CERVUS ELAPHUS ROSSII (MAMMALIA, ARTIODACTYLA), A NEW ENDEMIC SUB-SPECIES FROM THE MIDDLE PLEISTOCENE IN CORSICA

by

Elisabeth PEREIRA*

SUMMARY

* Université de Corse, Laboratoire de Géologie, U.F.R. Sciences et Techniques "CEVAREN". B.P. 52, 20250 Corte, France - Phone: 04 95 45 00 74 - Fax: 04 95 61 05 51- e-mail: pereira@univ-corse.fr

Key-words: Corsica, Pleistocene, Endemism, *Cervus elaphus*

Mots-clés: Corse, Pléistocène, Endémisme, *Cervus elaphus*

Palaeovertebrata, Montpellier, **30** (2-4): 189–213, 6 fig., 5 tabl., 2 pl.
(Reçu le 8 Novembre 2000, accepté le 23 Février 2001, publié le 28 Décembre 2001)

ABSTRACT

Several endemic deer remains from the Middle Pleistocene deposits of the Castiglione cave (Oletta, Haute-Corse) are examined here. A morphometric analysis allows to relate them to a new insular subspecies *Cervus elaphus rossii*. The bones were compared with those of the mainland early Middle Pleistocene subspecies *Cervus elaphus acoronatus* Beninde and the European species *Cervus elaphus* Linné (Late Middle Pleistocene and Upper Pleistocene forms (continental and insular)). The Castiglione fossil shows peculiar morphofunctional features in its appendicular skeleton suggesting a morphological convergence with certain Bovidae.

RÉSUMÉ

Des restes d'un Cervidae endémique provenant des dépôts du Pléistocène moyen du gisement de Castiglione (Oletta, Haute-Corse) sont ici analysés. Une analyse morphométrique permet de les rapporter à une nouvelle sous-espèce insulaire, *Cervus elaphus rossii*. Les ossements sont comparés à ceux de la sous espèce *Cervus elaphus acoronatus* Beninde du Pléistocène Moyen ancien et à ceux de l'espèce européenne *Cervus elaphus* Linné (formes continentale et insulaire du Pléistocène Moyen supérieur et du Pléistocène Supérieur). Le fossile de Castiglione possède au niveau de son squelette appendiculaire des caractères morphologiques particuliers et adaptatifs suggérant une convergence morphologique avec certains grands Bovidae.

INTRODUCTION

The study of Quaternary endemic deer from the Tyrrhenian Islands has aroused a strong interest from paleontologists for a long time (Depéret, 1897; Azzaroli, 1952, 1961, 1977; Caloi and Malatesta, 1974; Vigne, 1988; Petronio, 1990; Gliozzi *et al.*, 1993; Capasso-Barbato and Gliozzi, 1997...). These insular deer belong to two genera (Azzaroli, 1953) : *Cervus* LINNÉ, 1758 and *Megaloceros* BROOKES, 1828 (synonym *Megaceros* OWEN, 1844). The latter, has been divided into two groups by Azzaroli (1952, 1979) : the *Megaloceros giganteus* group BLUMENBACK, 1803 (synonym *Megaloceros* subgenus BROOKES, 1828, and *Megaceros* OWEN, 1844) and *Megaloceros verticornis* group DAWKINS, 1872 (synonym *Praemegaceros* subgenus PORTIS, 1920, *Megaceroides* JOLEAUD, 1914, and *Megaceroides* AMBROSETTI, 1967). This classification is based on the shape of the frontal bone and the position of the first tine in relation to the burr.

As examples from the Pleistocene insular species of the *Cervus* genus, we can cite *Cervus elaphus tyrrhenicus* (Capri - Azzaroli, 1961; Capasso-Barbato and Gliozzi, 1997), *Cervus elaphus siciliae* (Sicile - Gliozzi *et al.*, 1993). From the Mediterranean *Megaceros* related to the *Megaloceros verticornis* group Dawkins, 1872 (Azzaroli, 1953, 1979), we can cite *Megaloceros* cf. *messinae* (Malte, Sicile - Gliozzi and Malatesta, 1982), *Megaloceros calabriae* (Calabre - Bonfiglio, 1978).

In Corsica, two endemic deer (also present in Sardinia), one of which is a fossil, the other still living, are currently recognised belonging to Pleistocene and Holocene fauna : *Megaloceros (Nesoleipoceros) cazioti* DEPÉRET, 1897 (Sigogneau, 1960; Azzaroli, 1961; Caloi and Malatesta, 1974; Vigne, 1988; Pereira and Bonifay M.-F.,

1998; Pereira, 2000; Pereira, 2001) and *Cervus elaphus corsicanus* ERXLEBEN, 1777 (Vigne and Demeautis, 1987; Vigne, 1988). A third original type, related to the *Cervus* genus and of which the analytic study is presented here, was recently discovered in the Castiglione deposits (Oletta, Haute-Corse). The latter deer is not to be confused with the *M. N. cazioti* species due to a high number of varying morphological features (Pereira, 2001 – for example this species has a bilobated P/4 which presents a groove on the postero-lingual side (that of *M (N.) cazioti* is unilobated) and has a quadrangular molars, differences between the cross section of the mandible at the M/2 and M/3 level, differences regarding the shape of the trochanter and the diaphysis section of the femur, the shape of the phalanx etc.) and biometric features (this new type displays slightly larger dental and bone dimensions and is sturdier).

The remains of this new fossil deer come from cavities 1 (Ferrandini and Salotti, 1995) and 3 (Salotti *et al.*, 1997) of the Castiglione deposit (Oletta, Corsica). In cavity 3, the material (748 determinable remains) comes from the fossiliferous point Cast.3CG, located between -33 and -39 m from the surface. The fauna which was extracted from this homogeneous filling dating from the Middle Pleistocene (few Ur/Th calcitic datations indicate this period : Salotti *et al.*, 1997; Mourer-Chauviré *et al.*, 1997; Pereira *et al.*, 1999; Pereira, 2001), and which is still under study includes of reptiles, amphibians, endemic mammals among which *Prolagus sardus*, *Microtus (Tyrrhenicola) henseli*, *Rhagamys orthodon*, *Episoriculus corsicanus*, *Cynotherium sardus*, *Canis* sp. and *Cuoninae* undet. (Pereira, 2001; Pereira *et al.*, submitted), *Cyrnolutra castiglionis* sp. n. (Pereira and Salotti, 2000), a new endemic subspecies deer (different from *Megaloceros (Nesoleipoceros) cazioti*) and a very varied avifauna (Louchart, submitted). Among the birds, the presence in Cast.3CG of a subspecies of *Tyto balearica* (Louchart and Mourer-Chauviré, personnal communication), the barn-owl previously known only in the Plio-Pleistocene continental and insular deposits older than 1.8 Ma (Mourer-Chauviré and Sanchez-Marco, 1988), of *Athene angelis* a new endemic bird only known in Corsica (in Cast.3CG and Cast.1 – Mourer *et al.*, 1997) make it possible to stress the great antiquity of the Cast.3CG deposit (Pereira, 2001; Salotti *et al.*, submitted). In cavity 1, the material (10 determinable remains) comes from levels 3 and 4 lying at -40 and -55 meters respectively. These levels do not contain T. *balearica*, *C. castiglionis*, *Canis sp.*, and *Cuoninae* undet. but contain few bones, few antlers and mandibles fragments of *Megaloceros (Nesoleipoceros) cazioti* and therefore can be considered more recent than Cast.3CG (Pereira, 2001; Salotti *et al.*, submitted).

The bones of this new endemic deer, which were extracted from these deposits (Cast.3CG, levels 3 and 4), were not found in anatomic connections and were, for the most part, fragmented and covered with calcite. Neither entire skulls nor antlers were excavated. The skull remains (fragments of maxillae and mandibles) were otherwise poorly represented compared to the post-cranial remains. At least 25 individuals (18 young ones, 3 sub-adults and 3 adults (2 in Cast.3CG (= two left radius), 1 in Cast.1) were estimated from the long limb bones. This study deals with the bones of adult subjects because the latter display osteological characteristics undetectable on the non-epiphysed bones of young subjects.

The present study aims at analyzing the morphometry of these remains and determining their taxonomy. Particular attention was brought to the continental species *Cervus elaphus* LINNÉ, both fossil and current, a species presenting morphometric similarities with the Castiglione fossil. The presence of endemic fossil deer akin to the Pleistocene continental red deer on some present day Mediterranean islands (Petronio, 1990) has already been attested by several authors (Pianosa - *Cervus elaphus* (Upper Pleistocene - Azzaroli, 1978), Sicily - *Cervus elaphus siciliae* (Upper Middle Pleistocene and Upper Pleistocene - Gliozzi *et al.*, 1993), Capri - *Cervus elaphus tyrrhenicus* (Upper Pleistocene - Azzaroli, 1961; Capasso Barbato and Gliozzi, 1997)).

MATERIALS AND METHODS

The material analyzed here consists of 32 remains : Cast.3CG.176 - portion of a right maxilla bearing P4/-M3/; Cast.3CG.100 - portion of a right mandible bearing P/4-M/3; Cast.3CG.170 - left glenoid cavity; Cast.3CG.147 - right humerus, proximal epiphysis; Cast.3CG.413 - quasi entire left humerus; Cast.1.4.150 - right humerus, diaphysis and distal extremity; Cast.3CG.152 - left radius, distal epiphysis; Cast.3CG.153 and Cast.3CG.154 - left radius, distal and proximal epiphyses; Cast.3CG.171 - right radius, proximal epiphysis; Cast.3CG.099 and Cast.3CG.150 - left and right olecranons; Cast.1.3.206 - right olecranon; Cast.3CG.146 and Cast.3CG2.628 - left femur, distal and proximal epiphyses; Cast.3CG.172 - right tibia, proximal epiphysis; Cast.3CG6.44 - quasi entire right tibia; Cast.3CG.169 - right calcaneus; Cast.3CG.160 and Cast.3CG.760 - left tali; Cast.3CG1.638 - right talus; Cast.3CG6.38 - left cubo-navicular; Cast.3CG4.116 - right metatarsus, proximal epiphysis; Cast.3CG.159 - metatarsus, distal epiphysis; Cast.3CG.005, Cast.3CG.162 and Cast.3CG.168 - first phalanxes; Cast.3CG.163, Cast.3CG.164, Cast.3CG.165 and Cast.1.4.052 - second phalanxes; Cast.3CG.166 - third phalanx.

The measurements of the pieces were taken according to the protocol suggested by Heintz (1970) and Desse *et al.*, (1986). As for the description of teeth and limb bones, we shall refer respectively to Heintz (1970) and Barone (1976).

DESCRIPTIONS AND COMPARISONS

Teeth

The two dental remains (maxilla Cast.3CG.176 and mandible Cast.3CG.100) belonged to the same individual because of their robustness and their perfect dental occlusion. Traces of more or less deep grinding on the masticatory surface and the reduced height of the teeth (metacone height M2/ and M3/: 9.8 mm and 10.6 mm ; entoconid height M/2 and M/3: 9.9 mm and 10.1 mm) testify that they belonged to a mature adult subject. To simplify the description of the upper and lower molars, of the

lower fourth premolar (P/4), the figure 1 (a, b, c) shows the anatomical terms used.

The upper final set of teeth (Plate 1, fig. a) is characterized by large quadrangular molars. The three molars display, on their lingual side and on the hypocone front wing, a rather strong entostyle (3.7 mm thick) of triangular shape when the latter is not impaired by chewing. A slight front bend situated on the protocone front wing, is also visible on that side, on M2/ and M3/. From an occlusal point of view, M2/ and M3/ display a reduced hypoconal outcrop and a protoconal bend. On M1/, the tooth the most used, one may distinguish, on the contrary, a little enameled winding resulting from the fusion of the protoconal bend and the protocone back wing (fusion due to use). The labial wall of the molars presents a rather pronounced relief (parastyle, metastyle, paracone pillar); the element, which is most conspicuous, is the mesostyle and the least noticeable, the metacone pillar. The M1/-M3/ occlusal meso-distal diameter is 71,3 mm. P4/ is unilobed and its labial wall quasi symmetrical. Its lingual side shows a slight basilar fold as well as a front bend at the crown base.

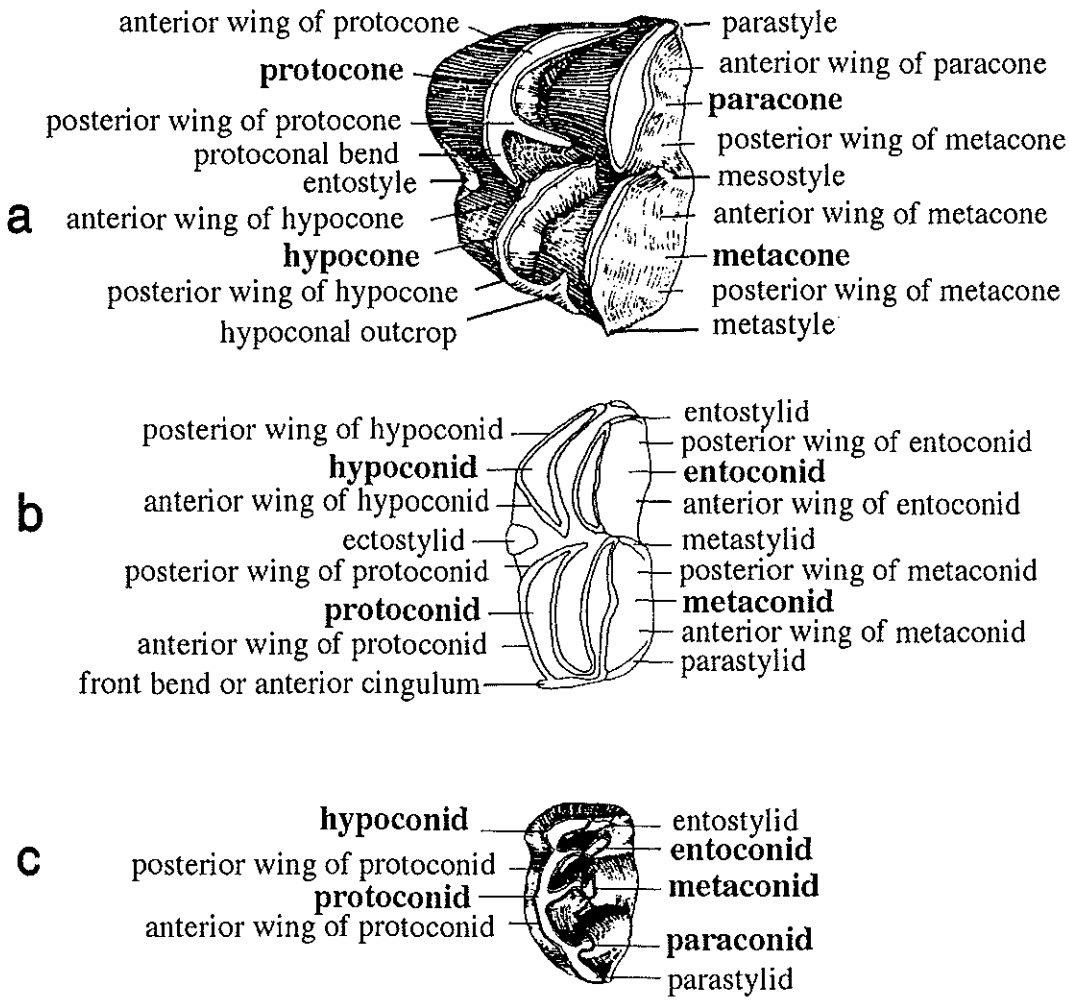


Figure 1.— Schematic diagram of cervid teeth : (a) upper molar, (b) lower molar, (c) fourth lower premolar (P/4). The nomenclature follows Heintz (1970).

The lower set of teeth (Plate 1, fig. b) is characterized by molars with a quasi flat lingual wall, the stylids of which (parastylid, metastylid and entostylid) are little or not marked and the conid pillars (metaconid and entoconid) are flat. These molars also present a front bend and a strong triangular ectostylid on their labial sides. In M/3, the latter is only present between the first two lobes. The M/1-M/3 occlusal meso-distal diameter is 74,4 mm. P/4 is bilobed (a postero-labial groove separating the protoconid from the hypoconid) and presents a low stage of molarisation. Thus, on the lingual side, the quite prominent paraconid strerches to the top of the crown, slightly joining with the front wing of the metaconid (the most developed conid). Vale 2, despite this weak joint, remains open on half of the crown. The back wing of this metaconid joins in turn with the front wing of the entoconid, remaining distinct from it. Vale 3, is barely open, shallow and more narrow. Vale 4 however, is nearly closed by the entoconid and entostylid joint.

The mandibular body of piece Cast.3CG.100 shows, under the central lobe of M/3, a transversal section characterized by a slightly convex lingual side and a labial side concave on the alveolar level and convex on the rest of the body, the two sides getting gradually thinner toward the lower part of the mandible. The robustness index (RI (h/t): 55.1%) and that of pachyostosis (PI (t/h): 1.81) of the mandible body were calculated using the thickness (t: 21.9mm) and height (h: 39.7mm) estimated behind M/2.

Therefore, the absence of a strong basilar cingulum on the labial and lingual sides of the molars of maxilla Cast.3CG.176, as well as the absence of pachyostosis, the thickening of the mandibular body, which is often found on some Pleistocene continental Praemegacerides (Azzaroli, 1952, 1977; Kahlke, 1960, 1965, 1969; Bonifay, 1981; Delpech and Guérin, 1996) allow us to dismiss any kinship with the species of the *Megaloceros* genus Bookes, 1828 (Lister, 1987) and of the *Praemegaceros* subgenus Portis, 1920 (= *Megaceroides* JOLEAUD, 1914 and *Megaceroides* AMBROSETTI, 1967). The pachyostosis index (IP: 1.81) differs from that of *P. verticornis* of Mosbach (IP: 1.56 - Kahlke, 1960) and Süssenborn (IP behind M/1: 1.24 -Kahlke, 1969) and *P.* sp. of Atapuerca (PI behind M/2: 1.61- Azanza and Sanchez, 1990).

The size criterion enables us to also distinguish the upper and lower teeth of the fossil from those of the continental and insular Praemegacerides and thereby to isolate it from the Megacerini tribe. Indeed the dental dimensions (Table 1a and 1b), are inferior to those of the continental ones and by far superior to those of the insular ones (Fig. 2 (example of lower teeth)). However, the pachyostosis index of the fossil is close to that of the Pleistocene continental elaphs (ex: *Cervus elaphus* of Atapuerca PI between 1.79 and 2.10 - Azanza and Sanchez, 1990). In the same way, the morphology of the upper and lower jugal teeth obviously brings to mind that of the continental and insular elaphines deer, both fossil and current (Laquay, 1981; Kahlke, 1984; Delpech, 1988; Cardoso, 1993; Gliozzi *et al.*, 1993; Guadelli, 1996; Noury, 1997). One can thus find on the upper molars the protoconal bend, the hypoconal outcrop and the antero-labial bend (also visible on lower molars), which are features often mentioned and represented in publications. The only slight difference lies in the stage of molarisation of the last premolar (P/4). The latter shows a vale 2, which is still open, whereas it is most often closed in red deer (P/4 of f type according to the Laquay classification (1981)).

However, this feature (openness or closure of vale 2) is extremely variable and the stage of molarisation then corresponds to the percentage of individuals concerned by this phenomenon (Janis and Lister (1985) show moreover that the degree of molarisation can vary quite radically between and within populations of *C. elaphus*). In Castiglione, the evaluation of this percentage is made impossible by the lack of material.

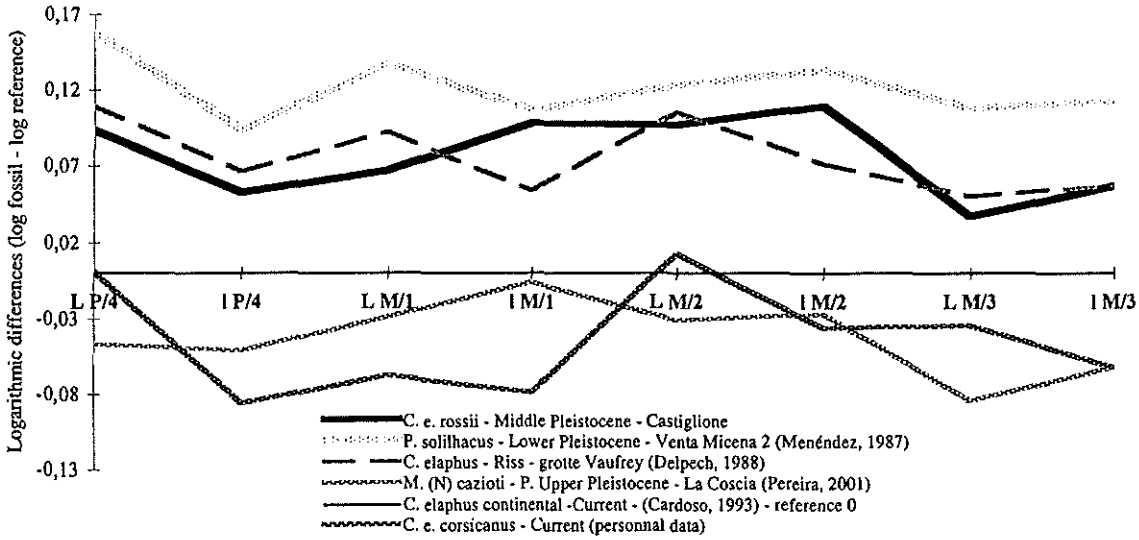


Figure 2.— Ratio diagram for comparison between the Castiglione fossil lower teeth (mean length and the mean width) and some megacerides and elaphines.

Moreover, the size (occlusal or at the neck) of each of the upper and lower teeth of the fossil (Table 1a and 1b) enable us to isolate it from the Pleistocene insular elaphines (ex. *Cervus elaphus siciliae* (Gliozzi *et al.*, 1993), *Cervus elaphus tyrrhenicus* (Capasso Barbato and Gliozzi, 1997), *Cervus elaphus jerseyensis* (Lister, 1989)), and current elaphines (*Cervus elaphus corsicanus* - Vigne, 1988) which are characterized by slightly inferior dimensions (ex. *C. e. corsicanus* and *C. e. siciliae* - Table 1a and 1b; Fig.3 (example of the lower teeth)). In fact these values bring the fossil rather closer to the Pleistocene and current continental elaphines (Table 1a and 1b, Fig.3). The length data at the neck of our dental segments M1/-M3/ (70.6 mm), M2/-M3/ (48.1 mm), P4/-M3/ (84.9 mm), M/1-M/3 (75.6mm), M/2-M/3 (56.7 mm) and P/4-M/3 (94.1 mm) lie within the variation intervals (62.2 to 72.7 (N: 5); 43.4 to 49.2 (N: 5); 75.2 to 87.6 (N: 5); 71.5 to 83 (N: 13); 52.2 to 60.5 (N: 17); 87.3 to 101.7 (N: 13)) of the subspecies *Cervus elaphus acoronatus* of Mosbach (Middle Pleistocene (0.5 / 0.4 Ma approx.) - Kahle, 1960). On the other hand, they perfectly lie within the variation intervals mentioned for the Lunel-Viel elaph (Noury, 1997) and remain quite similar to those of some Rissian red deer (Lazaret - Bonifay, 1969; Abimes de la Fage - Bouchud, 1972; Chatillon St Jean - Mourer-Chauviré, 1972; Grotte vaufrey - Delpech, 1988) and Wurmian ones (Combe Grenal - Laquay, 1981). Yet, of all these former populations, our data are very close to those of the Vaufrey cave (Table 1a and 1b, Fig. 3). Finally the length of the upper teeth as well as the length and width of the lower teeth exceed those of the actual red deer (Pietschmann, 1977; Cardoso, 1993). The Castiglione fossil therefore seems to belong to the Cervini Tribe and to the continental species *Cervus*

elaphus LINNÉ.

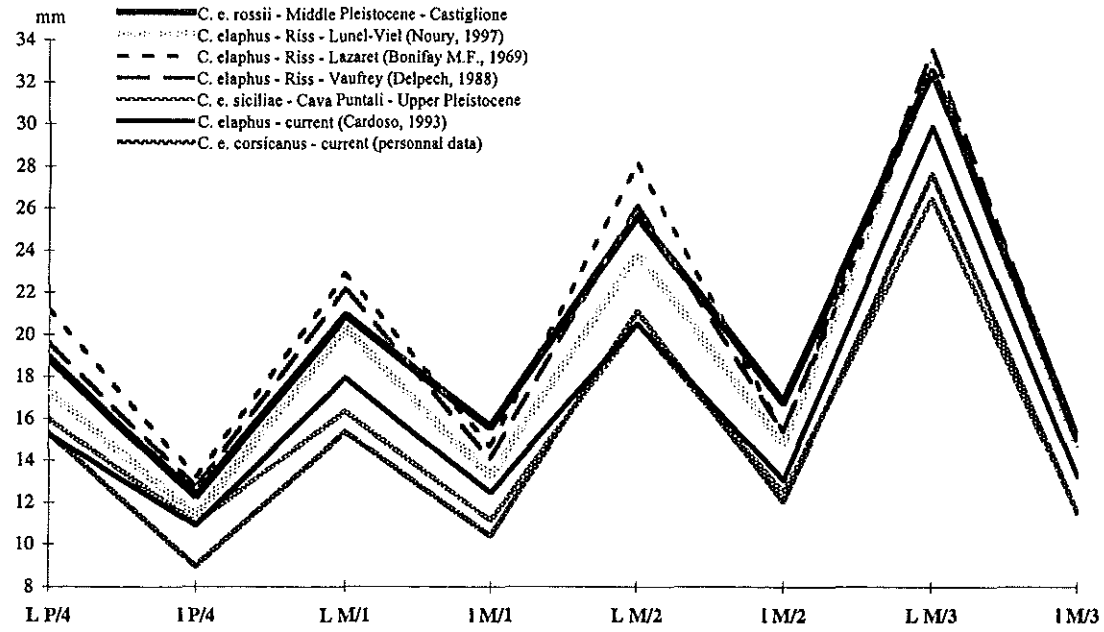


Figure 3.— Lower teeth (mean length and mean width) comparison between the Castiglione fossil and some continentaland insular elaphines.

The limb bones

The fossil bones of cavity 3 (fossiliferous point Cast.3CG) and of cavity 1 (levels 3 and 4) of the Castiglione deposit (Plate 1, fig. c-i; Plate 2, fig. a-n) undoubtedly belong to a Cervidae insofar as the main features evoked for this family (Heintz, 1963, 1966, 1970; Leinders, 1979) are also found here. Among the latter we can notice at the level of the first phalanx : absence of a postero-proximal fossa under the proximal area, the elongated shape of the postero-internal tuberosity and presence of the antero-internal tuberosity; behind the proximal articular side of the second phalanx: presence of the tabular continuation; on the third phalanx: absence of a pyramidal eminence, presence of an internal vascular hole, a little concave articular side and a regularly straight front border; a metatarsis presenting on its proximal articular side a long, horizontal, narrow, concave, rectangular posterior cubonavicular facet and a front median canal tapering into a point in its distal extremity and situated a certain distance apart from the guide quills. Besides, these bones correspond to the description of the red deer ones (Bouchud, 1966).

The morphological comparison of the fossil bones with those of *Cervus elaphus*, fossil and current forms, presented similarities as well as numerous differences. The latter, which are the only ones mentioned here, are summed up in tables 2, 3 and 4 and presented for some of them in figures 4, 5 and 6.

In spite of being an deer, the fossil presents specific features indicated in table 2, 3 and 4 by an asterisk. These features, which differ from those of *Cervus elaphus*, look like the ones of the Bovidae (Bonifay M.-F., 1966; Heintz, 1970; Leinders, 1979) (our

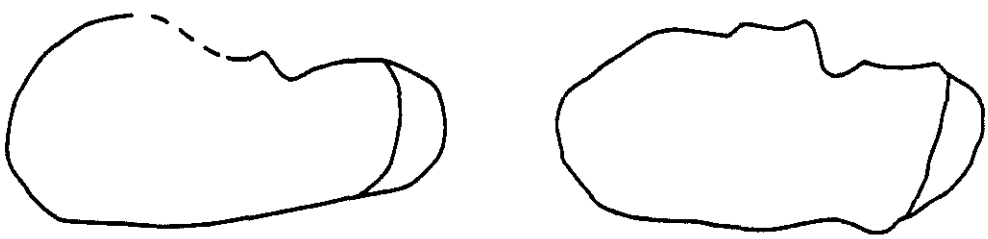
observations are based upon the morphological analysis of bones of the Lunel-Viel cave linked to *Bos* or *Bison* (Brugal, 1983) and the current cow skeleton bones (*Bos taurus*).

Castiglione fossil

Cervus elaphus L.

Figure 4.— Comparison of the transversal section of the femur diaphysis (x 0,95).

back side



Castiglione fossil

Cervus elaphus L.

Figure 5.— Comparison in upper view of the proximal articular surface of the radius (x 0,95).

Castiglione fossil

Cervus elaphus L.

Figure 6.— Comparison in upper view of the proximal articular surface of the 2nd phalanx (x 0,95).

However, differences were noticed between the bones of the Castiglione fossil and the Bovinae ones. For instance, the humerus olecranian fossa (long and narrow) of the Castiglione fossil differs from the humeri of the Bovinae (rather short and wide). In the same way, whereas the shape of the lateral cavity of the proximal articular surface of the radius is short and subcircular on our examples, it is rectangular in the Bovinae. The two crests (external and internal) situated on the postero-distal side of the radius are visible on the fossil whereas they are not on the Bovidae examined. The tibia proximal extremity shows, in the cranial area of the Bovinae, a blunt tibial crest the lateral surface of which is little or not concave whereas that of the fossil is deep on the contrary. The tibial spine (short) of the proximal articular surface also differs from those of the Bovinae (high). Furthermore, unlike what can be seen on the Bovinae's small phalanxes in the upper-rear area no depression is visible. The thickening observed in the rear part of the articular surface of the plantar sole of piece Cast.3CG.166, although significant, does not evoke the Bovinae phalanxes.

Finally, only the shape of both sides (front and back) of the metatarsus Cast.3CG4.116 differs from the one usually observed on the metatarsus of Cervidae and Bovidae (Heintz, 1970; Bonifay M.-F., 1966). In the Bovidae, the front side has a shallow median fissure delimited by two edges, the medial edge being the most significant one. On metatarsis Cast. 3CG4.116, the fissure is shallow but, on the other hand, the two edges are of equal height. In the Bovidae, the backside is rather flat (fissureless and edgeless) all along its length, whereas on the metatarsis, this side is slightly concave in its proximal area and flattens towards the diaphysis where the borders are still visible although hardly marked.

The bone dimensions of the Castiglione fossil are inferior to the Lower Middle Pleistocene red deer ones (*Cervus elaphus* cf. *acoronatus* - Soleilhac, *Cervus elaphus acoronatus* - Voigstedt (Kahlke, 1969), Süssenborn (Kahlke, 1965)) and of the Upper Middle Pleistocene (*Cervus elaphus* - Lazaret (Bonifay, 1969), Chatillon St Jean (Mourer-Chauviré, 1972), Abimes de la Fage (Bouchud, 1972)) (Table 5a, 5b and 5c). The fossil shows, contrary to these populations, smaller sized long bones with epiphysial diameters, whether proximal or distal, of little or no variety. The bone dimensions of the fossil are in fact similar to those of the current red deer ones (Cardoso, 1993) (excepting the distal transversal diameter of the bones) being however closer to the maximal values of the latter (exceeding them even sometimes) (Table 5a, 5b and 5c). The fossil femur nonetheless remains an exceptional bone : the antero-posterior diameter of the diaphysis (36,6mm) differs from that of all the elaphines by a more important lateral flatness.

Finally, the biometrical comparison of some bones (humerus, radius, ulna, tibia, talus) with those issued from Spain current red deer populations (Marieszkurrena and Altuna, 1983), for which males and females were distinguished, allows us to envisage, within the fossil species, an eventual sexual dimorphism (Plate 1, fig. f-g, h-i, l-m). Thus, pieces Cast.3CG.143, Cast.3CG.099, Cast.3CG1.638, Cast.3CG.760, Cast.1.150, Cast.1.3.206, Cast.1.3.201 can be probably attributed to a female individual and pieces Cast.3CG.147, Cast.3CG.150, Cast.3CG.153, Cast.3CG.160 to a male. Considering the great variation of the red deer in Europe (Pietschmann, 1977; Cardoso, 1993; Pfeiffer, 1999) and the small sample analysed at Castiglione, this hypothesis requires further

material before it is to be confirmed.

The teeth of the Castiglione fossil are undoubtedly connected with the species *Cervus elaphus* L. but the numerous particular morphological bone features mentioned below differentiate it from the standard species, testifying to a new endemic insular sub-species *Cervus elaphus rossii.*

SYSTEMATICS

Class MAMMALIA LINNAEUS, 1758
Order ARTIODACTYLA OWEN,1848
Family CERVIDAE GRAY, 1821
Sub-family CERVINAE BAIRD, 1857
Tribe CERVINI VIRET, 1961
Genus *CERVUS* LINNAEUS, 1758

Species ***Cervus elaphus*** LINNAEUS, 1758
Sub-species: ***Cervus elaphus rossii*** n. ssp.
(Plate 1, fig. a-m; Plate 2, fig. a-n)

Diagnosis: endemic sub-species whose size of teeth is very close to those of the Rissian red deer, whereas the size of the bones is similar to that of the current red deer. This cervine is characterized by a shortening of all long bones, of the distal elements and by specific anatomic features (for example: subtriangular diaphysis of the femur, epicondylian crest of the blunt humerus, muscular insertion tuberosities of strong blunt small phalanxes, distal median grooves not much dug in gutter on the humerus and radius, condyles close to one another on the femur); the proximal and / or distal extremities of the stylopodes (humerus, femur), the zeugopodes (radius, tibia), the metatarsis and the phalanxes which are affected.

Derivatio nominis: *rossii*, this sub-species is dedicated to the owner of the land in which the deposit is situated.

Holotype: Cast.3CG.176 - portion of a right maxilla bearing P4/-M3/; Cast.3CG.100 - portion of a right mandible bearing P/4-M/3; Cast.3CG.413 - quasi entire left humerus; Cast.3CG2.628 - left femur, distal and proximal epiphyses; Cast.3CG6.44 - quasi entire right tibia.

Place of conservation of the material: museum of Sartene (South-Corsica)

Horizons and locations: fossiliferous point Cast.3CG in cavity 3 and levels 3 and 4 in cavity 1 of the Castiglione deposit, district of Oletta, 2km South of St Florent, Corsica.

Stratigraphic distribution : Corsican Middle Pleistocene

CONCLUSION

The dental and bone remains of 3 individuals extracted from the fossiliferous point Cast.3CG in cavity 3 and from levels 3 and 4 in cavity 1 of the Castiglione (Oletta, North-Corsica) deposit are attributed to *Cervus elaphus* L. and refered to an insular sub-species, *Cervus elaphus rossii.*

Of the two cavities examined, the fossiliferous point Cast.3CG, dating back to the Middle Pleistocene is the oldest. These are new original data in Corsica since the Castiglione deposit is the only one until now to have produced evidence of the presence of red deer of the Middle Pleistocene on the island. This new fossil form, the antlers of which are unknown, the teeth and limbs of which are elaphoid, is endowed with particular anatomic bone features. The bone analysis of the fore and hind limbs of this new insular form showed indeed a certain morphological convergence with the Bovinae bones. These features are located at the level of the proximal (radius, second phalanx, talus) and / or distal area (humerus, radius, femur, tibia) of the limb bones and concern, above all, the muscular connection areas. They could actually result from an adaptation to a particular environment, perhaps humid ((?) – (furthermore, the associated avifauna consists of species related to fresh water areas and / or marshland *Scolopax rusticola, Circus cyaneus, Circus aeruginosus, Porzana porzana, Porzana parva* (Louchart, submitted)) requiring thus a greater stability of the animal on soft marshy ground. The morphofunctional study of the bones remains to be carried out. Is is difficult to draw a conclusion because as the ancestral population is not known, a possible genetic derivation cannot be confirmed, neither can possible founding effects be ruled out. The endemism of *C. e. rossii* was hence made clear by the acquisition of these morphological features but also by the shortening of its limb size, insofar as they are biometrically similar to those of the current continental red deer, a deer that, according to the literature, is smaller than its Late and Middle Quaternary kin. Conversely, there was no shortening of its teeth size. This allometry has already been observed in endemic insular Cervids of the *Megaloceros* and *Cervus* genera (Azzaroli, 1961; Vigne, 1988) in which the modifications of size and, above all, the morphofunctional modifications essentially linked to the insular environment have often been mentioned (Caloi and Palombo, 1990, 1994) and examined in some cases (Caloi and Palombo, 1991, 1995).

The presence of *C. e. rossii* in Cast.3CG, its concomitant presence with *Megaloceros (Nesoleipoceros) cazioti* on levels 3 and 4 of cavity 1 and the absence of *C. e. rossii* in the Upper and late Pleistocene Corsican deposits (La Coscia (Bonifay *et al.,* 1998), Castiglione (Fracture PL. Salotti *et al.*, 2000), Gritulu (Vigne *et al.*, 1997)) testify to the older migration of *C. e. rossii* ((at the end of the Lower Pleistocene ?) according to much literature, a migratory wave took place about 800 000 years ago, at the end of the Lower Pleistocene, a migratory wave which, in Sardinia at least, replaced the *Nesogoral* fauna by the *Tyrrhenicola* fauna (Bonifay E., 1995; Cordy, 1997; Van der Made, 1999; Sondaar, 2000...), of its persistence in the Middle Pleistocene along with *M. (N.) cazioti* and finally of its extinction during or at the end of the Middle Pleistocene.

ACKNOWLEDGEMENTS

The author wishes to thank M. Salotti for entrusting her with the study of this material and for her advice, M.-F. Bonifay for his advice and his reading of the manuscript, J.-P. Brugal and the Parc Naturel Régional de Corse for putting at her disposal for comparison aims, the former, a skeleton of Holocene elaph deer and the latter, two skeletons of the current sub-species *Cervus elaphus corsicanus*. I wish to also thank the Direction régionale des Affaires culturelles de Corse, the Collectivité territoriale de Corse and the Ecole Pratique des Hautes Etudes (Montpellier) for their financial help.

REFERENCES

AZANZA, B. & SANCHEZ, B., 1990. — Les cervidés du Pléistocène Moyen d'Atapuerca (Burgos, Espagne). *Quaternaire*, 3-4 : 197-212.

AZZAROLI, A., 1952.—La sistematica dei cervi giganti e i cervi nani delle isole. *Att. Soc. Tosc. Sci. Nat.*, 59 : 119-127.

AZZAROLI, A., 1953.— The deer of the Weybourn Crag and Forest Bed of Norfolk. *Bull. Brit. Mus., Geology*, 2 : 91p.

AZZAROLI, A., 1961.— Il nanismo nei cervi insulari. *Paleontogr. Italica*, 56 : 1-32.

AZZAROLI, A., 1977.— A skull of the Giant Deer *Megaceros verticornis* from Eastern Tuscany. *Acc. Naz. Lincei. Rendic. Cl. Sci. Fis. Mat. Nat.*, 61 : 485-487.

AZZAROLI, A., 1978.— Fossil Mammals from the island Pianosa in the northern Tyrrhenian sea. *Boll. Soc. Paleont. Ital.*, 71 : 5-16.

AZZAROLI, A., 1979.— Critical remarks of some giant deer (Genus *Megaceros* Owen) from the Pleistocene of Europe. *Paleontogr. Italica*, 56 : 1-32.

BARONE, R., 1976.— Anatomie comparée des mammifères domestiques. Tome premier : Ostéologie. Laboratoire d'Anatomie, Ecole vétérinaire nationale, Lyon : 761 p.

BONFIGLIO, L., 1978.— Resti di Cervide (*Megaceros*) dell'Eutirreniano di Bovetto (RC). *Quaternaria*, 20: 87-98.

BONIFAY, E., 1995.— La grotte de la Coscia (Macinaggio/Rogliano, Cap Corse) et le problème du peuplement des îles de Méditerranée occidentale par l'homme de Néandertal. In : "l'Homme préhistorique et la mer", 120ème congrès CTHS : 133-140.

BONIFAY, E., BASSIAKOS, Y., BONIFAY, M.F., LOUCHART, A., MOURER-CHAUVIRÉ, C., PEREIRA, E., QUINIF, Y.& Salotti, M., 1998.— La grotte de la Coscia (Rogliano, Macinaggio) : Étude préliminaire d'un nouveau site du Pléistocène supérieur de Corse. *Paléo*, 10 : 17-43.

BONIFAY, M.F., 1966.— Les Bovidés. *In* : R. Lavocat (Ed.), Faunes et flores préhistoriques de l'Europe Occidentale. Boubée édit., Paris : 230 -244.

BONIFAY, M.F., 1969.— Les grands mammifères découverts sur le sol de la cabane acheuléenne du Lazaret. *Bull. Soc. Préh.*, 7 : 59-73.

BONIFAY, M.F., 1981.— Les *Praemegaceros* du Pléistocène moyen de la grotte de l'Escale a Saint-Estéve-Janson (Bouches du Rhône) : leur intérêt dans le contexte biostratigraphique européen. *Bull. Assoc. fr. Et. Quat.*, 7-8 : 109-120.

BOUCHUD, J., 1966.— Les Cervidés. *In* : R. Lavocat (Ed.), Faunes et flores préhistoriques de l'Europe

Occidentale. Boubée édit., Paris : 244-277.

BOUCHUD, J., 1972.— Les grands herbivores rissiens des "Abimes de la Fage" en Corrèze (Cervidés, Bovidés, Capridés, Rupicaprinés, Suidés et Equidés). *Nouv. Arch. Mus. Hist. Nat.*, 10 : 33-59.

BRUGAL, J.P., 1983.— *Applications des analyses multidimensionnelles à l'étude du squelette des membres des grands Bovidés pléistocènes (grotte de Lunel-Viel, Hérault) ; perspectives évolutives.* Thèse de doctorat 3ème Cycle, Univ. Aix-Marseille II, 449p.

CALOI, L. & MALATESTA, A., 1974.— Il cervo pleistocenico di Sardegna. *Mem. Ist. It. Paleont. Umana*, 2 : 163-260.

CALOI, L. & PALOMBO, M.R., 1990.— Gli erbivori pleistocenici delle isole del Mediterraneo : adattamenti. *Hystrix*, 2 : 87-100.

CALOI, L. & PALOMBO, M.R., 1991.— Morfologia e funzione della mano e del piede del Megacerino del Pleistocenico superiore di Dragonara (Sardegna, Italia). *Atti Acc. Peloritana dei Pericolanti, Cl. Sci. Fis. Mat. Nat.*, LXVII : 319-341.

CALOI, L. & PALOMBO, M.R., 1994.— Functional aspects and ecological implications in Pleistocene endemic herbivores of mediterranean islands. *Historical Biology*, 8 : 151-172.

CALOI, L. & PALOMBO, M.R., 1995.— Functional aspects and ecological implications in Pleistocene endemic cervids of Sardinia, Sicily and Crete. *Géobios*, 28 : 247-258.

CAPASSO-BARBATO, L. & GLIOZZI, E., 1997.— Fossil remains of *Cervus* from the Middle Pleistocene-Holocene of the island of Capri (Southern Italy) : palaeogeographical implications. *Boll. Soc. Paleont. Ital.*, 36 : 399-406.

CARDOSO, J.L., 1993.— *Contribuiçao para o conhecimento dos grandes mamiferos do Plistocenico superior de Portugal.* Thèse de doctorat, Univ. nova de Lisboa, Câmara municipal de Oieras édit., 567p.

CORDY, J.M., 1997. – I Karst fossiliferi di Orosei. *In* : Ginesu S. & Cordy J.M. (ed.) : Il Monte Tuttavista Orosei-Galtelli : I riempimenti carsici e la scoperta delle nuove specie del Pleistocene : 34-45.

DELPECH, F., 1988.— Les grands mammifères à l'exception des Ursidés. *Mém. Soc. préh. fr.*, 19 : 213-289.

DELPECH, F. & GUÉRIN, C., 1996.— Famille des Cervidae. *In* : Guérin CL. & Patou-Mathis (Ed.), Les grands mammifères Plio-Pléistocènes d'Europe, Masson édit., Paris : 47-62.

DEPÉRET, C., 1897.— Etude de quelques gisements nouveaux de Vertébrés pléistocènes de l'île de Corse. *Ann. Soc. Linn.* Lyon, 134 : 1472-1474.

DESSE, J., CHAIX, L., DESSE-BERSET, N., 1986.— "OSTÉO". Base-réseau de données ostéométriques pour l'archéozoologie. C.N.R.S. édit., Paris, 161 p.

Di STEFANO, G. & PETRONIO, C., 1992.— Nuove osservazioni su *Cervus elaphus acoronatus* Beninde del Pleistocene europeo. *Boll. Soc. Paleont. Ital.*, 31 : 295-315.

FERRANDINI, J., SALOTTI, M., BAILON S., BONIFAY, M.F., MOURER-CHAUVIRÉ, C., RÉAL-TESTUD, A.M., 1995.— Découvertes d'importants remplissages fossilifères d'âge Pléistocène supérieur et Holocène dans le Karst de la région d'Oletta (Haute-Corse). *Géobios*, 28 : 117-124.

GLIOZZI, E. & MALATESTA, A., 1982.— A megacerini in the Pleistocene of Sicily. *Geol. Rom.*, 21 : 311-389.

GLIOZZI, E., MALATESTA, A., SCALONE, E., 1993.— Revision of *Cervus elaphus siciliae* Pohlig, 1893, Late Pleistocene endemic deer of the Siculo-maltese district. *Geol. Rom.*, 29 : 307-353.

GUADELLI, J.L., 1996.— Les cerfs du Würm ancien en Aquitaine. *Paléo*, 8 : 99 -108

HEINTZ, E., 1963.— Les caractères distinctifs entre métatarses de Cervidae et Bovidae actuels et

fossiles. *Mammalia*, 27 : 200-209.

HEINTZ, E., 1966.— Caractères distinctifs entre Cervidés et Bovidés actuels et Quaternaires. Phalange II. *Mammalia*, 30 : 138-141.

HEINTZ, E., 1970.— Les Cervidés villafranchiens de France et d'Espagne. *Mem. Mus. Nat. Hist. Nat.*, Paris, 509 p.

JANIS, C.M. & LISTER A., 1985. – The morphology of the lower fourth premolar as a taxonomic character in the ruminantia (Mammalia, Artiodactyla), and the systematic position of triceromeryx. *J. Paleont.*, 59 : 405-10.

KAHLKE, H.D., 1960.— Die Cervidenreste aus den Altpleistozänen sanden von Mosbach (Biebrich-Wiesbaden). *Akademie Verlag*, 7 : 1-75.

KAHLKE, H.D., 1965.— Die Cervidenreste aus den Tonen von Voigtstedt in Thüringen. *Paläont. Abh.*, 2 : 379-428.

KAHLKE, H.D., 1969.— Die Cervidenreste aus den Kiesen von Süssenborn bei Weimar. *Paläont. Abh.*, 3 : 547-610.

KAHLKE, H.D., 1984.— Die Cervidenreste aus den Travertinen von Weimar (Travertinen im Stadtgebiet) : *Quärtärpaläontologie*, 5 : 361-367.

LAQUAY, G., 1981.— *Recherches sur les faunes du Würm I en Périgord.* Thèse de doctorat 3ème cycle, Univ. Bordeaux I, 429 p.

LEINDERS, M., 1979.— On the osteology and function of digits of some ruminants and their bearing on taxonomy. *Z. Säugetierkunde*, 44 : 305-319.

LISTER, A.M., 1987.— *Megaloceros* Brookes, 1828 (Mammalia, Artiodactyla) : proposed emendation of the original spelling. *Bull. Zool. Nom.*, 44 : 255-256.

LISTER, A.M., 1989.— Rapid dwarfing of red deer on Jersey in the last interglacial. *Nature*, 342 : 539-542.

MARIEZKURRENA, K. & ALTUNA, J., 1983.— Biometria y dimorfismo sexual en el esqueleto de *Cervus elaphus* würmiense, postwürmiense y actual del Cantabrico. *Munibe*, 35 : 203-246.

MENENDEZ, E., 1987.— Cérvidos del yacimiento del Pleistoceno inferior de Venta Micena 2, Orce (Granada, Espana). *Paleont. i Evol.*, 1 : 129-181.

MOURER-CHAUVIRÉ, C., 1972.— Etude de nouveaux restes de vertébrés provenant de la carrière Fournier à Châtillon-Saint-Jean (Drôme). III. Artiodactyles, chevaux et oiseaux. *Bull. Ass. fr. Et. Quat.*, 4 : 271-305.

MOURER-CHAUVIRÉ, C. & SANCHEZ-MARCO, A., 1988.— Présence de *Tyto balearica* (Aves, Strigiformes) dans des gisements continentaux du Pliocène de France et d'Espagne. *Géobios*, 21 : 639-644.

MOURER-CHAUVIRÉ, C., SALOTTI, M., PEREIRA, E., QUINIF, Y., COURTOIS, J.Y., DUBOIS, J.N., La MILZA, J.C., 1997.— *Athene angelis* n. sp. (Aves, Strigiformes), nouvelle espèce endémique insulaire éteinte du Pléistocène moyen et supérieur de Corse (France). *C. R. Acad. Sci.*, série IIa, 324 : 677-684.

NOURY, F., 1997.— *Analyse et distinction des Cervidés du Pléistocène moyen de la grotte I du Mas des Caves (Lunel-Viel, Hérault, france).* DEA d'Anthropologie option Préhistoire. I.P.G.Q. Univ. Bordeaux, 125p.

PETRONIO, C., 1990.— Les cervidés endémiques des îles méditerranéennes. *Quaternaire*, 3/4 : 259-264.

PEREIRA, E., 2000.— Présence du Cervidé *Megaloceros (Nesoleipoceros) cazioti* (Depéret, 1897) dans le gisement pléistocène de Corte (Corse). *Géodiversitas*, 22, 3 : 433-455.

PEREIRA, E., 2001.— *Le peuplement mammalien quaternaire de Corse (Post-Glaciaire exclu) : son*

contexte environnemental, biologique et physique. Thèse de 3ème cycle, Université Pascal Paoli, Corse : 341p.

PEREIRA, E. & BONIFAY, M.F., 1998.— Étude préliminaire des restes de cervidés de la grotte de la Coscia (Rogliano, Haute-Corse). *Paléo*, 10 : 43-61.

PEREIRA, E., ROUZAUD, F., SALOTTI, M., DUBOIS, J.N., FERRANDINI, J., OTTAVIANI-SPELLA, M.M., QUINIF, Y., 1999.— Castiglione (Oletta, Haute-Corse) : relationships between phenomena of calcification and tectonic fossiliferous fracture dating. *Geodinamica Acta*, 12 : 371-375.

PEREIRA, E. & SALOTTI, M., 2000.— *Cyrnolutra castiglionis*, une nouvelle forme de loutre (Mustelidae, Lutrinae), dans un dépôt du Pléistocène moyen " Castiglione 3CG " (Oletta, Haute-Corse). *C. R. Acad. Sci.*, série IIa, 331 : 45-52.

PFEIFFER, T., 1999. – Sexualdimorphism, ontogeny and intraspecific variation of the Pleistocene cervid populations of *Dama geiselana* Pfeiffer 1998 and *Cervus elaphus* L. (Cervidae, Mammalia) from Neumark-Nord (SW Halle a.d. Saale, Sachsen-Anhalt, Germany). *Geowiss Abh.*, 30 : 207-343.

PIETSCHMANN, W. 1977. – Zur Grösse des Rothirsches (*Cervus elaphus* L.) in vor und frühgeschtlicher Zeit (untersuchung an Knochenfunden aus archäologischen Ausgegrabungen). Univ. München éd., Munich : 154p.

SALOTTI, M., BAILON, S., BONIFAY, M.F., COURTOIS, J.Y., DUBOIS, J.N., FERRANDINI, J., FERRANDINI, M., La MILZA, J.C., MOURER-CHAUVIRÉ, C., POPELARD, J.B., QUINIF, Y., RÉAL-TESTUD, A.M., MINICONI, C., PEREIRA, E., PERSIANI C., 1997.— Castiglione 3, un nouveau remplissage fossilifère d'âge Pléistocène moyen dans le Karst de la région d'Oletta (Haute-Corse, France). *C. R. Acad. Sci.*, série IIa, 323 : 67-74.

SALOTTI, M., BELLOT-GOURLET, L., COURTOIS, J.Y., DUBOIS, J.N., LOUCHART, A., MOURER-CHAUVIRÉ, C., OBERLIN, C., PEREIRA, E., POUPEAU, G., TRAMONI, P., 2000.— La fin du Pléistocène supérieur et le début de l'Holocène en Corse : apports paléontologique et archéologique du site de Castiglione (Oletta, Haute-Corse). *Quaternaire*, 11 (3-4) : 219-230.

SIGOGNEAU, D., 1960.— Etude d'un Cervidé pléistocène de Corse. *Ann. Pal.* (Vertébrés-Invertébrés), 46 : 44-77.

SONDAAR, P.Y., 2000.— Early human exploration and exploitation of islands. *Tropics*, 10 : 203-230.

VAN der MADE, J., 1999. – Biogeography and stratigraphy of the Moi-Pleistocene mammals of Sardinia and the description of some fossils. *In* : Reumer J.W.F. & De Vos J. (ed.) : Elephants have a snorkel! Papers in honour of Paul Y. Sondaar. *Deinsea*, 7 : 337-360.

VIGNE, J.D., 1988.— Les mammifères post-glaciaires de Corse : étude archéozoologique. *Gallia Préhistoire* , 26ème suppl. : 337 p.

VIGNE, J.D. & DEMEAUTIS, G., 1987.— Le cerf élaphe, *Cervus elaphus*. *In* : Les mammifères en Corse, espèces éteintes et actuelles. P.N.R.C. édit., Ajaccio : 131-137.

VIGNE, J.D., BAILON, S., CUISIN, J., 1997.— Biostratigraphy of amphibians, reptiles, birds and mammals in Corsica and the role of man in the Holocene faunal turnover. *Anthropozoologica*, 25-26 : 587-604.

	P4/		M1/		M2/		M3/	
	MDD	VLD	MDD	VLD	MDD	VLD	MDD	VLD
Castiglione Fossil (maxilla Cast.3CG.176) Middle Pleistocene	16,2	17,1	22,8	22,1	24,4	22,1	24,8	21,3
Praemegaceros solilhacus - Venta Micena 2	(24) 16.83	(24) 21.84	(16) 23.3	(16) 23.71	(21) 26.4	(18) 26.78	(17) 26.14	(18) 26.31
approx. 1.4 Ma (Menendez, 1987)	15.2-17.9	20.3-23	20.9-25.5	22.3-25.4	23.7-28.7	24.4 - 29.2	22.5 - 28.5	23.5 - 28
Megaceros (Nesoleipoceros) cazioti - Coscia	(2) 13 -13	(2) 15-15	(3) 17	(2) 14 - 18	(4) 19	(4) 18	(4) 20	(3) 17
Upper Pleistocene (Pereira & Bonifay M.F., 1998)			16-20		18 - 20	14 - 20	18 - 21	17 - 18
Megaceros carburangelensis - Capo Tindari	(7) 10.5	(7) 15.07	(12) 15.45	(9) 17.7	(12) 18.06	(10) 18.76	(12) 17.9	(12) 16.9
Upper and Middle Pleistocene (Gliozzi & Malatesta, 1982)	10 - 11	14.5 - 16	14 -17	17 - 18.4	17- 19	17.6 - 20	16.6 - 19	15 - 19
Cervus elaphus - Lunel-Viel	(17) 14.93	(17) 17.78	(20) 21.27	(20) 21.47	(19) 24.14	(19) 23.2	(18) 23.27	(18) 22.82
approx. 0.35 Ma (Noury, 1997)	12.8 - 16.8	16.6 - 18.7	18.4 - 23.7	20.2 - 23.2	21.2 - 26.8	21.5 - 25.2	22 - 24.7	21.1- 25
Cervus elaphus - Grotte Vaufrey	(12) 15.8	(11) 19.2	(17) 22.5	(16) 22.6	(12) 25.9	(12) 24.5	(12) 24.5	(12) 24.6
Riss (Delpech, 1988)	14 - 17	17 - 21.3	19.5 - 25.3	20.8 - 24	24.1 - 28.7	23 - 26.8	23 à 27.5	23.5 - 26.7
Cervus elaphus - collection MNHN	(11) 11.7	(11) 17.8	(12) 16.46	(12) 20.5	(11) 18.73	(10) 22.5	(11) 19.74	(8) 22.1
Current (Cardoso, 1993)	8.5 - 14.8	14 - 19.9	12 - 19.2	17.2 - 21.8	13.4 - 20.4	18.9 - 25.2	14.4 - 24.2	18.3 - 25.8
Cervus elaphus corsicanus - Current (personal data)	(2) 13.4 - 14.1	(2) 11.4 - 14.2	(2) 17.1 - 18.1	(2) 14.9 - 16.5	(2) 19.9 - 21.9	(2) 14.9 - 17.3	(2) 21.1 - 22.8	12.9 - 14.4
Cervus elaphus siciliae - Cave Puntali								
Upper Pleistocene (Gliozzi *et al* ., 1993)	(2) 12 - 13.4	(2) 16 - 16	(2) 17 - 17	(2) 19 - 19.3	(2) 19-20	(2) 18-21	(1) 20	(1) 19

Abbreviations: MDD: mesio-distal diameter, VLD: vestibulo-lingual diameter

For each measurement are given respectively, the number of specimen in brackets, the mean and the range of variation when necessary.

Table 1a.— Upper teeth occlusal measurements of the Castiglione fossil. For comparison, measurements of Pleistocene megacerins and of Pleistocene Current elaphs

	P/4		M/1		M/2		M/3	
	MDD	VLD	MDD	VLD	MDD	VLD	MDD	VLD
Castiglione Fossil (mandible Cast.3CG.100) Middle Pleistocene	18,9	12,3	20,9	15,6	25,6	16,8	32,5	15,1
Praemegaceros solilhacus - Venta Micena 2	(32) 21.98	(32) 13.5	(27) 24.61	(25) 15.93	(30) 27.2	(28) 17.76	(28) 38.24	(30) 17.18
approx. 1.4 Ma (Menendez, 1987)	20.5 -24.1	12.3 - 14.9	21.9 - 27.7	13.6 - 18	25.9 - 29.9	16 - 19.5	34 - 43.2	34 - 43.2
Megaceros (Nesoleipoceros) cazioti - Coscia	(4) 14	(4) 10	(3) 17	(3) 13	(3) 20	(3 13	(4) 25	(5) 13
Upper Pleistocene (Pereira & Bonifay M.F., 1998)	13 - 15	10 - 11	16 - 18	13 -13-13	17 - 18	13 - 14	24 - 26	12-13
Megaceros carburangelensi s - Capo Tindari	(17) 12.84	(17) 8.70	(14) 15.4	(13) 10.11	(13) 17.96	(13) 11.15	(13) 22.4	(12) 10.38
Middle and Upper Pleistocene (Gliozzi & Malatesta, 1982)	11 - 14.5	6.5 - 10	14.5 - 17	8 - 11.5	16 - 20	10 - 12	20 - 23.7	9 - 11
Cervus elaphus - Lunel-Viel	(32) 17.32	(32) 11.36	(33) 20.3	(33) 13.24	(33) 23.85	(33) 14.8	(27) 32.81	(27) 14.67
approx. 0.35 Ma (Noury, 1997)	15.2 - 19.8	9 - 13.1	16.8 - 23.3	11.4 - 14.8	21.2 - 26.6	13.9 - 15.9	29.6 - 37.3	13.4 - 15.7
Cervus elaphus - Lazaret	(4) 21.2	(4) 13.2	(3) 22.9	(3) 14.7	(3) 28.1	(3) 15.4	(3) 32.5	(3) 15.3
Riss (Bonifay M.F., 1969)	20 - 21.9	12.4 - 13.8	21.2 - 25.5	13.9 - 15.2	26.9 - 30	15.2 - 15.8	30.5 - 33.9	15 - 15.5
Cervus elaphus - Grotte Vaufrey	(10) 19.6	(10) 12.7	(11) 22.15	(10) 14.1	(9) 26.1	(10) 15.4	(10) 33.5	(10) 15.1
Riss (Delpech, 1988)	17.6 - 21	11.3 - 14	20.5 - 24	13-15.3	24.5 - 28.2	14.2 - 16.7	28.5 - 37.1	13.4 - 16.5
Cervus elaphus - collection MNHN	(10) 15.26	(9) 10.9	(10) 17.93	(9) 12.46	(10) 20.5	(9) 13.08	(7) 29.84	(8) 13.26
Current (Cardoso, 1993)	12 - 18.2	8.5 - 12.6	12.2 - 20.6	11.4 - 13.6	14 - 24.3	10 - 15.6	20.6 - 33	12 - 15.2
Cervus elaphus corsicanus - Current (personal data)	(2) 14.9 - 15.7	(2) 8.2 - 9.7	(2) 15.2 - 15.5	(2) 9.9 - 10.9	(2) 20.1 - 22.1	(2) 10.9 - 13.2	(2) 27.4 - 27.8	(2) 10.6 - 12.4
Cervus elaphus siciliae - Cave Puntali					(3) 20;5	(3) 12.5		
Upper Pleistocene (Gliozzi *et al* ., 1993)	(1) 16	(1) 11	(2) 16 - 16.7	(2) 11 - 11.3	19 - 23	12.5 - 12.6	(2) 26 - 26.9	(2) 11 - 12

Abbreviations: MDD: mesio-distal diameter, VLD: vestibulo-lingual diameter

For each measurement are given respcctively, the number of specimen in brackets, the mean and the range of variation when necessary.

Table 1b.— Lower teeth occlusal measurements (mm) of the Castiglione fossil. For comparison, measurements of Pleistocene megacerins and of Pleistocene Current elaphs

	Castiglione fossil	*Cervus elaphus L.*
proximal extremity	**Humerus**	
- big trochiter summit	rather rounded.	rather square.
- bicipital slide	wide and shallow.	narrow and shallow thin.
- deltoidian tuberosity	prominent, thick and elongated	cutting and short.
distal extremity	**Humerus**	
- epicondylian crest	blunt and flat*.	pinched, thin with a certain posterior cavity tall.
- lip separating lateral lip from trochlea and condyle	small height and blunt*.	hight, sharp and cutting.
- condyle	not really withdrawn from lateral lip, situated at the same level as the trochlea median.	withdrawn from lateral lip and set lower than the groove
- trochlea median groove	groove*.	deep and gutter-shaped.
- epitrochlea medial profile	shallow*.	rather vertical and pinched.
- shape of olecranian fossa	rounded and thick long, narrower and triangular in its summital part.	shorter, wider and slightly rounded in its summital part.
proximal extremity	**Radius**	
- median glenoid cavity	wide with a rounded outline.	wide with a subrectangular outline.
- shape of lateral part	short, wide, little or not concave and subcircular.	outstretched, narrow, concave and rectangular with a caudal extremity tapering into a point narrow.
- shape of lateral tuberosity	short and small surface with a rounded outline, heightened or implanted at the level of the lateral part.	oblique surface, longer and withdrawn from the lateral part.
- indentation situated at the level of depression on cranial side	rather short indentation, V or U shaped*.	deeper indentation, reaching far into depression and V shape.
distal extremity	**Radius**	
- front part of the scaphoidian facet	convex and delimited by two blunt crests*.	concave, dug in gutter-shape and delimited by two sharp crests.
- scaphoidian facet	heightened from the semi-lunear facet.	not much or not heightened.
- central and front parts of the facet for the semi-lunar	1st not much strangled, 2nd convex*.	1st highly strangled, 2nd concave and dug in gutter-shape slightly.
- distal facet for the pyramidal	rather oblique position*.	more horizontal position.

Table 2.— Morphological differences noticeable at the level of the fore limb.

	Castiglione fossil	*Cervus elaphus L.*
proximal extremity	**Femur**	
- trochanter	very prominent and blunt.	thin, cutting and slightly.
- diaphysis section	subtriangular*.	longer subcircular to circular.
distal extremity	**Femur**	
- medial lip of trochlea	blunt, of little height, goes little back up in proximal direction*.	thin, cutting, tall, goes quite high up in proximal direction.
- lateral lip of the trochlea	thin, rather cutting and as tall as medial lip*.	thinner, quite cutting and shorter than medial lip.
- median groove of the trochlea	shallow*.	rather deep and gutter-shaped.
- trochlea profile in its lower part, from cranial view	shortened ; rather pointed at its intercondylian fossa level (point directed toward groove) ; continuity between median groove of the trochlea and intercondylian fossa*.	wide; rounded at its intercondylian fossa level forming a sort of horizontal ledge leading to a rupture between the median groove and this fossa.
- intercondylian line situated between the two condyles in caudal view	narrow and short, condyles being rather close to one another.	a little wider and longer, condyles being rather spaced out.
-sus-condylian crests (lateral and medial)	prominent and blunt*.	pinched and cutting.
distal extremity	**Tibia**	
- medial malleolus in caudal view	flat malleolus.	highly convex malleolus.
- caudal indentation between the two malleoli	little or not pronounced.	well marked.
-caudal rim of the two malleoli	blunt and curved.	pinched, rectilinear (lateral malleolus) and pointed (medial malleolus).
-medial tendinous slide	slightly marked and shallow*.	marked and deep.
-lateral tendinous slide	poorly marked and shallow.	marked, deep and little wider.
-medial malleolus profile	rounded, thick and blunt thick.	pointed, more outstretched, thin and cutting thin.
-edge of the median projection in cranial view	rectilinear, blunt edge.	pointed, jutting edge.
-lateral rugosity situated on the lateral side in cranial view	prominent and short.	less prominent and spread out.
proximal extremity	**Astragalus**	
- shape of proximal groove	in V; the two lips are close to another.	large U; the two lips are far apart.
- internal edge of lateral lip	very oblique in dorsal view.	less oblique.
proximal extremity	**Metatarsus**	
- foreside	shallow median fissure delimited by little-marked lateral and medial edges of equal height.	deeper dissymmetrical median fissure delimited by a medial edge and a lateral edge of different heights, the former being higher.
- rear side	little concave in its proximal part with a slight fissure and delimited by two edges, then progressively flattened,deprived of median fissure at the diaphysis level, edges delimitating it are poorly marked	concave all along the bone with a deep median fissure, either delimited by a high and jutting lateral edge, or at the same time by high and jutting lateral and medial edges.
- postero-external tuberosity	little prominent and blunt.	prominent and pinched.
- postero-internal tuberosity	little prominent and not jutting much out.	prominent (but less than the external tuberosity) and jutting out much.

Table 3.— Morphological differences noticeable at the level of the hind limb.

	Castiglione fossil	*Cervus elaphus L.*
proximal extremity	**1st phalanx**	
- antero-internal tuberosity	prominent and blunt.	less prominent and smoother.
- postero-internal tubercle	long, very prominent and blunt, not reaching the diaphysis.	Very long, less prominent and pinched, spreading down half size of the diaphysis.
- postero-external tubercle	short, prominent and blunt.	less short and pinched.
proximal extremity	**2nd phalanx**	
- proximal articular side	narrow in the antero-posterior direction and wide in the transversal direction.	more outstretched in the antero-posterior direction and narrower in the transversal direction.
- shape of the front edge	prominent spout turning up*.	far less marked spout.
- postero-external tubercle	prominent, jutting, blunt, wide and short*	thin, jutting out much, very outstretched, pinched along the palmar side down to the diaphysis.
- postero-internal tubercle	very prominent, blunt, very short*.	less prominent, pinched and a little longer.
- back slide between the two tubercles	inexistent, tubercles joined up by a horizontal protuberance*.	well marked, narrow and more or less deep.
proximal extremity	**3rd phalanx**	
- articular side	dissymmetrical, divided into two unequal facets by an oblique carina*.	symmetrical, divided into two more or less equal facets by a median carina.
- rear thickening of the plantar sole	quite significant.	small.
- plantar sole width	quite significant.	variable.

Table 4.— Morphological differences noticeable at the level of phalanxe.

Scapula	**TDgc**	**APDgc**				
Castiglione fossil	43.9	46.9				
Humerus	**Lh**	**TDP**	**TDdia**	**APDdia**	**TDD**	**APDP**
Castiglione fossil	(1) > 234.9	(2) 70.5-75.8	(1) 29.8	(1) 36.8	(1) 55.5	(1) 59.4
C. e. cf. *acoronatus*			(1) 31.5	(1) 39.9	(5) 56.9	(5) 59.2
(0,9 Ma) Soleilhac					55.7-58.8	58.3-61.4
C. elaphus - current	(8) 256.4	(8) 69.7	(8) 25.8	(8) 32.1	(8) 51.6	(8) 48.5
MNHN collection (Cardoso, 1993)	224.5-278.8	61.5-78	21.7-30.7	28.1-36	46.2-55.5	43.5-52.3
Radius	**TDP**	**APDP**	**TDdia**	**APDdia**	**TDD**	
Castiglione fossil	(2) 61.1-62.1	(2) 30.8-31.9	(1) 34.8	(1) 20.5	(2) 45.1-51.4	
C.e. cf. *acoronatus*	(3) 60.2				(5) 52.9	
Soleilhac (0,9 Ma)	56.3-64.8				51.2-54.9	
C.e. cf. *acoronatus* - Süssenborn	(1) 64	(1) 34.3				
(0,5/0,4 Ma) (Kahlke, 1969)						
C. e. acoronatus - Mosbach	(15) 61	(15) 32.5	(14) 36.7	(14) 22.2		
(0,5/0,4Ma) (Di stefano & Petronio, 1992)	53-69	29-36	30-41	18-27		
C. elaphus - Chatillon St. Jean	(5) 67.9	(5) 38.4	(3) 43.6	(3) 26.6		
Riss - (Mourer-Chauviré, 1972)	58.8-74	33.8-41	41-46	25-28		
current *C. elaphus*	(8) 51.9	(8) 28.5	(8) 29.9	(8) 16.2	(8) 47	
MNHN collection (Cardoso, 1993)	46.3-58.1	26.5-31.6	25.8-34.9	13.7-19.5	42.6-51.9	
Ulna	**min APD ol**	**APDanc**	**TDsurf art**	**L ol**		
Castiglione fossil	(3) 43.16	(3) 49.4	(2) 27.1-32.7	(2) 63.8-72.5		
	38.4-46.2	44.6-52.5				

Abbreviations : TD gc : transverse diameter of the glenoid cavity ; APDC : antero-posterior diameter of the glenoid cavity; Lh : maximal length from the head; TDP : transverse diameter of the proximal epiphysis; APDP : antero-posterior diameter of the proximal epiphysis; TDdia : minimum transverse diameter of the diaphysis; APDdia : minimum antero-posterior diameter of the diaphysis; TDD : transverse diameter of the distal epiphysis; APDD : antero-posterior diameter of the distal epiphysis; min APD ol : minimum antero-posterior diameter of the olecranon ; APD anc : antero-posterior diameter to the anconeal process; TDsurf art : transverse diameter of the articular surface; L ol : length of olecranon.
For each measurement are given respectively, the number of specimen in brackets, the mean and the range of variation when necessary

Table 5a.— Measurements (mm) of the Castiglione fossil fore limb. For comparison, measurements of several continental fossil and current elaphs.

Femurs	**TDP**	**TDdia**	**APdia**	**TDD**	**APDD**		
Castiglione fossil	(1) 84,3	(1) 28,1	(1) 36,6	(1) 72,4	(1) 89,4		
C. elaphus - Abimes de la Fage		(2) 24-30	(2) 28-33	(2) 62-75	(3) 89,6		
Riss (Bouchud, 1972)					82-104		
C. elaphus- current	(6) 79,3	(22) 26,9			(6) 85,9		
MNHN collection (Cardoso, 1993)	71,4-86,7	22-28,3			79,2-93,7		
Tibias	**ML**	**extL**	**TDP**	**TDdia**	**APDdia**	**TDD**	**APDD**
Castiglione fossil	(1) > 342.7	(1) 325.5	(1) > 78.9	(1) 33.6	(1) 24.7	(1) 48.4	(1) 38.1
C.e. cf. *acoronatus* - Süssenborn	(1) 407		(1) 87.9	(1) 36	(1) 30.5	(1) 57.7	(1) 42.5
(0,5/0,4 Ma) (Kahlke, 1969)							
C. e. acoronatus - Mosbach	(2) 409-411		(1) 92	(7) 36.5	(7) 31.2	(13) 53	(12) 39.8
(0,5/0,4Ma) (Di stefano & Petronio, 1992)				33-40	28-35	45-60	34-47
C. elaphus - Abimes de la Fage	(1) 379		(1) 76	(1) 34	(1) 23,4	(1) 51	(2) 39-42
Riss (Bouchud, 1972)							
C. elaphus - Chatillon St. Jean						(3) 60.3	(3) 45.3
Riss (Mourer-Chauviré, 1972)						55-63	43-48
C. elaphus - current	(6) 341.3		(6) 71.4	(6) 28.4	(6) 23.7	(6) 45.1	(6) 35.7
MNHN collection (Cardoso, 1993)	313.8-363.5		68.4-75.8	25.2-33.8	22.8-24.7	40.7-49.4	31.3-37.8
Metatarsi	**TDP**	**APDP**	**TDdia**	**APDdia**	**TDD**	**APDD**	
Castiglione fossil	(1) 36.5	(1) 39,3	(1) 20.9	(1) > 23,7	(1) 45.9	(1) 29.4	
C.e. cf. *acoronatus* - Süssenborn	(1) 42	(1) 48,2	(1) 27		(1) 49.3	(1) 31.6	
(0,5/0,4 Ma) (Kahlke, 1969)							
C. e. acoronatus - Mosbach	(32) 40.5	(35) 43.7	(35) 26.4	(35) 29.7	(22) 47.8	(22) 29.9	
(0,5/0,4Ma) (Di stefano & Petronio, 1992)	34-47	38-51	24.9-32	25.5-35	41.5-58	25.5-34.5	
C. elaphus - current	(6) 33.3	(7) 36.7	(7) 21.3	(7) 23.6	(7) 38.3	(7) 25.7	
MNHN collection (Cardoso, 1993)	26.7-37.1	33.2-38.4	18.8-23.8	21.7-27.1	35.2-42.3	24.4-27.3	
Tali	**extL**	**intL**	**ext thi**	**int thi**	**TDD**	**TDP**	
Castiglione fossil	(2) 46.9-58.1	(3) 47.06	(3) 27.3	(2) 26.1-33.4	(2) 27.7-31.6	(3) 30.7	
		44.1-53.6	25.1-31.4			28.3-35.4	
Calcanei	**ML**	**TD max**					
Castiglione fossil	(1) > 112.5	(1) 34.6					
Cubo-naviculars	**H**	**TDP**	**APD**				
Castiglione fossil	(1) 31.1	(1) 42.8	(1) 37.6				

Abbreviations : TDP : transverse diameter of the proximal epiphysis; APDP : antero-posterior diameter of the proximal epiphysis; TDdia : minimum transverse diameter of the diaphysis; APDdia : minimum antero-posterior diameter of the diaphysis; TDD : transverse diameter of the distal epiphysis; APDD : antero-posterior diameter of the distal epiphysis; ML : maximal length of the bone; extL : maximal external length; intL : maximal internal length; ext thi : maximal external thickness; int thi : maximal internal thickness; TD max : maximal transverse diameter; H : height.
For each measurement are given respectively, the number of specimen in brackets, the mean and the range of variation when necessary.

Table 5b.— Measurements (mm) of the Castiglione fossil hind limb. For comparison, measurements of several continental fossil and current elaphs.

1st phalanxes	ML	TDP	APDP	TDdia	APDdia	TDD	APDD
Castiglione fossil	(3) 55.6	(3) 23.2	(3) 26.8	(3) 18.23	(3) 18.1	(3) 20.5	(3) 17.8
	54.5-57.1	23.1-23.4	25.5-29.1	17.9-18.9	18.1-18.1	20.1-20.8	17.7-17.9
C.e. cf. *acoronatus* - Soleilhac (0,9 Ma)	(2) 60.6-60.9	(2) 23.2-23.4	(2) 27.1-28.1	(2) 18.5-19.4	(2) 20.1-20.3	(2) 20.8-21.5	
C. e. acoronatus - Voigstedt (0,9/0,8Ma) (Kahlke, 1965)	(1) 67.7	(1) 26.3		(1) 17.4		(1) 22.8	
C. elaphus - Abimes de la Fage	(5) 58.1	(4) 21.8	(6) 27.8			(5) 20.8	
Riss (Bouchud, 1972)	56.5-60	21-23	25.9-29			20.3-21.2	
C. elaphus - current	(12) 52.5	(12) 19.4		(6) 15.35	(12) 18.41	(6) 14.6	
MNHN collection (Cardoso, 1993)	48.3-57.3	17.8-21.3		13.4-18.6	16.4-21.1	14.4-14.8	
2nd phalanxes	**ML**	**TDP**	**APDP**	**TDdia**	**APDdia**	**TDD**	**APDD**
Castiglione fossil	(4) 38.4	(4) 21.8	(4) 27.52	(4) 17.5	(4) 21	(4) 18.8	(4) 27.03
	33.1-41.1	19.8-22.1	23.9-29.7	16.5-18.2	19.5-21.9	18.1-19.7	24.6-29.9
3rd phalanxes	**Lsole**	**Ldor**	**H**	**TD art**	**APD art**	**D Tsole**	
Castiglione fossil	(1) 49.1	(1) 43.4	(1) 29.2	(1) 18.6	(1) 29.2	(1) 18.3	

Abbreviations : ML : maximal length of the bone; TDP : transverse diameter of the proximal epiphysis; APDP : antero-posterior diameter of the proximal epiphysis; TDdia : minimum transverse diameter of the diaphysis; APDdia : minimum antero-posterior diameter of the diaphysis; TDD : transverse diameter of the distal epiphysis; APDD : antero-posterior diameter of the distal epiphysis; Lsole : length of the sole; Ldor : length of the dorsal surface; H : height of the phalanx; TD art : transverse diameter of the articular facet ; APD art : antero-posterior diameter of the articular facet; TD sole : median tranverse diameter of the sole.
For each measurement are given respectively, the number of specimen in brackets, the mean and the range of variation when necessary.

Table 5c.— Measurements (mm) of the Castiglione fossil phalanxes. For comparison, measurements of several continental fossil and current elaphs.

CAPTIONS OF PLATES

PLATE 1

Cervus elaphus rossii

Castiglione (Oletta, North-Corsica).

a: portion of right maxilla (Cast.3CG.176) bearing P4/-M3/ in occlusal view.

b: portion of right mandible (Cast.3CG.100) bearing P/4-M/3 in occlusal view.

c-d: left humerus (Cast.3CG.143) in back (c) and front (d) view.

e-f: left radius, proximal [Cast.3CG.154 (e)] and distal epiphyses [Cast.3CG.153 (f)] in front view.

g: left radius (Cast.3CG.152), distal epiphysis in front view.

h: right olecranon (Cast.3CG.150) in medial view.

i: right olecranon (Cast.1.3.206) in medial view.

j: right metatarsus (Cast.3CG1.116), proximal epiphysis and diaphysis in front view.

k: ind. metatarsus (Cast.3CG.159), distal epiphysis in front view.

l: right talus (Cast.3CG1.638) in back view.

m: left talus (Cast.3CG.160) in back view. Scales = x 1/2.

PLATE 2

Cervus elaphus rossii

Castiglione (Oletta, North-Corsica).

a-b: left femur, proximal [Cast.3CG2.628 (a)] and distal epiphysis [Cast.3CG.146 (b)] in front view.

c-d, left femur, proximal [Cast.3CG2.628 (c)] and distal [Cast.3CG.146 (d)] in back view.

e-f: right tibia (Cast.3CG6.44) in front (e) and back view (f).

g-h-i: 1st right phalanx (Cast.3CG.162 in front (g), back (h) and upper view (i).

j-k: 2nd right phalanx (Cast.3CG.163) in front (j) and back view (k). i – 2nd left phalanx (Cast.3CG.165) in upper view. m-n, 3rd phalanx in lateral (m) and medial view (n). Scales = x 1/2.

PLATE 1

PLATE 2