

ANNALES

Anali za istrske in mediteranske študije
Annali di Studi istriani e mediterranee
Annals for Istrian and Mediterranean Studies
Series Historia Naturalis, 34, 2024, 2





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Series Historia Naturalis, 34, 2024, 2

ISSN 1408-533X
e-ISSN 2591-1783

UDK 5

Letnik 34, leto 2024, številka 2

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Založništvo PADRE d.o.o.

Izdajatelj/Editori/Published by:

Zgodovinsko društvo za južno Primorsko - Koper / Società storica del Litorale - Capodistria®

Inštitut IRRIS za raziskave, razvoj in strategije družbe, kulture in okolja / Institute IRRIS for Research, Development and Strategies of Society, Culture and Environment / Istituto IRRIS di ricerca, sviluppo e strategie della società, cultura e ambiente®

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SI-6330 Piran / Pirano, Fornače/Fornace 41, tel.: +386 5 671 2900, fax +386 5 671 2901;
e-mail: annales@mbss.org, internet: www.zdjp.si

Redakcija te številke je bila zaključena 16. 12. 2024.

**Sofinancirajo/Supporto finanziario/
Financially supported by:**

Javna agencija za znanstveno-raziskovalno in inovacijsko dejavnost Republike Slovenije (ARIS)

Annales - Series Historia Naturalis izhaja dvakrat letno.**Naklada/Tiratura/Circulation:**

300 izvodov/copie/copies

Revija Annales, Series Historia Naturalis je vključena v naslednje podatkovne baze / La rivista Annales, series Historia Naturalis è inserita nei seguenti data base / Articles appearing in this journal are abstracted and indexed in: BIOSIS-Zoological Record (UK); Aquatic Sciences and Fisheries Abstracts (ASFA); Elsevier B.V.: SCOPUS (NL); Directory of Open Access Journals (DOAJ).

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received: 2024-08-14

DOI 10.19233/ASHN.2024.23

NEW NON-NATIVE AND RARE MARINE INVERTEBRATES IN SYRIAN WATERS

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ABSTRACT

Recent biological surveys of the Syrian coast have documented the first occurrences of non-native species from various origins, as well as rare native species. This paper describes the first findings of Isognomon bicolor (C. B. Adams, 1845), Escharoides coccinea (Abildgaard, 1806), Tyrodina perversa (Gmelin, 1791), Planocera graffi Lang, 1879, and Planocera pellucida (Mertens, 1833) in Syrian waters, and provides further information on Branchiomma luctuosum (Grube, 1870). The impact of non-native species on native biodiversity is briefly discussed.

Key words: non-native species, rare species, Eastern Mediterranean, Syria

NUOVE SPECIE DI INVERTEBRATI MARINI ALLOCTONI E RARI IN ACQUE SIRIANE

SINTESI

Recenti indagini biologiche lungo la costa siriana hanno documentato le prime presenze di specie alloctone di varia origine e di rare specie autoctone. Il presente lavoro descrive i primi ritrovamenti di Isognomon bicolor (C. B. Adams, 1845), Escharoides coccinea (Abildgaard, 1806), Tyrodina perversa (Gmelin, 1791), Planocera graffi Lang, 1879 e Planocera pellucida (Mertens, 1833) nelle acque siriane e fornisce ulteriori informazioni su Branchiomma luctuosum (Grube, 1870). L'impatto delle specie alloctone sulla biodiversità autoctona viene brevemente discusso.

Parole chiave: specie alloctone, specie rare, Mediterraneo orientale, Siria

INTRODUCTION

The dispersal of non-native species far from their original distribution areas, along with the expansion of their geographical range and impact, is a significant concern in biology and ecology (Albano *et al.*, 2021a; MMC, 2024). The migration of these species occurs through various pathways, including biofouling (Ulman *et al.*, 2019), ballast water, waterways, and mariculture (Vidas & Kostelac, 2011). The presence of invasive species in shipyards and marine docks reinforces the belief that ports are the main transit gateway for these species via shipping (Tempesti *et al.*, 2020; Massé *et al.*, 2023; Serrano *et al.*, 2023). Inventories of non-native species have been compiled for various regions of the Mediterranean Sea, with 1006 non-native marine species documented as of 2020 (Galanidi *et al.*, 2023). An increase in the number of species of tropical Atlantic and Indo-Pacific origin has been reported throughout the Mediterranean Sea, with the largest number of them found in the Eastern Mediterranean and Italy (Tiralongo *et al.*, 2022; Zenetos *et al.*, 2022; Christidis *et al.*, 2024). This significant change in the species composition of Mediterranean bio-communities is attributed to the environment's readiness to be invaded by alien species due to the diversity of climatic conditions and circumstances across its regions, from temperate to subtropical (Vermeij, 2011; Pisano *et al.*, 2020). The climate warming in the eastern Mediterranean is accelerating the loss of native biodiversity and creating conditions suitable for the settlement and stability of tropical species (Albano *et al.*, 2021b; Digenis *et al.*, 2024).

However, continuing research and increased field efforts help track the presence of new and rare invertebrate species in the Mediterranean Sea and determine their biological and environmental characteristics. Reporting the occurrence of rare and endangered species and studying their geographical distribution is important for enhancing knowledge of biodiversity and managing these species. Many rare species in the Mediterranean have been discussed in collective articles (Santin *et al.*, 2021; Tsagarakis *et al.*, 2021), and many have been documented in specific habitats such as marine protected areas and caves (UNEP/MAP - SPA/RAC, 2022). The marine environment in Syria, part of the eastern Mediterranean, has seen a significant rise in the number of non-native species discovered in recent years, especially at port sites, which are hotspots for biological invasion. Their percentage exceeded 36% in the fishing port of Ras al-Basit (Alo, 2024) and 50% in the Al-Massab basin (Ammar, 2023a). Among them, several Atlantic tropical species have been documented, including the anemone *Teimactis panamensis* (Verrill, 1869) (Arabia *et al.*, 2023), the yellow sponge *Aplysina*

insularis (Duchassaing & Michelotti, 1864) (Ammar *et al.*, 2023a), and the red alga *Hypnea cornuta* (Kützinger) J. Agardh, as well as some cephalopods and marine crabs (Ammar *et al.*, 2023b). Their presence can be attributed to maritime transport activities, which have greatly aided long-distance migration of warm-water species to environments experiencing increasing temperatures due to global warming, especially to the eastern Mediterranean (Costa *et al.*, 2019; Zittis *et al.*, 2022).

In this research, we highlight records of marine



Fig. 1: Study areas in the Syrian coast.
Sl. 1: Obravnavana območja sirske obale.

invertebrates new to Syrian waters, in particular non-native benthic species, but also rare native species. The continuous influx of non-native benthic species into the Syrian marine environment, and the increasing number of newly established species pose a significant threat to local marine biodiversity. This trend aligns with a potential scenario in which the entire Mediterranean Sea transforms into a tropical sea due to the invasion of species from the tropical Atlantic, as well as Indian and Pacific Oceans (Albano *et al.*, 2024).

MATERIAL AND METHODS

The species were observed and collected through diving between 2020 and 2024 from rocky substrates at several locations in the tidal and subtidal zones of the southern and northern sectors of the Syrian coast (Fig. 1). Some species were observed and photographed on site, while specimens of others were collected, transported to the laboratory at the High Institute of Marine Research, and preserved in 5% formaldehyde. The samples were classified following the keys of Riedl (2011), Bariche (2012), and Zenetos *et al.* (2003), along with specialized references and databases (MolluscaBase, 2023), adopting the nomenclature from the World Register of Marine Species (WoRMS, 2024).

RESULTS AND DISCUSSION

Planocera graffi Lang, 1879

Planocera pellucida (Mertens, 1833)

(Platyhelminthes: Polycladida: Planoceraidae)

These two species belong to the phylum Platyhelminthes, or flatworms. This is a very diverse phylum with more than 100,000 species known to date (Rawlinson, 2014). The genus *Planocera* Blainville, 1828 is widely distributed throughout the world's seas and is represented in the Mediterranean Sea by three species (Rawlinson, 2014): *Planocera folia* Grube, 1840, *Planocera graffi* Lang, 1879, and *Planocera ceratommata* (Palombi, 1936).

Five individuals belonging to the genus *Planocera* Blainville, 1828, were collected in 2021, 2022, and 2023 from four different sites. The samples were photographed, collected, and preserved in 5% formalin. Two individuals were collected in 2022, respectively, from the underside of beach stones near the High Institute of Marine Research (35.5922090°N, 35.742187°E) (Fig. 2a) and from the Al-Massab site north of Tartus (34.9684°N, 35.8750°E) (Fig. 2b). Both were classified as *Planocera graffi* Lang, 1879, identified according to relevant references (Lang, 1879, 1884; Faubel, 1983; Digenis *et al.*, 2024). The length of the individuals did not exceed 12 mm and the width

was approximately 9 mm. The body shape was broadly oval, almost round, with the edges slightly ruffled; the ground color was yellow-orange, with an accumulation of reddish network-like pigment granules along the midline of the body following the branches of the intestine. The terminal branches on the dorsal side and the edges of the body of this species can sometimes reflect the white color. The body appeared fleshy but very transparent and delicate. There were two conical tentacles near the brain, away from the edges, with numerous eyes at the base of each tentacle. There were many small cerebral eyes in front of and behind the tentacles, the latter more abundant than the former. The broad, frilled pharynx occupied the central region of the body.

A third specimen of *P. graffi* was collected on 1 September 2021 from the fishing port of Ras al-Basit (35.854361°N, 35.817528°E). It was characterized by its thickness, the white coloration of its ventral face, and different patterns on its upper surface (Fig. 2c). A similar individual (a fourth specimen) of the same species was collected from the Marine Research Area in the same year (Fig. 2d).

Planocera graffi was first described in the Gulf of Naples, Italy (Lang, 1879, 1884; Tyler *et al.*, 2012). Its presence has since been recorded in Cape Verde, along the Catalan coast (Faubel & Noreña, 2001), and the Spanish coast (Marquina *et al.*, 2014). While it has recently also appeared in marine caves in Greece (Digenis *et al.*, 2024), this is the first time it has been reported from Syria and the eastern Mediterranean. It is unclear whether this delay in its discovery is due to the species' rarity in the region or its late, only recent arrival in the area.

A fifth *Planocera* specimen was collected on 22 September 2023 from the beach of Chalet Al-Basit (35.850389°N, 35.842139°E) at a depth of 3 m, and was identified as *P. pellucida* (Mertens, 1833) (Fig. 2e), a cosmopolitan species occurring in the Atlantic, North Sea, Pacific Ocean, and Red Sea (Faubel, 1984; Marquina *et al.*, 2014; Digenis *et al.*, 2024). Lang (1879, 1884) noted strong similarity between *P. pellucida* and *P. pelagica* (Moseley, 1877), which led Faubel to adopt the former name as a synonym of the latter (1983). Bock (1913) and Faubel (1983) also explained some morphological differences between *P. pellucida* and *P. graffi*. The former is typically oval and tapers towards the back, while the latter is round and sometimes wider than it is long. However, *P. pellucida* may exhibit both slightly elongated and rounded forms (Prudhoe, 1985), and this variation is the only difference between the two species. An anatomical study conducted on samples of the two species from the Atlantic Ocean and Mediterranean Sea showed no differences between them, leading to suggestion to synonymize

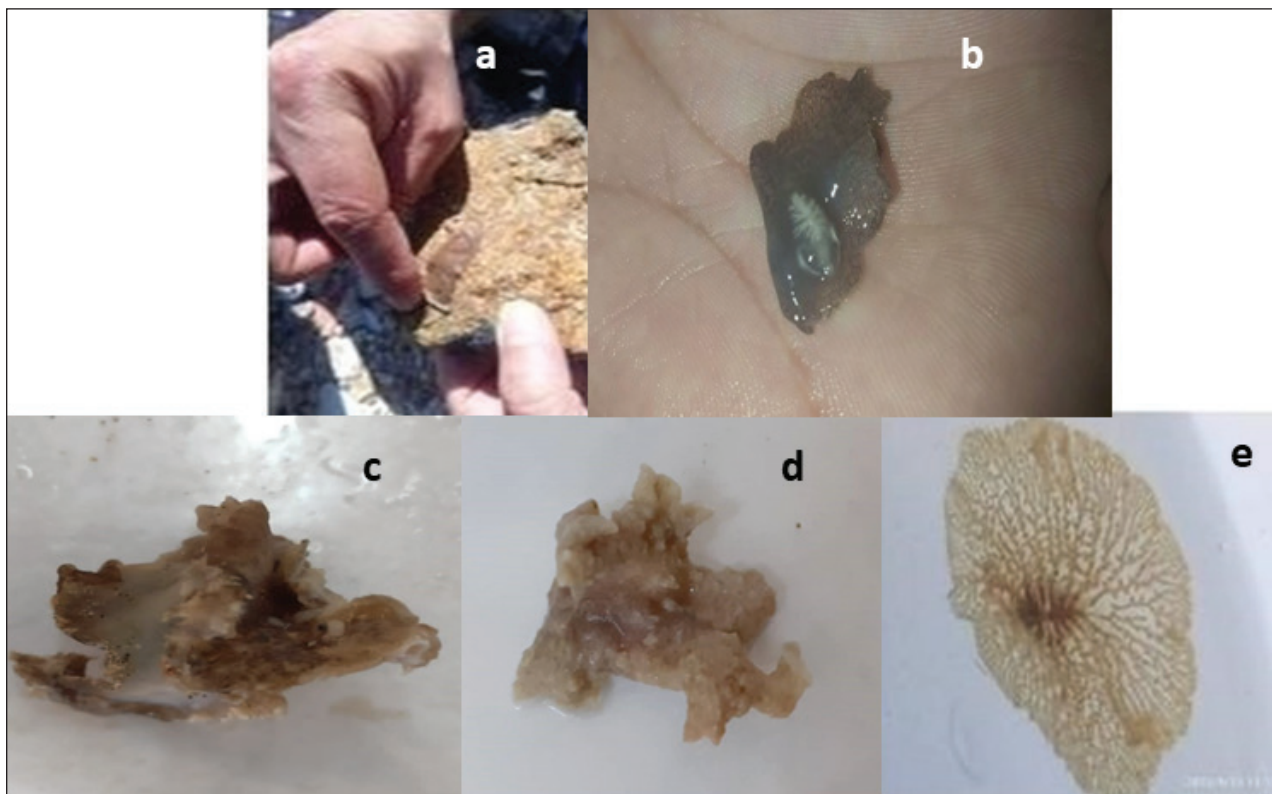


Fig. 2: Different specimens of *Platyhelminthes* *Planocera graffi* (a, b, c, d) and *Planocera pellucida* (e) from the Syrian coast.
Sl. 2: Različni primerki vrtničarjev *Planocera graffi* (a, b, c, d) in *Planocera pellucida* (e) iz sirske obale.

P. graffi with *P. pellucida* (Marquina *et al.*, 2014). Consequently, the distribution of *P. pellucida* now also includes the Mediterranean (Cuadrado *et al.*, 2021). It is worth noting that the finding described in the present study is the first record of this species in Syrian coastal waters.

***Tylodina perversa* (Gmelin, 1791)**

(Heterobranchia: Umbraculidae: Tylodinidae)

This species of mollusk is typically found in the North Atlantic Ocean and in the western and eastern Mediterranean (WoRMS, 2024), but it has also been recorded in the Aegean and Mediterranean Turkish waters (Öztürk *et al.*, 2014) and reported from the Levantine Basin, specifically Cyprus (Öztürk *et al.*, 2004). Recently, it has also appeared in the western and eastern Adriatic according to Zenetos *et al.* (2016) and, spotted at a depth of 12.3–31.4 m, on the Sicilian island of Pantelleria (Lombardo & Marletta, 2023). A single specimen, not exceeding 3 cm in length, was observed and photographed on 18 June 2024, on the Latakia coast opposite Sports City (35.572912°N, 35.732057°E), at a depth of 9–10 meters (Fig. 3). It was identified from photos following Riedl (2011).

Tylodina perversa is commonly found on yellow sponges of the genus *Aplysina*. In fact, the presence of two species from this genus, *A. insularis* (Duchassaing & Michelotti, 1864) and *A. aerophoba* Nardo, 1843, has been previously documented at this site and several others along the Syrian coast (Ammar *et al.*, 2008; Ammar *et al.*, 2023a). This is the first observation of *T. perversa* on the Syrian coast. The species was not included in the list by Ammar (2024) as it was discovered after the publication of that work.

***Isognomon bicolor* (C. B. Adams, 1845)**

(Mollusca: Bivalvia: Ostreida: Isognomonidae)

The purse oyster *I. bicolor* is distributed in the South Atlantic Ocean, including the Caribbean Sea, Colombia, Cuba, the Gulf of Mexico, and Venezuela. The presence of the genus *Isognomon* was first recorded in the Mediterranean Sea in 2004 (Öztürk & Salman, 2004) and confirmed in Turkey and Greece in 2017 (Ovalis & Zenetos, 2017; Angelidis, 2017). It was also recorded in Libya, Cyprus, and the Aegean Sea but under different names, until molecular evidence confirmed that the species found in the Mediterranean was the Atlantic oyster *Isognomon bicolor*.



Fig. 3: *Tylodina perversa* from Latakia coast (Syria). Photograph by Nouh Abbas.
Sl. 3: *Tylodina perversa* iz obale Latakije (Sirija). Fotografija: Nouh Abbas.

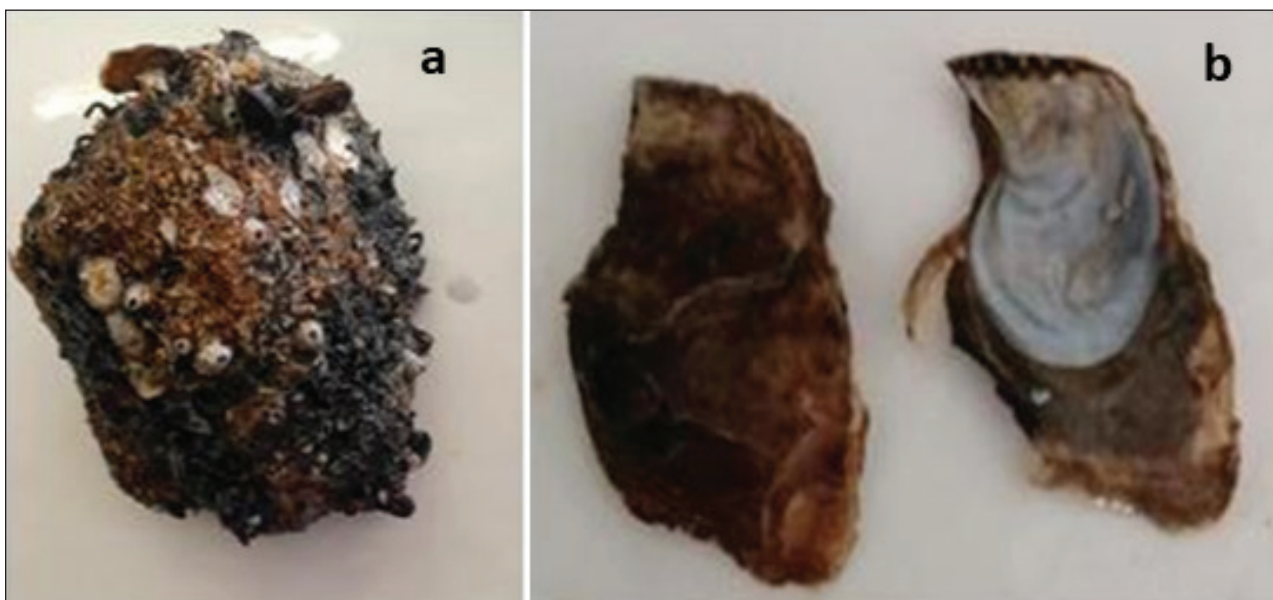


Fig. 4: *Isognomon bicolor* from the Al-Ahlam beach near Tartus (a) and from the Tartus seaport (b).
Sl. 4: *Isognomon bicolor* s plaže Al-Ahlam beach blizu Tartusa (a) in iz pristanišča Tartus (b).



Fig. 5: Underwater photographs of the bryozoan *Escharoides coccinea* from the Ibn Hani MPA, north of Latakia (Syria). Photograph by Nouh Abbas.

Sl. 5: Podvodne fotografije mahovnjaka vrste *Escharoides coccinea* iz morskoga zavarovanega območja Ibn Hani, MPA, severno od Latakije (Sirija). Fotografija: Nouh Abbas.

This finding suggests that global climate change may have facilitated the species' introduction and rapid spread in the Mediterranean Sea (Garzia *et al.*, 2022). In Syria, the species was observed, photographed, and collected for the first time on the intertidal rocky shore at Ahlam Beach (34.863154°N, 35.886355°E) near Tartus (Ammar, 2023b) on 31 May 2023 (Fig. 4a). The specimens were identified following Zenetos *et al.* (2003) and Garzia *et al.* (2022). Subsequently, many additional individuals were collected from Tartus seaport (34.87395°N, 35.880702°E) in June 2024 (Fig. 4b). Current field work reports an abundance of *I. bicolor* in the ports of Tartus and Arwad Island.

***Escharoides coccinea* (Abildgaard, 1806)**

(Bryozoa: Gymnolaemata: Cheilostomatida: Exochellidae)

The bryozoan *Escharoides coccinea* forms orange-red, crust-like colonies composed of numerous square zooids with a convex surface. The upper surface of each zooid exhibits a wide orifice covered by a gill structure featuring a broad shelf along the outer edge and tooth-like projections along its inner edge. The individuals (zoophages) are separated from each other by deep furrows. The side of the opening that faces the colony edge bears an arch of 6 long tubular spines and is lined by large pores (source: Bryozoa of the British Isles <https://britishbryozoans.myspecies.info/>). The species was observed in March 2020, on the rocky bottom of the shallow coastal area of the Ibn

Hani Marine Protected Area (MPA) at a depth of 5 m (Fig. 5) and identified from photos following Richards (2008) and the Checklist dataset of Bryozoa of the British Isles. The species is found in the North Atlantic (Davoult *et al.*, 1993) and the Mediterranean Sea (Gerovasileiou & Rosso, 2016; Achilleos *et al.*, 2020). This bryozoan has not been recorded in Syria before.

***Branchiommma luctuosum* (Dalyell, 1853)**

(Annelida: Polychaeta: Sabellida: Sabellidae)

The polychaete *B. luctuosum* is an invasive non-native species from the Red Sea (Fernández-Romero *et al.*, 2021; Galanidi *et al.*, 2023). It is one of the most frequently recorded non-native species in the Mediterranean, from the western to the eastern basin (Çinar, 2009; Tempesti *et al.*, 2020), and is currently spreading along the Mediterranean coasts of Morocco (Mabrouki & Taybi, 2024). Several individuals of this invasive species were observed in October 2021 in the subtidal zone of the Al-Massab basin north of Tartus (Ammar, 2023a), where the bottom is rocky and covered by a thin layer of sand (Fig. 6a, b, c). Identification was carried out following El Haddad *et al.* (2008) and Licciano *et al.* (2012). A clear decline in the native species *Sabella spallanzanii* (Gmelin, 1791) on the Syrian coast may have been brought on by the presence of *B. luctuosum* (personal observations), as competition between these two species is also believed to exist in Mediterranean ports and coastal ponds (Flagella & Abdulla, 2005). Large



Fig. 6: The polychaete *Branchiomma luctuosum* from Tartus (Syria). Photograph by Mahmoud Halhal.
Sl. 6: Mnogoščetinec vrste *Branchiomma luctuosum* iz Tartusa (Sirija). Fotografija: Mahmoud Halhal.

numbers of *B. luctuosum* were collected recently, in June 2024, as part of biofouling removal in Tartus seaport (Fig. 6d).

Unpublished data from an ongoing study limited to the fishing ports of Tartus and Arwad Island indicate a high proportion of non-native bivalves, echinoderms, ascidians, and polychaetes, with some species even becoming dominant (Ammar, 2023a; Alo, 2024). Studies examining the spread of non-native species in Syrian ports, particularly the two largest commercial terminals in Tartus and Latakia, and the oil port of Baniyas, but also the main fishing ports in Baniyas, Jableh, and Latakia, will no doubt contribute to the early detection of these species, help explain the mechanisms of their migration and arrival in the region, and

fill related knowledge gaps. Furthermore, these data could be integrated into monitoring and assessment programs for the Mediterranean Sea.

The occurrence of Atlantic species reported in the present study (*O. patagonica* and *I. bicolor*) and others previously documented in Syria and the Levantine Sea, along with their increasing numbers over time, confirms the rapid trend of these species passing through the Strait of Gibraltar and the western Mediterranean to settle in the region (Bianchi *et al.*, 2012). The Syrian coast evidently provides a favorable environment for these newcomers, which could significantly impact native biodiversity in the eastern Mediterranean if they succeed in establishing themselves.

NOVI PRIMERI O POJAVLJANJU TUJERODNIH IN REDKIH MORSKIH NEVRETENČARJEV V SIRSKIH VODAH

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POVZETEK

Nedavne biološke raziskave sirske obale so obelodanile prve pojave nekaterih tujerodnih vrst iz različnih okolij, pa tudi nekatere redke domorodne vrste. Avtor opisuje prvi primer najdbe vrst *Isognomon bicolor* (C. B. Adams, 1845), *Escharoides coccinea* (Abildgaard, 1806), *Tylodina perversa* (Gmelin, 1791), *Planocera graffi* Lang, 1879, in *Planocera pellucida* (Mertens, 1833) v sirskih vodah ter podaja dodatne podatke o vrsti *Branchiomma luctuosum* (Grube, 1870). Nadalje avtor razpravlja o vplivu tujerodnih vrst na domorodno biodiverziteto.

Ključne besede: tujerodne vrste, redke vrste, vzhodno Sredozemsko morje, Sirija

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