

## FIRST RECORDS OF *CROCIDURA SUAVEOLENS* (MAMMALIA, SORICOMORPHA, SORICIDAE) ON KARPATHOS AND SARIA ISLANDS (DODECANESE, GREECE)

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### Abstract

*Crocidura suaveolens* was identified amongst skull remains from raptor pellets on Karpathos and in a discarded bottle on Saria. There are no data for this species in these two islands. In the Mediterranean basin, the insular presence of *C. suaveolens* is a result of Pleistocene survivors as well as human introductions. An investigation into the origin of Karpathos and Saria shrews would be interesting. Due to the finding in raptor pellets on Karpathos, the presence of a stable population of *C. suaveolens* must be confirmed here.

**Key words:** Biogeography, *Crocidura*, islands, Mediterranean, shrews, Soricidae

### Introduction

The Aegean Sea, located in the eastern part of the Mediterranean, includes a dense network of islands, more or less close to each other and also close to the continental coasts of Greece and Turkey. Few islands are therefore really “isolated” and in addition to their current and past geographical position (with sea level drops and consequent land connections between islands and continents), their biogeography has also been affected by human action, such as trade and colonization since ancient times.

Due to the complexity of these islands, and despite the numerous works on flora and fauna conducted in the past, it is still possible to report new species or recover interesting data, such as the remains of mammals, during naturalistic research. This happened on the islands of Karpathos and Saria; the results are presented here.

Karpathos and Saria are two islands located in the Karpathian Archipelago, the part of the Aegean Sea between Crete, Karpathos, Rhodes and Astypalea islands. Karpathos (Fig. 1), together with Kasos and Armathia in the southwest, the nearby Saria in the north and several offshore islets, form the Karpathos Archipelago and are a constituent part of the South Aegean island Arc (Greuter et al. 1983).

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Karpathos covers an area of 302.15 km<sup>2</sup>. Its coastline is 160 km long and the longest distance from the canal of Saria (north) to Cape Castello (south) is 48 km. The northern part of Karpathos, together with Saria, constitutes a Special Protection Area and a Site of Community Importance, according to the respective European directives (1992/43/EC and 2009/147/EC). Due to its paleogeography, the area covers a variety of habitats and hosts rare and endemic species on a national and European level. Karpathos is quite mountainous with few flat areas, which are located mostly near Afiartis in the south, Lastos in the centre and Avlona in the north. The northern part of the island is long and narrow and is built up of limestone, dolomitic limestone (Jurassic-Eocene) and flysch (Eocene) and hosts several reliefs, the highest being Profitis Ilias (719 m). The centre of the island, which corresponds to Mt. Kali Limni, the tallest peak of the island (1.215 m), is composed of limestone and constitutes the Kalilimni Unit (Jurassic-Eocene). The southern part of the island is built up mainly of flysch and sandstone with the exception of the Menetes area, also part of the Kalilimni Unit (Cordey & Quillévére 2019). Karpathos is not particularly rich in surface water. There are many streams and underground waters and the island is mostly covered by phrygic vegetation. The central and the northern part of the island are characterized by forests of *Pinus brutia* in pure stands (Grano & Cattaneo 2019).

Karpathos has a long history of human occupation, dating back to 4000 BC. Currently, according to the 2011 census, the population of Karpathos amounts to 7.111 people, concentrated mainly in the south of the island.

According to Masseti (2012), the mammal species recorded on Karpathos are: *Erinaceus roumanicus*, *Crocidura leucodon*, *Lepus europaeus*, *Apodemus mystacinus*, *A. sylvaticus*, *Rattus norvegicus*, *R. rattus*, *Mus musculus* and *Martes foina*.



**Fig. 1.** The islands of Karpathos and Saria and their location in the Aegean Sea, with an indication of the places where the skulls were found.

Saria (Fig. 1) is a small island very close to Karpathos, with a surface area of 20.4 km<sup>2</sup>. Similarly to Karpathos, it is also quite mountainous, reaching 630 m. a.s.l. (Pachy Vouno), with steep cliffs and screes. Together with the northernmost part of Karpathos, the island is made up mainly of limestone and dolomitic limestone (Jurassic - Eocene) (Cordey & Quillévére 2019). Saria is characterized by a sclerophyllous primary maquis, whose most representative elements are *Pistacia lentiscus* (pulvinate) and *Juniperus turbinata* and by a phrygic community mainly composed of *Sarcopoterium spinosum*, *Erica manipuliflora*, *Cistus creticus* subsp. *creticus* and *C. salviifolius* (Cattaneo pers. data). Saria and the northern part of Karpathos are included

in the Natura 2000 network of protected areas (GR4210003). Indeed, Saria is very important for the avifauna of Greece. The island is a notable location for species associated with Mediterranean scrub and for breeding seabirds. Cliffs and screes host a community of rare chasmophilous plants. The monk seal *Monachus monachus* frequents the coasts of Saria as well as those of the whole island of Karpathos (Notarbartolo di Sciara 2013). Currently, the island is uninhabited and the main human activities are livestock-farming and hunting. The main threats are from illegal hunting and fires.

### Materials and methods

The analyzed material consists of four skulls and six hemi-mandibles found in unidentified raptor pellets (28 whole and others fragmented) on Karpathos and of two skulls and one hemi-mandible found in a discarded bottle on Saria. The identification was carried out according to Richter (1970), Vogel et al. (1989), Niethammer & Krapp (1990), Sarà et al. (1990) and Kryštufek & Vohralík (2001). The characters studied are: profile of the skull in lateral view, shape of the zygomatic bones, shape of the upper fourth premolar, shape of the articular condyle of the jaw. Zygomatic breadth and mandibular height was measured by a calliper of 1/100 mm precision, the values were later approximated at 1/10 mm.

The specimens are preserved in Collezione Osteologica Mauro Grano (COMGR), Roma, Italy.

### Results and discussion

On the basis of the morphological and biometrical analyses, the studied specimens belong to the lesser shrew, *C. suaveolens* (Pallas, 1811). In the specimens of Karpathos, the values of the zygomatic width are 5.5, 5.7, 5.8, 5.9 mm and of the hemi-mandible height 4.3, 4.2 mm (2 specimens), 4.5, 4.6 mm (2 specimens); in the specimens of Saria, the values of the zygomatic width are 5.6 and 6.0 mm and of the hemi-mandible height 4.5 mm.

In the present paper, material from raptor pellets and an abandoned bottle were studied. When considering the pellet material, there is a possibility of predation on other islands or on the mainland, with a subsequent emission of the pellets somewhere else (Nappi 2011). On the contrary, the discovery of the remains of small mammals in discarded bottles represents a reliable criterion to establish the presence of certain species in an area (Morris & Harper 1965, Pagels & French 1987, Gerard & Feldhamer 1990, Muir & Morris 2013).

*Crociodura suaveolens* shows a wide distribution across the Palaearctic, from the Atlantic coast of Iberian Peninsula extending eastwards through Europe and Asia to Siberia (Palomo et al. 2016). Regarding the eastern Mediterranean area, previous reports of *C. russula* must be considered incorrect and attributable to *C. suaveolens* (Catzefflis et al. 1985, Vogel et al. 1986, Hofmann 1996, Zaitsev 1991, Kefelioğlu & Tez 1999, Bannikova et al. 2006, Vogel et al. 2003, Dubey et al. 2006, 2007).

At present, among the Greek islands, *C. suaveolens* is reported from Corfu, Zakynthos, Kythera, Euboea, Crete, Theodorou, Rhodes, Amorgos, Kos, Samos, Psara, Chios, Lesbos, Samothrace, Astypalea and Thasos (Masseti 2012, Angelici et al. 2018). Karpathos is inhabited by another shrew species, the bicolored shrew *Crociodura leucodon*, reported from barn owl *Tyto alba* pellets (Paragamian 1999).

On the basis of recent research carried out by analysing mitochondrial cytochrome b gene, around the Mediterranean basin, the insular presence of *C. suaveolens* is a result of Pleistocene survivors as well as human introductions (Dubey et al. 2007). During the Pleistocene (between 0,4 and 0,021 Mya) in

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particular, due to the lowering of the sea level, Saria, Karpathos and Kasos were connected, forming a single large island (Sfenthourakis & Triantis 2017). Based on these data, an investigation of the origin of Karpathos and Saria shrews would be interesting. On Karpathos, in particular, further research is needed to establish more objectively which species of the genus *Crocidura* are present.

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### Literature

- Angelici, F. M., Cattaneo, C., Grano, M. & Nappi, A. 2018. About the presence of *Crocidura suaveolens* group (Soricomorpha, Soricidae) on Astipalaia Island (Dodecanese, Greece). - Natural History Sciences. Atti della Società italiana di Scienze naturali e del Museo civico di Storia naturale di Milano 5 (1): 3-6. DOI 10.4081/nhs.2018.338.
- Bannikova, A. A., Lebedev, V. S., Kramerov, D. A. & Zaitsev, M. V. 2006. Phylogeny and systematics of the *Crocidura suaveolens* species group: corroboration and controversy between nuclear and mitochondrial DNA markers. - Mammalia 70: 106-119.
- Catzefflis, F., Maddalena, T., Hellwing, S. & Vogel, P. 1985. Unexpected findings on the taxonomic status of East Mediterranean *Crocidura russula* auct. (Mammalia, Insectivora). - Zeitschrift für Säugetierkunde 50: 185-201.
- Cordey, F. & Quillévéré, F. 2019. Reassessing the age of Karpathos ophiolite (Dodecanese, Greece): consequences for Aegean correlations and Neotethys evolution. - Geological Magazine 157 (2): 263-274.
- Dubey, S., Zaitsev, M., Cosson, J.-F., Abdulkadier, A. & Vogel, P. 2006. Pliocene and Pleistocene diversification and multiple refugia in a Eurasian shrew (*Crocidura suaveolens* group). - Molecular Phylogenetics and Evolution 38: 635-647.
- Dubey, S., Cosson, J.-F., Magnanou, E., Vohralík, V., Benda, P., Frynta, D., Hutterer, R., Vogel, V. & Vogel, P. 2007. Mediterranean populations of the lesser white-toothed shrew (*Crocidura suaveolens* group): an unexpected puzzle of Pleistocene survivors and prehistoric introductions. - Molecular Ecology 16: 3438-3452.
- Gerard, A. S. & Feldhamer, G. A. 1990. A comparison of two survey methods for shrews: pitfalls and discarded bottles. - The American Midland Naturalist 124: 191-194.
- Grano, M. & Cattaneo, C. 2019. First record of the rough-tailed Agama *Stellagama stellio* (Linnaeus, 1758) (Reptilia, Agamidae) from Karpathos island (Dodecanese, Greece). - Parnassiana Archives 7: 51-54.
- Greuter, W., Pleger, R. & Raus, T. 1983. The vascular flora of the Karpathos island group (Dodecanesos, Greece). A preliminary checklist. - Willdenowia: 43-78.
- Kefelioğlu, H. & Tez, C. 1999. The distribution problem of *Crocidura russula* (Hermann, 1780) (Mammalia: Insectivora) in Turkey. - Tr. J. of Zoology 23: 247-251.
- Kryštufek, B. & Vohralík, V. 2001. Mammals of Turkey and Cyprus. Introduction, Checklist, Insectivora. - Knjižnica Annales Majora, Koper, Republic of Slovenia, 140 + xvi.
- Masseti, M. 2012. Atlas of terrestrial mammals of the Ionian and Aegean islands. De Gruyter, Berlin/Boston.
- Morris, P. A. & Harper, J. F. 1965. The occurrence of small mammals in discarded bottles. - Proc.

- Zoological Society of London 145: 148-153.
- Muir, G. & Morris, P. 2013. How to Find and Identify Mammals. The Mammal Society, Southampton.
- Nappi, A. 2011. L'analisi delle borre degli uccelli: metodiche, applicazioni e informazioni. Un lavoro monografico. - *Picus* 37: 106-120.
- Niethammer, J. & Krapp, F. 1990. Handbuch der Säugetiere Europas. Band 3/I. Insektenfresser-Insectivora, Herrentiere-Primates. - Akademische Verlagsgesellschaft, Wiesbaden.
- Notarbartolo di Sciarra G. 2013. Draft regional strategy for the conservation of monk seals in the Mediterranean (2014-2019). United Nations Environment Programme / Mediterranean Action Plan (UNEP/MAP) / Regional Activity Centre for Specially Protected Areas (RAC/SPA), Tunis.
- Pagels, J. F. & French, T. W. 1987. Discarded bottles as a source of small mammal distribution data. - *The American Midland Naturalist* 118: 217-219.
- Palomo, L., Kryštufek, B., Amori, G. & Hutterer, R. 2016: *Crocidura suaveolens*. The IUCN Red List of Threatened Species 2016: e.T29656A22296429. <https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T29656A22296429.en>. [accessed 20 March 2020]
- Paragamian, K. 1999. Barn owl (*Tyto alba*) pellet analysis from Karpathos island, Greece. Abstracts of the 8th International Congress on the Zoogeography and Ecology of Greece and Adjacent Regions (ICZEGAR). - Hellenic Zoological Society, Athens: 112.
- Richter, H. 1970. Systematisch-taxonomische Untersuchungen an palarktischen Wimperspitzmäusen der Gattung *Crocidura* (III). Zur Taxonomie und Verbreitung der palarktischen Crociduren (Mammalia, Insectivora, Soricidae). - *Zoologische Abhandlungen aus dem Museum für Tierkunde in Dresden* 31 (17): 293-304.
- Sarà, M., Lo Valvo, M. & Zanca, L. 1990. Insular variation in central Mediterranean *Crocidura* Wagler, 1832 (Mammalia, Soricidae). - *Bollettino di Zoologia* 57: 283-293.
- Sfenthourakis, S. & Triantis, K. A. 2017. The Aegean archipelago: a natural laboratory of evolution, ecology and civilisations. - *Journal of Biological Research-Thessaloniki* 24: 4. DOI 10.1186/s40709-017-0061-3.
- Vogel, P., Maddalena, T. & Catzefflis, F. 1986. A contribution to the taxonomy and ecology of shrews (*Crocidura zimmermanni* and *C. suaveolens*) from Crete and Turkey. - *Acta Theriologica* 31 (39): 537-545.
- Vogel, P., Hutterer, R. & Sarà, M. 1989. The correct name, species diagnosis, and distribution of the Sicilian shrew. - *Bonner zoologische Beiträge* 40 (3/4): 243-248.
- Vogel, P., Cosson, J.-F. & Jurado, L. F. L. 2003. Taxonomic status and origin of the shrews (Soricidae) from the Canary Islands inferred from a mtDNA comparison with the European *Crocidura* species. - *Mol. Phylogenet. Evol.* 27: 271-282.
- Zaitsev, M. V. 1991. Species composition and questions of systematics of white-toothed shrews (Mammalia, Insectivora) of the fauna of USSR. In: Zaitsev M. V. (ed.). Questions of systematics, faunistics and palaeontology of small mammals. - *Proc. Zool. Inst. USSR Acad. Sci.* 243: 3-46.