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Notes on the Soricidae (Insectivora, Mammalia) from Crete. II. The shrew remains from Minoan and Classical Kommos

by

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Introduction

The recent shrew fauna of Crete consists of three species: the endemic species *Crocidura zimmermanni* Wettstein, 1953; the endemic subspecies *Crocidura suaveolens caneae* Miller, 1909; and *Suncus etruscus* (Savi, 1822). Of these three, *C. zimmermanni* has probably been present since early Pleistocene times. It has been found in association with the endemic island mammals which lived in Crete during the Pleistocene, and which became extinct after the gradual introduction by man of the mammals comprising the fauna of today (De Vos 1984; Reumer 1986).

The other two shrews, *C. s. caneae* and *S. etruscus*, were apparently absent during the Pleistocene, and were most probably introduced by man. It is not known when these introductions took place, as until now no small mammals from archaeological deposits had been studied. The availability of a sample of small mammals including many shrew remains from the archaeological site of Kommos offers the possibility of comparing the recent shrew fauna with that from historic (Minoan to Roman, 1700 BC—150 AD) times.

The locality, material and methods

Kommos lies on the south coast of Crete at the western end of the Mesara plain, not far from Agia Triadha and Phaistos (see map in Warren 1985, p. 76). The site has recently been excavated by a Canadian team under the direction of Prof. J. W. Shaw of the University of Toronto.

The Minoan occupation (c. 2000—1250 BC) featured a town and, in the south, a series of very large ashlar buildings palatial in scale but probably used largely in connection with the adjacent harbour front. The site was then re-used as a sanctuary, with temple buildings first constructed in the Protogeometric period (c. 1000 BC) and then used and rebuilt at various times until the Roman period. Further details are given in a series of preliminary excavation reports (Shaw 1977—1984).

The small mammal remains from Kommos were recovered in the course of sample water-sieving carried out by excavation personnel. The samples, which varied in size from the contents of single pots to several hundred kilograms of earth, were water-sieved through 1—2 mm window-screening, and the small mammal remains were picked out along with other small bones and other finds. Details of the archaeological contexts of the different samples are given in Appendix 1.

Appendix 1. Details of archaeological contexts.

Sample reference	Context details and reference	Date
a	79: 28B/62, contents of C2219. Room 25, CH, pithos contents	Middle Minoan III, c. 1650—1550 BC
e	79: 29A1/68, 71. Temple B3, ritual deposit around tripillar shrine	c. 600 BC
g	79: 29A1/12—14, 16—19, 21, 29—30, 32, 36—37, 47. Temple C, above and on slab floor	c. 400 BC — 150 AD
j	80: 33C/51. Temple B3, general upper pails, interior	c. 600 BC
nn	79: 29A1/87. Temple B3, lower hearth/floor around tripillar shrine	c. 600 BC
ww	80: 33C/81—88. Temple A, interior floors	c. 1000—800 BC
lll	80: 33C/48—50, 52—55, 65—66, 71—73. Temple B3, general upper pails, interior	c. 600 BC
mmm	80: 33C/60. Temple B1, outside in court	c. 800 BC
nnn	80: 33C/79. Temple B1, first (lowest) hearth/altar	c. 800 BC
ooo	81: 40A/92, vessel contents. C4633, East Room, CH	Late Minoan IIIA2—B c. 1370—1200 BC
ppp	81: 42A/30. Temple B2, court	c. 700 BC
ttt	81: 41A/70. Fill in Room 47, CH	Middle Minoan IIB—III c. 1700—1550 BC
www	85: 66A/24, pithos contents (C8297).	Late Minoan IIIA2—B c. 1370—1200 BC

A description of the rodents (Muridae) and a preliminary description of the shrews are given by Payne (in press). For comparative purposes, material of Cretan *Crocidura suaveolens caneae* and *Suncus etruscus* was available from the first author's private collection (*C. s. caneae*: Stavros, n=1, coll. no. 7615; Mavro Muri, n=11, coll. no. 7617; Georgioupolis, n=9, coll. no. 7625; Petres River, n=2, coll. no. 7629; *Suncus etruscus*: Mavro Muri, n=1, coll. no. 7618; Georgioupolis, n=1, coll. no. 7623).

Furthermore, the first author was also able to study three skulls of recent *C. zimmermanni* that were collected in August 1985 by Prof. P. Vogel and that are stored in the Institut de Zoologie et d'Ecologie Animale (IZEA) of Lausanne University (nos. IZEA 2053, 2058 and 2065; see Reumer 1986).

The measurements were made (by JWFR) using the Nikon measuring equipment at the IZEA, Lausanne. The results of the measurements of the Kommos specimens and the comparative material are given in table 1 for *Suncus etruscus*, in table 2 for *Crocidura s. caneae* and in table 3 for *C. zimmermanni*.

Some of the parameters used are after Vesmanis (1976): zygomatic width of the skull (ZW, = Vesmanis no. 7); length of the mandible including the lower incisor (L+I, = Vesmanis 25); the same but not including I (L—I, = Vesmanis 26); length of the mandible from the condyle, not including I (LC, = Vesmanis 27); coronoid height (HC, = Vesmanis 30); height to the upper sigmoid notch (HUS, = Vesmanis 31); length of the lower condylar facet (LLF, = Vesmanis 34); condylar height (CH, = Vesmanis 35); condylar length (CL, = Vesmanis 36) and condylar width (CW, = Vesmanis 37). The remainder are after Reumer (1984): PE = length to the posterior emargination; LL = lingual length;

BL = buccal length; W = width; AW = anterior width; PW = posterior width; L = length; TRW = trigonid width; TAW = talonid width.

Other abbreviations used in tables 1, 2 and 3 are: prm = parameter, n = number of observations, $\bar{x}$ = mean of the observations, sd = standard deviation.

Measurements of left and right jaws and teeth are not treated separately in tables 1—3, but have been amalgamated (the only unpaired parameter is skull ZW). The number of cases for statistical testing has been taken both as n, which assumes that there are no left + right pairs included in the data, and as n/2, which assumes that all observations are from left + right pairs and provides a more conservative estimate. In the present context n/2 is probably closer to the real situation, as the modern samples are either trapped individuals (table 3), in which case we know that the data are provided by left + right pairs, or owl pellet samples (tables 1 and 2), in which a high proportion of the specimens are known (maxillae) or likely (mandibles) to be left + right pairs; and the archaeological samples are mainly provided by local concentrations in which, again, many of the specimens are known or likely to be left + right pairs. In recognition of this probability, sd's have been calculated when $n>5$, but are given in parentheses unless $n>10$ (in which case at least six individuals must be represented). Inclusion of a mixture of left + right pairs and unpaired specimens can also cause minor deviations in sample means.

The drawings (figs. 1, 2 and 3) were made using a Wild M4 binocular microscope fitted with a drawing prism. The samples include postcranial remains of *Crocidura* sp./spp.; these we have not studied. The Kommos small mammal remains are deposited with the other excavated materials from the site, at Pitsidia.

Descriptions and remarks

Suncus etruscus (Savi, 1822)

(figure 1)

Available material: 1 right mandible with I and M_1—M_3, sample no. www. 34 (Late Minoan III A2—B); 1 left femur, sample ww (c. 1000—800 BC); 1 left mandible with M_1—M_3, sample no. j. 1 (c. 600 BC); 1 left femur, sample lll (c. 600 BC); 1 right maxilla with P^4 and M^1, sample no. g. 16 (c. 400 BC — 150 AD).

Measurements: see table 1.

Remarks: The material does not differ morphologically from recent *S. etruscus* from Crete; neither do the measurements suggest any significant difference (table 1). The remains can therefore with certainty be identified as belonging to *S. etruscus*, which confirms the provisional identification presented elsewhere (Payne, in press).

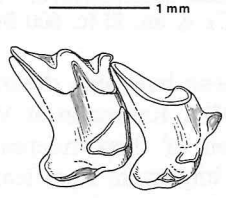

Fig. 1. *Suncus etruscus*, P^4—M^1 dex., Kommos, sample no. g. 16.

This species was reported from Crete only as late as 1970, by Spitzenberger, who described a single specimen from owl pellets collected in 1965 in N. W. Crete (Kolymvarion). Pieper (1976) then confirmed its presence in Crete and reported the species from many localities. Our data now show that *S. etruscus* inhabited Crete by as early as the fourteenth/thirteenth century BC (Late Minoan III A2—B).

Table 1. Measurements of *Suncus etruscus* from Kommos and from a recent owl pellet collection from Crete. Sizes are given in mm, see text for an explanation of parameters and abbreviations. [1]) = one of the specimens lost during study, its measurements after Payne, in press.

element	prm	Kommos sample n	Kommos sample $\bar{x}$	recent sample n	recent sample $\bar{x}$
P^4	PE	1	0.56	2	0.55
	LL	1	0.58	1	0.68
	BL	1	1.25	2	1.30
	W	1	1.09	2	1.10
M^1	PE	1	0.76	2	0.71
	LL	1	0.97	2	0.95
	BL	1	1.03	2	1.05
	AW	1	1.17	2	1.17
	PW	1	1.49	2	1.51
M_1	TRW	1	0.66	3	0.65
	TAW	1	0.73	3	0.72
	L	1	1.08	3	1.08
M_2	TRW	1	0.63	3	0.63
	TAW	1	0.66	2	0.67
	L	1	1.09	3	1.08
M_3	W	1	0.47	2	0.48
	L	1	0.82	3	0.83
M_1—M_3	L	2[1])	2.64	3	2.63

***Crocidura suaveolens caneae* Miller, 1909**
(figure 2)

Available material: numerous maxillary and mandibular remains, including 8 I sup., 13 P^4, 10 M^1, 7 M^2, 6 M^3, 8 I inf., 13 M_1, 9 M_2, 5 M_3, 12 measurable condyles and numerous upper and lower antemolars; from samples ttt (Middle Minoan IIB—III); a (Middle Minoan III); ooo, www (Late Minoan III A2—B); ww (c. 1000—800 BC); mmm, nnn (c. 800 BC); ppp (c. 700 BC); e, nn, lll (c. 600 BC); g (400 BC — 150 AD).
Measurements: see table 2.

Remarks: Recent *C. s. caneae* has been described and/or figured by Von Wettstein (1953), Richter (1970), Kahmann & Vesmanis (1975), Vesmanis & Kahmann (1978). Comparison of these references with our material from Kommos does not reveal any important significant differences. To check this, we have ourselves studied and measured recent *C. s. caneae*. The results are presented in table 2.

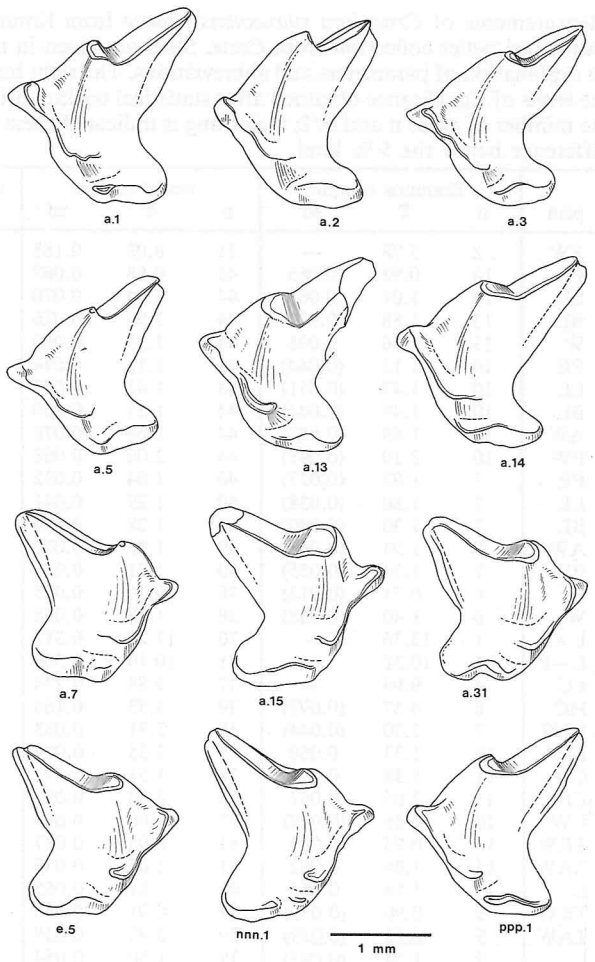

Fig. 2. *Crocidura suaveolens caneae*, P^4, Kommos, sample nos. indicated below the teeth.

The similarity in sizes between the Kommos sample and the recent comparative material is quite striking; there is no evidence for a significant size change. A few parameters show significant differences at the 5 % level, but the only one of these that is highly significant (0.1 % level), in condyle CH, can probably be explained by some loss of bone by corrosion in the Kommos specimens.

A large proportion of the specimens of this species was found in sample a, from Middle Minoan III levels (c. 1650—1550 BC).

Table 2. Measurements of *Crocidura suaveolens caneae* from Kommos and from a recent owl pellet collection from Crete. Sizes are given in mm, see text for an explanation of parameters and abbreviations. The right hand column gives the levels of significance obtained after statistical testing of both samples for the number of cases n and n/2; if nothing is indicated there is no significant difference below the 5 % level.

		Kommos sample			recent sample			t-testing based on	
element	prm	n	$\bar{x}$	sd	n	$\bar{x}$	sd	n	n/2
skull	ZW	2	5.78	—	21	6.03	0.185		
P^4	PE	13	0.93	0.065	43	0.88	0.067	5 %	
	LL	13	1.01	0.069	44	0.94	0.070	1 %	5 %
	BL	13	1.88	0.077	44	1.94	0.076	5 %	
	W	13	1.56	0.091	44	1.55	0.069		
M^1	PE	10	1.13	(0.044)	43	1.11	0.044		
	LL	10	1.47	(0.051)	43	1.41	0.043	0.1 %	5 %
	BL	10	1.49	(0.044)	44	1.51	0.050		
	AW	10	1.68	(0.052)	44	1.68	0.078		
	PW	10	2.10	(0.095)	44	2.06	0.068		
M^2	PE	7	1.03	(0.027)	40	1.04	0.032		
	LL	7	1.30	(0.038)	40	1.29	0.041		
	BL	7	1.30	(0.040)	40	1.28	0.039		
	AW	7	1.94	(0.066)	40	1.95	0.072		
	PW	7	1.74	(0.055)	40	1.71	0.057		
M^3	L	6	0.71	(0.012)	38	0.70	0.035		
	W	6	1.40	(0.038)	38	1.38	0.058		
lower	L+I	1	12.36	—	30	12.26	0.317		
jaw	L—I	1	10.32	—	31	10.19	0.306		
	LC	4	9.99	—	37	9.88	0.274		
	HC	6	4.57	(0.097)	39	4.53	0.164		
	HUS	7	2.30	(0.044)	38	2.31	0.083		
condyle	LLF	12	1.33	0.060	37	1.35	0.074		
	CH	11	1.38	0.051	38	1.51	0.071	0.1 %	0.1 %
	CL	11	2.05	0.087	38	2.08	0.097		
	CW	10	0.96	(0.049)	37	1.00	0.048	5 %	
M_1	TRW	13	0.95	0.053	41	0.95	0.037		
	TAW	13	1.06	0.062	41	1.07	0.035		
	L	13	1.58	0.063	41	1.61	0.055		
M_2	TRW	9	0.90	(0.039)	39	0.91	0.036		
	TAW	9	0.95	(0.039)	39	0.95	0.039		
	L	9	1.54	(0.043)	39	1.50	0.054	5 %	
M_3	W	5	0.68	—	41	0.67	0.037		
	L	4	1.20	—	40	1.20	0.045		
M_1—M_3	L	3	3.93	—	40	3.96	0.103		
I—M_3	L	1	7.66	—	35	7.60	0.180		

Crocidura zimmermanni Wettstein, 1953

(figure 3)

Available material: exclusively found in sample www (Late Minoan III A2—B): maxillary and mandibular material including 3 I sup., 5 AA sup. (amongst which one complete series A^1—A^3), 2 P^4, 2 M^1, 2 M^2, 3 I inf., 3 A_1, 5 P_4, 5 M_1, 3 M_2, 3 M_3, and 2 measurable condyles.

Measurements: see table 3.

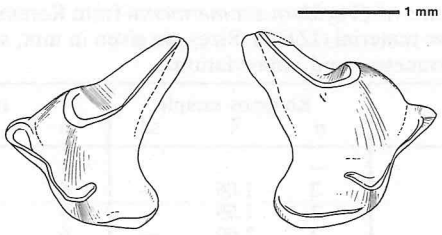

Fig. 3. *Crocidura zimmermanni*, P^4, Kommos, sample nos. www. 41 (left) and www. 43 (right).

Remarks: Descriptions and/or illustrations of recent and fossil *C. zimmermanni* have been given by Von Wettstein (1953), Richter (1970), Kahmann & Vesmanis (1974, 1975), Vesmanis & Kahmann (1978) and Reumer (1986). Apart from morphometrical features, the species may easily be distinguished from *C. s. caneae* by its considerably longer rostrum and antemolar tooth row; by the more anterior position of the mental foramen (below P_4 in *C. zimmermanni*, below M_1 in *C. s. caneae*) and by the morphology of the P^4. The P^4 of *C. zimmermanni* is depicted in Richter (1970, fig. 5, p. 285), Kahmann & Vesmanis (1974, fig. 4, p. 318), Reumer (1986, fig. 1) and in our figure 3. Comparison with the P^4 of *C. s. caneae* (our figure 2) shows the more lingually situated protocone of *C. zimmermanni*, and the virtual absence of a groove between the protocone and the hypoconal ridge. There is no doubt in the assignment of almost all *Crocidura* material from sample www to *C. zimmermanni* (the only possible exception being a small M_1, that might belong to *C. s. caneae*). This is the only sample from Kommos in which this species has been encountered.

Discussion

All three species that make up the shrew fauna of present-day Crete have been found in the Kommos samples. For *C. zimmermanni* this is not very surprising, as this species was already present in Pleistocene times (Reumer 1986). We found *C. zimmermanni* in one sample only, viz. www from the Late Minoan III A2—B (c. 1370—1200 BC). All other samples, whether Minoan or younger, only contained *C. suaveolens caneae* as representative of the genus *Crocidura*. The abundant presence of *C. zimmermanni* in Pleistocene deposits near sea-level shows that it was originally widespread in lowland areas (Reumer 1986). Its scarcity in the Minoan samples from Kommos suggests that it had already been replaced to a large degree by the introduced *C. suaveolens* in the lowland region round Kommos. It was probably forced to a refuge in somewhat more elevated and climatically more severe areas, where it still survives. Data are needed from other (archaeological) sites before we can form any picture of the time and the rapidity of the process of replacement.

Table 3. Measurements of *Crocidura zimmermanni* from Kommos and from the recent comparative material (IZEA). Sizes are given in mm, see text for an explanation of parameters and abbreviations.

element	prm	Kommos sample n	$\bar{x}$	sd	recent sample n	$\bar{x}$	sd
skull	ZW	—			3	6.25	—
P^4	PE	2	1.06	—	6	1.06	(0.080)
	LL	2	1.09	—	6	1.16	(0.080)
	BL	2	2.00	—	6	2.06	(0.046)
	W	2	1.53	—	6	1.55	(0.057)
M^1	PE	2	1.10	—	6	1.10	(0.037)
	LL	2	1.38	—	6	1.41	(0.041)
	BL	2	1.52	—	6	1.56	(0.046)
	AW	2	1.69	—	6	1.74	(0.077)
	PW	2	2.05	—	6	2.17	(0.059)
M^2	PE	1	0.95	—	6	1.05	(0.030)
	LL	1	1.12	—	6	1.28	(0.021)
	BL	1	1.26	—	6	1.33	(0.018)
	AW	1	1.82	—	6	1.97	(0.055)
	PW	1	1.56	—	6	1.68	(0.030)
M^3	L	—			6	0.60	(0.029)
	W	—			6	1.19	(0.034)
lower	L+I	—			6	13.91	(0.281)
jaw	L—I	—			6	11.47	(0.194)
	LC	—			6	10.99	(0.154)
	HC	1	4.77	—	6	4.99	(0.168)
	HUS	1	2.41	—	6	2.46	(0.108)
condyle	LLF	2	1.35	—	6	1.41	(0.030)
	CH	2	1.32	—	6	1.47	(0.117)
	CL	2	2.00	—	6	2.10	(0.089)
	CW	2	0.85	—	6	0.96	(0.070)
M_1	TRW	5	0.95	—	6	0.97	(0.023)
	TAW	5	1.07	—	6	1.11	(0.023)
	L	5	1.54	—	6	1.61	(0.030)
M_2	TRW	3	0.92	—	6	0.95	(0.012)
	TAW	3	0.94	—	6	1.00	(0.013)
	L	3	1.50	—	6	1.54	(0.032)
M_3	W	3	0.67	—	6	0.67	(0.017)
	L	3	1.16	—	6	1.16	(0.018)
M_1—M_3	L	3	3.93	—	6	3.99	(0.051)
I—M_3	L	2	8.39	—	6	8.63	(0.167)

C. s. caneae seems to have been the earlier of the other two shrew species to arrive on Crete. Its presence in considerable quantities in a Middle Minoan context indicates a date of introduction not later than c. 1700—1550 BC. This result contrasts that obtained for Menorca, where the conspecific *C. suaveolens* (now ssp. *balearica*) became introduced, probably by the Romans, around the 2nd century BC (Sanders & Reumer 1984; Reumer & Sanders 1984), at least one and a half millennia later. The difference may be explained by the early presence of well-developed civilizations with associated sea-trade in Crete, while in the Western Mediterranean there were no such civilizations on islands until the establishment of Roman colonies.

Suncus etruscus is first represented in a Late Minoan III A2—B sample, dating from c. 1370—1200 BC. It is surprising that this species went completely unnoticed on Crete until 20 years ago. A somewhat comparable situation occurs in the Aegean island of Chios, where *S. etruscus* was found in (unfortunately undated) Holocene levels (Besenecker et al. 1972). It has not been encountered yet in the recent mammal fauna, but its presence could not be excluded either (Kock 1974). Other occurences on islands in the Eastern Mediterranean have been reported by Pieper, 1966 (Rhodes), Van Laar and Daan, 1967 (Samos) and Spitzenberger, 1978 (Cyprus); but in none of these cases the date of introduction is known.

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Summary

The shrews from the archaeological deposits of Kommos, Crete, are studied. All three species that comprise the present-day Cretan shrew fauna are represented in the samples. The endemic *Crocidura zimmermanni* is only found in one sample of Late Minoan III A2—B age (c. 1370—1200 BC). It had apparently been largely replaced in low altitude regions by the introduced *C. suaveolens caneae*, which was present as early as Middle Minoan IIB—III (c. 1700—1550 BC). The earliest occurrence of *Suncus etruscus* is in the Late Minoan III A2—B (c. 1370—1200 BC).

Zusammenfassung

Reste von Spitzmäusen aus der archäologischen Fundstelle von Kommos, Kreta, werden untersucht. Alle drei rezenten Spitzmausarten Kretas sind in den Proben vertreten. Die endemische *Crocidura zimmermanni* ist nur in der spätminoischen Probe III A2—B (ca. 1370—1200 BC) vertreten. Diese Art wurde offenbar in tieferen Lagen weitgehend von der introduzierten *C. suaveolens caneae* verdrängt, die erstmals in mittelminoischer Zeit IIB—III (ca. 1700—1500 BC) auftauchte. Der älteste Nachweis von *Suncus etruscus* stammt aus spätminoischer Zeit III A2—B (ca. 1370—1200 BC).

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