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DIET OF *CROCIDURA PACHYURA* (KÜSTER, 1835) (MAMMALIA: SORICIDAE) IN SEVERAL LOCALITIES OF ALGERIA

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RÉSUMÉ.— *Régime alimentaire de* Crocidura pachyura *(Küster, 1835) (*Mammalia, Soricidae*) dans plusieurs localités d'Algérie.*— Le régime alimentaire de *Crocidura pachyura* (Küster, 1835) a été étudié grâce à l'analyse des contenus stomacaux de 95 spécimens collectés sur le terrain de juin 2007 à septembre 2008 et de mars 2012 à mai 2014. Ces individus ont été collectés au moyen de pièges Sherman et de pots-enterrés dans 8 localités d'Algérie du Nord et du Centre, du niveau de la mer à 1390 m d'altitude (Tigzirt, Boukhalfa, Ouadias, El Misser, Darna, Tala Guilef, Zeralda et Reghaia). On trouve 99 proies différentes distribuées dans 7 taxons d'invertébrés (Clitellates, Nématelminthes, Gastropodes, Arachnides, Crustacés, Myriapodes et Insectes), un vertébré (Squamate) et des plantes indéterminées, notamment des graines. Les invertébrés représentent 77,05 % du régime alimentaire et les insectes sont les proies les plus fréquentes avec 54,3 %. *Crocidura pachyura* se nourrit de petites proies de taille inférieure à 17 mm (moyenne 4 mm) et la diversité des proies (indice de diversité de Shannon-Weaver) varie de 1,58 à 4,88 (moyenne de 2,4). La comparaison avec les travaux similaires effectués en Algérie et en Europe sur *C. russula* montre quelques différences de régime, surtout en ce qui concerne les proportions des proies Coleoptères, Hyménoptères et Diptères.

SUMMARY.— Ecological information, including food habits, on African shrews is scarce. The aim of this study was to describe the diet of *Crocidura pachyura* (Küster, 1835) in Algeria. Its diet was studied by analysing stomach contents of 95 shrews collected in pitfall and Sherman traps, from June 2007 to September 2008 and from March 2012 to May 2014, in eight localities of North-Central Algeria, from the sea level until 1390 m (Tigzirt, Boukhalfa, Ouadias, El Misser, Darna, Tala Guilef, Zeralda and Reghaia). The diet was composed of 99 different prey taxa distributed in seven invertebrate classes (Clitellata, Nematelminthes, Gastropoda, Arachnida, Crustacea, Myriapoda and Insecta), one vertebrate (Squamata) and plants, particularly seeds. The most important components of the diet were invertebrates: their contribution was 77.05 % of the overall diet composition. Insects were the most frequent prey with 54.3 %. *Crocidura pachyura* feeds on small preys lower than 17 mm (average 4 mm) and the diversity index of Shannon-Weaver varied between 1.58 and 4.88 (average 2.4). Comparisons with similar studies in Algeria and Europe for *C. russula* showed some differences especially for Coleoptera, Hymenoptera and Diptera proportions.

Shrews are abundant ground-dwelling insectivores and with their high energy requirements and voracious feeding habits they are an important component of the dynamics of terrestrial ecosystems (Buckner, 1969; Churchfield & Brown, 1987; Churchfield *et al.*, 1991). Shrews maintain a high and constant body temperature during activity. To keep themselves warm, they have a very active metabolism. Because of their very high mass-specific metabolic rate (Vogel, 1976,

1980; Hanski, 1984) and small body reserves, shrews need a constant supply of food. The shrews satiate their voracious appetite with protein-rich insects, a high-quality resource, but they have very few energy reserves onboard and only few hours without feeding (Barnard & Hurst, 1987) can lead to death (Crowcroft, 1957; Vogel, 1976).

Shrew diversity of Africa, and especially in the Maghreb, is not yet fully known and only few ecological studies have attempted to precise their diet (Hutterer, 2005; Brahmi *et al*., 2012). Recent molecular analyses confirmed the presence of *C. pachyura* in Algeria from sea level up to 1390 m (Nicolas *et al*., 2014). The sister species of *C. pachyura, Crocidura russula*, is widely distributed in western Algeria, Morocco and western Europe (Ramalhinho *et al.*, 1999), while *C. pachyura* is considered to occur in Algeria (Kabylie region), Tunisia and the Mediterranean islands Pantelleria, Sardinia and Ibiza (Brändli *et al*., 2005; Turni *et al*., 2007; Nicolas *et al*., 2014). According to Contoli & Aloise (2001), *C. pachyura* could be present from Tunisia up to the Cherchell site (wilaya of Tipaza, 80 km west of Alger) in Algeria. Both species are closely related and were for a long time considered as conspecific (Contoli, 1990; Turni *et al*., 2007). However, several studies based on morphometry, chromosomes, allozymes, mitochondrial and nuclear DNA show that they should be considered as distinct species (see references in Nicolas *et al*., 2014). The ecology of both species in North Africa is poorly known, especially their diet. One study was performed on the shrew population from Akfadou forest (70 km east of Tizi-Ouzou) in Algeria (Brahmi *et al*., 2012). In their study, Brahmi *et al.* (2012) called the species *C. russula*, but according to its geographical origin it could also refer to *C. pachyura*. The diet of European *C. russula* is only known by one study (Bever, 1983).

We report here for the first time the diet of *C. pachyura* based on digestive tract contents of 95 individuals collected from eight localities of Algeria. All these specimens were identified to species level by molecular or morphometric analyses.

MATERIALS AND METHODS

SHREWS TRAPPING

Shrews were collected in the field thanks to the use of pitfall traps which are efficient for capturing shrews (French, 1984; Handley & Kalko, 1993; Kirkland & Sheppard, 1994), or with Sherman traps, baited with a mixture of dried figs, bread, and sardine fish. All shrews were weighed and measured, examined for sex, maturity and pregnancy. Then they were euthanized following ethical guidelines and dissected to extract the digestive tracts. For each specimen tissue samples were collected for DNA analyses and skull extracted for morphometric analyses. They are all housed in the laboratory of the University Mouloud Mammeri of Tizi-Ozou (Algeria). In total, 95 specimens of *Crocidura* were used in this study. Because of the cost of sequencing and/or quality of the DNA preservation only 36 of these specimens were attributed unambiguously to *C. pachyura* based on molecular analyses, and the others were identified as *C. pachyura* through morphometrical analyses (Amrouche–Larabi *et al*., in prep). For comparisons, the previous diet study made on so-called *C. russula* specimens in North-Central Algeria must be treated with caution due to the possible existence of both species in sympatry in central Algeria. We will refer them as *C.* cf. *russula* in the text.

The fieldwork was conducted in eight Algerian localities: six localities from Kabylie (Tizi-Ouzou region: Tala Guilef, Darna, El Misser, Ouadhia, Boukhalfa and Tigzirt) and two localities (Réghaia and Zéralda) in the center of Algeria (Fig.1). Trapping occurred from June 2007 to September 2008, and from March 2012 to May 2014. Altitudes varied from sea level to 1390 m. Four localities are in the lowlands: Reghaia (36°45' to 36°48'N - 3°20' E, 4 to 35 m a.s.l.), Zeralda (36°00N - 2° 53E, 50 m a.s.l.), Boukhalfa (36°42'N - 3°59'E; 150 m a.s.l.), and Tigzirt (36°89'N - 4°12' E, 338 m a.s.l.). At Reghaia shrews were collected on the edge of the lake in a swampy zone with *Phragmites communis*. At Zeralda we captured shrews within Cervids enclosures with *Pinus halepensis, Quercus suber, Pinus canariensis, Pinus pinea, Pinus brucia, Eucalyptus gunili, Fraxinus oxyphylla, Casuarina equisetifolia*, *Acacia cyanophylla* and *Celtis australis.* At Boukhalfa, shrews were captured in *Eucalyptus camaldulensis, Cupressus sempervirens*, and *Casuarina equisetifolia* hedge bordering a citrus orchard and agricultural hill. At Tigzirt, shrews were captured in wheat fields, olive tree nurseries, and oldfields. The other four localities are situated in the Djurdjura Mountains: Ouadhias (36°31''N - 4°06'E, 624 m a.s.l.), El Misser (36°38'N - 4°15'E, 667 m a.s.l.), Darna (36°29 'N - 4 °17' E, 1319 m a.s.l) and Tala Guilef (36°28'N -3°59'E, 1390 m a.s.l.). Shrews were trapped in dense ripisylve and olive tree at Ouadhias, in degraded maquis at El Misser, in a dense Holm Oak forest (*Quercus ilex*) at Darna, and in a *Cedrus atlantica* forest mixed with deciduous tree without undergrowth or in *Cedrus atlantica* forest with undergrowth composed of *Rubus ulmifolius*, *Rosa secula* and *Crataegus monogyna* at Tala Guilef.

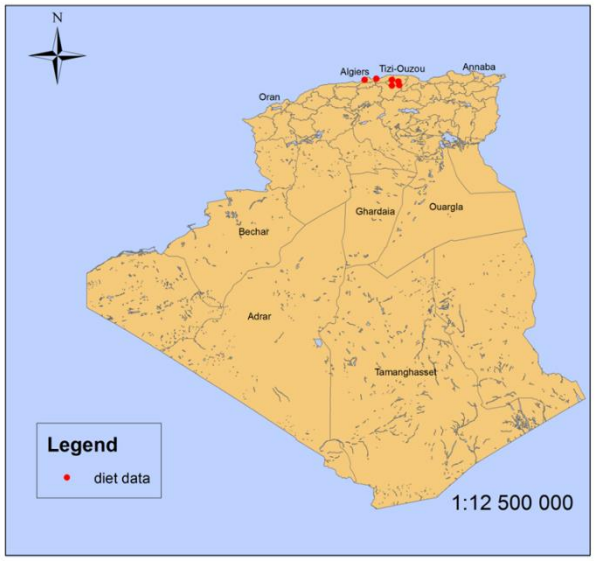

Figure 1.— Map of sampling localities.

STOMACH CONTENT ANALYSES

The diet was studied by analysing the digestive tracts (41 females, 47 males and 7 with unidentified sex). Stomachs and intestines were dissected and the complete contents removed for analysis of food remains. The content of each digestive tract was preserved in 95 % ethanol, then identified using a microscope Optickam PRO3, PRO5. All identifiable fragments (legs, wings, cerci, antennae and other cephalic structures) and other taxonomic diagnostic structures of the consumed preys were separated and identified at the order or family or species level, depending of the magnitude of items digestion and fragmentation. Taxonomic identification of animal remains was made following the literature (Balachowsky, 1962; Berland, 1940; Chopard, 1943; Duchatenet, 1986; Perrier, 1923, 1927, 1937; Perrier *et al*., 1932, 1935) and the reference collection of the École Nationale supérieure Agronomique in El Harrach (Département de Zoologie agricole et forestière). Following previous works on *Crocidura*'s diet (e.g., Clausnitzer *et al*., 2003; Brahmi *et al*., 2012) different parameters were calculated: a) the frequency of occurrence of different food items (% F, the percentage of stomachs containing a named food taxon); b) the dietary occurrence of food items (% D, the number of occurrences of a named food taxon as a proportion of the total occurrences of all food taxa); c) the percentage of prey biomass (% B, the weight of a named food taxon as a proportion of the total weight of all food taxa).

In order to compare food niche breadth between shrews of different localities, we used the Shannon-Weaver diversity index *(H')* calculated as follows*:* diversity index $H' = - \Sigma q_i \log 2 (q_i)$, where qi represents the proportion of each prey type in the diet.

Prey weights were extracted from literature and implemented with local captures. The size of prey was estimated from the chitin or skeleton fragments.

RESULTS

The analysis of the 95 stomachs revealed 562 items belonging to 99 prey taxa representing nine different classes (or higher-level taxa) and 16 orders (Tab. I). Insects are the most abundant prey in terms of frequency of occurrence (% F cumulated per class = 71.84 %). Arachnids are the second main category (14.89 %). Other taxa are plants (% F = 4.53 %), Crustaceans (% F = 2.59 %), Squamates (% F=2.27%), Gastropods (% F = 1.62 %), Myriapods (% F = 0.65 %) and Oligochaetes (% F = 0.32 %), In terms of dietary occurrence, Insects are also the most abundant prey (% D = 54.27 %). Plants (with six fragments and 115 seeds) are the second main category in the stomach contents (% D = 21.71 %), followed by Oligochaetes (5.16 %), Arachnids (9.96 %), Crustaceans (1.42 %), Squamates (1.25 %), Gastropods (0.89 %) and

Myriapods (0.36 %). Undetermined hairs and small stones also have been found in almost all stomach contents.

TABLE I

Diversity estimates for the diet of the Crocidura pachyura
Dietary occurrence (% D, n = 562 items) and frequency of occurrence (% F, N = 95 stomachs)of food types and percentage of prey biomass (% B)

Class or higher-level taxa	Lower-level taxa	% D	% F	% B
Clitatella	Oligochaeta	5.16	0.32	7.64
Nematoda		4.98	1.29	0.001
Gastropoda		0.89	1.62	1.51
Arachnida	Araneae	5.16	7.57	0.92
	Acariform	2.67	3.89	0
	Opiliones	0.18	0.32	0.18
	Phalangida	1.96	2.91	1.16
Myriapoda		0.36	0.65	0.31
Crustacea		1.42	2.59	4.53
Insecta	Insecta	0.18	0.32	0.26
	Orthoptera	0.18	0.32	1.9
	Blattoptera	2.67	4.53	4.74
	Dermaptera	1.6	2.27	0.67
	Hemiptera	3.91	6.15	0.97
	Homoptera	1.78	1.94	0.06
	Coleoptera	14.23	22.43	9.35
	Hymenoptera	24.38	26.31	0.53
	Lepidoptera	0.53	0.97	0.26
	Diptera	4.8	6.8	0.96
Plantae		21.71	4.53	1.51
Reptilia	Squamata	1.25	2.27	62.73

TABLE II

Size of items ingested by C. pachyura *from Central Algeria*
Size = prey size. ND: number of preys of each size, %: percentage of each size.

Size (mm)	ND	%
0-0,5	3	0,53
0.5-0.8	1	0,18
0.8-1	2	0,36
>1	15	2,67
>2	69	12,28
>3	104	18,51
>4	120	21,35
>5	130	23,13
>6	30	5,34
>7	24	4,27
>8	20	3,56
>9	10	1,78
>10	5	0,89
>11	1	0,18
>12	10	1,78
>13	5	0,89
>14	3	0,53
>15	2	0,36
>17	1	0,18
<36	7	1,25

For insects, the most important preys are Hymenoptera, Coleoptera, and Hemiptera, in terms of both frequencies and dietary occurrence. These are also the most diversified prey orders in shrews' stomachs with 23 Coleoptera, 18 Hymenoptera and 7 Hemiptera taxa

(Appendix). Hymenoptera are the more diversified, with *Tetramorium semilaeve* (26 specimens), *Tapinoma* sp. (22 specimens), *Tetramorium* sp. (17 specimens), *Tapinoma nigerrimum* (10 specimens), *Messor* sp. (8 specimens), *Crematogaster* sp., *Aphaenogaster* sp., *Tetramorium biskrensis* and *Pheidole pallidula*. Coleoptera include mainly Curculionidae (17 specimens), Carabidae (Larvae; 13 specimens), Staphylinidae (11 specimens plus 5 larvae), Harpalidae (5 specimens), Scarabaeidae (4 specimens). Hemiptera include Hemiptera ind. (9 specimens), Corixidae (3 specimens) and *Scolopostethus* sp., Aphididae and Eriosomatinae with one specimen each.

In terms of biomass Squamata constitute the main prey (% B = 62.73 %) followed by Insecta (% B = 19.7 %) and then by Oligochaetes (7.64 %).

The size of the preys varies between 0.5 mm and 36 mm (Tab. II) with a mode between 3 and 5 mm and a high percentage of prey of 5 mm length (% D = 23.13 %). Few animals over 10 mm are found in the diet, these are the Myriapoda and Reptilia that represent a large amount of the prey biomass even if not integrally consumed.

The diet of *C. pachyura* varies between localities. The values of Shannon-Weaver's diversity index (H') calculated for the six localities varied between 1.58 bits in Ouhadia to 4.88 in Boukhalfa (Tab. III).

TABLE III

Shannon-index of diversity for all studied localities with notification of the dominant prey taxa and comparisons with C. cf. russula *from Algeria (Brahmi* et al.*, 2012) and* C. russula *from Germany (Bever, 1983)*

Locality	N stomachs	Shannon-index	Dominant taxa
Tala Guilef	2	2.12	Hymenoptera
Darna	8	2.85	Oligochaeta
El Misser	8	4.71	Hymenoptera
Ouadhia	2	1.58	Co-dominance of Orthoptera and Coleoptera
Tigzirt	1	1.95	Hymenoptera
Boukhalfa	23	4.88	Hymenoptera
Reghaia	18	3.38	Plantae
Zeralda	33	3.53	Plantae
Akfadou forest (Brahmi *et al.*, 2012)	15		Hymenoptera
Germany (Bever, 1983)	73		Homoptera

DISCUSSION

For the first time, the diet of unambiguously identified specimens of *C. pachyura* from Algeria is described, and we explored its variability among localities. Our results showed that the Algerian *C. pachyura* mostly feeds on insects (% D = 54.27). A similar finding was reported for the shrew population from Akfadou forest (Brahmi *et al*., 2012), where the proportion of Insects was even higher (% D = 83.7). For Germany *C. russula,* Bever (1983) reported a lower predominance of insects (41.7 %) (Tab. IV). Other taxa, like Arachnida, are less abundant in the diet of *C. pachyura* (5.16 %) compared to *C. russula* (11.3 %) and *C.* cf. *russula* (4.5 %). The Myriapoda are more abundant in European *C. russula* diet (7.2 %) than in Algerian *C.* cf. *russula* (2.6 %, Brahmi *et al.*, 2012) and *C. pachyura* (0.36 %, this study). Araneae are more abundant in the diet of *C. pachyura* (9.96 %) than in *C.* cf. *russula* diet (2.6 %, Brahmi *et al*., 2012). Bever (1983) reported 4.4 % in German *C. russula*.

Among the other high-level taxa included in shrew's diet, Gastropoda were more abundant in the diet of *C. russula* from Germany (5.3 %) than in our study (0.89 %) but less than in *C.* cf. *russula* of Akfadou forest in Algeria (0.6 %).

TABLE IV

Diet of C. pachyura *(this study),* C. russula *(Germany; Bever, 1983) and* C. *cf.* russula *(Algeria, Brahmi* et al.*, 2012) expressed in dietary occurrence (%D). X = presence of hairs and small stones*

		C. pachyura	*C. russula* Bever, 1983	*C.*cf. *russula* Brahmi *et al*., 2012
Clitatella	Oligochaeta	5.16	2.8	–
	Nematoda	4.98	–	–
Gastropoda	Gastropoda	0.89	5.3	0.6
Arachnida	Pseudoscorpiones		–	–
	Opiliones		2.7	–
	Araneae	5.16	4.4	2.6
	Opiliones	0.18		
	Acari	2.67	4.2	0.6
	Phalangida	1.95	–	1.3
Chilopoda	Myriapoda	0.36	7.2	2.6
Crustacea	Crustacea	0 ;71	–	–
Malacostraca	Isopoda	0.71	16.9	1.3
Collembola	Collembola	–	0.6	–
	Podurata	–	–	1.3
Insecta	Blattoptera	2.67	–	0.6
	Mantoptera	–	–	0.6
	Orthoptera	0.18	–	6.5
	Dermaptera	1.6	1	3.2
	Heteroptera	–	0.4	0.6
	Hemiptera	5.34	–	–
	Homoptera	1.6	26.5	1.9
	Anoplura	–	0.4	–
	Coleoptera	14.23	4.4	12.9
	Hymenoptera	24.38	–	32.3
	Siphonaptera	–	0.3	–
	Trichoptera	–	–	–
	Lepidoptera	0.53	7.2	0.6
	Diptera	4.98	1.5	22.6
Squamata	Lacertilia	1.25	–	1.9
	Feathers	–	–	–
	Hairs. Tissues	X	–	–
	Seeds. Plants	21.71	–	5.8
	Eggs	–	6	–
	Unidentified		8.9	–

In our study, seeds and plant fragments were identified in twenty stomachs of *C. pachyura* wich represents 21.71 % of the diet of the species during our study. This type of vegetarian food was less common in the diet of *C.* cf. *russula* from Akfadou in Algeria (where it was represented by only two fragments representing 5.8 % of the total diet (Brahmi *et al*., 2012). Plants were absent in the diet of *C. russula* from Germany (Bever, 1983). According to Clausnitzer *et al*. (2003), plant consumption occurs when invertebrate preys are in short supply. Seeds may be an important part of the diet for some species of shrew, especially in winter. Dokuchaev (1989) and Athanaze (2000) reported that *C. russula* can even specialize in fruits in certain conditions.

Another type of prey is squamates, and other small vertebrate preys, which bring significant amount of biomass in *C. pachyura* in Algeria despite a low abundance. Brahmi *et al*. (2012) reported *C.* cf. *russula* to catch lizards in Akfadou (Kabylia). Bever (1983) did not report any small vertebrates in *C. russula'*s diet in Germany. The presence of Squamates in the diet of Algerian *C.* cf. *russula* and *C. pachyura*, could be the result of a scavenging activity and opportunistic behaviour.

Among insect preys several differences appeared between the Algerian *C. pachyura*, the Algerian *C.* cf. *russula* and the German *C. russula* diet. The main orders in *C. pachyura* diet are Hymenoptera, Coleoptera, Hemiptera, with Diptera, Orthoptera in lower percentages. In the Algerian *C.* cf. *russula* (Brahmi *et al.*, 2012) the main components of the diet are Hymenoptera,

Diptera, Coleoptera and Orthoptera. In *C. russula* from Germany, Homoptera (Aphididae) and Lepidoptera larvae are the most abundant preys (Bever, 1983). It would be interesting to get data on the abundance of these preys in the field to test whether the observed geographic variation in the diet is a simple consequence of differences in prey availability among regions or is due to prey selection. With 24.38 % of dietary occurrence (for a small biomass), Hymenoptera were the most common preys in Algerian *C. pachyura* diet. Similarly, for the Algerian *C.* cf. *russula* diet, Brahmi *et al.* (2012) reported a dietary occurrence of Hymenoptera of 32.3 %. The latter were absent in the diet of German *C. russula* (Bever, 1983). The highest level of predation on ants, such as *Tetramorium semilaeve, Tapinoma* sp., and Formicidae, was reported for *C. pachyura*, as well as in the Algerian *C.* cf. *russula* (Brahmi *et al*. 2012). Some ants, such as *Camponotus* sp. are well represented in the diet of North African *C. pachyura* (this study) and *C.* cf. *russula* (Brahmi *et al*., 2012). In our study, Diptera were not numerous in the diet (4.9 %). A similar result was found for *C. russula* in Germany (1.5 %; Bever, 1983). On the contrary, the highest occurrence of Diptera preys was found in *C.* cf. *russula* from Algeria with 22.6 % (Brahmi *et al*., 2012). The preys eaten by *C. pachyura* are mostly small-sized (84 %) and are under 6 mm, but some larger invertebrates and small vertebrates compose nearly 70 % of the biomass. This distribution of the prey sizes is similar to the results reported by Brahmi *et al*. (2012), with a major occurrence of Hymenoptera and Diptera, which are mostly of small size (57 % are under 4 mm).

The diversity index of Shannon-Weaver varies greatly according locality (from 1.58 to 4.88; Tab. II). In most Algerian localities we obtained values ranging from 1.58 to 3.53, except in Boukhalfa and El Misser where the value was higher 4.88 and 4.71. We could not establish any link between vegetation or altitude and the diversity index. Coastal Algeria and Djurdjura mountains display degraded environments due to pastoral and agricultural activities but *C. pachyura* seems to keep its diet in such degraded environments. The diversity of food ingested by *C. pachyura* is high and its preys belong to a wide range of taxa confirming the opportunistic behaviour of this predator.

It is the first time that the presence of hairs is reported in the shrews' stomachs. This presence can be explained by scratching during toilet, by the refection and also by coprophagy behaviour. It has been suggested that refection is a method of increasing the assimilation of essential substances otherwise lost in the faeces (Crowcroft, 1957, Goulden & Meester, 1978).

The difference observed in the diet of *C. pachyura* in this work and that of *C.* cf. *russula* in Kabylia (Brahmi *et al*., 2012) (which may eventually be a *C. pachyura* or a mix of *C. pachuyra* and *C. russula*) may be due to the number of stomach contents studied: 95 contents in our case against 15 in the diet studied by Brahmi *et al.* (2012). We also collected samples in 8 different localities with various habitats against only one locality in Bouzeguène massif in the study of Brahmi *et al.* (2012).

CONCLUSION

The results of this study provide the first insight into the diet of *C. pachyura*. It seems to be a generalist and opportunistic insectivore species, foraging mainly on the ground surface and amongst leaf litter in a Mediterranean forest with large numbers of Hymenoptera, Plants and Coleoptera. *Crocidura pachyura* individuals probably eat any animal of small size (between 0.5 and 17 mm, average 3.4-5 mm) which they can catch and handle, including some reptilian that complement their diet. We collected *C. pachyura* in sympatry with *Suncus etruscus* at Reghaia and Darna, but we never collected it in sympatry with other shrews like *Crocidura russula*, and *Crocidura whitakeri* that are known to live in the same habitats and same geographical region. Future questions about competition and coexistence amongst these morphologically similar and closely related species still need to be addressed.

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APPENDIX

Diet of *Crocidura pachyura* in Algeria.

Nd = number of individuals; % D = dietary occurrence; N = number of appearances of species; % F = frequency of occurrence; % B = percentage of prey biomass

Class/Embranchment	Order	Family	Genus	Species	Nd	% D	N	% F	% B
Clitellata	Oligochaeta	Oligochaeta fam.ind.		Oligocheta	29	5.16	1	1.05	7.644
Nematelminthes				Nematoda	8	1.42	1	1.05	0
Secernentea	Ascaridida	Ascarididae	*Ascaris*	*Ascaris* sp.	20	3.56	3	3.16	0.001
Gastropoda	Pulmonea	Cochlicellidae	*Cochlicella*	*Cochlicella* sp.	1	0.18	1	1.05	0.032
		Helicellidae		Helicidae	4	0.71	4	4.21	1.476
Arachnida	Aranea	Aranea fam. ind.		Aranea sp1.	28	4.98	23	24.21	0.886
				Aranea sp2.	1	0.18	1	1.05	0.032
		Oribatidae	*Oribatida*	Oribate sp1.	1	0.18	1	1.05	0
				Oribate sp2.	3	0.53	3	3.16	0
		Acari fam. ind.		Acari	11	1.96	8	8.42	0.001
	Opiliones	Opiliones fam. ind.		Opiliones	1	0.18	1	1.05	0.105
		Trogulidae		Trogulidae	3	0.53	2	2.11	0.316
		Phalangida		Phalangida	8	1.42	7	7.37	0.843
Myriapoda	Myriapoda	Iulidae	*Iulus*	*Iulus* sp.	1	0.18	1	1.05	0.047
				Chilopoda	1	0.18	1	1.05	0.264
Crustacea	Crustacea			Crustacea	3	0.53	3	3.16	1.582
		Oniscoidea		Oniscoidea	1	0.18	1	1.05	0.59
	Isopoda			Isopoda	4	0.71	4	4.21	2.362
Insecta				Insecta	1	0.18	1	1.05	0.264
	Orthoptera	Gryllidae		Gryllidae	1	0.18	1	1.05	1.898
	Blattoptera	Blattidae		Blattidae	7	1.25	7	7.37	2.214
			Ectobius	*Ectobius* sp.	8	1.42	7	7.37	2.53
	Dermaptera	Dermaptera fam.ind.		Dermaptera	1	0.18	1	1.05	0.037
		Forficulidae		Forficulidae Larvae	2	0.36	1	1.05	0.074
		Forficulidae		Forficulidae	1	0.18	1	1.05	0.037
		Carcinophoridae	*Anisolabis*	*Anisolabis* sp.	5	0.89	4	4.21	0.527
	Hemiptera	Hemiptera fam.ind.		Hemiptera	1	0.18	1	1.05	0.026
		Rhyparochromidae	*Scolopostethus*	*Scolopostethus* sp.	9	1.6	6	6.32	0.38
		Aphididae		Aphididae	1	0.18	1	1.05	0.016
				Eriosomatinae	1	0.18	1	1.05	0.037
		Corixidae		Corixidae	1	0.18	1	1.05	0.032
		Psyllidae	*Psylla*	*Psylla* sp.	2	0.36	2	2.11	0.032
		Pentatomidae	*Nezara*	*Nezara viridula torquata*	1	0.18	1	1.05	0.042
	Heteroptera	Cydnidae	*Sehirus*	*Sehirus* sp.	3	0.53	3	3.16	0.079
		Miridae		Miridae	2	0.36	2	2.11	0.053
				Miridae Larvae	1	0.18	1	1.05	0.026
		Lygaeidae		Lygaeidae	8	1.42	4	4.21	0.211
		Reduviidae		Reduviidae	1	0.18	1	1.05	0.026

		Jassidae		Jassidae	1	0.18	1	1.05	0.026
	Coleoptera	Coleoptera fam.ind.		Coleoptera	7	1.25	7	7.37	0.148
		Carabidae		Carabidae Larvae	13	2.31	9	9.47	0.137
				Carabidae	2	0.36	2	2.11	0.105
			Harpalus	*Harpalus* sp.	5	0.89	5	5.26	1.582
		Tenebrionidae		Tenebrionidae	1	0.18	1	1.05	0.053
		Tenebrionidae	*Latheticus*	*Latheticus* sp.	2	0.36	2	2.11	0.105
		Anthicidae	*Anthicus*	*Anthicus* sp.	1	0.18	1	1.05	0.053
		Scarabidae		Scarabidae	4	0.71	3	3.16	0.843
			Rhizotrogus	*Rhizotrogus* sp.	2	0.36	2	2.11	0.527
		Dytiscidae		Dytiscidae	1	0.18	1	1.05	0.158
		Scutellaridae		Scutellaridae	1	0.18	1	1.05	0.042
		Cholividae		Cholividae	1	0.18	1	1.05	0.105
		Alleculidae		Alleculidae	2	0.36	2	2.11	0.211
		Staphylinidae	*Philonthus*	*Philonthus* sp.	1	0.18	1	1.05	0.105
				Staphylinidae Larvae	5	0.89	2	2.11	3.479
				Staphylinidae	11	1.96	9	9.47	0.527
		Phalacridae	*Olibrus*	*Olibrus* sp.	2	0.36	2	2.11	0.316
		Chrysomelidae		Chrysomelidae	2	0.36	2	2.11	0.105
		Curculionidae		Curculionidae	8	1.42	8	8.42	0.422
			Acalles	*Acalles* sp.	1	0.18	1	1.05	0.053
				Apionidae	5	0.89	4	4.21	0.211
			Rhythirrhinus	*Rhythirrhinus* sp.	1	0.18	1	1.05	0.053
			Malvapion	*Malvapion* sp.	2	0.36	2	2.11	0.053
	Hymenoptera			Hymenoptera	2	0.36	2	2.11	0.042
		Formicidae		Formicidae	32	5.69	28	29.47	0.135
			Crematogaster	*Crematogaster* sp.	3	0.53	2	2.11	0.003
			Tetramorium	*Tetramorium* sp.	17	3.02	10	10.53	0.007
				Tetramorium biskrensis	3	0.53	3	3.16	0.001
				Tetramorium semilaeve	26	4.63	4	4.21	0.014
			Tapinoma	*Tapinoma nigerrimum*	10	1.78	3	3.16	0.005
				Tapinoma sp.	22	3.91	11	11.58	0.012
			Pheidole	*Pheidole pallidula*	3	0.53	2	2.11	0.002
				Pheidole sp.	1	0.18	1	1.05	0.001
			Messor	*Messor* sp.	8	1.42	6	6.32	0.084
			Aphaenogaster	*Aphaenogaster* sp.	3	0.53	2	2.11	0.005
				Aphaenogaster testaceo-pilosa	1	0.18	1	1.05	0.002
			Plagiolepis	*Plagiolepis* sp.	2	0.36	2	2.11	0.001
		Ichneumonidae		Ichneumonidae	1	0.18	1	1.05	0.053
		Proctotrupidae		Proctotrupidae .	1	0.18	1	1.05	0.005
		Halictidae	*Lasioglossum*	*Lasioglossum* sp.	1	0.18	1	1.05	0.079
		Andrenidae	*Andrena*	*Andrena* sp.	1	0.18	1	1.05	0.079
	Lepidoptera	Lepidoptera fam.ind.		Lepidoptera	2	0.36	2	2.11	0.158
		Tineidae		Tineidae	1	0.18	1	1.05	0.105
	Diptera	Cecidomyiidae		Diptera sp1.	4	0.71	4	4.21	0.084
				Diptera sp2.	2	0.36	2	2.11	0.042
		Diptera fam.ind.		Diptera sp3.	2	0.36	2	2.11	0.042
				Diptera sp. Larve	6	1.07	3	3.16	0.032
			Cyclorrhapha	*Cyclorrhapha* sp.	1	0.18	1	1.05	0.011
		Scatophagidae		Scatophagidae	3	0.53	2	2.11	0.079
				Antomoyiidae	1	0.18	1	1.05	0.079
		Calliphoridae		Calliphoridae	7	1.25	5	5.26	0.554
		Psycodidae		Psycodidae	1	0.18	1	1.05	0.021
Plantae	indet. order	Indet.fam. Plantae		Indet. Plantae	6	1.07	5	5.26	0.032
				seeds sp.	3	0.53	3	3.16	0.016
				Poacae . (seed)	3	0.53	2	2.11	0.016
				Indet.seeds black	109	19.4	3	3.16	1.437
				Indet. seeds brown	1	0.18	1	1.05	0.005
Reptilia	Squamata			Reptilia	7	1.25	7	7.37	62.734
Mammalia				Indet. Hair	X				
Other				Small stones	X				