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Studies on the genus *Crocidura* (Insectivora, Mammalia) in Algeria

[With 10 text-figs.]

Studia nad rodzajem *Crocidura* (Insectivora, Mammalia) w Algierii

Abstract. The paper contains a description of two species of the genus *Crocidura* WAGLER 1832, belonging to the modern fauna of Algeria: *C. whitakeri* DE WINTON 1897 and *C. russula* HERMANN 1780. The material consists of remains derived from owls' pellets found in 27 places in northern and central Algeria and a small number of specimens caught in killing traps. Members of the genus *Crocidura* have not been observed in the Sahara, that is, to the south of the Saharan Atlas Mts. The paper comprises also a discussion of the systematic position of the above-mentioned forms, their measurements and drawings showing the methods of measuring and presents the morphological differences between these two species.

I. INTRODUCTION

Shrews were first mentioned from Algeria as early as the mid-19th c., e.g. POMEL (1856) describes *Sorex mauritanicus* as a new species from the Oran Province, LOCHE (1858) reports the occurrence, among other forms, of *Sorex tetragonurus* HERMANN from the region of Algiers and *Crocidura aranea* DE SELYS LONGCHAMPS from all over Algeria. In the list of the Sahara fauna TRISTRAM (1860) names also *S. tetragonurus*, *S. araneus* L. and *S. agilis* LE VAILLANT and LATASTE (1885), *Crocidura araneus* SCHREBER 1775 from the Annaba region, *C. suaveolens* PALLAS 1811 from the Blidah area and *Sorex vulgaris* L. and *S. fodiens* PALLAS 1756, without giving their places of occurrence. However, the works of these and other authors of that period give so vague descriptions, if any, of the specimens collected that on their bases they cannot be included in the species living in Algeria and her vicinity now. In his works of 1975 and 1976a VESMANIS made attempts to elucidate to which species the names given by those authors correspond.

In more recent works concerning Algeria the authors most frequently mention two species of shrews: *Crocidura russula* HERMANN 1780, now living in south-western Europe (TROUESSART 1905; THOMAS 1913; JORDAN and ROTH-SCHILD 1912, 1914; JOLEAUD 1927; HEIM DE BALSAC 1936; ELLERMANN and

MORRISON-SCOTT 1951; VESMANIS 1975 and others) and *C. whitakeri* DE WINTON 1897 described from Morocco (THOMAS 1913; JOLEAUD 1927; HEIM DE BALSAC 1936; SEURAT 1943; VESMANIS 1976b; VESMANIS and VESMANIS 1980). Besides, in 1975 VESMANIS described a new species from Oran, *C. heljanensis*.

No papers hitherto published are based on fairly abundant and actual material. And so it has not been known how many and which species live in Algeria nowadays, whether *C. suaveolens*, widely distributed in Europe and Asia and reaching as far as north-eastern Africa, occurs there and whether *C. whitakeri* is a separate species or only subspecies of *C. suaveolens*.

I wish to express my thanks to Mrs Małgorzata PRAYER for drawing figures for this paper.

II. MATERIAL AND METHOD

In 1979—1982 the authoress, together with Kazimierz KOWALSKI, gathered numerous pellets of owls, chiefly of the Barn-Owl *Tyto alba*. These pellets contained many remains of shrews of the genus *Crocidura*. Eight specimens were

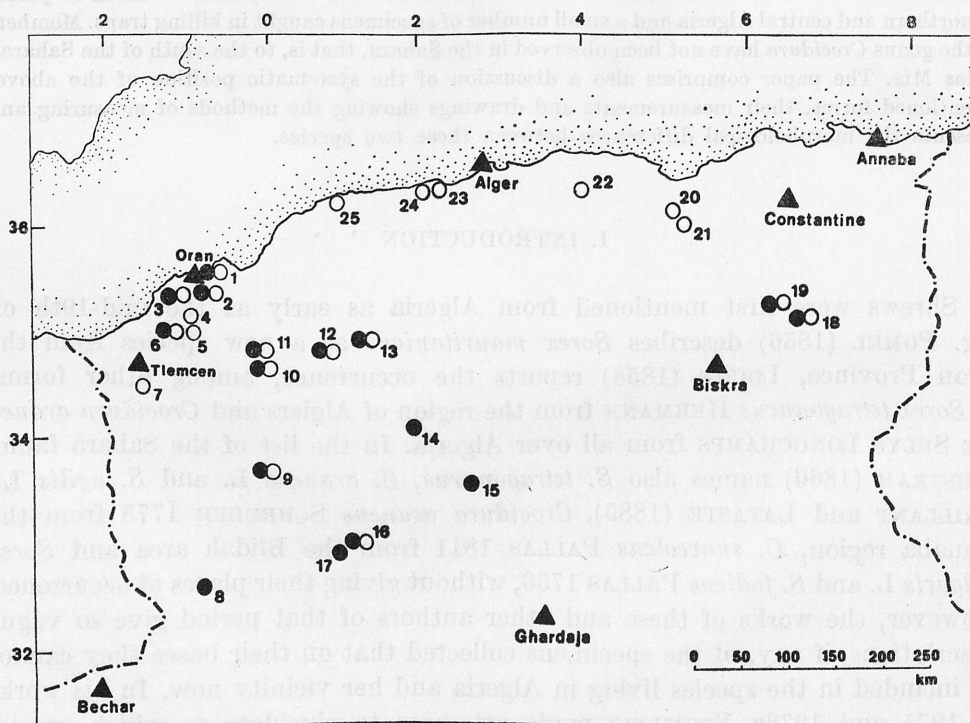


Fig. 1. The distribution of *Crocidura* in Algeria. Empty circles — *C. russula*, full circles — *C. whitakeri*. 1 — Oran = Es-Senia, Mourdjadjo, Misserghin, 2 — Tafaraoui, 3 — El-Amria, 4 — Tessala, 5 — Sidi-Driss, 6 — Pierre du Chat, 7 — Sebdu, 8 — Ain-Sefra, 9 — Alfaville, 10 — Saida, 11 — Sidi-Amar, 12 — Frenda, 13 — Ain-Said, 14 — Aflou, 15 — Laghouat, 16 — Arbauats, 17 — Brezina, 18 — D. Chelia, 19 — Timgad, 20 — Aokas, 21 — D. Megriss, 22 — Beni Yenni, 23 — Tipasa, 24 — Cherchel, 25 — Souk Elbakar

in addition captured in killing traps and insect funnel traps. These materials were used to explain some of the problems posed above.

The remains of shrews of the genus *Crocidura* collected in Algeria come from 27 localities. These are Tafaraoui (35°29'N, 00°31'W), Misserghin (35°41'N, 00°39'W), Djebel Megriss (36°20'N, 05°21'E), Beni-Yenni (36°37'N, 04°12'E), Mourdjadjo (35°41'N, 00°41'W), Pierre du Chat (35°09'N, 01°27'W), Cherchel (36°36'N, 02°11'E), Tipasa (36°35'N, 02°27'E), Timgad (35°28'N, 06°28'E), Djebel Chelia (35°19'N, 06°40'E), Sidi-Driss (35°10'N, 01°39'W), Ain-Said (35°05'N, 01°30'E), Arbauats (33°10'N, 01°35'E), Alfaville (33°52'N, 00°20'E), Es-Senia (Oran) (35°41'N, 00°39'W), El-Amria (35°32'N, 01°02'W), Sebdou (34°30'N, 01°20'W), Aokas (36°38'N, 05°14'E), Tessala (35°13'N,

Table I

The number of skulls and mandibles of *C. whitakeri* and *C. russula* in 27 localities in Algeria

	<i>Crocidura whitakeri</i>		<i>Crocidura russula</i>	
	skulls or their fragments N	mandibles or their fragments N	skulls or their fragments N	mandibles or their fragments N
Es-Senia (Oran)	2	3	12	33
Mourdjadjo	0	0	1	4
Misserghin	0	1	2	4
Tafaraoui	2	4	3	6
El-Amria	2	6	8	13
Tessala	0	0	1	2
Sidi Driss	0	0	44	144
Pierre du Chat	1	5	1	11
Sebdou	0	0	0	4
Ain-Sefra	0	1	0	0
Alfaville	2	3	0	8
Saida	5	5	9	45
Sidi-Amar	5	56	23	73
Frenda	1	0	0	1
Ain-Said	3	8	1	2
Aflou	128	243	0	0
Laghouat	6	3	0	0
Arbauats	0	1	0	1
Brezina	1	3	0	0
Djebel Chelia	0	3	2	9
Timgad	0	1	1	2
Aokas	0	0	59	157
Djebel Megriss	0	0	1	2
Beni Yenni	0	0	1	2
Tipasa	0	0	2	3
Cherchel	0	0	4	8
Souk-Elbakar	0	0	0	1

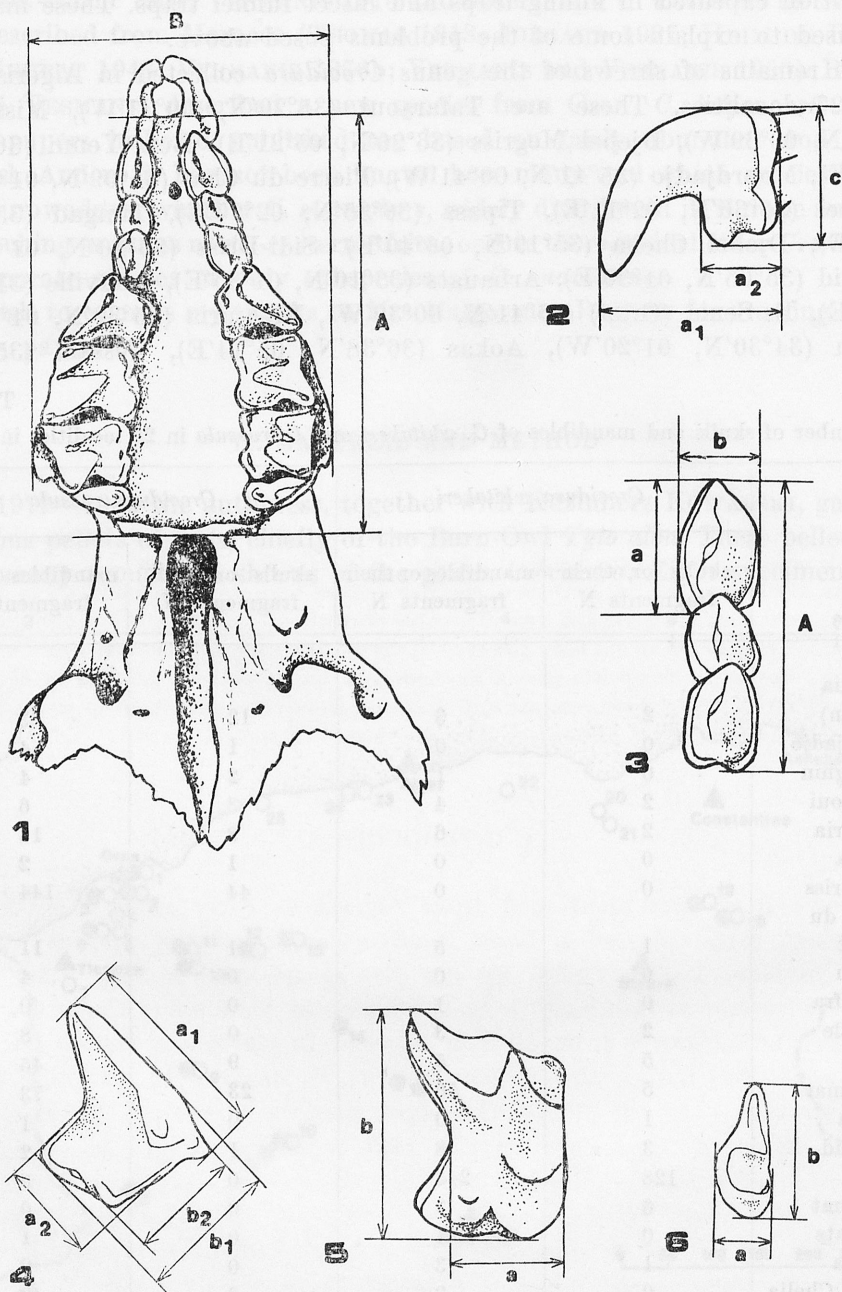


Fig. 2. The method of measuring of *Crocidura* skull and upper teeth. 1. A — length of palate, B — width on zygomatic process. 2. I¹: a₁ — length, a₂ — length of talon, c — height of talon. 3. A¹-A³: A — length of A¹-A³, a — length of A¹, A² or A³, b — width A¹, A² or A³. 4. P⁴: a₁ — buccal (external) length, a₂ — median length, b₁ — maximal width, b₂ — anterior width. 5. M¹ and M²: a — median length, b — maximal width. 6. M³: a — length, b — width

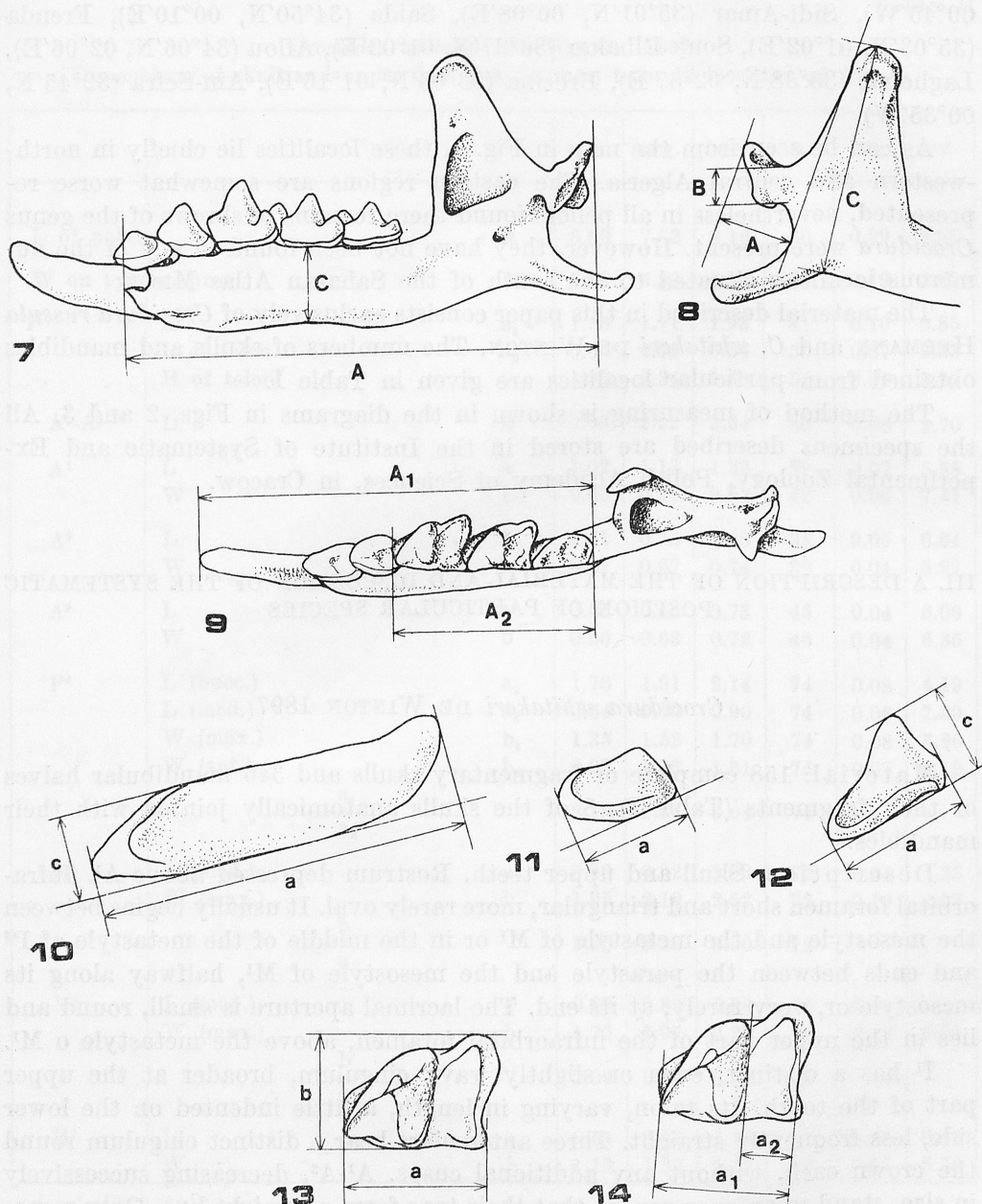


Fig. 3. The method of measuring of *Crocidura* mandible and lower teeth. 7. A — length of mandible without I_1 , C — height of mandible below M_2 . 8. A — length of processus condyloideus, B — width of processus condyloideus, C — height of ascending ramus. 9. I_1 - M_3 : A_1 — length of I_1 - M_3 , A_2 — length of M_1 - M_3 . 10. I_1 : a — length of I_1 , c — height of I_1 . 11. A_1 : a — buccal (external) length of A_1 . 12. P_4 : a — buccal (external) length of P_4 , c — height of P_4 . 13. M_1 , M_2 or M_3 : a — length of molar, b — width of molar. 14. M_1 : a_1 — occlusal length of M_1 , a_2 — length of talonid

00°45'W), Sidi-Amar (35°01'N, 00°08'E), Saida (34°50'N, 00°10'E), Frenda (35°03'N, 01°02'E), Souk Elbakar (36°27'N, 01°02'E), Aflou (34°06'N, 02°06'E), Laghouat (33°38'N, 02°57'E), Brezina (33°06'N, 01°16'E), Ain-Sefra (32°45'N, 00°35'W).

As can be seen from the map in Fig. 1, these localities lie chiefly in north-western and central Algeria. The eastern regions are somewhat worse represented, nevertheless in all pellets found there remains of shrews of the genus *Crocidura* were present. However, they have not been found in any of the numerous localities situated to the south of the Saharan Atlas Mts.

The material described in this paper consists exclusively of *Crocidura russula* HERMANN and *C. whitakeri* DE WINTON. The numbers of skulls and mandibles obtained from particular localities are given in Table I.

The method of measuring is shown in the diagrams in Figs. 2 and 3. All the specimens described are stored in the Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, in Cracow.

III. A DESCRIPTION OF THE MATERIAL AND DISCUSSION OF THE SYSTEMATIC POSITION OF PARTICULAR SPECIES

Crocidura whitakeri DE WINTON 1897

Material: 158 complete or fragmentary skulls and 346 mandibular halves or their fragments (Table I); 8 of the skulls anatomically jointed with their mandibles.

Description. Skull and upper teeth. Rostrum depressed above A¹. Infra-orbital foramen short and triangular, more rarely oval. It usually begins between the mesostyle and the metastyle of M¹ or in the middle of the metastyle of P⁴ and ends between the parastyle and the mesostyle of M¹, halfway along its mesostyle or, very rarely, at its end. The lacrimal aperture is small, round and lies in the upper part of the infraorbital foramen, above the metastyle of M¹.

I¹ has a distinct, even or slightly wavy cingulum, broader at the upper part of the tooth. Its talon, varying in length, a little indented on the lower side, less frequently straight. Three antemolars bear a distinct cingulum round the crown each, without any additional cusps. A¹-A³, decreasing successively in size, stand in an even row so that their tops form a straight line. Only sometimes the top of A³ is slightly directed to the inside.

A³, as a rule one-rooted, is generally the smallest, although sometimes it equals A² in size. It is quite visible from the outer side or somewhat intercepted by the parastyle of P⁴.

P⁴ is characterized by its narrow but distinct parastyle, separated from the paracone. Its protocone is more or less shifted on to the anterior wall of the tooth, which is usually a little concave. The talon, surrounded by the cin-

Table II

Crocidura whitakeri DE WINTON, 1897

Dimensions of skull and upper dentition (in mm) from 12 localities of Algeria

			min.	avg.	max.	n	sd	cv
L of palate		A	6.60	7.52	8.16	56	0.29	3.86
W on zygom. proc.		B	5.48	5.88	6.21	56	0.19	3.23
I ¹	L	a ₁	1.55	1.71	1.93	41	0.10	5.85
	L of talon	a ₂	0.60	0.75	0.94	55	0.07	9.33
	H of talon	c	1.20	1.34	1.48	54	0.07	5.22
A ¹ -A ³	L	A	2.08	2.22	2.34	30	0.06	2.70
A ¹	L	a	1.02	1.19	1.33	39	0.07	5.88
	W	b	0.65	0.81	0.93	42	0.06	7.41
A ²	L	a	0.61	0.72	0.86	38	0.05	6.94
	W	b	0.57	0.67	0.74	38	0.04	5.97
A ³	L	a	0.56	0.66	0.73	46	0.04	6.06
	W	b	0.55	0.63	0.72	46	0.04	6.35
P ⁴	L (bucc.)	a ₁	1.76	1.91	2.14	74	0.08	4.19
	L (med.)	a ₂	0.64	0.79	0.90	74	0.06	7.59
	W (max.)	b ₁	1.35	1.52	1.70	74	0.08	5.26
	W (ant.)	b ₂	0.93	1.13	1.31	74	0.07	6.19
		$\frac{a_1}{a_2}$	2.18	2.44	3.04	74		
M ¹	L (med.)	a	0.86	0.92	1.03	72	0.04	4.35
	W (max.)	b	1.95	2.19	2.52	72	0.10	4.57
		$\frac{b}{a}$	2.20	2.38	3.00	72		
M ²	L (med.)	a	0.80	0.88	0.98	66	0.03	3.41
	W (max.)	b	1.75	1.97	2.20	66	0.10	5.08
		$\frac{b}{a}$	2.09	2.22	2.54	67		
M ³	L	a	0.54	0.62	0.70	52	0.04	6.45
	W	b	1.13	1.30	1.47	53	0.07	5.38

gulum, which extends to the very end of the posterior wall, is of the "lingual" type, because the anterolingual angle of the tooth is obtuse and rounded and the emargination of the tooth is considerable. The hypocone, which is a cusp on the cingulum, is small but distinct.

M¹ and M² also show a considerable emargination, and as a result give the impression of elongated rectangles. The valley between their paracone, metacone and protocone is open. M³ reduced. Zygomatic process visible in line with the

Crocidura whitakeri DE WINTON, 1897

Dimensions of mandible and lower dentition (in mm) from 16 localities of Algeria

			min.	avg.	max.	n	sd	cv
I ₁	L	a	2.81	3.35	3.69	70	0.22	6.57
	H	c	0.73	0.90	1.05	88	0.05	5.55
A ₁	L (bucc.)	a	1.00	1.15	1.35	54	0.08	6.96
P ₄	L (bucc.)	a	1.20	1.35	1.52	87	0.07	5.18
	H (bucc.)	c	0.70	0.81	0.92	70	0.05	6.17
$\frac{a}{c}$			1.49	1.68	1.95	70		
M ₁	L	a	1.23	1.36	1.49	99	0.05	3.68
	W	b	0.95	1.07	1.19	103	0.05	4.67
	L of talonid	a ₂	0.33	0.39	0.45	101	0.02	5.13
	L (occl.)	a ₁	1.16	1.26	1.38	96	0.05	3.97
$\frac{a_1}{a_2}$			2.90	3.22	3.56	96		
M ₂	L	a	1.18	1.29	1.39	101	0.04	3.10
	W	b	0.82	0.94	1.03	101	0.04	4.25
M ₃	L	a	0.97	1.17	1.29	96	0.06	5.13
	W	b	0.51	0.64	0.71	98	0.04	6.25
M ₁ -M ₃	L	A ₂	3.36	3.72	4.14	96	0.13	3.49
I ₁ -M ₃	L	A ₁	6.90	7.20	7.92	66	0.56	7.79
proc. condyloideus	L	A	1.20	1.45	1.68	92	0.11	7.59
	W	B	0.67	0.90	1.06	95	0.07	7.78
$\frac{A}{B}$			1.28	1.62	1.88	92		
L of mandible without I ₁		A	7.98	8.97	9.72	87	0.35	3.90
H of mandible below M ₂		C	1.35	1.56	1.85	106	0.10	6.41
H of ascending ramus		C	3.92	4.54	5.10	95	0.23	5.07

extension of the mesostyle or between the mesostyle and the metastyle of M².

Mandible and lower teeth. Horizontal ramus of mandible slightly concave between M₁ and M₂. In most specimens examined the mental foramen lies under P₄ or, more rarely, between P₄ and M₁. The ascending ramus of the mandible forms a somewhat obtuse angle with its horizontal ramus. Coronoid process fairly broad at top, its coronoid spicule being well-developed. External temporal fossa distinct. Condyloid process sharply separated from ascending ramus of mandible and as a rule broad. Pterygoid spicule of medium size. The

fairly low internal temporal fossa occupies more or less a half of the height of the coronoid process and often has the form of an equilateral triangle. The mandibular foramen is situated under the posterior half of the lower edge of the internal temporal fossa.

I_1 with a smooth cutting edge and an end bent a little upwards. One-cuspid A_1 is rather short, whereas P_4 is elongate, for its talonid, in its lateral view, is long and overlaps the lateral surface of the madible.

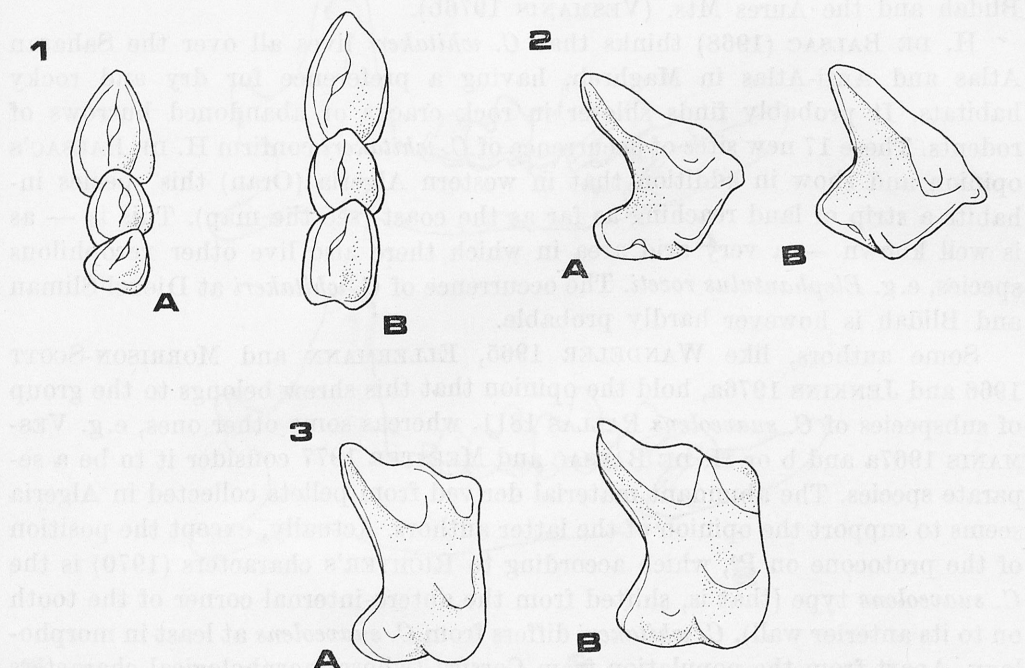


Fig. 4. Differences in morphology of upper teeth between *C. whitakeri* (A) and *C. russula* (B) in Algeria. Explanations in table VI. 1. A^1 - A^3 . 2. P^4 . 3. M^1

M_1 has its protoconid and metaconid placed close to each other, the talonid is rather narrow and the cingulum round its posterior root broad, in the shape of the letter "U". M_2 , as usual, fourcuspid, with reduced talonid. Cingulum massive on all lower teeth.

Dimensions

Tables II and III.

Systematic position and distribution

The size of the specimens (see Tables II and III) and their morphological features, like the shift of the protocone of P^4 on to its anterior wall, the presence of small A^3 , smaller than A^2 , and narrow molars in the shape of elongated rectangles, the "lingual" shape of the talon of P^4 (Fig. 4A), P_4 elongated in its lateral view and M_1 with a shortened talonid, the cingulum of which, round the posterior root, has the shape of the letter "U" (Fig. 5A), indicate that we are concerned with *Crocidura whitakeri*.

A comparison of the material from 17 localities in which this species was found showed (except for individual variation) no significant differences in size or in structure.

C. whitakeri was first described by DE WINTON from the village of Sierzet situated half-way between Mogador and Marrakesh in Morocco in 1897. It was later observed also in the Western Sahara, in Mauritania, Algeria and Tunisia. In Algeria it was recorded from Biskra, Ain-Sefra, Djebel Sliman, Blidah and the Aures Mts. (VESMANIS 1976b).

H. DE BALSAC (1968) thinks that *C. whitakeri* lives all over the Saharan Atlas and Anti-Atlas in Maghreb, having a preference for dry and rocky habitats. It probably finds shelter in rock cracks or abandoned burrows of rodents. These 17 new sites of occurrence of *C. whitakeri* confirm H. DE BALSAC's opinion and show in addition that in western Algeria (Oran) this species inhabits a strip of land reaching as far as the coast (see the map). This is — as is well known — a very arid area in which there also live other xerophilous species, e.g. *Elephantulus rozeti*. The occurrence of *C. whitakeri* at Djebel Sliman and Blidah is however hardly probable.

Some authors, like WANDELER 1965, ELLERMANN and MORRISON-SCOTT 1966 and JENKINS 1976a, hold the opinion that this shrew belongs to the group of subspecies of *C. suaveolens* PALLAS 1811, whereas some other ones, e.g. VESMANIS 1967a and b or H. DE BALSAC and MEESTER 1977 consider it to be a separate species. The abundant material derived from pellets collected in Algeria seems to support the opinion of the latter authors. Actually, except the position of the protocone on P^4 , which according to RICHTER's characters (1970) is the *C. suaveolens* type (that is, shifted from the antero-internal corner of the tooth on to its anterior wall), *C. whitakeri* differs from *C. suaveolens* at least in morphology. Apart from the population from Corsica (whose morphological characters are besides typical of the species — CATALAN et al. 1981), *C. suaveolens*, is above all, much smaller, its A^3 is bigger than A^2 , P^4 and the upper molars are broad, P_4 as a rule rather short and the talonid of M_1 broad, with its cingulum round the posterior root narrow and long.

In all probability *C. suaveolens* is absent from Algeria and those smaller shrews encountered in the north-western part of the country belong to *C. whitakeri*. Anyhow, caryological and biochemical studies are needed to settle this problem definitively, for CATZEFLIS et al. (1985) recently proved that shrews counted in *C. russula gueldenstaedti* PALLAS 1811 and *C. russula monacha* THOMAS 1906 are in fact nothing but *C. suaveolens*. Their caryotype is the same as in *C. suaveolens* from Central Europe and they come near to it in respect of biochemistry. *C. suaveolens* shows great morphological and biochemical polymorphisms, but its caryotype is invariable in the whole European and eastern Mediterranean population. A morphological differentiation connected, e.g., with diet and unaccompanied by the phenomenon of speciation has recently been discovered in many groups of vertebrates, among others, in the American rodent *Peromyscus* (LEMEN 1980).

A study on the fossil material of remains of the genus *Crocidura* (RZEBIK-KOWALSKA 1988) in Algeria shows that *C. whitakeri* occurred in this area as early as the Middle Pleistocene. It has been found at Ain-Mefta in western Algeria, close to the Moroccan frontier. The size of the remains from Ain-Mefta

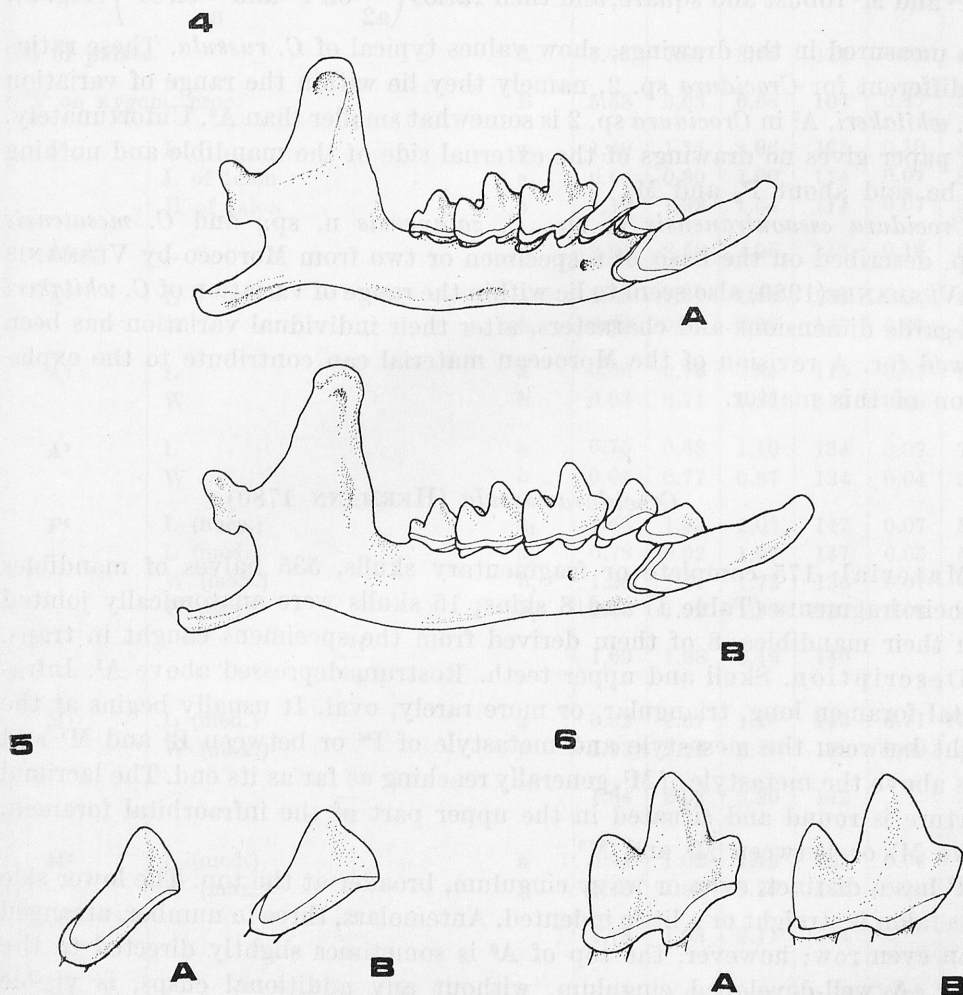


Fig. 5. Differences in morphology of mandible and lower teeth between *C. whitakeri* (A) and *C. russula* (B) in Algeria. Explanations in table VII. 4. mandible. 5. P_4 . 6. M_1

and their morphological characters correspond perfectly well with those of the modern specimens under study. Because now *C. whitakeri* lives exclusively in dry areas of north-western Africa, it may well be that the evolution of this form took place in this very region.

In 1976a VESMANIS described 2 specimens of *Crocidura* from Algeria which he came upon in the British Museum as *Crocidura* sp. 1 and *Crocidura* sp. 2. The description and the drawings included show that *Crocidura* sp. 1 caught

in the region of Algiers is most probably *C. russula* and *Crocidura* sp. 2 from the Oran area *C. whitakeri*.

Despite the fact that the protocone on P^4 of *Crocidura* sp. 1 is shifted on to the anterior wall of the tooth (this character is not stable), its A^3 is bigger than A^2 , P^4 and M^1 robust and square, and their ratios $\left(\frac{a1}{a2} \text{ on } P^4 \text{ and } \frac{b}{a} \text{ on } M^1\right)$ (Fig. 2), even measured in the drawings, show values typical of *C. russula*. These ratios are different for *Crocidura* sp. 2, namely they lie within the range of variation of *C. whitakeri*. A^3 in *Crocidura* sp. 2 is somewhat smaller than A^2 . Unfortunately, that paper gives no drawings of the external side of the mandible and nothing can be said about P_4 and M_1 .

Crocidura essaouiranensis n. sp., *C. zaianensis* n. sp., and *C. mesatensis* n. sp. described on the basis of a specimen or two from Morocco by VESMANIS and VESMANIS (1980) also seem to lie within the range of variation of *C. whitakeri* as regards dimensions and characters, after their individual variation has been allowed for. A revision of the Moroccan material can contribute to the explanation of this matter.

Crocidura russula (HERMANN 1780)

Material: 175 complete or fragmentary skulls, 535 halves of mandibles or their fragments (Table I) and 8 skins; 15 skulls were anatomically jointed with their mandibles, 8 of them derived from the specimens caught in traps.

Description. Skull and upper teeth. Rostrum depressed above A^1 . Infra-orbital foramen long, triangular, or more rarely, oval. It usually begins at the height between the mesostyle and metastyle of P^4 or between P^4 and M^1 and ends above the metastyle of M^1 , generally reaching as far as its end. The lacrimal aperture is round and situated in the upper part of the infraorbital foramen, above M^1 or between M^1 and M^2 .

I^1 has a distinct, even or wavy cingulum, broader at the top. The lower side of its talon is straight or a little indented. Antemolars, three in number, arranged in an even row; however, the top of A^3 is sometimes slightly directed to the inside. A well-developed cingulum, without any additional cusps, is visible on all these three teeth. A^1 is the biggest, A^3 comes next in size and A^2 is the smallest. A^3 is whole seen from the outside, or somewhat intercepted by the parastyle of P^4 . It usually has a double root or even two roots.

P^4 is characterized by its well-developed parastyle, separated sharply from the paracone. Its protocone is as a rule situated in the antero-internal corner. The talon surrounded by the cingulum, which extends to the end of the posterior wall of the tooth, is short and "square", since the antero-lingual (internal) angle is not rounded but right or only somewhat obtuse and the emargination of the tooth is moderate. The hypocone is commonly seen as a tiny cusp on the cingulum.

Table IV

Crocidura russula HERMANN, 1780

Dimensions of skull and upper dentition (in mm) from 18 localities of Algeria

			min.	avg.	max.	n	sd	cv
L of palate		A	7.04	7.87	8.66	111	0.52	6.61
W on zygom. proc.		B	5.58	6.03	6.68	104	0.47	7.79
I ¹	L	a ₁	1.49	1.74	1.96	105	0.10	5.75
	L of talon	a ₂	0.64	0.80	1.00	114	0.07	8.75
	H of talon	c	1.12	1.32	1.54	114	0.07	5.30
A ¹ -A ³	L	A	2.21	2.58	2.95	118	0.16	6.20
A ¹	L	a	1.15	1.31	1.45	133	0.06	4.58
	W	b	0.75	0.85	0.99	133	0.05	5.88
A ²	L	a	0.56	0.76	0.94	113	0.07	9.21
	W	b	0.63	0.74	0.84	113	0.04	5.40
A ³	L	a	0.75	0.88	1.10	134	0.07	7.95
	W	b	0.65	0.77	0.87	134	0.04	5.19
P ⁴	L (bucc.)	a ₁	1.63	1.83	2.03	147	0.07	3.82
	L (med.)	a ₂	0.78	0.92	1.07	147	0.05	5.43
	W (max.)	b ₁	1.28	1.51	1.73	136	0.07	4.64
	W (ant.)	b ₂	1.06	1.22	1.39	137	0.06	4.92
	$\frac{a_1}{a_2}$		1.69	1.98	2.19	146		
M ¹	L (med.)	a	0.92	1.07	1.20	143	0.11	10.28
	W (max.)	b	1.93	2.16	2.40	143	0.09	4.17
	$\frac{b}{a}$		1.84	2.02	2.20	143		
M ²	L (med.)	a	0.91	1.02	1.13	125	0.04	3.92
	W (max.)	b	1.78	1.98	2.20	124	0.10	5.05
	$\frac{b}{a}$		1.78	1.98	2.11	124		
M ³	L	a	0.55	0.63	0.70	101	0.03	4.76
	W	b	1.20	1.33	1.56	102	0.06	4.51

M¹ and M² also show a moderate emargination and, as a result they give the impression of being square. The valley between their paracone, metacone and protocone is open and the hypocone well developed. M³ is reduced. The zygomatic process is seen in the line which forms the extension of the mesostyle or between the mesostyle and metastyle of M².

Mandible and lower teeth. Horizontal ramus of mandible is slender and a little concave between M₁ and M₂. Mental foramen usually between P₄ and M₁, or under the anterior root of M₁, rarely under P₄. The ascending ramus

Crocidura russula HERMANN, 1780

Dimensions of mandible and lower dentition (in mm) from 23 localities in Algeria

			min.	avg.	max.	n	sd	cv
I ₁	L	a	3.10	3.52	4.04	147	0.17	4.83
	H	c	0.79	0.91	1.06	184	0.05	5.49
A ₁	L (bucc.)	a	1.18	1.31	1.45	148	0.06	4.58
P ₄	L (bucc.)	a	1.10	1.26	1.40	205	0.06	4.76
	H (bucc.)	c	0.74	0.87	1.04	100	0.06	6.90
$\frac{a}{c}$			1.30	1.40	1.59	100		
M ₁	L	a	1.29	1.46	1.57	228	0.05	3.42
	W	b	0.92	1.12	1.27	233	0.10	8.93
	L of talonid	a ₂	0.43	0.51	0.61	239	0.03	5.88
	L (occl.)	a ₁	1.20	1.37	1.52	230	0.06	4.38
$\frac{a_1}{a_2}$			2.30	2.65	2.88	230		
M ₂	L	a	1.24	1.39	1.50	229	0.05	3.60
	W	b	0.88	0.99	1.14	229	0.04	4.04
M ₃	L	a	0.55	0.67	0.77	214	0.03	4.48
	W	b	0.98	1.21	1.35	215	0.06	4.96
M ₁ -M ₃	L	A ₂	3.57	3.95	4.21	209	0.13	3.29
I ₁ -M ₃	L	A ₁	7.03	7.84	8.57	151	0.27	3.44
proc. condyloideus	L	A	1.27	1.56	1.85	199	0.11	7.05
	W	B	0.52	0.78	1.01	221	0.10	12.82
$\frac{A}{B}$			1.50	2.03	3.02	199		
L of mandible without I ₁			8.30	9.58	10.60	182	0.39	4.07
H of mandible below M ₂			1.31	1.51	1.98	235	0.10	6.62
H of ascending ramus			4.05	4.60	5.15	204	0.37	4.60

of the mandible forms a slightly obtuse angle with its horizontal ramus. Coronoid process fairly broad at top and coronoid spicule distinct. External temporal fossa usually well seen. The condyloid process is sharply separated from the ascending ramus and generally narrow. The pterygoid spicule is moderately well developed and the internal temporal fossa rather high, often occupying more than half the height of the coronoid process and then it has the shape of an isosceles triangle. The mandibular foramen is situated in the posterior half of its margin close to the middle.

I_1 has a smooth cutting edge and its top is a little bent upwards. One-cuspid A_1 is as a rule fairly long, P_4 , seen from the external side, short and with a short talonid. The protoconid and metaconid on M_1 are situated close to each other. The talonid of this tooth is broad and the cingulum round the posterior root narrow, in the form of the lying letter "L". M_3 is reduced.

Dimensions

Tables IV and V.

Systematic position and distribution

The size of the specimens (see Tables IV and V) and such morphological characters as the presence of big A^3 , bigger than A^2 , P^4 with the protocone situated in the antero-internal corner of the tooth, the broad upper molars, the "square" shape of the talon of P^4 (Fig. 4B), P_4 short in its lateral view and characteristic M_1 with a relatively broad talonid and narrow cingulum, round its posterior root, in the shape of the lying letter "L" (Fig. 5B), refer these specimens to *Crocidura russula*. The characters CATALAN et al. (1981) mentioned for *C. russula* from southern France, i.e. the position of the aperture in the nasal cavity, the size of the basosphenoidal foramina and the shape of the bone ridge of the cerebral cranium have not been confirmed in Algeria.

A comparison of the material from 23 localities in which this species was present showed no significant differences in their morphological structure except for individual variation. On the other hand, there are some differences in size between the specimens derived from dryer areas, e.g. from the Oran region (smaller specimens) and those from the locality of Aokas, known for its considerable humidity (bigger specimens).

Nowadays *Crocidura russula* lives in western and central Europe up to the line marked by Nice, Munich, Dresden and the estuary of the Elbe and in North Africa (Morocco, Algeria, Tunisia and Libya). Some authors (VESMANIS 1975, VESMANIS and VESMANIS 1980, HEIM DE BALSAC and MEESTER 1977) think that in Maghreb *C. russula* specimens belong to the subspecies *C. r. yebalensis*.

In 1913 CABRERA described *C. yebalensis* from Morocco, but in 1932 he himself admitted that it was only a subspecies of *C. russula*. In distinguishing the subspecies, he based himself chiefly on the dimensions of specimens from Maghreb. In his work of 1975 VESMANIS, having at his disposal 36 specimens from the British Museum and the A. Koenig Museum in Bonn, states that the Algerian population is visibly smaller than the European population, notably its part from Spain and Germany.

An analysis of the new material, i.e. 175 skulls or their fragments and 535 mandibles and their fragments used in the present work, widens the range of variation of *C. russula* from Algeria very much and the population from Aokas seems to reach the level of the European populations in size. It suffices to compare such dimensions as the width of the skull at the zygomatic process, the length of the hard palate or the height of the cornoid process. The other dimensions are not fully comparable because of the different methods of measuring applied by various authors.

Crocidura heljanensis described by VESMANIS in 1975 is characterized by its morphological features, identical with those of *C. russula* but, according to the author, it has much smaller dimensions. A comparison of its dimensions with those of *C. russula* given in Fig. 6 shows that they lie within the range of variation of this last form. JENKINS (1976) and CORBET (1978) are also of the opinion that *C. heljanensis* is nothing but a juvenile form of *C. russula*.

In the fossil state *C. russula* is known to have occurred in Europe since the younger Middle Pleistocene of Hungary (JANOSSY 1969) and the Biharian of Czechoslovakia (STEHLIK 1934) and Italy (PASA 1947a) and in Maghreb since the Middle Pleistocene. It has been found at the locality Ain Mefta in north-western Algeria (RZEBIK-KOWALSKA 1988). The population from Ain Mefta is morphologically identical with the modern members of this species, but bigger, even than the specimens from Aokas.

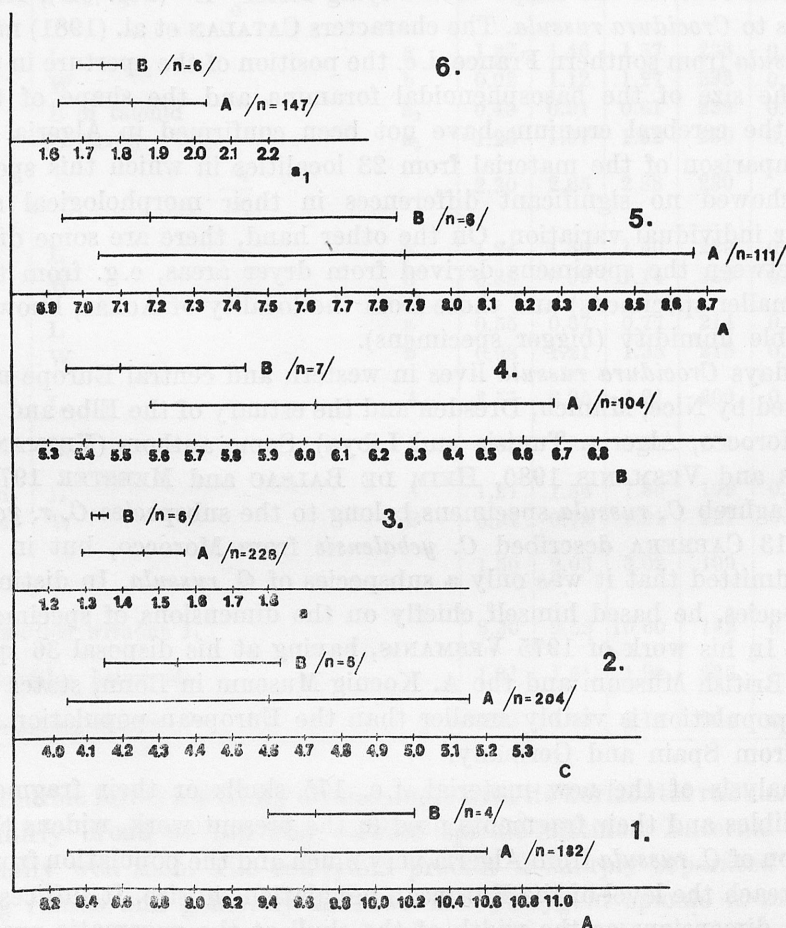


Fig. 6. Variation in some measurements (in mm) of the skull, mandible and teeth in *C. russula* (A) and *C. heljanensis* (B) in Algeria (*C. heljanensis* after VESMANIS, 1978). 1. length of mandible without I_1 (A). 2. height of ascending ramus (C). 3. length of M_1 (a). 4. width on zygomatic process (B). 5. length of palate (A). 6. external length of P^4 (a_1)

The evolution of *C. russula* probably took place in north Africa and next this species passed to Europe (perhaps through Gibraltar), reaching Italy and Hungary. Later on, it withdrew to western Europe, where it lives now. As has already been mentioned (p. 176), studies carried out by CATZEFLIS et al. (1985) show that *C. r. gueldenstaedti* and *C. r. monacha* from the Near East

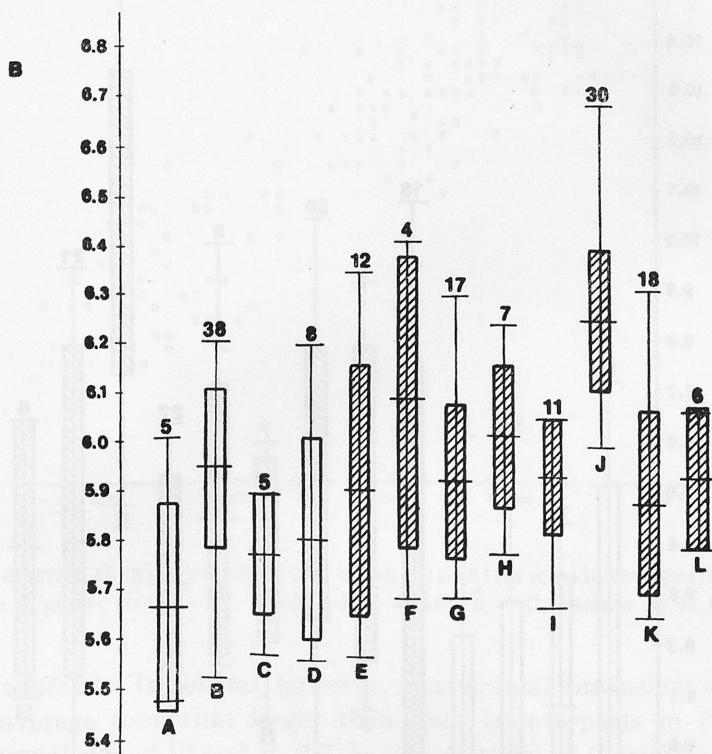
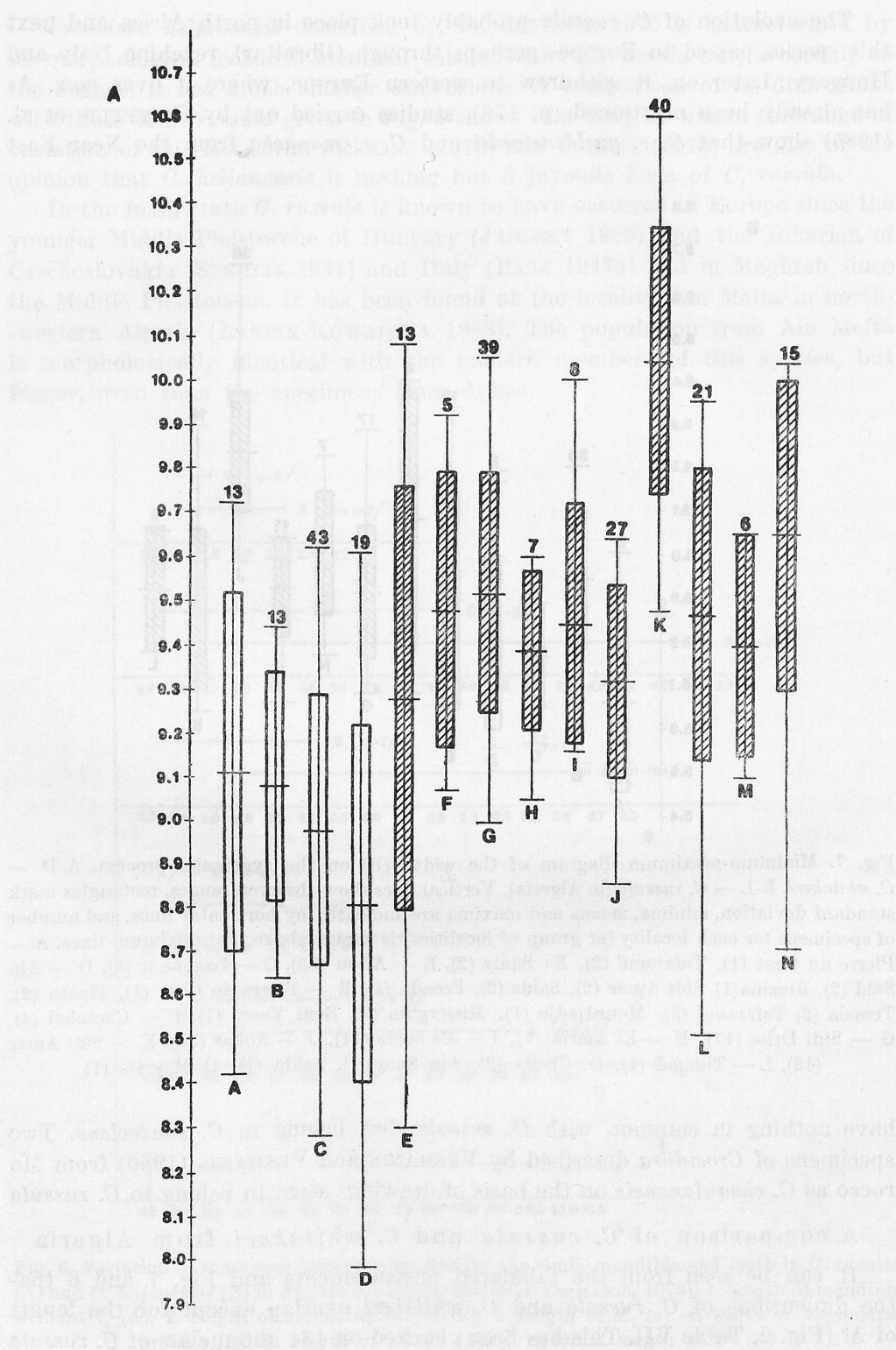


Fig. 7. Minimum-maximum diagram of the width (B) on the zygomatic process. A-D — *C. whitakeri*, E-L — *C. russula* (in Algeria). Vertical lines show observed ranges, rectangles mark standard deviation, minima and maxima are indicated by horizontal lines, and number of specimens for each locality (or group of localities) is shown above the maximum lines. A — Pierre du Chat (1), Tafaraoui (2), Es Sania (2), B — Aflou (38), C — Laghouat (5), D — Ain Said (2), Brezina (1), Sidi Amar (2), Saida (2), Frenda (1), E — Pierre du Chat (1), Tipasa (2), Tessala (2), Tafaraoui (3), Moudjadjo (1), Misserghin (2), Beni Yenni (1), F — Cherchel (4), G — Sidi Driss (17), H — El Amria (7), I — Es Senia (11), J — Aokas (30), K — Sidi Amar (18), L — Timgad (1), D. Chelia (2), Ain Said (1), Saida (1), D Megriss (1)

have nothing in common with *C. russula*, but belong to *C. suaveolens*. Two specimens of *Crocidura* described by VESMANIS and VESMANIS (1980) from Morocco as *C. choanianensis* on the basis of drawings seem to belong to *C. russula*

A comparison of *C. russula* and *C. whitakeri* from Algeria

It can be seen from the tabulated measurements and Fig. 7 and 8 that the dimensions of *C. russula* and *C. whitakeri* overlap except for the length of A³ (Fig. 9, Table VI). This has been checked on 134 antemolars of *C. russula*



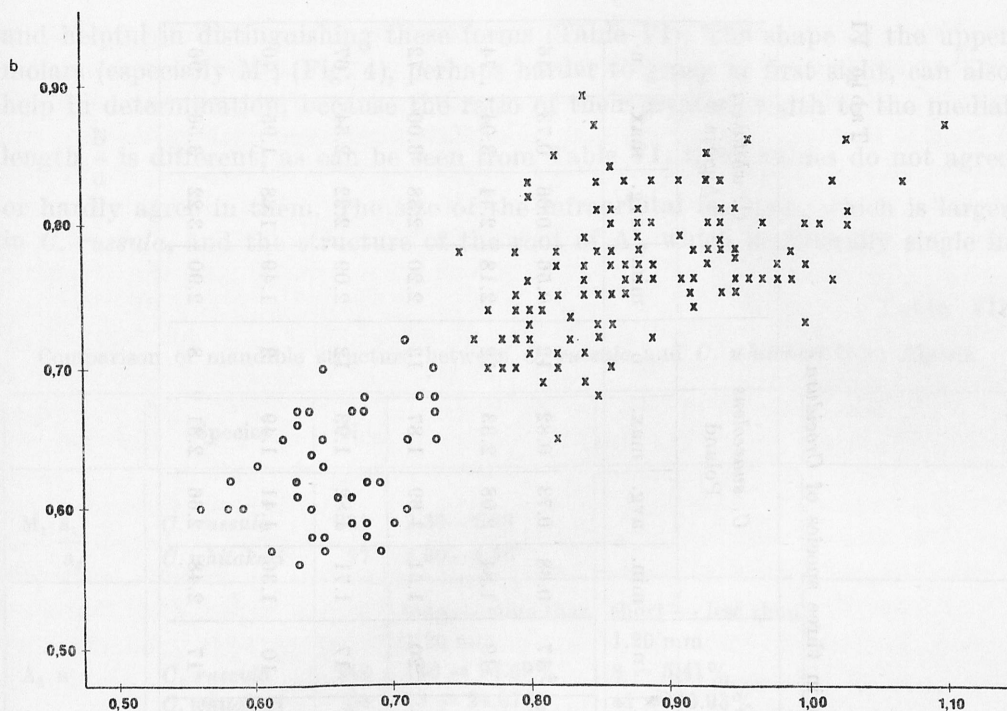


Fig. 9. Scatter diagram showing length (a) and width (b) of A^3 (in mm) in two species of *Crocidura* from Algeria: circles — *C. whitakeri* (n = 46), x — *C. russula* (n = 134)

and 46 of *C. whitakeri*. In general, however, most cranial dimensions of *C. russula* are on the average somewhat larger than their counterparts in *C. whitakeri*. Only the external side of P^4 and P_4 (in the lateral view) of *C. russula* are slightly shorter, the mandible under M_2 slightly lower and the condyloid process narrower.

These two species differ in the position of the protocone on P^4 (see the description and Fig. 4), but this character is not very stable and it is sometimes hard to fix the species in hand exclusively on its basis. However, the shape of this tooth and the ratio of its external length to the medial one, $\frac{a_1}{a_2}$, are different

Fig. 8. Minimum-maximum diagram of the length (A) of the mandible without I_1 . A—D — *C. whitakeri*, E—N — *C. russula* (in Algeria). Vertical lines show observed ranges, rectangles mark standard deviation, minimum, means and maxima are indicated by horizontal lines, and number of specimen for each locality (or group of localities) is shown above the maximum lines. A — Pierre du Chat (3), Tafaraoui (2), El Amria (5), Es Senia (3), B — D. Chelia (1), Laghouat (3), Ain Said (3), Brezina (1), Alfaville (3), Saida (2), C — Aflou (43), D — Sidi Amar (19), E — Mourdjadjo (3), Misserghin (2), Tipasa (2), Tafaraoui (3), Tessala (1), Beni Yenni (1), Souk Elbakar (1), F — Pierre du Chat (5), G — Sidi Driss (39), H — Cherchel (7), I — El Amria (8), J — Es Senia (27), K — Aokas (40), L — Sidi Amar (21), M — D. Chelia — (6), N — Timgad (2), Ain Said (2), Alfaville (2), Saida (7), Frenda (1), D. Megriss (1)

Table VI

Length of A^3 and proportions of some teeth in three species of *Crocidura*

	<i>C. russula</i> Algeria				<i>C. russula</i> Belgium				<i>C. suaveolens</i> Poland				<i>C. whitakeri</i> Algeria			
	min.	avg.	max.	n	min.	avg.	max.	n	min.	avg.	max.	n	min.	avg.	max.	n
A^3 a	0.75	0.88	1.10	134	0.79	0.92	1.02	17	0.68	0.73	0.82	12	0.56	0.66	0.73	46
$P^4 \frac{a1}{a2}$	1.69	1.98	2.19	146	1.86	1.93	2.01	19	1.84	2.08	2.33	12	2.18	2.44	3.04	74
$M^1 \frac{b}{a}$	1.84	2.02	2.20	143	1.74	1.88	2.03	20	1.51	1.69	1.87	13	2.20	2.38	3.00	72
$M^2 \frac{b}{a}$	1.78	1.95	2.11	124	1.80	1.98	2.12	17	1.71	1.82	1.93	12	2.09	2.22	2.54	67
$P^4 \frac{a}{c}$	1.30	1.40	1.59	100	1.31	1.45	1.55	10	1.36	1.41	1.49	3	1.49	1.68	1.95	70
$M_1 \frac{a1}{a2}$	2.30	2.65	2.88	230	2.46	2.66	2.81	17	2.48	2.66	2.81	8	2.90	3.22	3.56	96

and helpful in distinguishing these forms (Table VI). The shape of the upper molars (especially M_1) (Fig. 4), perhaps harder to grasp at first sight, can also help in determination, because the ratio of their greatest width to the medial length $\frac{b}{a}$ is different; as can be seen from Table VI, these values do not agree or hardly agree in them. The size of the infraorbital foramen, which is larger in *C. russula*, and the structure of the root of A^3 , which is generally single in

Table VII

Comparison of mandible structure between *C. russula* and *C. whitakeri* from Algeria

	Species	N			
$M_1 \frac{a_1}{a_2}$	<i>C. russula</i>	231	2.30—2.88		
	<i>C. whitakeri</i>	97	2.90—3.56		
$A_1 a$	<i>C. russula</i>	148	long — more than 1.20 mm 140 = 94.59%	short — less than 1.20 mm 8 = 5.41%	
	<i>C. whitakeri</i>	54	13 = 24.07%	41 = 75.93%	
$P_4 \frac{a}{c}$	<i>C. russula</i>	100	short — ratio below 1.55 90 = 90%	intermediate — ratio between 1.55—1.59 10 = 10%	long — ratio above 1.59 0 = 0%
	<i>C. whitakeri</i>	70	1 = 1.43%	14 = 20%	55 = 78.57%
condyloid process			narrow — ratio above 1.85	intermediate — ratio between 1.70—1.85	broad — ratio below 1.70
$\frac{A}{B}$	<i>C. russula</i>	199	151 = 75.88%	33 = 16.58%	15 = 7.54%
	<i>C. whitakeri</i>	95	1 = 1.05%	29 = 30.53%	65 = 68.42%
Position of mental foramen	<i>C. russula</i>	235	under M_1 47 = 20%	between P_4 and M_1 176 = 74.89%	under P_4 12 = 5.11%
	<i>C. whitakeri</i>	100	0 = 0%	22 = 22%	78 = 78%
Shape of cingulum round the posterior root of M_1	<i>C. russula</i>	237	narrow, in the shape of lying letter „L” 217 = 91.56%	atypical, between „L” and „U” varying in thickness 18 = 7.59%	broad, in the shape of the letter „U” 2 = 0.83%
	<i>C. whitakeri</i>	100	0 = 0%	14 = 14%	86 = 86%

C. whitakeri, while in *C. russula*, in which this antemolar is big, the root is double or there are even two roots, may also be helpful in distinguishing these species from each other.

Having at my disposal two large populations, one of which from Aokas in the north was whole identified as *C. russula* on the basis of the cranial characters and the other from Aflou in the south, referred whole to *C. whitakeri*, I tried to find some characters such as would permit us to distinguish these two species on the basis of mandibles only. The structure of M_1 seems to be the best in this respect. In *C. whitakeri* its talonid is narrower and the cingulum round the posterior root is massive and has the shape of the letter "U" in 86% of specimens. In *C. russula* the talonid is somewhat broader and the cingulum usually narrow, in the shape of the lying letter "L" (Tables VI and VII, Fig. 10).

The characters of P_4 , if it is only slightly worn or not worn at all, are useful in determination. In 78.57% of the specimens of *C. whitakeri* this tooth is long and low, whereas in 90% of the specimens of *C. russula* it is short and higher (Tables VI and VII, Fig. 5).

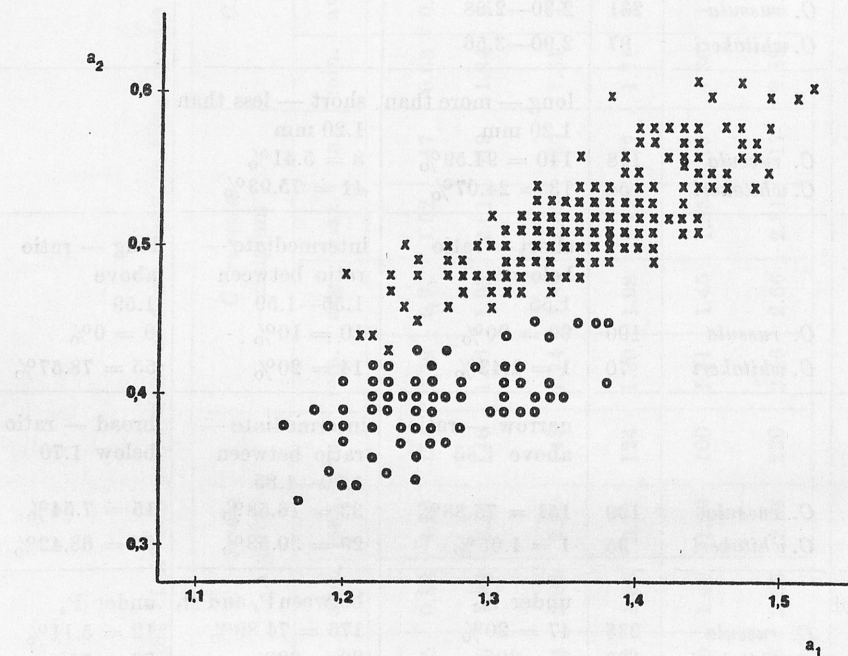


Fig. 10. Scatter diagram showing occlusal length (a_1) and length of talonid (a_2) of M_1 (in mm) in two species of *Crocidura* from Algeria: circles — *C. whitakeri* ($n = 96$) and x — *C. russula* ($n = 231$)

C. whitakeri is also characterized by its shorter A_1 (seen from the lateral side), broader condyloid process and, in addition, in 78% of the specimens examined the mental foramen lay under P_4 and never under M_1 . In *C. russula* this foramen usually lies between P_4 and M_1 , more rarely under M_1 and only in 5.11% of the specimens under P_4 (Table VII, Fig. 5).

And so, although the determination based on the characters of the upper teeth is more reliable, yet having at one's disposal a set of characters typical of the mandible and some experience, one can also determine the species to a great probability from mandibles only.

IV. CONCLUSIONS

The foregoing analysis of the abundant material collected at 27 sites in Algeria permits us to state nearly to a certainty that nowadays that country is inhabited by two species, *C. russula* and *C. whitakeri*.

C. russula inhabits mainly the more humid Mediterranean zone and does not specially differ from the European population in structure and size. However, if the determination of *C. russula* from two south localities (Alfaviile and Arbauats) based on the mandibles only is good there is also a possibility (probability) that those bones have been brought along there by owls or other carnivores, because no living animal was captured. *C. whitakeri* lives in the dry regions of the Saharan Atlas, reaching with a narrow strip of the Oran area as far as the coast. Morphologically it differs sufficiently distinctly from *C. suaveolens* to be regarded a separate species. It is however necessary to carry out some caryological and biochemical studies to establish its status.

C. suaveolens has not been found in the material studied. The small forms of *Crocidura* living in north-western Algeria appeared to be either *C. whitakeri* or small specimens of *C. russula*, smaller because inhabiting dryer areas.

Neither does it seem that some other species of this genus, described from Morocco, live in Algeria. To be sure, there is a possibility for animals from sub-Saharan Africa to travel along the Atlantic coast and certainly the fauna of shrews in Morocco is richer, but the number of forms given by VESMANIS and VESMANIS (1980) is quite improbable. Those authors describe many of them as new species on the basis of a specimen or two, without taking into consideration individual or geographical variation. And so the material from Morocco needs a thorough revision.

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STRESZCZENIE

Praca zawiera szczegółowy opis i porównanie dwu współcześnie żyjących w Algierii gatunków z rodzaju *Crocidura*: *C. whitakeri* DE WINTON i *C. russula* HERMANN. Opiera się na dużym materiale zebrany przez autorkę wspólnie z K. KOWALSKIM w latach 1979—1982. Materiał pochodzi głównie ze zrzutek sów (*Tyto alba*), nieliczne okazy zostały złapane w pułapki zabijające.

Analiza 158 czaszek lub ich fragmentów i 346 połówek zuchw lub ich fragmentów *C. whitakeri* zebranych w 17 stanowiskach nie wykazała żadnych istotnych różnic w wielkości i w budowie między nimi, natomiast potwierdziła tezę VESMANISA (1967a i b, 1977) i HEIM DE BALSACA i MEESTERA (1977) stwierdzającą, że morfologicznie ryjówki te należą do odrębnego gatunku, a nie podgatunku *C. suaveolens*, jak sugerują ELLERMANN, MORRISON-SCOTT (1966), JENKINS (1976a) i in. Dopiero jednak badania kariologiczne i biochemiczne wyjaśnią tę sprawę do końca.

W pracy wykazano również, że *C. whitakeri*, o której wiadomo było, że zamieszkuje w Maghrebie cały Atlas Saharyjski i AntyAtlas, w Algierii wchodzi wąskim, suchym pasem Oranii do samego wybrzeża. Z badań nad materiałami kopalnymi szczątków rodzaju *Crocidura* w Algierii (RZEBIK-KOWALSKA 1988) wynika, że *C. whitakeri* była obecna na tym terenie już od środkowego plejstocenu, gdyż znaleziono ją w stanowisku Ain-Mefta, w północno-zachodniej części kraju. Ponieważ dziś żyje wyłącznie w Afryce północno-zachodniej, nie jest wykluczone, że tam właśnie przebiegała jej ewolucja.

C. russula została znaleziona w 23 stanowiskach. Analiza 175 czaszek lub ich fragmentów i 535 połówek zuchw lub ich fragmentów nie wykazała również

istotnych różnic w budowie, stwierdzono natomiast pewne różnice w wielkości pomiędzy populacjami z terenów suchszych Oranii i bardziej wilgotnych, np. ze stanowiska w Aokas. Okazy z terenów suchszych są mniejsze.

Według VESMANISA (1975) populacja algierska należy do podgatunku *C. r. yebalensis* opisanego przez CABRERĘ w 1932 roku, charakteryzującego się mniejszymi wymiarami od populacji europejskich. Analiza nowych, licznych materiałów użytych do powyższego opracowania znacznie rozszerzyła zakres zmienności *C. russula* Algierii, a okazy z Aokas dorównują wielkością okazom z Europy. Jest prawdopodobne, że ewolucja *C. russula* nastąpiła również w północnej Afryce, a następnie gatunek przeszedł do Europy (być może przez Gibraltar), gdzie żyje do dziś, osiągając linię Nicea—Monachium—Drezno — ujście Łaby. Jego szczątki kopalne znaleziono bowiem również w stanowisku Ain-Mefta.

Nie stwierdzono występowania ryjówek z rodzaju *Crocidura* w Algierii, w licznie znajdowanych zrzutkach sów na południe od Atlasu Saharyjskiego.

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