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Rediscovery of the type series of the Sacred Shrew, *Sorex religiosus* I. Geoffroy Saint-Hilaire, 1826, with additional notes on mummified shrews of ancient Egypt (Mammalia: Soricidae)

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Abstract

In 1826, Isidore Geoffroy Saint-Hilaire described the Sacred Shrew, *Sorex religiosus* [= *Crocidura religiosa*] from a series of 22 embalmed individuals that comprised a portion of the Italian archeologist Joseph Passalacqua's collection of Egyptian antiquities from an ancient necropolis near Thebes, central Egypt. Living members of the species were not discovered until the beginning of the 20th century and are currently restricted to the Nile Delta region, well north of the type locality. In 1968, the type series of *S. religiosus* was reported lost, and in 1978, a neotype was designated from among a small collection of modern specimens in the Natural History Museum, London. Our investigations have revealed, however, that the type series is still extant. Most of the specimens used by I. Geoffroy Saint-Hilaire to describe *S. religiosus* still form part of the Passalacqua Collection in the Ägyptisches Museum, Berlin, Germany. We summarize the taxonomic history of *S. religiosus*, review the history of the Passalacqua collection, and explain why the type series was thought to have been lost. We designate an appropriate lectotype from among the original syntypes of *S. religiosus* in the Ägyptisches Museum. Our examination of the shrew mummies in the Passalacqua collection also yielded a species previously unrecorded from either ancient or modern Egypt: *Crocidura pasha* Dollman, 1915. Its presence increases the number of soricid species embalmed in ancient Egypt to seven and provides additional evidence for a more diverse Egyptian shrew fauna in the archeological past. Finally, we provide details that will assist in better understanding the variety of mummification procedures used to preserve animals in ancient Egypt.

Key words: ancient Egyptian history, animal mummy, *Crocidura olivieri, Crocidura pasha*, *Crocidura religiosa*, embalming practices, taxonomy

Introduction

Shrews (Soricidae) held an important role in the religious customs of the ancient Egyptians. Small statues of shrews and even embalmed or mummified shrews—some contained in small wooden, stone, or metal coffins—were used as votive offerings to certain deities (Ikram, 2005a,d). One thought is that shrews acted as representatives of one of the two contrasting aspects (day vs. night, light vs. dark) of the Egyptian god Horus (Brunner-Traut, 1965), although other interpretations of their significance also have been suggested (Lurker, 1974; Kessler, 1989, 2007; Osborn & Osbornová, 1998; Fitzenreiter, 2003; Ikram, 2005a, e). While there is a wealth of information available on the archaeological aspects of mummified shrews, few studies have dealt with the zoological aspects of their historical and faunal legacy (Heim de Balsac & Mein, 1971; Hutterer, 1994).

In 1826, the Italian archeologist and antiquarian Joseph Passalacqua (also known as Guiseppe Passalacqua, 1797–1865) published *Catalogue Raisonné et Historique des Antiquités Découvertes en Égypte*, an account of his 1823 discovery and excavation of what he claimed was an intact royal tomb in the ancient Egyptian necropolis at Thebes (Passalacqua, 1826; Fielding, 1826; Fig. 1). This site later proved to be the partially looted tomb of Queen Mentuhotep, wife of Pharaoh Djehuti of the 17th Dynasty of the Second Intermediate Period (ca. 1630–1539 BC;

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chronology based on Rice, 1999; Grajetzki, 2005), at Dra′ Abu el-Naga′ on the west bank of the Nile River (Winlock, 1924; Thompson, 2015). Passalacqua's *Catalogue* included a detailed listing of 1921 diverse objects in his collection, as well as scholarly contributions from a variety of French academics and scientists who had examined them. Alexandre Brongniart, for example, described mineral and rock materials in the collection. Louis Nicolas Vauquelin, Jean Pierre Joseph Darcet, M. Le Baillif, and Étienne Julia-Fontenelle reported on chemical analyses of individual organic and inorganic objects. Carl Sigismund Kunth identified remains of fruits, and Pierre André Latreille examined the insects. Two physicians, M. De Verneuil and M. C. Delattre, addressed the human mummies and embalming practices. The naturalist Étienne Geoffroy Saint-Hilaire discussed the embalmed remains of vertebrate animals other than humans (Passalacqua, 1826).

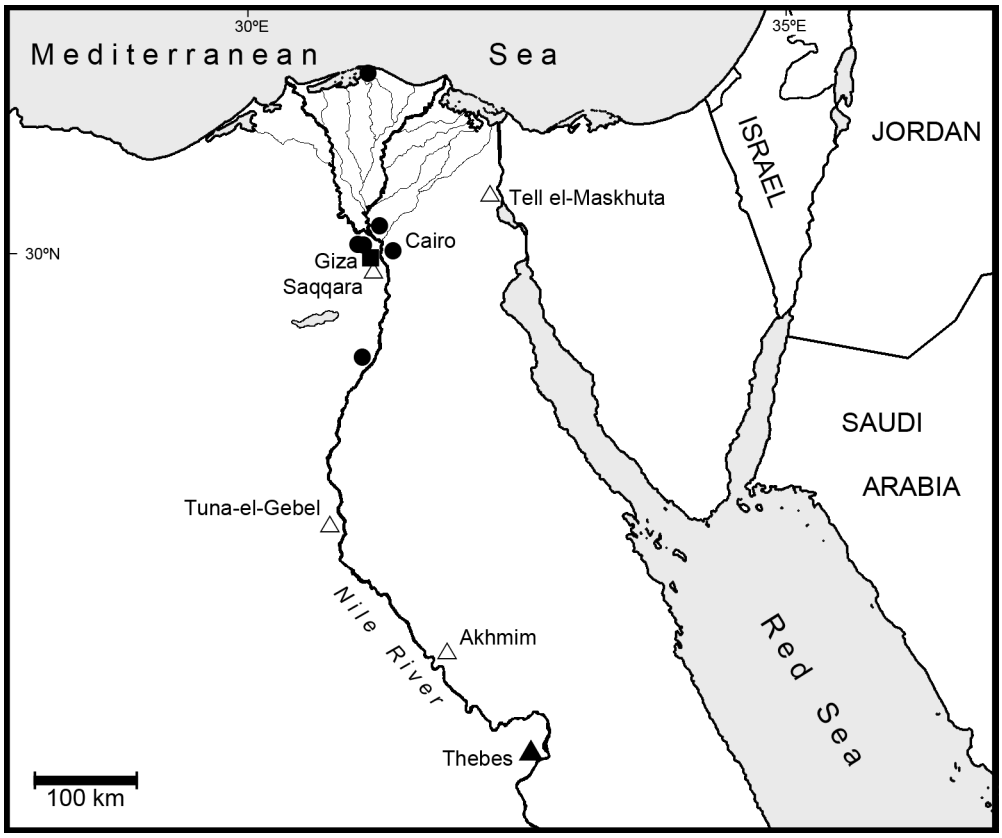

FIGURE 1. Map of northeastern Egypt, showing the distribution of *Crocidura religiosa* along the Nile River valley. Symbols: solid triangle, original type locality at Thebes; open triangles, other ancient necropoli (Lortet & Gaillard, 1903; Boessneck, 1988; Kessler, 2007); solid square, Corbet's (1978) neotype locality at Giza; solid dots, modern specimen localities (de Winton, 1902; Bonhote, 1909, 1912; Flower, 1932; Setzer, 1957; Osborn & Helmy, 1980; Handwerk, 1990, 1998). A presumed Pleistocene record from Bir Tarfawi, southern Egypt (Kowalski *et al.,* 1989) is not included.

Among the animal remains in his collection, Passalacqua (1826: 21) cataloged two "rats" (Passalacqua's *Catalogue* numbers 396, 397) and 24 "souris développées" ("developed mice": numbers 398–421) that É. Geoffroy Saint-Hilaire (1826) identified as shrews (Soricidae). The naturalist thought the two larger "rats" probably represented his Indian shrew, *Sorex indicus* É. Geoffroy Saint-Hilaire, 1811 [= *Suncus murinus* (Linnaeus, 1766)], but was uncertain about the specific identities of the 24 smaller shrews (numbers 398–421). He suggested that they all might belong to the common shrew (= *Sorex araneus* Linnaeus, 1758), but did not identify them definitively, stating, "Nous sommes assuré de cette détermination quant au genre, mais nous ne pouvons rien affirmer quant à l'espèce: nous connaissons plusieurs musaraignes d'une aussi petite taille" [We are sure of the determination of the genus, but we can say nothing as to the species: we know several shrews of such a small size] (É. Geoffroy Saint-Hilaire, 1826: 234).

In a footnote to a subsequent section of the *Catalogue* by the archeologist Jacques-Joseph Champollion-Figeac, who contributed a chapter on specific artifacts and ancient Egyptian chronology, É. Geoffroy Saint-Hilaire's son, Isidore Geoffroy Saint-Hilaire, then an assistant naturalist at the Muséum Royal d'Histoire Naturelle,

described a large subset of the smaller shrews (*n* = 22; numbers 398–419) as a new species he named *Sorex religiosus* (I. Geoffroy Saint-Hilaire, 1826: 294–295). Although he claimed in the footnote to have already described and named this shrew in the 11th volume of *Dictionnaire Classique d' Histoire Naturelle*, that volume was not published until January of the following year (I. Geoffroy Saint-Hilaire, 1827a; see also Woodman, 2015). He subsequently published a third description of the species in *Mémoires du Muséum d'histoire naturelle*, along with a plate illustrating three size classes of mummified shrews in the collection (I. Geoffroy Saint-Hilaire, 1827b; Fig. 2).

The Sacred Shrew was first determined to be an extant member of the modern Egyptian fauna near the beginning of the 20th century, when William Edward de Winton (1902) identified 10 individuals of the species obtained near Cairo by N. Charles Rothschild in May 1901 and donated to the British Museum (Natural History) (Fig. 1). De Winton thought that another specimen from Cairo in the Stuttgart Museum might also belong to this species, but that specimen was lost in the mail when it was loaned to him for examination. By that time, *Crocidura* Wagler, 1832, had come into common usage as the generic name for African and Eurasian white-toothed shrews (e.g., Peters, 1852: 52; Hutterer, 2005), and *Sorex religiosus* was referred to this genus as *Crocidura religiosa* (e.g., de Winton, 1902).

The Sacred Shrew was accepted as a valid species (e.g., de Winton, 1902; Lortet & Gaillard, 1903, 1909; Bonhote, 1909, 1912; Dollman, 1916; Setzer, 1957) until Heim de Balsac & Verschuren (1968: 41) questioned its taxonomic status in their study of small crocidurine shrews from the Democratic Republic of the Congo (D.R.C.). Although they defined a "*C. religiosa* Group" to include two tiny shrew species (*C. pasha* Dollman, 1915 and *C. nanilla* Thomas, 1909), they considered *C. religiosa* to be unidentifiable. Unable to locate the original type series of *S. religiosus*, they instead examined a separate group of shrew mummies from Akhmim in the collection of the Musée Guimet de Lyon, France (Heim de Balsac & Mein, 1971; Hutterer, 1994). Among the remains, they noted the presence of two tiny species of shrews [a small *Crocidura* sp. and *Suncus etruscus* (Savi, 1822)]. Because they considered the external characters I. Geoffroy Saint-Hilaire (1827b) used to describe *S. religiosus* could apply to either *C. religiosa* or to *S. etruscus*, they advised against the use of the former name. Heim de Balsac & Verschuren (1968: 41) further asserted that, "Le type de *religiosa* n'a pas été conservé ou n'existe plus" [The type of *religiosa* has not been preserved or no longer exists]. This statement probably reflects their expectation that, if the type series survived, it should be in the collection of the Muséum national d'Histoire naturelle in Paris, the successor to the institution in which I. Geoffroy Saint-Hilaire worked (see also Knight, 1843). It may also reflect their misunderstanding of I. Geoffroy Saint-Hilaire's (1827b: 144; Fig. 2) plaint that his illustrations of the shrew mummies were, "avec quelques descriptions, tout ce qui nous reste aujourd'hui des Musaraignes de Thèbes" [with some descriptions, all that remains to us today of the shrews from Thebes].

Heim de Balsac & Mein (1971) subsequently undertook a comprehensive study of the Akhmim shrew mummies in the Musée Guimet in Lyon. They formally rejected the name *C. religiosa* and referred the tiny *Crocidura* from the ancient tombs at Thebes and from the modern Giza–Nile Delta region to *Crocidura nana* Dobson, 1890, which at that time was considered to have a widespread distribution in Africa. This change in nomenclature was followed by Osborn & Helmy (1980), Osborn & Osbornová (1998), Hoath (2003), and Ikram (2005a).

In contrast, Corbet (1978: 27) determined that I. Geoffroy Saint-Hilaire's (1827b) description of *S. religiosus* was "perfectly consistent with the living species," and he recognized *C. religiosa* as a senior synonym of *C. nana*. To compensate for the loss of the type series, as reported by Heim de Balsac & Verschuren (1968), he designated a modern specimen from Giza, Egypt (Natural History Museum, London, catalog number 10.6.18.4), as the neotype for *S. religiosus*.

Hutterer (1993) subsequently showed that the holotype of *C. nana* is a juvenile of a species much larger than *C. religiosa* and recognized the two names as representing distinct species (Hutterer, 1993, 1994, 2005). As currently understood, *C. nana* inhabits a limited range in Somalia, Ethiopia, Kenya, and Tanzania (Hutterer, 2005; Stanley *et al.,* 2007; Churchfield & Jenkins, 2013a), and modern *C. religiosa* is endemic to the region of the Nile River Delta in northern Egypt (Fig. 1; Hutterer *et al.,* 2008).

This situation served well, as long as the type series was "lost" and the specimen in London's Natural History Museum legitimately was considered to be the valid name-bearing neotype for the species. Our recent investigations revealed, however, that the type series of *S. religiosus* is still extant and cataloged in the collections of a major metropolitan museum, where it is available for study.

FIGURE 2. Mummified remains of *Sorex religiosus* (figure 1, top), the middle-size shrew (figure 2, middle: *Crocidura floweri* ?), and *Crocidura olivieri* (figure 3, bottom) from Thebes (I. Geoffroy Saint-Hilaire, 1827b: Plate 4, Figure 1). The shrews illustrated in figs. 1 & 2 are now lost; the specimen of *C. olivieri* is identifiable as ÄM 7044. Image from the Biodiversity Heritage Library (www.biodiversitylibrary.org). Digitized by Smithsonian Libraries, Washington. Original page is ca. 258 x 190 mm.

History of the Passalacqua Collection. Despite Heim de Balsac & Verschuren's (1968) statement to the contrary, I. Geoffroy Saint-Hilaire's type series of *Sorex religiosus* was never lost. Although its significance to zoological taxonomy is clear to biologists, these mummified shrews comprised a small portion of the larger Passalacqua Egyptian Collection, which was primarily of archeological interest. The history of the type series therefore tracks the history of the Passalacqua Collection, a collection primarily of Egyptian artifacts that was deposited ultimately in the Ägyptisches Museum, Berlin, Germany (Hunt, 1827; Lichtenstein, 1829).

As was the case with many early collections of Egyptian artifacts brought to Europe, Passalacqua's Collection was for sale. At the urging of the explorer and naturalist Alexander von Humboldt, the Prussian crown prince,

Friedrich Wilhelm IV, purchased the Passalacqua collection in Paris in 1827 for 100,000 francs (I. Geoffroy Saint-Hilaire, 1827b; Hunt, 1827; Ehrenberg, 1835; Thompson, 2015). The following year, the collection was moved to the Monbijou Palace along the Spree River in Berlin, where, along with other Egyptian collections, it served as a foundation for the city's Königliche Museen (Royal Museums) (Generalverwaltung Königliche Museen zu Berlin, 1899; Ägyptisches Museum und Papyrussammlung, 2015; Sammlung Scharf-Gerstenberg, 2015; Thompson, 2015). In lamenting the "loss" of the Theban shrews, I. Geoffroy Saint-Hilaire (1827b: 144) was not mourning the destruction of these specimens, but their removal from the scientific circles of Paris, where Passalacqua had permitted him ready access to them, to Berlin, then an intellectual backwater that even Humboldt attempted to avoid (Wulf, 2016). Lichtenstein (1829) confirmed the incorporation of these shrews into the collection of Berlin's Königliche Museen when he commented critically on I. Geoffroy Saint Hilaire's (1827b) taxonomic conclusions regarding the shrews.

Passalacqua accompanied the collection to Berlin as director of the new museum, a position he held until his death in 1865. The expanding Egyptian collection moved in 1850 to the newly constructed Neues Museum on Museumsinsel in the Spree River. During World War II, the Neues Museum was heavily damaged, and by the end of the war, the extensive Egyptian collection was scattered. Egyptian artifacts in the Democratic Republic of Germany eventually returned to the Bode-Museum on Museumsinsel in what was then East Berlin, while those in the Federal Republic of Germany were concentrated in a renovated art museum, the Sammlung Scharf-Gerstenberg, in West Berlin. German unification in 1990 led to re-organization of the museums in 1991, and the surviving Egyptian collections, including the Passalacqua Collection, were re-united in the Archäologisches Zentrum, adjacent to Museumsinsel, as part of the Ägyptisches Museum und Papyrussammlung of the Staatliche Museen in Berlin in 2005 (Ägyptisches Museum und Papyrussammlung, 2015; Sammlung Scharf-Gerstenberg, 2015; Thompson, 2015).

In this paper, we report on the current condition of the shrew mummies in the Passalacqua Collection and identify them using external and cranial measurements and qualitative characters derived from X-rays images and micro-CT scans. We designate an appropriate lectotype for *S. religiosus* from the original series of syntypes and re-describe the species in light of current understanding of modern soricid diversity. Finally, we discuss shrew diversity in ancient Egypt and address embalming practices as they pertain to the Passalacqua shrews.

Materials and methods

Eight species of soricids [*Crocidura balsamifera* Hutterer, 1994*, C. floweri* Dollman, 1915*, C. fulvastra* (Sundevall, 1843), *C. olivieri* (Lesson, 1827), *C. religiosa, C. whitakeri* de Winton, 1898*, Suncus etruscus, S. murinus*] have been recorded from within the modern boundaries of Egypt at some time from the beginning of the Early Dynastic Period (ca. 3000 BC) to the modern day (Hutterer, 1994). One of these species (*C. balsamifera*) is now extinct, a second (*C. fulvastra*) is extirpated from Egypt, but still inhabits neighboring Sudan (Hutterer, 1984), and a third (*S. murinus*) is a human-introduced exotic species that probably no longer occurs in Egypt (Hutterer & Tranier, 1990). This last species was unlikely to have been present in ancient Egypt, and we do not consider it further. To ascertain the identities of the mummified specimens in the Passalacqua Collection, we examined the type series of *C. balsamifera* [Musée Guimet d'Histoire naturelle de Lyon (holotype—transferred to the Musée des Confluences, Lyon), and Centre de Paléontologie, Université Claude Bernard, Lyon (paratype), France] and 210 modern specimens of seven other species of shrews from the collections of the Natural History Museum, London, UK (BMNH); Field Museum of Natural History, Chicago, IL, USA (FMNH); National Museum of Natural History, Washington, DC, USA (USNM); Peabody Museum, Yale University, New Haven, CT, USA (YPM); and Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK) (Appendix I—specimens examined). For modern specimens, two external measurements, length of tail (LT) and length of hind foot including the claws (HF) were recorded from skin labels. We measured skulls using a digital caliper to record the following measurements: greatest length of skull, from the anterior-most tip of the upper first incisors to the occipital condyles (GLS); greatest breadth of the braincase (BB); length of palate (PL); interorbital breadth (IO); length of toothrow from anterior of I1 to posterior of M3 (I1–M3); and breadth across post-glenoid capitular facets (LMA; Table 1). We also measured maxillary breadth (MB) and height of the coronoid process (COR) from CT scans. All measurements are in mm.

TABLE 1. External and skull measurements for eight Egyptian shrews. Summary statistics are mean ± SD and range of measurements.

Suncus etruscus	*C. pasha*[1]	*C. religiosa*	*C. whitakeri*	*C. floweri*[2]	*C. balsamifera*[3]	*C. fulvastra*[4]	*C. o. olivieri*[5]
External measurements:							
n = 14	*n* = 2	*n* = 19	*n* = 7	*n* = 2		*n* = 29	*n* = 67
Length of tail (LT)							
29 ± 4	29, 38	33 ± 4	31 ± 5	57	—	61 ± 6	69 ± 6
22–33		28–40	25–39	58, 56		45–73	57–84
Length of hind foot (HF)							
7 ± 1	7.5, 9	9 ± 1	12 ± 1	14	—	15 ± 1	20 ± 1
5–9		8–11	11–13	13, 14		14–19	16–23
Skull measurements:							
n = 32	*n* = 4	*n* = 23	*n* = 7	*n* = 5	*n* = 2	*n* = 28	*n* = 85
Greatest length of skull (GLS)							
13.3 ± 0.4	14.2	15.4 ± 0.5	17.3 ± 0.3	17.9 ± 0.6	22.1	22.9 ± 0.9	27.8 ± 0.9
12.4–14.1	13.9–15.1	14.4–16.1	16.7–17.7	17.1–18.7	(*n* = 1)	21.2–25.0	25.7–30.1
(*n* = 23)		(*n* = 13)	(*n* = 6)			(*n* = 21)	(*n* = 74)
Breadth of braincase (BB)							
6.0 ± 0.1	6.5	6.9 ± 0.2	8.0 ± 0.1	7.9 ± 0.3	9.8	9.7 ± 0.4	11.8 ± 0.4
5.7–6.3	6.3–6.6	6.6–7.4	7.9–8.1	7.5–8.2	(*n* = 1)	9.0–10.8	11.0–12.5
(*n* = 21)		(*n* = 13)	(*n* = 6)			(*n* = 21)	(*n* = 76)
Palatal length (PL)							
5.0 ± 0.2		6.2 ± 0.3	7.1 ± 0.3	7.1 ± 0.2	9.5	9.8 ± 0.5	12.2 ± 0.5

	4.6–5.3 (*n* = 31)		5.7–6.7	6.6–7.4	6.9–7.4	9.1, 9.8	8.9–10.8 (*n* = 27)	11.0–13.8 (*n* = 83)
Interorbital breadth (IO)								
	2.9 ± 0.1		3.1 ± 0.1	3.6 ± 0.1	3.7 ± 0.2	4.6	4.3 ± 0.1	5.2 ± 0.2
	2.3–3.0		2.8–3.3	3.5–3.8	3.6–4.0	4.5, 4.6	4.0–4.6	4.9–5.7 (*n* = 77)
Toothrow length (I1–M3)								
	5.5 ± 0.2	5.9	6.4 ± 0.2	7.5 ± 0.2	7.6 ± 0.2	9.8	9.9 ± 0.5	12.5 ± 0.4
	5.0–5.8	5.6–6.4	5.9–6.8	7.1–7.8	7.3–7.8	9.6, 9.9	9.1–10.8 (*n* = 27)	11.2–13.3
Length across postglenoid capitular facets (LMA)								
	4.3 ± 0.2		4.8 ± 0.2	5.7 ± 0.1	5.3 ± 0.2	6.4	6.4 ± 0.2	8.0 ± 0.4
	3.6–4.6 (*n* = 31)		4.3–5.1 (*n* = 22)	5.5–5.9	5.1–5.5	(*n* = 1)	6.1–7.0 (*n* = 26)	6.3–8.8 (*n* = 81)

[1] Summary measurements from Hutterer & Kock (1983) and Churchfield & Jenkins (2013b).
[2] External measurements are those of the holotype reported by Dollman (1916) and FMNH 106469.
[3] Measurements from Hutterer (1994).
[4] Includes *C. fulvastra* from Sudan only.
[5] *Crocidura olivieri olivieri* is restricted to northern Egypt but may occur also further south in Sudan (Jacquet et al., 2015).

We examined the 19 surviving specimens of embalmed shrews in the Passalacqua Collection of the Ägyptisches Museum, Berlin (= ÄM) and took approximate external measurements with a ruler. Because the mummified soft tissues obscure skeletal features (Fig. S1), all individuals were X-rayed at the Gemäldegalerie (Art Gallery) in Berlin with a General Electric Eresco apparatus. Subsequently, a subset of six mummies was X-rayed at Zoologisches Forschungsmuseum Alexander Koenig, Bonn, with a digital Faxitron X-ray LX60 (Table 2). The resulting images were imported into Photoshop CS3 Extended (version 10.0.1, Adobe Systems Incorporated, San Jose, California), and skull measurements were recorded using the custom Ruler Tool in the Analysis menu (e.g., see Woodman & Stabile 2015) or directly from the screen or printed images. In addition, six selected specimens were scanned with a micro-CT (Bruker Skyscan 1272) using a source voltage of 60–70 kV and having a resulting resolution of 16–19.8 µm. Raw data were reconstructed with NRecon (Version 1.7.0.3, Bruker microCT), and 3D models were built with the CTvox software (Version 3.0.0 r1114, Bruker microCT). Measurements were taken directly from the screen using the 1 mm scale provided by the program.

Results

The extant Passalacqua shrews. I. Geoffroy Saint-Hilaire (1827a, b) stated that Passalacqua originally recovered 27 shrew mummies from the necropolis at Thebes. These included 2 large *Sorex indicus* or *S. giganteus* I. Geoffroy Saint-Hilaire, 1827, 2 individuals of a medium-sized species that he thought comparable to European *S. araneus*, and 23 small *S. religiosus* (Fig. 2). In the *Catalogue*, where they are listed with Passalacqua's catalog numbers, however, Passalacqua (1826: 21) and É. Geoffroy Saint-Hilaire (1826: 233) noted only 26 shrews. Similarly, in his original description of *S. religiosus* in the *Catalogue*, I. Geoffroy Saint-Hilaire (1826: 294) definitively refers only 22 specimens to that species by their catalog numbers. The missing specimen of *S. religiosus* is probably an individual mentioned by É. Geoffroy Saint-Hilaire (1826: 234), and later by I. Geoffroy Saint-Hilaire (1827b: 131), that was given to the chemist Michel Eugène Chevreul to clean:

> "... car avec l'aide du célèbre et savant chimiste, M. Chevreul, nous avons cherché à débarrasser l'un des individus de la croûte bitumineuse qui l'enfermait, pour voir et prendre les couleurs du pelage. Nous avons fait bouillir de sujet dans de l'esprit de vin pur, ce qui a opéré la dissolution de toute la matière résineuse. Un moment, l'animal a été rappelé à son état primitif; il nous a montré distinctement un poil gris-de-souris. Cependant l'action du feu ayant été trop prolongée a fini par tout détruire
> [... with the help of the famous and learned chemist, M. Chevreul, we sought to rid one of the individuals of the bituminous crust that enclosed it, in order to see, and determine the colour of, the fur. We boiled the subject in spirits of pure wine, which affected the dissolution of all resinous matter. For a moment the animal was recalled to its primitive state; it showed us a distinctly mouse-gray pelage. However, the window of action having been too prolonged, it ended up destroying it entirely.] (É. Geoffroy Saint-Hilaire, 1826: 234)".

The destruction of that specimen would have left the 22 individuals that I. Geoffroy Saint-Hilaire (1826) used to describe *Sorex religiosus* and a total of 26 shrew mummies.

Passalacqua's collection of mummified shrews currently numbers 19 specimens (Table 2; Fig. S1). In addition to the specimen boiled out of existence by M. Chevreul, seven other shrews have been lost, probably during the disruptions caused by the Second World War (K. Finneiser, in litt., 14 & 25 August 2015). Two of the missing specimens are the two smaller individuals figured by I. Geoffroy Saint-Hilaire (1827b: Plate 4; see our Fig. 1). Unfortunately, Passalacqua's original numbers from his *Catalogue* are no longer associated with the specimens, and neither É. Geoffroy Saint-Hilaire (1826) nor I. Geoffroy Saint-Hilaire (1826) published individual descriptions of specimens.

TABLE 2. Identification of the 19 surviving shrew mummies from the Passalacqua collection. Numbers in bold were studied as micro-CT-scans. Passalacqua (1826) originally recorded 26 shrew mummies (2 "rats" and 24 "mice").

species	number of specimens	ÄM catalog numbers	Passalacqua catalog numbers
C. olivieri	2	7044, 7085	396, 397
C. religiosa	15	**688**, 689, **690**, 691, 692, 694, 695, 696, 698, 699, 7050, **7051**, **7056**, 7087, 7088	
C. pasha	2	**697**, **7089**	

Species determination. The extant Passalacqua Collection includes the two largest shrews (numbers 396 & 397, now ÄM 7044, 7085), which are identifiable as *Crocidura olivieri*. These two individuals correspond to the specimens referred to *S. indicus* by É. Geoffroy Saint-Hilaire (1826) and to *S. giganteus* by I. Geoffroy Saint-Hilaire (1827b). One of these (ÄM 7044) was figured by I. Geoffroy Saint-Hilaire (1827b: Plate 4; see our Fig. 1). The other (ÄM 7085) lacks its head and skull and is probably the individual that was partially dissected by I. Geoffroy Saint-Hilaire (1827b: 142) to inspect its dentition:

"M. Passalacqua a eu l'extrême complaisance de nous confier l'un de ses deux individus, et de nous permettre d'enlever la peau sur un des côtés de la tête, pour mettre à découvert le crâne et les dents."

"[Mr. Passalacqua had the extreme kindness to give us one of his two individuals, and allow us to remove the skin on one side of the head, to expose the skull and teeth."]

Unfortunately, the skull of ÄM 7085 is no longer with the collection. The two *Crocidura olivieri* are easily recognized, however, by their large body size (Fig. S1; Table 3).

Neither of the two middle-sized shrews (Fig. 2) mentioned by I. Geoffroy Saint-Hilaire (1827b: 142) currently exist. They may have represented *Crocidura floweri*, a species larger than *C. religiosa*, but considerably smaller than *C. olivieri* (Table 1). The remaining 17 specimens are all small (Table 3), but two specimens (ÄM 697, 7089) are even smaller, particularly in the lengths of their hind feet, and we discuss them further below.

We can now identify a series of 15 specimens as the remaining syntypes of *Sorex religiosus* (Tables 2, 3). Their external measurements (TL 28–35 mm, HF 8–9 mm) fall within the range of modern specimens of this species (Table 1). Likewise, cranial measurements taken from X-rays and CT-scans of four specimens (Table 4) fall well within the range of extant *C. religiosa* and differ clearly from the five other species of *Crocidura* known to occur in Upper Egypt (Table 1). I. Geoffroy Saint-Hilaire's *C. religiosa*, therefore, was correctly recognized by de Winton (1902) as an extant species in Egypt.

The remaining two specimens of small shrews (ÄM 697, 7089) do not belong to the syntypes series of *Sorex religiosus*, but instead represent a distinct, even smaller, species. Contrary to the expectation (as suggested by Heim de Balsac & Mein, 1971), this is not *Suncus etruscus*, but an almost equally small species of *Crocidura*, as indicated by its possession of three pairs of unicuspid teeth in the upper jaw (rather than the four pairs typical of *Suncus*). The tail of ÄM 697 is short (25 mm), and the hindfoot is only 7 mm long (Table 3). The skull is shorter (GLS 13.3–14.1 mm) than the skull of *C. religiosa* (GLS 14.4–16.1 mm) (Fig. 3) and other small species such as *C. nanilla* (Thomas, 1909), *C. arabica* Hutterer & Harrison, 1988 (GLS 17.8 mm; Hutterer & Harrison, 1988), and *C. katinka* Bate, 1937 (Hutterer & Kock, 2002). The two specimens from Thebes are most similar to *Crocidura pasha*, a species that today occurs in the savannah of Sudan, South Sudan, and western Ethiopia (Hutterer & Kock, 1983; Churchfield & Jenkins, 2013b). In Fig. 3, the skull of the mummified specimen ÄM 697 is compared with that of a modern specimen of *C. pasha*. Both are of the same size and share a slender rostrum, short interorbital region, and narrow braincase. The two specimens agree perfectly with the holotype of *C. pasha* (BMNH 8.9.22.1: GLS, 14.1 mm; I1-M3, 5.6 mm) and with a specimen from Garamba National Park (D.R.C.) figured by Heim de Balsac & Verschuren (1968). Measurements from the two mummies (Table 4) fall within ranges of measurements supplied by Churchfield & Jenkins (2013b) and by Hutterer & Kock (1983) from the Nuba Mountains, Sudan (GLS, 13.4 mm; I1-M3, 5.4–5.8 mm).

TABLE 3. External measurements of tail length (TL) and hindfoot (HF) from the Passalacqua Collection shrews and their physical condition as observed from X-ray images and micro-CT-scans.

ÄM Cat.			Vertebral column					
No.	TL	HF	lumbar	thoracic	cervical	Ribs	Braincase	Species
688	32	8		broken			broken	*C. religiosa*
689	-	8	broken*					*C. religiosa*
690	28	8		broken				*C. religiosa*
691	-	8						*C. religiosa*
692	-	8						*C. religiosa*
694	-	-			broken			*C. religiosa*
695	28	8			broken		broken	*C. religiosa*
696	28	-						*C. religiosa*
698	20+	9		broken				*C. religiosa*
7050	32+	9			broken		broken	*C. religiosa*
7051	20+	-		broken*			broken	*C. religiosa*
7055	-	8	broken		broken		broken	*C. religiosa*
7056	30	-	broken*					*C. religiosa*
7087	28+	8						*C. religiosa*
7088	35	8				cut		*C. religiosa*
697	25	7						*C.* sp.
7089	-	7					?	*C.* sp.
7044	60	21						*C. olivieri*
7085	75	20					broken	*C. olivieri*

* Specimens completely broken in two at the dorsal or thoracic region.

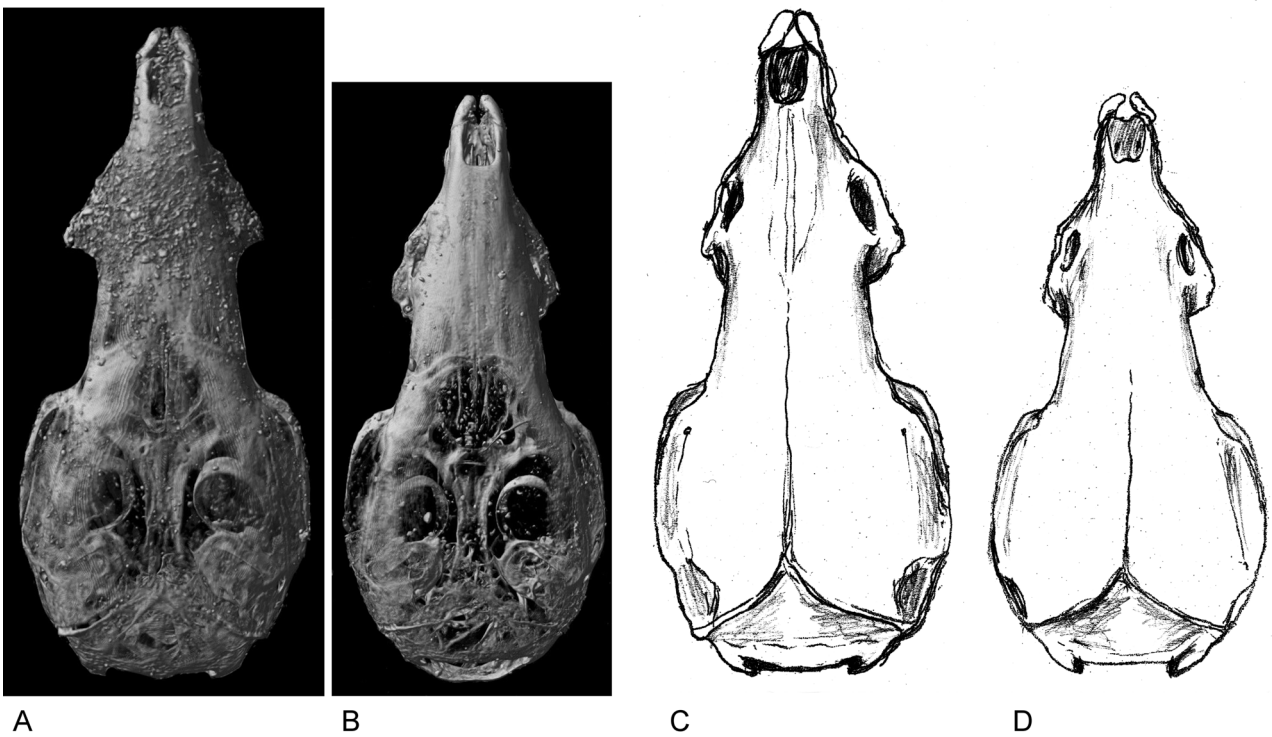

FIGURE 3. Dorsal views of the skulls of mummified (micro-CT-scans) and extant (camera lucida drawings) specimens of shrews. *C. religiosa*: A, Passalacqua specimen ÄM 690 (GLS 15.3 mm), C, Giza, Egypt, BMNH 10.6.18.5 (GLS 15.6 mm). *C. pasha*: B, Passalacqua specimen ÄM 697 (GLS 14.1 mm), D, Khartoum, Sudan, BMNH 9.9.2.31 (GLS 14.1 mm).

Designation of a lectotype for *Sorex religiosus*. Under Article 75.8 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature [ICZN] 1999), the name-bearing type series for *S. religiosus* reverts to the original type series of specimens described by I. Geoffroy Saint-Hilaire (1826), and a lectotype may be selected from that series (ICZN 1999. article 74). The neotype designation by Corbet (1978) is set aside. In its place, we designate Ägyptisches Museum No. ÄM 690 as the lectotype for *Sorex religiosus* I. Geoffroy Saint-Hilaire, 1826 (Figs. 4, 5). This is an embalmed and desiccated mummy from the tomb of Queen Mentuhotep at Dra′ Abu el-Naga′, near Thebes, west bank of the Nile River, Egypt (Fig. 1), acquired by J. Passalacqua in 1823.

The designation of a lectotype is necessary and justified, according to the Code (ICZN, 1999: Article 74).

1. *Crocidura religiosa* is a member of a group of small species (the *C. religiosa* group of Heim de Balsac & Mein, 1971) and is difficult to distinguish from other closely related species. A clear standard for the species is therefore warranted.

2. We provide evidence that the type series was not lost, contrary to the statements of previous authors (see Article 75.3.4.).

3. The lectotype agrees in morphology and dimensions with modern specimens from Egypt (Table 1).

FIGURE 4. Lectotype ÄM 690 of *Sorex religiosus* I. Geoffroy Saint-Hilaire, 1826. A, External view of mummy; B, X-ray of entire specimen. Scale in mm. Photograph courtesy of S. Steiss, Berlin; X-ray image courtesy of C. Schmidt, Berlin.

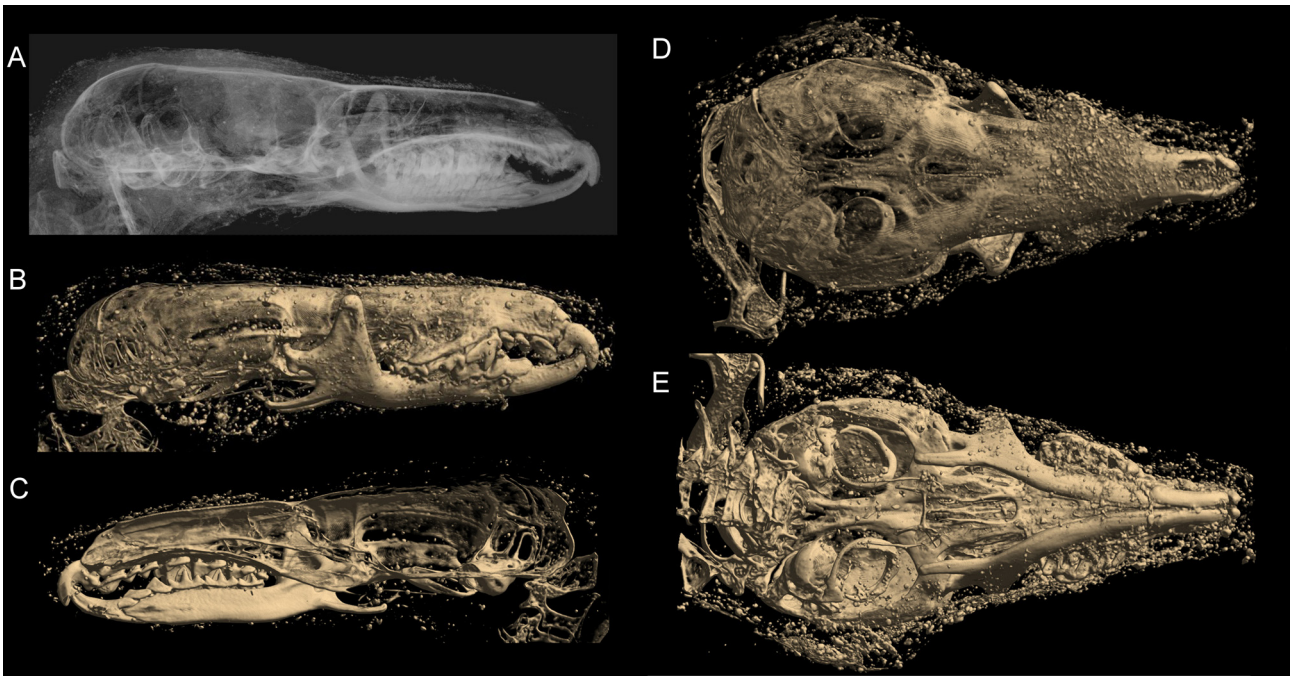

FIGURE 5. X-ray (A) and micro-CT-scans (B-E) of the skull of the lectotype AM 690 of *Sorex religiosus* I. Geoffroy Saint-Hilaire, 1826 (GLS 15.3 mm): A, B, lateral views; C, sagittal cross section: D, dorsal view; E, ventral view. See the interactive 3D scan in Fig. S2.

FIGURE 6. *Crocidura religiosa*, as seen by the Victorian artist P.J. Smit. Detail from plate 23 in Anderson & de Winton (1902).

Taxonomic summary

Crocidura religiosa (I. Geoffroy-Saint Hilaire, 1826)

Sorex religiosus I. Geoffroy Saint-Hilaire, 1826; 1827a, b, 1831; Fischer, 1829; Lichtenstein, 1829; Ehrenberg, 1835; Partington, 1837; Wagner, 1841; Knight, 1843; Smedley *et al.,* 1845.

Crocidura religiosa: Fitzinger, 1868; de Winton, 1902; Cabrera, 1925; Flower, 1932; Setzer, 1957; Bodenheimer, 1960; Hoogstraal, 1962; Heim de Balsac & Meester, 1971; Gureev, 1971, 1979; Hutterer *et al.,* 1982; Hutterer, 1993, 2005; Wolsan & Hutterer, 1998; Grimmberger *et al.,* 2009; Aulagnier et al., 2009, Happold, 2013.

Crocidura nana (not of Dobson, 1890): Heim de Balsac & Verschuren, 1968; Heim de Balsac & Mein, 1971; Osborn & Helmy, 1980; Le Berre, 1990; Hoath, 2003; Ikram, 2005a.

Lectotype. ÄM 690, complete embalmed mummy (Figs. 3, 4, 5, 7, 8, S2), acquired by J. Passalacqua in 1823; collector and preparator unknown.

Type locality. Specimen recovered from: Egypt, Qena Governorate, near Thebes, western bank of the Nile River, necropolis Dra′ Abu el-Naga′ (25°44’07”N, 32°37’14”E), tomb of Queen Mentuhotep. The exact source of the preserved specimen is unknown, but presumed to be from the vicinity of Thebes.

Diagnosis. Small and greyish-brown *Crocidura* with paler underparts and limbs. Fur short and silky. Tail thick at base and covered with long bristle-like hairs over most of its length. Head and body length 54 mm, tail 26-40 mm, hindfoot short (8–10 mm s.u., 9–11 mm c.u.). Skull short (GLS 14.4-16.1 mm, Table 1) and slender; braincase flat and dorsal profile straight. Upper toothrow (I1-M3) 5.9-6.8 mm, height of coronoid process (COR) 3.0-3.7 mm. Dentition not specialized. First upper incisor robust, but of medium size (Figs. 3, 5, S2). Upper unicuspid teeth with well-developed cinguli. Upper premolar (P4) with a short parastyle. M1 and M2 with well-separated protocone and hypocone. Upper third molar small. Cutting surface of lower incisor smooth.

Description of the lectotype. Specimen ÄM 690 is fully preserved and embalmed (Fig. 4A). The cover of resin and other preservatives obscures the colour of the fur and longer bristles. Head and body length is 46 mm, tail length 28 mm (61% of head and body length), and hind foot length 8 mm. An X-ray image of the body (Fig. 4B) shows that the skeleton is complete. The age of the specimen based on suture fusion and tooth wear is young adult. The skull (Figs. 3, 5, S2) is short (GLS 15.3 mm) and slender with a flat dorsal profile. The rostrum is long (PL 6.0 mm) and narrow (MB 4.8 mm), and the interorbital region is comparatively long and narrow (IO 3.2 mm). The braincase is long and wide (BB 6.8 mm). Lambdoid crests are developed. The mandible is short and robust (COR 3.6 mm), with a slender angular process. Length of the upper toothrow (I1-M3) is 6.2 mm. The first upper incisor is robust with a long anterior hook and a pronounced secondary cusp (Figs. 3, 5). There are three pairs of unicuspid teeth, the first one largest, the followed posteriorly by two that are subequal in size. Cinguli on the unicuspids are well pronounced. The upper premolar (P4) has a short parastyle. M1 and M2 are almost equal in size, and the protocone and hypocone on these teeth are clearly separated. The cutting surface of the lower incisor is smooth.

We provide an interactive 3D scan of the skull of the lectotype online in the Supplementary material (Fig. S2).

Paralectotypes. We consider all of the 17 surviving specimens of small shrews as part of the original type series of *S. religiosus* I. Geoffroy Saint-Hilaire, 1826a. However, two specimens belong to a different species and must be excluded. Of the 15 remaining specimens identified as *C. religiosa* based on external measurements (Table 3), we were able to examine only four in detail using micro-CT-scans and high resolution X-rays (Table 4). We therefore propose to regard only specimens ÄM 688, 7051, 7056 as paralectotypes until such time that the remaining specimens also can be examined in detail.

Distribution. Today, *C. religiosa* is confined to the Upper Nile valley and delta (Fig. 1). Its current population status is unknown (Hutterer *et al.,* 2008; Happold, 2013). The most recently reported collection dates from 1988 (Handwerk, 1990). A possible Pleistocene record from Bir Tarfawi indicates the species also may have occurred in southern Egypt at that time, but the identity of the fossil fragments needs to be confirmed (Kowalski *et al.,* 1989; Butler, 1998).

Vernacular name. We propose to use "Sacred Shrew" as the English common name for this small species. The name coined for it by I. Geoffroy Saint-Hilaire (1826: 294–295) is “musaraigne sacrée,” first translated into English by Partington (1837) and subsequently used by Smedley *et al.* (1845), Reichenbach (1852: "Heilige Spitzmaus"), Fitzinger (1868), Bodenheimer (1960), and Woodman (2015). “Egyptian Pigmy Shrew” has been used by Le Berre, 1990, Wolsan & Hutterer (1998), Wilson & Cole (2000), Hutterer (2005), Aulagnier *et al*. (2008), and Happold (2013), while Osborn & Helmy (1980), Osborn & Osbornová (1998), and Hoath (2003) used “Dwarf Shrew.”

TABLE 4. Cranial measurements (mm) of 6 selected specimens of Passalacqua's shrews based on X-ray (XR) and micro-CT-scan (CT). Abbreviations of measurements as in Table 1.

Catalog number	XR CT	GLS	MB	BB	PL	IO	I1-M3	LMA	COR	ID
ÄM 690	XR	15.2	-	-	-	-	6.4	-	3.1	*C. religiosa*
	CT	15.3	4.8	6.8	6	3.2	6.2	4.7	3.6	
ÄM 688	XR	15.4	-	-	-	-	6.2	-	3	*C. religiosa*
	CT	15.2	4.5	7.1	5.9	3.3	6.1	5.2	3.4	
ÄM 7051	XR	15.6	-	7.1	-	3.6	6.3	-	3.5	*C. religiosa*
	CT	16.6	4.6	6.9	6.1	3.5	6.5	5.1	3.2	
ÄM 7056	XR	15.6	4.8	7.5	5.7	3.5	6.5	4.9	3.7	*C. religiosa*
	CT	16.1	4.6	7.2	6.2	3.3	6.5	4.8	3.2	
ÄM 697	XR	14.1	-	-	-	-	5.6	-	3	*C. pasha*
	CT	13.7	4	6.2	5.4	3	5.6	3.5	2.8	
ÄM 7089	XR	14.1	-	-	-	-	6.2	-	-	*C. pasha*
	CT	13.3	3.7	5.5	5.6	2.8	6.1	3.9	2.4	

Illustrations. No photograph of a live *C. religiosa* exists. The best approximation of the appearance of the living shrew is a colour plate by the Victorian artist Pierre Jacques Smit (1863–1960; Schoonraad, 1964), which shows the silky greyish-brown pelage, pale (whitish) limbs, and the thick and hairy tail (Fig. 6). Other drawings in Le Berre (1990) and Aulagnier *et al.* (2009) show the dorsal fur as too pale and are less likely to represent the natural colors.

Condition and Mummification of Passalacqua's shrews

According to I. Geoffroy Saint-Hilaire (1827a: 324, 327–328; 1827b: 130–132, 141–142), Passalacqua's notes indicated that he had discovered the mummified shrews in the necropolis at Thebes, where they were mixed with the embalmed remains of other animals, including a scarab beetle, toads, a small snake, a small falcon, and some swallows. A note in the published catalog of the Königliche Museen Collection appears to describe this collection of remains (Generalverwaltung Königliche Museen zu Berlin, 1899: 317):

> Vögel, Mäuse, Kröten, Schlangen, Käfer, 55 an der Zahl, zusammen eingewickelt und in einem Tiergrabe Thebens als eine Mumie beigesetzt. Es sind 16 Schwalben—1 Ziegenmelker (7065)—29 kleine Spitzmäuse, crocidura religiosa—2 grössere, crocidura crassicauda—3 grüne Kröten—1 Teichfrosch (7059)—eine Schlange (Brillenschlange?)—ein Mistkäfer (Skarabaeus) und ein anderer Käfer (Buprestide). Vermutlich sollten sie den dort beigesetzten Tieren als Nahrung dienen.
>
> [Birds, mice, toads, snakes, beetles, 55 in number, wrapped together and buried in an animal tomb of Thebes as a mummy. There are 16 swallows — 1 nightjar (7065) — 29 small shrews, Crocidura religiosa — 2 larger ones, Crocidura crassicaudata — 3 large toads — 1 frog (7059) — one snake (cobra?) — one dung beetle (Scarabaeus) and another beetle (Buprestidae). Presumably they were meant to serve as food for the buried animals.]

The total of 31 shrews listed here may be a misprint (Generalverwaltung Königliche Museen zu Berlin, 1899: 137). Alternatively, at least three of the surviving specimens are broken in half, and an inflated number may have resulted from counting the pieces rather than the individual shrews. This would also then indicate that those specimens already were broken when they were cataloged into the collection.

Unlike stereotypical Egyptian animal mummies, none of these animals was individually wrapped in cloth strips. Each was covered in a "croûte bitumineuse" [bituminous crust], which was presumed to have been a preservative used in the embalming process. I. Geoffroy Saint-Hilaire (1827a; 1827b) noted a similarity with mummified shrew remains discovered earlier at "Acquisir" near Memphis by the French naturalist Guillaume Antoine Olivier (1807: 164–166). In that case, however, broken up remains of at least seven shrews, covered in resin and mixed with eggshell fragments, a handful of grass seeds, and the head of a mouse, were wrapped together within a single bundle that was made up to resemble the mummy of an ibis [*Threskiornis aethiopicus* (Latham, 1790)]. Other bundles, typically 25–30 cm in diameter by 15 cm in breadth and containing 50–75 shrews, as well as other animals, were reported by Lortet & Gaillard (1909) from Akhmim and examined by one of us (RH) in Lyon. They were wrapped with linen and firmly fixed with black, tar-like resin. In such wrapped mummies, the body is typically extended, and the extremities lie parallel to the body's long axis (e.g., McKnight *et al.*, 2015). The positioning of the extremities of the Passalacqua shrew mummies coupled with evidence from the micro-CT scans, however, suggests that these specimens were processed in a different manner.

Today, the Passalacqua shrews still retain a thin coating of resin—"croûte bitumineuse"—and are brittle. Optical cross sections of CT-scans of the shrews' skulls show a fairly homogenous crust of resin, covered on the surface by a thin layer of small globular particles with a density similar to that of bone (Fig. 7). These particles are rounded and typically have diameters of about 1 mm (mean: 0.9, median: 1.75, range: 0.5–3.0 mm; $n = 100$). We have not yet had the opportunity to determine the chemical composition of the particles, but they may be limestone, natron (a powdered mixture of hydrated sodium carbonate, sodium bicarbonate, and other compounds), or some other mineral.

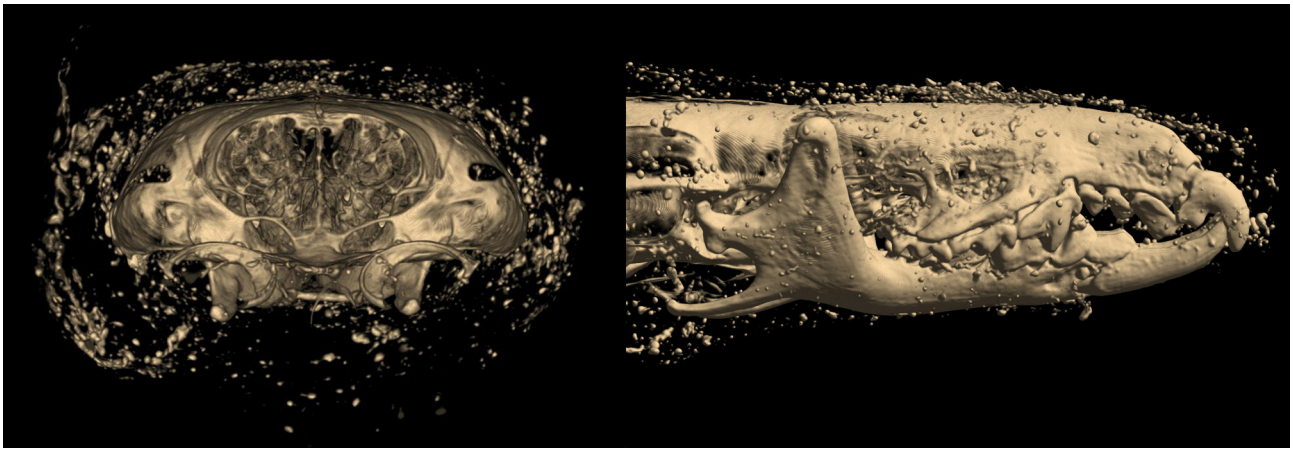

FIGURE 7. Micro-CT-scans of a cross section through the head and the lateral view of the skull of an embalmed shrew (ÄM 690) from the Passalacqua Collection. The skull is surrounded by dry tissue and mineral dust. Width of bony braincase is 6.8 mm. Please see interactive 3D scan in Fig. S2.

The fragile limbs, tails, and ears are present in most specimens, but the ears, whiskers, and tail vibrissae generally are embedded in the resin and no longer visible (Fig. S1). The good preservation and the extended positions of the limbs and tails of the shrews away from their bodies (Figs. 2, 4) is consistent with their never having been firmly wrapped individually. They appear to simply have been treated with resin, covered with mineral powder, and desiccated. Close inspection of the X-rays revealed that twelve out of nineteen shrews (63%) show some damage to the skeleton (Table 3; Fig. 8). In three specimens, the lumbar portion of the vertebral column is either distorted or completely severed (today, three specimens are in two pieces each), in four specimens the thoracic vertebrae are distorted or broken (Fig. 8 A, B), in four specimens the cervical vertebrae are broken, and in at least six specimens the braincase is crushed (Fig. 8 C, D). The twisted vertebrae, necks, and heads of the shrews probably resulted from drying and are further evidence that they were not wrapped. In one specimen a rib and part of the body were cut, perhaps as a result of opening the belly to remove organs or to hasten drying.

Discussion

We show that the type series of *Sorex religious* was not lost, but was transferred from Paris to Berlin, a fact published soon after (Hunt, 1827; Lichtenstein, 1829), but forgotten nearly a century and a half later. Consequently, the neotype designation of Corbet (1978) is set aside and a lectotype selected from the syntypes. Modern techniques such as high resolution X-ray and micro-CT-scan allow us to document and measure skulls and other skeletal elements, and our study based on these techniques supports the conclusion of de Winton (1902), Flower (1932), Setzer (1957), Corbet (1978), and other authors that the extant shrew called *C. religiosa* is fully consistent with its mummified counterpart from ancient Egypt.

Our study revealed that the type series of *C. religiosa* is not homogenous, but contains two specimens of a smaller shrew that we identify as *C. pasha*, a species not known to occur in Egypt today. This interesting new record demonstrates that the diversity among the embalmed shrews is higher than previously realized. Archaeological collections such as the one we studied are a valuable resource for zoogeographical and palaeoclimatical studies (Hutterer, 1994; Evans, 2015). Only three large collections of embalmed shrews have been studied in detail (Table 5). These mummies document the existence of seven species of shrews among the fauna of ancient Egypt, three of which are now either extinct or have been extirpated from modern Egypt. The three shrew assemblages differ considerably in age: Thebes is about 3500 years old, Akhmim about 2500 years, and Tuna-el-Gebel about 1500 years (Table 5). Temporal and geographical differences may explain some of the variation in their species spectra, but cultural causes must be considered as well. There is no agreement as to whether the animals used to manufacture mummies were taken from the wild locally, collected at distant locations and transported to burial sites, or bred in animal husbandries (Fitzenreiter, 2003). Necropoli containing millions of mummified ibises, birds of prey, dogs, or cats may support the latter (Ikram, 2005a; Kessler & Nur el-Din, 2005; Zivie & Lichtenberg, 2005; Ikram, 2015). Captive maintenance of shrews was known at least by the time of Pliny (23–79 CE; see Plinius Secundus, 1942: Book viii.82.224) and may have begun earlier. A breeding colony of shrews, however, would be expected to produce a large number of individuals of a single species, in contrast with the multiple species that have been documented as mummies at individual sites (Heim de Balsac & Mein, 1971; Hutterer, 1994; this study). Most of these species (except for three) occur in the region of the Nile Delta today (Osborn & Helmy, 1980), which makes it more likely that mummified shrews found in that area were obtained locally. One possibility is that domestic cats collected the shrews opportunistically. Cats often take shrews and other prey alive, typically they do not eat shrews, and often deliver them whole to a human keeper. This would also explain why the frequency of species in the mummy assemblages (Table 5) approximates the abundances of the three shrew species occurring in the lower Nile valley where *C. olivieri* and *C. religiosa* are common and *C. floweri* is rare (Setzer, 1957; Hoogstraal, 1962; Osborn & Helmy, 1980; Saleh & Hutterer, 2008).

TABLE 5. Summary of zoological studies of three larger shrew assemblages from ancient Egypt (Heim de Balsac & Mein, 1971; Hutterer, 1994; I. Geoffroy Saint-Hilaire, 1827a, b; Kessler, 2007; and present study).

SITE:	Thebes, tomb of Queen Mentuhotep	Akhmim	Tuna-el-Gebel
Age	c. 1630–1539 BC [1]	530 ±186 cal BC [2]	c. 550–100AD[3]
N	19 (26)	50	78
C. religiosa	15 (22)	9	15
C.olivieri	2	26	38
C. floweri	0 (2)	3	0
C. balsamifera	0	3	0
C. pasha	2	0	0
C. fulvastra	0	2	0
C. indet	0	0	25
S. etruscus	0	7	0

[1] Rice (1999), Grajetzki (2005); [2] Radiocarbon Laboratory of University Lyon, in Heim de Balsac & Mein (1971), calibrated with CalPal (Weninger & Jöris, 2008); [3] Kessler (2007), nomenclature corrected.

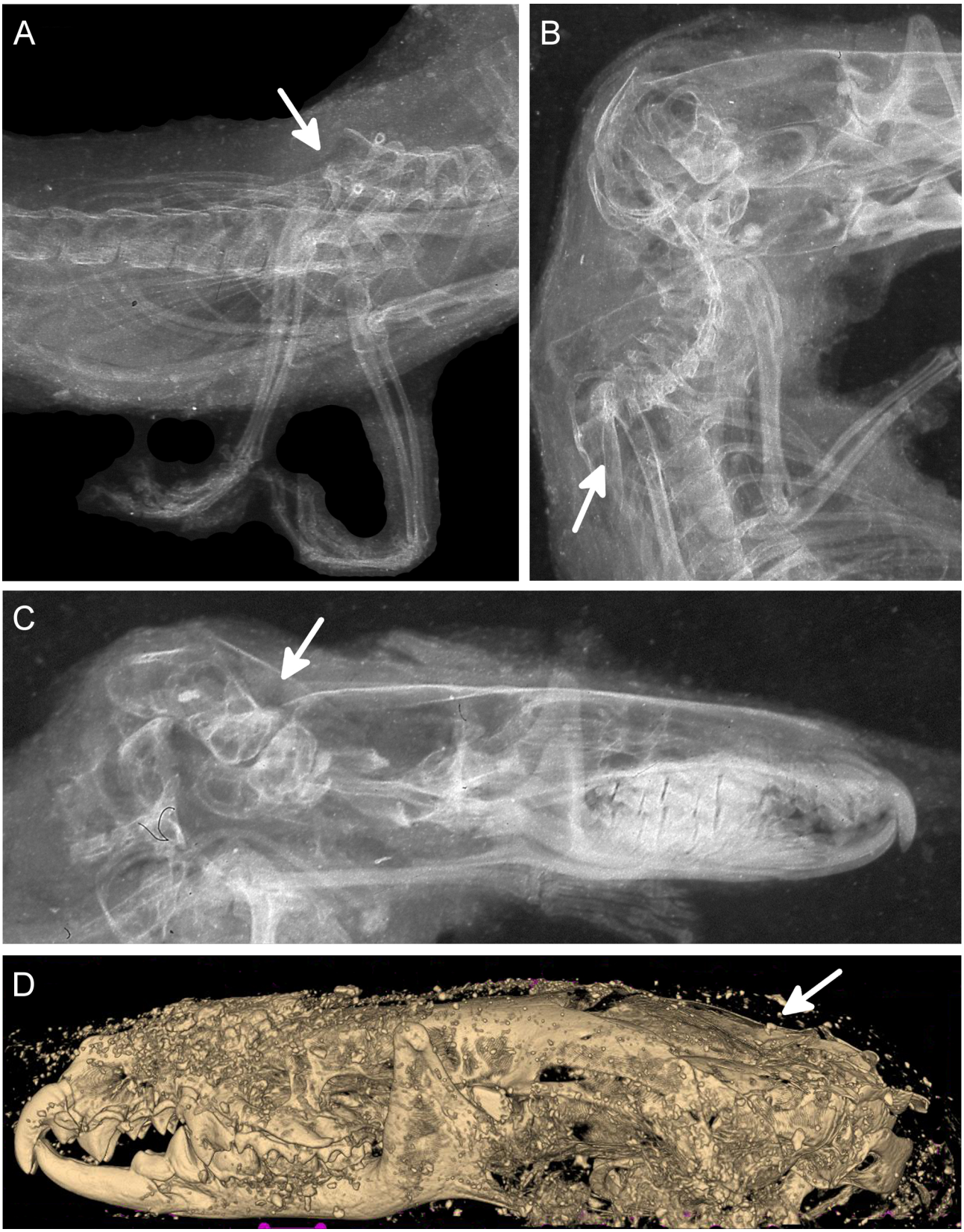

FIGURE 8. Taphonomic features of the Passalacqua shrew mummies. A, distorted thoracic vertebrae of ÄM 690; B, distorted thoracic vertebrae of ÄM 7050; C, broken braincase of ÄM 7055; D, broken braincase of ÄM 7051. X-rays (A-C) and Micro-CT-scan (D).

The taphonomy of the shrew mummies from Passalacqua's Collection holds promise for providing additional information on mummification practices as well as contributing to our understanding of the fauna of ancient Egypt. Ikram (2005b, c) studied the technology of mummification in ancient Egypt and documented some of the known practices for embalming animals. Animal bodies were often eviscerated (sometimes through a cut into the abdomen), injected with turpentine (causing maceration of the viscera and collapse of the skeletal articulation), desiccated using natron, and eventually wrapped in strips of linen. In the case of shrews, several individuals might be treated with resin and wrapped together into a single large bundle, often with other small vertebrates, insects, and other organisms (Lortet & Gaillard, 1903, 1909; Heim de Balsac & Mein, 1971; Ikram, 2005c). In other instances, a single shrew was wrapped in linen and placed in a wood, stone, or bronze coffin, which was sometimes painted or decorated with a shrew sculpture on top (Ikram, 2005d). Such small coffins are found in many art museum collections around the world, but, unfortunately, their contents are rarely retained and their provenances rarely recorded (Brunner-Traut, 1965; Hutterer, 1994; Osborn & Osbornová, 1998; Ikram, 2005a, d; Kessler, 2007).

The Passalacqua shrews were preserved in a different way. First, rather than being wrapped in cloth, they were treated with resin and subsequently dried in mineral powder (Fig. 7). Second, most of the skeletons are still fully articulated, including the fragile limbs and tails (Figs. 2, 4). Fore and hind feet are not folded or oriented in line with the body, as would be expected for a wrapped mummy, but remain in a more natural position, although tails and necks are often bent, as is typical for dried carcasses. There are, however, traumatic fractures of the skeleton, including dislocated vertebrae (Fig. 8 A, B), broken skulls (Fig. 8 C, D), and cut ribs. Whether this damage was caused by predators (cats?) or during processing is difficult to say. No canine punctures, a typical result of predation, are visible. The skulls are crushed in the dorsal braincase region, and the vertebrae are distorted in the thoracic or the cervical region. Armitage and Clutton-Brock (1981) and Zivie & Lichtenberg (2005) found cranial fractures and dislocated vertebrae in a large number of mummified cats from the Saqqara necropolis that they interpreted as causes of death. The congruence between their study on cats and our study on shrews is suggestive. There is still much about funerary practices and the role of shrews in the society of ancient Egyptians that can be learned from the abundant archaeological remains still in Egypt and residing in museums around the world. These collections also have more to tell us about the faunal diversity and the temporal changes that occurred in the Nile valley over the past several thousand years.

Acknowledgments

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Literature cited

Ägyptisches Museum und Papyrussammlung (2015) Available from: http://www.smb.museum/en/museums-and-institutions/aegyptisches-museum-und-papyrussammlung/home.html (accessed 18 August 2015)

Anderson, J. & de Winton, W.E. (Eds.) (1902) *Zoology of Egypt: Mammalia.* Hugh Rees, London, 347 pp.

Armitage, P.L. & Clutton-Brock, J. (1981) A radiological and histological investigation into the mummification of cats from Ancient Egypt. *Journal of Archaeological Science*, 8, 185–196. https://doi.org/10.1016/0305-4403(81)90023-6

Aulagnier, S., Haffner, P., Mitchell-Jones, A.J., Moutou, F. & Zima, J. (2009) Mammals of Europe, North Africa and the Middle East. A&C Black Publishers, London, 272 pp.

Bate, D.M.A. (1937) New Pleistocene mammals from Palestine. *Annals and Magazine of Natural History*, Series 10, 20 (117),

397–400.
Bodenheimer, F.S. (1960) *Animal and Man in Bible Land*. E.J. Brill, Leiden, 235 pp.
Boessneck, J. (1988) *Die Tierwelt des Alten Ägypten untersucht anhand kulturgeschichtlicher und zoologischer Quellen*. C.H. Beck, München, 197 pp.
Bonhote, J.L. (1909) On a small collection of mammals from Egypt. *Proceedings of the Zoological Society of London*, 79, 788–802.
https://doi.org/10.1111/j.1469-7998.1910.tb06973.x
Bonhote, J.L. (1912) 1912. On a further collection of mammals from Egypt and Sinai. *Proceedings of the Zoological Society London*, 1912 (1), 224–231.
Brunner-Traut, E. (1965) Spitzmaus und Ichneumon als Tiere des Sonnengottes. *Nachrichten der Akademie der Wissenschaften in Göttingen I. Philologisch-Historische Klasse*, 7, 123–163.
Butler, P. (1998) Fossil history of shrews in Africa. *In*: Wójcik, J.M. & Wolsan, M. (Eds.), *Evolution of shrews*. Mammal Research Institute, Polish Academy of Sciences, Bialowieza, pp. 121–132.
Cabrera, A. (1925) *Genera mammalium, Insectivora, Galeopithecia*. Museo Nacional de Ciencias Naturales, Madrid, 232 pp., 18 pls.
Churchfield, S. & Jenkins, P.D. (2013a) *Crocidura nana* Somali Dwarf Shrew. *In*: Happold, M. & Happold, D.C.D. (Eds.), *Mammals of Africa. Vol. 4. Hedgehogs, shrews and bats*. Bloomsbury Publishing, London, pp. 111.
Churchfield, S. & Jenkins, P.D. (2013b) *Crocidura pasha* Sahelian Tiny Shrew. *In*: Happold, M. & Happold, D.C.D. (Eds.), *Mammals of Africa. Vol. 4. Hedgehogs, shrews and bats*. Bloomsbury Publishing, London, pp. 121.
Corbet, G.B. (1978) *The mammals of the Palaearctic Region: a taxonomic review.* British Museum (Natural History), London, 314 pp.
de Winton, W.E. (1898) A new species of shrew from Ashantee. *Annals and Magazine of Natural History*, Series 7, 2, 484–485.
https://doi.org/10.1080/00222939808678524
de Winton, W.E. (1902) Soricidae. *In*: Anderson, J. & de Winton, W.E. (Eds.), *Zoology of Egypt: Mammalia.* Hugh Rees, London, pp. 166–170, pl. 23.
Dobson, G.E. (1890) Description of a new species of *Crocidura* from Africa. *Annals and Magazine of Natural History*, Series 6, 5, 225.
Dollman, G. (1915) On the African shrews belonging to the genus *Crocidura*-VI. *Annals and Magazine of Natural History*, Series 8, 15, 517.
Dollman, G. (1916) On the African shrews belonging to the genus *Crocidura*-VII. *Annals and Magazine of Natural History*, Series 8, 17, 188–209.
Ehrenberg, H. (1835) Über den *Cynocephalus* der Ägyptier nebst einigen Betrachtungen über die ägyptische Mythe des Thot und Sphinx vom naturhistorischen Standpunkte. *Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin*, 1833, 337–367, 4 pls.
Evans, L. (2015) Ancient Egypt's fluctuating fauna: Ecological events or cultural constructs? *Proceedings of the National Academy of Sciences*, 112, 1–239. [E239]
Fielding, J. (1826) Varieties. *European Magazine, and London Review*, 2 (6), 538–542.
Fischer, J.G. (1829) *Synopsis mammalium*. J.G. Cotta, Stuttgart, 527 pp.
Fitzenreiter, M. (Ed.) (2003) *Tierkulte im pharaonischen Ägypten und im Kulturvergleich*, IBAES IV, Berlin.
Available from: http://www2.rz.hu-berlin.de/nilus/net-publications/ibaes4/publikation/tierkulte.pdf (accessed 15 March 2017).
Fitzinger, L.J. (1868) Kritische Untersuchungen über die natürliche Familie der Spitzmäuse (Sorices) angehörigen Arten. *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften,* I. Abtheilung, 57 (Feb.), 1–90.
Flower, S.S. (1932) Notes on the recent mammals of Egypt, with a list of the species recorded from that Kingdom. *Proceedings of the Zoological Society of London*, 1932 (2), 369–450.
https://doi.org/10.1111/j.1096-3642.1932.tb01081.x
Generalverwaltung Königliche Museen zu Berlin (1899) *Ausführliches Verzeichnis der Egyptischen Altertümer und Gipsabgüsse. Zweite völlig umgearbeitete Auflage*. W. Spemann, Berlin, 519 pp.
Geoffroy Saint-Hilaire, É. (1811) Mémoire sur les espèces des genres *Musaraigne* et *Mygale*. *Annales di Muséum d'Histoire Naturelle*, 17, 169–194.
Geoffroy Saint-Hilaire, É. (1826) Communication faite à l'Académie royale des Sciences, dans sa séance du 9 janvier 1826. *In*: Passalacqua, J. (Ed.), *Catalogue raisonné et historique des Antiquités découvertes en Égypte.* La Galerie d'Antiquités Égyptiennes, Paris, pp. 231–236.
Geoffroy Saint-Hilaire, I. (1826) Footnote. *In*: Passalacqua, J. (Ed.), *Catalogue raisonné et historique des Antiquités découvertes en Égypte*. La Galerie d'Antiquités Égyptiennes, Paris, pp. 294–295.
Geoffroy Saint-Hilaire, I. (1827a) Musaraigne. *Sorex*. *In*: Bory de Saint-Vincent, M. (Ed), *Dictionnaire Classique d'Histoire Naturelle. Vol. 11*. Rey & Gravier & Baudouin Brothers, Paris, pp. 313–329.
Geoffroy Saint-Hilaire, I. (1827b) Mémoire sur quelques espèces nouvelles ou peu connues de genre musaraigne. *Mémoires du Muséum d'Histoire Naturelle*, 15, 117–144, pl. 4.
Geoffroy Saint-Hilaire, I. (1831) Mammifères. In: *Bélanger, C., Voyage aux Indes-orientales, par le nord de l'Europe, les provinces du Caucase, La Géorgie, l'Arménie et la Perse, suivi de détails topographiques, statistiques et autres sur le*

Pégou, les Iles de Java, de Maurice et de Bourbon, sur le Cap-de-Bonne-Espérance et Sainte-Hélène, pendant les années 1825, 1826, 1827, 1828 et 1829. Vol. 1. Arthus Bertrand, Paris, pp. 3–160.
Grajetzki, W. (2005) *Ancient Egyptian queens*. Golden House Publications, London, 121 pp.
Grimmberger, E., Rudloff, K. & Kern, C. (2009) *Atlas der Säugetiere Europas, Nordafrikas und Vorderasiens*. Natur und Tier-Verlag, Münster, 495 pp.
Gureev, A.A. (1971) *Zemleroiki (Soricidae) fauny mira. [Shrew (Soricidae) fauna of the world]*. Nauka, Leningrad, 252 pp.
Gureev, A.A. (1979) *Nasekomoyadnie (Mammalia, Insectivora). Fauna SSSR, Mlekopitayushchie*. *4 (2)*. Nauka, Leningrad, 502 pp.
Handwerk, J. (1990) Die Waldohreule (*Asio otus*) in Ägypten. *Bonner zoologische Beiträge*, 41, 171–179.
Handwerk, J. (1998) *Zur Oekologie von Prädatoren (Mammalia, Aves, Serpentes) und deren Wirkung auf die Populationen von* Mus musculus praetextus *Brants, 1827, und* Arvicanthis niloticus *Desmarest, 1822, im Niltal Ägyptens.* Unpublished PhD, Rheinische Friedrich-Wilhelms-Universität, Bonn, 321 pp.
Happold, D.C.D. (2013) *Crocidura religiosa* Egyptian Pygmy Shrew. *In*: Happold, M. & Happold, D.C.D. (Eds.), *Mammals of Africa. Vol. 4. Hedgehogs, shrews and bats*. Bloomsbury Publishing, London, pp. 127–128.
Heim de Balsac, H. & Meester, J. (1971) Part 1, Order Insectivora. *In*: Meester, J. & Setzer, H.M. (Eds.), *The mammals of Africa. An identification manual*. Smithsonian Institution Press, Washington, D.C., pp. 1–29.
Heim de Balsac, H. & Mein, P. (1971) Les musaraignes momifiées des hypogées de Thèbes. Existence d'un metalophe chez les *Crocidurinae* (*sensu* Repenning). *Mammalia*, 35, 220–244.
https://doi.org/10.1515/mamm.1971.35.2.220
Heim de Balsac, H. & J. Verschuren. (1968) Exploration du Parc National de la Garamba: Insectivores. *Parc National de la Garamba, Mission H. de Saeger, Kinshasa*, 54, 1–50, 3 pls.
Hoogstraal, H. (1962) A brief review of the contemporary land mammals of Egypt (including Sinai), 1: Insectivora and Chiroptera. *The Journal of the Egyptian Public Health Association*, 37 (4), 143–162.
Hoath, R. (2003) *A field guide to the mammals of Egypt*. The American University in Cairo Press, Cairo & New York, 236 pp.
Hunt, L. (1827) Newspaper Chat. *The Examiner, London*, 1016 (July), 456–457.
Hutterer, R. (1984) Status of some African *Crocidura* described by Isidore Geoffroy Saint-Hilaire, Carl J. Sundevall and Theodor von Heuglin. *Annales Musée Royal de l'Afrique Centrale, Sciences zoologiques*, 237, 207–217.
Hutterer, R. (1993). Order Insectivora. *In:* Wilson, D.E. & Reeder, D.M. (Eds.), *Mammal Species of the World*, *Second Edition*. Smithsonian Institution Press, Washington, D.C., pp. 69–130.
Hutterer, R. (1994) Shrews of ancient Egypt: Biogeographical interpretation of a new species. *In*: Merritt, J.F., Kirkland Jr., G.L. & Rose, R.K. (Eds.), Advances in the Biology of Shrews. *Carnegie Museum of Natural History Special Publication*, 18, pp. 407–414.
Hutterer, R. (2005) Order Soricomorpha. *In*: Wilson, D.E. & Reeder, D.M. (Eds.), *Mammal species of the world: a taxonomic and geographic reference. 3rd Edition.* The Johns Hopkins University Press, Baltimore, Maryland, pp. 220–311.
Hutterer, R. & Harrison, D.L. (1988) A new look at the shrews (Soricidae) of Arabia. *Bonner zoologische Beiträge*, 39, 59–71.
Hutterer, R. & Kock, D. (1983) Spitzmäuse aus den Nuba-Bergen Kordofans, Sudan (Mammalia: Soricidae). *Senckenbergiana biologia*, 63, 17–26.
Hutterer, R. & Kock, D. (2002) Recent and ancient records of shrews from Syria, with notes on *Crocidura katinka* Bate, 1937 (Mammalia : Soricidae). *Bonner zoologische Beiträge*, 50, 249–258.
Hutterer, R. & Tranier, M. (1990) The immigration of the Asian house shrew (*Suncus murinus*) into Africa and Madagascar. *In*: Peters, G. & Hutterer, R. (Eds.), *Vertebrates in the tropics*. Alexander Koenig Zoological Research Institute and Zoological Museum, Bonn, pp. 309–319.
Hutterer, R., Jones, G.S., Rossolimo, O.L., Van Gelder, R.G. & Wang, S. (1982) Family Soricidae. *In*: Honacki, J.H., Kinman, K.E. & Koeppl, J.W. (Eds.), *Mammal Species of the World, a taxonomic and geographic reference*. Allen Press & Association of Systematics Collections, Lawrence, Kansas, pp. 67–102.
Hutterer, R., Amori, G., Kryštufek, B., Yigit, N., Mitsain, G. & Palomo, L.J. (2008) *Crocidura religiosa*. *In*: The IUCN Red List of Threatened Species 2008: e.T5616A11421345. Available from: https://doi.org/10.2305/IUCN.UK.2008.RLTS.T5616A11421345.en (accessed 5 March 2017)
Ikram, S. (2005a) *Divine creatures: Animal mummies in Ancient Egypt.* American University in Cairo Press, Cairo & New York, 316 pp.
Ikram, S. (2005b) Manufacturing divinity. The technology of mummification. *In*: Ikram, S. (Ed.), *Divine creatures: Animal mummies in Ancient Egypt.* American University in Cairo Press, Cairo & New York, pp. 16–43.
Ikram, S. (2005c) Protective pets and cleaning crocodiles. *In*: Ikram, S. (Ed.), *Divine creatures: Animal mummies in Ancient Egypt.* American University in Cairo Press, Cairo & New York, pp. 207–227.
Ikram, S. (2005d) A moment in miniature: The eternal resting place of a shrew. *In*: Jánosi, P. (Ed.), *Structure and significance: Thoughts on Ancient Egyptian architecture (Festschrift für Dieter Arnold)*. Österreichische Akademie der Wissenschaften. Denkschriften der Gesamtakademie 33, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Instituts 25, Wien, pp. 336–340.
Ikram, S. (2015) Speculations on the role of animal cults in the economy of Ancient Egypt. *In*: Massiera, M., Mathieu, B., and Rouffet, F. (Eds.), *Apprivoiser le sauvage/Taming the Wild (CENiM 11). Vol. 3.* University Paul Valéry Montpellier, Montpellier, pp. 211–228.

International Commission on Zoological Nomenclature. (1999) *International code of zoological nomenclature. 4th Edition*. The International Trust for Zoological Nomenclature, London, 306 pp.

Jacquet, F., Denys, C., Verheyen, E., Bryja, J., Hutterer, R., Kerbis Peterhans, J.C., Stanley, W.T., Goodman, S.M., Couloux, A., Colyn, M. & Nicolas, V. (2015) Phylogeography and evolutionary history of the *Crocidura olivieri* complex (Mammalia, Soricomorpha): from a forest origin to broad ecological expansion across Africa. *BMC Evolutionary Biology*, 15 (71), 1–15.
Doi 10.1186/s 12862-015-0344-y

Kessler, D. (1989) *Die heiligen Tiere und der König. Teil I. Beiträge zur Organisation, Kult und Theologie der spätzeitlichen Tierfriedhöfe. Ägypten und Altes Testament*, 16, 1–303, 10 pls.

Kessler, D. (2007) Spitzmaus, Ichneumon und Ratte im Tierfriedhof. *Bulletin of the Egyptian Museum Cairo*, 4, 71–82.

Kessler, D. & Nur el-Din, A.H. (2005) Tuna al-Gebel. Millions of ibises and other animals. *In*: Ikram, S. (Ed.), *Divine creatures: Animal mummies in Ancient Egypt.* American University in Cairo Press, Cairo & New York, pp. 120–163.

Knight, C. (1843) British shrews. *Penny Magazine of the Society for the Diffusion of Useful Knowledge*, 12, 249–252.

Kowalski, K., van Neer, W., Bochenski, Z., Mlynarski, M,, Rzebik-Kowalska, B., Szyndlar, Z., Gautier, A., Schild, R., Close, A.E. & Wendorf, F. (1989) A last interglacial fauna from the eastern Sahara. *Quaternary Research*, 32, 335–341.
https://doi.org/10.1016/0033-5894(89)90099-9

Le Berre, M. (1990) *Faune du Sahara 2 Mammifères*. R. Chabaud, Lechvalier, 360 pp.

Lesson, R.P. (1827) *Manuel de mammalogie, ou histoire naturelle des mammifères*. Roret, Paris, 442 pp.

Lichtenstein, M.K.H. (1829) Ueber die afrikanischen und asiatischen Arten der Gattung *Sorex*. *Verhandlungen der Gesellschaft naturforschender Freunde zu Berlin*, 1 (6), 381–388.

Linnaeus, C. (1758) *Systema Naturae per regna tria naturae, secundum classis, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Vol. 1. 10th Edition*. Laurentii Salvii, Stockholm, 824 pp.

Linnaeus, C. (1766) *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio duodecima, reformata*. *Vol. 1*. Laurentii Salvii, Stockholm, 532 pp.

Lortet, L. & Gaillard, C. (1903) La faune momifiée de l'ancienne Égypte. *Archives du Muséum d'histoire naturelle de Lyon*, 8 (2), i–viii, 1–206.

Lortet, L. & Gaillard, C. (1909) La faune momifiée de l'ancienne Égypte et recherches anthropologiques. *Archives du Muséum d'histoire naturelle de Lyon*, 10 (2), 1–336.

Lurker, M. (1974) *Götter und Symbole der alten Ägypter*. Scherz, Bern and Munich, 220 pp.

McKnight, L.M., Atherton-Woolham, S.D. & Adams, J.E. (2015) Imaging of ancient Egyptian shrew mummies. *Radiographics*, 35, 2108–2120.
https://doi.org/10.1148/rg.2015140309

Olivier, G.A. (1807) *Voyage dans l'empire Othoman, l'Egypte et la Perse. Vol. 3*. H. Agasse, Paris, 432 pp.

Osborn, D.J. & Helmy, I. (1980) The contemporary land mammals of Egypt (including Sinai). *Fieldiana: Zoology*, New Series, 5, 1–579.

Osborn, D.J. & Osbornová, J. (1998) *The mammals of Ancient Egypt. The natural history of Egypt. Vol 4.* Aris & Phillips Ltd., Warminster, 213 pp.

Partington, C.F. (1837) *The British cyclopaedia of natural history: combining a scientific classification of animals, plants, and minerals; with a popular view of their habits, economy, and structure. Vol. 3*. W.S. Orr & Co, London, 844 pp.

Passalacqua, J. (1826) *Catalogue raisonné et historique des Antiquités découvertes en Égypte*. La Gallerie d'Antiquités Égyptiennes, Paris, 303 pp.

Peters, W.C.H. (1852) *Naturwissenschaftliche Reise nach Mossambique auf Befehl seiner Majestät des Königs Friedrich Wilhelm IV. in den Jahren 1842 bis 1848 ausgeführt. Zoologie. I. Säugethiere*. Georg Reimer, Berlin, 202 pp., 46 pls.

Plinius Secundus, G. (1942) *Natural History. Vol. 3.*. Harvard University Press, Cambridge, 624 pp. [Rackham, H., transl.]

Reichenbach, H.G.L. (1852) *Die vollständigste Naturgeschichte des In- und Auslandes. Die Raubsäugethiere*. Carl Ramming, Dresden & Leipzig, 398 pp.

Rice, M. (1999) *Who's who in ancient Egypt*. Routledge, New York, 257 pp.

Saleh, M. & Hutterer, R. (2008) *Crocidura floweri*. The IUCN Red List of Threatened Species 2008: e.T5600A11403125.
http://dx.doi.org/10.2305/ IUCN.UK.2008.RLTS. T5600A11403125.en

Sammlung Scharf-Gerstenberg (2015) Available from: http://www.smb.museum/en/museums-and-institutions/sammlung-scharf-gerstenberg/home.html (accessed 18 August 2015)

Savi, P. (1822) Osservazioni sopra il Mustietto, o Mustiolo, nuova specie di topo ragno Toscano (*Sorex etruscus* nob.). *Nuovo Giornale de' Letterati*, 1, 60–71.

Schoonraad, M. (1964) Life and work of the Rev. P. J. Smit. *Nature*, 4929, 235–236.
https://doi.org/10.1038/202235a0

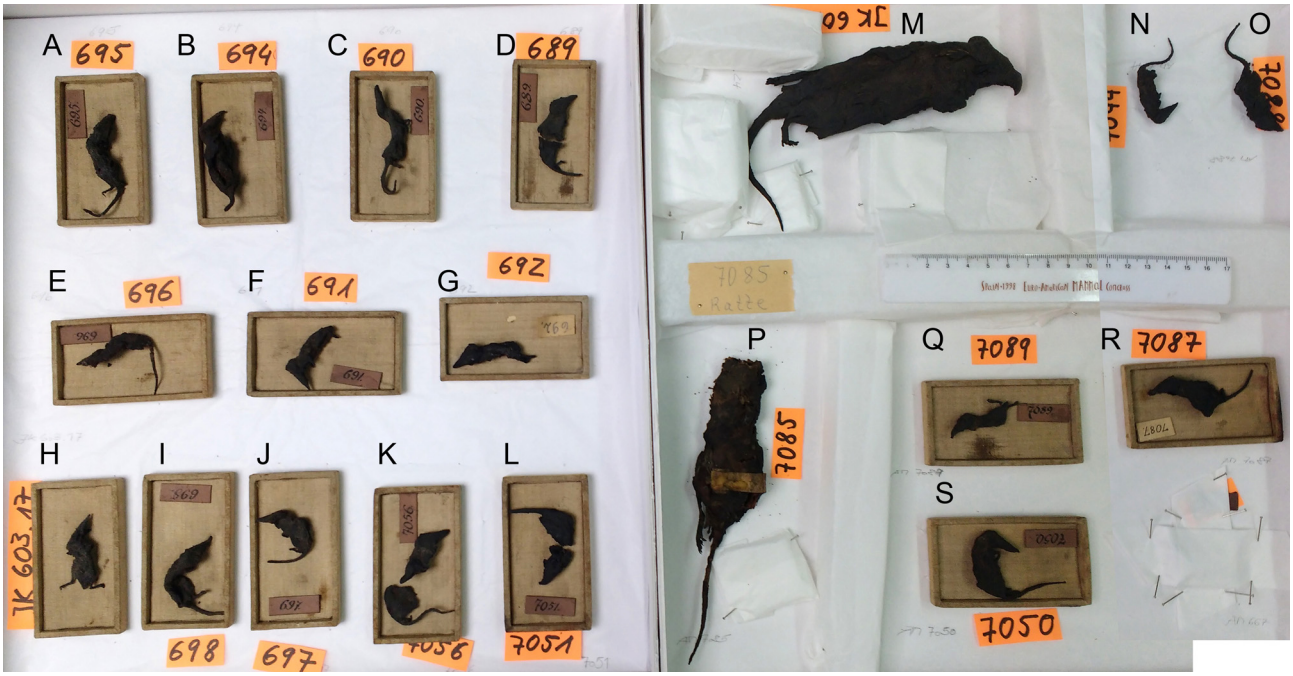
Setzer, H.W. (1957) The hedgehogs and shrews of Egypt. *The Journal of the Egyptian Public Health Association*, 32, 1–17.

Smedley, E., Rose, H.J., Rose, H.J. (1845) *Encyclopaedia metropolitana; or, universal dictionary of knowledge, on an original plan: comprising the twofold advantage of a philosophical and alphabetical arrangement, with appropriate engravings*. *Vol. 24*. Fellowes, B. et al., London, 864 pp.

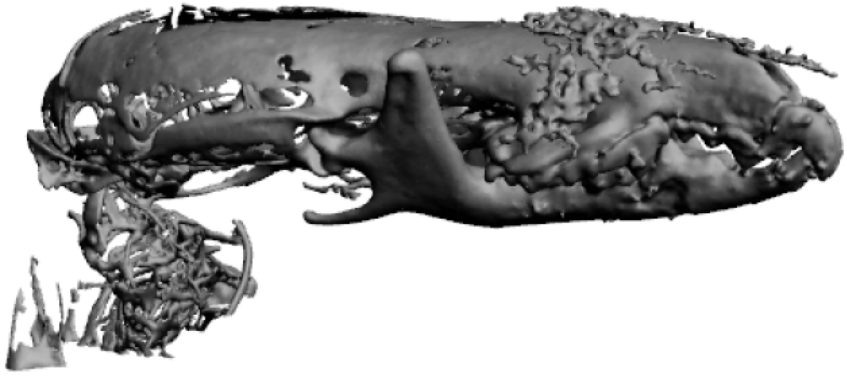
Stanley, W.T., Rogers, M.A., Sentoza, R.B.M., Mturi, F.A., Kihaule, P.M., Moehlman, P.D. & O'Connor, B.M. (2007) Surveys of mammals in Tarangire National Park, Tanzania. *Journal of East African Natural History*, 96, 47–71.

https://doi.org/10.2982/0012-8317(2007)96[47:SOSMIT]2.0.CO;2
Sundevall, C.J. (1843) Om slägtet *Sorex*, med nagra nya arters beskrifning. *Kungliga svenska Vetenskaps-Akademiens Handlingar*, 1842, 163–188.
Thomas, O. (1909) New African small mammals in the British Museum Collection. *Annals and Magazine of Natural History*, Series 8, 4, 98–112.
https://doi.org/10.1080/00222930908692647
Thompson, J. (2015) *Wonderful things: a history of Egyptology 1: from antiquity to 1881*. American University in Cairo Press, Cairo, 352 pp.
Wagler, J.G. (1832) Mittheilungen über einige merkwürdige Thiere. I. Säugethiere. *Isis von Oken*, 25, 275–281.
Wagner, J.A. (1841) *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen von Dr. Johann Christian Daniel von Schreber fortgesetzt. Supplement 2. Die Raubthiere*. Erlangen, 558 pp.
Weninger, B. & Jöris, O.A. (2008) A 14C age calibration curve for the last 60 ka: the Greenland-Hulu U/Th timescale and its impact on understanding the Middle to Upper Palaeolithic transition in Western Eurasia. *Journal of Human Evolution*, 55, 772–781.
https://doi.org/10.1016/j.jhevol.2008.08.017
Wilson, D.E. & Cole, F.R. (2000) *Common names of mammals of the world*. Smithsonian Institution Press, Washington, 204 pp.
Winlock, H.H. (1924) The tombs of the kings of the 17th Dynasty at Thebes. *Journal of Egyptian Archaeology*, 10, 217–277.
https://doi.org/10.2307/3853927
Wolsan, M. & Hutterer, R. (1998) A list of the living species of shrews. *In*: Wójcik, J.M. & Wolsan, M. (Eds.), *Evolution of shrews*. Mammal Research Institute, Polish Academy of Sciences, Bialowieza, pp. 425–448.
Woodman, N. (2015) On the original description of the Sacred Shrew, *Sorex religiosa* I. Geoffroy Saint-Hilaire, 1826 [nec 1827] (Mammalia: Soricidae). *Bionomia*, 9, 50–53.
https://doi.org/10.11646/bionomina.9.1.5
Woodman, N. & Stabile, F.A. (2015) Variation in the myosoricine hand skeleton and its implications for locomotory behavior (Eulipotyphla: Soricidae). *Journal of Mammalogy*, 96, 159–171.
https://doi.org/10.1093/jmammal/gyu017
Wulf, A. (2016) *The invention of nature. Alexander von Humboldt's new world*. Alfred Knopf, New York, 506 pp.
Zivie, A. & Lichtenberg, R. (2005) The cats of the Goddess Bastet. *In*: Ikram, S. (Ed.), *Divine creatures: Animal mummies in Ancient Egypt.* American University in Cairo Press, Cairo & New York, pp. 109–119.
https://doi.org/10.5743/cairo/9789774248580.003.0005

Online supporting information.



S1. Photograph of the surviving shrew mummies in the Passalacqua Collection, Ägyptisches Museum, Berlin.



S2. 3D scan of the skull of the lectotype (ÄM 690) of *Sorex religiosus*.

APPENDIX 1. Specimens examined.

Institutional abbreviations: BMNH: Natural History Museum, London, UK; FMNH: Field Museum of Natural History, Chicago, IL, USA; USNM: National Museum of Natural History, Washington, DC, USA; YPM: Peabody Museum, Yale University, New Haven, CT, USA; ZFMK: Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

Crocidura balsamifera (*n* = 2).—EGYPT: Akhmim (Musée de Confluences, Lyon, no number—holotype; Centre de Paléontologie, Université Claude Bernard, Lyon, no number—paratype).

Crocidura floweri (*n* = 5).—EGYPT: Giza (BMNH 10.6.18.2, 10.6.18.3, 10.6.18.6, 10.6.18.7—includes holotype); 1 km S Baltim Beach (FMNH 106469).

Crocidura fulvastra (*n* = 30).—SOUTH SUDAN: Al-Istiwa'Iyah Ash-Sharqiyah Province: Kapoeta (USNM 317888). A`Ali An-Nil Province: Paloich, Niayok (USNM 325928–325932); Paloich, 12 Mi N of Niayok (USNM 325933); Paloich, Tir, Paloi (USNM 325934); Paloich, 0.5 Mi NE of Tir (USNM 325935, 325938); Tir, Toich, Thaak (USNM 325936, 325937). Upper Nile Province: 1 mi N Melut (FM 91778); Niayok (FMNH 93701, 93702, 93704, 93706, 93709); Paloich, Niayok, 12 mi N (FMNH 93711); Paloich, Niayok, 1 mi N (FMNH 93712); Paloich, Tir, Paloi (FMNH 93843); Paloich, Tir, 2 mi N (FMNH 98973); Paloich, Tir, 1 mi NE (FMNH 93844); Paloich, Tir, 5 mi NE (FMNH 93846); Paloich, Tir, Toich, Thaak (FMNH 93848); Paloich, Tir, Toich, Thaak, 2 mi S (FMNH 93851); Paloich, Kum Kum Forest (FMNH 96213). Eastern Equatoria Province: Kapoeta (FMNH 85173). SUDAN: Ash-Shariqyah Kassala Province: Aroma Madart, on River Gash, 13 Mi SSE Of Kassala USNM 325927). Southern Kordofan Province: Buk (FMNH 29008).

Crocidura olivieri olivieri (*n* = 96).—Egypt: no locality (YPM 5963); Beni Suef, near Giza channel (ZFMK 1989.0102); Cairo, Abassia, NAMRU (FMNH 140086); Cairo, Mina House (BMNH 95.9.2.1–95.9.2.6); Dumyat, Damietta (FMNH 74556; USNM 311742); Gharbiya Tanta, Abu Gazia (FMNH 140088); Tanta (ZFMK 3 specimens); Giza (BMNH 4.5.15.1, 4.5.15.2, 9.7.1.14, 9.7.1.15—holotype; 9.7.1.81, 10.6.18.1); Giza: Abu Ghalib (FMNH 74937,74939, 74940, 91331; USNM 311749 – 311752); Giza: Abu Rawash (FMNH 74945, 75666, 79797,87600, 90459, 92259, 98972, 100740, 100743, 100777, 101374, 101375, 101886, 101997, 101998; USNM 311743, 311746, 311759, 311760, 341923, 341929, 341931; YPM 2803, 5828–5830); Giza: Abu Rawash & El Mansuriya (FMNH 77323); Giza: Dahshur (FMNH 77322); Giza: El Baraqil (FMNH 80524; USNM 311744, 311745); Giza: El Mansuriya (FMNH 74558, 74568; 74569; USNM 341932, 311763, 311764); Giza: Kirdasa (FMNH 90458; USNM 341924, 341925); Giza: Manshiyet Radwan (USNM 311758); Giza: Nahya (FMNH 74570, 91218; USNM 311748); Giza: Saft el Laban (FMNH 89983); Giza: Sakkara (USNM 341930); Giza: Talbia (USNM 277293); Giza: Tanash (USNM 311747); Giza: Wardan (FMNH 74564, 74565; 74567, 74932, 74933, 74934; USNM 311753–311757). El Faiyum: Kom O Shim (FMNH 75667, 75668, 98166, 98167, 98168, 98221); El Faiyum:Kom Maushim (YPM 2802, 2937, 11500); El Faiyum: 3 Mi N Faiyum at Royal Shooting Club, Western Desert (USNM 311761, 311762).

Crocidura pasha (*n* = 5).—SUDAN: Atbara River (BMNH 8.9.22.1—holotype); Khartoum (BMNH 9.9.2.31); Kordofan, Nuba Mts. (ZFMK 1982.150-1982.152).

Crocidura religiosa (*n* = 30).—EGYPT; Aburoash, near Cairo (BMNH 19.8.16.2, 19.8.16.3); Cairo (BMNH 4.8.2.4–4.8.2.8); East Bank of Nile, University Farm, Assuit (BMNH 76.547); Giza (BMNH 10.6.18.4—holotype; 10.6.18.5; ZFMK 1986.040, 1986.041). Giza Imbaba: Abu Rawash (FMNH 84639, 84653, 89580, 89985, 95891, 98169, 100739, 105063, 106443; 108383; USNM 311766, 341933; YPM 5840); Nahya (FMNH 84567; USNM 311768); Minshat el Bakkari (FMNH 84753); Minufiya Mit Faris (FMNH 101505); Kafr Hakim (USNM 311767).

Crocidura whitakeri (*n* = 10).—ALGERIA: Ain Sefra, S.W. Algeria, 1100
m (BMNH 13.8.6.11, 13.8.6.12); Blidat, North Algeria (BMNH 19.7.7.1847). EGYPT: Matruh, 1 mi W Marsa Matruh (FMNH 91183); Matruh, 3 mi W Marsa Matruh (FMNH 91184); Sinai, north of Romana, near Lake Bardawil (FMNH 151603). MOROCCO: "Sierzet, about halfway between Morocco city and Mogador" (BMNH 98.7.4.5—holotype); Safi: 5 km NE Essaouira (USNM 482019, 482020, 485838).

Suncus etruscus (*n* = 34).—ETHIOPIA: Bahar Dar (BMNH 70.513). INDIA: Manipur Karong (FMNH 75818); Meghalaya Khasi Hills, Mawphlang (FMNH 76208, 76209); Manipur Karong (FMNH 76211); Bihar Luia (FMNH 82547, 82550); West Bengal, Bhutan Duars, Hasimara (FMNH 82553–82555); West Bengal, Darjeeling, Pashok (FMNH 82556). IRAQ: Amara, Mesopotamia (BMNH 18.8.5.2). IRAN: Mazandaran Gorgan: 9 mi N, 1 mi W Gorgan (FMNH 98722). ISRAEL: 15 miles West of Jerusalem (BMNH 18.8.1.5, 18.8.1.6, 18.8.1.7); Rehoboth, currently Rehovot, Palestine (BMNH 21.5.5.1); Tiberias, Palestine (BMNH 32.2.2.1). ITALY: Brozzi, near Florence (BMNH 62.1285, 62.1286); Florence (USNM 105379, 105381); Dintorne di Pisa (BMNH 69.3.4.1); Genoa (USNM 18547, 18548); Sardinia (BMNH 11.10.1.1); Sardegna, Assuni (USNM 173176); Sicily (BMNH 52.2.26.23). NIGERIA: Sherifuri Azare District, North Nigeria (BMNH 46.517). OMAN: Salalam, Plain, South Oman (BMNH 79.234). PAKISTAN: North-West Frontier: Malakand Division: Malakand (USNM 429329). SPAIN: Marismas, Lower Guadalquivir (BMNH 11.12.19.1–11.12.19.3). TUNISIA: no locality (BMNH 4.4.15.2).