Ancient Monuments Laboratory
Report 17/92

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Summary

The skeletons of six common shrews and a woodmouse were found in a bucket in a Saxon chalk-cut grave dated to the sixth century. The shrews have been identified by the size and shape of their mandibles and a suite of non-metric characters as Sorex araneus, common on the English mainland, rather than the closely-related S.coronatus, present on the continent and in Jersey. Carrion-feeding insects and their larvae may have attracted the shrews to the grave while curiosity probably led them to make their fateful climb into the bucket.

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Introduction

A Saxon bucket (Small Finds Number 3306, AML 812525) was excavated in 1981 from the south-west corner of a chalk-cut grave (excavator's ref no. 1626) dated to the sixth century AD at Carisbrooke Castle in the Isle of Wight. The bucket lay between and very close to the wall of the grave and the skull, and was removed and transported for conservation to the Ancient Monuments Laboratory (Hutchinson and Knight, n.d.).

The bucket contained dry chalk rubble. Numerous snail shells and the skeletons of a woodmouse (*Apodemus* sp.*) and several (probably six) shrews were found towards the bottom of the fill. They appeared as a "dark humic stain" (Hutchinson and Knight, n.d.).

The bucket, constructed from some 16 yew staves, bound with copper alloy hoops, had an estimated diameter of 16-18 cm. Each stave was probably at least 3.5 cm wide, 15.5 cm long, and 4 mm thick (Knight, in press).

Small mammals such as shrews are often accidentally introduced onto islands by man. Since the shrews in this Saxon bucket come from an island whose faunal history is little known and given the presence of a continental species of shrew, *Sorex coronatus*, on certain islands such as Jersey, it was felt worthwhile investigating these Saxon remains from the Isle of Wight. The purpose of this note is to identify the shrews and speculate why they made their fateful journey into the bucket in antiquity.

Zoogeography and zoology

Three species of shrew inhabit mainland Britain today. They are the pygmy shrew *Sorex minutus*, the common shrew *S. araneus*, and the water shrew *Neomys fodiens*. However other species inhabit several islands (eg, white toothed shrews *Crocidura suaveolens* on most of the Scilly Isles, Jersey, Sark, Ouessant and Yeu, and *C. russula* on Alderney, Guernsey and Herm). On the continent and in Jersey, *S. coronatus*, a sibling species to *Sorex araneus*, has been recognised karyotypically (Corbet and Harris, 1991).

The skulls and mandibles of most of these species are easy to separate by tooth colour and measurements (see below). However *S. araneus* and *S. coronatus* are very similar, and are often grouped together. At first sight it was quite clear that the shrews from Carisbrooke with their pigmented teeth and medium size belong to this "*Sorex araneus* group". While very small metric differences between these two species do exist (Loch, 1977; Corbet and Harris, 1991) the separation is too small to usefully separate individual specimens and small samples. In this study we have, therefore, resorted to shape and non-metric characters to determine whether the Carisbrooke *Sorex* belongs to *araneus* or *coronatus*. Morphological differences in the mandible have been reported (Hausser and Jammot, 1974). The most striking of these are the shape of the coronoid process and the shape of the condyle (see figure 1).

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* The minimum mandibular height of both woodmouse mandibles (one left and one right) is 3.2 mm - a value which falls within the range of overlap between *Apodemus sylvaticus* and *A. flavicollis* (Davis, 1991).

When seen from the side, the coronoid in *coronatus* appears to project forward, while in *araneus* it is vertical. In posterior view, the condyle of *coronatus* appears to form a somewhat elongate triangle, while that of *araneus* forms a more equilateral one.

In addition, non-metric characters separating these two species have been discovered by King (in prep., and see below).

Methods

The shrews were identified by the following methods: a) size and tooth-colour, b) shape of the mandibular condyle and coronoid process and c) non-metric characters on the skull and mandible.

a) Measurements

The shrew mandibles (labelled "a" to "k") were measured under a Wild M3C binocular microscope fitted with an eyepiece 'cross-hair' graticule and a micrometer travelling stage with a digital display reading to the nearest 0.001 mm.

Each measurement was taken twice, first by moving the stage in one direction and then in the opposite direction. If the two readings agreed to within 0.015 mm, they were accepted and the mean calculated. Readings differing by more than 0.015 mm were rejected and that measurement then re-taken afresh.

Three mandible measurements were taken (figure 2): 1) The length of the molar teeth M_1-M_3 - measured from the anterior edge of the M_1 cingulum or crown (whichever projects further forwards) to the posterior-most part of the posterior edge of the M_3 cingulum. This is Hausser's (1984) measurement "4". 2) The maximum (crown) length of the two unicuspid teeth, and 3) The length from the base of the incisor to the condyle. This is Vesmanis' (1976) measurement "27".

b) Morphology of the mandible.

The Carisbrooke shrew mandibles were compared, under a low power microscope, with the silhouettes provided in Hausser and Jammot (1974) and drawings in Lange et al. (1986). A drawing tube fitted to a Wild M5A binocular microscope was used to draw sketches of the shrew mandibles.

c) Non-metric characters

The material was examined for 21 non-metric characters under a Wild M3C microscope at a power of X10, occasionally increasing to X16 where there was some doubt about the variant state. 18 characters were scored from the skulls although a number of these were not scoreable in all skulls because of the incomplete nature of the material. Three characters were scored from the mandibles. The material was reasonably clean and no significant difficulty was found in scoring any of the variants.

The characters scored are a large subset of those used by King (in prep), omitting those which can only be reliably determined from well cleaned museum specimens. The location of each character is shown in figure 3 and they are named below. [The character state pointed to in figure 3 are given in square brackets after the description of the character.]

0; Anterior maxillary foramen present or absent, [0].
1; Premaxillary foramen single or double, [1].
3; One or both orbito-sphenoidal foramina fused to the sphenopalatine foramen (F): normal unfused state called 1, [1].
5; Posterior alisphenoid foramen single or double, [2].
5A; Pneumatic foramen present or absent, [1].
6; Parieto-frontal foramen present or absent, [1].
7; Anterior lateral sinus foramen single or double, [1].
8; Posterior lateral sinus foramen fused to the suture between the parietal and pro-otic bones (F): normal unfused state called 1, [F].
8A; Auxiliary posterior lateral sinus foramen present or absent, [1].
16; Medial lateral sinus foramen present (uncommonly double), or absent, [1].
4; Auxiliary bony spur on olfactory capsule present (H): absence of spur is called A, [H on left; A on right].
9; Hypoglossal foramen single or double, [2].
10; Basisphenoidal foramen present (uncommonly double) or absent, [1].
10A; Foramen ovale single or double [1].
10P; Basisphenoidal process present or absent, [P].
12; Posterior palatine foramen single or double, [2].
12A; Medial palatine foramen present or absent, [1].
5UC; Fifth upper unicuspid present or absent, [1].
13; Mental foramen with secondary foramen anterior to it - present (2) or absent (1), [2].
13L; Auxiliary mental foramen absent, or present ventral to the major one (this not uncommonly has a secondary foramen anterior to it also), [1].
15; Dentary canal between coronoid fossa and mandibular foramen absent or present (rarely it may be double), [1].

Results (for measurements of modern shrew mandibles see appendix)

The teeth of the Carisbrooke shrews are red-tipped and in the skulls there are five pairs of unicuspid teeth - both are characteristic of *Sorex* and not *Crocidura*. The measurements of the mandibular unicuspids and molars (table 1 and figure 4) show quite clearly that the shrews belong to the '*Sorex araneus*' group.

Comparison of the shape of the coronoid processes of the Carisbrooke mandibles with the drawings in Hausser and Jammot (1974) and Lange et al. (1986) (see also figures 1 and 5) indicate that the Carisbrooke specimens are more similar to *Sorex araneus* than *S. coronatus*: the coronoid on most of the Carisbrooke mandibles is vertical and does not project forward, and the condyle, when viewed from behind, forms a more or less equilateral triangle.

Previous study of populations of shrews belonging to the species *S. araneus* and *S. coronatus* revealed considerable differences in their pattern of non-metric character variation (King, in prep.). 15 of the 21 characters scored on the Carisbrooke specimens showed differences in frequency significant at the 1% level between the two largest populations previously studied - Wytham Woods (near Oxford): *S. araneus* n = 289 and Cap Gris Nez (Pas de Calais): *S. coronatus* n = 213. In contrast Wytham differed from other English *S. araneus* populations at no more than four characters at this level of significance. This level of distinction between the two species does not mean that discrimination of individual skulls is always possible; no single character is absolutely diagnostic.

The difference in frequency between the pooled samples of "all English *S. araneus*" and "all *S. coronatus*" does exceed 0.5 at two of the characters, however. These are the variants 4 and 5A. *S. coronatus* usually have the auxilliary bony spur present, and *S. araneus* usually lack it (variant 4). *S. coronatus* usually have a pneumatic foramen, whereas *S. araneus* usually do not have it, (variant 5A). No mandibular variant is as useful in separating the species, although the frequency of both secondary mental foramen (variant 13) and auxiliary ventral mental foramen (variant 13L) is substantially higher in *S. araneus* than in *S. coronatus*. Indeed the second of these variants is not present in any individual of the latter species examined by King (in prep). It should nevertheless be emphasized that the degree of discrimination of mandibles possible by these characters is not great, certainly substantially less than that suggested by Hausser and Jammot (1974) for the mental foramen (variants 13 and 13L were undivided in their publication). The dental canal is more frequently absent (variant 15) in *S. araneus* than in *S. coronatus* aiding identification of the mandible but individual mandibles still cannot generally be placed in one taxon or the other by this method.

Nor can an individual skull always be identified, although it is usually possible to make a fairly certain identification. In the case discussed in this paper, however, there is no such problem. A sample of six shrews is quite sufficient to make a definite statement as to which form is present, assuming that there is only one of the two species in the sample, which is almost certain in view of their almost totally allopatric distribution in Europe.

Table 2 shows that at variant 4 the bony spur (variant state H) occurred three times in twelve. This is about the frequency expected in a sample of six *S. araneus* from England. In strong contrast to this, *S. coronatus* would show variant state H ten or eleven times out of twelve. At variant 5A the pneumatic foramen was present six times in eleven. This is higher than usual for *S. araneus* but is lower than usual for *S. coronatus*, so no decision can be based on this variant frequency. Table 3 shows that in the mandibles variant 13L - auxiliary ventral mental foramen - is present four times in eleven and double once. This, along with the dentary canal (variant 15) being absent three times in ten, is also strongly indicative that the shrews are *S. araneus*, as expected, and not *S. coronatus*.

Consideration of the variant frequencies in both skull and mandible confirms that the Carisbrooke shrews are indeed *Sorex araneus*, in agreement with the mandibular morphology.

Discussion

How did the Carisbrooke shrews meet their fate? Shrews are small insectivorous animals well known for their curiosity. They will on occasion burrow and crawl down holes and crevices in search of worms and insects. Crowcroft (1957) found that his captives would dig tunnels when supplied with adequate amounts of earth, and that digging activity of some individuals was quite intense. My (PK) experience with captive shrews (of the same species) is contrary to this: I found that one animal was keen on digging holes and burrowing, but that the large majority would only do a little desultory digging, or would show no interest at all, and strongly suspect habitat/locality dependent differences in shrew behaviour.

Nonetheless shrews are prone to push through small holes, so it does not really matter whether they dug the hole into the grave, whether voles or moles did it, or whether it was just ground subsidence that made a small opening in

the interment. In any case carrion beetles and flies would have entered the grave, and their larvae, feeding on the corpse, would have attracted the shrews.

Once, on Bookham Common, one of us (PK) found a discarded Pepsi-Cola can wedged almost upright in dense hedgerow vegetation with its base about 5 cm above ground level. It contained remains of two pygmy shrews and one common shrew, and disarticulated parts of about 25 ground beetles (mostly *Abax parallelepipedus* with a few *Pterostichus madidus*). No doubt the beetles entered the discarded can through the ring-pull hole in search of nourishment, suggested by the smell of drying cola. (Many ground beetles, including these species, are not obligate carnivores and will take a wide range of food.) Once in the can they were probably either mired or drowned in the sticky mess, and even if not they would have had great difficulty in climbing out. The struggling beetles attracted shrews to the can, and they squeezed through the ring-pull hole in pursuit of a meal, and were themselves trapped. In this case the motive in climbing into the can was clear.

It is less certain why shrews climbed into the bucket in grave 1626. Possibly once they had fed on the larvae (and perhaps adult beetles) that were devouring the corpse they decided to explore all other parts of the grave. Because of the position of the bucket in the interment some shrews managed to climb in, but once inside were unable to escape by scaling its steep sides, and so met their fate.

Acknowledgements

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Table 1

Measurements in millimetres of the Carisbrooke castle shrew mandibles. These have been labelled "a" - "k". L = left, R = right.

Mandible	L/R	l. M_1-M_3	l. uni-cuspids	l. base of I - condyle
"a"	L	3.76	1.81	9.97
"b"	L	3.69	-	9.79
"c"	L	3.76	1.73	9.79
"d"	L	3.85	1.74	9.75
"e"	L	3.80	1.75	9.81
"f"	L	3.75	1.76	9.57
"g"	R	3.80	-	9.66
"h"	R	3.83	1.70	9.77
"i"	R	3.85	1.82	10.00
"j"	R	3.85	1.74	9.75
"k"	R	3.79	1.78	9.75

Table 2

Non-metric variants of the Carisbrooke shrew skulls. These have been labelled "P" - "U".

	left side																	right side															
Characters:	0	1	3	5	5A	6	7	8	8A	16	4	9	10	10A	10P	12	12A	5UC	0	1	3	5	5A	6	7	8	8A	16	4	9	10	10A	10P	12	12A	5UC
Skull																																				
"P"	1	1	1	2	-	1	-	-	-	-	H	-	1	1	0	1	0	1	0	1	1	1	1	1	-	-	-	-	H	-	1	1	0	1	0	1
"Q"	0	1	-	1	1	1	-	-	-	-	A	-	1	1	0	1	0	1	0	-	-	-	-	-	-	-	-	-	A	-	1	1	0	1	0	1
"R"	0	2	1	1	0	1	1	1	0	0	A	-	0	1	0	1	0	1	0	2	1	1	0	1	1	1	0	0	A	-	1	1	0	2	0	1
"S"	0	1	1	1	0	1	-	1	0	1	A	-	1	1	1	1	0	1	0	1	1	1	1	1	-	-	-	-	A	-	1	1	1	1	0	1
"T"	0	1	1	1	0	1	1	F	0	1	A	1	1	1	0	1	0	1	0	1	1	1	0	1	1	F	0	0	H	1	1	1	0	1	0	1
"U"	0	2	1	1	1	1	1	-	-	-	A	1	1	1	0	2	0	1	0	1	1	1	1	1	1	1	1	0	1	A	1	1	1	0	1	0	1

Character 4, A = auxilliary arch of bone absent, H = the auxilliary arch of bone present
Character 8, F = foramen fused to suture between bones, 1 = the foramen not fused
Character 3, F = one or both of the orbito-sphenoidal foramina and the spheno-palatine foramen fused, 1 = these foramina not fused
other characters, 0 = foramen absent, 1 = foramen present and single, 2 = foramen double

Table 3

Non-metric variants of the Carisbrooke shrew mandibles, labelled "a" - "k". 0 = foramen absent, 1 = foramen present and single, 2 = foramen double.

	left side			right side		
Characters:	13	13L	15	13	13L	15
Mandible						
"a"	1	1	1			
"b"	1	0	0			
"c"	2	0	1			
"d"	1	0	0			
"e"	2	0	1			
"f"	1	0	0			
"g"				1	0	1
"h"				1	1	1
"i"				1	2	1
"j"				1	0	-
"k"				1	1	1

Figure 1

Mandibles of *Sorex araneus* (a) and *S. coronatus* (b) from behind and in lateral view to show the differences in shape of the condyle and coronoid. Redrawn from Lange et al. (1986)

Figure 2

Sketch of a shrew mandible in lateral view to illustrate how measurements were taken.

Figure 3

Sketches to illustrate the locations of non-metric skull and mandible characters. a) Skull in lateral view (dashed line encloses the area within which the foramen of the medial-lateral sinus may occur - character 16), b) Skull in ventral view, c) View of the olfactory capsule through the foramen magnum, d) Lateral view of mandible (dashed lines show coronoid fossa and mandibular fossa on the other face of the mandible).

Figure 4

Scatter diagram of the maximum length of the unicuspids against length of M_1-M_3 of shrew mandibles. Key: Triangles = *Sorex minutus*, Circles = *S. araneus*, Squares = *Neomys fodiens*. "C" = Carisbrooke shrews.

Figure 5

Sketches of the six left shrew mandibles from Carisbrooke, "a" to "f" from top to bottom, to show the shape of the coronoid process. Scale = 10 mm.

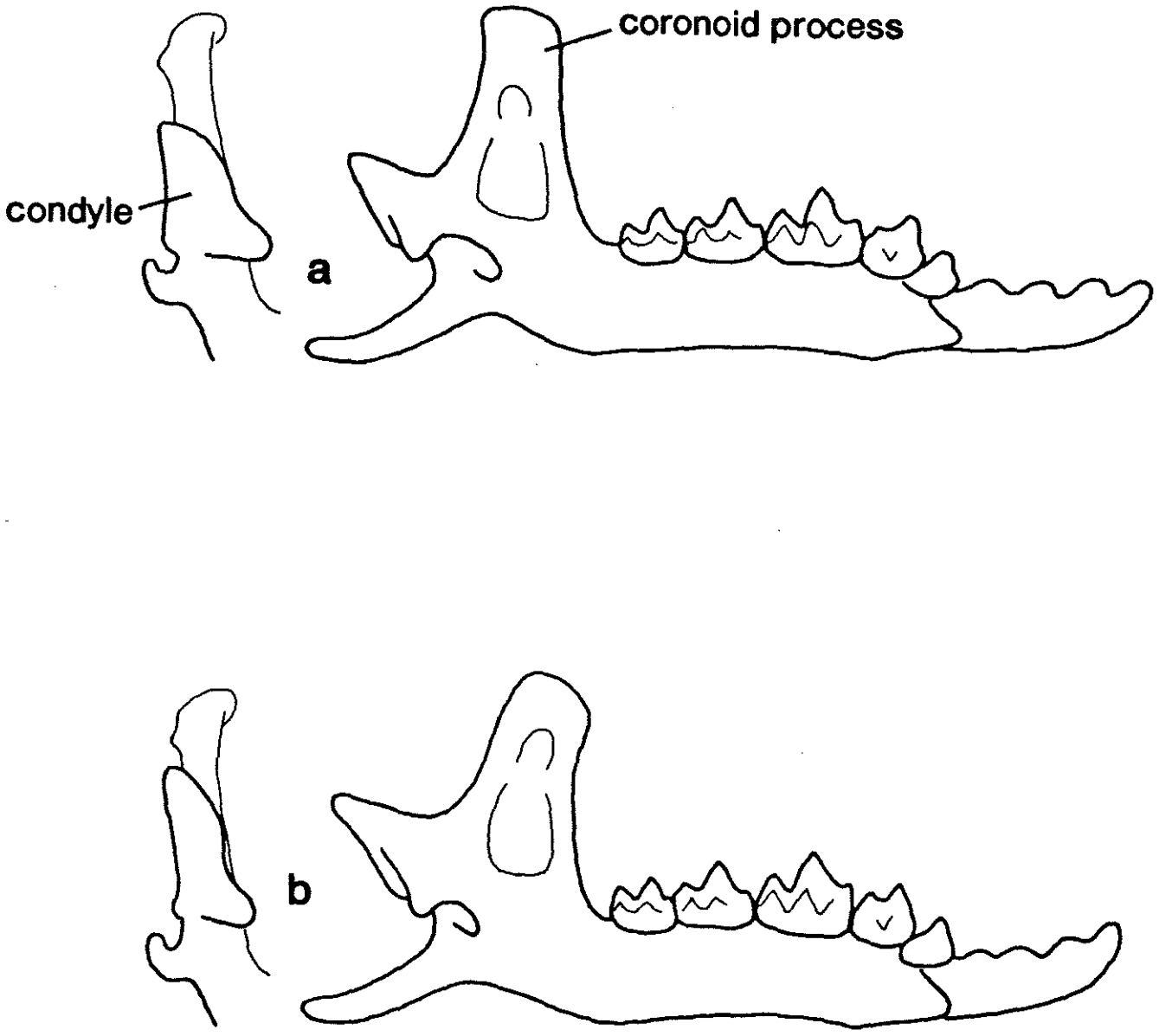
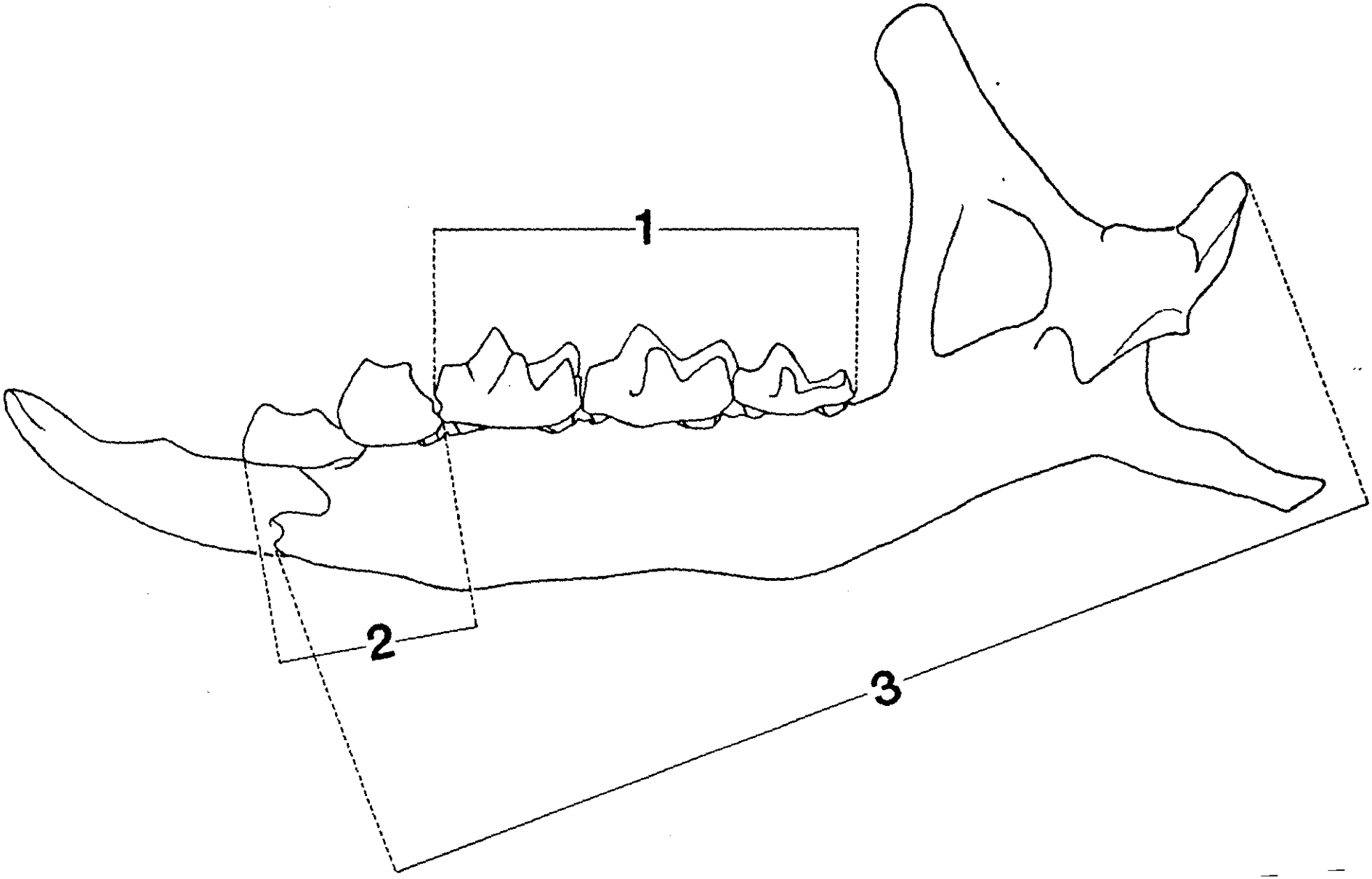


Figure 1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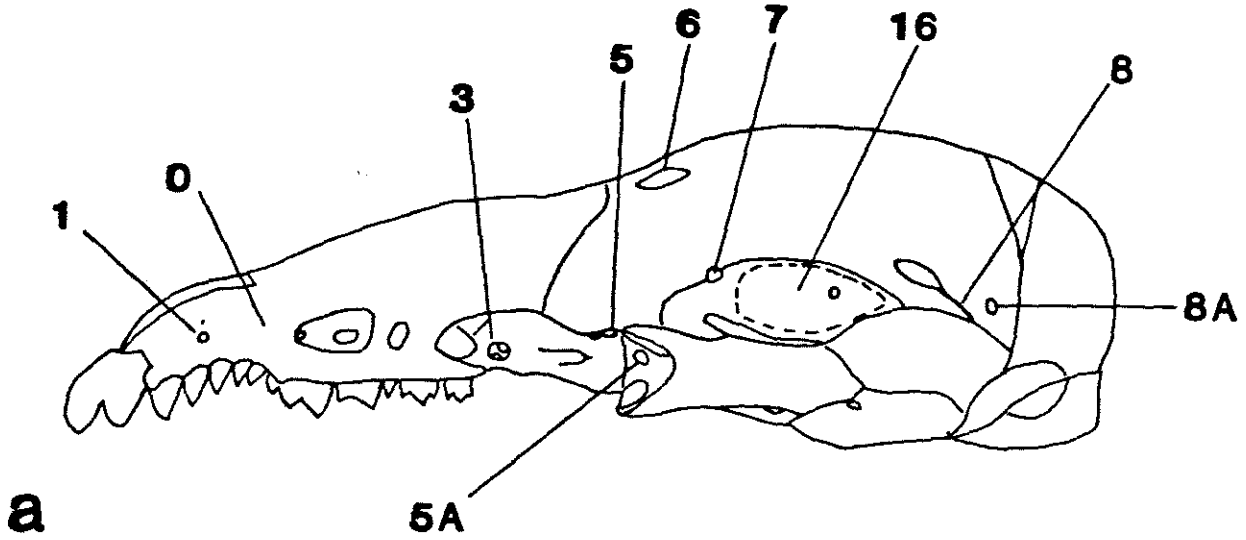
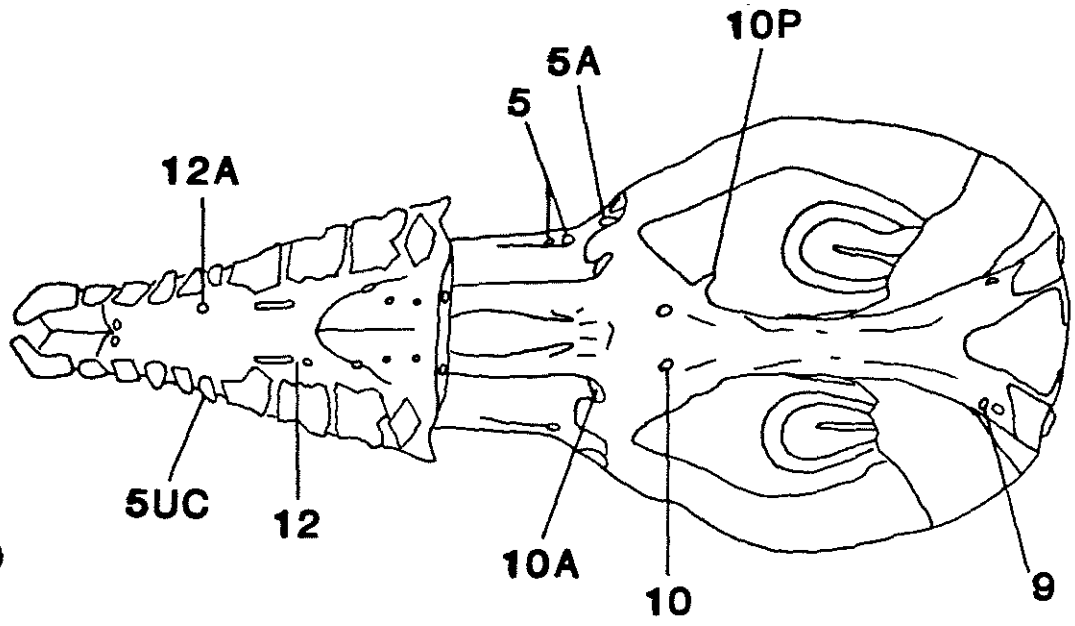
2
3



a



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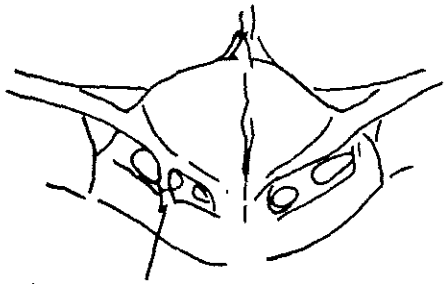
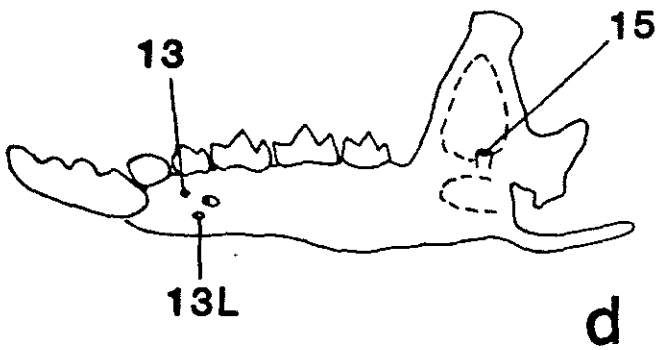


4 variant H

4 variant A

c



d

Figure 3

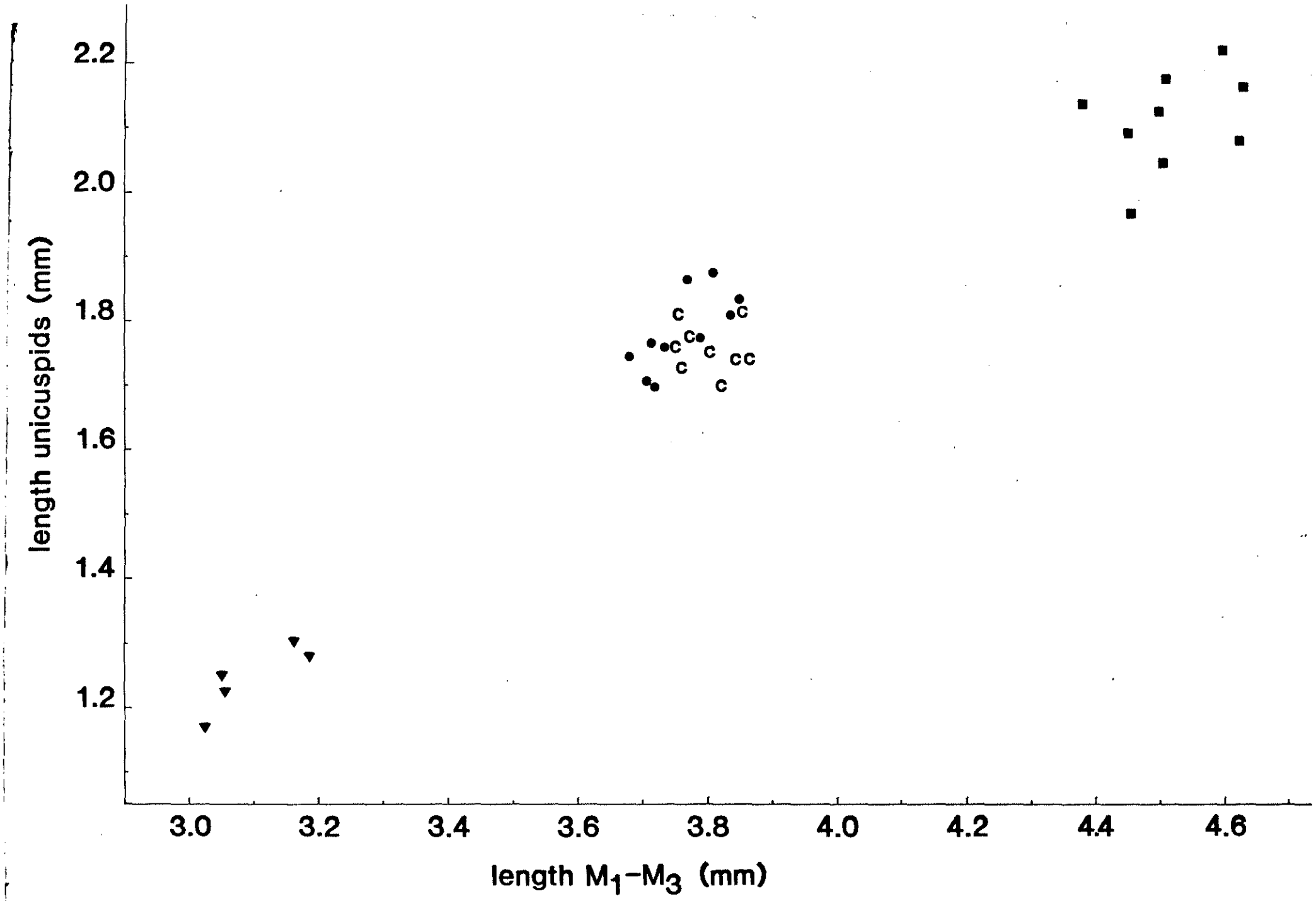

length unicuspids (mm)
2.2
2.0
1.8
1.6
1.4
1.2
3.0
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
length M_1–M_3 (mm)

Figure 4

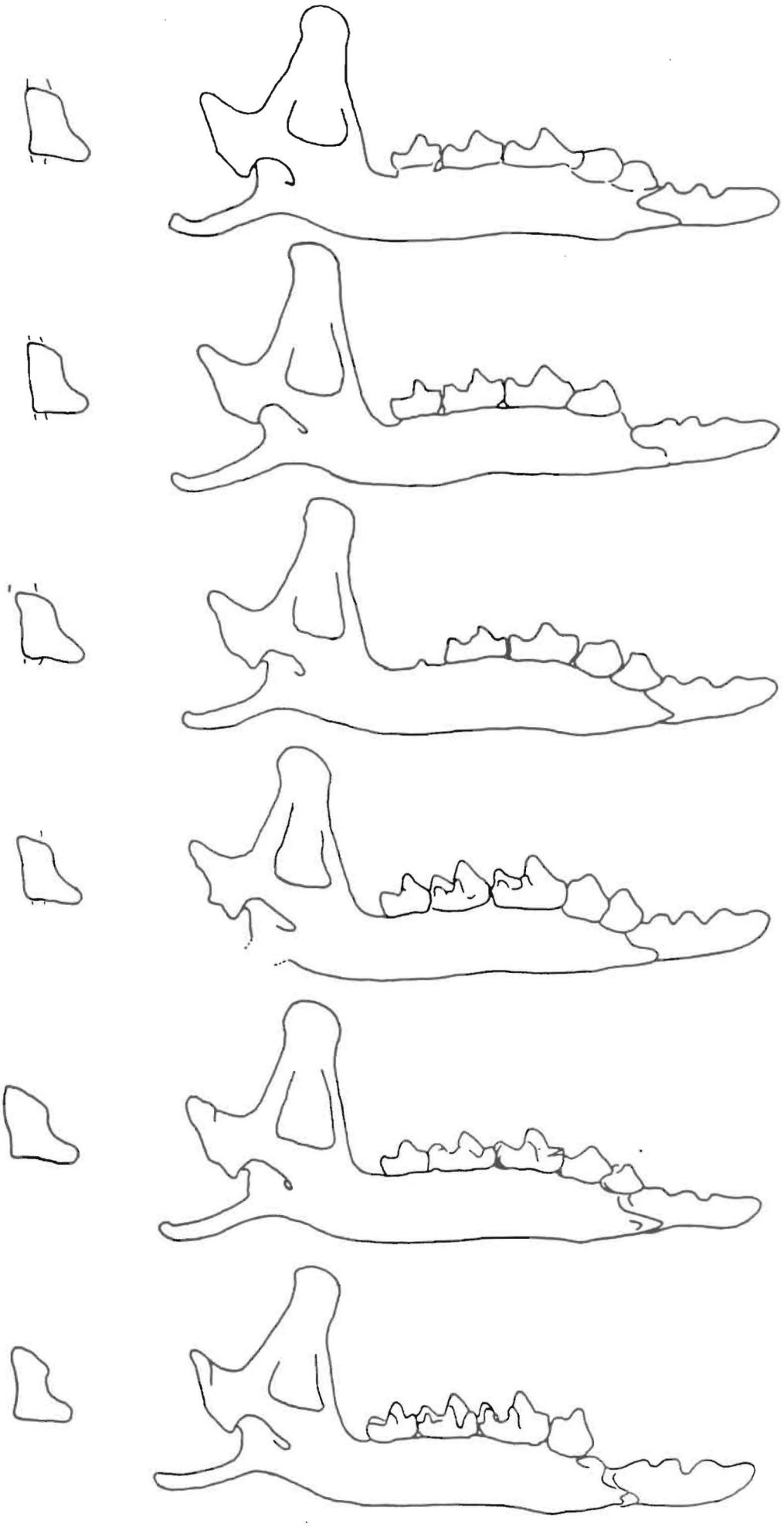


Figure 5

Appendix

Measurements in millimetres of mandibles of British pygmy shrews in the AMLab comparative collection

***Sorex minutus*, pygmy shrew**

AML no.	Sex	Locality	l. M_1-M_3	l. uni-cuspids	l. base of I - condyle
1002	m	Lewis, Outer Hebrides	3.14	-	7.83
1197	m	Hants	3.19	-	7.63
1191	?m	Oxon	3.05	1.22	7.20
1198	m	Oxon	3.13	-	7.62
2096	m	Oxon	3.18	1.28	7.61
1196	m	Hants	3.21	-	7.72
1194	m	Oxon	3.16	1.31	7.69
1192	m	Oxon	3.03	1.17	7.11
1193	f	Oxon	3.05	1.25	7.54
1195	f	Hants	3.14	-	7.68
1228	-	Mainland, Orkney	3.07	-	7.65
1227	-	Mainland, Orkney	3.12	-	7.80

Appendix (cont.)

Measurements in millimetres of mandibles of British common shrews in the AMLab comparative collection

***Sorex araneus*, common shrew**

AML no.	Sex	Locality	l. M_1-M_3	l. uni-cuspids	l. base of I - condyle
1140	m	Surrey	3.73	-	10.13
1146	m	Surrey	3.72	-	9.79
2216	m	Cambs	3.78	1.77	9.81
1150	?m	Surrey	3.81	-	9.96
1153	m	Surrey	3.74	-	9.64
2235	m	Herts	3.74	1.76	9.93
1149	m	Surrey	-	-	9.59
1148	m	Surrey	-	-	9.56
1139	m	Surrey	-	-	9.69
1135	m	Surrey	3.65	-	9.30
1141	f	Surrey	3.71	1.77	9.79
1137	f	Surrey	3.84	-	9.87
1170	f	Bucks	3.75	-	9.66
1208	?f	Cambs	3.71	1.71	9.64
1142	f	Surrey	3.71	1.70	9.67
1144	f	Surrey	-	1.68	9.27
1143	f	Surrey	3.78	-	9.40
1134	f	Surrey	3.77	1.86	9.92
1145	f	Surrey	-	-	9.44
1152	f	Surrey	3.63	-	9.20
1136	f	Surrey	3.79	-	9.83
1138	f	Surrey	3.64	-	9.50
1147	f	Surrey	3.83	-	9.75
1151	f	Surrey	-	-	9.88
1054	f	Kent	3.70	-	9.55
1132	-	Cambs	3.88	-	9.96
2201	-	Norfolk	3.68	1.75	9.66
2233	-	Norfolk	3.81	1.88	10.01
2202	-	Norfolk	3.84	1.81	9.63
1212	-	Bucks	-	-	10.01
1017	-	-	3.85	11.83	10.20

Appendix (cont.)

Measurements in millimetres of mandibles of British water shrews in the AMLab comparative collection

***Neomys fodiens*, water shrew**

AML no.	Sex	Locality	l. M_1-M_3	l. uni-cuspids	l. base of I - condyle
1160	m	Surrey	4.51	2.18	11.09
1158	m	Surrey	4.63	2.17	11.07
1202	m	Surrey	4.45	1.97	10.49
1157	m	Surrey	4.44	-	10.90
1199	m	Berks	4.60	2.23	11.16
1203	m	Surrey	4.50	2.08	11.11
2728	m	H & W	4.65	-	11.16
1156	m	Surrey	4.45	-	11.10
1200	f	Hants	4.45	2.10	10.90
1201	f	Surrey	4.50	2.05	11.11
1154	f	Surrey	4.38	2.14	11.04
1161	f	Surrey	4.41	-	11.22
2690	f	Cambs	4.57	-	11.63
1018	-	-	4.63	2.09	11.05