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New records of hard-bottom polychaete species in the central Adriatic Sea

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Abstract: Adriatic Sea is a diverse marine ecosystem that supports a rich biodiversity of polychaete species on soft and hard-bottoms, with 764 recorded species in the latest inventory list. Benthic surveys conducted in 2018 in the hard-bottom infralittoral zone on the east coast of the central Adriatic Sea revealed one previously unreported species for the Adriatic Sea, *Syllis kabilica* Ben-Eliahu, 1977 (Syllidae), as well as two species reported for the first time in the eastern Adriatic Sea, *Syllis tyrrhena* (Licher and Kuper, 1998) (Syllidae), and *Streblosoma nogueirai* Lezzi and Giangrande, 2019 (Terebellidae). Furthermore, one alien species was identified, *Lysidice collaris* Grube, 1868 (Eunicidae). These findings provide new insights into the distribution and diversity of polychaete fauna in the Adriatic Sea.
Keywords: Polychaeta; Annelida; Mediterranean; *Syllis kabilica*; *Syllis tyrrhena*; *Streblosoma nogueirai*; *Lysidice collaris;* alien species

Sažetak: NOVI NALAZI MNOGOČETINAŠA ČVRSTIH PODLOGA NA PODRUČJU SREDNJEG JADRANA. Ekosustav Jadranskog mora je raznolik s velikom bioraznolikošću vrsta mnogočetinaša na čvrstim i na pomičnim podlogama, sa 764 zabilježene vrste prema posljednjem popisu. Tijekom provedenih istraživanja na čvrstim podlogama u zoni infralitorala na istočnoj strani srednjeg Jadrana tijekom 2018. godine, otkrivena je prethodno nezabilježena vrsta mnogočetinaša za Jadransko more, *Syllis kabilica* Ben-Eliahu, 1977 (Syllidae), kao i dvije vrste prvi put zabilježene u istočnom Jadranu, *Syllis tyrrhena* (Licher and Kuper, 1998) (Syllidae) i *Streblosoma nogueirai* Lezzi and Giangrande, 2019 (Terebellidae). Zabilježena je i jedna strana vrsta mnogočetinaša, *Lysidice collaris* Grube, 1868 (Eunicidae). Ovi nalazi pružaju novi uvid u rasprostranjenost i raznolikost faune mnogočetinaša u Jadranskom moru.
***Ključne riječi*:** Polychaeta; Annelida; Sredozemno more; *Syllis kabilica*; *Syllis tyrrhena*; *Streblosoma nogueirai*; *Lysidice collaris*; strane vrste

INTRODUCTION

Polychaetes, a diverse group of marine organisms belonging to the phylum Annelida, inhabit a wide range of aquatic environments, from shallow coastal waters to the deep sea (Fauchald, 1977; Fauchald and Jumars, 1979; Rouse and Fauchald, 1997). In terms of both species number and abundance, polychaetes are frequently the dominant macrobenthic group in both soft and hard-bottom assemblages (Knox, 1977; Hutchings, 1998; Giangrande *et al*., 2005). Due to their ecological significance and diversity, polychaetes have been a subject of extensive research in the Adriatic Sea since the 19th century, starting in the northern Adriatic, and later expanding to the central and southern regions, mostly focusing on the soft-bottoms (Grube, 1855; Ehlers, 1864, 1868; Marenzeller, 1874; Stossich, 1883; Fauvel, 1940; Zavodnik, 1965; Katzmann, 1971, 1972; Amoureux, 1976; Bellan, 1976; Požar-Domac, 1986; Giangrande and Montanaro, 1999; Mikac and Musco, 2010).

The latest comprehensive inventory of polychaete species found in the Adriatic Sea contains 764 species in 360 genera and 62 families (Mikac, 2015). The presence of a broad range of diverse habitats and environmental conditions in the Adriatic Sea provides favourable conditions for highly abundant and diverse polychaete fauna, which encompasses 68% of the polychaete species found in the Mediterranean (Arvanitidis *et al*., 2002; Coll *et al*., 2010; Mikac, 2015). Considering the abovementioned favourable conditions in the Adriatic Sea that support a diverse polychaete fauna, coupled with the persistent rise in the number of introduced species due to the growing marine traffic (Grossi *et al*., 2017; Spagnolo *et al*., 2019), it is anticipated that the number of polychaete species will continue to increase in the years to come. The aim of this study was to provide new insights into the distribution and diversity of polychaete fauna in the Adriatic Sea. Improving the knowledge of polychaete fauna in the Adriatic Sea is essential to gain a better understanding of the region's

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biodiversity and ecosystem functioning. Moreover, new records of polychaete species and their spatial distribution could serve as a valuable tool for future monitoring of the Adriatic Sea.

MATERIALS AND METHODS

The samples used in this study were collected during a polychaete community ecological survey from hard bottoms at four sites in the vicinity of the city of Split in 2018 (Fig. 1). Site 1 (43° 30' 31.74" N, 16° 23' 26.05" E) was situated at the entrance of Kaštela Bay; it has a southern and south-eastern exposure and a slight slope. Site 2 (43° 31' 21.42" N, 16° 24' 55.49" E) was situated on the rock of Školjić, on the eastern side of Kaštela Bay; it is characterized by a northern exposure and a slight slope. Site 3 (43° 32' 52.66" N, 16° 23' 22.14" E) was situated in the vicinity of the town Kaštel Lukšić, located on the northern side of Kaštela Bay; it is characterised by a southern exposure and a slight slope. Site 4 (43° 29' 34.98" N, 16° 21' 55.02" E) was situated at Rt Supetar, on the northern side of the island of Čiovo, at the entrance of Kaštela Bay; it is characterized by water exchange with the open sea, with a north-eastern exposure and a slight slope. The specimens were obtained by autonomous diving using the destructive method of scraping the 20x20 cm (400 cm^2) surface with a hammer and chisel. Larger segments of the material were taken manually, while the residual matter was extracted using a manually operated suction sampler (MANOSS) (Chatzigeorgiou *et al*., 2013). Polychaetes were sorted using a 500 µm sieve, immersed in an 8% formaldehyde solution for preservation, and subsequently stored in 70% alcohol. Specimens were identified using available taxonomic keys (Fauvel, 1923, 1927; Fauchald, 1977; Cantone, 1993; Parapar *et al*., 1996; San Martín, 2003; Viéitez *et al*., 2004; Jirkov and Leontovich, 2013; San Martín and Worsfold, 2015; Lezzi and Giangrande, 2019; Lavesque *et al*., 2021), and deposited in the Institute of Oceanography and Fisheries in Split. The nomenclature used is consistent with WoRMS (2024).

RESULTS AND DISCUSSION

Three previously unreported polychaete species, and one alien species were found on four stations in the investigated area. The species recorded for the first time in the Adriatic Sea (*Syllis kabilica* Ben-Eliahu, 1977), alongside the species reported for the first time in the eastern Adriatic Sea (*Syllis tyrrhena* Licher and Kuper, 1998) belong to the family Syllidae, which prevails on hard substrates (Abbiati *et al*., 1987; Giangrande *et al*., 2005; Musco, 2012). Furthermore, Syllidae stands out as the most species-rich family (112 species) in the Adriatic Sea, representing 15% of all the identified taxa (Mikac, 2015). Another species reported for the first time in the eastern Adriatic Sea belongs to the family Terebellidae (*Streblosoma nogueirai* Lezzi and Giangrande, 2019), and this finding is only the second report in the Mediterranean Sea. The alien species that was reported belongs to the family Eunicidae (*Lysidice collaris* Grube, 1868). This record of alien species is of particular interest, as it has been previously reported in the Adriatic Sea but with limited information on its distribution and abundance. The presence of alien species in a new habitat can have a significant impact on the local ecosystem and may alter the existing community structure (Schwindt *et al*., 2001; Occhipinti-Ambrogi *et al*., 2011; Çinar, 2013). Therefore, continued monitoring of alien species and their distribution is essential for assessing their impact on the marine environment.

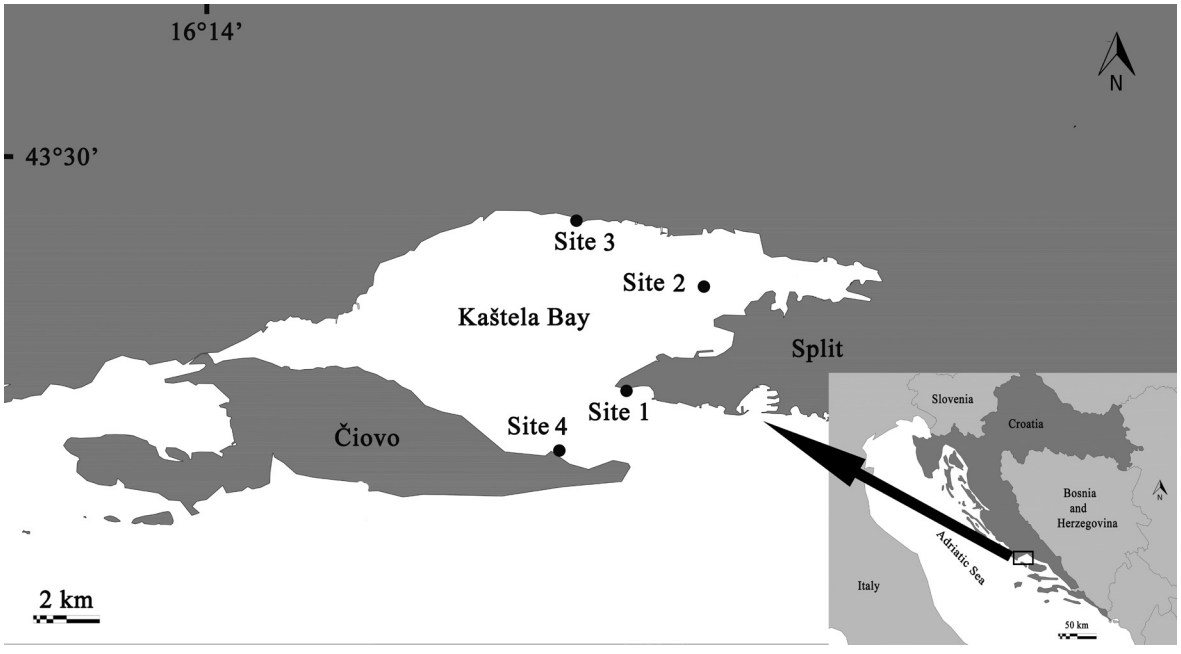

Fig. 1. Study area and sampling sites.

Syllis kabilica Ben-Eliahu, 1977

Material examined

One specimen, Site 4, in an infralittoral algal bed dominated by *Cystoseira crinitophylla* at 1 meter of depth, 20 June, 2018; Two specimens, Site 2, in the algal community characterized by the presence of *Dictyota dichotoma*, *Lithophyllum incrustans*, *Ellisolandia elongata* and *Alsidium helmintochorton* at a depth of 1 meter, 3 October, 2018.

Dimensions

Specimen 1. Partially damaged (posterior body part missing); 3.5 mm long; 0.5 mm wide, 25 chaetigers;

Specimen 2. Complete; 4.2 mm long; 0.7 mm wide, 68 chaetigers (Fig. 2);

Specimen 3. Complete; 5.4 mm long; 1 mm wide, 82 chaetigers

Remarks

Body without coloration, prostomium slightly rounded with short palps of similar length; two pairs of eyes in a trapezoidal arrangement; large provetriculus; bidentate composite setae short and triangular with both teeth of similar size, relatively proximal; medial acicula rounded and slightly bent at an angle.

The species *S. kabilica* was originally described from specimens collected from the intertidal algal pools at the Gulf of Elat, Red Sea, as *Syllis (Typosyllis) alternata kabilica* (Ben-Eliahu, 1977). In the Mediterranean, it was recorded for the first time from the Iberian Peninsula, near the town Murcia, where only one specimen was found in gastropod *Dendropoma cristatum* (Biondi-Giunti, 1859) formations, within the mediolittoral zone (Campoy, 1982). Subsequently, the species was reported from the Ria of Ferrol, a saline estuary in the North Atlantic Ocean, in infralittoral algal bed with *Fucus vesiculosus* and in the intertidal rocky shores (Parapar *et al*., 1996; Tato *et al*., 2009). More recently, this species was documented on the northwestern part of Sicily in the Tyrrhenian Sea, from mediolittoral hard bottoms up to the depth of 5 meters (Keklikoglou *et al*., 2013). The biology of this species is poorly known. It has only been found in vermetid reefs and subtidal soft bottoms (Parapar *et al*., 1996). Considering the scarcity of reports of this species, it is unclear whether this species is alien in the Mediterranean. This current observation is the first record of the species in the Adriatic Sea.

Syllis tyrrhena (Licher and Kuper, 1998)

Material examined

One specimen, Site 3, on a rocky substrate dominated by alga *Dictyopteris polypodioides*, at a depth of 1 meter, 9 October, 2023.

Dimensions

Complete specimen; 4 mm long; 0.7 mm wide, 52 chaetigers (Fig. 3)

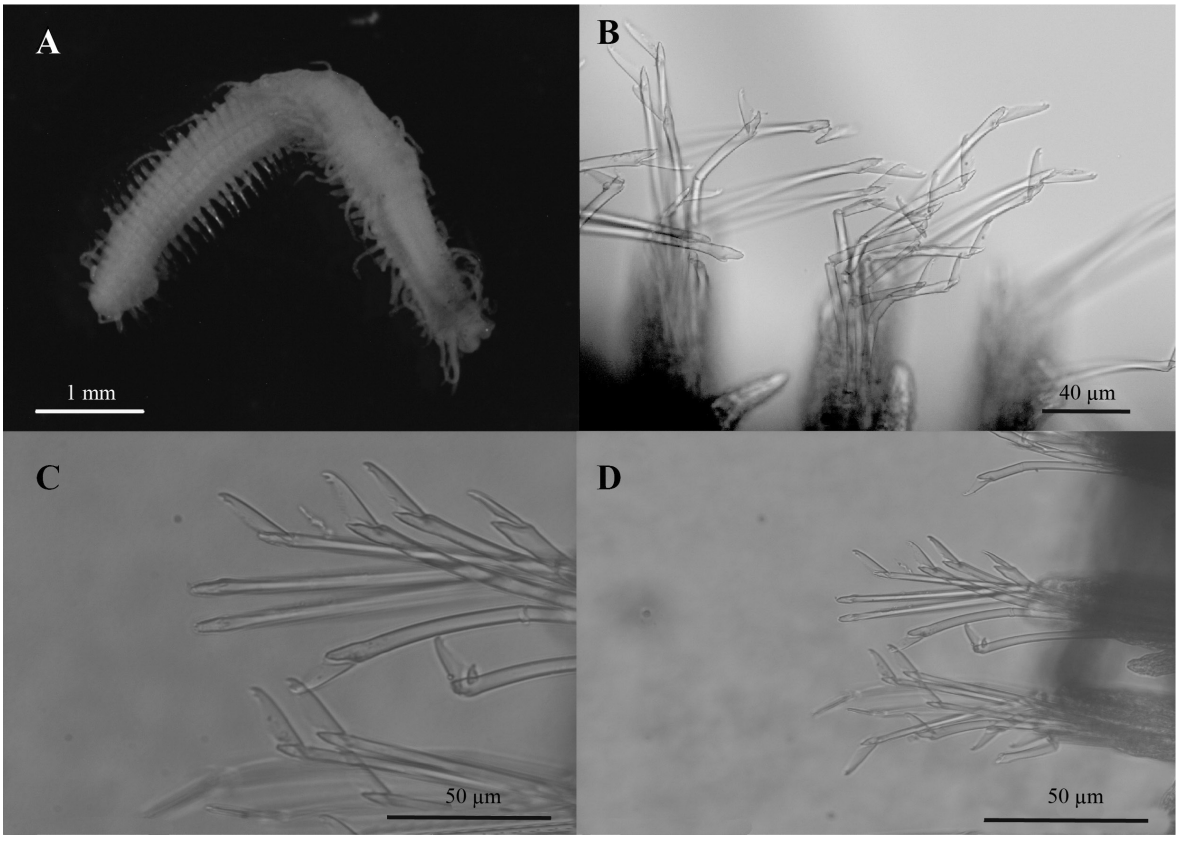

Fig. 2. *Syllis kabilica;* whole animal (**A**); anterior parapodia, composite setae and cirri (**B**); medial composite setae (**C**); Anterior composite setae and parapodia (**D**).

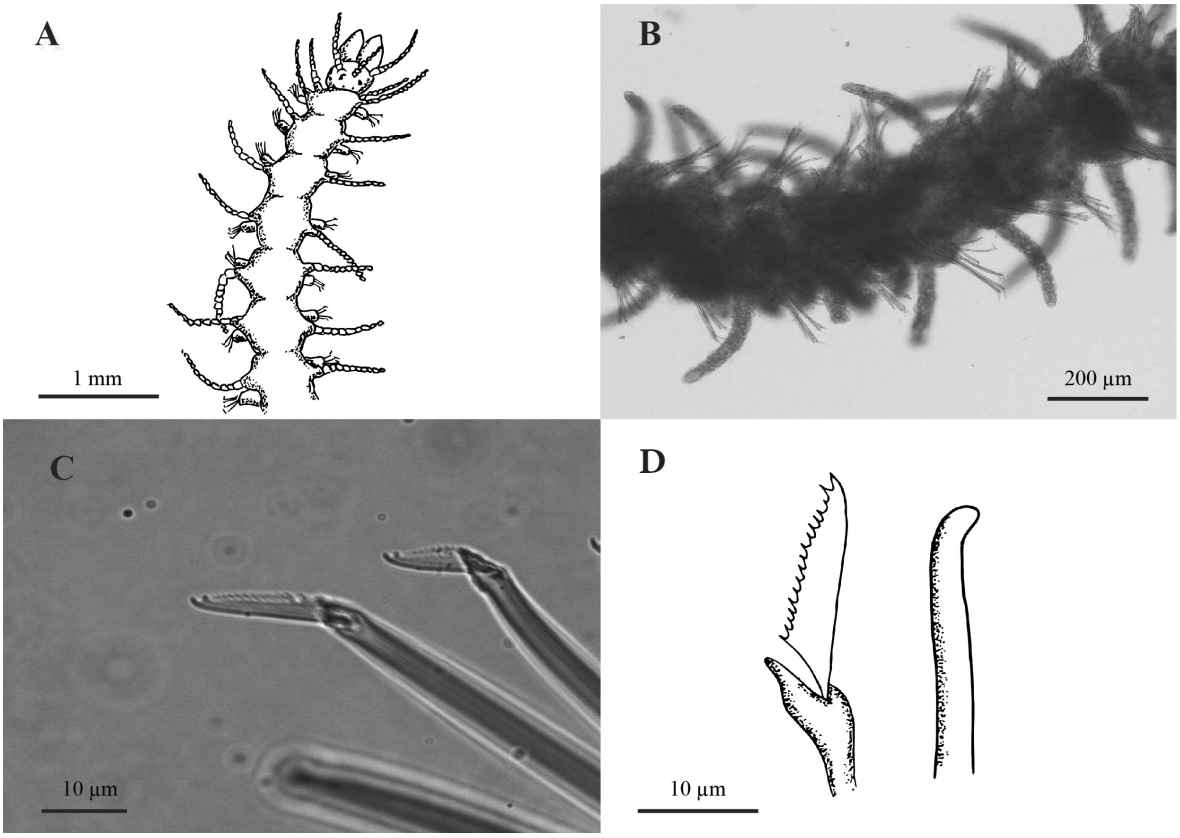

Fig. 3. *Syllis tyrrhena*; anterior region (**A**); composite setae, cirri and parapodia from the medial part of the body (**B**); medial composite setae (**C**); anterior composite setae and acicula (**D**).

Remarks

Body elongated and slender; without coloration; segments longer than wider; prostomium slightly rounded with two pairs of eyes in a trapezoidal arrangement, palps separated, longer than prostomium, ventral cirri digitiform, composite setae bidentate with teeth of similar size, clearly separated; proventriculus short.

This species was originally described as *Typosyllis tyrrhena* Licher and Kuper, 1998, collected from the island of Elba in the Tyrrhenian Sea in mixed sand of different grain sizes in subtidal habitats (Licher and Kuper, 1998). The species is accordingly distributed in the Mediterranean (Faulwetter *et al*., 2011), but was also recorded in Brazil from corals in shallow habitats (Nogueira and San Martín, 2002). In the Mediterranean, it was recorded south of the Iberian Peninsula, at the island of Alborán, and is reported to be interstitial, inhabiting the coarse sand and maerl, up to the depth of 49 meters (San Martín, 1999, 2003). Subsequently, it was reported from the island of Crete on rocks among algae from 10 metres of depth (Faulwetter *et al*., 2011), and from the northeast coast of Egypt in muddy sediments at 50 metres of depth (Abd-Elnaby, 2014).

Our finding represents the first documented occurrence of the species in the Adriatic Sea.

***Streblosoma nogueirai* Lezzi and Giangrande, 2019**

Material examined

One specimen, Site 1, in an infralittoral algal bed dominated by *Ericaria amentacea*, at a depth of 1 meter, 9 October, 2018.

*Dimension*s

Complete specimen, dried-out; 8 mm long; 0.8 mm wide, 52 chaetigers (Fig. 4)

Remarks

Three pairs of branchial scars on segments 2-4; prostomial eyes present; uncini in C-shaped loops from mid thorax; uncini breviavicular with dorsal button extending the prow, curved at the bottom; chetae not reaching posterior part of the body, notopodia starting from segment 2.

Streblosoma nogueirai was originally described from Torre Guaceto in the south Adriatic Sea, inhabiting hard bottoms covered by algae at 3 metres of depth, and it is considered an endemic Mediterranean species (Lezzi and Giangrande, 2019). This species finding was initially reported as *Streblosoma hesslei* Day, 1955, an alien species from the South Africa (Giangrande *et al*., 2004). Most probably, *S. nogueirai* corresponds to the species identified by Giangrande *et al*. (1981) at the island of Ischia near Naples, also as *S. hesslei*. However, this finding cannot be confirmed because the authors did not describe the torus arrangement, and the original

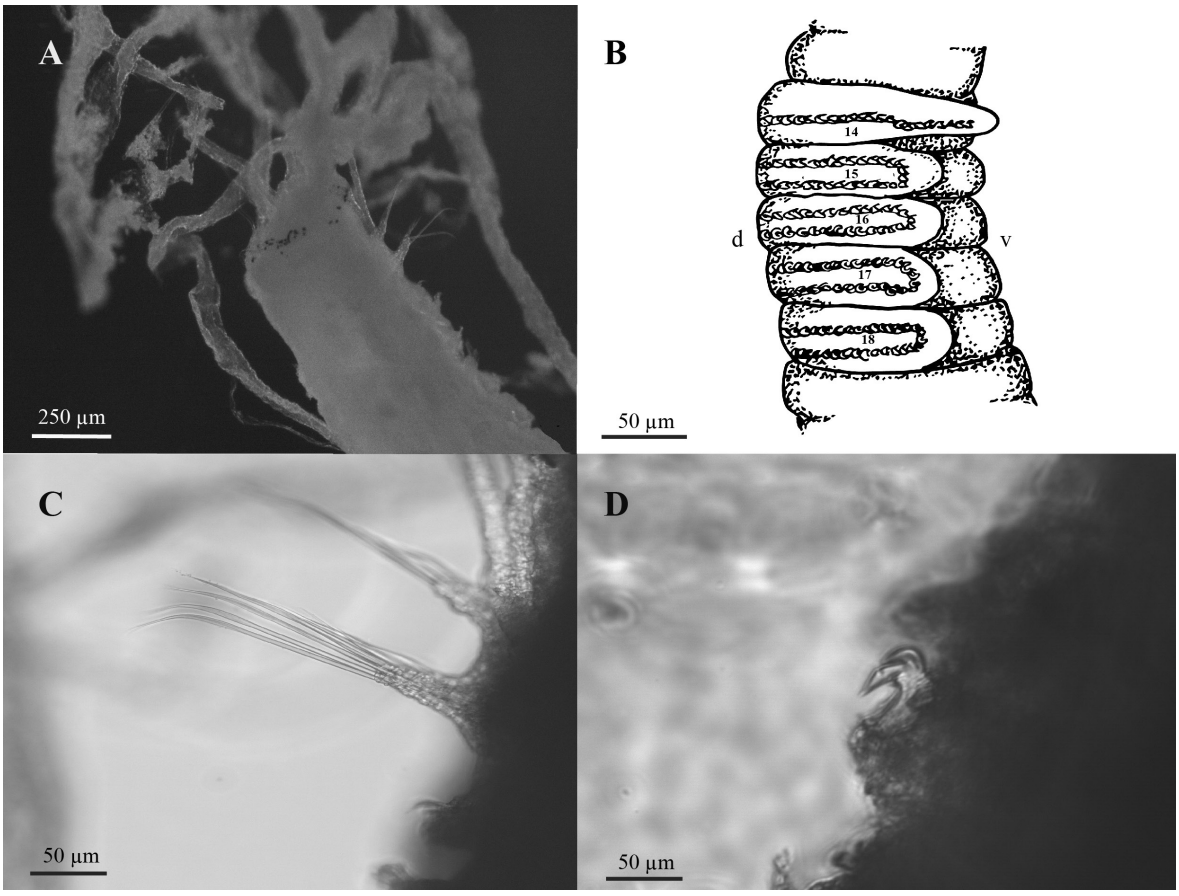

Fig. 4. *Streblosoma nogueirai*; anterior region (**A**); uncinigerous tori (d – dorsal; v – ventral) (**B**); notochetae from anterior parapodia (**C**); lateral view of uncini from the abdominal part of the body (**D**).

material has been lost (Lezzi and Giangrande, 2019). Langeneck *et al*. (2020) suggest that *S. hesslei* should be removed from the Mediterranean checklists.

Our record represents the second finding of this recently described species in the Mediterranean Sea, and the first record of the species in the eastern Adriatic Sea.

***Lysidice collaris* Grube, 1868**

Material examined

Two specimens, site 1, in an *Ericaria amentacea* dominated algal bed, at a depth of 1 meter, 14 June, 2018.

Dimensions

Specimen 1. Broken in two pieces; 42 mm long; 1 mm wide; 242 chaetigers (Fig. 5)

Specimen 2. 25 mm long; 0.8 mm wide; 170 chaetigers

Remarks

Body slightly iridescent and rounded; prostomium bilobed with three antennas barely reaching the prostomium end, aciculae pale yellow; eyes reniform; compound falciger chetae bidentate and elongated, pectinate chetae with 24 fine teeth.

Lysidice collaris was originally described from the Red Sea (Grube, 1868). It is a widely distributed species across tropical and temperate zones. It is reported to be found in the Indo-Pacific region, Red Sea as well as the Caribbean Sea and the Gulf of Mexico (Fauchald, 1970; Ben-Eliahu, 1972, 1976; Gambi *et al*., 2003). The species is reported to inhabit and bore calcareous algae, and therefore it is commonly found in shallow and deep water coralligenous habitats (Ben-Eliahu, 1976; Martin, 1987). In the Mediterranean, it is considered an alien species believed to have originated from the Red Sea, probably introduced through the Suez Canal, and has since spread its distribution (Zenetos *et al*., 2010; Occhipinti-Ambrogi *et al*., 2011). However, Çinar (2005), and Kurt-Şahin and Çinar (2009; 2017) oppose the concept that *L. collaris* was introduced into the Mediterranean through the Suez Canal, and suggest re-examining reports in the eastern Mediterranean, suspecting they might belong to a closely similar species native in the Mediterranean, *Lysidice margaritacea* Claparède, 1868. On the other hand, the presence of *L. collaris* in the western Mediterranean has been proven (Kurt-Şahin and Çinar, 2017). Several studies have reported the presence of the species in multiple locations in the Mediterranean: near Catania in Sicily, Ionian Sea, in the upper infralittoral zone (Tenerelli, 1962); on

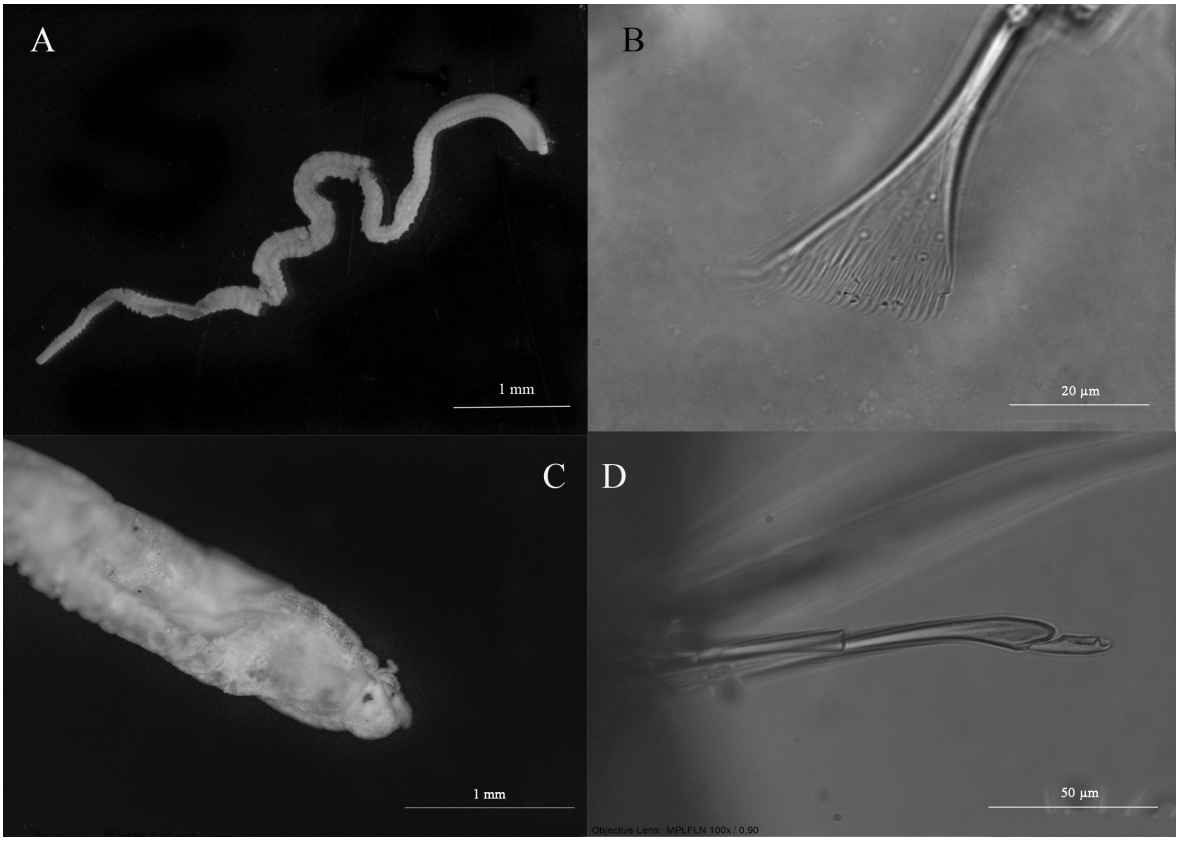

Fig. 5. *Lysidice collaris*; whole specimen (**A**); pectinate chetae (**B**); anterior region (**C**); hooded hook (**D**).

the Catalan coasts of the Iberian peninsula, from the calcareous algae concretions in the littoral zone (Martin, 1987); near Balearic islands in *Posidonia oceanica* rhizomes from 0 to 40 metres of depth (Sardá, 1991); in Antalya Bay in southern Turkey on hard-substrata covered by algae (Ergen and Çinar, 1997); at Pianosa Island, Tyrrhenian Sea, in coralligenous habitat at 35 metres of depth (Bedini *et al*., 2014); and near Tuscany, in Ligurian sea, on rocky substrate covered by macroalgae at 6 metres of depth (Pinna *et al*., 2020).

In the Adriatic Sea, *L. collaris* was reported near Otranto in the south Adriatic Sea in hard bottom infralittoral algal fringe at 5 and 15 metres of depth (Giangrande *et al*., 2003, 2004; Gambi and Cigliano, 2006); at the island of Brač, in central Adriatic Sea, from *P. oceanica* rhizomes (Iannotta *et al*., 2007); in the vicinity of city of Rovinj in northern Adriatic Sea on hard bottoms covered by algae from 5 to 25 metres, as well as in soft bottoms collected with a grab (Mikac, 2015); in Kvarner Bay ports in the north Adriatic Sea on hard substrata from 3 to 7 metres of depth (Travizi *et al*., 2018); in Pula and Rijeka harbors in the north Adriatic Sea on hard-bottoms (Spagnolo *et al*., 2019), near Otranto in the south Adriatic Sea, in mesophotic bioconstructions at 40 to 50 metres of depth (Gravina *et al*., 2021) in Capraia island and Castellammare del Golfo, Tyrrhenian sea, on hard-bottoms at 0,2 and 5 metres of depth (Langeneck *et al*., 2020) and along the Cyprus coasts, both in soft and hard bottoms, in associations with flora or sponges, from 0-46 metres of depth (Rousou *et al.*, 2023). Langeneck *et al*. (2020) suggest that the majority of reports from the Italian coasts probably belong to a closely similar congener, *L. margaritacea*.

Our finding indicates a new documented presence of the species in the Adriatic Sea. Considering all the sites where the species was documented, it may be inferred that it has successfully established a consistent population throughout the Mediterranean, as well as across the north, central, and south Adriatic Sea. Geo-referenced findings of alien species, including the present one, are highly valuable for evaluating their invasion progress and distribution patterns, as well as the invasion potential (Katsanevakis *et al*., 2020).

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