

The common weasel *Mustela nivalis* L., 1766 from Sarakenos Cave (Greece) and the difficulty to distinguish small mustelid species in the fossil record

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Abstract. The common weasel *Mustela nivalis* is the only carnivore found in trench A of Sarakenos Cave. It is represented by three male mandibles of robust build and very large size, two dated at the Late Pleistocene and one from a Mesolithic layer. Metrically and morphologically they are indistinguishable from the southern, large weasels: *Mustela nivalis boccamela* and *Mustela nivalis numidica*. The results exclude the occurrence of stoat *Mustela erminea*, the only species which can be mistaken for the weasel. In the Pleistocene the common weasel receded far to the south (as far as Egypt, where a relict population survives), and today it is restricted to northern Lebanon and Syria. *Mustela nivalis* is widespread in the Mediterranean, where it was introduced by man on many islands.

Key words: small mustelids, sexual dimorphism, taxonomy, Late Pleistocene, size variation.

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I. INTRODUCTION

The common weasel *Mustela nivalis* LINNAEUS, 1766 is a permanent, but never abundant component of faunal assemblages from archaeological sites of the Mediterranean region (DAYAN & TCHERNOV 1988). Today in this region it occurs in a few North African countries (Morocco, Algeria and Tunisia), in northern Maghreb (ZYLL DE JONG 1992), in most of southern Europe and in Anatolia (MASSETI 1995; KING & POWELL 2007). In SW Asia its occurrence is restricted to the northern areas of Levant (also Lebanon and northern Syria) (MASSETI 1995). Since the Early Bronze Age the species has been reported neither from the northern Arabian Peninsula nor from Israel (BOESSNECK 1977; DAYAN & TCHERNOV 1988). In this context, the modern population of the weasel in northern Egypt, along the Nile delta and valley, is regarded as a glacial relic (DAYAN & TCHERNOV 1988)

rather than a Roman introduction (RÜPPELL 1826; MASSETI 1995). The latter hypothesis is based on the fact that the Egyptian population is almost completely synanthropic (OSBORN & HELMY 1980). Moreover, the Egyptian weasel, with its robust build, very large size and quite ancestral morphology, is now regarded as a distinct species *Mustela subpalmata* (ZYLL DE JONG 1992; ABRAMOV & BARYSHNIKOV 2000; KING & POWELL 2007). Today, the weasel is also widely distributed on many Mediterranean islands, being often one of very few native carnivores on them. However, in many cases its presence is a result of human introduction (KING 1989). Today it is found on Asinara, Corfu, Corsica, Crete, Malta, Mallorca, Menorca, Sardinia, Sicily, Skopelos and Thera (MASSETI 1995 and references therein).

The occurrence of the common weasel in the Mediterranean has a much longer history than that deduced from archaeological sites. The species was present in Greece already in the Late Pleistocene: it was found in Kitsos Cave Cave (JULLIEN 1973, 1981; SOMMER & BENECKE 2004) and Vraona Cave (RABEDER 1995; RABEDER & SYMENOIDIS 1995). The number of weasel sites of post-glacial age is much higher, and those assigned to the Neolithic and Roman periods are the most numerous (SOMMER & BENECKE 2004). One of

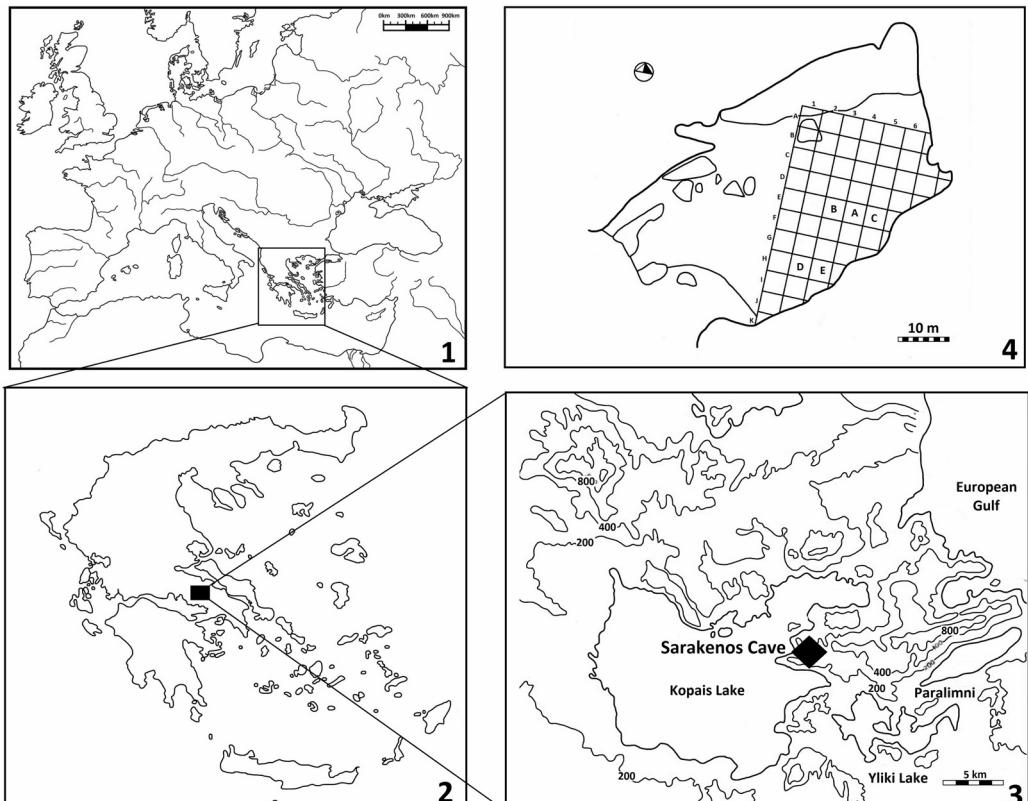


Fig. 1. Location of Sarakenos Cave in Europe (1), Greece (2), Beotia region (3) and plan of the site (4) after SAMPSON et al. (2009).

such localities, with sediments of post-glacial and Holocene age and with the richest fauna, is the Sarakenos Cave.

The Sarakenos Cave ($37^{\circ}56'16''N$, $21^{\circ}0'18''E$, 180 m a. s. l.) is located on the eastern slope of the largest karstic formation, pre-eminent on the eastern part of a former, now completely dry Lake Copais (Kopais) (Fig. 1). The cave forms one large main chamber with the entrance ca. 25 m wide. The excavations started in the early 1970's and were conducted by SPYROPOULOS (1973). Later, a Greek-Polish team, headed by A. SAMPSON, started a systematic documentation of all karstic formations in the Kopais area. One of them was Sarakenos Cave, where the excavations are still in progress (SAMPSON et al. 2009). The studies yielded impressive archaeological and palaeontological finds, which were repeatedly mentioned, but never described in detail. This paper focuses on three mandibles of the common weasel, found in trench A.

The Kitsos Cave (180 m a. s. l.) is located on the eastern slope of the largest karstic formation, pre-eminent on the eastern part of a former, now completely dry Lake Copais (Kopais) (Fig. 1). The cave forms one large main chamber with the entrance ca. 25 m wide. The excavations started in the early 1970's and were conducted by SPYROPOULOS (1973). Later, a Greek-Polish team, headed by A. SAMPSON, started a systematic documentation of all karstic formations in the Kopais area. One of them was Sarakenos Cave, where the excavations are still in progress (SAMPSON et al. 2009). The studies yielded impressive archaeological and palaeontological finds, which were repeatedly mentioned, but never described in detail. This paper focuses on three mandibles of the common weasel, found in the trench A.

II. MATERIAL AND METHODS

The material includes three quite well present mandibles of the common weasel, found in trench A of Sarakenos Cave. Specimens are temporarily deposited in the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences in Kraków. All the specimens are adult males with permanent dentition, with one (S3) younger than the other two (S1 and S2).

Measurements were taken point to point, with an electronic calliper, to the nearest 0.01 mm. Each value given here is the mean of three measurements. Additionally some measurements were taken using an image analysis set Olympus (Olympus stereo microscope ZSX 12, camera Olympus DP 71, programme Cell D). Osteological and dental terminology follows VON DEN DRIESCH (1976). The measurement schemes of the mandible and the lower carnassial (m1) are shown in Figs 2-3.

Specimen no. 1 (S1) (Tr. A, Sq 7, sp. 31, "H-M", 6.10.2002, Mesolithic) is a left mandible, without symphysal area and upper part of ramus, and with m1 preserved (Fig. 4/1a-c). Its large size, robust build and permanent, unworn dentition indicate an adult male, in his prime at the moment of death. Dimensions (number and value [mm] of measurement): **7** – 5.84, **12** – 3.84, **13** – 2.27, **14** – 4.14, **15** – 2.29; **m1**: **L** – 4.99, **L tri** – 3.53, **L tal** – 1.46, **B tri** – 1.76, **B tal** – 1.61.

Specimen no. 2 (S2) (A57, T 11, S 51, 9.10.2012, latest part of the Late Pleistocene) is a right mandible of considerable size, with damaged symphysal area and ramus, and with m1

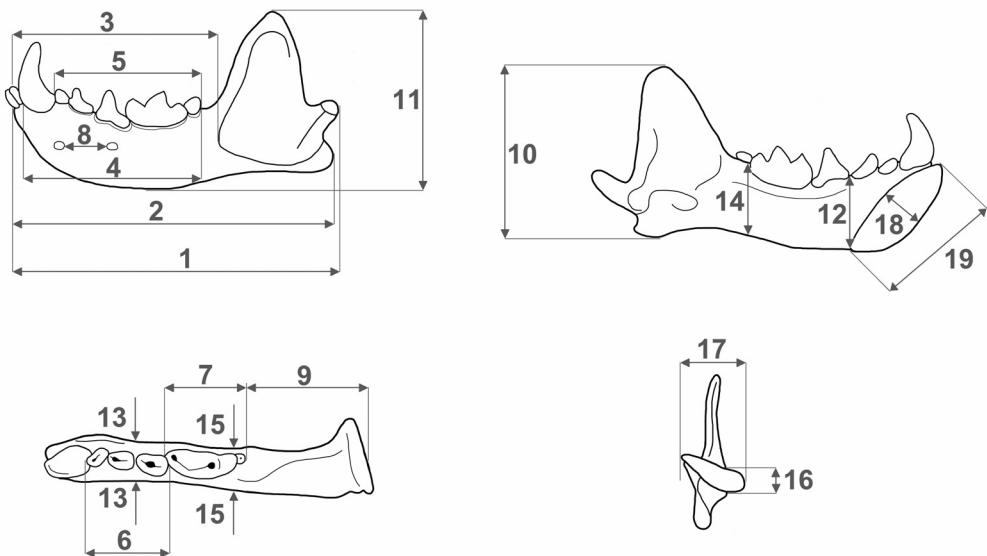


Fig. 2. Scheme of mandible measurements. 1 – total length (condyle to infradentale), 2 – distance angular process to infradentale, 3 – distance infradentale to anterior margin of masseter fossa, 4 – distance anterior margin of c1 to posterior margin of m2, 5 – cheek teeth row length (anterior margin of p2 to posterior margin of m2), 6 – premolar row length (anterior margin of p2 to posterior margin of p4), 7 – molar row length (anterior margin of m1 to posterior margin of m2), 8 – distance between mental foramina, 9 – distance posterior margin of m2 to condyle, 10 – distance angular process to coronoid process, 11 – mandible greatest height, 12 – mandible body height between p3 and p4, 13 – mandible body thickness between p3 and p4, 14 – mandible body height between m1 and m2, 15 – mandible body thickness between m1 and m2, 16 – condyle height, 17 – condyle breadth, 18 – symphysis major diameter, 19 – symphysis minor diameter.

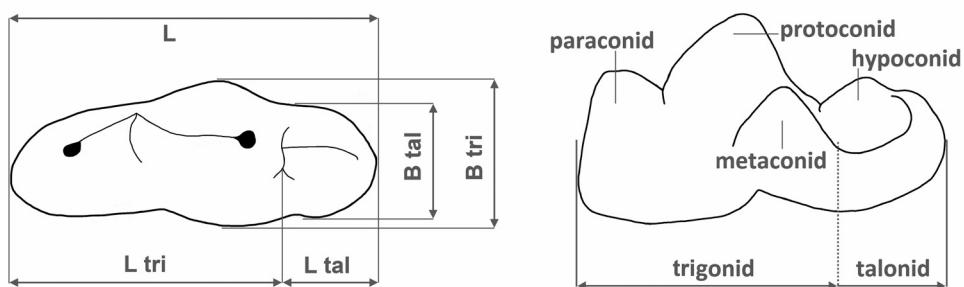


Fig. 3. Lower carnassial (m1) measurements (left) and cusps terminology (right) scheme. L – total length, L tri – trigonid length, L tal – talonid length, B tri – trigonid breadth, B tal – talonid breadth, tri – trigonid, tal – talonid, par – paraconid, pro – protoconid, met – metaconid, hyp – hypoconid.

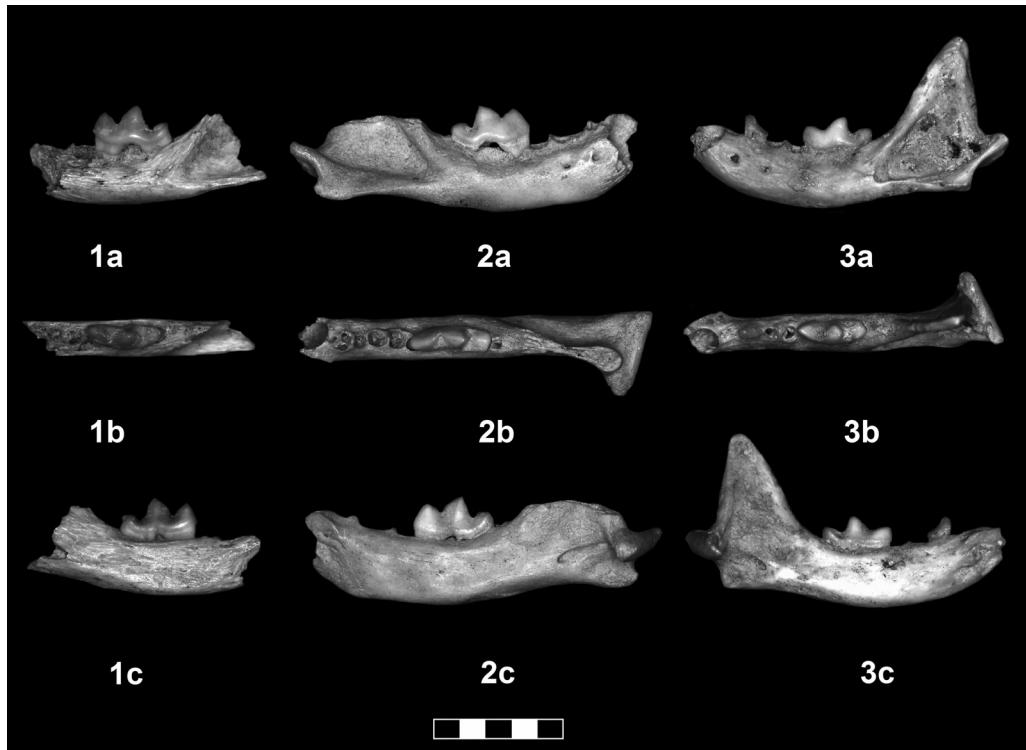


Fig. 4. Common weasel *Mustela nivalis* from Sarakenos Cave: S1 (1a-c), S2 (2a-c), S3 (3a-c), a – buccal view, b – occlusal view, c – lingual view. All individuals shown to the same scale, scale bar 10 mm.

preserved (Fig. 4/2a-c). Its large size (for the weasel), robust build and permanent, unworn dentition point to an adult male, dead in his prime. Dimensions: **5** – 11.78, **6** – 6.57, **7** – 6.03, **8** – 1.98, **9** – 9.69, **12** – 4.59, **13** – 2.69, **14** – 4.64, **15** – 2.62, **16** – 1.84, **17** – 5.96; **m1**: L – 5.23, **L tri** – 3.74, **L tal** – 1.49, **B tri** – 1.77, **B tal** – 1.63.

Individual no. 3 (S3) (T 15, A56, S2, 29.9.2012/1.10.2012, latest part of the Late Pleistocene) is the only complete specimen from Sarakenos, represented by a left mandible with p3 and m1 (Fig. 4/3a-c). The specimen is smaller than the preceding two, of a size comparable to males of the Central European common weasel of the *nivalis-vulgaris* group (Fig. 5). Its smaller size, slender build and permanent, unworn dentition indicate a small, young adult male. Dimensions: **1** – 19.16, **2** – 17.96, **3** – 13.02, **4** – 9.74, **5** – 9.94, **6** – 4.97, **7** – 4.74, **8** – 1.44, **9** – 7.19, **10** – 9.28, **11** – 11.07, **12** – 3.78, **13** – 2.06, **14** – 3.92, **15** – 2.27, **16** – 1.64, **17** – 5.12, **18** – 5.78, **19** – 2.96; **p3**: L – 1.57, **B** – 0.87; **m1**: L – 4.27, **L tri** – 2.94, **L tal** – 1.33, **B tri** – 1.49, **B tal** – 1.38.

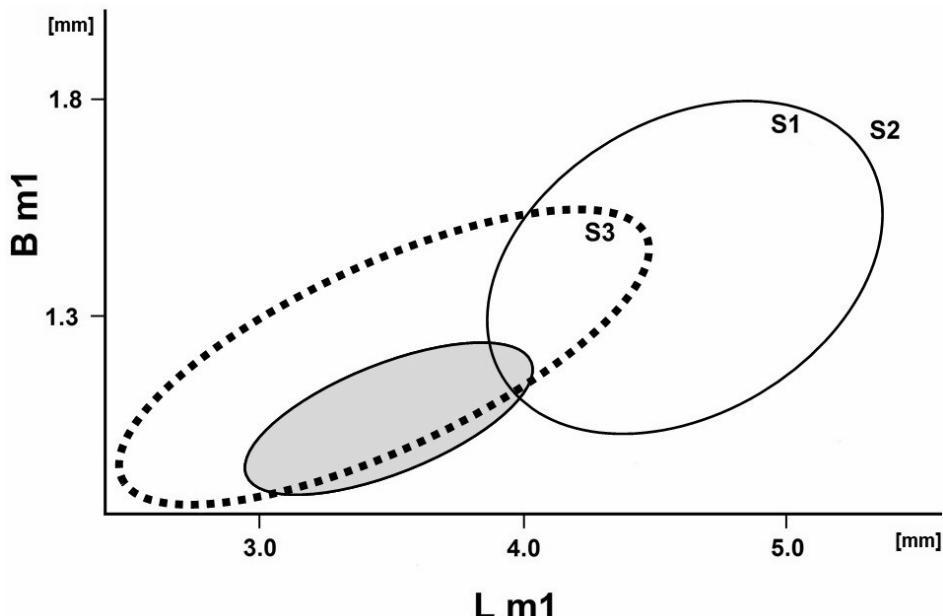


Fig. 5. Length (L) and breadth (B) ratio of m1 of the common weasel from Europe compared with the examined individuals from Sarakenos Cave (S1, S2, S3). Note large size of Sarakenos specimens. Solid line – *Mustela nivalis* modern males, dotted line – *Mustela nivalis* modern females, grey ellipse – Late Pleistocene and post-glacial *Mustela nivalis* from Poland (both sexes). Data according to MARCISZAK (2012).

III. SYSTEMATIC PART

All three mandibles of small carnivores found in the Sarakenos sediments were classified as representing the common weasel *Mustela nivalis* LINNAEUS, 1766. Their general size and shape are indistinguishable from those of the modern weasel, except for their larger size. Among other carnivores, the Sarakenos specimens can be mistaken only for the ermine *Mustela erminea* LINNAEUS, 1758. Small mustelids show a great size variation, uniform morphology and extremely pronounced sexual dimorphism (HEPTNER et al. 1967; KING & POWELL 2007; MARCISZAK 2012). As a result, in many cases a male of a smaller species is similar to or sometimes even larger than females of a larger species, for example weasel and stoat, or stoat and Siberian weasel. Besides, local climatic conditions and huge geographical variation may obscure the picture. While most cranial features distinguishing the stoat and the common weasel can be found on the calvarium, the mandible almost lacks such characters. Some authors (e.g. BISHOP 1982; HELLER 1983) suggest the stoat's larger size as the main distinguishing character, but this is not a strict rule, and the feature has only an auxiliary value (MARCISZAK 2012).

The common weasel, together with few other carnivores, such as wolf, brown bear and leopard, is among species with the greatest size variation among carnivores. Interestingly, it does not follow the Bergman rule and its size decreases northward (KING & POWELL

2007). In this species the larger, southern weasels can be twice longer and ten times heavier than the dwarf, northern subspecies (ABRAMOV & BARYSHNIKOV 2000; MARCISZAK & SOCHA 2014). The most reliable characters to distinguish the two small mustelid species reside in the lower dentition: the stoat has proportionally broader posterior part of p4, and m1 with shorter and narrower talonid, as well as much more pronounced broadening of the crown on the border between trigonid and talonid of m1 (MARCISZAK 2012) (Fig. 6). While p4 is missing in all three specimens, the morphology of m1 clearly indicates weasel and not stoat: the lower carnassial is elongated, but quite narrow, with relatively weakly broadened crown and quite long and broad talonid.

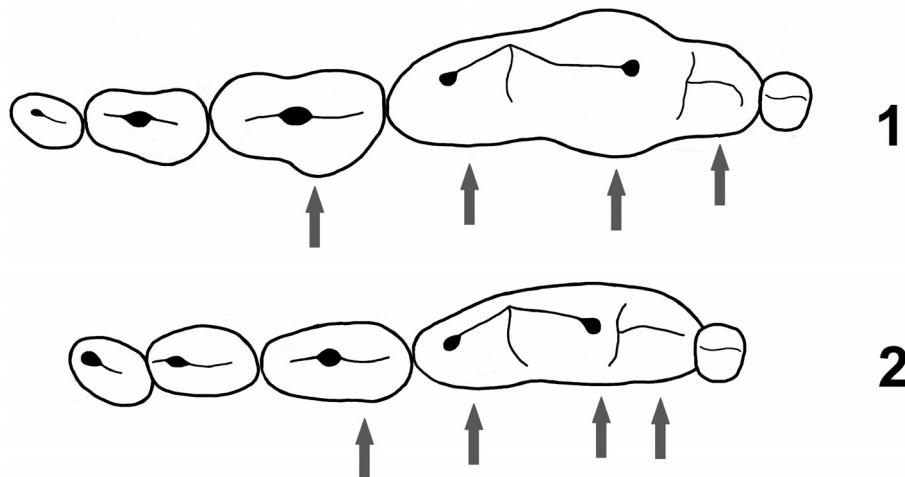


Fig. 6. Lower dentition characters distinguishing the ermine *Mustela erminea* (1) and the common weasel *Mustela nivalis* (2). Arrows indicate differences in teeth morphology. Standardised drawing according to RABEDER (1976), MARCISZAK (2012) and MARCISZAK & SOCHA (2014).

The ratio of talonid length to m1 total length is very useful when separating the two species. The length ratio of talonid to trigonid shows very striking differences: the reduction of the talonid in the ermine is especially well visible. In the ermine the average value of this ratio is 23-24, while in the weasel it exceeds 40 (MARCISZAK 2012). In the Sarakenos specimens the ratio is as follows: no. S1 – 41.4, no. S2 – 39.8, no. S3 – 45.2, which confirms their identification as weasel (Fig. 7). The weasel talonid is not only noticeably longer, but also proportionally broader than that of the ermine. The talonid to trigonid breadth ratio also shows great differences, with the variation ranges only slightly overlapping. The mean value of this ratio for the ermine is 76.0, while in the weasel it is usually close to 90 or higher. In the Sarakenos specimens the ratio is: no. S1 – 91.5, no. S2 – 92.1, no. S3 – 92.6. I suspect that the smaller degree of specialisation of the weasel is associated with taking on average smaller prey than the stoat, and thus such a massive dentition with an efficient cutting projection is not crucial. Besides, the two species differ in another morphological character. In both species the lower carnassial is two-rooted, with its anterior

root longer but slimmer and the posterior one somewhat shorter, but more massive. However, the ermine m1 has an additional, narrow median rootlet, placed almost exactly in the median part of the crown (HUGUENEY 1975; BARYSHNIKOV 2009; MARCISZAK 2012). This structure in the weasel is almost never present, and, when present, it is rudimentary and never reaches the same size as in the stoat. The large size and quite ancestral morphology (shallow and short masseter fossa and weakly widening m1 with proportionally long and wide talonid) allow to assign the specimens to the southern, ancestral weasel of the *boccamela-numidica* group.

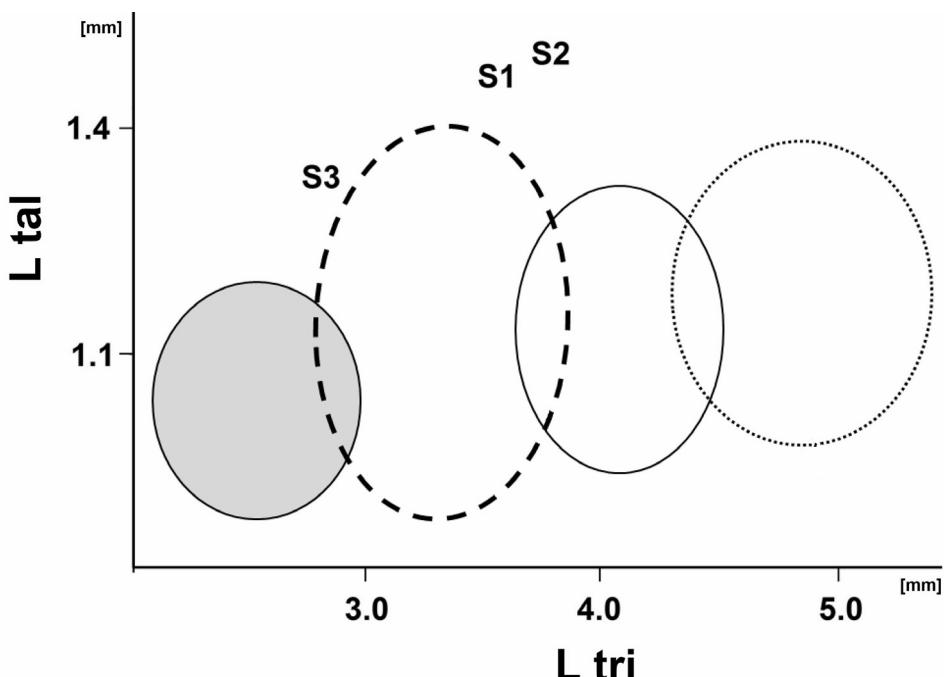


Fig. 7. Trigonid and talonid length ratio of two small mustelids, divided into sexes (from left to right): common weasel females, common weasel males, stoat females and stoat males. Note proportionally longer trigonid and shorter talonid of stoat and position of the Sarakenos specimens (S1, S2, S3). Data according to MARCISZAK (2012).

Two of the common weasel mandibles were found in layers dated as the Late Pleistocene (layers 9-5), while one came from the Mesolithic layer 4. All three were found in trench A. The species is the only carnivore in Sarakenos Cave, which may be due to the difficult access to the entrance, and the accumulation process which was most probably due to human activity. The weasel remains from Sarakenos Cave bear no signs of burning, cutting or crushing which could be attributed to human activity. Besides these three mandibles, no other cranial or postcranial bones were found. The sediments from the site were quite thoroughly sieved, so it is rather unlikely that some remains would have remained undetected.

This puts restrictions on attempts to reconstruct the depositional history and the possible factor responsible for the accumulation of bones. Other species from the site heavily outnumber the weasel, which is a typical situation in most archaeological localities. The lack of traces of human activity and the limited number of bones suggest that the mandibles belonged to animals which died in a natural rather than culture-related way. Even the deposition time is uncertain. The animals may have found their death at the locality during the depositional phase, or may have been re-deposited, for example by water.

The mentions of weasel-like animals in the mythologies of Greece and other Mediterranean countries almost certainly refer to *Mustela nivalis*. The stoat was not found in archaeological or palaeontological localities in either Greece or Italy (MARCISZAK 2012). Late Pleistocene, southernmost records of the ermine are known from the Balkan Peninsula, for example layer 11 of Bacho Kiro Cave (WISZNIOWSKA 1982). The common weasel which recently does not occur in many places in Asia Minor, where it lived in the Late Pleistocene, at that time reached as far south as Egypt. It was previously thought that *Mustela nivalis* was not native to North Africa and was introduced there by Romans or Persians (DAYAN & TCHERNOV 1988). The hypothesis was supported by the fact that the species is almost completely synanthropic in Egypt (OSBORN & HELMY 1980). However, discoveries of the last 30 years showed that during cooler phases of the Late Pleistocene the common weasel shifted its distribution range southward along the Mediterranean Sea coast as far as Egypt. When the climate became warmer, it retreated to the north, the populations in Egypt became glacial relicts and, being isolated, evolved into a distinct species *Mustela subpalmata* (ZYLL DE JONG 1992; ABRAMOV & BARYSHNIKOV 2000). While some authors suggest that the large size (the Egyptian weasel is almost as large as the Irish and English stoat, the largest among the ermine subspecies) might be associated with the absence of larger cousins (DAYAN & TCHERNOV 1988). However others, I among them, suggest that the size could also be regarded as an archaic feature, since the Egyptian weasel has been isolated for a relatively long time (ZYLL DE JONG 1992). ABRAMOV & BARYSHNIKOV (2000) proposed a similar scenario for the large, southern weasels. Later this hypothesis was also confirmed by KING & POWELL (2007) and MARCISZAK & SOCHA (2014).

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