



Arrivals and departures: exploring sea slug diversity (Mollusca, Gastropoda) in the Salento Peninsula harbours

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Abstract

This study investigates the Heterobranchia species present in the harbours of the Salento Peninsula, in southern Italy, in the central Mediterranean Sea. A total of 158 specimens from 21 families and 54 species were recorded from 2020 to 2025, including five non-indigenous species (NIS): *Anteaeolidiella lurana*, *Bermudella polycerelloides*, *Camachoaglaja africana*, *Polycera hedgpethi* and *Stiliger* cf. *auarita*. Among the total 54 Heterobranchia species, one is a new record for the Mediterranean Sea; five are new records for the Ionian and/or Adriatic Seas; and 12 species are added to the Salento Peninsula fauna. The finding of about one-third of the total number of species known for the Salento Peninsula, from ports and marinas is noteworthy and emphasizes the need for continuous monitoring of areas under anthropological stress for early warning of NIS and of neglected endemic diversity. The methodology used to collect heterobranchs in these restricted access habitats revealed to be powerful and effective to unravel small and difficult-to-see organisms such as most of the species here recorded. This research contributes to expanding the knowledge of marine Heterobranchia biodiversity enhancing the known Mediterranean diversity and shedding light on anthropized and poorly known environments such as harbours and marinas.

Keywords Checklist · Heterobranchia · Non-indigenous species · Mediterranean Sea · Italy

Introduction

The Mediterranean Sea is a global hub for maritime activity with harbours classified as “Heavily Modified Water Bodies” that play a pivotal role in commercial traffic, passenger transport and recreational boating (Chatzinikolaou

et al. 2018; WFD 2000/60/EC). These highly anthropized areas are critical marine ecosystems characterized by artificial substrate, low oxygen levels, restricted hydrodynamics, high organic content and intense pollution resulting from port activities and maritime traffic (Cognetti and Maltagliati 2005; Romeo et al. 2015). Maritime activity, particularly in harbours, plays a key role in the spread of marine species primarily through hull fouling and ballast water, making ports as hotspots for marine species exchange (Occhipinti-Ambrogi et al. 2011; Seebens et al. 2013; Katsanevakis et al. 2013; Romeo et al. 2015; Tempesti et al. 2020a, b; Tempesti et al. 2025). An ever-increasing bibliography focused on this issue has revealed the crucial role played by ports and marinas in the introduction, establishing and possible spread of non-indigenous species (NIS) into the Mediterranean Sea (Ulman et al. 2017; Ferrario et al. 2017; Tempesti et al. 2020a; Mioni and Furfaro 2022). Harbours can be divided into commercial harbours influenced by national or international traffic (with cargo ships) or touristic ports influenced by local traffic and artisanal fishery (Tempesti et al. 2020b). Regardless of the typology to which they belong, these semi-enclosed areas with characteristic physical and environmental features constitute a unique environment that can host various marine

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organisms, including Heterobranchia. This specialized group of marine molluscs are characterized by the reduction, internalization, or complete loss of their shell during the adult stage, a significant evolutionary change that developed alongside highly specialized defensive mechanisms (Cimino and Ghiselin 1998; Wägele and Klussmann-Kolb 2005; Putz et al. 2010; Winters et al. 2018; Furfaro and Mariottini 2021). The defensive chemical or mechanical compounds are typically stolen from Heterobranchia prey like sponges, ascidians, or cnidarians, although some species can modify or synthesize *de novo* new active molecules (Willis et al. 2017; De Masi et al. 2015; Avila et al. 2018; Goodheart et al. 2018; Maggioni et al. 2023). To enhance predator recognition and avoidance, they often pair these compounds with bright colour patterns that act as aposematic signals (Avila 1995; Ritson-Williams and Paul 2007; Winters et al. 2022). A high number of sea slugs are stenophagous and feed on species specific invertebrates or algae (Kaligis et al. 2018a, b; Furfaro et al. 2017; Canessa et al. 2021). This group of shell-less molluscs are usually collected from coastal areas by hand picking technique through SCUBA diving to not damage their soft bodies; however, this methodology has inherent limitations, such as a limited range of collecting depth (around 40 m as the maximum depth), the preference for clean waters and biodiverse marine environments and the direct dependence on the ability and skill of the diver (Parera et al. 2020; Toma et al. 2022; Furfaro et al. 2024). However, to investigate heterobranchs from less known Mediterranean marine environments, such as coastal lagoons, rocky tide pools, harbours and marinas, and the deep sea requires different sampling techniques due to the different accessibility (physical or regulatory) of the aforementioned places (Furfaro et al. 2018, 2020a; 2024; Chimienti et al. 2020; Parera et al. 2020; Mioni and Furfaro 2022; Toma et al. 2022; Toso et al. 2024). In this context the Salento Peninsula (Southern Italy) revealed a hot spot for the Heterobranchia fauna with a total of 160 species reported so far (Furfaro et al. 2020b) and characterized by a strategic position being located in the Central Mediterranean Sea between the Adriatic and the Ionian Seas, in front of the Suez Canal (Bonanno and Orlando-Bonaca 2019; Kalimeris and Kassis 2020; Albano et al. 2020; 2021; Toso and Musco 2023; Martines et al. 2023, 2024). The Salento Peninsula hosts two commercial harbours and a total of around 30 touristic ports and marinas. The two commercial ports are the harbour of Brindisi (in the Adriatic Sea) and the harbour of Taranto (in the Ionian Sea), already known for the presence of a high number of alien species, especially in the Gulf of Taranto where aquaculture plants and mussel farming facilitate this phenomenon (Borghese et al. 2025; Tempesti et al. 2020a; Garzia et al. 2022; Langeneck et al. 2024). Furthermore, the high number of touristic ports and marinas

(defined as small, almost natural port with very few boats, mainly used for costal fishing) in this Southern Apulian area is noteworthy because these anthropogenic sites can play a crucial role in the exchange of native and NI species also at local scale (Ferrario et al. 2017; Langeneck et al. 2024; Toso and Musco 2023). Although the importance of these environments also for the protection of the Mediterranean endemic diversity, no systematic study on Heterobranchia within Mediterranean harbours has been conducted so far except for one study which focused on the Heterobranchia fauna inhabiting Spanish harbours (in the Barcelona area) from which 73 taxa, including two NIS, were reported (Parera et al. 2020). For all these reasons, the present study aims to unravel for the first time in the Central Mediterranean Sea, the Heterobranchia fauna associated with commercial and touristic ports and marinas, highlighting the importance of monitoring understudied environments that are heavily impacted by human activities to provide early warning NIS and protect Mediterranean biodiversity.

Material and methods

Between 2020 and 2025, 30 sampling activities were conducted across 10 different harbours around the Salento Peninsula; namely, two commercial harbours (Brindisi and Taranto), seven touristic ports (San Foca, Otranto, Tricase Porto, Leuca, Gallipoli, Porto Gaio and Santa Caterina), and one marina (Porto Badisco) distributed on both sides of the Salento coasts (Fig. 1; Table 1).

The sampling stations in the commercial harbours were selected in the touristic area, where smaller boats and vessels are located. The qualitative sampling was performed randomly by scraping the harbour walls and collecting material from the mooring buoys and ropes along the docks and the artificial structures from 0 to 3 m. The hard substrate was collected using a homemade scraping device of 200 × 150 mm and made of steel reinforced with an inox steel blade, equipped with a net of 0.5 mm, similar to the instrument previously used by other authors (Tempesti et al. 2022; 2025). In the marina of Porto Badisco and outside the port of Brindisi, the sampling involved also SCUBA diving techniques, allowing the collection of the deepest samplings (up to 15 m). Once the material was collected, it was transported to the University of Salento for further sorting. All the specimens were sorted alive under the stereomicroscope Nikon SMZ800N equipped with the Nikon Digital Sight 1000 camera, on the same day or, at most, the day after collection. Each of the collected individuals was photographed and catalogued with 'RM3_number' voucher, preserved in 96% ethanol and stored at the University of Salento.

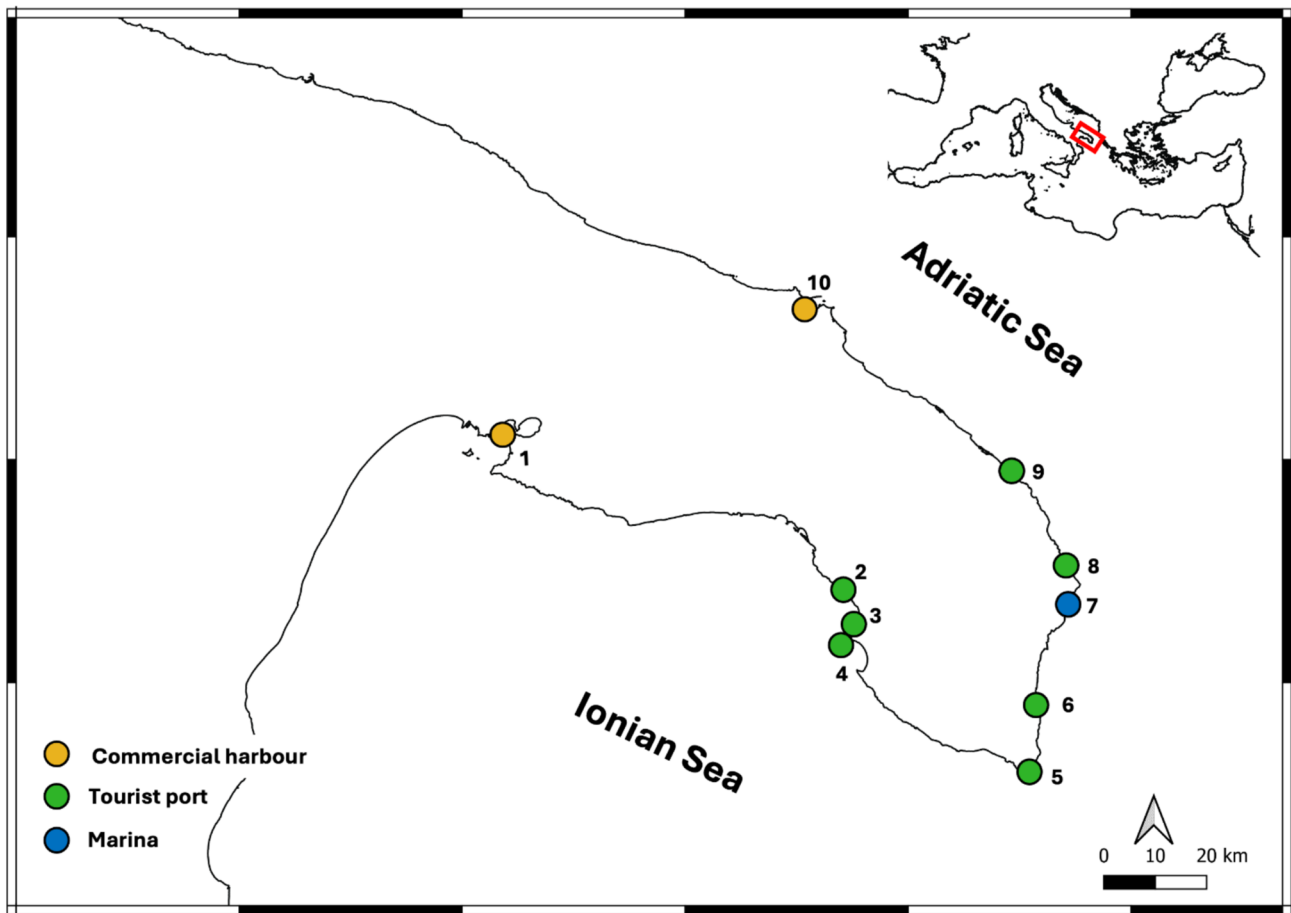


Fig. 1 Map of the study area. The different types of harbours, like commercial and tourist ports and marinas, are highlighted with different colours (yellow, green and blue). All the investigated stations are indicated with numbers from 1 to 10, as follows: (1) Taranto, (2)

Santa Caterina, (3) Porto Gaio, (4) Gallipoli, (5) Leuca, (6) Tricase Porto, (7) Porto Badisco, (8) Otranto, (9) San Foca and (10) Brindisi. Additional information on the sampling stations is reported in Table 1

Results

A total of 158 specimens, belonging to 21 families and at least 54 species, were recorded in the study area (Table 2; Figs. 2, 3, 4 and 5). Among the 54 recorded species, the orders in which they were distributed were as follows: two Aplysiida, four Cephalaspidea, 32 Nudibranchia (grouped in 23 Cladobanchia and nine Doridina), one Pleurobranchida, two Runcinida and 13 Sacoglossa. As expected, the Nudibranchia order was the most species-rich order (32) followed by Sacoglossa (13), Cephalaspidea (4), Aplysiida and Runcinida (2) and Pleurobranchida (1) (Table 2).

Twelve species are added to the list of the Heterobranchia previously known from the Salento Peninsula (Furfaro et al. 2020b) (Table 3) and among the added taxa, four are yet undetermined (*i.e.* *Haminoea* sp. 1, *Haminoea* sp. 2, *Tenellia* sp. 1 and *Stiliger* cf. *auarita* Caballer et al. 2009) and will require further morphological and molecular analyses

to correctly assign them at the species level. A total of five NI species are found in this study (highlighted with the asterisk in Tables 2 and 3): *Camachoaglaja africana* Pruvot-Fol, 1953 found only in the touristic Tricase Porto, *Anteaeolidiella lurana* Ev. Marcus & Er. Marcus, 1967, *Bermudella polycerelloides* Ortea & Bouchet, 1983, *Polycera hedgpethi* Er. Marcus, 1964 exclusively found at the commercial Brindisi harbour and *Stiliger* cf. *auarita*. The latter finding occurred from both sides of the Salento Peninsula, in the Ionian (from Santa Caterina di Nardò; Station 3) and the Adriatic (Brindisi; Station 10) Seas and represents the first finding of this species for the whole Mediterranean Sea (Table 3). The comparison between the number of species found in each station is not possible because a different sampling effort was applied based on the idea that to better investigate the Heterobranchia diversity, it is necessary to preliminary explore the more diverse kind of habitats as possible (Kaligis et al. 2018a, b; Undap et al. 2019; Furfaro

Table 1 The studied harbours with the number of the stations and the geographic coordinates

Italian Sea	Harbour	Station	Geographic coordinates
Ionian Sea	Taranto	1	40°28'40"N 17°13'54"E
	Porto Gaio	2	40°03'37"N 17°59'29"E
	Santa Caterina di Nardò	3	40°08'22"N 17°59'11"E
	Gallipoli	4	40°03'29"N 17°58'44"E
	Leuca	5	39°47'44"N 18°21'45"E
	Tricase Porto	6	39°55'54"N 18°23'45"E
	Porto Badisco	7	40°04'50"N 18°29'01"E
Adriatic Sea	Otranto	8	40°08'49"N 18°29'36"E
	Lecce, San Foca	9	40°18'11"N 18°24'26"E
	Brindisi	10	40°39'29"N 17°57'49"E

et al. 2020b; Chow et al. 2022; Furfaro et al. 2025), and this approach does not allow to design a statistically supported experiment but provides the best results in terms of overall diversity. Despite due considerations, the Brindisi harbour hosted the greatest number of species (almost half of the total collected species) and four out of the five NIS, with three of them exclusively found in this harbour (Table 3).

Unidentified species

***Haminoea* spp.** The specimens with vouchers RM3_2153 (Fig. 2d) and RM3_2679 (Fig. 2e), respectively named as *Haminoea* sp. 1 and *Haminoea* sp. 2, belong to the Haminoeidae Pilsbry, 1895 family due to the overall body shape with the characteristic ovoidal globose shell and the typical lobes of the cephalic portion.

Even if this group of cephalaspidean species was the object of a recent systematic revision which maintained the Atlantic and eastern pacific species in the genus *Haminoea* sensu stricto (type species *Haminoea hydatis* Linnaeus, 1758 from the Mediterranean Sea) (Oskars et al. 2019; Oskars and Malaquias 2019), and some Mediterranean taxa were investigated through an integrative taxonomy approach (Furfaro et al. 2023), to date the species identification based only on external characters is not reliable (Furfaro et al. 2023). For all these reasons, the specimens here observed and collected

were provisionally identified as *Haminoea* sp. 1 and *Haminoea* sp. 2 until further in-depth anatomical and molecular analyses will be done. In particular, the *Haminoea* sp. 1 individual shows an atypical light/whitish colour and shape of the cephalic part that could even suggest a different genus that, however, will be clarified in the future.

***Tenellia* sp. 1** The specimen with voucher RM3_3659 was found exclusively from the tourist port of Gallipoli (Station 4 in Fig. 1 and in Table 1) in the Ionian Sea. This specimen does not recall any known Mediterranean species, and it could be a taxon possibly new for science. In fact, after a careful comparison with all the known taxa, it revealed similar to *Tenellia lucerna* Korshunova, Martynov, Lundin & Malmberg, 2022 a species recently described from Vietnam (Indo-West Pacific region), that however, shows some important differences like a red spot longitudinally in the middle of the head that is lacking in our specimen and a different shape of the red rings in the upper part of the cerata (Korshunova et al. 2023). These characteristics together with the geographical origin of the species suggest that these two taxa are separated species and that *Tenellia* sp. 1 will require a future in depth anatomical and molecular study.

***Stiliger* cf. *auarita*.** Four specimens with vouchers RM3_2918 (Fig. 5j), RM3_2920, RM3_3654 and RM3_3655 were collected from two stations (3 and 10 in Fig. 1) and identified as *Stiliger* cf. *auarita* based on the similar external body shape (Caballer et al. 2009). The Sacoglossan *Stiliger auarita* Caballer et al. 2009 was originally described in 2009 from the Canary Island and recently reported for Cape Verde (Cabbaler et al. 2009; Ortea and Moro, 2017). The specimens found in the Salento Peninsula differ from those reported in the original description of *Stiliger auarita* for the presence, on the notum, of a characteristic bright white trapezoidal spot clearly visible in all the specimens observed in Salento and that is lacking in *Stiliger auarita*. Furthermore, the cerata are less in number and more rounded in the Salento individuals than those described for *Stiliger auarita*. For all these reasons, we conservatively name the specimens here observed as *Stiliger* cf. *auarita* until further integrative analyses will be done to finally assess the species identity.

Discussion

In this study, based on 30 sampling campaigns carried out between 2020 and 2025, heterobranch fauna was investigated from ten heavily anthropized environments, like commercial and touristic ports and marinas, located along the Salento

Table 2 List of all the Heterobranchia species collected during the survey. In bold are the species new for the Salento Peninsula. The symbol (*) indicates the NI species

Order	Family	Species
Aplysiida	Aplysiidae	<i>Aplysia fasciata</i> Poiret, 1789
		<i>Aplysia punctata</i> Cuvier, 1803
Cephalaspidea	Aglajidae	<i>Camachoaglaja africana</i> Pruvot-Fol, 1953*
	Haminoeidae	<i>Haminoea</i> sp. 1 <i>Haminoea</i> sp. 2 <i>Roxaniella jeffreysi</i> Weinkauff, 1866
Nudibranchia (Cladobranchia)	Aeolidiidae	<i>Anteaeolidiella lurana</i> Ev. Marcus & Er. Marcus, 1967* <i>Berghia verrucicornis</i> A. Costa, 1867 <i>Limenandra nodosa</i> Haefelfinger & Stamm, 1958 <i>Spurilla neapolitana</i> Delle Chiaje, 1841
		<i>Doto cervicenigra</i> Ortea & Bouchet, 1989 <i>Doto paulinae</i> Trinchese, 1881 <i>Doto pygmaea</i> Bergh, 1871
	Eubranchidae	<i>Eubranchus exiguus</i> Alder & Hancock, 1848 <i>Eubranchus viriola</i> Korshunova et al., 2020
		<i>Cratena peregrina</i> Gmelin, 1791 <i>Facelina rubrovittata</i> A. Costa, 1866 <i>Favorinus branchialis</i> Rathke, 1806
	Fionidae	<i>Fiona pinnata</i> Eschscholtz, 1831
	Flabellinidae	<i>Edmundsella pedata</i> Montagu, 1816 <i>Flabellina ischitana</i> Hirano & T. E. Thompson, 1990
		<i>Antiopella cristata</i> Delle Chiaje, 1841
	Scyllaeidae	<i>Scyllaea pelagica</i> Linnaeus, 1758
	Trinchesiidae	<i>Tenellia adpersa</i> von Nordmann, 1845 <i>Tenellia genovae</i> O'Donoghue, 1926 <i>Tenellia granosa</i> Schmekel, 1966 <i>Tenellia miniostrata</i> Schmekel, 1968 <i>Tenellia</i> sp. 1
		<i>Candiella manicata</i> Deshayes, 1853
	Nudibranchia (Doridina)	<i>Felimare villafranca</i> Risso, 1818
		<i>Doris ocelligera</i> Bergh, 1881
	Discodorididae	<i>Tayuva lilacina</i> A. Gould, 1852
	Goniodorididae	<i>Bermudella polycerelloides</i> Ortea & Bouchet, 1983*
		<i>Pelagella castanea</i> Alder & Hancock, 1845
	Onchidorididae	<i>Idaliadoris neapolitana</i> Delle Chiaje, 1841
	Polyceridae	<i>Kaloplocamus ramosus</i> Cantraine, 1835 <i>Polycera hedgpethi</i> Er. Marcus, 1964* <i>Polycera quadrilineata</i> O. F. Müller, 1776 <i>Berthella aurantiaca</i> Risso, 1818
Pleurobranchida	Runcinidae	<i>Runcina adriatica</i> T. E. Thompson, 1980 <i>Runcina brenkoe</i> T. E. Thompson, 1980
Sacoglossa	Hermaeidae	<i>Aplysiopsis elegans</i> Deshayes, 1853
	Limapontiidae	<i>Ercolania coerulea</i> Trinchese, 1892 <i>Ercolania viridis</i> A. Costa, 1866 <i>Placida cremoniana</i> Trinchese, 1892 <i>Placida tardyi</i> Trinchese, 1874 <i>Placida viridis</i> Trinchese, 1874

Table 2 (continued)

Order	Family	Species
		<i>Stiliger</i> cf. <i>auarita</i> Caballer et al. 2009*
	Plakobranchidae	<i>Bosellia mimetica</i> Trinchese, 1891
		<i>Elysia timida</i> Risso, 1818
		<i>Elysia gordanae</i> T. E. Thompson & Jaklin, 1988
		<i>Elysia</i> cf. <i>translucens</i> Pruvot-Fol, 1957
		<i>Elysia viridis</i> Montagu, 1804
		<i>Thuridilla hopei</i> Vérany, 1853

Peninsula, in Southern Italy, right in the middle of the Mediterranean Sea. A total of 54 Heterobranchia species were recorded, and, among them, some are rare or newly reported for the Mediterranean Sea (one species), the Ionian and/or Adriatic Seas (five species) or for the Salento Peninsula (12 species) (Tables 2 and 3) (Renda et al. 2022). The last available checklist of the Heterobranchia from the Salento Peninsula (which however did not consider harbours) reported

a total of 160 species distributed between the Ionian and Adriatic Seas (Furfaro et al. 2020b). The finding of about one-third of the total number of species known from the Salento Peninsula, in ports and marinas is noteworthy and highlights the importance of these anthropogenic habitats in hosting a high heterobranch diversity. Four out of the 12 species added to the Salento fauna belong to the genus *Tenellia* A. Costa, 1866, suggesting this genus could mask yet

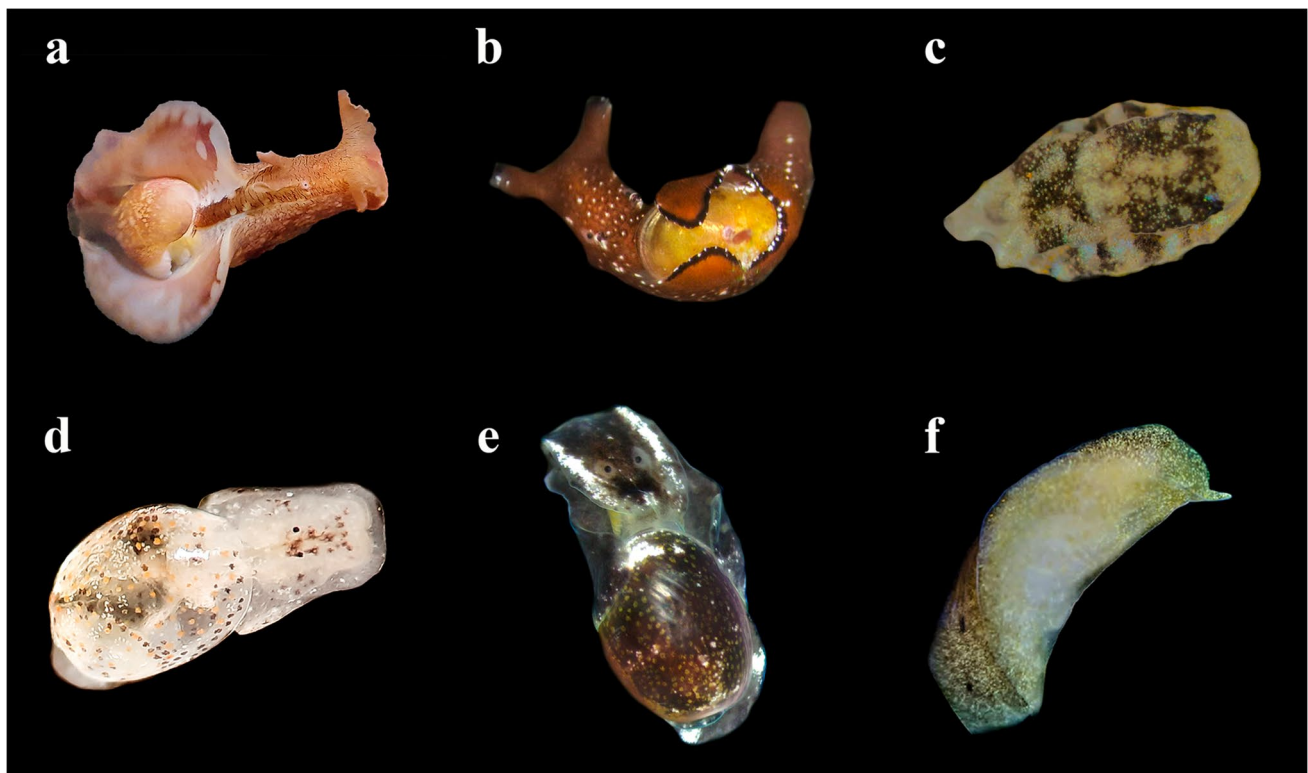


Fig. 2 Images of all the Aplysiida and Cephalaspidea species found in the present study **a** *Aplysia fasciata*, specimen with voucher RM3_2077; **b** *Aplysia punctata*, specimen with voucher RM3_2659; **c** *Camachoaglaja africana*, specimen with voucher RM3_2669;

d *Haminoea* sp. 1, specimen with voucher RM3_2153; **e** *Haminoea* sp. 2, specimen with voucher RM3_2679; **f** *Roxaniella jeffreysi*, specimen with voucher RM3_2847

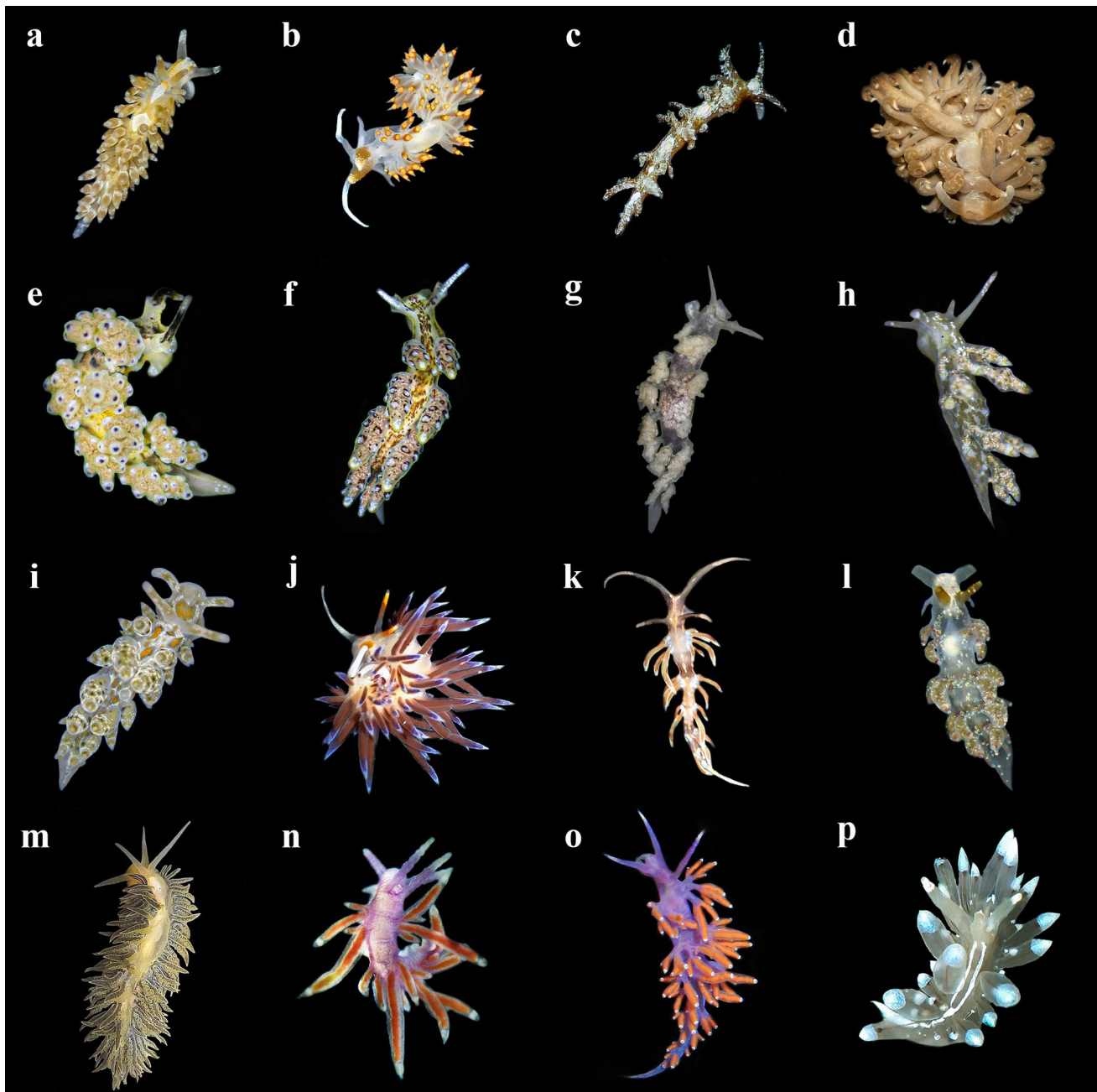


Fig. 3 Images of the Nudibranchia species found in the harbours of the Salento peninsula **a** *Antaeolidiella lurana*, specimen with voucher RM3_2683; **b** *Berghia verrucicornis*, specimen with voucher RM3_2389; **c** *Limenandra nodosa*, specimen with voucher RM3_2079; **d** *Spurilla neapolitana*, specimen with voucher RM3_2894; **e** *Doto cervicenigra*, specimen with voucher RM3_3667; **f** *Doto paulinae*, specimen with voucher RM3_3674; **g** *Doto pygmaea*, specimen with voucher RM3_3502; **h** *Eubranchius*

exiguus, specimen with voucher RM3_3426; **i** *Eubranchius viriola*, specimen with voucher RM3_3396 **j** *Cratena peregrina*, specimen with voucher RM3_2691; **k** *Facelina rubrovittata*, specimen with voucher RM3_2804; **l** *Favorinus branchialis*, specimen with voucher RM3_2664; **m** *Fiona pinnata*, specimen with voucher RM3_3515; **n** *Edmundsella pedata*, specimen with voucher RM3_2904; **o** *Flabellina ischitana*, specimen with voucher RM3_2908; **p** *Antiopella cristata*, specimen with voucher RM3_2154

hidden Mediterranean diversity. The case of *Tenellia* species is noteworthy and deserves particular attention, considering that four out of the five *Tenellia* species here observed are new for the Salento fauna and include two overlooked

species and one possibly new for science. In fact, only two species, *Tenellia adspersa* and *T. genovae*, can be confidently identified, having well-defined external diagnostic features and being species whose diffusion is verified on

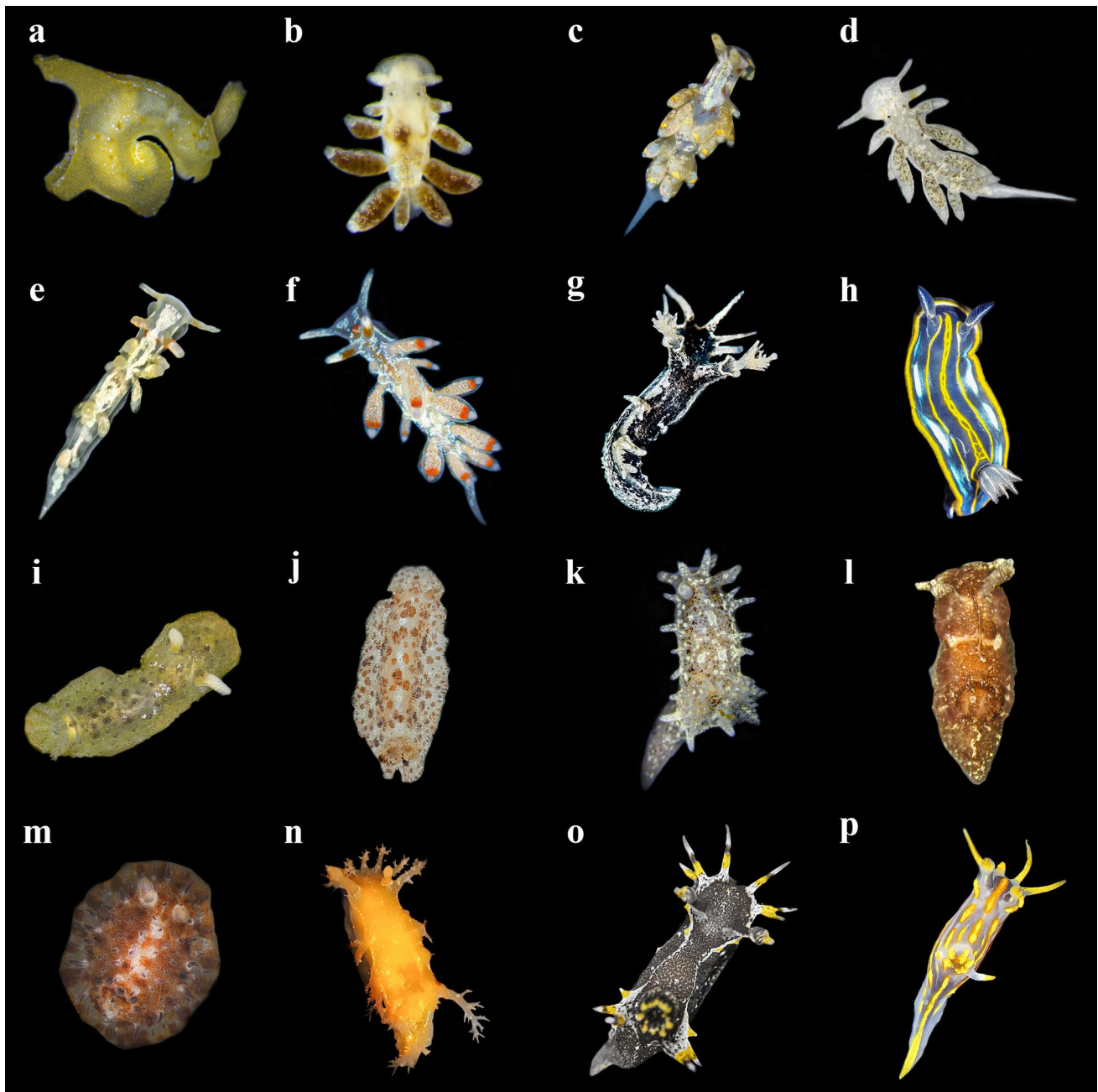


Fig. 4 Images of the Nudibranchia species found in the harbours of the Salento peninsula **a** *Scyllaea pelagica*, specimen with voucher RM3_3494; **b** *Tenellia adspersa*, specimen with voucher RM3_2791; **c** *Tenellia genovae*, specimen with voucher RM3_2887; **d** *Tenellia granosa*, specimen with voucher RM3_3083; **e** *Tenellia miniostrata*, specimen with voucher RM3_2663; **f** *Tenellia* sp. 1, specimen with voucher RM3_3659; **g** *Candiella manicata*, specimen with voucher RM3_2798; **h** *Felimare villafranca*, specimen with voucher

RM3_2071; **i** *Doris ocelligera*, specimen with voucher RM3_2850; **j** *Tayuva lilacina*, specimen with voucher RM3_2076; **k** *Bermudella polycerelloides*, specimen with voucher RM3_3152; **l** *Pelagella castanea*, specimen with voucher RM3_2673; **m** *Idaliadoris neapolitana*, specimen with voucher RM3_2838; **n** *Kaloplocamus ramosus*, specimen with voucher RM3_2922; **o** *Polycera hedgpethi*, specimen with voucher RM3_3420; **p** *Polycera quadrilineata*, specimen with voucher RM3_2840

a large geographical scale. The two overlooked species, *T. granosa* and *T. miniostrata*, are part of a group of taxa originally described from samples collected in the Gulf of

Naples (Italy) by Luise Schmekel and characterized by very few subsequent updates or records. In the case of *T. granosa*, the identification was based on the correspondence

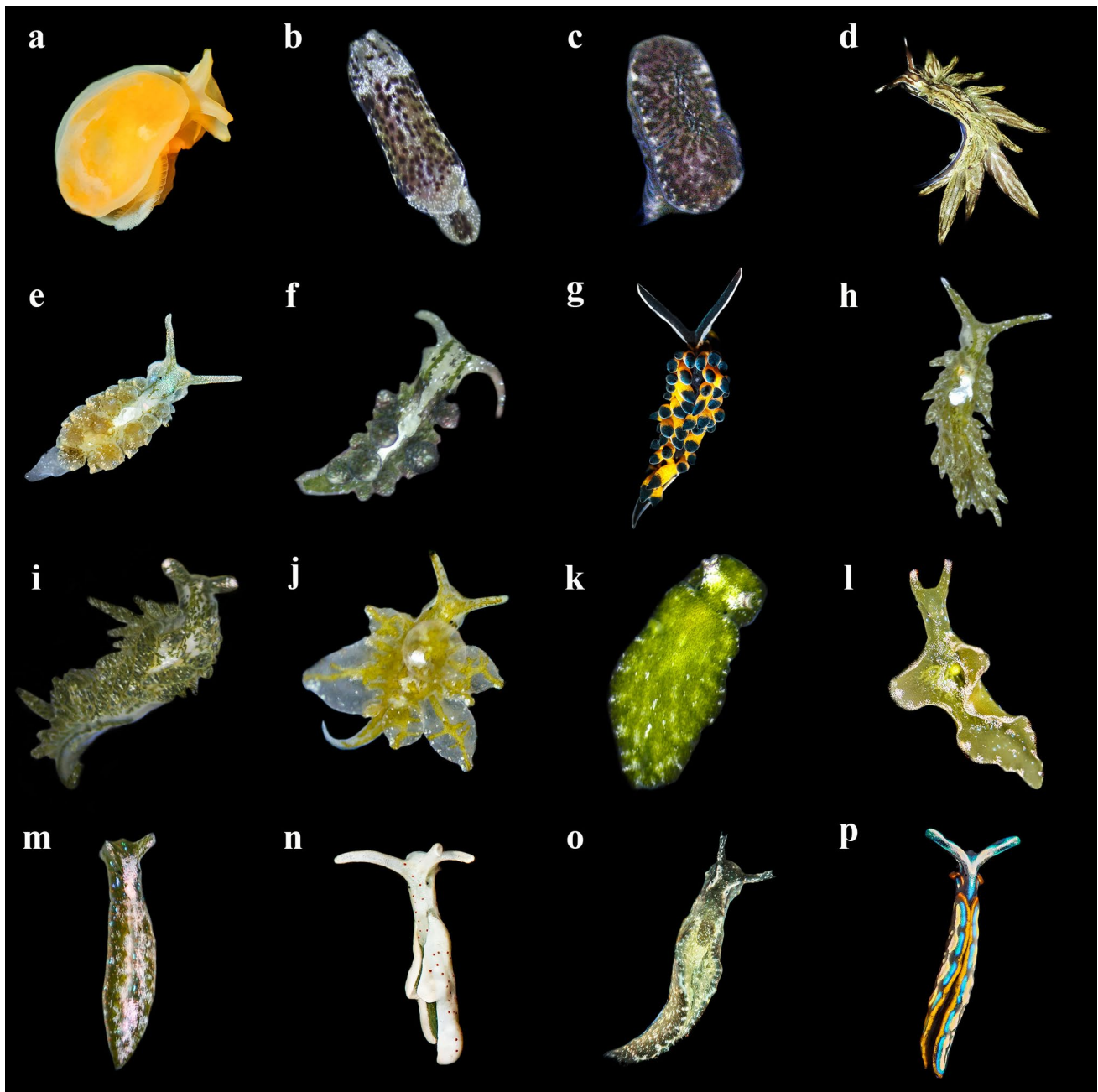


Fig. 5 Images of all the Pleurobranchida, Runcinida and Saccoglossa species found in the present study **a** *Berthella aurantiaca*, specimen with voucher RM3_2075; **b** *Runcina adriatica*, specimen with voucher RM3_2801; **c** *Runcina brentkoae*, specimen with voucher RM3_2805; **d** *Aplysiopsis elegans*, specimen with voucher RM3_2841; **e** *Ercolania coerulea*, specimen with voucher RM3_2689; **f** *Ercolania viridis*, specimen with voucher RM3_2907; **g** *Placida cremoniana*, specimen with voucher RM3_2069; **h** *Placida*

tardyi, specimen with voucher RM3_2802; **i** *Placida viridis*, specimen with voucher RM3_3336; **j** *Stiliger* cf. *auarita*, specimen with voucher RM3_2918; **k** *Bosellia mimetica* specimen with voucher RM3_2665; **l** *Elysia* cf. *translucens*, specimen with voucher RM3_2853; **m** *Elysia gordanae*, specimen with voucher RM3_2928; **n** *Elysia timida*, specimen with voucher RM3_2155; **o** *Elysia viridis*, specimen with voucher RM3_2851; **p** *Thuridilla hopei*, specimen with voucher RM3_2070

of the following elements of the external morphology common to the original description and the colour representation contained in Schmekel and Portmann (1982): “General

body-colour transparent white. Head, body, rhinophores, and oral tentacles covered with a very fine opaque white, which is mostly absent on foot and cerata. Rhinophores and

Table 3 List of the species found during this study and their relative presence into the investigated harbours (from 1 to 10 according to Table 1) and the comparison between previous (Furfaro et al. 2020b) and present (2025) Ionian (I) and Adriatic (A) records.

In bold are those species that were not reported (n.r.) in Furfaro et al. 2020b) and that are added in the present study. The symbol (*) indicates the NI species

Species	1	2	3	4	5	6	7	8	9	10	2020	2025	New records
<i>Aplysia fasciata</i>		x									I, A	I	
<i>Aplysia punctata</i>						x			x	x	I, A	I, A	
<i>Camachoaglaja africana</i> *						x					I	I	
<i>Haminoea</i> sp. 1							x				n.r.	I	Salento, Ionian side
<i>Haminoea</i> sp. 2	x			x		x			x		n.r.	I, A	Salento, Adriatic side
<i>Roxaniella jeffreysi</i>										x	n.r.	A	Salento, Adriatic side
<i>Anteaeolidiella lurana</i> *										x	n.r.	A	Adriatic Sea
<i>Berghia verrucicornis</i>										x	I	A	Salento, Adriatic side
<i>Limenandra nodosa</i>		x									I	I	
<i>Spurilla neapolitana</i>	x								x	x	I	I, A	Salento, Adriatic side
<i>Doto cervicenigra</i>										x	I	A	Salento, Adriatic side
<i>Doto paulinae</i>										x	I	A	Salento, Adriatic side
<i>Doto pygmaea</i>								x			I	A	Adriatic Sea
<i>Eubbranchus exiguus</i>				x						x	I	I, A	Salento, Adriatic side
<i>Eubbranchus viriola</i>				x						x	I	I, A	Salento, Adriatic side
<i>Cratena peregrina</i>										x	I, A	A	
<i>Facelina rubrovittata</i>				x							I	I	
<i>Favorinus branchialis</i>				x		x				x	I	I, A	Salento, Adriatic side
<i>Fiona pinnata</i>	x							x			I	I, A	Adriatic Sea
<i>Edmundsella pedata</i>	x									x	I, A	I, A	
<i>Flabellina ischitana</i>	x										I	I	
<i>Antiopella cristata</i>							x			x	I	I, A	Salento, Adriatic side
<i>Scyllaea pelagica</i>								x			I	A	Salento, Adriatic side
<i>Tenellia adspersa</i>							x				n.r.	I	Salento, Ionian side
<i>Tenellia genovae</i>	x			x						x	I	I, A	Salento, Adriatic side
<i>Tenellia granosa</i>										x	n.r.	A	Salento, Adriatic side
<i>Tenellia miniostrata</i>						x				x	n.r.	I, A	Ionian and Adriatic side
<i>Tenellia</i> sp. 1				x							n.r.	I	Salento, Ionian side
<i>Candiella manicata</i>		x		x							I	I	
<i>Felimare villafranca</i>		x				x					I	I	
<i>Doris ocelligera</i>	x									x	I	I, A	Salento, Adriatic side
<i>Tayuva lilacina</i>		x									I, A	I	
<i>Bermudella polycerelloides</i> *										x	I	A	Adriatic Sea
<i>Pelagella castanea</i>						x			x		I	I, A	Salento, Adriatic side
<i>Idaliadoris neapolitana</i>	x								x	x	n.r.	I, A	Salento, both sides
<i>Kaloplocamus ramosus</i>										x	I	A	Adriatic Sea
<i>Polycera hedgpethi</i> *										x	I	A	Salento, Adriatic side
<i>Polycera quadrilineata</i>	x					x				x	I	I, A	Salento, Adriatic side
<i>Berthella aurantiaca</i>		x									I, A	I	
<i>Runcina adriatica</i>				x		x					I	I	
<i>Runcina brenkoe</i>				x							I	I	
<i>Aplysiopsis elegans</i>										x	I	A	Salento, Adriatic side
<i>Ercolania coerulea</i>										x	I	A	Salento, Adriatic side
<i>Ercolania viridis</i>	x					x					I	I	
<i>Placida cremoniana</i>		x								x	I	I, A	Salento, Adriatic side
<i>Placida tardyi</i>				x							n.r.	I	Salento, Ionian side
<i>Placida viridis</i>	x										n.r.	I	Salento, Ionian side

Table 3 (continued)

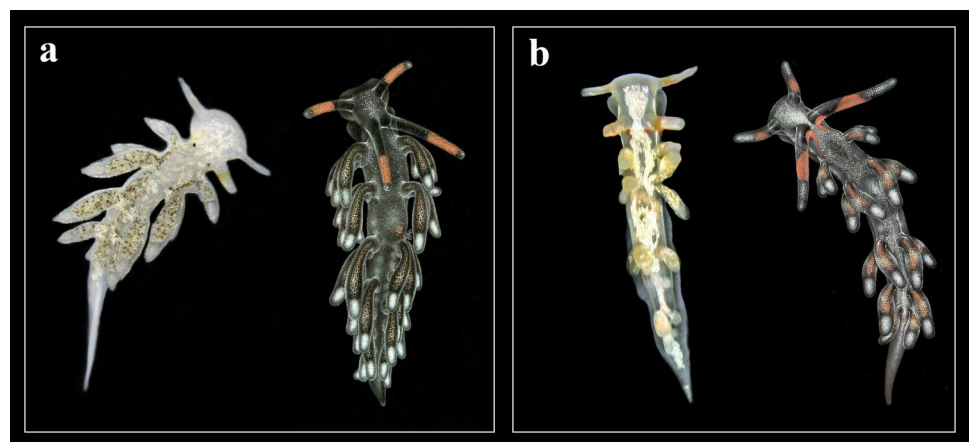
Species	1	2	3	4	5	6	7	8	9	10	2020	2025	New records
<i>Stiliger</i> cf. <i>auarita</i> *			x							x	n.r	I, A	Mediterranean Sea
<i>Bosellia mimetica</i>						x					I	I	
<i>Elysia</i> cf. <i>translucens</i>		x									I	I	
<i>Elysia gordanae</i>										x	I	A	Salento, Adriatic side
<i>Elysia timida</i>							x				I, A	I	
<i>Elysia viridis</i>	x	x		x						x	I, A	I, A	
<i>Thuridilla hopei</i>		x		x		x					I, A	I	

oral tentacles display a bright orange in their outer half. Midgut gland in cerata brown, with scattered dark brown spots, which may be clustered in the region below the big white cnidosac". The comparison between the images of the specimens in our possession and the drawing must be made considering that the drawing is made on a black background and that therefore the rendering of the transparency of the body is inferior to reality and that the same support requires an emphasis of the colours (Fig. 6). The same considerations must be applied to *T. miniostrata*, where in our sample the correspondence of the following characteristics is evident: location of the orange spots and in particular of the one that descends from the rhinophores towards the first row of cerata surrounding the eye spots; distribution of the opaque white spots on the head and back where there are two ellipsoidal

areas with less pigmentation: midgut gland in cerata brown; white cnidosac visible (Fig. 6).

Furthermore, it is interesting to notice that, only two out of the 12 heterobranchs new for the Salento Peninsula, are NIS, while the other ten species share a Mediterranean/Atlantic origin. This evidence is quite unexpected if considering the anthropogenic habitats that were investigated and could suggest that these particular semi-closed habitats could be important also for indigenous diversity. In this context, the collection methodology used in these restricted access habitats revealed powerful and effective to unravel small and difficult-to-see organisms such as most of the Heterobranchia species here recorded. The ability to collect samples of substrates and to bring them in the laboratory where they were observed in detail using

Fig. 6 Comparisons between the drawings of the species made by Schmekel and Portmann (1982) and in vivo images of the specimens collected in the present study. **a** *Tenellia granosa*; **b** *Tenellia miniostrata*



the stereomicroscope, revealed the best option to obtain a reliable checklist of the Heterobranchia fauna from such anthropic areas.

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