

CERVUS ELAPHUS SICILIAE FROM PLEISTOCENE LACUSTRINE DEPOSITS OF ACQUEDOLCI (NORTH-EASTERN SICILY, ITALY) AND ITS TAPHONOMIC SIGNIFICANCE

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With 6 figures and 12 tables

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Abstract

Systematic excavations carried out on the Pleistocene lacustrine deposits of Acquedolci (North-Eastern Sicily, Italy) yielded a very rich fossil vertebrate assemblage, containing thousands of remains of *Hippopotamus pentlandi*, the endemic hippo of the Siculo-Maltese archipelago, associated with remains of *Cervus elaphus siciliae* and scarce remains of *Ursus* cf. *arctos*, *Canis lupus*, *Testudo* cf. *hermanni*, *Elephas mnaidriensis* and *Aves*. This paper presents a morphological, biometrical and taphonomical analysis of *Cervus elaphus siciliae* remains. Morphological and biometrical features are in the range of the variability of *Cervus elaphus siciliae* Pohlig, the endemic deer of Sicily which is characterized by a slightly smaller size compared to the populations of the Italian peninsula. Taphonomical features, such as spatial distribution and orientation of the remains, composition of the skeletal part, age distribution, degree of skeletal articulation, fragmentation and bone modification, indicate that *Cervus elaphus siciliae* remains did not accumulate "in situ", unlike the autochthonous remains of *Hippopotamus pentlandi*, but probably they were occasionally deposited in the lacustrine basin as fragments of carcasses belonging to the animals inhabiting the surrounding area.

Introduction

The lacustrine sediments of Acquedolci are located on the northern flank of the Nebrodi range (North-Eastern Sicily), at the base of the high vertical cliff of the Pizzo Castellaro carbonatic massif, on which the well-known S. Teodoro Cave opens. The deposit is composed of silt, gravel and pebbles of variable size, probably fallen from the adjacent cliff. It is superimposed on a Late Pleistocene marine terrace located 131 m a.s.l. and represents the remains of a late Middle Pleistocene lacustrine basin (Bonfiglio, 1985; 1987; 1989; 1992). During the years 1982–1987 systematic excavations were carried out and seven trenches of different width and depth have been excavated over an area of 104 m² (Fig. 1). About 130 m³ of sediments were removed and the entire succession of the deposit, which was originally about 14 m thick, was investigated. In trench G the lacustrine sediments containing fossil remains are absent.

Most of the collected remains come from the trench F, which was deepened for 6 m. In the other trenches, which have a maximum depth of about 2 m, the fossil bones have been partially preserved in situ because of their spectacular abundance, in order to establish a field Museum.

A total number of 3.016 remains of *Hippopotamus pentlandi*, the endemic hippo of the Siculo-Maltese archipelago, together with 104 remains of the endemic deer of Sicily, *Cervus elaphus siciliae*, and very scarce remains of *Ursus* cf. *arctos* (15), *Canis lupus* (7), *Testudo* cf. *hermanni* (6), *Elephas* sp. (1) and *Aves* (2) were collected (Bonfiglio, 1995). One of the two remains of *Aves* belongs to *Gyps melitensis* Lydekker, an extinct vulture (griffon) species (Pavia, 2001).

This faunal assemblage belongs to the "*Elephas mnaidriensis* Faunal Complex", one of the five Pleistocene faunal complexes recognized in Sicily, referred to the late Middle Pleistocene–early Late Pleistocene (Bonfiglio *et al.*, 2001; 2002). Amino-

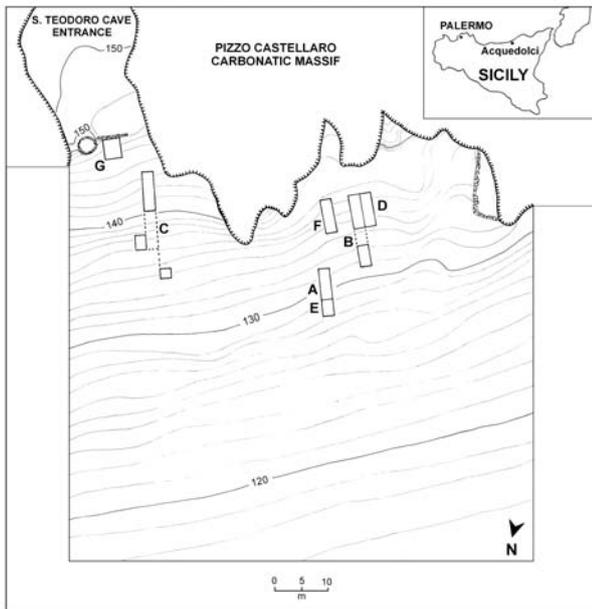


Fig. 1: Topography of the Acquedolci area and location of the excavation trenches (A-G) (modified from Bonfiglio, 1987).

Skeletal element	N.R.
skull	3
antler	23
vertebrae	7
ribs	15
scapula	1
humerus	4
radius	11
femur	2
tibia	4
podials	5
metapodials	22
phalanges	7
Total	104

Tab. 1: Composition of the skeletal part of *Cervus elaphus siciliae* remains from Acquedolci.



Fig. 2: Right shed antler of *Cervus elaphus siciliae*, internal view.

acid racemization dating yielded an age of 200 ± 40 Ky for the *Hippopotamus pentlandi* remains of Acquedolci (Bada *et al.*, 1991).

Morphological and biometrical descriptions

A total number of 104 strongly fragmented remains of *Cervus elaphus siciliae* were collected. The only complete and well preserved bones are represented by two metacarpals. Antlers and metapodials are the most frequent skeletal elements (Tab. 1). A morphological and biometrical comparison with the remains of *Cervus elaphus siciliae* Pohlig from different Pleistocene deposits of Sicily, described by Gliozzi *et al.* (1993), is presented. At present, the data published by Gliozzi *et al.* (1993) about the remains of *Cervus elaphus siciliae* from Sicily are the only available ones. The remains from Acquedolci do not have a catalogue number.

ANTLER	right	(Gliozzi <i>et al.</i> , 1993)
transverse diameter of the burr	47	–
antero-posterior diameter of the burr	63	min 51 – max 67
transverse diameter of the beam above the bez-tine	37	–
antero-posterior diameter of the beam above the bez-tine	42	min 34 – max 44

Tab. 2: Measurements (mm) of the antler of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of antlers described by Gliozzi *et al.*, 1993.

SCAPULA	right
transverse diameter of the glenoid cavity	33
antero-posterior diameter of the glenoid cavity	37
antero-posterior diameter of the neck	31
antero-posterior diameter of the articulation surface	49

Tab. 3: Measurements (mm) of the scapula of *Cervus elaphus siciliae* from Acquedolci.

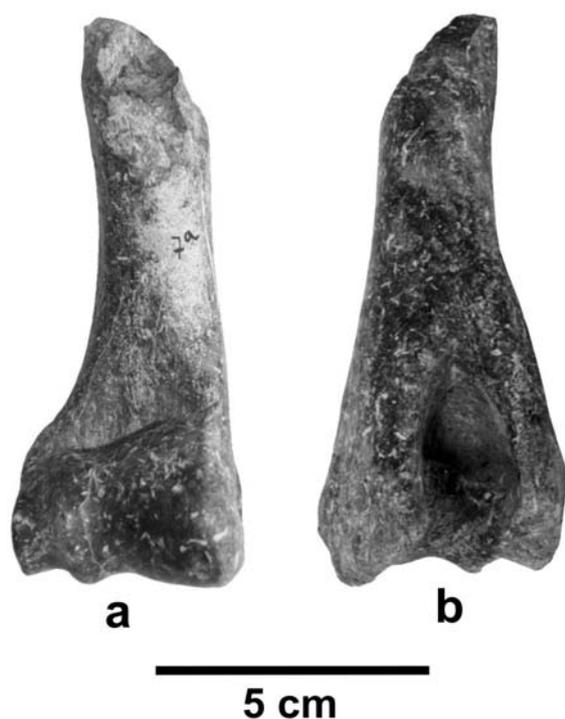


Fig. 3: Right distal humerus of *Cervus elaphus siciliae*; a) anterior view, b) posterior view.

Skull. The skull remains are represented by 3 pedicle fragments only. The most complete of these bones is a left pedicle, which is rather short and strong. The antero-posterior diameter is 44 mm, while the transverse diameter is 41 mm. The skulls of *Cervus elaphus siciliae* collected in the Puntali Cave (Palermo) have antero-posterior diameters of the pedicles varying between 34.8 and 40.6 mm, and the transverse diameter of the pedicles ranging

between 33.4 and 41 mm (Gliozzi *et al.*, 1993). Another fragment of skull from the Villafranca Tirrena deposit (Messina) has an antero-posterior diameter of the pedicle measuring 43 mm (Mangano, 2000).

Antlers. A total number of 23 antler fragments were recovered: 7 fragments of tines, 9 fragments of beams and 7 shed antler fragments with burr. The only measurable remain is a right shed antler fragment, which was strongly fractured and reconstructed by restoration (Fig. 2). The burr and the first portion of the beam are preserved, the brow-tine and bez-tine are broken. The burr is moderately developed and formed by little pearls. The approximate measurements of this specimen are listed in Tab. 2. The dimensions of the antero-posterior diameter of the burr and of the beam above the bez-tine are in the range of the variability of *Cervus elaphus siciliae* (Gliozzi *et al.*, 1993).

Vertebrae. 6 vertebrae are present. They are fractured and incomplete. Two fragments belong to young individuals.

Ribs. 15 fragments of ribs lacking the articulation surface were recovered.

Scapula. The scapula is represented only by one proximal right fragment (Tab. 3). The glenoid cavity is slightly ovoidal in shape with a well developed concave surface. The glenoid tubercle is very strong. The neck is rather short and slender. The remains of scapula of *Cervus elaphus siciliae* recovered in the Fata Donnavilla Cave (Messina) display the same morphological features (Gliozzi *et al.*, 1993).

Humerus. The humerus is poorly represented by 4 fragmentary specimens: 2 distal fragments preserv-

HUMERUS	right	left	(Gliozzi <i>et al.</i> , 1993)
transverse diameter of the distal end	48	42	min 40 – max 49.2
antero-posterior diameter of the distal end	49	43	min 37.5 – max 46
transverse diameter of the trochlea	45	40	–

Tab. 4: Measurements (mm) of the humerus of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi *et al.*, 1993.

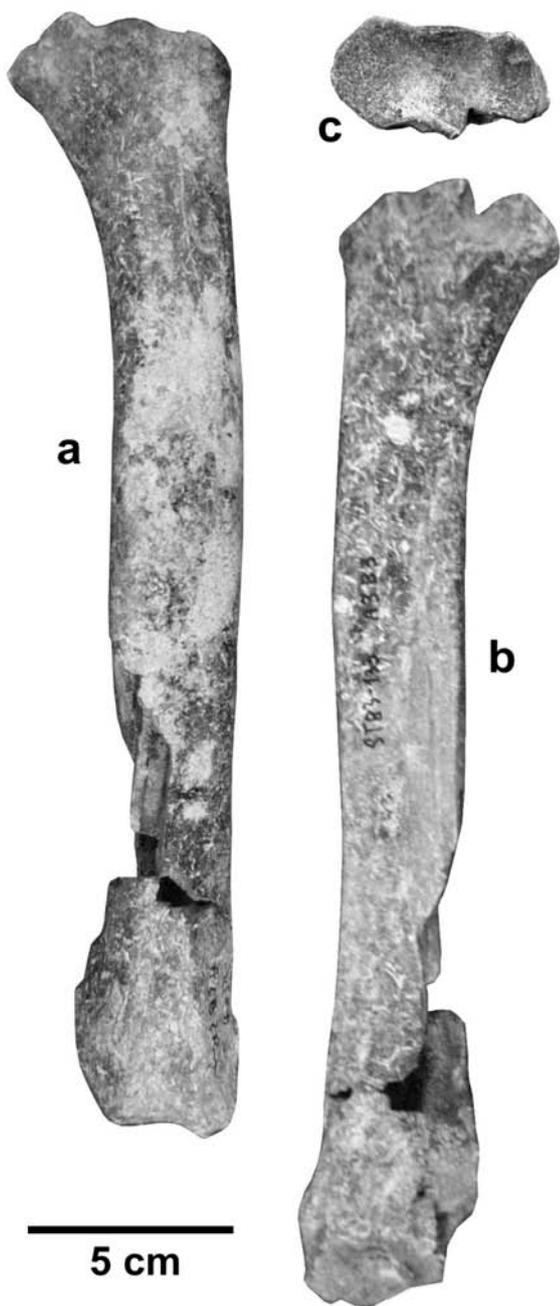


Fig. 4: Semicomplete right radius of *Cervus elaphus siciliae*; a) anterior view, b) posterior view, c) proximal articular surface.

ing the articular surface, 1 small fragment of the distal articular surface and 1 fragment of the shaft. The diaphysis seems to have a great torsion. The olecranon fossa is deep and triangular in shape; the trochlea is developed and medially inclined (Fig. 3, a-b). The transverse diameter of the distal end is within the range of the values of *Cervus elaphus siciliae* (Gliozzi *et al.*, 1993) while the antero-poste-

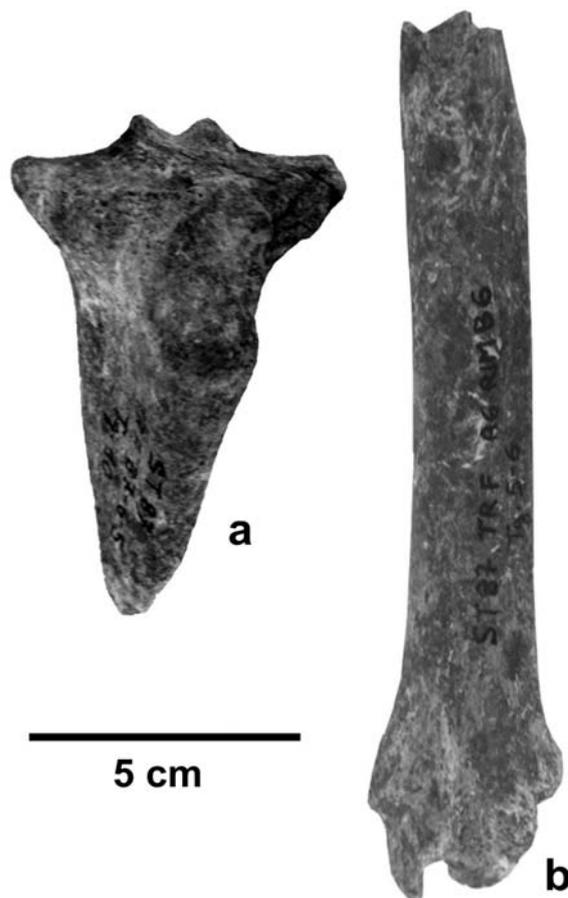


Fig. 5: Tibia of *Cervus elaphus siciliae*; a) left proximal fragment, posterior view; b) left distal fragment, posterior view.

rior diameter of the distal end is slightly larger (Tab. 4).

Radius. 10 remains of radius were recovered, including 1 semicomplete right radius with a broken distal end (Fig. 4, a-b-c), 5 proximal fragments and 4 distal fragments including one juvenile remain. The posterior face of the diaphysis has a deep radio-ulnar groove. The proximal articular surface is sub-rectangular with a wide sigmoid notch which separates it into two very unequal articular facets, whose medial one is very large. Most of the remains, particularly the semicomplete right radius, have a larger size than those described by Gliozzi *et al.* (1993) (Tab. 5). Since other biometric data on *Cervus elaphus siciliae* are lacking in the literature, these differences in dimensions at present cannot be correctly evaluated.

Femur. Only 2 femur fragments are present: 1 fragment of the proximal articular surface (head) and 1 fragment of the distal articular surface. The head is not fused. The condyles of the distal articular surface are less

RADIUS	right	right	right	left	right	right	left	(Gliozzi et al., 1993)
greatest length	270	-	-	-	-	-	-	min 206 – max 237
transverse diameter of the proximal end	54	44	42	50	-	-		min 39 – max 44.7
antero-posterior diameter of the proximal end	29	23	25	27	-	-	-	min 21 – max 24.5
transverse diameter at half length of the shaft	31	20	-	-	-	-	-	min 22 – max 26.5
antero-posterior diameter at half length of the shaft	19	10		-	-	-	-	min 12.5 – max 16
transverse diameter of the distal end	-	-	-	-	43	46	45	min 27 – max 39
antero-posterior diameter of the distal end	-	-	-	-	29	33	30	min 25.5 – max 29.1

Tab. 4: Measurements (mm) of the humerus of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

RADIUS	right	right	right	left	right	right	left	(Gliozzi et al., 1993)
greatest length	270	-	-	-	-	-	-	min 206 – max 237
transverse diameter of the proximal end	54	44	42	50	-	-		min 39 – max 44.7
antero-posterior diameter of the proximal end	29	23	25	27	-	-	-	min 21 – max 24.5
transverse diameter at half length of the shaft	31	20	-	-	-	-	-	min 22 – max 26.5
antero-posterior diameter at half length of the shaft	19	10		-	-	-	-	min 12.5 – max 16
transverse diameter of the distal end	-	-	-	-	43	46	45	min 27 – max 39
antero-posterior diameter of the distal end	-	-	-	-	29	33	30	min 25.5 – max 29.1

Tab. 5: Measurements (mm) of the radius of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

developed and separated by a wide intercondylar fossa. The medial condyle is strongly laterally inclined. The remains are not measurable.

Tibia. Tibia remains are represented by 1 proximal, 1 medio-proximal and 2 distal fragments (Fig. 5, a-b). The proximal articulation surface is wide and two very concave condylar facets are present. The edges of the condylar facets bordering the intercondylar area, which is narrow, are raised into two prominent crests. The tuberosity of the diaphysis is well developed and shows a great torsion. The distal articulation surface is irregularly trapezoidal in shape. The edge of the lateral cochlea ends with a prominent hook. The morphological and biometrical features of the remains are in the range of the

variability of *Cervus elaphus siciliae* (Gliozzi et al., 1993) (Tab. 6).

Podials. Only 5 podial bones are present: 2 carpal bones (scaphoid, lunar) and 3 tarsal bones (1 cuneiform, 2 astragali). The two astragali are broken. The lateral length and the lateral antero-posterior diameter of the two astragali are within the range of the values reported by Gliozzi et al. (1993) (Tab. 7).

Metapodials. 22 metapodial fragments were collected: 9 metacarpal remains, 6 metatarsal remains and 6 undeterminable metapodial remains. Metacarpal remains include 2 complete and well preserved bones (Fig. 6, a-b-c-d), 1 proximal fragment, 1 distal fragment and 5 shaft fragments. Metatarsal remains are represented by 2 distal frag-

TIBIA	left	left	left	right	(Gliozzi et al., 1993)
transverse diameter of the proximal end	63	59	-	-	min 48.5 – max 63.5
antero-posterior diameter of the proximal end	-	57	-	-	min 50 – max 64
transverse diameter at half length of the shaft	26	-	23	-	min 21 – max 28.6
antero-posterior diameter at half length of the shaft	24	-	20	-	min 19 – max 27.5
transverse diameter of the distal end	-	-	37	46	min 33 – max 49
antero-posterior diameter of the distal end	-	-	30	32	min 24.5 – max 35

Tab. 6: Measurements (mm) of the tibia of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

PODIAL BONES	SCAPH. right	LUNAR right	CUNEIF. left	ASTR. right	ASTR. left	(Gliozzi et al., 1993)
transverse diameter	27	23	30	-	-	–
lateral length	-	-	-	47	-	min 41.3 – max 47.8
medial length	-	-	-	44	42	–
transverse diameter of the distal end	-	-	-	28	27	–
lateral antero-posterior diameter	-	-	-	25	-	min 24 – max 32
medial antero-posterior diameter	-	-	-	25	21	–

Tab. 7: Measurements (mm) of the podial bones of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

METACARPAL	right	left	left	left	(Gliozzi et al., 1993)
greatest length	221	222	-	-	min 195 – max 226
transverse diameter of the proximal end	33	34	33	-	min 29 – max 35.6
antero-posterior diameter of the proximal end	23	24	24	-	min 19 – max 26
transverse diameter at half length of the shaft	18	20	-	-	min 16 – max 23.7
antero-posterior diameter at half length of the shaft	21	22	-	-	min 18 – max 22.4
transverse diameter of the distal end	34	35	-	34	min 27 – max 38.8
antero-posterior diameter of the distal end	22	22	-	22	min 19 – max 24.4

Tab. 8: Measurements (mm) of the metacarpal of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

METATARSAL	right	left	(Gliozzi et al., 1993)
transverse diameter of the distal end	35	34	min 29 – max 35
antero-posterior diameter of the distal end	24	22	min 18 – max 23.4

Tab. 9: Measurements (mm) of the metatarsal of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi et al., 1993.

ments and 4 shaft fragments, including one juvenile specimen. The metacarpals are very slender. The palmar surface of the diaphysis is poorly channelled; the ventral surface has a wide furrow along the entire length of the diaphysis. At the proximal end, the articulation facet for the magnum is wide, while the articulation facet for the unciform is very small; at the distal end, the two lateral condyles are separated by a narrow intercondylar notch. On the contrary, the palmar surface of the metatarsals diaphysis has a well developed central channel, and the lateral condyles of the distal end are separated by a wide intercondylar notch. The morphological features and the dimensions of the metapodials (Tabs. 8-9) are comparable with those detected by Gliozzi *et al.* (1993) on other Sicilian specimens of *Cervus elaphus siciliae*.

Phalanges. 7 remains were recovered: 4 fragmentary first phalanges and 3 complete second phalanges, including one juvenile specimen. The dimensions of the remains (Tabs. 10-11) are in the range of the variability of *Cervus elaphus siciliae* (Gliozzi *et al.*, 1993).

Taphonomical observations

Some taphonomical features, such as spatial distribution and orientation of the fossil remains, composition of the skeletal part, age distribution, degree of skeletal articulation, fragmentation and bone modification have been considered in order to determine the biological processes that influenced the accumulation of *Cervus elaphus siciliae* bones (Badgley & Behrensmeyer, 1980; Behrensmeyer, 1975; Behrensmeyer Dechant Boaz, 1980).

In the lacustrine deposits of Acquedolci the number of *Cervus elaphus siciliae* fossil remains is very low, with respect to the number of the remains of *Hippopotamus pentlandi*.

The remains of deer were collected in all the excavated trenches, with the exception of trench G which is sterile, and about half of them come from trench F. In each trench the remains are distributed over the entire thickness of the sediments. The bones are not concentrated and their spatial distribution is absolutely random, without preferential orientation. Almost all the skeletal remains are very fragmentary and fractured; complete specimens are very rare. Articulated skeletal elements are absent. Adult specimens are absolutely prevailing over juvenile remains, which are very scarce. Mandibles and

teeth are absent; skulls, short bones and phalanges are rare. The minimum number of individuals, based on the most abundant long bone (the radius), is 5.



Fig. 6: Left metacarpal of *Cervus elaphus siciliae*; a) anterior view; b) posterior view; c) proximal articulation; d) distal articulation.

FIRST PHALANX					(Gliozzi <i>et al.</i>, 1993)
transverse diameter of the proximal end	18	-	-	17	-
antero-posterior diameter of the proximal end	22	-	-	22	-
transverse diameter at half length of the shaft	13	15	12	-	min 11 – max 15.7
antero-posterior diameter at half length of the shaft	17	18	-	-	-
transverse diameter of the distal end	-	17	15	-	-
antero-posterior diameter of the distal end	-	10	13	-	-

Tab. 10: Measurements (mm) of the first phalanx of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi *et al.*, 1993.

SECOND PHALANX			(Gliozzi <i>et al.</i>, 1993)
greatest length	37	34	min 33 – max 38
transverse diameter of the proximal end	18	16	-
antero-posterior diameter of the proximal end	23	21	-
transverse diameter at half length of the shaft	13	13	min 10 – max 15
antero-posterior diameter at half length of the shaft	15	16	-
transverse diameter of the distal end	14	14	-
antero-posterior diameter of the distal end	19	20	-

Tab. 11: Measurements (mm) of the second phalanx of *Cervus elaphus siciliae* from Acquedolci compared with the dimensions of the remains described by Gliozzi *et al.*, 1993.

	<i>Cervus elaphus siciliae</i>	<i>Hippopotamus pentlandi</i>
Number of Remains	104	3.016
Spatial distribution	random absence of orientation absence of concentration	random absence of orientation extreme concentration
Minimum Number of Individuals	5	33
Age distribution	predominantly adult, rare juvenile	adult, juvenile, infantile
Skeletal part composition	absence of mandibles and teeth rare skull, short bones and phalanges	all skeletal parts represented
Skeletal articulation	disarticulated bones	anatomical connection
Degree of fragmentation	very high	very low
Bone modification	cracking, abrasion (not frequently)	no

Tab. 12: Comparison between taphonomical features of *Cervus elaphus siciliae* and *Hippopotamus pentlandi* remains from Acquedolci deposit (taphonomic data about *Hippopotamus pentlandi* from Bonfiglio, 1995).

Bone modifications are observed at about 20 % of the remains, showing traces of cracking (stage 1, according to Behrensmeyer, 1978) and/or abrasion.

A comparison between taphonomical features of *Cervus elaphus siciliae* and *Hippopotamus pentlandi* remains from the Acquedolci deposit is shown in Tab. 12.

From a taphonomical point of view, the small number of recovered remains of *Cervus elaphus siciliae*, with respect to the extension of the deposit and to the number of the hippo remains, their random distribution over the entire thickness of the deposit, the lack of skeletal articulation, the presence of selected skeletal elements and the degree of fragmentation, indicate an allochthonous fossilization, although the slight traces of abrasion and cracking suggest a minimal transportation and/or a short period of subaerial exposure.

The taphonomical analysis indicates that the remains are allochthonous and probably were deposited in the lacustrine basin as fragments of carcasses from animals living in the area,

testifying, therefore, a different accumulation process in comparison with the remains of *Hippopotamus pentlandi*, which accumulated and fossilized "in situ", in the lacustrine basin where the hippos have lived (Bonfiglio, 1995).

Conclusion

The morphological and biometrical features of the remains are in the range of the variability of *Cervus elaphus siciliae* POHLIG, the Pleistocene endemic deer of Sicily which is characterized by a moderately reduced size compared to the populations of the Italian peninsula.

The small number of specimens belonging to deer, as well as those belonging to the other associated species, if compared with the very large number of the recovered hippo remains, probably is to correlate with the different accumulation processes of the remains and it does not reflect the real composition of the faunal populations living in the area.

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