

## *Equus hydruntinus* from the Upper Pleistocene (MIS 4) of Calabria, Southern Italy

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**ABSTRACT** - A third lower molar of *Equus hydruntinus* and two teeth of a large bovid have been recovered at Le Castella (Calabria), in marine deposits located in the Crotone-Capo Spartivento basin and dated 62 ka B.P. (MIS 4). The teeth were associated with a rich invertebrate fauna having Mediterranean character. This is the first record of *E. hydruntinus* in Calabria, adding new data to palaeobiogeography of mammals from peninsular Italy. Because of Calabria has been a dispersal route for faunas from peninsular Italy to Sicily, the occurrence of *E. hydruntinus* allows some considerations on the connection between mainland and island during the Late Pleistocene.

**RIASSUNTO** - [*Equus hydruntinus* nel Pleistocene superiore (MIS 4) della Calabria, Sud Italia] - A Le Castella (Calabria), in un deposito marino ubicato nel bacino di Crotone-Capo Spartivento, sono stati rinvenuti alcuni denti attribuibili ad *Equus hydruntinus* e ad un bovide di grande taglia.

I denti erano associati ad una ricca fauna ad invertebrati, a carattere mediterraneo. Tra gli invertebrati, abbondano i molluschi. Le datazioni su *Cladocora coespitosa* e su diversi molluschi danno un'età di circa 62.000 anni, riferibile al MIS 4.

Il ritrovamento di *E. hydruntinus* è il primo in Calabria ed aggiunge nuovi dati alla paleobiogeografia dei mammiferi della penisola italiana. Inoltre, poiché la Calabria è stata una via di dispersione delle faune terrestri verso la Sicilia, il ritrovamento consente considerazioni sulle connessioni terraferma-isola durante il Pleistocene superiore. Fino a questo ritrovamento, la presenza di *E. hydruntinus* nel Pleistocene superiore della Calabria si poteva solamente supporre, considerando la sua distribuzione nel resto dell'Italia peninsulare ed in Sicilia. La dispersione della specie sull'isola è probabilmente avvenuta in un periodo posteriore al MIS 5e ed anteriore al tardiglaciale.

Alcuni autori hanno considerato la presenza in Sicilia della specie, tipica di spazi aperti, come una delle evidenze dell'esistenza di una connessione via terra nello Stretto di Messina. Tale ipotesi, tuttavia, è ancora oggetto di discussioni. La presenza di *E. hydruntinus* e di un bovide di grande taglia sono coerenti con il clima arido registrato durante il MIS4, che potrebbe averne favorito la dispersione. Il ritrovamento di *E. hydruntinus* a Le Castella conferma la presenza della specie nel periodo di tempo in cui è ipotizzato un evento dispersivo di faune dalla Calabria verso la Sicilia.

### INTRODUCTION

Few teeth attributed to *Equus hydruntinus* and to a large bovid, have been recovered at Le Castella (Crotone, Calabria; Fig. 1), in deposits dated 62 ka (MIS 4). Although represented by only one molar, this is the first record of *E. hydruntinus* in Calabria.

The three teeth here described come from a marine deposit 10 m above the sea level, located near the village

of Le Castella. The presence of a rich invertebrate fauna allowed palaeoenvironmental reconstructions and absolute dating of the deposit.

### GEOLOGIC AND STRATIGRAPHIC SETTING (by E.B.)

The stratigraphic section of Le Castella is located in the Crotone-Capo Spartivento basin, characterized by an intensive faulting oriented NW-SE, NNE-SSW, and ESE-WNW. The section represents a part of a marine terrace, located near Baia del Tucano at 10 m a.s.l. (Fig. 2). The exposed section is made up of (from the bottom to the top):

1) bathyal clays and sandy marls, Middle-Late Pliocene in age, known as Cutro Formation ("Formazione di Cutro" *sensu* Ogniben, 1973);

2) marine biocalcarene belonging to the homologous terrace of Le Castella, and having an age probably not anterior to the Late Pleistocene (Gliozzi, 1987; Nosjean, 1998).

The teeth have been recovered in the marine biocalcarenes, in a 60 cm thick layer, associated with a rich invertebrate fauna (gastropods, bivalves, and scaphopods). The invertebrate and the teeth were



Fig. 1 - Location of the sites quoted in the text.

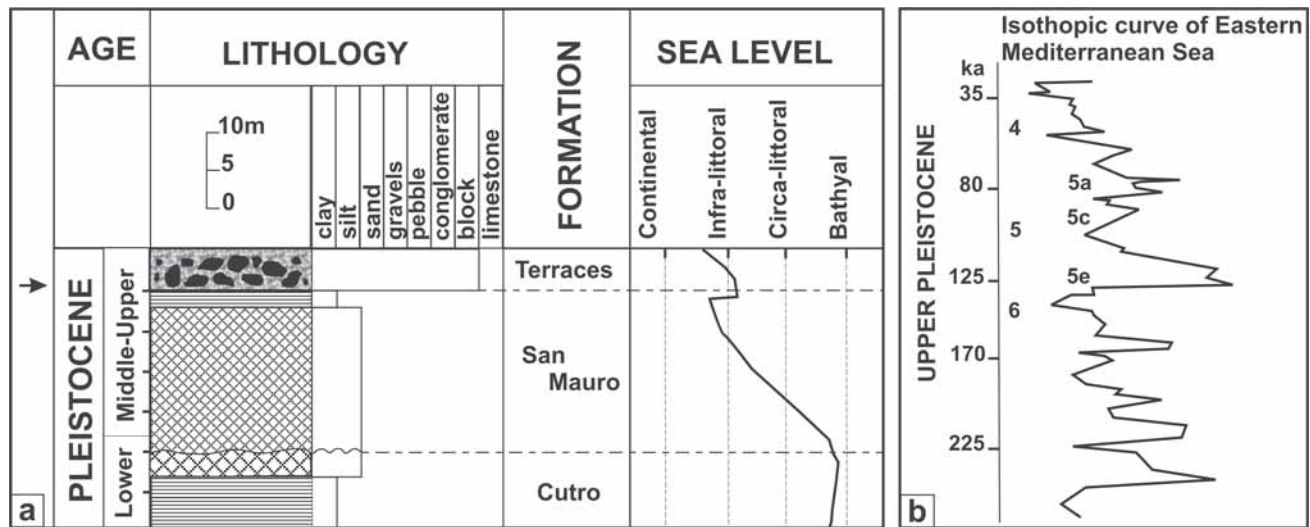


Fig. 2 - a) Stratigraphic scheme of the Pleistocene of the "Crotone Basin", the arrow indicates the stratigraphic position of the new findings; b) isotopic curve of the Eastern Mediterranean Sea. (Re-elaborated after Nosjean, 1998 and Parisi & Cita, 1982).

chaotically accumulated. The invertebrates showed disarticulated valves with concavity randomly oriented upwards and downwards. The preservation state of teeth seems to be coherent with the deposits.

#### TAXONOMY AND PALAEOECOLOGY OF THE INVERTEBRATE FAUNA (by E.B.)

The bionomical analysis of a bulk sample (5 dm<sup>3</sup>) revealed different molluscs species, of which the best preserved and more abundant were the following bivalves: *Lithophaga lithophaga*, *Barbata barbata*, *Arca noae*,

*Striarca lactea*, *Spondylus gaederopus*, *Lima lima*, *Chlamys pesfelis*, *C. varia*, *Anomia aephippium*, *Venus verrucosa*. Among gastropods, the following species have been identified: *Astraea rugosa*, *Patella cerulea*, *Cerithium vulgatum*, *Haliotis lamellosa*, *Bittium reticulatum*, *Homalopoma sanguineum*, *Diodora gibberula*; among corals, *Cladocora coespitosa* is present. The represented species and their relative abundance are listed in Tab. 1. The nomenclature and classification follow Sabelli et al. (1993); paleobionomy and ecobiostratigraphy are according to Di Geronimo & Raffi (1989).

The invertebrate assemblage is characterized by a predominance of molluscs, represented by different

| Lamellibrancs                                   | NS        | RA           | Gastropods                               | NS         | RA           |
|-------------------------------------------------|-----------|--------------|------------------------------------------|------------|--------------|
| <i>Nucula nucleus</i> Linnaeus                  | 4         | 1,67         | <i>Diodora gibberula</i> (Lamarck)       | 4          | 1,67         |
| <i>Arca noae</i> Linnaeus                       | 3         | 1,26         | <i>Jujubinus exasperatus</i> (Pennant)   | 21         | 8,79         |
| <i>Barbata barbata</i> (Linnaeus)               | 8         | 3,35         | <i>Gibbula ardens</i> (Von Salis)        | 9          | 3,77         |
| <i>Striarca lactea</i> (Poli)                   | 6         | 2,51         | <i>Clanculus corallinus</i> (Gmelin)     | 7          | 2,93         |
| <i>Glycymeris glycymeris</i> (Linnaeus)         | 3         | 1,26         | <i>Astraea rugosa</i> (Linnaeus)         | 12         | 5,02         |
| <i>Lithophaga lithophaga</i> (Linnaeus)         | 2         | 0,84         | <i>Homalopoma sanguinea</i> (Linnaeus)   | 9          | 3,77         |
| <i>Chlamys varia</i> (Linnaeus)                 | 3         | 1,26         | <i>Turbona cimex</i> (Linnaeus)          | 6          | 2,51         |
| <i>Chlamys pesfelis</i> (Linnaeus)              | 1         | 0,42         | <i>Theridium vulgatum</i> (Bruguere)     | 17         | 7,11         |
| <i>Pecten jacobaeus</i> (Linnaeus)              | 1         | 0,42         | <i>Bittium reticulatum</i> Da Costa      | 22         | 9,21         |
| <i>Spondylus gaederopus</i> (Linnaeus)          | 4         | 1,67         | <i>Triphora perversa</i> (Linnaeus)      | 13         | 5,44         |
| <i>Anomia aephippium</i> Linnaeus               | 6         | 2,51         | <i>Ocenebrina edwardsii</i> (Payraudeau) | 4          | 1,67         |
| <i>Lima lima</i> (Linnaeus)                     | 4         | 1,67         | <i>Pisania maculosa</i> (Lamarck)        | 2          | 0,84         |
| <i>Ctena decussata</i> (Da Costa)               | 6         | 2,51         | <i>Mitrella scripta</i> (Linnaeus)       | 7          | 2,93         |
| <i>Cardita calyculata calyculata</i> (Linnaeus) | 7         | 2,93         | <i>Euthria cornea</i> (Linnaeus)         | 2          | 0,84         |
| <i>Papillicardium papillosum</i> (Poli)         | 15        | 6,28         | <i>Columbella rustica</i> Linnaeus       | 11         | 4,60         |
| <i>Venus verrucosa</i> (Linnaeus)               | 3         | 1,26         | <i>Pusia tricolor</i> (Gmelin)           | 3          | 1,26         |
| <i>Gouldia minima</i> (Montagu)                 | 7         | 2,93         | <i>Conus mediterraneus</i> (Bruguere)    | 7          | 2,93         |
| <b>Bivalve total number</b>                     | <b>83</b> | <b>34,73</b> | <b>Gastropod total number</b>            | <b>155</b> | <b>65,27</b> |
| <b>TOTAL</b>                                    |           |              |                                          | <b>239</b> | <b>100%</b>  |

Tab. 1 - Invertebrate species recovered in the biocalcarenitic level of "Le Castella". NS = number of specimens; RA = relative abundance in the bulk sample.

species, and can be referred to a “mixed fossil assemblage” (Fagerström, 1964). Among the different biocenotic stocks recognised (LEE, AP, HP, RI, RM, SFBC, *sensu* Pérès & Picard, 1964, Pérès, 1967, 1982), only the AP-HP (Biocenosis of the Photophilic Algae and Biocenosis of the *Posidonia* Meadows *sensu* Pérès & Picard, 1964, Pérès, 1967, 1982) ones can be considered as autochthonous. The lack of molluscs typical of lower Infra- and Circa-littoral zones could indicate sedimentation in the upper part of the Infra-littoral zone (*sensu* Pérès & Picard, 1964, Pérès, 1967), not deeper than 15-20 m.

The age of the layer can confidently be supposed to be not older than Late Pleistocene, in consideration of:

- its short elevation above the sea level;
- the stratigraphic position of the level;
- the comparison with similar series, well dated and considered as synchronous;
- the “Mediterranean” typology of its invertebrate fauna;
- the absence of species known as climatic markers in the Mediterranean basin during the Pleistocene (“Senegalese guests” and “boreal guests”, *sensu* Raffi, 1986; Di Geronimo et al., 1994; Bellomo & Sabelli, 1995; Bellomo, 1996, 1997; Ragaini et al., 2006).

Absolute dating of the deposit by means of  $^{230}\text{Th}/^{234}\text{U}$  on molluscs and on *Cladocora coespitosa*, and by means of isoleucine epimerization on *Glycymeris* sp., gave an age of 62,000 years BP and a value of 0.24 for Ale/Ile ratio, corresponding to amino-group C and to MIS 4 (*sensu* Hearty et al., 1986; Gliozzi, 1987; Belluomini et al., 1988).

The absence of both boreal and Senegalese guests in the invertebrate fauna fits well with a “Mediterranean character” of the invertebrate assemblage, relating it to the beginning of the MIS 4 peak, as suggested by the absolute dating (Parisi & Cita, 1982).

#### MORPHOLOGICAL DESCRIPTION OF THE MAMMAL FAUNA (by A.C.M.)

The recovered teeth were chaotically accumulated among shells and show abrasion by water transport. Investigations carried out in the neighbouring of the recovered teeth did not lead to new findings. The remains probably underwent transportation from the sub-aerial environment to the infra-littoral stage (about 0-10 m), maybe in charge of rivers.

Class MAMMALIA  
Order PERISSODACTYLA  
Family EQUIDAE

Genus *Equus* Linné, 1758

Species *Equus hydruntinus* Regalia, 1904

**Third lower molar (Fig. 3)** - The left M/3 is broken on the anterior (parastylid) and posterior (hypoconulid) sides. Its surface is abraded.

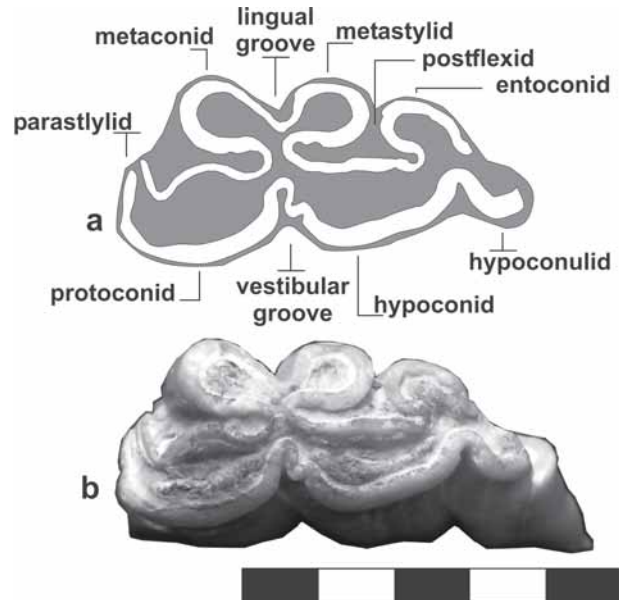


Fig. 3 - *Equus hydruntinus* from Le Castella, left M/3. a) Drawn of the occlusal surface with adopted nomenclature; b) occlusal view. Scale bar = 25 mm.

**Occlusal view.** The protoconid is oval, with a more rounded labial margin and a more straight lingual margin. In the labial side, the vestibular groove is deep. Its posterior margin forms a small fold. The hypoconid is elongated. The metastylid and the metaconid are well rounded, and separated by a pronounced groove. The entoconid is rounded and forms a narrow anterior fold.

Measurements at mid-crown height: Length: 24.8 mm; Breadth: 10.0 mm.

Measurements at occlusal surface: OL (Occlusal Length): 26.8 mm; OB (Occlusal Breadth): 11.3 mm; PL (Postflexid Length): 9.8 mm.

Height: 39.7 mm. PI (Postflexid Index =  $100 \times \text{Occlusal Postflexid Length} / \text{Occlusal Length}$ ): 36.6.

Order ARTIODACTYLA  
Family BOVIDAE

A premolar and a molar of a large bovid have been recovered. Their incompleteness does not enable a definite classification.

**Upper premolar (Fig. 4a)** - A left P4 is incomplete and slightly abraded. The rounded wall of the buccal side seems to be more similar to *Bison* than to *Bos*, where it is more straight (Sala 1986, fig. 3a).

Measurements: Labial-buccal width: 16.7 mm; antero-posterior length (incomplete): 14.8 mm.

**Upper molar (Fig. 4b)** - The right upper molar found at Le Castella is incomplete and strongly abraded. The entostyle, which could be indicative for the classification, is broken, as well as the styles of the labial side. The presence of a pillar at the centre of the occlusal surface, and the protocone narrow and protruded toward the labial

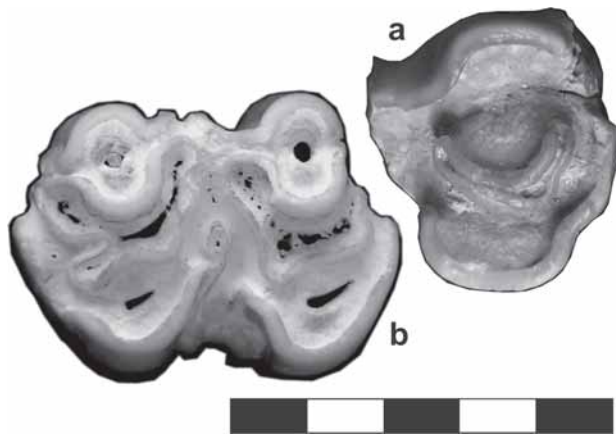


Fig. 4 - Bovid from Le Castella. a) Left P4 in occlusal view; b) right upper molar in occlusal view. Scale bar = 25 mm.

side are like in the genus *Bison*. Discussing the distinction between the genera *Bos* and *Bison*, Sala (1986) indicated these features as belonging to *Bison*.

Measurements: Labial-buccal width (incomplete): 19.1 mm; antero-posterior length (incomplete): 25.9 mm.

#### PALAEOGEOGRAPHIC AND CHRONOLOGIC DISTRIBUTION OF *EQUUS HYDRUNTINUS* (by A.C.M.)

*Equus hydruntinus* had a wide geographic distribution, from Spain to Middle East (Iran; Orlando et al., 2006). In Europe, the northernmost occurrence is near the North Sea, while the southernmost one is in Sicily

(Orlando et al., 2006, and references therein). In Africa, this species can be confused with zebra, but it seems to be present in northern Africa (Libya and Tunisia; Orlando et al., 2006, and references therein).

This small equid is known from 350,000 years BP (at Lunel Viel, Southern France; Bonifay, 1991) to the Iron Age (Willms, 1989; Orlando et al., 2006). It could be the equid cited in Portuguese manuscripts, surviving until the Middle Age (Antunes, 2006).

In Italy, *E. hydruntinus* has been considered present from the early-middle Aurelian mammal age (MIS 7) to the beginning of the Holocene (Gliozzi et al., 1997). New absolute dating on volcanic ash at Sedia del Diavolo (a local faunal unit referred to mid-Aurelian Mammal Age), where *E. hydruntinus* was present, gave an age between 355 and 285 ka (MIS 9; Palombo, 2004). So, *E. hydruntinus* occurred for the first time in Italy during the MIS 9.

Cavinato et al. (2001) reported *E. hydruntinus* associated with *Dama dama* and *Cervus elaphus* in the Middle Pleistocene of the Mercure River Basin, in the Pollino Mt. area, at the boundary between Basilicata and Calabria (Fig. 1). The authors referred the association to the late Aurelian mammal age, as defined by Gliozzi et al. (1997).

In Calabria, the fossil record of Pleistocene mammals is very poor and did not include *E. hydruntinus* before this report (Tab. 2).

This equid is instead known in the near island of Sicily, which has had five faunal complexes during Pleistocene, each one with different degree of endemism due to insular conditions (Bonfiglio et al., 2002). *E. hydruntinus* occurred in Sicily in the "Grotta S. Teodoro - Pianetti" faunal complex, probably later than MIS 5e, and in the "Castello" faunal complex, late Late Pleistocene (Bonfiglio et al., 2001).

| MIS           | SITE                                                     | MAMMAL ASSEMBLAGES                                                                                                                                                                                                                     | REFERENCES                                                                                                             |
|---------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| later than 5e | Ianni di S. Calogero, eolian sands overlying fine sands  | <i>Homo neanderthalensis</i><br><i>Elephas (Palaeoloxodon) antiquus</i><br><i>Stephanorhinus</i> sp. [ <i>Dicerorhinus</i> sp.]<br><i>Hippopotamus</i> sp.<br><i>Bos primigenius</i><br><i>Crocota</i> sp.                             | Bonfiglio et al., 1986                                                                                                 |
| later than 5e | Ianni di S. Calogero, fine sands underlying eolian sands | <i>Elephas</i> cfr. <i>antiquus</i><br><i>Dama dama</i> [ <i>Megaceros</i> cfr. <i>calabriae</i> ]                                                                                                                                     | Bonfiglio et al., 1986                                                                                                 |
| later than 5e | S. Francesco di Archi                                    | <i>Homo neanderthalensis</i><br><i>Elephas (Palaeoloxodon) antiquus</i><br><i>Stephanorhinus kirchbergensis</i> [ <i>Dicerorhinus merckii</i> ]<br><i>Bos</i> cfr. <i>primigenius</i><br><i>Cervus elaphus</i><br><i>Megaceros</i> sp. | Ascenzi & Segre, 1971; Bonfiglio & Berdar, 1986; Bonfiglio et al., 2002.                                               |
| 5e            | Bovetto                                                  | <i>Dama dama tiberina</i> [ <i>Megaceros (Megaceroides) calabriae</i> ]<br><i>Hippopotamus</i> cfr. <i>amphibius</i><br><i>elephant?</i>                                                                                               | Abbazzi et al., 2001; Bonfiglio, 1972; Bonfiglio, 1978; Bonfiglio & Berdar, 1986; Bonfiglio et al., 2002; Marra, 2000. |

Tab. 2 - Synoptic table of the main records of Pleistocene mammals in Calabria. Where necessary, species name is according to the recent reviews, with obsolete names in square brackets. Locations of the cited sites are shown in Fig. 1.

In the “Grotta S. Teodoro - Pianetti” faunal complex, *E. hydruntinus* is associated with some endemic species surviving from the “*Elephas mnaidriensis*” faunal complex” (late Middle Pleistocene- early Late Pleistocene) and with non-endemic species, newly arrived; biodiversity is lower than in peninsular Italy (Bonfiglio et al., 2001; Marra, 2005). The “Castello” faunal complex is made by non-endemic species but has a low biodiversity with respect to peninsular Italy (Bonfiglio et al., 2001; Marra 2005). The non-endemic species of the “Grotta S. Teodoro - Pianetti” faunal complex, including *E. hydruntinus*, reveal a dispersal event across the Straits of Messina.

Bonfiglio et al. (2001) pointed out that the occurrence of lithic artifacts of Aurignatian age (found at Fontana Nuova, Ragusa; Guerreschi, 1992; Martini, 1997) should indicate a human dispersal from mainland occurred about 28,000 years BP. The dispersal event recorded in the “Grotta S. Teodoro - Pianetti” faunal complex, could have been posterior to MIS 5e and anterior to the late Glacial (Bonfiglio et al., 2001). Furthermore, Bonfiglio et al. (2001) suggested that the spreading of *E. hydruntinus*, requiring open landscapes, and of the associated vole *Crocidura savii*, having fossorial habits, needed an emerged land bridge maybe occurred during an eustatic lowstand.

On the other hand, Abbazzi et al. (1996) considered *E. hydruntinus* a solitary form similar to extant ass, adapted to dry Mediterranean conditions that did not depend on open landscape. Burke et al. (2003) proposed that *E. hydruntinus* lived in small herds, characterized by the presence of territorial males, which used small territories and dispersed easily. The dispersal ability of the species across a sea strait is hard to infer.

## DISCUSSION AND CONCLUSIONS

Before the finding at Le Castella, the presence of *Equus hydruntinus* in Calabria should have been supposed for its occurrence in the Mercure River Basin and in Sicily.

Calabria represented an important dispersal route from peninsular Italy to Sicily during Quaternary. Every new finding of fossil mammals in Calabria contributes to clarify the dispersal events from peninsular Italy to Sicily, with implications in reconstructing palaeogeography, as well as evolutionary patterns in insular environment.

The occurrence of *E. hydruntinus* in the MIS 4 at Le Castella fits well with its spreading to Sicily in an age posterior to MIS 5e and anterior to late Glacial, supposed by Bonfiglio et al. (2001).

The presence in Sicily of *E. hydruntinus*, typical of open landscapes, has been considered one of the evidences of a land connection in the Messina Straits in the Late Pleistocene (Bonfiglio et al., 2001). However, the existence of a land bridge in the Messina Straits is highly debated by a geological point of view and the dispersal ability of *E. hydruntinus* and associated mammals across this narrow sea strait needs more investigations. Moreover, the biodiversity of non-endemic mammals recorded in the “Grotta S. Teodoro - Pianetti” faunal complex and in the “Castello” faunal

complex is lower than that of peninsular Italy, indicating a possible but difficult sea crossing (Marra, 2005).

By a palaeoecological point of view, the presence of *E. hydruntinus* and of a large bovid at Le Castella is coherent with the arid climate recorded in the MIS 4 of Southern Italy.

The teeth of large bovid have some features similar to the genus *Bison*, but they are too fragmentary for a determination.

In conclusion, *E. hydruntinus* from Le Castella:

- is the first record of the species in Calabria;
- is well dated (MIS 4) by the associated marine molluscs;
- confirms the presence of the species in the time-span in which it dispersed from Calabria to Sicily.

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Described fossils are stored at: Soprintendenza alle Antichità della Calabria, Servizio di Preistoria e Protostoria di Crotone. Financial support: PRA 2004, University of Messina.

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