

Small mammal remains from the Temple of Neptune, a window on the ancient landscape of the Sele Plain (Southern Italy)

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Abstract - The Sele Plain was once a marshy area that has recently been reclaimed. The analysis of skull and dental remains of small mammals, collected during the restoration of the Temple of Neptune, testifies the ancient existence of ecosystems that have now been greatly reduced in this area. In particular, the high percentage of remains of *Arvicola italicus*, a rodent that is now very rare throughout Italy, confirms the presence of aquatic environments.

Key words: archaeology, Campania, ecology, Rodentia, Soricomorpha.

Riassunto - Resti di piccoli mammiferi dal Tempio di Nettuno, una finestra sull'antico paesaggio della Piana del Sele (Sud Italia).

La piana del Sele, era un tempo un'area paludosa che in tempi recenti è stata sottoposta a bonifiche. L'analisi di resti cranici e dentari di piccoli mammiferi, raccolti durante le operazioni di restauro del Tempio di Nettuno, testimonia l'antica esistenza di ecosistemi oggi fortemente ridotti in quest'area. In particolare, l'alta percentuale di resti di *Arvicola italicus*, roditore oggi in forte rarefazione sull'intero territorio nazionale, conferma la presenza di ambienti acquatici.

Parole chiave: archeologia, Campania, ecologia, Rodentia, Soricomorpha.

INTRODUCTION

The study of qualitative-quantitative faunal compositions of small mammals in a certain territory provides useful information on the environmental characteristics of the territory itself, as this kind of associations are the product of different parameters such as temperature, moisture, vegetation and anthropic impact (Contoli, 1976, 1980, 1981; Aloise & Contoli, 1984; Castelli & Contoli, 1985; Contoli, 1985, 1988; Marzilli & Contoli, 1991; Nappi, 2004b). For the very same reason, these remains are widely studied in palaeontology (Kowal-

ski, 1966; Chaline, 1970, 1973, 1977, 1981; Kowalski, 1992), providing, for instance, good indications of the climate changes occurred during the glacial and interglacial periods of Pleistocene. Also in relation to historical periods, the analysis of bone and dental remains of small mammals can be useful in reconstructing any possible environmental changes that occurred due to both natural and anthropogenic causes (Kotsakis & Ruschioni, 1984; Vigne, 1996; Pardiñas *et al.*, 2000; Bon *et al.*, 2001; Cuenca-Bescós *et al.*, 2009; Lopéz-García *et al.*, 2013a, 2013b).

Based on these considerations, I found it interesting to study the mammal remains from the deposits of soil and debris accumulated over time in parts of the Temple of Neptune in southern Italy and recovered during restoration work (De Palma, 2019). The present work is a follow up of an earlier note derived from a partial analysis of the material (Nappi, 2010).

MATERIALS AND METHODS

The Temple of Neptune (40°25'11,70"N, 15°00'19,24"E), dated around the middle of the 5th century B.C., is located in the municipality of Capaccio, province of Salerno (Campania, southern Italy) (Fig. 1).



Fig. 1 - The location of the Temple of Neptune and other localities considered in the text. / La posizione del Tempio di Nettuno e di altre località menzionate nel testo.

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From a geographical point of view, the area is included in the Sele Plain, a region that was deeply altered by man in the last centuries. In particular, this area was characterized in the past by extensive marshes, which then underwent intense reclamation.

Cranial and dental remains of small mammals recovered during the restoration works of the Temple of Neptune were collected and used for the analysis. The identification was performed with binocular stereoscopic microscope according to the criteria proposed by Nappi (2001) and by Amori *et al.* (2008). Problems that arose during identification are discussed in the “Results and discussion” section of this paper. The count of individuals was based on the criterion of the minimum number of individuals, usually calculated considering the more representative hemimandible (right one or left one) for each *taxon* (Nappi, 2011).

Chiroptera and Talpidae were excluded from the calculation of the indices, while the wood mice (*Apodemus* sp.) were overall included as a genus.

The Margalef index was calculated in the form $D = (S - 1) / \log N$, where S indicates the total number of *taxa* (the species in most cases, or the genus in the case of *Apodemus*) and N indicates the total number of individuals.

The Trophic Level Index (TLI) was calculated as Soricidae/total mammals (Contoli, 1980).

The calculation of agronomic-environmental index (A) is expressed in its original formula as a ratio Cricetidae/Muridae (Contoli, 1980) that is to say *taxa* mostly linked to open areas/*taxa* mostly linked to wood or bushy areas; in this case I decided to follow Zangirolami (1988/89) to exclude *Myodes glareolus* (a species associated with woods) for the Cricetidae. For similar reasons, I decided to exclude *Arvicola italicus*, a species linked to water environments, and I chose instead to add *M. glareolus* to denominator, whose agronomic-environmental index was calculated with the following formula: Cricetidae – (*M. glareolus* + *A. italicus*)/Muridae + *M. glareolus*.

The thermoxerophilia index was calculated as TX = Crocidurinae/Soricidae (Contoli, 1980).

The values of the indices listed above were compared with those calculated for 10 sites in Campania (Fig. 1) whose qualitative and quantitative data on small mammal populations were obtained through the study of barn owl *Tyto alba* pellets.

Taxonomic arrangement and nomenclature follow Loy *et al.* (2019).

The studied mammal remains are kept at the Istituto Centrale per il Restauro, Rome.

RESULTS AND DISCUSSION

Considering their location within the temple, the remains examined were most likely the result of piles of pellets produced by nocturnal birds of prey, known to habitually roost in buildings.

The sampled remains were in quite good conditions of preservation so that species identification was possible for most of them. Only for most remains of the genera *Talpa* and *Microtus* and for all those of the genus *Apodemus*, identification problems have been encountered at species level.

As regards to the genus *Talpa*, the characters useful to distinguish *T. caeca* from *T. romana* (the two species present in Campania) were not always evident in the remains. In the genus *Microtus*, the teeth were almost completely missing, while for *Apodemus*, this problem is to be added to a generalized fragmentation of the skulls. Only for very few remains, it was possible to detect the finest characters, such as the rear edge of *foramina incisiva* surpassing the level of front edge's roots in the first upper molars and in the fourth and seventh tubercles of the same molars united.

These morphologies are typical but not exclusive of *A. sylvaticus*. On very few partially complete skulls, it was possible to calculate a morphometric index (Amori *et al.*, 1986) used to separate *A. flavicollis* and *A. sylvaticus*, and its value was in the overlap range. The difficult discrimination between *A. flavicollis* and *A. sylvaticus* due to North-South morphological variations is well known, leading the former species in particular to be frequently mistaken for the latter (Niethammer, 1969). A synthesis of the identification problems of the two species *Apodemus* in Italy is offered by Amori *et al.* (2008). Also for water shrews belonging to the genus *Neomys*, knowing the difficulties of determination at specie level, it was preferred to leave a margin of uncertainty about the proposed identification. For this reason, it was chosen to refer to *N. cfr. milleri*, being not possible to easily detect all useful diagnostic characters on the skull and on the mandibles to give a sounder identification.

The complete list of identified mammalian taxa is reported in Table 1. Even though it was not possible to date the remains with an absolute method, anyway one could make some historical-faunistic considerations. The most interesting aspect of this first analysis is the abundance of Italian water vole *Arvicola italicus*, a rodent whose presence testifies of humid environments now rarefied. In addition, the ancient presence of this vole now in strong recession in Italy due to loss and degradation of its wet habitat (Nappi, 2004a; Cagnin, 2008) represents an interesting faunal record at national scale.

In Campania, the species is included in the “Vulnerable” IUCN category (Carpino & Capasso, 2012) and in recent times it was certainly present in the territories of Partenio, between Naples and Avellino (Caputo, 1989; Capolongo & Caputo, 1990; Capasso & Carpino, 2008) and of Garigliano, province of Caserta (Scaravelli & Priori, 2009). In the Vesuvius area (province of Naples), in particular, it has no longer been reported (Maio *et al.*, 2000; Capasso *et al.*, 2009) after the end of the 1970s (Dinardo, 1991b). An old record for the Picentini Mountains, province of Avellino (Pasa, 1959) was followed by a recent one in 2013 (Raicaldo, 2020).

In the province of Salerno, not counting the case reported here, remains of *A. italicus* were found in the Ausino Cave (Barbera *et al.*, 1987; Jancarik & Horacek, 1988), which probably date from the Copper Age (Jancarik & Horacek, 1988). At present, the fact that this rodent has not been found around Paestum (Russo, 1997), Ausino Cave (Russo & Maglio, 1996) and other sites in the province of Salerno (Nappi, 1998/99, 2000) is not conclusive evidence of its disappearance in situ, but it can certainly testify to a rarefaction of this species. Another report to

Tab. 1 - Qualitative-quantitative composition of the small mammals' population of the Temple of Neptune, campinferred from the analysis of bone and dental remains. N: minimum number of individuals. / Composizione quali-quantitativa della popolazione di piccoli mammiferi del Tempio di Nettuno, dedotta dall'analisi dei resti ossei e dentari. N: numero minimo di individui.

Taxa	N	%
<i>Myotis myotis</i>	2	0.26
Vespertilionidae sp.	4	0.45
Tot. CHIROPTERA	6	0.68
<i>Sorex samniticus</i>	2	0.26
<i>Neomys</i> cfr. <i>milleri</i>	3	0.34
Tot. Soricinae	5	0.56
<i>Suncus etruscus</i>	2	0.26
<i>Crocidura leucodon</i>	50	5.64
<i>Crocidura suaveolens</i>	122	13.75
<i>Crocidura</i> cfr. <i>suaveolens</i>	1	0.11
<i>Crocidura</i> sp.	3	0.34
Tot. Crocidurinae	178	20.07
Tot. Soricidae	183	20.63
<i>Talpa romana</i>	4	0.45
<i>Talpa</i> sp.	13	1.47
Tot. Talpidae	17	1.92
Tot. SORICOMORPHA	200	22.55
<i>Eliomys quercinus</i>	2	0.26
<i>Muscardinus avellanarius</i>	8	0.90
<i>Glis glis</i>	4	0.45
Tot. Gliridae	14	1.58
<i>Arvicola italicus</i>	238	26.83
<i>Microtus savii</i> group	30	3.38
<i>Microtus</i> sp.	172	19.39
Tot. Cricetidae	440	49.61
<i>Apodemus</i> sp.	193	21.76
<i>Rattus rattus</i>	19	2.14
<i>Rattus</i> sp.	6	0.68
<i>Mus musculus</i>	3	0.34
Muridae sp.	6	0.68
Tot. Muridae	227	25.59
Tot. RODENTIA	681	76.78
TOTAL	887	-

be verified for the Salerno province, dated 1994, comes from the Tanagro River basin (Carpino & Capasso, 2012). More recently, the Italian water vole has been found along the Sarno River (Raicaldo, 2020). The query for museum records returned a single specimen collected in Salerno on 15 March 1903 and kept at the Zoological Museum 'La Specola' in Florence with catalogue number 6057 (P. Agnelli, personal communication).

Another important presence is *Neomys* cfr. *milleri*. Like *Arvicola italicus* also water shrews *Neomys* spp. suffer for the modifications to their habitats (Amori *et al.*, 2008). At present, the only certain record of Miller's water shrew *N. milleri* in Campania refers to a skull recovered from pellets of barn owl collected on 8 April 1996 at Guardia Lombardi (province of Avellino) and kept at the Zoological Museum of the University of Naples Federico II with catalogue number Z6256 (Nappi & Maio, 2002; Carpino & Capasso, 2012). In Campania, also this species is included in the "Vulnerable" IUCN category (Carpino & Capasso, 2012). The other species of the same genus, the Eurasian water shrew *Neomys fodiensis*, is included in the category "Data Deficient" (Carpino & Capasso, 2012). The records of Dinardo (1991a) for the Vesuvius area and dating at the beginning of the 1980s, were not confirmed later (Maio *et al.*, 2000; Capasso *et al.*, 2010), while a record for the National Park of Cilento and Vallo di Diano (Picariello *et al.*, 1999) is unreliable due to the lack of further evidence, not to mention the difficulty to correctly separate the two *Neomys* species (Carpino & Capasso, 2012).

The effective size of the Soricidae sample in particular could have been underestimated because their remains, usually fragile, could be preserved only partially in similar environmental conditions.

Considering the limitations involved in analysing this type of remains, such as the difficulty of correctly identifying them at species level, and the different ways in which different remains have been preserved over time (including the likely destruction of a significant part of them) it was possible to make some ecological considerations about the small mammal community and the environment they inhabit by using ecological indices (Tab. 2). In particular, the Margalef index and the Trophic Level Index returned high values when compared to those calculated for other sites from Campania. Basing on these results, one can hypothesize the ancient presence of a rich ecosystem in good ecological conditions. The agronomic-environmental index is suggestive of the presence of open environments interspersed with wooded and/or bushy areas. Finally, the index of thermoxerophilia allows us to assume the existence of a Mediterranean climate also in the past, in view of the clear prevalence of Crocidurinae.

In conclusion, the study confirms the importance of studying archaeozoological remains, including those referred to the most recent periods of the Pleistocene, in order to assess ancient faunal associations suggestive of past environmental conditions. For this reason and for its implications in delineating the environmental background underlying the cultures of the past, the collection of small mammal remains should be encouraged during the digging operations and restoration interventions in archaeological sites.

Tab. 2 - Values of some qualitative-quantitative indices on the small mammals' population of the Temple of Neptune and by comparison of other present-day sites from Campania. / Valori di alcuni indici qualitativi del popolamento di piccoli mammiferi del Tempio di Nettuno e per confronto con altri siti attuali della Campania. D) Margalef index. / Indice di Margalef. TLI Trophic level index. / Indice di livello trofico. A) Agronomic-environmental index. / Indice agronomico-ambientale. TX) Thermoxerophilia index. / Indice di termoxerofilia. ¹ Nappi (1998/99); ² Capasso *et al.* (2010); ³ Viglietti (1997/98); ⁴ Contoli (pers. com.); ⁵ Russo & Maglio (1996).

	D	TLI	A	TX
S. Giorgio La Molara ¹	3.37	0.07	1.98	0.53
Gesualdo ¹	2.56	0.07	0.72	0.25
Roccarainola ¹	3.80	0.09	0.71	0.45
Avellino ¹	1.84	0.03	1.37	0.93
Ottaviano ²	3.64	0.21	0.25	1
Portici ³	2.37	0.06	0.49	1
Persano ⁴	2.45	0.14	4,06	1
Castelcivita ⁵	2.82	0.14	0.31	1
Temple of Neptune	2.94	0.21	0.89	0.97
S. Marco di Castellabate ¹	2.42	0.05	0	1
Ogliastro Marina ¹	2.93	0.19	0.02	1

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