

# JOURNAL NATURAL HISTOR

Journal of Natural History

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tnah20

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To cite this article: Xavier Salvador, Robert Fernández-Vilert & Juan Moles (2022) Sea slug night fever: 39 new records of elusive heterobranchs in the western Mediterranean (Mollusca: Gastropoda), Journal of Natural History, 56:5-8, 265-310, DOI: 10.1080/00222933.2022.2040630

To link to this article: https://doi.org/10.1080/00222933.2022.2040630



Published online: 18 May 2022.



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# Sea slug night fever: 39 new records of elusive heterobranchs in the western Mediterranean (Mollusca: Gastropoda)

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#### ABSTRACT

Citizen (or community) science has provided copious and valuable information about charismatic marine taxa such as heterobranch gastropods, thus contributing enormously to the known geographic distribution of many sea slug species. This study reports new records of elusive sea slugs in the coastal western Mediterranean (especially on the Catalan and French Mediterranean coasts) and contributes to new ecological information regarding their phenology, diet and behaviour. Out of 39 species reported here, 23 are new records for the Catalan coast (NE Spain), three are new records of pelagic pteropods for the Spanish Iberian coast, and eight are new records for the French Mediterranean coast. With 25 species found active at night, this study highlights the importance of sampling at night and in shallow, often under-sampled waters with high species diversity. Shallow waters usually have less diving activity and are harder to survey with heavy scuba equipment. We believe that the high-quality photos herein and the related species information will enable researchers, divers and the community to find and recognise these rare species in the Mediterranean basin.

#### **ARTICLE HISTORY**

Received 31 May 2021 Accepted 7 February 2022

#### **KEYWORDS**

marine heterobranchs; new records; uncommon species; Mediterranean Sea; biodiversity

# Introduction

Marine heterobranch gastropods, traditionally called opisthobranchs, have an approximate worldwide diversity of over 6000 species (Carefoot 1987; Wägele et al. 2008). They are especially diverse in tropical and temperate waters where there is usually high overall molluscan diversity (Valentine and Jablonski 2015). Along the Iberian coast, including the Azores, Madeira, the Canary Islands and the Balearic Islands, 523 species have been recorded so far (Cervera et al. 2004). About half of these (n = 205 species) were found in coastal Catalonia, the north-eastern part of the Iberian Peninsula (Ballesteros et al. 2016).

Molecular assessments of species identity (e.g. DNA barcodes, gene-based species delimitation) of Mediterranean taxa are aiding in the discovery of many new species, some of which are cryptic and thus difficult to identify underwater and by morphology alone. Recent examples of such studies include four cryptic species within the genus

*Trinchesia* (Korshunova et al. 2019); a new species within the genus *Runcina* (Araujo et al. 2019); and the systematic revision of *Eubranchus farrani* (Alder and Hancock, 1844), now *Amphorina farrani*, that described a new species (Korshunova et al. 2020). Overall, there have been many systematic reassessments aided by molecular tools, and these keep revealing new taxa and leading to further taxonomic readjustments.

During the last few decades, numerous cases of new species arrivals have been detected in the Mediterranean (Fernández-Vilert et al. 2018). For instance, the aeolid nudibranchs *Godiva quadricolor* (Barnard, 1927) and *Polycera hedgpethi* Er. Marcus, 1964 are allochthonous species that are widening their distribution range (Cervera et al. 2010). Other common sightings in the region from localities with human impact are the sea hares *Bursatella leachii* Blainville, 1817, first reported in Israel (Bazzicalupo et al. 2018) and now found all over the Mediterranean (Rizgalla and Crocetta 2020), and *Aplysia dactylomela* Rang, 1828, which has an Atlantic origin (Valdés et al. 2013) and is currently found throughout the Mediterranean due to its pelagic larval phase (Moles et al. 2017).

In this study, we record 25 species that we observed to be active during the night sampling. The previous dearth of data for some of these species can likely be attributed to samplings only being done in the daytime, whereas many species are nocturnal and are difficult – some, nearly impossible – to find during day surveys. Of the 247 total species collected by the first author in his book, 98 species exhibit exclusively nocturnal activity; 73 species are active only during the day; and the rest, 76 species, may be active both day and night (Salvador 2020).

In the dynamically changing Mediterranean system, we use community or citizen science platforms to track down rare or new species (e.g. Trainito et al. 2017; Fernández-Vilert et al. 2021), distribution patterns (see GROC 2009–2021) and the spread of alien species (e.g. Fernández-Vilert et al. 2018; Kleitou et al. 2019). Community science is a good tool for obtaining information on large areas that scientists are unable to canvass, especially with new arrivals of alien species. Thanks to this community effort, specific environmental policies can be put in place locally (Cohen et al. 2011; Miller-Rushing et al. 2012), although the data generated should be curated for quality by specialists (Bonney et al. 2014).

In our case, the objective of the present study is to highlight the first records of scarce or poorly sampled species of heterobranchs along the western Mediterranean coast based on data gathered from the Catalan Opisthobranch Research Group (GROC). GROC serves as an observatory platform focused on the distribution and ecology of sea slugs based on community participation, mainly centred on the Catalan coast but with people already introducing data from areas all over the Mediterranean and Atlantic. The data quality is associated with the pictures that support the diver, linked to her diving point, and the data curators of the platform validate the specimens. Herein we provide highquality underwater photographs, some of which are the first-ever obtained (to our knowledge), of 39 species in the western Mediterranean and give morphological and ecological aspects of each. Most of these observations were gathered by freediving at night throughout the year and in shallow water.



**Figure 1.** Distribution map of the western Mediterranean coast showing the main sampling stations. There should be only one image, currently there is a duplicate

# **Material and methods**

Most heterobranch specimens were found while freediving at depths from 0 to 6 m; specimens were photographed underwater by X. Salvador with Nikon D90 and Nikon D7200 cameras coupled with a 60 mm and a 105 mm macro lens. A map of the sampling area was generated at https://www.simplemappr.net and it encompasses the Southern Mediterranean coast of France (Étang de Thau), the Catalan coast (NE Spain), Valencia (Levantine coast) and Granada along the south-eastern Spanish coast (Figure 1). External descriptions of species are based on our photographs; total length (*L*) for the analysed specimens was measured *in situ* using a ruler or in the lab under a stereomicroscope. All records were deposited in the online database of the Catalan Opisthobranch Research Group (GROC 2009–2021), at https://opistobranquis.org/en/home. Some interesting specimens were fixed in 95% ethanol and deposited in the Bavarian State Collection of Zoology (ZSM). Permits to collect samples were issued by the Catalan Government (permit nos. SF/0589/2018 and SF/0495/2019).



**Figure 2.** Photographs of live Cephalaspidea species: (a) The alien *Haloa japonica*. (b) *Haminoea orteai*. (c) Egg mass of *Haminoea orteai*. (d) *Philine catena*. The Nudibranchia species: (e) *Aegires palensis*. (f) White morphotype of *Aegires sublaevis*. (g) *Aldisa smaragdina* on top of the sponge *Phorbas topsenti*. (h) *Okenia longiductis* on the bryozoan *Amathia verticillata*.

# Result

SYSTEMATICS Subclass HETEROBRANCHIA Burmeister, 1837 Order CEPHALASPIDEA P. Fischer, 1883 Family HAMINOEIDAE Pilsbry, 1895 Genus *Haloa* Pilsbry, 1921 *Haloa japonica* (Pilsbry, 1895) (Figure 2(a))

# Material examined

Le Ponton, Étang de Thau, Sète (France), 43°25′28.5″N, 3°42′E, 3 November 2017, 2.1 m depth, 1 spc., adult, L = 20 mm; 14 April 2018, 1.7 m depth, 3 spcs, adults, L = 20–30 mm; 21 May 2018, 1.9 m depth, 8 spcs, adults, L = up to 35 mm.

#### External morphology

Shell external, translucent, background colour brown with large orange punctuations. Parapodia darker on top. Head lighter on edge, with darker central part between the eyes.

#### Ecology

Found at night on soft bottoms, between Ceramiales algal species and other red algae. Individuals found during April and May 2018 were mating.

# Distribution

Japanese coast (Pilsbry 1895); USA (Hanson et al. 2013; GBIF.org 2021); Italy (Crocetta et al. 2013); Atlantic Spanish coast: Galicia and Cantabria; Mediterranean Spanish coast: Andalucía (Cervera et al. 2004 as *Haminoea cadillegenita*); Mediterranean French coast (Hanson et al. 2013; this study).

#### Remarks

In the marine pools along the French south-eastern Mediterranean coast there are several marine species of Japanese origin, such as the alga wakame [*Undaria pinnatifida* (Harvey) Suringar, 1873] and the oyster [*Magallana gigas* (Thunberg, 1793)], so their presence may be caused by aquaculture (e.g. Faasse 2018).

Genus Haminoea Turton and Kingston [in Carrington], 1830

# Haminoea orteai Talavera, Murillo and Templado, 1987

(Figure 2(b,c))

#### Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'10.5''N$ ,  $3^{\circ}2'44.6''E$ , 16 October 2017, 0.6 m depth, >40 spcs, juveniles, adults and egg masses, L = 2-15 mm; 31 December 2017, 1.2 m depth, 3 spcs, juveniles and adults, L = up to 15 mm; Le Ponton, Étang de Thau, Sète

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(France),  $43^{\circ}25'28.5''N$ ,  $3^{\circ}42'E$ , 3 November 2017, 1.4 m depth, 2 spcs, adults, L = 20 mm; Forum pools, Barcelona (Spain),  $41^{\circ}24'34.5''N$ ,  $2^{\circ}13'36.8''E$ , 25 November 2017, 1.7 m depth, 2 spcs, adults and egg masses, L = 20 mm; 27 April 2018, 0.8 m depth, 1 spc., adult, L = 10 mm; l'Espigó, Roses (Spain),  $42^{\circ}15'39.8''N$ ,  $3^{\circ}10'26.8''E$ , 28 February 2020, 0.8 m depth, 5 spcs, adults and egg masses, L = 25 mm.

# External morphology

Shell external, translucent, background colour light brown to grey with dark brown, white and orange punctuations surrounded by small dark red points. Parapodia lighter in colour. Head lighter in colour, area around eyes pigmented.

# Ecology

Specimens were found crawling on calcareous rocks with green algae of undetermined species during night samplings. Egg masses were observed in November and juveniles in December 2017. Egg masses elongated, forming a 'C', with white eggs (Figure 1(c)).

# Distribution

Azores, Atlantic Spanish coast: Canary Islands; Mediterranean Spanish coast: Andalucía, Levantine coast (Cervera et al. 2004), Catalonia (this study); Mediterranean French coast (Garabedian et al. 2017; this study); Greece and Italy (Garabedian et al. 2017).

# Remarks

*Haminoea* species in the Mediterranean are understudied (Crocetta et al. 2015; Micaroni et al. 2018) and, thus, all morphological characters that may be useful in distinguishing species are not always clear. One visible distinguishing feature of this species is the presence of a pigmented periocular area. The presence of small orange dots under the shell surrounded by smaller dots of dark purple or black colour, forming a flower pattern, was found in all studied specimens.

Family PHILINIDAE Gray, 1850 (1815)

Genus Philine Ascanius, 1772

Philine catena (Montagu, 1803)

(Figure 2(d))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 13 December 2017, 1.3 m depth, 1 spc., adults, L = 5 mm; Punta del Romaní, L'Escala (Spain), 42°6′54″N, 3°10′9″E, 30 December 2017, 2.5 m depth, 2 spcs, adults, L = 3-7 mm; Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 31 January 2018, 1.2 m depth, 1 spc., adult, L = 5 mm.

# External morphology

Body elongate, narrow, white-beige or brown, with a discontinuous dark brown band over cephalic shield. Cephalic shield longer than shell. Parapodia short, not overlapping. Shell completely covered by mantle. Individuals likely hide in the sediment during the day and are active at night.

# Ecology

Specimens were found crawling at night on rocks with algae and sediment between rocky outcrops.

# Distribution

North Sea (GBIF.org 2021); Azores (Cervera et al. 2004); Portugal (Cervera et al. 2004); Italy and Croatia (Zenetos et al. 2016); Greece (Crocetta et al. 2015); Atlantic Spanish coast: Galicia and Cantabria (Cervera et al. 2004); Mediterranean Spanish coast: Catalonia (this study).

# Remarks

Molecular and morphological data indicate that this species may not belong to the genus *Philine* (J. Moles unpubl. data).

Order NUDIBRANCHIA Cuvier, 1817 Suborder DORIDINA Family AEGIRIDAE P. Fischer, 1883 Genus *Aegires* Lovén, 1844 *Aegires palensis* Ortea, Luque and Templado, 1990

(Figure 2(e))

# Material examined

Cala Ventosa, Sant Feliu de Guíxols (Spain), 41°47′5″N, 3°2′52″E, 13 September 2017, 1 m depth, 1 spc., adult, L = 10 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41° 47′10″N, 3°2′44″E, 7 May 2018, 1 m depth, 7 spcs, juveniles and adults, L = 3-15 mm; Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 25 May 2018, 1 m depth, 6 spcs, juveniles and adults, L = 6-15 mm.

# External morphology

Body elongate, rough, angulated, with tubercles in the laterals; body colour beige, with small white and light brown dots; rhinophores, rhinophoral sheaths and apical part of tubercles with dark brown spots. Branchial leaves protected by three tubercles, curved internally, equal in length.

# Ecology

All specimens were found on top of white calcareous sponges of the genus *Sycon* Risso, 1817 (pss. *S. elegans* (Bowerbank, 1845) and *S. raphanus* Schmidt, 1862) and *Ascandra contorta* (Bowerbank, 1866). Generally found at night at the entrance to or inside caves, crawling on walls.

# Distribution

Sardinia, Italy (Trainito and Doneddu 2015); Mediterranean Spanish coast: Andalucía and Levantine coast (Cervera et al. 2004), Catalonia (Cervera et al. 2004; Ballesteros et al. 2012–2021; this study).

# Remarks

This species can be differentiated from the other Atlantic species of *Aegires* by the shape and disposition of the tubercles around the gills and the dorsum, by the body colour, and by the dark brown dots in the sheaths and apex of the rhinophores (Ortea et al. 1990).

# Aegires sublaevis Odhner, 1932

(Figure 2(f))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'10''$ N,  $3^{\circ}2'44''$ E, 16 February 2018, 1 m depth, 1 spc., adult, *L* = 15 mm.

# External morphology

Body elongate, rough, angulated with central part of dorsum flattened, with black marks on dorsum and laterals; body colour variable white to yellow. Branchial leaves protected by three tubercles, the central one larger than the laterals. Rhinophores smooth, having a brown ring close to the top.

# Ecology

One specimen was found feeding on white calcareous sponges of the genus *Ascandra* Haeckel, 1872 and, thus, displaying the same white colouration as the sponge.

# Distribution

Madeira (Malaquias et al. 2001); Azores (Calado 2002; Fahey and Gosliner 2004); Atlantic Spanish coast: Canary Islands (Odhner 1931; Altimira and Ros 1979, as *Serigea sublaevis*; Pérez Sánchez et al. 1990; Ortea et al. 1996; 2001, 2003; Malaquias and Calado 1997), Mediterranean Spanish coast: Levantine coast (Templado et al. 1987), and Catalonia (this study).

# Remarks

According to Ortea et al. (1996), the colouration of this species varies from yellow to beige or white depending on the diet. Slugs are generally found feeding on *Clathrina coriacea* (Montagu, 1814).

Family CADLINIDAE Bergh, 1891

Genus Aldisa Bergh, 1878

# Aldisa smaragdina Ortea, Pérez and Llera, 1982

(Figure 2(g))

# Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57'49"N, 3°13'41"E, 24 April 2015, 3 m depth, 1 spc., L = 7 mm.

# External morphology

Body rounded, flat; light red, with two dark circles on dorsum; yellow-brown line present at laterals of body next to the first circle. Gills light red, white at tips of branchial leaves.

# Ecology

A single specimen was found at a shallow depth under a rock, on top of the sponge *Phorbas topsenti* Vacelet and Pérez, 2008.

# Distribution

Atlantic Spanish coast: Canary Islands (Pruvot-Fol 1953, as *Aldisa binotata*; Ortea et al. 1982); Mediterranean Spanish coast: Catalonia (this study).

# Remarks

In the original description the body was described as red with two large dark circles and a white line just after the first dark circle (Ortea et al. 1982). The specimen studied here has lighter red colouration and lacks the second dark circle. The gills are also light red and white on the top, while the conspecific *A. banyulensis* (Pruvot-Fol, 1951) has dark red gills, lacking the white top. Moreover, our specimen has a yellow line in the anterior part of the body, anterior to the first dot, while in *A. banyulensis* the yellow line is found between the first and second dots, displayed slightly towards the posterior part.

Family GONIODORIDIDAE H. Adams and A. Adams, 1854

Genus Okenia Menke, 1830

# Okenia longiductis Pola, Paz-Sedano, Macali, Minchin, Marchini, Vitale, Licchelli and Crocetta, 2019

(Figure 2(h))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 23 September 2016, 1 m depth, 5 spcs, juveniles, adults and egg masses, L = 2-8 mm; 14 September 2017, 1 m depth, 7 spcs, adults and egg masses, L = 5-13 mm; 16 October 2017, 1 m depth, >20 spcs, adults and egg masses, L = 7-13 mm; Cala Ventosa, Sant Feliu de Guíxols (Spain), 41°47'5"N, 3°2'52"E, 13 September 2017, 1 m depth, 2 spcs, adults and egg masses, L = 5 mm; Fòrum pools, Barcelona (Spain), 41°24'34.5"N, 2°13'36.8"E, 23 November 2017, 2.3 m depth, 7 spcs, adults and egg masses, L = 5-10 mm.

# External morphology

Body elongate, narrow, background colour light brown or white with irregular brown, black and white punctuations in adults. Papillae smooth, found scattered on dorsum and laterals. Rhinophores present a smooth front surface, lamellar in back. Discoidal branchial leaves.

# Ecology

All specimens at each locality were found on the bryozoans *Amathia verticillata* (Delle Chiaje, 1822), laying their egg masses.



**Figure 3.** Photographs of live Nudibranchia species: (a) *Palio nothus* and its egg mass. (b) The alien *Polycera hedgpethi*. (c) *Polycerella emertoni* and egg mass on *Amathia verticillata*. (d) *Thecacera pennigera* on top of the bryozoan *Bugula* sp. (e) Two specimens of *Anteaeolidiella lurana* and their egg masses. (f) *Doto cervicenigra*. (g) Doto fragilis (photo credit: Oriol Planas). (h) *Doto pygmaea*.

# Distribution

Recently reported in Italy and on the Mediterranean French coast (Pola et al. 2019); Mediterranean Spanish coast: Catalonia (Pola et al. 2019; this study).

# Remarks

Pola et al. (2019) recently confirmed the differences between this species and *O. zoobotryon* (Smallwood, 1910), previously recorded in the Mediterranean but originally described from the Islands of Bermuda. Morphological analyses in that study revealed differences in the reproductive system and the gill branches between these two species. Thus, according to Pola et al. (2019), previous records of *O. zoobotryon* in the Mediterranean are misidentifications of *O. longiductis*, and *O. zoobotryon* is only present in the western Atlantic.

Family POLYCERIDAE Alder and Hancock, 1845

Genus Palio Gray, 1857

#### Palio nothus (Johnston, 1838)

(Figure 3(a))

#### Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 16 January 2018, 1.7 m depth, 5 spcs, adults and egg masses, L = 8-14 mm; 7 May 2018, 1.4 m depth, 1 spc., adult and egg masses, L = 15 mm; L = 8-14 mm; 11 March 2020, 2 m depth, 7 spcs, juveniles.

#### External morphology

Body short, thick, background colour black with numerous white papillae. Mantle margin white. Rhinophores with lamellae, beige or white. Branchial leaves dark brown.

#### Ecology

Specimens were found mating and laying the egg masses on the bryozoans *Amathia lendigera* (Linnaeus, 1758) at the entrance of a cave, on overhangs. Egg masses were white with a soft brown colour and laid in a 'C' shape over the bryozoans. Juvenile specimens, only found in 2020, were also crawling on *A. lendigera*. Slugs are more active at night and may go unnoticed by divers and other observers during the day.

#### Distribution

North Sea (England and Norway; Johnston 1838; Evertsen and Bakken 2013); Mediterranean Spanish coast: Catalonia (Ballesteros et al. 2016; this study).

# Remarks

This species apparently has an Amphi-Atlantic and Boreo-Arctic distribution, but its identity may need confirmation since is easily confused with *Palio dubia* (M. Sars, 1829); therefore, several records may have been misidentified (Thompson and Brown 1984).

Genus Polycera Cuvier, 1816

# Polycera hedgpethi Er. Marcus, 1964

(Figure 3(b))

# Material examined

Le Ponton, Étang de Thau, Sète (France),  $43^{\circ}25'28.5''N$ ,  $3^{\circ}42'E$ , 8 April 2017, 1.2 m depth, 7 spc., adults and egg masses, L = 10-25 mm; 4 October 2017, 0.8 m depth, 3 spcs, adults, L = 20-25 mm; 21 May 2018, 1.5 m depth, 1 spc., adult, L = 45 mm; 1 November 2018, 1 m depth, 5 spcs, adults and egg masses, L = 15-30 mm; l'Espigó, Roses (Spain),  $42^{\circ}15'39.8''N$ ,  $3^{\circ}10'26.8''E$ , 28 February 2020, 0.6 m depth, 8 spcs, adults and egg masses, L = 10-20 mm.

# External morphology

Body short, thick, background colour black. Mantle margin white with numerous appendages of black and yellow, yellow close to apex, white papillae scattered all over body. Rhinophores lamellar, black forwards and white backwards, yellow on top. Gill leaves black, tips yellow.

# Ecology

All specimens in each locality were found in shallow waters on the bryozoan *Bugula neritina* (Linnaeus, 1758), feeding and laying the egg masses.

# Distribution

Originally from the north-central Pacific coast of America, this species is reported from Australia, Japan, South Africa, Morocco (Moro et al. 2017); Cantabrian Sea (Cervera et al. 2004); and in the Mediterranean Sea from Italy, Croatia (Servello et al. 2019); France (GBIF. org 2021; this study); and Spain: Catalonia (this study).

# Remarks

Its bryozoan prey grows on boat hulls, and thus movement via boats could be responsible for this species' range expansion. However, although this bryozoan is abundant at marine ports, *P. hedgpethi* has not been recorded in biofouling samples containing *B. neritina* (X. Salvador pers. obs.). Notably, this species, when found in the Mediterranean, is often in environments with variable salinity, such as the Étang de Thau, or the Espigó de Roses, where there is a fresh water supply.

Genus Polycerella A.E. Verrill, 1880

# Polycerella emertoni A.E. Verrill, 1880

(Figure 3(c))

#### Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 23 August 2017, 1 m depth, 11 spcs, juveniles, adults and egg masses, L = 2-5 mm; Alfacs mussel farms, Sant Carles de la Ràpita, Montsià (Spain), 40°37′20.1″N, 0°39′48.5″E, 12 September 2018, 0.7 m depth, >20 spcs, adults and egg masses, L = 4-5 mm; le Ponton, Étang de Thau, Sète (France), 43°25′28.5″N, 3°42′E, 1 November 2018, 1.2 m depth, 7 spc., adults and egg masses, L = 5-7 mm.

# External morphology

Body short, narrow, background colour white with irregular black and white-yellow punctuation. Gills composed of three leaves, with short, smooth papillae found on dorsum and body laterals. Rhinophores smooth.

#### Ecology

All specimens at each locality were found on the bryozoan *Amathia verticillata* (Delle Chiaje, 1822) where they laid egg masses.

#### Distribution

Species originally from the east coast of North America (GBIF.org 2021); Pacific coast of North America (Terrence 1988); now found in Morocco, Portugal and the south of Spain (Cervera et al. 2004); Italy (Servello et al. 2019); Greece (Crocetta et al. 2017); France (this study) and Catalonia (Camps and Prado 2018; this study).

#### Remarks

Originally described from the North American Atlantic coast (Verrill 1881), this species has been reported from the American Atlantic and Pacific coasts, and the Mediterranean Spanish, Italian, Greek and African coasts. Its bryozoan prey is commonly found attached to boat hulls. In the case of the specimens found in Catalonia, it was found in ports, bays and eutrophic locations.

Genus Thecacera J. Fleming, 1828

#### Thecacera pennigera (Montagu, 1813)

(Figure 3(d))

#### Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'10''N$ ,  $3^{\circ}2'44''E$ , 14 February 2018, 1.5 m depth, 1 spc., adult, L = 20 mm.

#### External morphology

Body short, thick, background colour white with numerous black and yellow dots. Rhinophores lamellar, protected by two papillae, the posterior one longer than those anterior. Gill leaves discoid in shape, protected by long posterior papillae.

# Ecology

The singleton specimen was found on an unidentified bryozoan species of the genus *Bugula*. The species is nocturnal; during the day slugs are found 'resting' at the base of bryozoans.

# Distribution

Originally described from the North Sea (England; Montagu 1813); New South Wales, Australia (Burn 1978); south-west coast of India (Mohamed Hatha 2017); north-east American coast, Portugal and Italy (Gerovasileiou et al. 2017; Bariche et al. 2020); Spain: the Canary Islands, Cantabric Sea (Cervera et al. 2004), Catalonia (this study).

# Remarks

This species has a broad distribution and is usually found in temperate waters (Dekker 1986). In the western Atlantic, *T. pennigera* has peaks of abundance during which, over the course of a few days, large numbers of specimens appear (Willan and Coleman 1984).

Suborder CLADOBRANCHIA

Family AEOLIDIIDAE Gray, 1827

Genus Anteaeolidiella M.C. Miller, 2001

# Anteaeolidiella lurana (Ev. Marcus and Er. Marcus, 1967)

(Figure 3(e))

# Material examined

Badia dels Alfacs port, Sant Carles de la Ràpita, Montsià (Spain), 40°37'1"N, 0° 35'52"E, 1.3 m depth, 3 spcs, adults and egg masses, L = 15 mm; Valencia's port (Spain), 39°27'39.9"N, 0°19'29.5"W, 18 January 2020, 0.2 m depth, 1 spc., adult, H = 10 mm.

# External morphology

Body elongate, narrow, with a white mark surrounded by orange on dorsum; background colour white, with two orange lines on the head, united behind eyes. Cerata short, round, background colour grey, white on top. Rhinophores long, equal, white with orange central region.

# Ecology

Specimens in Alfacs Bay (Catalonia) were found under rocks, mating and laying eggs during the day. The specimen found in Valencia was on a vertical wall in the port, moving around hydrozoans at night; thus, the species is likely nocturnal.

# Distribution

# Brazil (Marcus and Marcus 1967); Italy (Crocetta et al. 2013); Greece (Bariche et al. 2020); Mediterranean Spanish coast

Balearic Islands (GROC 2009–2021), Catalonia (this study).

#### Remarks

The species was described from Brazil and records of its first invasion in the Mediterranean to Italy were made by Alberto Piras (Cagliari, Italy (1983); Köhler 2021). The two locations where it was found in this study have eutrophic waters and ship activity, which may be related to its introduction.

Family DOTIDAE Gray, 1853

Genus Doto Oken, 1815

#### Doto cervicenigra Ortea and Bouchet, 1989

(Figure 3(f))

#### Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10.5"N, 3°2'44.6"E, 13 April 2016, 0.3 m depth, 1 spc., L = 5 mm; 31 December 2017, 1.2 m depth, 3 spcs, juveniles and adults, L = 15 mm; 13 January 2018, 0.4 m depth, 2 spcs, L = 3-7 mm; 31 December 2017, 1.2 m depth, 3 spcs, juveniles and adults, L = 15 mm; Le Ponton, Étang de Thau, Sète (France), 43°25'28.5"N, 3°42'E, 13 April 2018, 0.2 m depth, 4 spcs, adults, L = 7-10 mm; 21 May 2018, 0.2 m depth, 12 spcs, adults and egg masses, L = 7-10 mm; la Farge, Étang de Thau, Sète (France), 43°25'48"N, 3°42'14"E, 21 May 2018, 0.2 m depth, 17 spcs, adults and egg masses, L = 7-10 mm; Port de Sant Feliu (Spain), 41°46'42.2"N, 3°02'16.4"E, 29 January 2020, 0.2 m depth, 11 spcs, adults, juveniles and egg masses, L = 2-12 mm; Arenys de Mar port (Spain), 41°34'38.8"N, 2°33'23.5"E, 15 February 2020, 0.2 m depth, 2 spcs, adults, L = 10 mm; Port de Blanes (Spain), 41°40'25.5"N, 2°47'48.6"E, 2 March 2020, 0.2 m depth, 2 spcs, adults, L = 6-10 mm; Mar Menor, Cartagena (Spain), 37°38'6"N, 0°44'10.3"W, 27 September 2020, 0.3 m depth, 7 spcs, juveniles, adults and egg masses, L = 2-6 mm.

# External morphology

Body elongate, narrow, background colour white with black marks all along but most concentrated in the head area. Rhinophores black with white tips. Cerata with tubercles, apical part black.

# Ecology

Specimens were found at shallow depths where there was an influx of fresh water, on rocks and hydrozoans, possibly *Obelia* spp., feeding and laying large, short, linear, white egg masses (very different from the characteristic egg masses of the genus *Doto*, with an 'S' shape) at the bottom of the colony. Found to be more active at night.

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# Distribution

Corsica (Ortea and Bouchet 1989); Italy (Chiarore et al. 2019); Spain: Spanish Levantine coast (this study), Mallorca (GROC 2009–2021), Catalonia (this study); France (this study).

# Remarks

This species is easily distinguished from *Doto* conspecifics by the presence of black rhinophores and small tubercles with a black dot in the cerata (Ortea and Bouchet 1989).

# Doto fragilis (Forbes, 1838)

(Figure 3(g))

# Material examined

Punta del Romaní, L'Escala (Spain), 42°6′54″N, 3°10′9″E, 6 March 2021, 9 m depth, 1 spc., juvenile, L = 10 mm.

# External morphology

Body elongate, cream to brown, with numerous white spots in oral veil. Rhinophoral sheath and back with numerous white spots in juveniles; rhinophoral sheath completely white in adults. Cerata beige to ochre, darker than body. Rhinophores homogeneously ochre.

# Ecology

This species frequents cold waters, feeding on colonies of hydrozoans, especially of the genus *Nemertesia* Lamouroux, 1812, on which it lays egg masses in the form of a pink ribbon.

# Distribution

Widely recorded in the north-eastern Atlantic to the Galician coast (Ortea *et al*, 1978); Mediterranean Sea: Catalonian coast (this study).

#### Remarks

Often found feeding on *Nemertesia antenninna* (Linnaeus, 1758). This is the first record in the Mediterranean Sea, wherein it was observed inside a cave feeding on *Kirchenpaueria pinnata* (Linnaeus, 1758); after two weeks the specimen and its prey were not found anymore.

# Doto pygmaea Bergh, 1871

(Figure 3(h))

# Material examined

Cala d'Aiguablava, Begur (Spain), 41°56'13.4"N, 3°13'08.6"E, 22 June 2018, 0 m depth, 6 spcs, juveniles and adults, L = 2-5 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10.5"N, 3°2'44.6"E, 11 February 2020, 0.1 m depth, 7 spcs, adults and egg masses, L = 5-10 mm.



**Figure 4.** Photographs of live Nudibranchia species: (a) The pelagic *Phylliroe* cf. *bucephala*. (b) *Amphorina andra* surrounded by hydrozoans of the genus *Sertularella*. (c) *Eubranchus prietoi* on the hydrozoan *Kirchenpaueria halecioides*. (d) The alien *Godiva quadricolor*. (e) Three specimens of *Piseinotecus soussi* and their egg masses. (f) *Piseinotecus sphaeriferus* on top of the hydrozoan *Obelia* sp. (g) *Tenellia adspersa*. (h) *Trinchesia cuanensis* on top of the hydrozoan *Sertularella* sp.

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# External morphology

Body elongate, narrow, background colour white with black patches to completely black. Rhinophores elongate, transluscent white. Cerata displayed in a sinuous 'S' fashion with white tubercles only on the external part, the inner part being almost smooth.

# Ecology

Specimens found on floating debris. The specimens from Aiguablava were living on plastic debris eating hydrozoan colonies, probably of the genus *Obelia*. The specimens of Cala Maset were living on floating wood. Slugs mated and laid egg masses while eating hydrozoans of the genus *Tubularia*. Egg masses are shaped like a winding cord forming an 'S'; egg colour is yellowish.

# Distribution

Italy (Schmekel and Portmann 1982); Spain: Canary Islands (Cervera et al. 2004), Spanish Levantine coast (Cervera et al. 2004), Catalonia (this study).

# Remarks

This species can be differentiated from other *Doto* species by having a black body with very elongated rhinophores, a smooth edge on the rhinophoral sheath, and 'S'-shaped cerata, the inner part being almost smooth and the external with tubercles aligned longitudinally (Ortea et al. 1997).

Family PHYLLIROEIDAE

Genus Phylliroe Péron and Lesueur, 1810

# Phylliroe cf. bucephala

(Figure 4(a))

# Material examined

Cala d'Aiguablava, Begur (Spain), 41°56'13.4"N, 3°13'8.6"E, 29 March 2021, 3 m depth, 1 spc., adult, L = 20 mm; Cap de Begur, Begur (Spain), 41°57'2"N, 3°14'3.1"E, 30 March 2021, 2–4 m depth, 4 spcs, adults, L = 20-30 mm; Cala Sa Tuna, Begur (Spain), 41°57'38"N, 3°13'52"E, 31 March 2021, 1 m depth, 5 spcs, adults, L = 10-20 mm; Montiel, Tamariu (Spain), 41°54'55.9"N, 3°12'46.3"E, 1 April 2021, 3 m depth, 2 spcs, adults, L = 20 mm.

# External morphology

Body flat, laterally compressed, ending in a fishtail shape; translucent tegument, internal organs seen by transparency (four digestive gland ramifications, reproductive and nervous systems); numerous yellow, iridescent spots on dorsal and ventral sides. Rhinophores long, smooth, slightly rippled once in ethanol.

# Ecology

The species lives in the open sea, generally at great depths, having a body adapted for swimming. Feeds on jellyfish, although its diet is not well studied.

# Distribution

Syria (Durgham and Ikhtiyar 2020); Italy (Schmekel and Portmann 1982); Spain: Canary Islands (Cervera et al. 2004), Spanish Levantine coast (Cervera et al. 2004), Catalonia (this study).

# Remarks

According to Lamarck's description (1816) and his illustrations, our specimens resemble *P. bucephala*, but a molecular analysis is required to validate its identity due to its similarities to *P. lichtensteinii* Eschscholtz, 1825, which has also been recorded in the Mediterranean Sea. In any case, this represents the first record of the genus *Phylliroe* on the Iberian Spanish coast.

Family EUBRANCHIDAE Odhner, 1934

Genus Amphorina Quatrefages, 1844

# Amphorina andra Korshunova, Malmberg, Prkić, Petani, Fletcher, Lundin, Martynov, 2020

(Figure 4(b))

#### Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 22 June 2013, 18 m depth, 1 spc., juvenile, L = 3 mm (GROC 2009\_2021); Balaruc-les-Bains (France), 43°26′28.8″N, 3°41′3″E, 5 April 2014, 2 m depth, 2 spcs, adults, L = 10-15 mm; Barra de l'Arbre, Mataró (Spain), 41° 31′57.9″N, 2°28′21.2″E, 1 May 2014, 20 m depth, 1 spc., juvenile, H = 2 mm; Punta del Romaní, L'Escala (Spain), 42°6′54″N, 3°10′9″E, 12 April 2015, 4 m depth, 3 spcs, adults, L = 10-12 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 16 January 2018, 1 m depth, 2 spcs, adults, L = 10 mm; 16 January 2018, 1 m depth, 2 spcs, adults, L = 10 mm; 16 January 2018, 1 m depth, 2 spcs, adults, L = 10 mm; 22 January 2018, 0.7 m depth, 6 spcs, adults, mating and egg masses, L = 12-15 mm; 16 February 2018, 1.2 m depth, 2 spcs, adults, L = 8-10 mm; 9 March 2018, 0.6 m depth, 6 spcs, adults, mating and egg masses, L = 10-12 mm; Cova de l'infern (Spain), 42°19′2.75″N, 3°19′12.74″E, 2 March 2019, 1 m depth, 3 spcs, adults and egg masses, L = 10-12 mm; Cova de l'infern (Spain), 42°19′2.75″N, 3°19′12.74″E, 2 March 2019, 1 m depth, 3 spcs, adults and egg masses, L = 10-12 mm; Cova de l'infern (Spain), 42°19′2.75″N, 3°19′12.74″E, 2 March 2019, 1 m depth, 3 spcs, adults and egg masses, L = 10-20 mm.

# External morphology

Body elongate, narrow, background colour variable, typically white with black and orange marks, some specimens with completely white or orange colouration. Rhinophores and oral tentacles smooth and yellow, white apically. Cerata globular, with white and black marks, apical part yellow.

#### Ecology

Specimens found at a broad range of depths, always associated with hydrozoan colonies. The specimens of Sant Feliu were found inside a cave and associated with hydrozoans of the genus *Sertularella*, on which they often lay their egg masses. Active at night, mating and laying eggs. During the day they are found at the base of the hydrozoans. The egg mass is spiral-shaped, usually laid on rocks, but also on the hydrozoans upon which they feed.

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# Distribution

Italy and Croatia (Korshunova et al. 2020); France (this study); Spain: Catalonia (this study).

# Remarks

This species was recently described, but up to now it was considered a morphotype of *Eubranchus farrani*, now *Amphorina farrani* (Alder and Hancock 1845). *Amphorina andra* is variable in body colour, from completely white or orange to a white with black spots and orange circles on the dorsum. Specimens found at deeper depths were typically small, whereas specimens found at very shallow depths, mostly in caves, were larger and found on hydrozoan colonies of the genera *Obelia* and *Sertularella*, among others. Populations observed in Croatia were in shallow waters, between 0 and 0.5 m (Korshunova et al. 2020), as was the population studied in Sant Feliu, Catalonia (Spain).

Genus Eubranchus Forbes, 1838

# Eubranchus prietoi Llera and Ortea, 1981

(Figure 4(c))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'10''$ N,  $3^{\circ}2'44''$ E, 11 to 16 February 2018, 1.5–2 m depth, 13 spcs, adults and egg masses, L = 4-7 mm; 9 to 15 March 2018, 1.5 m depth, 13 spcs, juveniles, adults and egg masses, L = 6-10 mm; 30 March 2018, 1.5 m depth, 7 spcs, juveniles, adults and egg masses, L = 7-15 mm; 15 April 2018, 1.5 m depth, 2 spcs, adults, L = 8 mm; 7 May 2018, 0.7 m depth, 2 spcs, adults, L = 7 mm.

# External morphology

Body elongate, narrow, with a black mark on the dorsum (corresponding to digestive gland seen by transparency), starting between the first couple of cerata and ending at the last group of cerata. Background colour beige with brown and white punctuation. Rhinophores long, equal. Cerata large and fusiform compressed at the middle, transparent with white to dark brown visible digestive gland, white tips.

# Ecology

Specimens found during the day at the base of the hydrozoan *Kirchenpaueria halecioides* (Alder, 1859), but actively crawling, mating and feeding on the colony at night. 'C'-shaped egg masses were found on the hydrozoan.

# Distribution

Ghana; Strait of Gibraltar (García-Gómez 1987); France (Rudman 2020); Atlantic Spanish coast: Cantabria (Ortea and Bacallado 1981); Mediterranean Spanish coast: Catalonia (this study).

# Remarks

When active, the cerata are completely lateralised. Slugs are camouflaged from the pycnogonids also found on the hydrozoan colonies (X. Salvador pers. obs.). Specimens can be differentiated externally from other *Eubranchus* species by the insertion of the first cerata groupings and the visible black digestive gland on the dorsum between cerata (Llera and Ortea 1981).

Family FACELINIDAE Bergh, 1889

Genus Godiva Macnae, 1954

# Godiva quadricolor (Barnard, 1927)

(Figure 4(d))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10.5″N, 3°2′44.6″E, 31 December 2017, 2 m depth, 1 spc., L = 10 mm; 5 January 2018, 1.3 m depth, 1 spc., adult, L = 25 mm; 22 January 2018, 1.3 m depth, 1 spc., adult, L = 25 mm; 29 January 2018, 1.3 m depth, 1 spc., adult, L = 25 mm; Le Ponton, Étang de Thau, Sète (France), 43°25′28.5″N, 3°42′E, 8 April 2017, 1 m depth, 5 spc., adults and egg masses, L = 20–40 mm; 20 May 2018, 1 m depth, 4 spc., juveniles, adults and egg masses, L = 5–30 mm.

# External morphology

Body elongate, narrow, background colour light orange with whitish-blue electric marks. Oral tentacles present a whitish blue line connecting apical part with base of rhinophores. Rhinophores conical, slightly annulated, whitish-yellow apically. Cerata abundant, smooth, base red, tops orange, blue and yellow.

# Ecology

This species has a very broad diet (Betti et al. 2015), and is commonly found eating anemones (e.g. the genera *Anemonia* and *Aiptasia*), worms (e.g. *Sabella*), and other heterobranchs such as *Spurilla neapolitana* (Delle Chiaje, 1841).

# Distribution

This is an invasive species originally from South Africa and the Pacific Sea [e.g. Australia (Nimbs and Smith 2017), Hawaii (Gosliner 1980), now found in Italy, France, the Mediterranean Spanish coast: Andalucía (Zenetos et al. 2016; Gerovasileiou et al. 2017) and Catalonia (this study).

# Remarks

This species is a large facelinid with a very characteristic colour pattern, making it difficult to misidentify. In the Étang de Thau, France, the species is very abundant during spring.]

Family PISEINOTECIDAE Edmunds, 1970

Genus Piseinotecus Er. Marcus, 1955

# Piseinotecus soussi Tamsouri, Carmona, Moukrim and Cervera, 2014

(Figure 4(e))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'10''$ N,  $3^{\circ}2'44''$ E, 22 January 2018, 1.8 m depth, 7 spcs, juveniles, adults and egg masses, L = 4-25 mm; 29 January 2018, 1.6 m depth, 9 spcs, adults and egg masses, L = 12-25 mm.

# External morphology

Body elongate, narrow, background colour violet or pink. Rhinophores and oral tentacles smooth, white apically with degraded white punctuation. Cerata smooth, long, translucent, with digestive gland visible in orange; white apically, presenting profuse white punctuation.

# Ecology

Specimens found mating and laying the egg masses on unidentified species of hydrozoans at night, and inactive at the base of the colonies during the day.

# Distribution

Morocco (Tamsouri et al. 2014); Italy (Ballesteros et al. 2012–2021), Catalonia (Ballesteros et al. 2016; this study).

# Remarks

Originally described from Morocco, it is quite widespread on the Catalan coast. Differs from similar-looking species, such as *Edmundsella pedata* (Montagu, 1816), by the presence of abundant white spots in the cerata, rhinophores and oral tentacles.

# Piseinotecus sphaeriferus (Schmekel, 1965)

(Figure 4(f))

# Material examined

Punta del Romaní, l'Escala, Girona (Catalunya),  $42^{\circ}6'53.088''N$ ,  $3^{\circ}10'6.765''E$ , 8 November 2014, 1 spc.; Le Ponton, Étang de Thau, Sète (France),  $43^{\circ}25'28.5''N$ ,  $3^{\circ}42'E$ , 20 May 2018, 0.4 m depth, 1 spc., adult, L = 13 mm.

# External morphology

Body elongate, narrow, background colour transparent white. Rhinophores and oral tentacles smooth, translucent with white spots. Cerata smooth, background colour white or beige, base with a green iridescent sphere at their base; first and second row of cerata connected with a dark line.

# Ecology

The singleton specimen was found on the hydrozoan Obelia sp. at night.

# Distribution

Ghana (Edmunds 1977); Portugal (Cervera et al. 2004); Italy and Adriatic Sea (Zenetos et al. 2016); Spain: Canary Islands (Ortea et al. 2003), Catalonia (GROC 2009–2021; Ballesteros et al. 2016); France (this study).

# Remarks

This elusive species is easily diagnosed by an iridescent green sphere at the base of the cerata (Ortea et al. 2003).

Family TRINCHESIIDAE F. Nordsieck, 1972

Genus Tenellia A. Costa, 1866

# Tenellia adspersa (Nordmann, 1845)

(Figure 4(g))

# Material examined

Port de Blanes (Spain),  $41^{\circ}40'25.5''$ N,  $2^{\circ}47'48.6''$ E, 21 January 2019, 0.1 m depth, 1 spc., adults, L = 7 mm.

# External morphology

Body elongate, narrow, background colour black. Rhinophores smooth; oral veil very well developed and without oral tentacles. Cerata lateral, elongated; tip swollen.

# Ecology

A single specimen was found in a mass of hydrozoans in a floating dock with other sea slugs.

# Distribution

North-east Atlantic (OBIS 2021); Pacific North American coast (iNaturalist.org 2021; OBIS 2021); Portugal (Encarnação et al. 2020); Spain: Canary Islands, Atlantic Andalusian coast, Galicia, Levantine coast (Cervera et al. 2004), Catalonia (this study).

# Remarks

This species has a widespread and cosmopolitan distribution (Roginskaya 1970), being found in oceanic and brackish waters (Thompson and Brown 1984). *Tenellia adspersa* can be differentiated from conspecifics by having an oral veil connecting the oral tentacles and the cerata are clustered (Evertsen et al. 2004). Typically, the colour of the body and cerata varies from black to creamy with their diet (authors pers. obs.). Encarnação et al. (2020) found this species associated with the invasive hydrozoan *Cordylophora caspia* (Pallas, 1771) on artificial structures.

Genus Trinchesia Er. Ihering, 1879

# *Trinchesia cuanensis* Korshunova, Picton, Furfaro, Mariottini, Pontes, Prkić, Fletcher, Malmberg, Lundin and Martynov, 2019

(Figure 4(h))

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# Material examined

Punta del Romaní, L'Escala (Spain), 42°6'54"N, 3°10'9"E, 10 February 2014, 7 m depth, 1 spc., juvenile, L = 3 mm; 14 February 2015, 14 m depth, 1 spc., adult, L = 10 mm; Le Ponton, Étang de Thau, Sète (France), 43°25'28.5"N, 3°42'E, 14 April 2018, 1 m depth, 3 spc., adults, L = 7-20 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41° 47'10"N, 3°2'44"E, 15 April 2018, 0.6 m depth, 15 spcs, juveniles, adults and egg masses, L = 4-15 mm; 6 June 2018, 0.6 m depth, 20 spcs, adults and egg masses, L = 10-15 mm; 11 March 2020, 0.5 m depth, 12 spcs, adults and mating, L = 7-15 mm; Tamariu beach (Spain), 41°55'0.5"N, 3°12'27.1"E, 11 February 2019, 2 m depth, 4 spcs, adults, L = 6-10 mm.

# External morphology

Body elongate, narrow, background colour white or light yellow. Rhinophores and oral tentacles smooth, more intensely white than the body. Red or orange mark between eyes and on central dorsum. Cerata globular, displaying a bright yellow-blue-yellow colouration.

# Ecology

Specimens found mating and laying the eggs on the hydrozoans *Sertularella mediterranea* Hartlaub, 1901 and *Sertularella polyzonias* (Linnaeus, 1758) inside superficial caves.

# Distribution

North-east Atlantic (Korshunova et al. 2019); Adriatic Sea (Ballesteros et al. 2012–2021); Mediterranean French coast (this study); Spain: Catalonia (this study).

# Remarks

This species was recently described and observed in the North Atlantic and Mediterranean Sea (Korshunova et al. 2019). It is different from similar *Trinchesia* species by having one light or pale red marking between the eyes and in the middle part of the back. This species likely has a shorter life cycle than *T. morrowae* (Korshunova *et al.* 2019), since it has only been observed in the winter and spring months, whereas *T. morrowae* is observed year-round. *Trinchesia caerulea* (Montagu, 1804) has been found only during spring and autumn and is usually found in deeper waters than *T. cuanensis* (X. Salvador pers. obs.).

Order PTEROPODA Cuvier, 1804 Family CRESEIDAE Rampal, 1973 Genus *Creseis* Rang, 1828

# Creseis virgula (Rang, 1828)

(Figure 5(a))



**Figure 5.** Photographs of live Pteropoda species: (a) *Creseis virgula*. (b) *Hyalocylis striata*. (c) *Peracle reticulata*. (d) *Pneumodermopsis canephora*. Runcinida: (e) *Runcina ornata*. Sacoglossa: (f) *Aplysiopsis elegans*. (g) *Caliphylla mediterránea*. (h) *Cyerce graeca*.

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# Material examined

Ullastres 3, Llafranc (Spain),  $41^{\circ}53'14.1''N$ ,  $3^{\circ}12'26.0''E$ , 27 February 2019, 0.5 m depth, 3 spcs, adults, L = 10 mm; Cala Sa Tuna, Begur (Spain),  $41^{\circ}57'38''N$ ,  $3^{\circ}13'52''E$ , 9 March 2019, 0.8 m depth, 1 spc., adult, L = 10 mm; Montiel, Tamariu (Spain),  $41^{\circ}54'55.9''N$ ,  $3^{\circ}12'46.3''E$ , 13 March 2019, 1 m depth, 20 spcs, adults, L = 5-10 mm.

# External morphology

Shell narrow, elongated, conical, back end slightly curved, smooth. Parapodia transparent, large, with double-axe shape.

# Ecology

Found in open waters close to the surface and around other pelagic pteropod and salp species.

# Distribution

Cosmopolitan. In the Mediterranean Sea this species has been reported from the eastern and western Mediterranean, and in the Malta stretch and between Mallorca and Sicily (OBIS 2021). This is the first report of this species from the Mediterranean Spanish coast.

# Remarks

Almost all records in the Mediterranean are based on shell observations or from specimens caught in plankton tows in open waters, at superficial (0–10 m) or greater depths (600–700 m; OBIS 2021). Our specimens were found from February to March along with the massive arrival of pelagic zooplankton in superficial waters. This species is very similar to *C. conica* Eschscholtz, 1829, so several specimens with slightly different morphologies have been collected to determine whether both species could be present. In the case of both species, this record represents the first observation of either taxon for the Catalan coast.

Genus Hyalocylis Fol, 1875

# Hyalocylis striata (Rang, 1828)

(Figure 5(b))

# Material examined

Cala Sa Tuna, Begur (Spain), 41°57′38″N, 3°13′52″E, 9 February 2019, 1 m depth, 1 spc., adult, L = 6 mm; Montiel, Tamariu (Spain), 41°54′55.9″N, 3°12′46.3″E, 13 March 2019, 1 m depth, 4 spcs, adults, L = 6-10 mm; 14 March 2019, 1 m depth, 3 spcs, adults, L = 6-10 mm.

# External morphology

Shell wide, short, striated, conical, translucent. Parapodia large, transparent. Statocysts visible between shell and parapodia.

# Ecology

Found in open waters close to the surface and around other pelagic pteropod and salp species.

# Distribution

Cosmopolitan. In the Mediterranean Sea, it is commonly reported in the eastern part (Koukouras 2010; OBIS 2021) and from the Italian coast (OBIS 2021). This species was recorded in Spanish Mediterranean waters by the study of Cervera et al. (2004) but only in remote areas tens of miles from the coast. This is the first report in the vicinity of the Mediterranean Spanish coast and the first record for Catalonia.

# Remarks

As for *C. virgula*, almost all records in the Mediterranean Sea are based on shells of specimens caught with plankton nets in open waters and at great depths (OBIS 2021). Our specimens were found from February to March along with the massive arrival of pelagic zooplankton.

Family PERACLIDAE Tesch, 1913

Genus Peracle Forbes, 1844

# Peracle reticulata (d'Orbigny, 1835)

(Figure 5(c))

# Material examined

Cala Sa Tuna, Begur, NE Spain, 41°57′38″N, 3°13′52″E, 31 March 2021, 1 m depth, 2 spcs, adults, L = 4 mm; 2 April 2021, 3 m depth, 1 spc., L = 4 mm.

# External morphology

Shell helicoidal, conical, with reticulated microsculpture, orange due to digestive gland seen by transparency. Wing flaps broad, extending over the length of the shell.

# Ecology

This is a pelagic species living in offshore waters and its life cycle has not been well studied.

# Distribution

Cosmopolitan; widely recorded in the Atlantic Ocean (OBIS 2021). Portugal, Canary Islands, Strait of Gibraltar (Cervera et al. 2004); the Mediterranean Sea from the Andalusian coast (Cervera et al. 2004), Italy (OBIS 2021), Greece (GBIF.org 2021) and Catalonia (this study).

# Remarks

Easily identified by its morphology, but since it is a cosmopolitan and scarcely studied species, of which often only the shell is found, several specimens were collected for sequencing.

Family PNEUMODERMATIDAE Latreille, 1825

Genus Pneumodermopsis Keferstein, 1862

# Pneumodermopsis canephora Pruvot-Fol, 1924

(Figure 5(d))

# Material examined

Montiel, Tamariu (Spain), 41°54′55.9″N, 3°12′46.3″E, 13 February 2019, 1 m depth, 9 spcs, adults, L = 7-10 mm; Montiel, Tamariu (Spain), 41°54′55.9″N, 3°12′46.3″E, 12 March 2021, 3 m depth, 1 spc., adult, L = 5 mm; Cala Sa Tuna, 41°57′38″N, 3°13′52″E, 31 March 2021, 1 m depth, 2 spcs, juvenile and adult, L = 2-10 mm.

# External morphology

Body rounded, transparent, with numerous glands, dark chromatophores can be seen by transparency all over body. Lateral gill extremely long, posterior gill absent. Posterior end with two ciliated bands. Head with two apical tentacles.

# Ecology

Found in open waters close to the surface and with other pteropods and pelagic salps.

# Distribution

North Atlantic (OBIS 2021); Mediterranean Sea (Pruvot-Fol 1924); this is the first report of this gastropod from the Catalan coast (Spain).

# Remarks

Mostly found in North Atlantic waters (Pruvot-Fol 1924). Of the eight specimens collected and housed alive in the same container, two disappeared along with some other species of pteropods, likely indicating that in stressful situations this species may be cannibalistic.

Order RUNCINIDA

Family RUNCINIDEA H. Adams and A. Adams, 1854

Genus Runcina Forbes [in Forbes and Hanley], 1851

# Runcina ornata (Quatrefages, 1844)

(Figure 5(e))

# Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 13 October 2017, 0.1 m depth, 7 spcs, adults, L = 2-3 mm; 21 November 2017, 0.1 m depth, 1 spc., adult, L = 2 mm; 31 January 2018, 0.1 m depth, 9 spcs, adults, L = 2-3 mm; 23 April 2018, 0.1 m depth, 2 spcs, adults, L = 3 mm; 25 May 2018, 0.1 m depth, 2 spcs, adults, L = 3 mm; Punta del Romaní, L'Escala (Spain), 42°6′54″N. 3°10′9″E, 10 January 2018, 0.2 m depth, 4 spcs, adults, L = 2-3 mm; 24 April 2018, 0.2 m depth, 3 spcs, adults, L = 2-3 mm; 7 December 2018, 0.2 m depth, 7 spcs, adults, L = 2-3 mm; Punta d'en Bosch, Sant Feliu de Guíxols (Spain), 41°45′54″N, 3°0′11″E, 17 April 2018, 0.1 m depth, 5 spcs, adults, L = 1-3 mm.

#### External morphology

Body elongate, narrow, black or brown in colour, rear tail darker. Foot large.

# Ecology

Specimens found grazing on biofouling at night over calcarean red algae or boulders, in very superficial waters.

# Distribution

Atlantic Spanish coast: Canary Islands and Strait of Gibraltar (Cervera et al. 2004) and Mediterranean Spanish coast: Catalonia (this study).

#### Remarks

This species is rarely observed and very small. Easily distinguishable from other *Runcina* species by its absence of spots and white marks and its uniform black colour (Quatrefages 1844).

Superorder SACOGLOSSA Ihering, 1876

Family HERMAEIDAE H. Adams and A. Adams, 1854

Genus Aplysiopsis Deshayes, 1853

#### Aplysiopsis elegans Deshayes, 1853

(Figure 5(f))

#### Material examined

Cova de l'infern (Spain), 42°19'2.75"N, 3°19'12.74"E, 19 November 2017, 1.2 m depth, 5 spcs, adults and egg masses, L = 15-20 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 13 September 2019, 1.3 m depth, 1 spc., adult, L = 15 mm; Punta de la Mona, Andalucía (Spain), 36°43'12.9"N 3°43'43.1"W, 19 September 2020, 3 m depth, 1 spc., adult and egg masses, L = 20 mm.

#### External morphology

Body elongate, narrow, background colour white with longitudinal dark red lines on dorsum and lateral body parts. Cerata long, smooth; background colour green with white punctuation, dark red vertical lines, pink on tips.

#### Ecology

Specimens were found feeding on the green alga *Cladophora prolifera* (Roth) Kützing, 1843. The egg mass is whitish, cylindrical, found associated with algae. The specimen observed in 2019 was found at night crawling over algae, while the 2017 specimens were hidden inside algae. This could mean that slugs are mostly nocturnal, hiding among algae during the day.

#### Distribution

Greece (OBIS 2021); Croatia (Mavrič et al. 2014); Spain: Canary Islands (Ortea et al. 1998, 2001), Balearic Islands (Ballesteros and Templado 1996), Catalonia (this study).

# Remarks

This species is rarely observed. It is found among algae, especially *Cystoseira, Cladophora* and *Halopteris scoparia* (Linnaeus) Sauvageau, 1904 (Mavrič et al. 2014), and probably feeds on them.

Genus Caliphylla A. Costa, 1867

# Caliphylla mediterranea A. Costa, 1867

(Figure 5(g))

# Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 5 September 2017, 0.8 m depth, 2 spcs, adults, L = 17 mm; CalaVentosa, Sant Feliu de Guíxols (Spain), 41°47′5″N, 3°2′52″E, 13 September 2017, 1.5 m depth, 1 spc., adult, L = 20 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 5 December 2017, 0.7 m depth, 9 spcs, adults and egg masses, L = 5-40 mm; Fòrum pools, Barcelona (Spain), 41°24′34.5″N, 2°13′36.8″E, 5 December 2017, 0.7 m depth, 8 spcs, juveniles, adults and egg masses, L = 5-40 mm; Cova de l'infern (Spain), 42°19′2.75″N, 3°19′12.74″E, 18 September 2018, 1.3 m depth, 1 spc., adult and egg masses, L = 40 mm; Punta de la Mona, Andalucía (Spain), 36°43′12.9″N 3°43′43.1″W, 20 September 2020, 1–5 m depth, >40 spcs, juveniles, adults and egg masses, L = 4-30 mm.

# External morphology

Body elongate, thick, background colour light green with small brown and white dots along body, and a white pigmented area between eyes. Cerata numerous, flat; transparent with green lines running towards apex. Rhinophores long, folded, divided in 'Y' shape, tips divided into two unequal parts.

# Ecology

Specimens found at night and during the day on the green algae *Bryopsis duplex* (De Notaris, 1844) and *Cladophora prolifera* laying egg masses. At night slugs actively crawled and laid egg masses, while by day they hid among the algae.

# Distribution

Gulf of Mexico (BioGoMx 2021); Brazil (GBIF.org 2021); Gibraltar (García-Gómez 2002); Atlantic Spanish coast: Canary Islands (Ortea and Bacallado 1981; Ortea et al. 1999, 2001; Moro et al. 2003); Mediterranean Spanish coast, Andalucía (Luque 1983; García Raso et al. 1992; Ocaña et al. 2000), Levantine coast (Templado et al. 1987, 2002), Balearic Islands (GROC 2009–2021), Catalonia (this study).

# Remarks

This species is distinguished from similar ones like *C. viridis* (Deshayes, 1857) (formerly *Polybranchia viridis*) by the presence of a ramified digestive gland in the cerata (see *Poybranchia viridis* in Rudman 2021).

#### Genus Cyerce Bergh, 1870

#### Cyerce graeca Thompson T., 1988

(Figure 5(h))

#### Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57'49"N, 3°13'41"E, 26 August 2015, 0.5 m depth, 1 spc., adult, L = 15 mm; 3 August 2017, 2.3 m depth, 1 spc., adult; Cala Ventosa, Sant Feliu de Guíxols (Spain), 41°47'5"N, 3°2'52"E, 13 September 2017, 1.3 m depth, 1 spc., adult; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 29 January 2018, 1.2 m depth, 1 spc., adult; 14 February 2018, 0.7 m depth, 1 spc., juvenile, L = 3 mm; 22 February 2019, 1 m depth, 1 spc., adult, L = 12 mm; 20 February 2020, 0.7 m depth, 1 spc., adult, L = 10 mm.

#### External morphology

Body elongate, thick, background colour transparent to beige with darker dorsum. Cerata rounded, globular, beige to semi-transparent in colour, with blunt and dark brown digitations on top and white dots concentrated under these digitations. Rhinophores divided into a 'Y' shape.

#### Ecology

Specimens found on unidentified red algae; juveniles were found in February. Slugs were active at night and usually under rocks in areas with abundant algae during the day.

#### Distribution

Originally described from Greece (Thompson 1988); the Adriatic Sea and Italy (Ballesteros et al. 2012–2021); Spain: Balearic Islands (GROC 2009–2021), Catalonia (Ballesteros et al. 2016; this study).

#### Remarks

Easily differentiated from other Mediterranean *Cyerce* species by its rounded parapodial margin and digitate cerata tips, whereas *C. cristallina* has an angular parapodial margin and roughened but not digitated cerata apexes (Thompson 1988).

Genus Hermaea Lovén, 1844

#### Hermaea bifida (Montagu, 1816)

(Figure 6(a))

# Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57'49"N, 3°13'41"E, 31 March 2017, 1 m depth, 9 spcs, adults, L = 7-12 mm; 25 December 2017, 1 m depth, 5 spcs, adults and juveniles; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 31 December 2017, 0.7 m depth, 2 spcs, juvenile and adult, L = 2-6 mm; 8 March 2018, 1.4 m depth, 2 spcs, adults and egg masses, L = 12 mm; Cala Sa Tuna, 41°57'38"N, 3°13'52"E, 3 January 2018,



**Figure 6.** Photographs of live Sacoglossa species: (a) *Hermaea bifida* and close-up on its egg mass at the base of an alga. (b) *Hermaea cantabra*. (c) *Hermaea paucicirra*. (d) *Limapontia capitata* on *Ulva lactuca*. (e) *Placida tardyi*. (f) *Placida viridis*. (g) *Elysia flava*. Siphonariidae: (h) *Williamia gussoni*.

0.8 m depth, 4 spcs, adults, L = 5-7 mm; Punta del Romaní, L'Escala (Spain), 42°6′54″N, 3° 10′9″E, 6 January 2018, 0.7 m depth, 1 spc., juvenile, L = 2 mm; Cala Trons, Lloret de Mar (Spain), 41°41′57″N, 2°51′52″E, 20 January 2018, 1.7 m depth, 1 spc., adult, L = 12 mm.

# External morphology

Body elongate, narrow, background colour red and semi-transparent, with dispersed white dots concentrated around head, cerata and rhinophore apexes. Cerata globular, leaf-shaped, semi-transparent, with internal lines of red colour running towards apex and surrounded by four tubercles. Rhinophores beige, internally rolled, bifid with superior apex slightly longer than inferior one.

# Ecology

Specimens were found on the red alga *Bornetia secundiflora* (J.Agardh) Thuret, 1855, where they were mating and laying the eggs. The egg mass is whitish, cylindrical and 'C'-shaped (Figure 5(b), close-up); they were laid under the algae, around *B. secundiflora* but not on it.

#### Distribution

Central American coast and England (iNaturalist.org 2021); Portugal (Cervera et al. 2004); Gibraltar (García-Gómez 2002); Spain: Galicia (Rolán 1983), Andalucía (Cervera et al. 1988), Levantine coast (Templado 1982; Templado et al. 1983, 1984; Marín and Ros 1988), Balearic Islands, Spain (GROC 2009–2021), Catalonia (Ballesteros et al. 2016; this study); France (Rudman 2021).

#### Remarks

In the Spanish Balearic Islands this species was reported on the invasive alga *Lophocladia lallemandii* (Montagne) F. Schmitz, 1893 (GROC 2009–2021), off Catalonia we commonly found it on *B. secundiflora*; juvenile specimens had a fluorescent orange colouration on their cerata, similar in colour to the latter alga.

#### Hermaea cantabra Caballer and Ortea, 2015

(Figure 6(b))

#### Material examined

Es Caials, Cadaqués (Spain),  $42^{\circ}17'5.1''$ N,  $3^{\circ}17'50''$ E, 20 February 2010 10 m depth, 2 spcs, adults, H = 6–10 mm; Tamariu beach (Spain),  $41^{\circ}55'0.5''$ N,  $3^{\circ}12'27.1''$ E, 11 February 2019, 5 m depth, 1 spc., adult, *L* = 5 mm.

# External morphology

Body elongate, narrow, background colour semi-transparent, with two lateral and two dorsal red narrow lines close to eyes, little visible at the end of body. Cerata globular, semi-transparent, with red digestive gland seen by transparency running towards apex, external white punctuations scattered throughout but most concentrated into two tubercles before each ceras top. Rhinophores beige in apical part, with a central red line and white coloured scattered dots.

# Ecology

The specimen was found in a red filamentous alga sample at superficial depths.

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# Distribution

North Spanish coast (Caballer and Ortea 2015); Catalonia (GROC 2009-2021; this study).

# Remarks

This species is distinguished from *H. bifida* by the presence of red lines that run from the rhinophores, passing between the eyes, to the dorsum, the absence of oral appendages (present in *H. bifida*), and a less ramified digestive gland (Caballer and Ortea 2015). The species description of *H. cantabra* was only established in 2015, and thus some previous records of *H. bifida* in the Iberian Peninsula could be misidentifications (e.g. Salvat 1968; Ortea 1977).

# Hermaea paucicirra Pruvot-Fol, 1953

(Figure 6(c))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47′10″N, 3°2′44″E, 5 January 2018, 0.4 m depth, 3 spcs, adults and copulation, L = 2-3 mm.

# External morphology

Body elongate, narrow, background colour translucent white, with red lines on dorsum from apex of rhinophores to tail, and on laterals from eyes; with white opaque dots scattered on dorsum. Cerata club-shaped, red in colour, with white punctuation more concentrated in apex. Rhinophores internally rolled, posterior part longer than anterior part, transparent white with opaque white dots.

# Ecology

Specimens found feeding and mating on the red alga *Antithamnion cruciatum* (C.Agardh) Nägeli, 1847 and were active at night.

# Distribution

The species description of this slug was from specimens in Atlantic waters of Morocco and Senegal (Pruvot-Fol 1953); also found in Portugal (Cervera et al. 2004); Gibraltar (Cervera and García-Gómez 1986); Spain: Canary Islands, Andalucía, Galicia, Cantabric Sea, Levantine coast (Cervera et al. 2004), Catalonia (Ballesteros et al. 2016; this study).

# Remarks

This species is distinguished from *H. bifida* by having more globular and rounded cerata, and more abundant white body punctuation (Salvat 1968). *Hermaea paucicirra* can be differentiated from its sympatric species *H. cantabra* by the presence of a more opaque white body with a red mark on the eyes. Because the epidermal red pigmentation on the dorsum obscures the digestive gland as it also happens with the cerata, not as in *H. cantabra* (Caballer and Ortea 2015).

Family LIMAPONTIIDAE Gray, 1847 Genus *Limapontia* Johnston, 1836

#### Limapontia capitata (O.F. Müller, 1774)

(Figure 6(d))

#### Material examined

Le Ponton, Étang de Thau, Sète (France),  $43^{\circ}25'28.5''$ N,  $3^{\circ}42'$ E, 18 May 2017, 1 m depth, 2 spcs, adults, *L* = 3 mm.

#### External morphology

Body short, thick, background colour dark brown, periocular area and tail white. Rhinophores very short, crest-like. Parapodia absent. Protuberance caused by pericardial system seen in dorsum.

#### Ecology

Specimens found in brackish waters on substrate extensively covered by the green alga *Ulva lactuca* Linnaeus, 1753.

#### Distribution

Originally described in the North Sea (England and Norway; Muller 1773); also, Portugal (Cervera et al. 2004); Spain: Cantabric Sea, Galicia, Levantine coast (Templado et al. 1983; Cervera et al. 2004); Mediterranean French coast (this study).

#### Remarks

This species has been reported from eutrophic areas with variable salinity, although its presence has been attributed to having been washed there by waves (Rudman 2021). It has always been found with green algae of the genera *Cladophora, Ulva* and *Bryopsis*. It can be distinguished from *L. senestra* (Quatrefages, 1844) because it lacks long cephalic extensions, and from *L. depressa* Alder and Hancock, 1862 because of its particular head shape (Gascoigne 1952).

Genus Placida Trinchese, 1876

#### Placida tardyi (Trinchese, 1874)

(Figure 6(e))

#### Material examined

Fòrum pools, Barcelona (Spain), 41°24'34.5"N, 2°13'36.8"E, 23 November 2017, 0.4 m depth, 12 spcs, juveniles, adults and egg masses, L = 3-20 mm; le Ponton, Étang de Thau, Sète (France), 43°25'28.5"N, 3°42'E, 21 May 2018, 0.5 m depth, 3 spcs, adults, L = 17-25 mm; Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 19 December 2018, 2 m depth, 2 spcs, adults and egg masses, L = 10-15 mm; 1 January 2019, 1.3 m depth, 3 spcs, adults, L = 13-15 mm; Cala Sa Tuna, Begur (Spain), 41°57'38"N, 3°13'52"E, 31 January 2019, 0.5 m depth, 1 spc., juvenile, L = 3 mm; Tamariu Beach (Spain), 41°55'0.5"N, 3°12'27.1"E, 10 September 2019, 1 m depth, 4 spcs, adults with egg masses, L = 10-20 mm; Punta de la Mona, Andalucía (Spain), 36°43'12.9"N, 3°43'43.1"W, 19 September 2020, 2 m depth, 2 spcs, adults, L = 15-20 mm.

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# External morphology

Body elongate, narrow, background colour white and semi-transparent with a central white circle on dorsum. Lateral body parts and foot with dark brown or purple colour. Cerata long, smooth; background colour green, with white spots, tip dark garnet in colour. Rhinophores smooth, large, with white dots concentrated at apexes. Oral tentacles wide and short.

# Ecology

Specimens found in masses of the green alga *Bryopsis duplex*, mating, and laying whitish and cylindrical egg masses at the base of the alga. This species can go completely unnoticed within the algal masses; moves actively at night.

# Distribution

Originally described from Italy: Genoa (Trinchese 1874), Gulf of Naples (Gascoigne and Sordi 1980); also, Portugal (Calado et al. 2003); Gibraltar (Cervera et al. 1988); Spain: Andalusian coast (this study), Catalonia (this study); France (this study).

# Remarks

This species can be misidentified as *P. vidiris* (Trinchese, 1874), but it is distinguishable by its brown or purple body margins and the tip of the cerata darkly coloured in garnet (Pruvot-Fol 1954).

# Placida viridis (Trinchese, 1874)

(Figure 6(f))

# Material examined

Cala Ventosa, Sant Feliu de Guíxols (Spain),  $41^{\circ}47'5''N$ ,  $3^{\circ}2'52''E$ , 13 September 2017, 0.1 m depth, 5 spcs, adults and egg masses, L = 7-20 mm; Cala Sa Tuna,  $41^{\circ}57'38''N$ ,  $3^{\circ}13'52''E$ , 8 March 2018, 0.1 m depth, 6 spcs, juveniles and adults, L = 2-15 mm; Punta d'en Bosch, Sant Feliu de Guíxols (Spain),  $41^{\circ}45'54''N$ ,  $3^{\circ}0'11''E$ , 17 April 2018, 0.1 m depth, 5 spcs, adults and egg masses, L = 12-20 mm.

# External morphology

Body elongate, narrow, background colour white and semi-transparent with digestive branches of dark green. Cerata long, smooth; background colour dark green, with white punctuation, apex white. Rhinophores long, translucent white with green branches and white punctuation on tips.

# Ecology

Specimens found on the green alga *Bryopsis mucosa* (J.V. Lamouroux, 1809) laying cylindrical and white egg masses. Specimens in this study were found within a few centimetres' depth feeding on *B. mucosa*, which is commonly found at subtidal depths.

# Distribution

Israel (Monselise and Mienis 1977); Greece and Black Sea (OBIS 2021); Italy (Ballesteros et al. 2012–2021); Spain: Catalonia (Cervera et al. 2004; this study); France (this study).

#### Remarks

See the Remarks section on *P. tardyi* above.

Family PLAKOBRANCHIDAE Gray, 1840

Genus Elysia Risso, 1818

#### Elysia flava Verrill, 1901

(Figure 6(g))

#### Material examined

Cala d'Aiguafreda, Begur (Spain), 41°57′49″N, 3°13′41″E, 30 July 2015, 2.3 m depth, 6 spcs, adults, L = 5-12 mm; Roqueo de los 14, La Herradura (Spain), 36°43′13.2″N, 3°43′43.5″W, 18 September 2016, 1.6 m depth, 3 spcs, adults, L = 7-10 mm.

#### External morphology

Body elongate, narrow, background colour green/yellow, dark green in parapodia, margin of parapodia wavy, white. Rhinophores short, apex white, with two white spots between eyes.

#### Ecology

Specimens found in July mating on unidentified algae. This species is strictly nocturnal, found during the day under rocks and at night on algae, especially green filamentous algae such as *Cladophora*.

#### Distribution

Caribbean Sea (GBIF.org 2021); Madeira (Cervera et al. 2004); Azores (Malaquias et al. 2009); Greece and Adriatic Sea (Ballesteros et al. 2012–2021); Spain: Canary Islands, Levantine coast, Catalonia (Cervera et al. 2004; this study), Andalucía (this study).

#### Remarks

This species is differentiated from sympatric *Elysia* by the yellowish colour of the body as well as the green dark colour in the parapodia (Thompson and Jaklin 1988).

Superorder SIPHONARIMORPHA

Family SIPHONARIIDAE Gray, 1827

Genus Williamia Monterosato, 1884

# Williamia gussoni (O.G. Costa, 1829)

(Figure 6(h))

# Material examined

Cala Maset caves, Sant Feliu de Guíxols (Spain), 41°47'10"N, 3°2'44"E, 30 September 2020, 1 m depth, 4 spcs, adults and egg masses, L = 2-5 mm; 31 October 2020, 1 m depth, 2 spcs, juveniles, L = 2 mm; 12 December 2020, 1 m depth, 1 spc., juvenile, L = 2 mm; 22 December 2020, 1 m depth, 2 spcs, juveniles, L = 2 mm; 31 December 2020, 1 m depth, 2 spcs, juveniles, L = 2 mm; 14 January 2021, 1 m depth, 2 spcs, juveniles, L = 2 mm; 27 February 2021, 1 m depth, 2 spcs, juveniles, L = 2 mm; Barceloneta Beach, Barcelona (Spain), 41°22'49.5"N, 2°11'43.3"E, 30 April 2021, 4 m depth, 1 spc., juvenile, L = 1 mm.

# External morphology

Shell external, patelliform, covering entire body; protoconch on the posterior part, farther from the head; with white longitudinal lines, background red. Body background beige to white with concentrations of red marks in the front.

# Ecology

All specimens found in communities of the red alga *Peyssonnelia rosa-marina* Boudouresque and Denizot, 1973, grazing and laying the egg masses at night.

# Distribution

Throughout the Mediterranean and the eastern Atlantic, in the Azores, Cavo Verde, the Canary Islands and the north-eastern African coast (GBIF.org 2021).

# Remarks

*Williamia gussoni* could be confused with the sympatric *Tectura virginea* (O.F. Müller, 1776), from which it can be distinguished by the absence of long oral tentacles typical of *Tectura*. Also, in *Tectura* the apical part of the shell is in the anterior segment of the body, near the head. The pattern of the shell ribs is also different, with a greater number of vertical and more irregularly distributed white lines. Remarkably, the photograph herein is, to our knowledge, the first one taken of live *W. gussoni* specimens in their habitat. This species has been widely cited based only on shells found on sediments, with scarce data on living specimens, related to red algae of the genus *Peyssonnelia* Decaisne, 1841. In our study, we observed a specimen from 31 October 2020 until 27 February 2021, always on the same algal frond of *P. rosa-marina*.

# Discussion

In the present study, we provide high-quality images, morphological descriptions and ecological remarks on 39 Mediterranean species of elusive heterobranchs. These correspond to 23 new records for the Catalan coast (NE Spain; see Table 1). Our new data, together with the recently described *Trinchesia morrowae* (Korshunova *et al.* 2019) and *Tylodina rafinesquii* (Fernández-Vilert *et al.* 2021), increase the overall diversity of marine heterobranchs in this region by 10%, to a total of 230 species. We also provide a new species record from the southern Spanish Mediterranean coast for the sacoglossan *Elysia flava*. Moreover, three species of pelagic pteropods are new records for Spain (i.e. *Creseis virgula, Hyalocylis striata* and *Pneumodermopsis canephora*), and eight other species are new records for the French Mediterranean coast (i.e. *Doto cervicenigra, Piseinotecus sphaeripherus, Polycerella emertoni, Amphorina andra, Trinchesia cuanensis, Limapontia* 

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Species	New record
Haminoea orteai	Catalonia
Aegires sublaevis	Catalonia
Aldisa smaragdina	Catalonia
Polycera hedgpethi	Catalonia
Polycerella emertoni	Mediterranean French coast and Catalonia
Thecacera pennigera	Catalonia
Anteaeolidiella lurana	Spanish Levantine coast and Catalonia
Doto cervicenigra	Spanish Levantine Coast, Mallorca, Catalonia and Mediterranean French coast
Doto fragilis	First record in the Mediterranean Sea, Catalonia
Doto pygmaea	Catalonia
Phylliroe cf. bucephala	Catalonia
Amphorina andra	Mediterranean French coast and Catalonia
Eubranchus prietoi	Catalonia
Godiva quadricolor	Catalonia
Piseinotecus sphaeriferus	Mediterranean French coast
Tenellia adspersa	Catalonia
Trinchesia cuanensis	Mediterranean French coast and Catalonia
Creseis virgula	Catalonia
Hyalocylis striata	Catalonia, first record in Spanish Mediterranean coast
Peracle reticulata	Catalonia
Pneumodermopsis canephora	Catalonia
Runcina ornata	Catalonia
Aplysiopsis elegans	Andalusian coast and Catalonia
Caliophylla mediterranea	The Balearic Islands and Catalonia
Limapontia capitata	Mediterranean French coast
Placida tardyi	Mediterranean French coast, Catalonia and Andalusian coast
Placida viridis	Mediterranean French coast
Elysia flava	Andalusian coast

capitata, Placida tardyi and Placida viridis). Regarding introduced non-native species, we document the known range of five: Haloa japonica (in France), Anteaeolidiella lurana (in Spain: Catalonia and Valencia), Godiva quadricolor (in Catalonia), Polycerella emertoni (in France and Catalonia) and Polycera hedgpethi (in France and Catalonia).

In addition to these new records, the natural history information on body morphology, phenology, egg mass morphology and ecology of many taxa provided herein will enable a better understanding of these species. For example, among nudibranchs, numerous specimens of Eubranchus prietoi were firstly observed displaying the cerata in a lateralised position when disturbed, resembling sympatric pycnogonid species. A specimen of Aldisa smaragdina reported here lacked the second dark circle present in its original description. Thus, we suggest a molecular revaluation of specimens of this genus would be useful to ascertain whether such chromatic variability corresponds to either population or species molecular diversity. Doto cervicenigra individuals were found with hydrozoans collected in harbours at 1 m depth. Another species of Doto, D. pygmaea, was found on floating objects (especially plastics) transported by sea currents and feeding on the hydrozoan Tubelaria sp.; previous observations reported this slug feeding on Obelia geniculata (Linnaeus, 1758) (Ortea et al. 1997). The eastern Atlantic species Doto fragilis is recorded for the first time from the Mediterranean Sea, in a cave and feeding on the hydroid Kirchenpaueria pinnata. Also, we found phenological differences between the recently described species of Trinchesia: T. cuanensis has been observed in winter and spring, T. morrowae is present all year long, and T. caerulea was found only in spring and autumn. A rare species found in the Mediterranean, Palio nothus, was regularly found in overhangs,

especially in the entrance of caves that lacked direct sunlight, feeding on the bryozoan *Amathia lendigera*. Interestingly, several specimens of the pelagic *Phylliroe* cf. *bucephala* were found close to shore and photographed; collected specimens will be DNA barcoded to discern species identity. Concerning the Pteropoda, the elusive gymnosome *Pneumodermopsis canephora* was observed to exhibit cannibalistic behaviour, and live pictures of the three described species are some of the few published so far. Also, we provide the first photos of the adult free-swimming thecosomate *Peracle reticulata*. Regarding sacoglossans, we provide new data on the diet of several species. For instance, specimens of *Hermaea bifida* were recorded on the red alga *Bornetia secundiflora* for the first time (reviewed in Caballer and Ortea 2015) at a few metres' depth, in rock overhangs without solar radiation. When the sacoglossan species fed on the alga, the latter acquired a fluorescent orange colour, also displayed in the cerata of juvenile slugs, thus acquiring an excellent camouflage.

Overall, we recorded information about 25 marine gastropod species; all are active at night and most observations were made in shallow depths no greater than 5 m. Therefore, we speculate that many known heterobranch species living under rocks may have nocturnal activity. In other words, the species for which we have scant records may be common at night, when sampling is scarce. Thus, changing our sampling habits would probably effectively increase the diversity of a particular area, as we have seen in this study.

Here we also show the importance of public science participation, particularly by divers, in the study of this particularly attractive group, the heterobranchs, and using underwater photography. Online platforms that host photos of species observations, such as GROC (GROC 2009–2021) or OPK Opistobranquis (Ballesteros et al. 2012–2021), represent a powerful tool to discover new species records, track the spread of introduced species and contribute with observations that advance knowledge about ecology and phenology in this group. To date, within the GROC project association (GROC 2009–2021), a total of 194 collaborators have entered 23,663 observations, corresponding to 74,784 specimens or individuals belonging to 236 species. These were recorded in 2963 diving sites along the Spanish and southern French Mediterranean coast and represent far more observations that the scientific community could have made alone. Our long-term goals include DNA barcoding of all western Mediterranean species to then include them in phylogenetic studies of broad biogeographic and phylogenetic scope (Moles and Giribet 2021).

#### Acknowledgements

We are indebted to the nearly 200 collaborators of GROC who regularly monitor the Catalan coast and adjacent waters, and especially to Xavier Lindo for directing the project and GROC association. Peter C. Kohnert is acknowledged for the taxonomic insight provided for the pteropod species. For J. Moles, a postdoctoral fellowship was supported by the Alexander von Humboldt Foundation (Germany). This is study #7 of the GROC Association.

#### **Disclosure statement**

No potential conflict of interest was reported by the authors.

# Funding

Sampling was partially funded by the Artenvielfalt erforschen und retten Association (https://www.artenforschung.de/; Germany).

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