazioni sono espresse in %) determinate mediante ICP-MS.

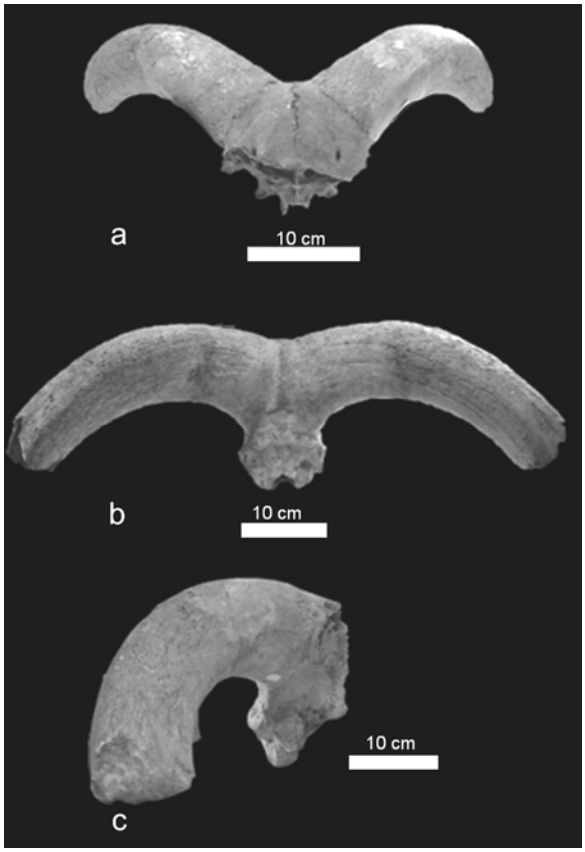

Fig. 2 - Incomplete skull of *Ovis ammon antiqua* from the Magliana area; a) frontal view; b) posterior view; c) lateral view.

Cranio incompleto di Ovis ammon antiqua *della Magliana; a) norma frontale; b) norma posteriore; c) norma laterale.*

The content of Li and K (with its vicariant elements Rb, Tl and Pb) testifies to the presence of leucite in the analysed sediment. Moreover Ba, Sr and Rb are related to pyrossens, while U, Cr and W derive from volcanic minerals in general.

Since the analysis of trace elements confirms the presence of volcanic minerals, such as micas, pyrossen and leucite at various stages of alteration in analcime or clay minerals, the skull of *Ovis ammon antiqua* found at La Magliana is at least younger than the beginning of the volcanic activity in the study area, even though we cannot confirm whether these particles are related to the "Pozzolane grigie" or not. However, considering the macroscopic similarity between the "Pozzolane grigie" and the "Tufo Pisolitico" (the first pyroclastic flow unit of the Alban Hills volcanism, DE RITA *et al.*, 1988; MARRA & ROSA, 1995), locally cropping out in the study area, the hypothesis that elements such as Li and K originated from the alteration of these older products cannot be ruled out.

The $^{40}Ar/^{39}Ar$ age of leucite in "Tufo Pisolitico" sampled at La Magliana is about 561 ± 1 ka (KARNER & RENNE, 1998; KARNER *et al*., 2001) and the deposition of this volcanic horizon is related to MIS 14 (KARNER & MARRA, 1998). All in all, we could assume that the argali skull might have been buried during or after the beginning of the "Tufo Pisolitico" deposition. Accordingly, since: the sequence boundary between the PG3 and PG4 is an unconformity surface related to a lowstand phase during MIS 14 (MILLI, 1997); the deposits of PG4 sequence widely outcrops at the top of the hills in the Fosso della Magliana area, while outcrops of PG5 sequence are scantily or not present and Portis considered the skull of *Ovis ammon antiqua* as found at La Magliana in levels whose description is consistent with the lacustrine-lagoonal deposits of the TST/HST of the PG4 sequence, we could hypothesize that the study specimen settled in a period covering the ending of MIS 14 and the beginning of MIS 13.

Accordingly, the incomplete skull of *Ovis ammon antiqua* might tentatively be ascribed to Fontana Ranuccio FU as the argali from Visogliano, though the latter could be slightly younger (see below).

On the other hand, owing to the doubt about the actual location of the finding, and taking into account the age of the oldest volcanic deposits in the area, included in the "Santa Cecilia Formation" (KARNER & RENNE, 1998; KARNER *et al*., 2001; FUNICIELLO & GIORDANO, 2008), we cannot exclude that the argali skull could be older (Isernia FU), if recovered from deposits of PG3 sequence.

3. *OVIS AMMON ANTIQUA* FROM MAGLIANA IN A WESTERN EUROPEAN CONTEXT: COMPARISONS AND REMARKS

The argali is mainly recorded in Europe during the Middle Pleistocene, geographically ranging from Georgia to Portugal (CRÉGUT-BONNOURE, 2005), though scanty remains close to the species have been reported in the Early Peistocene local faunal assemblages of Sénèze, Slivnitsa and Apollonia I (KOSTOPOULOS, 1996; SPASSOV & CRÉGUT-BONNOURE, 1999; CRÉGUT-BONNOURE, 2007). Its occurrence in the Late Pleistocene (Koudaro I, Sakajia, Ortvala, Azykh, Taglar and Mezmaiskaya) needs to be confirmed (CRÉGUT-BONNOURE, 2005; 2007).

The type of the species *«Ovis antiqua»*, found at Pont-du-Château and described by Pommerol in 1880 (POMMEROL, 1880), might be regarded as penecontemporaneous with the argali specimens from La Caune de L'Arago (CRÉGUT-BONNOURE, 2007). It comes from levels whose faunal content might be tentatively related to the so-called G3 western Mediterranean faunal complex, to which early Middle Pleistocene LFAs referable to French MN 23, Spanish MmQ3 (in part) ''zones'', and Italian Fontana Ranuccio FU (late Galerian) have been ascribed (see PALOMBO, 2010 and references therein).

The richest samples of *Ovis ammon antiqua* come from La Caune de L'Arago (MONCHOT, 1998; RIVALS, 2004), where 12,771 remains were retrieved from levels of the middle complex (MIS 14-12) (MOIGNE *et al*., 2006; RIVALS *et al.*, 2008 and references therein). The specimens found in the two levels don't show remarkable morphological and biometrical differences. The morphology of the skull and teeth of the specimens found at La Caune de L'Arago is consistent with the type of the species (RIVALS, 2004; MOIGNE *et al*., 2006).

The incomplete skull from La Magliana (Fig. 2) shows some peculiarities in comparison with the remains of *Ovis ammon antiqua* found at La Caune de L'Arago (Fig. 3) and with the type of the species retrieved at Pont-du-Château (Fig. 4).

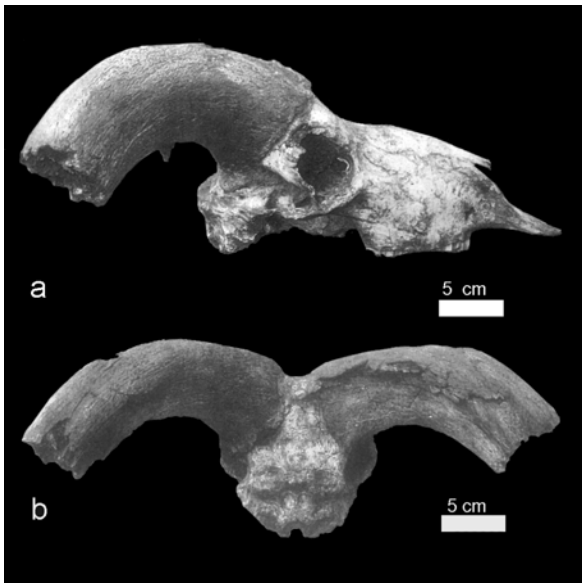

Fig. 3 - Skull of *Ovis ammon antiqua* from La Caune de l'Arago; a) lateral view; b) posterior view (modified after RIVALS, 2004).

Cranio di Ovis ammon antiqua *da La Caune de l'Arago; a) norma laterale; b) norma posteriore (modificato da RIVALS, 2004).*

In the posterior view, the Italian skull differs from the French ones in having squat, less twisted and larger horn-cores relative to the braincase (Figs. 2b, 3b, 4b). Moreover, the occipital bone of the specimen found at La Magliana shows a squared outline, as the specimens from La Caune de L'Arago, but clearly differing from the type specimen characterized by a rounded and compressed shape of this region. Since the dimensions of the remains coming from Pont-du- Château (POMMEROL, 1880) and La Caune de L'Arago are rather similar (RIVALS, 2004; MOIGNE *et al*., 2006), the differences in the morphology of the horn-cores and of the occipital area cannot be explained in terms of sexual dimorphism, but could be related to intraspecific variability.

In the lateral view, a more pronounced dorso-ventral curvature and a minor constriction of the horn-cores characterize the Italian skull (Figs. 2c, 3a, 4c). Since different morphotypes, in particular in the horn-cores, have been recognized in the extant argali and mouflon (FISCHER *et al.*,1983), these differences, as well, could be related to intraspecific variability.

The differences in morphology are confirmed by biometrical data, indicating that the occipital region is slightly more vertically elongated in the specimen from La Magliana than in the argali from La Caune de L'Arago.

Despite such differences, the skull found at La Magliana shares a broad similarity in shape and proportions with the specimens used for comparison. In particular, the dimensions of the horn-cores fit well within the range of variability of the larger specimens, likely males, found at La Caune de L'Arago (MONCHOT, 1998; RIVALS, 2004) (Fig. 5).

4. CONCLUDING REMARKS

The results obtained on the one hand show that the morphology and biometry of *Ovis ammon antiqua* skull from La Magliana fall within the range of variability of the males found at the French site of La Caune de L'Arago (Corbières Massif) in the stratigraphic unit CM1 (about 570 to 530 ka), CM2 (about 530 to 480 ka), and CM3 (about 480 to 400 ka) of the Middle Complex CM, whose faunas have been correlated with the Italian local faunal assemblages (LFAs) of Isernia (middle Galerian) (CM1), and Fontana Ranuccio (late Galerian) (CM2 and CM3) (DE LUMLEY *et al.*, 1984; MOIGNE *et al.,* 2006); on the other hand they confirm that the La Magliana specimen is younger than the beginning of the volcanic activity in the area, but they do not enable us to unequivocally determine its stratigraphical position.

Assuming that *Ovis ammon antiqua* was found in the PG4 deposits, this means that the argali was present during the late Galerian not only in the north-eastern corner of the Italian peninsula (Visogliano, ABBAZZI *et al.*, 2000), but also in central Italy, albeit in different climate and environmental conditions.

The extant argali sheep inhabits mountainous areas in central Asia at elevations above 1000 m, though

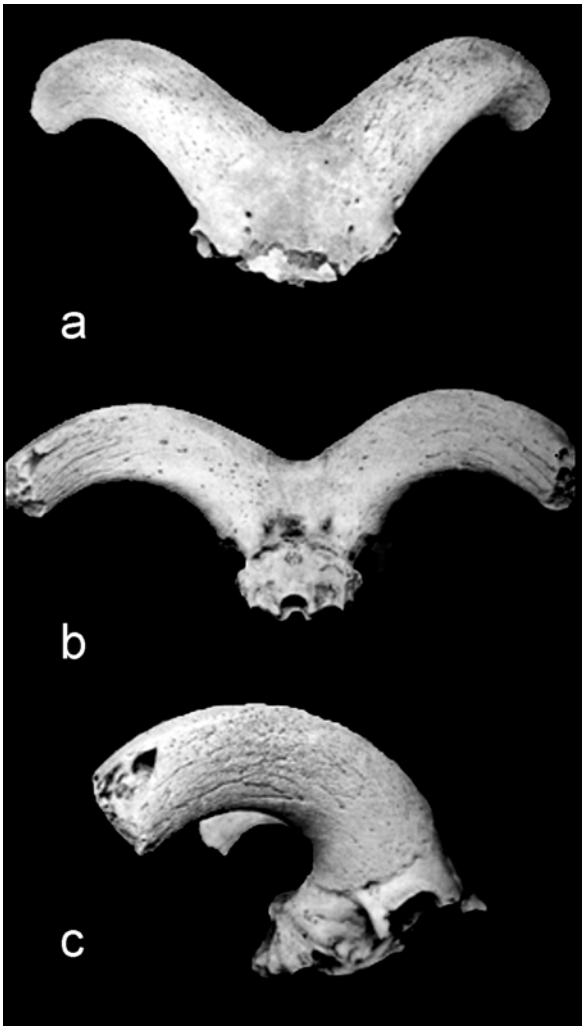

Fig. 4 - Type of the species <<*Ovis antiqua*>> from the Pommerol collection; a) frontal view; b) posterior view; c) lateral view (modified after CRÉGUT-BONNOURE E. & GUÉRIN C., 1996).

Tipo della specie <<Ovis antiqua>> *dalla collezione di Pommerol; a) norma frontale; b) norma posteriore; c) norma laterale (modificato da CRÉGUT-BONNOURE E. & GUÉRIN C., 1996).*

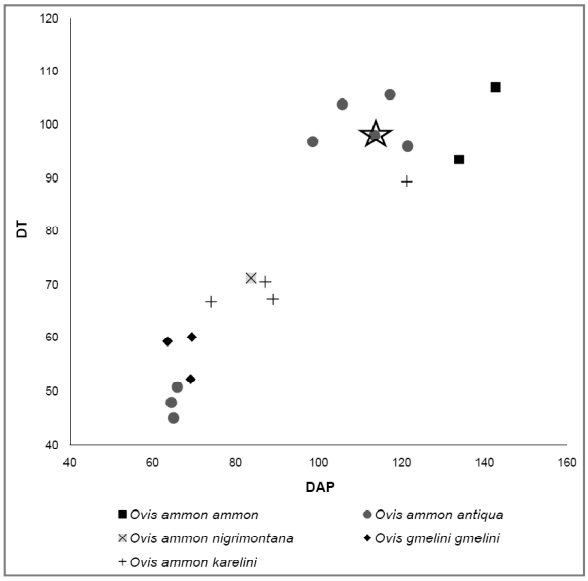

Fig. 5 - Scatter diagram comparing the transverse diameter (TD) and the antero-posterior diameter (APD) of the horn-cores of both extant and extinct species of the genus *Ovis*. The grey point marked with a star corresponds to *Ovis ammon antiqua* from La Magliana. Measurements from Rivals, 2004, except for the studied specimen.

Grafico a dispersione che mette in relazione il diametro trasverso (DT) ed il diametro antero-posteriore (DAP) dei cavicchi ossei di specie sia fossili che attuali del genere Ovis. Il punto grigio circondato da una stella corrisponde all'esemplare di Ovis ammon antiqua della Magliana. Misure tratte da Rivals, 2004 e originali per l'esemplare in studio.

they are not good mountain-dwellers, and prefer slightly sloping areas and open temperate-cold environments dominated by grasses, with very few trees present on the landscape (CLARK, 1964; SHACKLETON & SHANK, 1984; GEIST, 1991).

The preferred habitat of the European fossil subspecies would not have been so different, except for elevation, as inferred, for instance, by the environmental context of both late Galerian sites of Visogliano (northeastern Italy) (CATTANI *et al.*, 1991; ABBAZZI *et al.*, 2000; AROBBA *et al.*, 2004; FALGUERES *et al.*, 2008) and La Caune de l'Arago (France) (FALGUERES *et al.*, 2004; MOIGNE *et al.*, 2006; RIVALS *et al.,* 2008 and references therein).

At Visogliano, argali remains come from deposits of the middle and upper part (layers 39-11) of shelter A, which were deposited during cold climatic phases, while the species is absent in the lower levels (39-45), deposited during a warm and moist period (AROBBA *et al.*, 2004). According to FALGUERES *et al.*, 2008, available data might indicate that the lowest levels possibly deposited during the Marine Isotope Stage MIS 13 or that the ''cold'' levels (levels 11-39) could be correlated with MIS 12 and 10, while MIS 11 would be largely eroded, contrary to what has already been suggested by various authors (see e.e. ABBAZZI *et al.*, 2000; AROBBA *et al.*, 2004). The estimated ages of levels 38-24 range between 445 and 383 ka, suggesting that these layers were deposited shortly after the lowest ones, holding human remains, in spite of the change in climate conditions and faunal content, differentiating layers 45-40 and 39-24. Whatever the age of the levels yielding *O. ammon antiqua* remains, they reasonably deposited during a climate worsening phase. Accordingly, the argali was present in the North-Eastern Italy in quite cold and arid periods, when grasses expanded, forest reduced, and steppe taxa such as *Ochotona, Citellus*, *Microtus gregalis* and *Equus* were present, while more temperate species such as *Dama clactoniana*, *Sus scrofa, Macaca* and *Crocidura* declined or disappeared (ABBAZZI *et al.*, 2000).

At La Caune de L'Arago, the stratigraphical unit CM3, correlated with MIS 12, shares with Visogliano a few similarities in radiometric data and faunal assemblages (FALGUERES *et al.*, 2004; 2008; MOIGNE *et al.,* 2006). In the faunal assemblage, *O. ammon antiqua* is present together with some open environment dwellers (e.g. *Equus, Hemitragus, Rupicapra, Praeovibos, Bison priscus*) and "cold" species such as *Rangifer tarandus,* but forest dwellers (e.g. *Lynx*, *Felis silvestris)* also occur. Consistently, palynological data indicate a number of climatic fluctuations, with alternating phases of cold steppe and temperate forest (RENAULT-MISKOVSKY, 1980). Conversely, deciduous forests were present during the deposition of the stratigraphical unit CM2, correlated with MIS 13, while colder and drier conditions are documented at the time of the deposition of the stratigraphical unit CM1, correlated with MIS 14, when trees were rare and arid steppe spread (RENAULT-MISKOVSKY, 1980).

These data and, in particular, the persistence of *O. ammon antiqua* at La Caune de L'Arago during quite warm and moist phases, related to MIS 13, seem to indicate that the ecological flexibility of the argali allow it to inhabit sparsely wooded and fairly humid environments. On the other hand, a spread of forests in the Rome area is documented by the trees association (including broad-leaved trees typical of the rainy Colchic region) found in the so-called ''Tufi litoidi grigi'', the ''Peperino'' formation of Via Flaminia (Rome) (FOLLIERI, 2010), which have been recently dated at around 528 ka by means of $^{40}Ar/^{39}Ar$ (KARNER *et al*., 2001). The presence of forests in the Roman Basin at the beginning of MIS 13 raises further questions about the times of the presence of the argali in central Italy.

Additional data are needed to clarify times of dispersal towards an extent of dispersion across the Italian peninsula of *Ovis ammon antiqua*, as well as the suitable environmental context allowing to its sporadic appearence.

ACKNOWLEDGMENTS

The authors are grateful to D. De Rita and S. Milli for their useful discussion about volcanic products and the geological setting of the Magliana area, to Mario Barbieri for suggestions as to interpreting the geochemical data, and to L. Di Bella for the palaeontological analysis of the sediment filling the horn-cores. The authors thank the two anonymous reviewers for their comments to the manuscript.

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Ms. ricevuto il 25/05/2010
Testo definitivo ricevuto il 8/10/2010

Ms. received: May 25, 2010
Final text received: October 8, 2010