BioInvasions Records (2024) Volume 13, Issue 1: 97–107

Rapid Communication

First record of *Thalamita oculea* Alcock, 1899 (Crustacea: Decapoda: Portunidae) in the Mediterranean Sea

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Citation: Galil BS, Tagar A, Zirler R, Bronstein O, Feldstein-Farkash T (2024) First record of *Thalamita oculea* Alcock, 1899 (Crustacea: Decapoda: Portunidae) in the Mediterranean Sea. *BioInvasions Records* 13(1): 97–107, https://doi.org/10.3391/bir.2024.13.1.09

Received: 26 October 2023
Accepted: 18 February 2024
Published: 5 March 2024

Handling editor: Jasmine Ferrario
Thematic editor: April Blakeslee

Abstract

A single adult specimen of *Thalamita oculea*, a portunid crab known from the Indian Ocean, was recently collected off the Israeli coast, in the southeastern Mediterranean Sea. Morphological characters, as well as molecular analyses based on the mitochondrial barcoding gene 16S ribosomal RNA, support the identification. The species is described, illustrated, and differentiated from its Mediterranean congeners. As the Israeli shelf serves as an important way station and breeding ground for invasive Erythraean biota, *T. oculea* may potentially spread along the Levant coastline.

Key words: alien species, Suez Canal, Erythraean invasion, taxonomic validation

Introduction

The introduction of alien species has been viewed as one of the main direct drivers of biodiversity change and loss in marine ecosystems (Roy et al. 2023). Once established, alien species are unlikely to be contained or controlled and their impacts are irreversible. Alien species have become a concern in coastal waters around the world, but nowhere more so than in the Mediterranean Sea (Galil et al. 2021), where the Suez Canal is the most prolific pathway of introduction (Galil 2023). The Canal's successive enlargements have raised concern over increasing propagule pressure of both extant and newly arriving Erythraean species (Galil et al. 2015).

Portunid crabs, along with penaeid shrimps, are the most speciose families among the introduced decapod crustaceans recorded in the Mediterranean Sea. The earliest record, 1898, in Port Said, Egypt, was of *Portunus segnis* (Forskål, 1775) (Fox, 1924, as *Neptunus* (*Portunus*) *pelagicus*), followed by *Charybdis* (*Charybdis*) *hellerii* (A. Milne-Edwards, 1867) (Steinitz 1929), *Callinectes sapidus* Rathbun, 1896 (Georgiadis and Georgiadis 1974), *Thalamita poissonii* (Audouin, 1826) (Holthuis and Gottlieb 1958), *Charybdis* (*Archias*) *longicollis* Leene, 1938 (Lewinsohn and Holthuis 1964), *Thalamita gloriensis* Crosnier, 1962 (Relini Orsi and Mori 1979), *Callinectes danae* Smith, 1869 (Mizzan 1993), *Carupa tenuipes* Dana, 1852 (Yokes and Galil 2004), *Thalamita*

indistincta Apel and Spiridonov, 1998 (Hasan and Noel 2008), *Charybdis* (*C.*) *feriata* (Linnaeus, 1758) (Abello and Hispano 2006), *Charybdis* (*C.*) *japonica* (A. Milne Edwards, 1861) (Froglia 2012), *Charybdis* (*C.*) *lucifer* (Linnaeus, 1798) (Mizzan and Vianello 2009), *Gonioinfradens giardi* (Nobili, 1905) (Karhan and Yokes 2012, as *G. paucidentatus*), *Charybdis* (*C.*) *natator* (Herbst, 1789) (Orfanidis et al. 2021). *Thalamita oculea* Alcock, 1899, a species previously known from the Indian Ocean, is here reported for the first time in the Mediterranean Sea. The species is briefly described, illustrated, and differentiated from its Mediterranean congeners.

Materials and methods

Sampling and identification.

A specimen was collected off the Mediterranean coast of Israel, in the course of a trawl fisheries survey. The specimen was transported to the Steinhardt Museum of Natural History (SMNH), Tel Aviv University, photographed, measured and tissue samples removed for DNA extractions. The specimen, preserved in 70% EtOH, is deposited in the SMNH under voucher number SMNHTAU:Ar.30314. Specimens of *Thalamita poissonii* used in the molecular analysis were collected off the Israeli coast during 2023 (SMNHTAU: Ar. 30315-6).

Molecular analysis.

DNA extraction and amplification. DNA was extracted from *T. oculea* and *T. poissonii* using the Genomic DNA Mini Kit (Tissue) (GT100, Geneaid). Samples were digested over-night at 60 °C, and the extraction continued following the manufacturers' protocol. A fragment of *ca*. 550 bp of the mitochondrial 16S ribosomal RNA gene was amplified and sequenced with the 16sar-L and 16sbr-H primers (Palumbi et al. 1991). Sequences were deposited in GenBank under accession numbers OR690793-5.

Sequence analyses.

Thalamita oculea 16S sequence was submitted to a blastn search (12 September, 2023; BLASTN 2.13.0+ Zhang et al. 2000) against the nucleotide database of the National Center for Biotechnology Information (NCBI). Sequences from the blastn results, with a coverage > 80% were downloaded from the GenBank. For the reconstruction of a phylogenetic tree 16S sequences of *Thalamita* species were used that had at least two sequences deposited in the GenBank, or species distributed in the Mediterranean sea, Red Sea and Persian Gulf (Table 1). In cases of uncertainty as to the identification of the sequenced species, we used sequences that agree with the study of Evans (2018). Newly produced sequences of *T. poissonii* were added to the analysis. *Charybdis helleri* sequences were used to root the tree. The sequences were

Table 1. List of sequences used for the phylogenetic analysis based on 16S ribosomal sequence.

16S accession	Species	Locality	Source
OR690793	*Thalamita oculea* Alcock, 1899	Israel	Current study
OR690794	*Thalamita poissonii* (Audouin, 1826)	Israel	Current study
OR690795	*Thalamita poissonii* (Audouin, 1826)	Israel	Current study
KX959600	*Thalamita admete* (Herbst, 1803)	Pakistan	Unpublished
KX959598	*Thalamita admete* (Herbst, 1803)	Pakistan	Unpublished
KX959599	*Thalamita admete* (Herbst, 1803)	Pakistan	Unpublished
KT365562	*Thalamita admete* (Herbst, 1803)	Oman	Evans 2018
KT365561	*Thalamita* aff. *admete*	Australia, Queensland	Evans 2018
MW927207	*Thalamita chaptalii* (Audouin, 1826)	Saudi Arabia	Unpublished
KT365568	*Thalamita chaptalii* (Audouin, 1826)	France, Reunion Island	Evans 2018
KT365571	*Thalamita cooperi* Borradaile, 1902	Australia, Queensland	Evans 2018
KT365570	*Thalamita cooperi* Borradaile, 1902	French Polynesia	Evans 2018
MT180012	*Thalamita cooperi* Borradaile, 1902	Palmyra Atoll, Central Pacific	Servis et al. 2020
MH425338	*Thalamita crenata* Rüppell, 1830	China, Weizhou Island	Xie et al. 2018
NC_024438	*Thalamita crenata* Rüppell, 1830	Australia, Darwin	Unpublished
FM208754	*Thalamita crenata* Rüppell, 1830	USA, Hawaii	Schubart and Reuschel 2009
KT365572	*Thalamita crenata* Rüppell, 1830	USA, Hawaii	Evans 2018
FJ152164	*Thalamita crenata* Rüppell, 1830	USA, Hawaii, Oahu	Mantelatto et al. 2009
KY086005	*Thalamita crenata* Rüppell, 1830	Pakistan	Unpublished
KX959591	*Thalamita crenata* Rüppell, 1830	Pakistan	Unpublished
KY086006	*Thalamita crenata* Rüppell, 1830	Pakistan	Unpublished
KT365575	*Thalamita gatavakensis* Nobili, 1906	Australia, Queensland	Evans 2018
KT365576	*Thalamita gatavakensis* Nobili, 1906	Australia, Queensland	Evans 2018
KT365582	*Thalamita gloriensis* Crosnier, 1962	Australia, Queensland	Evans 2018
KT365578	*Thalamita integra* Dana, 1852	USA, Northern Mariana Is.	Evans 2018
NC_069013	*Thalamita integra* Dana, 1852		Unpublished
MZ429047	*Thalamita malaccensis* Gordon, 1938	eastern Arabian Sea	Cubelio et al. 2023
KT365580	*Thalamita mitsiensis* Crosnier, 1962	Guam	Evans 2018
KT365616	*Thalamita oculea* Alcock, 1899	Philippines	Evans 2018
MZ429045	*Thalamita oculea* Alcock, 1899	India, Bay of Bengal	Cubelio et al. 2023
MZ429044	*Thalamita oculea* Alcock, 1899	India, Bay of Bengal	Cubelio et al. 2023
NC_069014	*Thalamita prymna* (Herbst, 1803)		Unpublished
KT365610	*Thalamita pseudoculea* Crosnier, 1984	Madagascar	Evans 2018
KT365586	*Thalamita rubridens* Apel & Spiridonov, 1998	Oman	Evans 2018
KT365566	*Thalamita* cf. *rubridens*	Australia, Queensland	Evans 2018
KT365618	*Thalamita savignyi* A. Milne-Edwards, 1861	Oman	Evans 2018
KT365587	*Thalamita seurati* Nobili, 1906	France, Reunion Island	Evans 2018
MT179906	*Thalamita* aff. *seurati*	Palmyra Atoll, Central Pacific	Servis et al. 2020
MT179906	*Thalamita* aff. *seurati*	Palmyra Atoll, Central Pacific	Servis et al. 2020
MT179857	*Thalamita* aff. *seurati*	Palmyra Atoll, Central Pacific	Servis et al. 2020
MT179909	*Thalamita* aff. *seurati*	Palmyra Atoll, Central Pacific	Servis et al. 2020
MT179856	*Thalamita* aff. *seurati*	Palmyra Atoll, Central Pacific	Servis et al. 2020
MZ429053	*Thalamita sexlobata* Miers, 1886	western Andaman Sea	Cubelio et al. 2023
KT365619	*Thalamita sima* H. Milne-Edwards, 1834	Australia, Darwin	Evans 2018
MW446893	*Thalamita sima* H. Milne-Edwards, 1834	Western Australia	Dias et al. 2017
KT365620	*Thalamita spinicarpa* Wee & Ng, 1995	Singapore	Evans 2018
NC_069015	*Thalamita spinicarpa* Wee & Ng, 1995		Unpublished
MZ429051	*Thalamita spinifera* Borradaile, 1902	India, Bay of Bengal	Cubelio et al. 2023
KT365621	*Thalamita* aff. *spinifera*	French Polynesia	Evans 2018
KX060471	*Charybdis hellerii* (A. Milne-Edwards, 1867)	Brazil	Negri et al. 2018
KX060459	*Charybdis hellerii* (A. Milne-Edwards, 1867)	Panama	Negri et al. 2018
NC_060621	*Charybdis hellerii* (A. Milne-Edwards, 1867)		Unpublished

aligned with MAFFT 7.304 (Katoh and Standley 2013) using L-INS-i parameters. A maximum likelihood phylogenetic tree was reconstructed using PhyML 3.0 (Dereeper et al. 2008, Guindon et al. 2010) using the GTR model. Bootstrap percentages (BPs) were computed based on 100 replicates.

Figure 1. *Thalamita oculea* Alcock, 1899. Carapace, dorsal view (carapace width 20.4 mm). Photo by Oz Rittner, SMNH.

Results

Systematic account

Order Decapoda (Latreille, 1802)
Infraorder Brachyura (Latreille, 1802)
Family Portunidae (Rafnesque, 1815)
Genus *Thalamita* (Latreille, 1829)

***Thalamita oculea* Alcock, 1899**

(Figures 1–7)

Thalamita oculea Alcock 1899: 76, 91; Alcock and McArdle 1900: pl. 48, figs. 3, 3a; Rathbun 1902: 131; 1911: 210; Laurie 1906: 421; Crosnier 1962: 95, 109, figs. 173, 178, 180, 194; 1984: 414; Serène 1977: 49, 60, figs 22–24; Cubelio et al. 2023:11, figs. 4b, 11e–l, 14 u–v.

Material examined

Israel: ♂, carapace width 20.4 mm, 01°33.051N; 34°59.50E, 51–55 m, 12 June 2023, coll. Aviyam Tagar (SMNHTAU:Ar.30314).

Description

Carapace 1.52 as wide as long, densely pilose, bearing minutely granular transverse ridges: pairs on frontal and protogastric regions, one medially on mesogastric region, a pair of conspicuous, sinuous epibranchial lines between fifth anterolateral teeth, two subequal pairs on cardiac and mesobranchial regions (Figure 1). Front bilobate, frontal lobes nearly horizontal, wide, separated by minute notch, hardly produced beyond narrower, slightly arched internal

Figure 2. *Thalamita oculea* Alcock, 1899. Left cheliped, carpus, palm, dactylus, dorsal view. Photo by Oz Rittner, SMNH.

Figure 3. *Thalamita oculea* Alcock, 1899. Left cheliped, palm, dactylus, outer view. Photo by Oz Rittner, SMNH.

Figure 4. *Thalamita oculea* Alcock, 1899. Left cheliped, palm, pollex, ventral view. Photo by Oz Rittner, SMNH.

orbital lobes. Orbits large, wider than frontal lobe, their upper margin bifissured, inner angle of lower margin rounded. Basal antennal article large, granular, bearing distinct granular ridge. Anterolateral margins of carapace slightly arched, bearing five teeth: anterior tooth (exorbital) largest, blunt, second and third teeth successively smaller, acute, fourth and fifth teeth subequal, acute,

Figure 5. *Thalamita oculea* Alcock, 1899. Sternum and abdomen. Photo by Oz Rittner, SMNH.

Figure 6. *Thalamita oculea* Alcock, 1899. First gonopods. Photo by Oz Rittner, SMNH.

noticeably smaller than preceding tooth. Posterolateral margin sinuous, set with minute granules. Posterior margin raised, sinuous. Chelipeds massive, unequal, sheathed with closely spaced granular ridges separated by rows of bristles (Figures 2–4); anterior margin of merus with two spines distally, small pointy

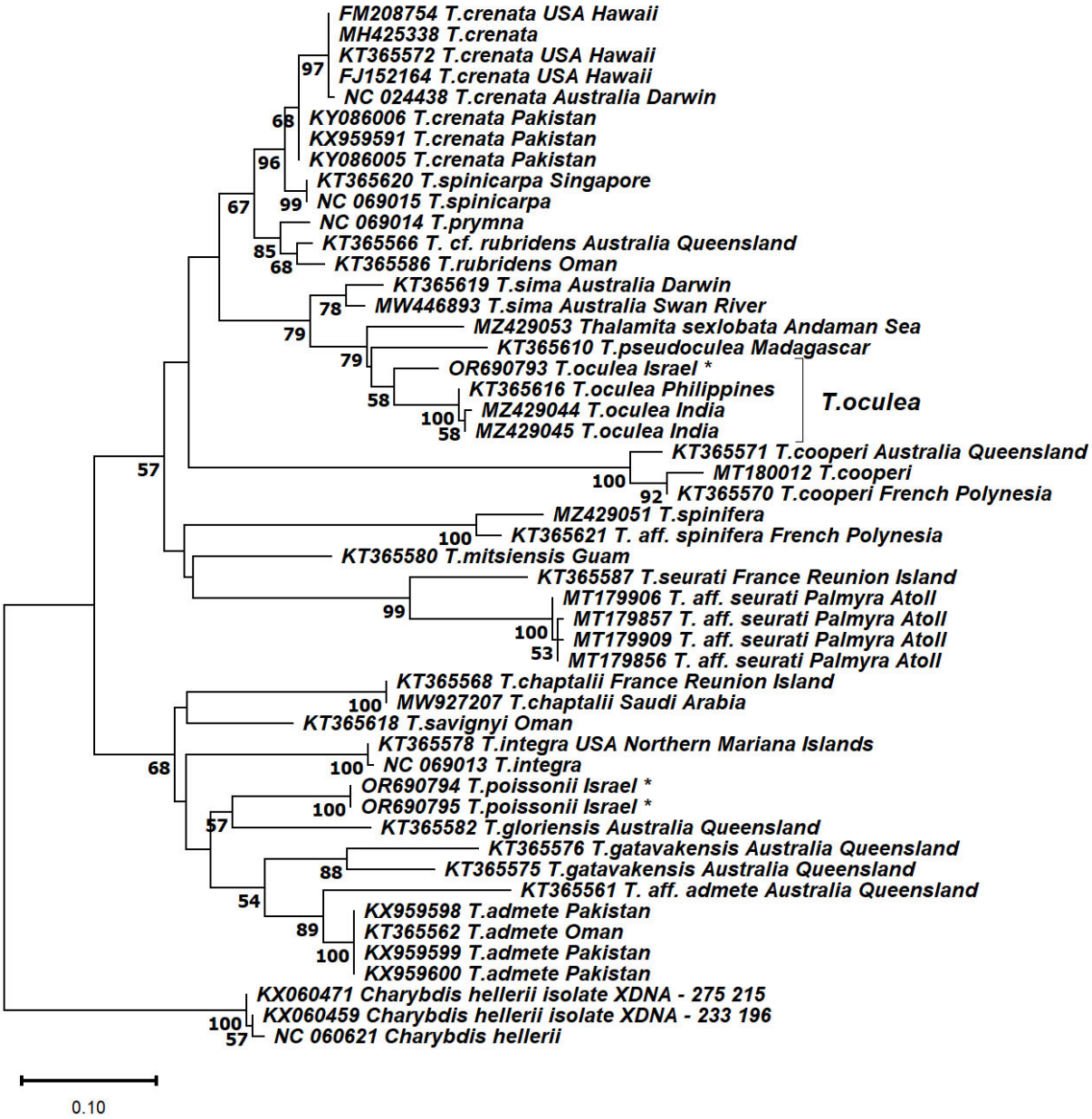

Figure 7. Phylogenetic tree of *Thalamita* spp. 16S sequences. The maximum likelihood tree was reconstructed with PhyML 3.0 using the GTR model of sequence evolution. Bootstrap supports higher than 50 are given near the corresponding nodes. New sequences are marked by an asterisk. *Charybdis helleri* sequences were used as outgroup.

granules proximally; inner angle of carpus prominently spinose; upper surface of propodus bearing a prominent spine mid-palm and smaller spine near dactylar articulation, outer surface grooved lengthwise, lower margin costate, granular; lower surface entirely covered with closely spaced granular ridges; fingers bearing raised rounded carinae interspaced by setose grooves. Pereopods setose; upper surface of anterior three pairs covered by squamiform granules; posterior margin of fifth pereopod merus bearing prominent subdistal spine, posterior margin of propodus smooth (Figure 1). Sternites boldly sculptured with transverse rounded ridges enclosing setose indentations posteriorly, short granular ridges anteriorly (Figure 5). Abdominal segments bearing transverse rounded ridges enclosing setose indentations; sixth abdominal segment 1.3 as wide as long, lateral margins gradually convergent; telson bluntly triangular,

somewhat 1.2 as long as wide. First gonopod tubular, elongate, narrowing distally, curved laterally; tip distinctly flared, bearing subdistal projection, lateral margin setose to midlength of neck (Figure 6).

Color

Colors alive unknown. Pale sandy-grey; carapace mottled brown; cheliped dactyl with transverse reddish band proximally, brown band subdistally, fixed finger bearing subdistal brown band (preserved in ethanol).

Geographical and bathymetric distribution

Indian Ocean (Seychelles, Saya de Malha Bank, Madagascar, Maldives, India, Sri Lanka, Andaman Sea, Bay of Bengal); depth 36–63 m.

Remarks

Thalamita oculea may be separated from the three alien congeners previously recorded in the Mediterranean Sea on the following combination of characters: front bilobed, versus divided into six lobes in *T. indistincta*; anterolateral margin bearing 5 teeth, versus 4 teeth in *T. gloriensis*; posterior margin of propodus of fifth pereopod with subdistal spine and underside of chela bearing transverse squamiform markings, versus posterodistal angle of propodus rounded and underside of chela without such markings in *T. poissonii*.

The 16S rRNA sequence of specimen SMNHTAU:Ar.30314 was 97% identical to *T. oculea* sequences available in GenBank in the blastn search, and cluster with these sequences in the phylogenetic reconstruction (Figure 7). It is clearly separated from *T. gloriensis* and *T. poissonii* by the 16S rRNA molecular marker.

Discussion

With a current count of 15 alien species, portunid crabs are one of the most speciose crustacean contributors in the Mediterranean Sea. Attempts at predicting which species are more successfully introduced have shown that the most reliable indicator is past performance, *i.e.*, widespread alien species are likely to disperse further (Galil et al. 2014). Examination of the alien portunids reveals that all but two (*Callinectes sapidus* and *C. danae*) were introduced through the Suez Canal (Table 2). Six of the seven species considered to have been introduced by shipping (*C. danae, Charybdis* (*Charybdis*) *feriata*, *C.* (*C.*) *japonica, C.* (*C.*) *lucifera, C.* (*C.*) *natator, Thalamita gloriensis*) are known from a single or at most a handful of specimens, whereas six of the seven Erythraean species (*Portunus segnis, C.* (*C.*) *hellerii, Thalamita poissonii, C.* (*C.*) *longicollis, Carupa tenuipes, Gonioinfradens giardi*) have spread beyond the Levantine Basin. *Thalamita oculea* may conceivably follow this pattern. As the genus *Thalamita* is the most speciose portunid genus with 89 species (WoRMS Editorial Board, 2023, accessed 2023-10-14), with four already introduced into the Mediterranean Sea, we may expect further congeners.

Table 2. Alien swimming crabs (Portunidae) reported from the Mediterranean Sea, their proposed introduction route, year of collection, reference of 1st record, known distribution.

Species	Route	1st collection	1st record reference	Country records
Callinectes danae Smith, 1869	Gibraltar	1981	Mizzan 1993	Italy
Callinectes sapidus Rathbun, 1896	Gibraltar	1930s	Georgiadis and Georgiadis 1974	Albania, Algeria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Malta, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey
Carupa tenuipes Dana, 1852	Suez Canal	1996	Yokes and Galil 2004	Cyprus, Greece, Israel, Libya, Turkey
Charybdis (*Charybdis*) *feriata* (Linnaeus, 1758)	Suez Canal	2004	Abello and Hispano 2006	Italy, Spain
Charybdis (*Charybdis*) *hellerii* (A. Milne-Edwards, 1867)	Suez Canal	1924–5	Steinitz 1929	Cyprus, Egypt, Greece, Israel, Lebanon, Syria, Turkey
Charybdis (*Charybdis*) *japonica* (A. Milne-Edwards, 1861)	Suez Canal	2006	Froglia 2012	Italy
Charybdis (*Charybdis*) *lucifera* (Fabricius, 1798)	Suez Canal	2006	Mizzan and Vianello 2009	Italy
Charybdis (*Charybdis*) *natator* (Herbst, 1794)	Suez Canal	2020	Orfanidis et al. 2021	Tunisia
Charybdis (Archias) longicollis Leene, 1938	Suez Canal	1954	Lewinsohn and Holthuis 1964	Cyprus, Egypt, Greece, Israel, Lebanon, Syria, Turkey
Gonioinfradens giardi (Nobili, 1905)	Suez Canal	2009	Karhan and Yokes 2012	Cyprus, Greece, Israel, Syria, Turkey
Portunus segnis (Forskål, 1775)	Suez Canal	1898	Fox 1924	Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Malta, Syria, Tunisia, Turkey
Thalamita gloriensis Crosnier, 1962	Suez Canal	1977	Relini Orsi and Mori 1979	Italy
Thalamita indistincta Apel & Spiridonov, 1998	Suez Canal	2002	Hasan and Noel 2008	Lebanon, Syria
Thalamita oculea Alcock, 1899	Suez Canal	2023	Present article	Israel
Thalamita poissonii (Audouin, 1826)	Suez Canal	1952	Holthuis and Gottlieb 1958	Cyprus, Greece, Israel, Lebanon, Libya, Syria, Turkey

Authors contribution

Bella S. Galil: species identification, writing – original draft, writing – review and editing. Aviyam Tagar: sampling. Rotem Zirler: sampling, molecular analysis. Omri Bronstein: data analysis and interpretation, review. Tamar Feldstein-Farkash: molecular analysis, interpretation, visualization, writing.

Acknowledgements

Sincere thanks to Oz Rittner, Steinhardt Museum of Natural History, for photography, and to the librarians of the American Museum of Natural History, New York, USA. We thank the reviewers for their careful suggestions. Funding was provided by the Department of Fisheries, Ministry of Agriculture, for the Israeli national monitoring of fisheries.

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