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A revision of medium and small sized deer from the Middle and Late Pleistocene of Calabria and Sicily

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ABSTRACT – The remains of *Megaceroides calabriae* from Middle Pleistocene deposits at locality Bovetto (Southern Calabria) and of *Megaceroides carburangelensis* from the late Middle and Late Pleistocene locality Cimillà (South-eastern Sicily) are revised. These deer were considered as endemic species of strongly reduced size, related to genus *Megaceroides* (=Praemegaceros), which evolved in insular environment similarly to the endemic megaceroids from Sardinia, Corsica and Crete, *M. cazioti* and *M. cretensis*. The comparison of *M. calabriae* and *M. carburangelensis* with representatives of genera *Megaceroides* and *Dama*, carried out in the present study, shows that the Calabrian and Sicilian deer belong to *Dama*. In particular the Calabrian form is comparable with *D. dama tiberina*, a fallow deer documented in the Italian peninsula during the late Middle Pleistocene (isotopic stage 7 of the $\delta^{18}\text{O}$ stratigraphy). The results of the present study other than the systematics of Italian cervids involve also the Pleistocene paleobiogeographic reconstructions of Southern Calabria and Sicily. Therefore a new hypothesis which takes into account the new systematic position of Calabrian and Sicilian deer is proposed.

RIASSUNTO – [Una revisione dei cervidi di media e piccola taglia del Pleistocene Medio e Superiore della Calabria e della Sicilia] – Vengono revisionati i resti attribuiti a *Megaceroides calabriae* dalla località Bovetto (RC) della fine del Pleistocene Medio e a *M. carburangelensis* da Cimillà (Sicilia sud-orientale; Pleistocene Superiore). Questi cervidi sono stati considerati in letteratura come specie endemiche di taglia fortemente ridotta, appartenenti al genere *Megaceroides* (=Praemegaceros), evolutisi in ambiente insulare analogamente ai megacerini endemici di Sardegna, Corsica e Creta. Il confronto dei cervidi calabresi e siciliani con i rappresentanti dei generi *Megaceroides* e *Dama*, effettuato nel presente lavoro, evidenzia come questi appartengano in realtà al genere *Dama*. In particolare la forma calabrese è confrontabile con *Dama dama tiberina*, un daino documentato nella penisola italiana durante la parte alta del Pleistocene Medio (stadio 7 della stratigrafia isotopica dell'ossigeno). Dai risultati emersi nel presente studio, emerge la necessità di rivedere le ipotesi di ricostruzioni paleobiogeografiche della Calabria meridionale e della Sicilia durante il Pleistocene.

INTRODUCTION

The opportunity to revise the generic and specific status of the small and medium sized deer from Calabria and Sicily has emerged in the course of the study, still in progress (Abbazzi *et al.*, in progress), of the remains of a rich population of a small sized deer from the late Middle and Late Pleistocene deposit of Cimillà locality (Hyblean Plateau, south-eastern Sicily), previously referred to *Megaceroides carburangelensis* (De Gregorio, 1925) by Bonfiglio *et al.* (1993).

Two species of endemic cervids are known in the “*Elaphas mnaidriensis* faunal Complex” of Sicily, late Middle and Late Pleistocene in age. The former is a red deer, of moderately reduced size, which is considered either a distinct species, *Cervus siciliae* Pohlig 1893 (Azzaroli, 1962), or a subspecies of red deer, *Cervus elaphus siciliae* (Caloi & Palombo, 1994; Gliozzi *et al.*, 1994). Another cervid of smaller size is very common in the Sicilian sites and is sometime associated with the red deer (cf. Gliozzi *et al.*, 1994; Di Maggio *et al.*, 1999). This deer has been referred to the genus *Cervus* (De Gregorio, 1925), to *Dama*

(Fabiani, 1928; Vaufrej, 1929; Maugeri Patanè, 1929; Kotsakis, 1979; Burgio & Di Patti, 1990), or to *Megaceros* or *Megaceroides* (=Praemegaceros) (Caloi, 1973; Silvestrini, 1974-75; Gliozzi & Malatesta, 1982; Bonfiglio *et al.*, 1993; Agnesi *et al.*, 1997).

The deer remains found in the locality Bovetto, (Southern Calabria, Bonfiglio, 1972), recovered in the lower levels of littoral deposits referred to the Eutyrrhenian (oxygen isotopic stage 5e of the $\delta^{18}\text{O}$ stratigraphy), are very important in order to clarify the systematics of Sicilian small deer. On the basis of comparisons with the remains from Capo Tindari cave (north-eastern Sicily) referred to *Megaceros* cf. *messinae* (Pohlig, 1909) by Caloi (1973) and Silvestrini (1974-75), Bonfiglio (1978) identified the fossil deer from Bovetto as *Megaceros* (*Megaceroides*) *calabriae*. *M. calabriae* was considered by the same Author a dwarfed species belonging to the *M. verticornis* group and the larger sized, lesser endemised forerunner of the Sicilian species. The same conclusions were achieved by Gliozzi & Malatesta (1982), who revised the material from Capo Tindari and from other Sicilian localities. The Authors referred

these remains to *Praemegaceros* (*Notomegaceros*) *carburangelensis* (De Gregorio, 1925). They rejected the validity of the name *M. messinae* since in their opinion the type material of this species, represented by a single fragment of antler from Puntali Cave (Pohlig, 1909) no longer available, does not show the features which occur in the richly figured *Cervus elaphus* "F.a" *carburangelensis* (De Gregorio, 1925).

In the following literature, the remains of this small sized Sicilian deer were generally referred to *Megaceroides* [= *Praemegaceros*] (*Notomegaceros*) *carburangelensis*. Nevertheless, Burgio & Di Patti (1990), Burgio (1997), Burgio *et al.* (1998), showed that evidence of the occurrence of *Dama* in the Sicilian Pleistocene faunal assemblages does exist, and underlined the need to review all the fossil remains belonging to *Megaceroides carburangelensis*. Indeed, Bonfiglio (1978), Gliozzi & Malatesta (1982) and Caloi & Palombo (1994) observed that the Sicilian and Calabrian species differ in several features from the other Mediterranean endemic megalocerines *M. cazioti* and *M. cretensis*. Gliozzi & Malatesta (1982) report that the proportions of limb bones and of vertebral column of the Sicilian species are closer to *Dama* than to *Megaceroides cazioti* and *M. cretensis*. Caloi & Palombo (1994) and Bonfiglio *et al.* (2000) too, stressed the morphological similarity of *M. carburangelensis* with *Dama*, interpreting it as the result of convergent evolution and of an adaptation to Mediterranean environment.

THE GENERIC STATUS OF SICILIAN AND CALABRIAN DEER

In the present revision, the comparisons are restricted to genera *Megaceroides* and *Dama* since on morphological basis they are the only potential fore-runners of the Calabrian deer and of its Sicilian relative. Both continental and endemic *Megaceroides* species, fossil and recent samples of *Dama* have been considered, taking into account the more recent literature (Abbazzi, 1995a, Abbazzi & Masini, 1997; Di Stefano, 1995, Di Stefano & Petronio, 1997; Lister, 1986, 1993, 1996; Pfeiffer, 1995, 1997, 1998). Description and comparisons are limited to features of antlers, skull and dentition since they are suitable for the purpose of this study.

DESCRIPTION

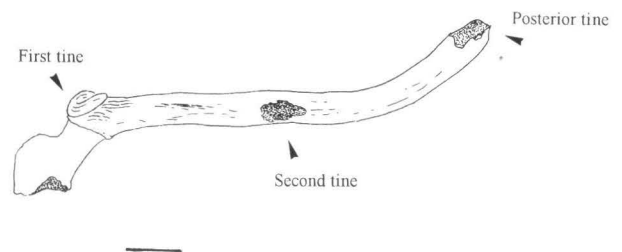
The description of "*M. carburangelensis*" is based on original data from the Cimillà sample which are part of a more detailed work still in progress (Abbazzi *et al.*, in progress) and on literature data (Gliozzi & Malatesta, 1982; Caloi & Palombo, 1994). The Bovetto deer, consisting in an incomplete antlered skull and a right maxillary, carefully described by Bonfiglio (1978), has been re-examined.

Antlers

The antlers belonging to the Cimillà deer are well developed relative to body size; they are quite divergent and oriented posterior-laterally. Divergence of beams becomes more pronounced during the ontogenesis and therefore shows a variability according to the age classes represented in the sample (see also Otsuka, 1988).

A first tine, fairly well developed, occurs in a basal and anterior-dorsal position, a second anterior tine occurs in middle position (Text-fig. 1). Above the latter tine, the beam curves becoming sub-vertical where the posterior tine springs out (not visible in Text-fig. 1); at the same time the beam has an inner side torsion (clockwise torsion in the left antler). The beam has a sub-circular cross-section at the base and is dorso-ventrally flattened in correspondence to the anterior tine. The beam becomes flat in the sub-vertical part, where a poorly developed palmation occurs. In some specimens, above the first basal tine, a fairly well developed ridge occurs up to the base of the second tine. This ridge is more pronounced in the sturdier specimens. Just above the first tine accessory points sometimes occur.

The angle formed by the first tine and the beam is variable but always greater than 100°. The basal tine is oriented at first forward and then bends laterally and gently upward. The second tine, smaller than the



Text-fig. 1 - Left antler of "*M. carburangelensis*" from Cimillà. Scale is 4 cm.

Measurements	mm	Measurements	mm
MDb	50.4	mDBa- 2t	37.2
mDb	47.5	MD 1t	26.2
MDBa-1t	36.4	mD 1t	19.7
mDBa- 1t	35.5	L-1t	200
MDBa- 2t	56.8	Dist-bpt	270

Tab. 1 - Measurement of right antler of "*M. calabriae*". Legend: MDb= maximum diameter of the burr; mDb= minimum diameter of the burr; MDBa-1t= maximum diameter of the beam above the 1° tine; mDBa-1t= minimum diameter of the beam above the 1° tine; MDBa-2t= maximum diameter of the beam above the 2° tine; mDBa-2t= minimum diameter of the beam above the 2° tine; MD 1t= maximum diameter of the base of 1° tine; mD 1t= minimum diameter of the base of 1° tine; L-1t= length of 1° tine; Dist-bpt= Distance between antler base and base of posterior tine.

first one, is inserted obliquely on the beam and forms with the distal tract of the beam an angle smaller than 90°; its cross section is variable, being in some specimens elliptic, with a variously pronounced dorso-ventral flattening. The posterior tine is inserted far from the second one.

The specimen of "*M. calabriae*" consists of an antlered braincase with frontals fragmented above the eye sockets belonging to an adult individual (Pl. 1; Tab. 1). The antlers are broken close to the third, posterior, tine, whose base is preserved on the right beam. Only the base of the second tine occurs. A well developed first tine is set very close to the burr; it is at first oriented in a fore-lateral direction forming a widely open angle with the beam, and then it curves laterally and slightly upwards. The beams are oriented posterior-laterally and in correspondence of the first tine they diverge markedly becoming sub-horizontal, then bending upwards at the insertion of the posterior tine. The section of the beams is sub-circular at the base and becomes flattened approaching to the posterior tine; a dorsal-anterior ridge occurs on the beams above the first tine. The section of the second tine is elliptic, as far as its preserved base shows. The above quoted features match closely those of the Cimillà sample, "*M. calabriae*" (Text-fig. 2) differing in the larger size (Text-fig. 3).

Skull

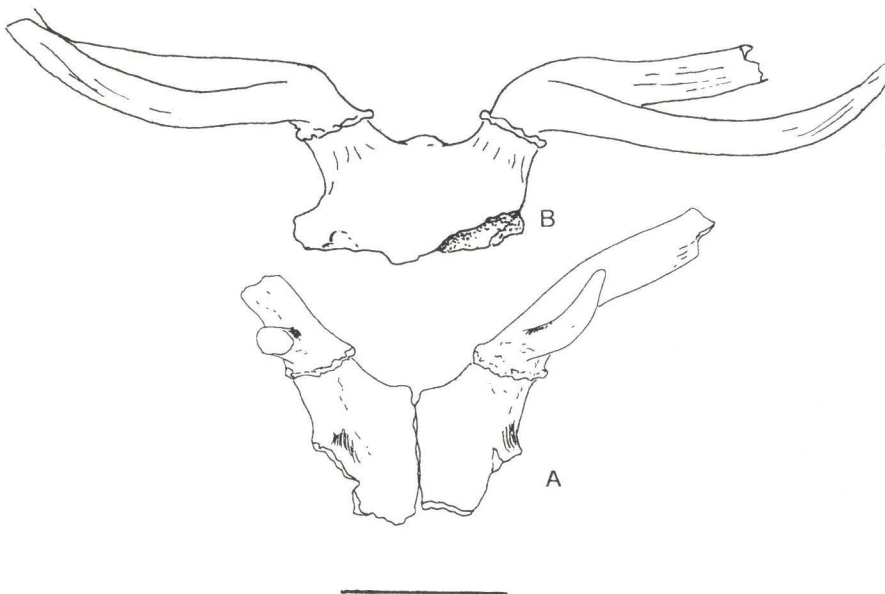
The neurocranium vault of the remains from Cimillà has a convex profile. The nuchal portion is low and wide, the nuchal ridge is protruding, the interparietal process of the supraoccipital is narrow and frontally stretched. The occipital condyles are strongly developed and posteriorly protruding. The

basioccipital is large and has a square-like shape: the muscular processes of basioccipital are poorly marked. The tympanic *bullae* are well developed. The forehead is bulged in correspondence of the sagittal suture, which is strongly protruding. Eye-sockets are large; pedicles are strong and inserted cranially; in lateral view they form an angle of about 110° with the forehead. The muzzle is short as suggested by both the shape of ascending *ramus* of prae-maxillary, which is high and short and tends to be vertical at the contact with *nasalia*, and by the short *diastema* of the mandible. The mandible is slender; the horizontal *ramus* is low and its lower profile has a weak, but sharp concavity at the height of the M/3 e M/2 contact. The *diastema* is short and robust, it is horizontally oriented relative to the alveolar part of the horizontal *ramus*. The ascending *ramus* is quite robust. It is not very high and forms an angle of about 110° with the horizontal *ramus*. The coronoid process is robust and has a variable inclination, the profile of the anterior border tends frequently to be rectilinear, rather than regularly curved.

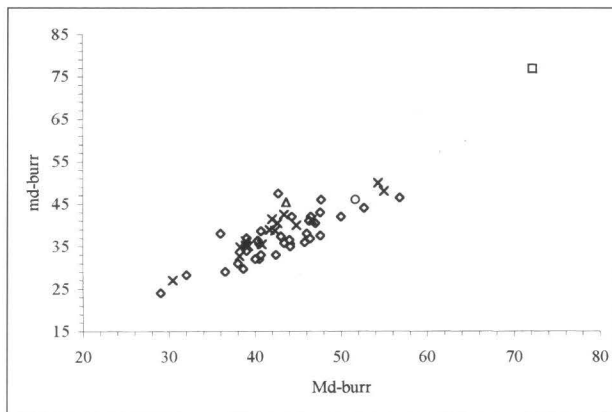
The morphology of the skull of Bovetto (Tab. 2), in what concern the neural portion and the forehead, is fully comparable to that of the Cimillà population. The neurocranium vault has a convex profile in lateral view; the forehead is bulged at the sagittal suture. The nuchal portion is wide and low; condyles are strongly developed. The pedicles are robust and divergent and have the same disposition as in the Cimillà sample (Pl. 1).

Dentition

Upper and lower teeth of the deer from Cimillà are fairly brachyodont as fallow deer. In the lower series, interlobal columns are poorly developed, the



Text-fig. 2 - Comparison of antler morphology between (A) "*M. carburangelensis*" from Cimillà and (B) "*M. calabriae*" from Bovetto. Scale is about 10 cm.



Text-fig. 3 - Scatter diagram of maximum diameter of burr (Md-burr) against minimum diameter of burr (md-burr). Legend: rhombus= "*M*". *carburangelensis* from Cimillà; circle= "*M*". *calabriae* from Bovetto; cross= Recent *Dama dama*; square= *D. clactoniana* from Riano.

cingulum is absent. Frequently, a feeble layer of dental cement occurs. Almost all P/4s are molarised; in poorly worn P/4s the ala of entoconid is separated in the upper part of crown. This character occurs, but is less developed also in some P/3s. The posterior lobe of M/3 is frequently strongly reduced to a kind of stilid. In the upper teeth, weak interlobal columns and a weak anterior cingulum occur.

The upper tooth series (Tab. 3) referred to "*M*". *calabriae* is brachyodont, molars have no interlobal columns and are characterised by a weak cingulum. P2/ is bilobate with a deep groove at the lingual wall. The size is significantly larger than that of the dentitions of the deer from Cimillà (Abbazzi *et al.*, in progress).

H	h	W	Dbp	Tdp	Apdp	Hp
78	*45	116.4	47	42.1	38	17

Tab. 2 - Measurements of skull of "*M*". *calabriae*. Legend: H= occipital height; h= height between occipital crest and upper border of *foramen magnum*; W= maximum width of occipital; Dbp= medial distance between the bases of pedicles; Tdp= transversal diameter of right pedicle; Apdp= anterior-posterior diameter of right pedicle; Hp= height of right pedicle.

Comparisons

Unravelling systematics and phylogeny of fossil mammals from insular environments is always a hard task affected by an additional amount of uncertainties and difficulties related to the endemic evolutionary modification which, in some cases may be so great to prevent the detection of the actual ancestors of endemites (see, for instance *Deinogalerix* and *Hoplitomericidae* from the Gargano paleo-archipelago, Butler, 1980; Leinders, 1984). Even though the present case is not so extreme, and the comparisons can be confidently restricted to two potential ancestors, the possibility that deep modifications can have evolved relative to the continental forerunner must always be taken explicitly into account.

Given these premises, in the following comparisons single characters have been evaluated very carefully, and differences in size, even very large ones, in principle have been considered not significant for phylogenetic conclusions.

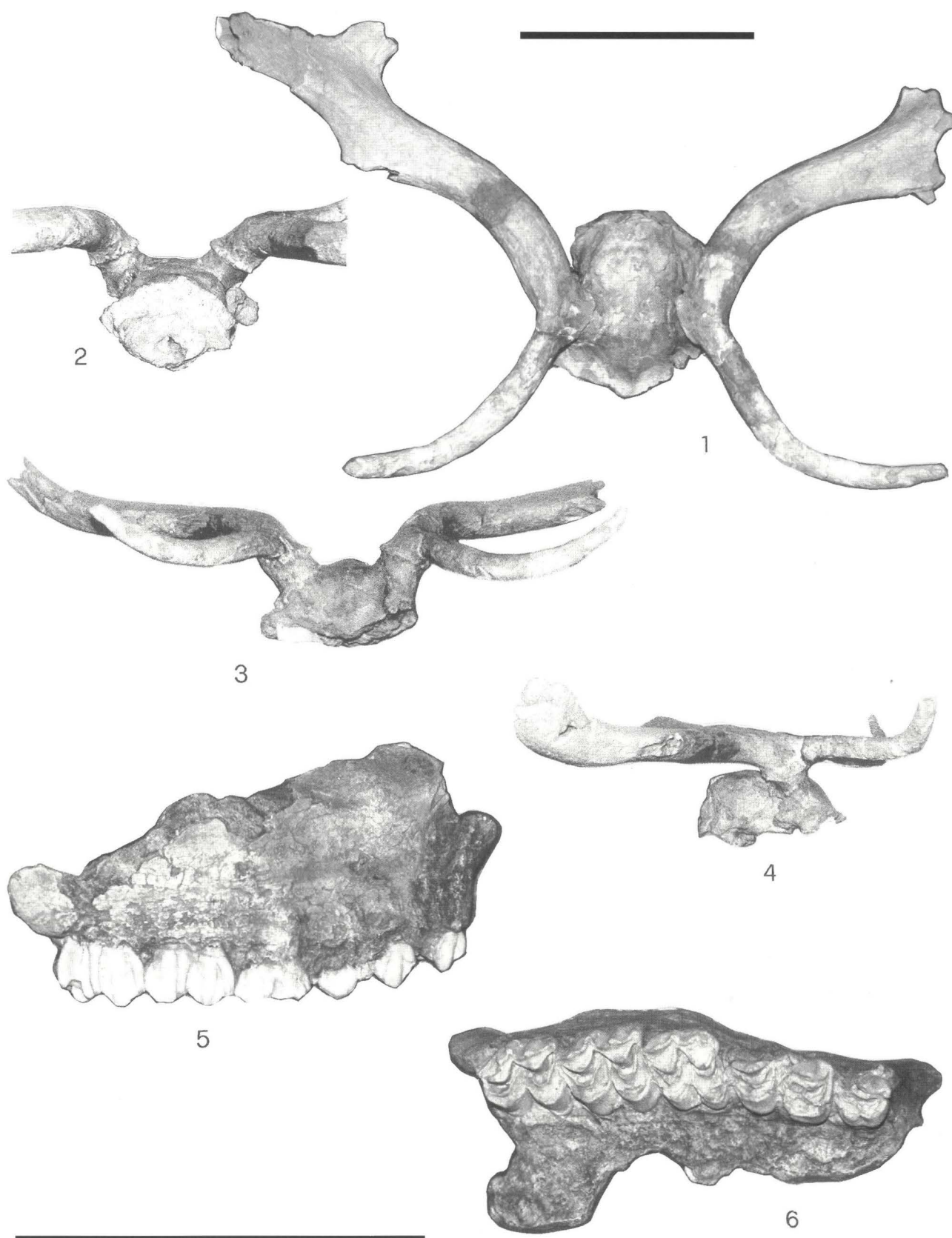
Antlers

Antlers of "*M*". *carburangelensis* have a large dimensional range and are in average slightly smaller than those of a Recent *Dama* population; the specimen from Bovetto falls close to the higher limit of the variation field of the Cimillà and Recent *Dama* samples (Text-fig. 3). The antlers of the Sicilian and Calabrian forms are relatively large respect to skull size, while, in insular *Megaceroides*, as far as can be observed in the endemic *M. cazioti* and *M. cretensis*, antlers are small respect to skull and body size and tend to display a simplified morphology (see also Azzaroli, 1962).

Antler features, *i.e.* beam orientation, number and position of tines in "*M*". *carburangelensis* and, as far as can be seen, in "*M*". *calabriae* are manifestly the same as in *Dama*. Even though the overall orientation of antlers recalls also that of *Megaceroides verticornis* and allied species, the tines in the antlers of Sicilian and Calabrian forms are not homologous to those of *Megaceroides*. The occurrence of a first tine set very close to the burr is a common trait of *Dama*. In the *Megaceroides* group the most archaic species, Early Pleistocene in age, bear two tines set in proximal position (Abbazzi, 1995a; Abbazzi *et al.*, 1999); the former is set very close to the burr and oriented downwards

EXPLANATION OF PLATE 1

- Figs. 1-6 - *Dama dama cf. tiberina* from Bovetto.
 1-4) Antlered skull in (1) dorsal view, (2) posterior view, (3) frontal view and (4) lateral view.
 Scale is 20 cm.
 5-6) Right maxillary in (5) labial view and (6) occlusal view.
 Scale is 10 cm.



Measurements	mm	Measurements	mm
OL M3\ -P2\	95.6	NL P4\	11
NL M3\ -P2\	95.2	MW P4\	-
OL M3\ -M1\	56.6	H P4\	7.3
NL M3\ -M1\	55.7	OL M1\	17.5
OL P4\ -P2\	35.9	NL M1\	16
NL P4\ -P2\	35.2	MW M1\	19.3
OL P2\	11.6	H M1\	7.7
NL P2\	9.7	OL M2\	21.5
MW P2\	9.3	NL M2\	18.4
H P2\	2.5	MW M2\	20.3
OL P3\	11.8	H M2\	11.5
NL P3\	11.4	OL M3\	20.5
MW P3\	14.6	NL M3\	20
H P3\	10.5	MW M3\	18.6
OL P4\	11.4	H M3\	11.8

Tab. 3 - Measurements of upper tooth series of "*M.* *calabriae*". Legend: OL= occlusal length; NL= neck length; MW= maximum width; H= height of the crown.

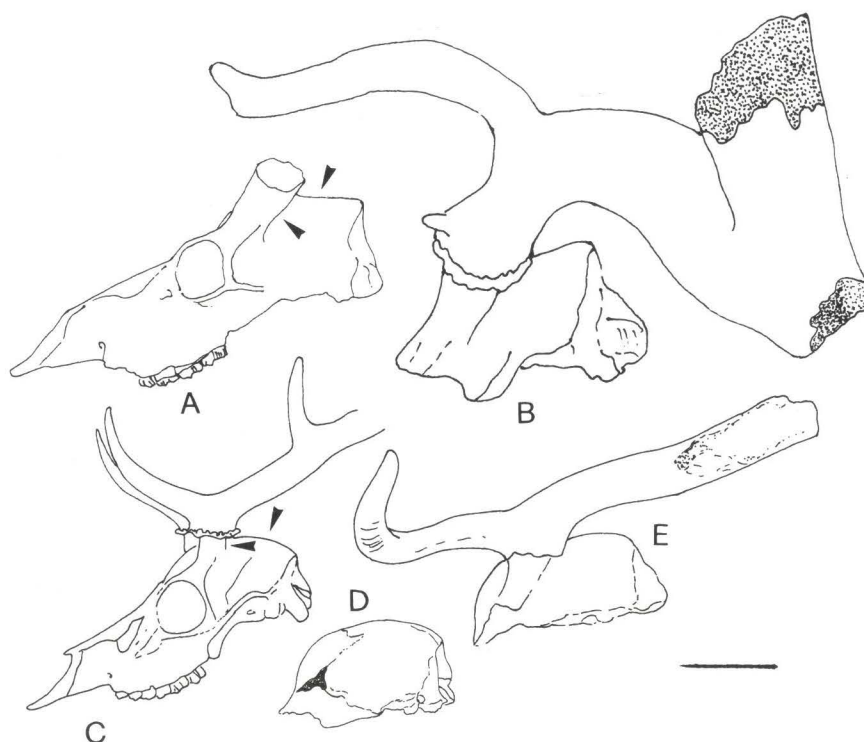
and forwards, while the latter one is inserted in dorsal position, at a certain distance from the burr. The second tine has a characteristic outline first bending forward and downwards and then medially. During the evolution of this group, a simplification of the proximal tract of antler occurs. In the late Early and early Middle Pleistocene representatives of the genus, as *M. verticornis*, the basal tine is reduced to a knob or is even absent. In *M. solilhacus*, the most derived species of this group, which occurs in the Italian localities of

Middle Pleistocene age (e.g. Isernia, Abbazzi & Masini, 1997; Venosa, Caloi & Palombo, 1979; see also Azzaroli, 1979), the second tine is absent too. Also in the endemic megalocerine *M. cazioti* and *M. cretensis*, the basal tine is lacking, while an anterior tine occurs far from the burr; this tine can be interpreted as homologous to the middle tine of the continental *M. verticornis* and *M. solilhacus*. The basal tine found in the Sicilian and Calabrian cervids cannot be considered strictly homologous either to first or second tine of *Megaceroides* because of its different insertion on the beam and its shape, while its homology to the first tine of *Dama* can be easily assumed on morphological basis.

Skull

The bulging neurocranium and forehead morphology of "*M.* *carburangelensis*" and "*M.* *calabriae*", is also observed in *Dama*. In *Megaceroides*, both continental (e.g. *M. verticornis*) and insular (*M. cazioti* and *M. cretensis*), the neurocranium roof is flattened or even slightly concave (Text-fig. 4), the forehead is flattened in the primitive species as *Megaceroides obscurus*, and tends to become convex in the derived forms as *M. verticornis*.

The morphology found in fallow deer and in the two considered Southern Italy deer can be seen as 'neotenic' and can be considered as a shared derived feature. The possibility that a megalocerine species could have achieved such a morphology by convergent evolution in Southern Italy cannot be ruled out

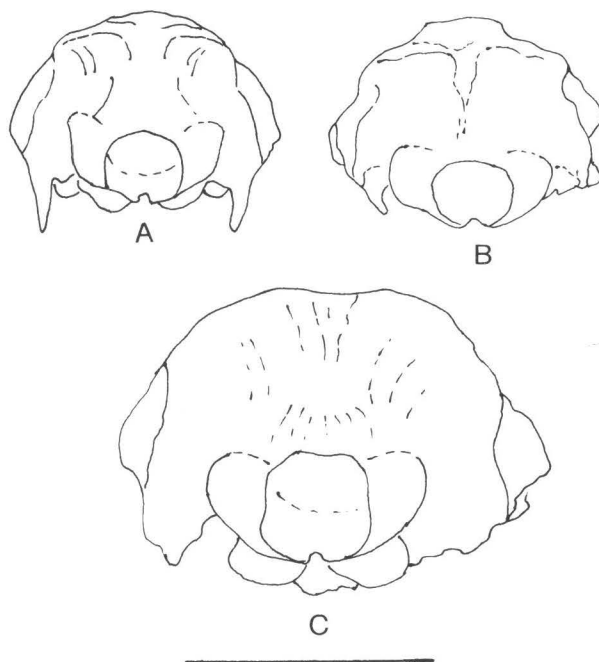


Text-fig. 4 - Comparison of skull morphology in *Megaceroides* and *Dama*. Arrows indicate the different morphology of neurocranium vault and the different insertion of pedicles, between *Dama* and *Megaceroides*. Legend: A = *Megaceroides cazioti* from Dragonara, from Caloi & Palombo (1995) redrawn and reversed; B = *Megaceroides verticornis* from Borgo Nuovo stored in the Natural History Museum (Geopaleontological section) of Florence University; C = Recent *Dama dama* stored in the Natural History Museum (Zoological section, "La Specola") of Florence University; D = "*M.* *carburangelensis*" from Cimililla, skull of a female specimen stored in the Archeological Museum of Kamarina (Ragusa, Sicily); E = "*M.* *calabriae*", holotype stored in the Department of Earth Sciences of the Messina University. Scale is 10 cm.

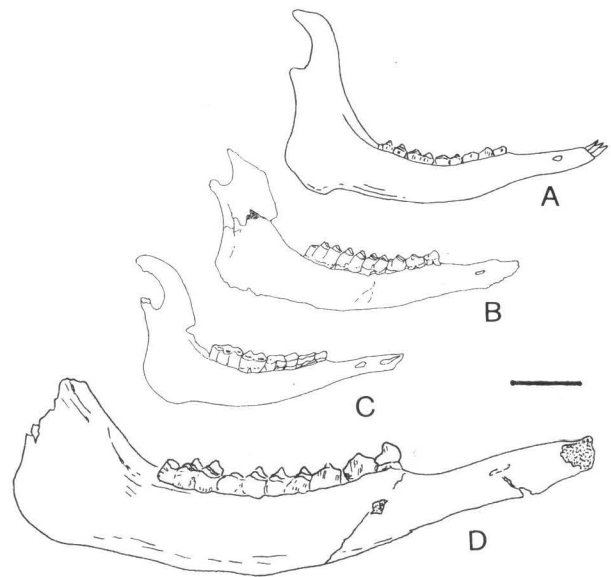
'a priori', however the fact that other insular *Megaceroides* maintain the status observed in continental forms suggests this was not the case.

The pedicles of "*M.* *calabriae*" and "*M.* *carburangelensis*" are divergent and do not lie on the same plane as the forehead, as occurs in *M. verticornis*, *M. solilhacus* and *M. cazioti*. Moreover, the pedicles are cranially inserted in "*M.* *calabriae*" and "*M.* *carburangelensis*" and in *Dama* representatives as well, while in *Megaceroides* they are set more laterally above the orbits (Text-fig. 4). These characters are observed in many Recent forms i.e. *Cervus elaphus*, *Capreolus* among the Odocoileinae, other than *Dama*. In the present context they can be considered as further evidences supporting the claim that the Sicilian and Calabrian forms do not belong to *Megaceroides*. Large orbits which are evident in "*M.* *carburangelensis*" are found in *Dama* and not in *Megaceroides*.

In the Sicilian and Calabrian species, as in *Dama*, jugular and mastoid apophyses in the occipital are relatively less developed than in *Megaceroides*, in which the latter are very strong and tend to protrude laterally, giving to this portion of skull a typical bell-shaped outline (Text-fig. 5). The latter feature, though not exhaustively documented owing to the scantiness of complete remains, is not found in



Text-fig. 5 - Comparison of occipital morphology in *Megaceroides* and *Dama*. Legend A = Recent *Dama dama* stored in the Natural History Museum (Zoological section, "La Specola") of the Florence University; B = *Dama carburangelensis* from Cimillà; C = *Megaceroides verticornis* from Voigtstedt stored in the Forschungsinstitut und Museum Senckenberg, Forschungsstation fuer Quartaerpalaeontologie of Weimar. Scale is 10 cm.



Text-fig. 6 - Comparison of mandible morphology in *Megaceroides* and *Dama*. Legend: A= Recent *Dama dama* B= *Dama carburangelensis* from Cimillà; C= *Megaceroides cretenensis* from Malatesta (1980), modified; D= *Megaceroides solilhacus* from Azzaroli, (1979), redrawn and reversed. Scale is 4 cm.

another deer groups and can likely be considered an autoapomorphy for the *Megaceroides* genus. The possibility it could have returned to its primitive status in the Sicilian and Calabrian deer seems highly improbable, given also that it is preserved at least in the insular *M. cazioti*.

Another shared feature of Sicilian and Calabrian forms is the shape of occipital condyles which are very protruding posteriorly. This character is not found in Recent fallow deer while it occurs in both late Middle and Late Pleistocene *Dama* and in *Megaceroides*. This character has likely a functional significance linked to the large size of antlers and to their widely divergent orientation. Its use for phylogenetic remarks is therefore limited.

Also the mandible is similar to *Dama*. The slenderness, the profile of the ventral border, the almost horizontal diastema are characters found in *Dama* while in *Megaceroides* the horizontal ramus is stronger and regularly curved up to the diastema, the angular process of ascending ramus is more robust (Text-fig. 6). The lack of pachyostosis found in the Sicilian sample is indeed a primitive character shared by many deer. Within *Megaceroides* the occurrence of pachyostotic mandibles is commonly documented in both continental and insular species (e.g. *M. cazioti* from Dragonara, cf. Caloi & Palombo, 1995; *M. cretenensis*, cf. Malatesta, 1980) since the Middle Pleistocene and is a derived character for the genus. Its absence in "*M.* *carburangelensis*" is a further evidence to exclude it belongs to *Megaceroides*.

Dentition

Dental morphology provides weak support for generic attribution of the deer considered. However, some characters, as the low hypsodonty, the frequent occurrence of highly molarised P/4, the shape of P/4 in which a deep groove between hypoconid and protoconid occurs, further link the Sicilian species to *Dama*. In *Megaceroides*, on the other hand, P/4 shows a variable degree of molarisation and, in occlusal view, its labial side has a characteristic hemi-circular profile. The detached entoconid in P/4s and in rare P/3s of the Sicilian population is frequently observed in *Dama* (Lister, 1986, 1996) and is an unusual feature in *Megaceroides* (few cases for instance in *M. verticornis* from Süssenborn, Kahlke, 1956-59).

The comparisons reported above show that the two considered cervids display derived characters which occur in *Dama* and not in *Megaceroides* (e.g. bulged neurocranium and frontals, cranially inserted pedicles forming an angle slightly greater than 90°, large orbits and antlers morphology), while they lack apomorphic features of *Megaceroides*, as the absence of basal tines, the pachyostotic mandible and the laterally protruding mastoid apophyses. It can be therefore concluded that the Calabrian and Sicilian deer belong definitely to *Dama*.

The disposition of antlers in the Sicilian and Calabrian deer is found not only in *Megaceroides* and *Dama*, but also in deer characterised by relatively large size antlers, as *Megaloceros* (e.g. *M. giganteus*) and some palmated *Cervus elaphus* populations (Abbazzi, 1995b). It is therefore evident that this feature underwent convergent evolution in Cervidae (see Vislobokova, 1990 for its functional meaning).

THE SPECIFIC STATUS OF *DAMA* FROM SICILY AND CALABRIA

The results of the comparisons lead to reconsider the specific status of Sicilian and Calabrian fallow deer. The occurrence of some endemic traits (*i.e.* smaller body size relative to the continental form, strongly reduced third lobe of M/3, etc.) suggests the opportunity to maintain a different taxonomic status at species level for *D. carburangelensis*. However, we prefer to deal with the formal revision of Sicilian deer in a following work (Abbazzi *et al.*, in progress).

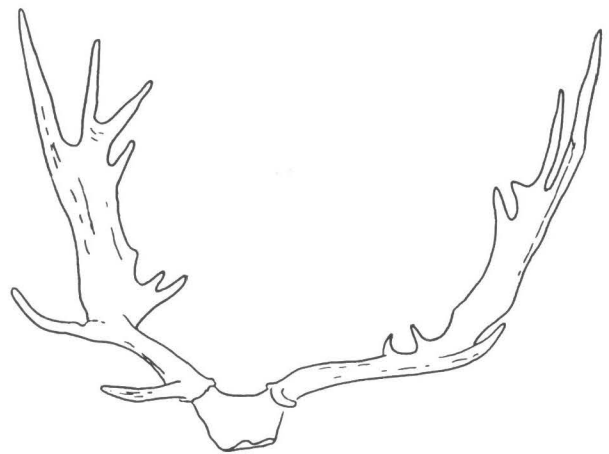
A more immediate and significant topic, for its stratigraphical and paleobiogeographical implications, is instead the revision of the status of the Bovezzo deer. Since it is evident that this fallow deer does not show endemic features, and taking also into account its late Middle Pleistocene - early Late Pleistocene age, it has been compared with Italian and European Middle and Late Pleistocene *Dama* species and subspecies.

There is a general agreement in the literature that genus *Dama* is firstly documented in Europe by

Dama clactoniana (or *Dama dama clactoniana* according to Lister 1986, Pfeiffer, 1999) since the beginning of Middle Pleistocene (Lister, 1986; Azanza & Sanchez, 1990). The last occurrence of this species is recorded in localities correlated with the IOS 9 (see also Lister, 1984) or 7 (Di Stefano & Petronio, 1997). The occurrence of the first representatives of modern fallow deer is recorded in the upper part of the Middle Pleistocene (IOS 7).

D. clactoniana, a widespread taxon in the European localities, is characterised by larger size than modern *Dama dama*, overlapping the dimensional range of the red deer. It shows antlers less diverging and with a narrower palmation than *Dama dama*; palm tines are set on the anterior border and not in the posterior as in *Dama dama*. The anterior part of the facial skull is longer than *Dama dama* (cf. Leonardi & Petronio, 1976, direct observation on *D. clactoniana* from Riano, Latium, stored in the Paleontological Museum of the Department of Earth Sciences of "La Sapienza" University, Rome).

The oldest representatives of *Dama dama*, which have been referred to various subspecies, show an intermediate size between *Dama clactoniana* and the Late Pleistocene populations of *Dama dama dama*. Di Stefano & Petronio (1997) refer to *Dama dama tiberina* the material found in Central Italy sites, of late Middle Pleistocene age (IOS 7). According to these Authors, this form is characterised by strongly developed tines set on the posterior border of the palmation, and, in the dentitions, by lesser developed cingulum relative to *Dama clactoniana*, but larger than *Dama dama dama*. These features are considered as derived respect to *Dama clactoniana* and closer to *Dama dama dama*. Pfeiffer (1997, 1998) described some populations of *Dama dama* from Germany, correlated to IOS 7 and 5e, attributed to *D. dama geise-*



Text-fig. 7 - *Dama dama tiberina* Di Stefano & Petronio from Ponte Molle type locality. From Di Stefano & Petronio, (1997) redrawn. About 1/10 of natural size.

liana. This subspecies is characterised, beyond the larger size relative to Recent fallow deer (more than 15%), also by highly divergent antlers, ("remnescent of *Megaloceros*"), strongly developed first tine, and by the occurrence of secondary knobs in the proximal part of the beam, above the basal tine. *D. dama geiseliana* appears more derived than *D. dama tiberina* for what concern the palmation, which is larger and with lesser developed tines. These differences could justify the subspecific distinctions between *D. dama geiseliana* and *D. dama tiberina*.

THE FALLOW DEER FROM BOVETTO

Family CERVIDAE Gray, 1821

Subfamily CERVINAE Baird, 1857

Genus DAMA Frisch, 1775

Species DAMA DAMA (Linneus), 1758

Subspecies DAMA DAMA cf. TIBERINA Di Stefano & Petronio, 1997
Pl. 1, figs. 1-6

1978 *Megaceros (Megaceroides) calabriae* BONFIGLIO, p. 87; figs. 2-3, 5-8.

1981 *Megaceroides calabriae* - BONIFAY, p. 112.

1982 *Praemegaceros (Notomegaceros) calabriae* - GLIOZZI & MALATESTA, p. 340.

The direct comparisons with the material referred to *D. dama tiberina* from Ponte Molle (type locality; Text-fig. 7) show that the antlered skull from Bovetto shares several characters with this form, namely strongly divergent and horizontally oriented beams, well developed first tine laterally oriented, and forming with the beam a very obtuse angle, narrow palmation, as far as can be inferred by its preserved base on the right antler. In the skull of both forms, pedicles are robust, the occipital is wide and low, with very protruding condyles. Regarding dentitions, the scarcely developed dental cingulum and interlobal columns in *Dama dama tiberina* are found also in the Bovetto material, however the systematic relevance of these characters, in particular of the development of entostyles/ectosylids is not clear.

On the other hand, the specimen from Bovetto differs from *Dama clactoniana* (direct comparison with the *D. clactoniana* from Riano and with literature data) in the more divergent antlers in the proximal part, more developed first tine, wider and lower occipital, and in the smaller size of skull and antlers. The wide and low occipital with protruding condyles, though a feature with a functional meaning, does not occur in *D. clactoniana*; strong proximal divergence of antlers is commonly found in the first representatives of modern fallow deer occurring at the IOS 7 and 5e, while it is lesser pronounced in *D. clactoniana*. The occurrence of very developed first tines which are set close to the burr and form an open angle with the beam is well documented in *Dama dama* populations of latest Middle Pleistocene age, while in *D. clactoniana* this tine is usually less developed and forms with the beam a more variable angle. Though these characters, individually taken, may be present in some *D. clactoniana* specimens, their joint occurrence in the latest Middle Pleistocene populations of *Dama dama* allow us to consider them as reliable features for recognising these forms on purely phenetic basis (Tab. 4).

From the above discussion it results that the Bovetto fallow deer is unlikely to belong to *D. clactoniana*, while it is closer to *D. d. tiberina*, among the described subspecies of *Dama dama*. This conclusion is supported also by the fact that the chronological position of the Bovetto *Dama* falls within the stratigraphic range of *D. d. tiberina*, and that southern Calabria is close to the known geographic distribution of this subspecies. However, several considerations suggest caution to classify the Bovetto fallow deer as *D. dama tiberina*, since a consistent evaluation of morphological population variability is a necessary, or at least a desired condition, when dealing with a subtle taxonomic rank as subspecies. In the present case it is worth to stress that the Bovetto fallow deer is represented only by two incomplete remains and the same *Dama dama tiberina* is actually known by a limited number of specimens. Thus a less definite, more 'open' classification as *Dama dama* cf. *tiberina* is preferable.

Characters	<i>D. clactoniana</i>	<i>D. d. tiberina</i>	<i>D. d. cf. tiberina</i>	<i>D. carburangelensis</i>	<i>Dama d. dama</i>
Protruding occipital condyles	?	++	++	++	-
Wide and low occipital	-	++	++	++	-
Short muzzle	-	?	?	++	+
Divergent pedicles	-	+	+	+	-
Strongly developed 1° tine	+	++	++	+	-
Poorly developed palm	+	+	?(+)	+	-
Posteriorly set palm tines	not	yes	?	yes	yes

Tab. 4 - Comparisons among the state of characters in antlers and skull of Middle and Late Pleistocene species and subspecies of *Dama*. ++, + or - mean the development degree of the characters; ? indicates a not observed character due to the fragmentary nature of the remains.

A NEW SIGHT TO THE PALEO GEOGRAPHY
AND MAMMAL DISPERSAL HISTORY
OF SOUTHERN CALABRIA AND SICILY

The results of the present revision have a certain impact on the reconstructions of the Pleistocene palaeogeographic changes of southern Calabria and Sicily.

The occurrence in southern Calabria of the supposed dwarfed megalocetine from Bovetto (actually a non endemic *D. dama* subspecies) and of a reduced sized elephant coming from Vallone Corvo site (Archi di Reggio Calabria; Bonfiglio & Berdar, 1986) was considered an evidence supporting the hypothesis of the "Calabrian Fossil island" by Azzaroli (1982). This hypothesis was sustained also by stratigraphic data from Bonfiglio (1978) and Bonfiglio & Berdar (1986) showing that, at least during the Tyrrhenian transgression, southern Calabria became isolated from the rest of the Italian peninsula in correspondence of the Catanzaro isthmus.

In a further elaboration Bonfiglio *et al.* (2000) considered the Catanzaro isthmus as the possible dispersal area (an intermittent barrier), through which at least two subsequent dispersal events occurred during the Middle Pleistocene. The former gave rise to an ancient Calabrian mammal population with medium to moderate endemic features, the latter, in a second time, involved both southern Calabria and Sicily, through a temporary connection *via* Messina Straits, permitting to species with a different degree of endemization to enter the island giving rise to the Sicilian population phase of the *E. mnaidriensis* faunal complex. In this scenario "*Megaceroides calabriae*" was thought to be a species dispersed in Calabria in the early Middle Pleistocene, which during a subsequent geographic isolation phase underwent significant endemic evolution. When in the late Middle Pleistocene Calabria and Sicily were temporarily connected, "*Megaceroides calabriae*" would have entered the island giving rise in turn the supposed "highly endemic" "*Megaceroides carburangelensis*" (Bonfiglio & Burgio, 1992; Bonfiglio *et al.*, 2000).

The attribution of the Bovetto deer to *Dama dama* cf. *tiberina* and of the Sicilian small sized deer to *Dama carburangelensis* changes some of the premises of the above scenario, particularly for what concerns the occurrence of an "ancient" insularity phase of southern Calabria, while it has a minor effect on the dispersal history which originated the *Elephas mnaidriensis* faunal complex. There is a general agreement in the recent literature concerning Sicilian mammals that the elements belonging to this faunal complex are moderately endemic taxa, closely comparable with those distributed in the Italian peninsula during the late Middle Pleistocene and first Late Pleistocene. The occurrence of a not endemic fallow deer in southern Calabria, and of its possible direct descendant *Dama carburangelensis*, a moderately

endemic fallow deer, in the *E. mnaidriensis* complex of Sicily is in good agreement with the general moderate endemic features of this complex as already suggested by Burgio (1997) and indicates that also fallow deer underwent a similar dispersal history as other taxa of the *E. mnaidriensis* Faunal Complex.

Dispersal of *D. d.* cf. *tiberina* through the Catanzaro Isthmus may have occurred late during the Middle Pleistocene emersion which followed the deposition of Plio-Pleistocene batial sediments, widely known in this area (Vrica, S. Maria di Catanzaro, Gignoux, 1913; Selli *et al.*, 1977). Possibly in a second time, still during the late Middle Pleistocene, *D. d.* cf. *tiberina* and other taxa of the *Elephas mnaidriensis* Complex dispersed to Sicily likely during the IOS 6 of the $\delta^{18}\text{O}$ stratigraphy (Bonfiglio & Burgio, 1992; Bonfiglio *et al.*, 2000).

Even though these new issues do not justify the occurrence of an 'ancient' (Middle Pleistocene) southern Calabrian paleo-island any more, nevertheless they do not exclude the possibility of a more recent insular phase (Tyrrhenian age?), as suggested by the smaller sized elephant from a little known stratigraphic series at Vallone Corvo and at the S. Francesco di Archi hill in southern Calabria too (Bonfiglio & Berdar, 1986). Stratigraphical and paleontological data from the continental gravel and sand deposits overlying the Tyrrhenian litoral deposits at the S. Francesco di Archi hill and at Ianni of S. Calogero (Ascenzi & Segre, 1971; Bonfiglio *et al.*, 1986) are to be revised. New research on the diverse mammal assemblages coming from these sites can clarify this point.

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