

GEA, FLORA ET FAUNA

Sea slugs (Mollusca, Gastropoda, Heterobranchia): the other inhabitants of the city of Barcelona (Spain)

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Rebut: 28.04.2020; Acceptat: 27.05.2020; Publicat: 30.06.2020

Abstract

Sea slugs in the broad sense (until recently called «opisthobranchs» and now within the Heterobranchia subclass of the Gastropoda), have aroused the interest of naturalists since they began to be studied by the end of the XVIII century. Their colorful and varied shapes make them very attractive to be studied and photographed. Numerous are the published works written to spread the knowledge of the biodiversity of these molluscs in all marine regions, however very few studies have been carried out to know these species that inhabit highly anthropized areas, such as the interior of commercial ports, marinas, artificial substrates or the coastal areas of large cities. Here are the results of a biodiversity study of marine heterobranchs conducted along the coast of the city of Barcelona (Spain). Numerous specimens of 73 species of sea slugs have been found, belonging to 5 orders: 4 Aplysiida, 5 Cephalaspidea, 3 Runcinida, 47 Nudibranchia and 4 Pleurobranchida, and 1 superorder: 10 Sacoglossa, including two alien species, *Polycerella emertoni* and *Bursatella leachii*, of wide circumtropical distribution. Our work proves that new habitats, created with the construction of marinas, breakwaters or submerged rock bars, are being colonized by seaweeds and marine invertebrates that set onto these artificial structures. Surprisingly our study found a high biodiversity of marine heterobranchs, even in waters with abundant organic matter and subjected to high anthropic pressure.

Key words: seaslugs, biodiversity, artificial structures, Barcelona, Spain.

Resum

Llimacs de mar (Mollusca, Gastropoda, Heterobranchia): els altres habitants de la ciutat de Barcelona (Espanya)

Els llimacs de mar en sentit ampli (fins fa poc anomenats «opisthobrànquids» i ara dins de la subclasse Heterobranchia dels Gastropoda) han despertat l'interès dels naturalistes des que van començar a conèixer-se a finals del s. XVIII. Les seves vistoses coloracions i variades formes els fan molt atractius per a estudiar-los i fotografiar-los. Nombroses són les obres que s'han escrit per donar a conèixer la biodiversitat d'aquests mol·luscs en totes les regions marines. Pocs estudis són, en canvi, els que s'han realitzat per conèixer les espècies que habiten en zones altament antropitzades com l'interior de ports comercials, marines esportives, substrats artificials o zones costaneres de grans ciutats. En aquest treball es presenten els resultats d'un estudi de biodiversitat d'heterobrànquids marins realitzat a la costa de la ciutat de Barcelona (Espanya). S'han comptabilitzat nombrosos exemplars de 73 espècies de llimacs marins pertanyents a 5 ordres: 4 d'Aplysiida, 5 de Cephalaspidea, 3 de Runcinida, 47 de Nudibranchia i 4 de Pleurobranchida, i un superordre: 10 de Sacoglossa, incloses dues espècies al·lòctones, *Polycerella emertoni* i *Bursatella leachii*, d'àmplia distribució circumtropical. El nostre treball comprova que en les estructures artificials creades amb la construcció de marines, esculleres o barres submergides s'estableixen nous ambients capaços de ser colonitzats per algues i invertebrats marins. Sorpren en el nostre estudi l'alta biodiversitat trobada quant a heterobrànquids marins, fins i tot en aigües amb abundant matèria orgànica i que estan sotmeses a una alta pressió antròpica.

Paraules clau: llimacs de mar, biodiversitat, substrats artificials, Barcelona, Espanya.

Introduction

Sea slugs in the broad sense (until recently called «opisthobranch» and now within the Heterobranchia subclass of the Gastropoda) have always aroused great interest in biologists and marine naturalists because of their colourful shapes. Since the beginning of the 19th century many great naturalists have studied them, describing new species, providing

data on their biology and, occasionally, writing priceless monographs (Alder & Hancock, 1855; Trinchese, 1881; Vayssièrre, 1888; Bergh, 1905) even by today's standards. For this reason numerous researchers have dedicated their lives to the study of the sea slugs in all oceans. It is worth mentioning that, since the 1970s Spanish researchers such as Ros, Ortea, Ballesteros, Urgorri, García-Gómez and Cervera, among others, made the Iberian coasts some of the best known in the

world, in terms of «opisthobranch» biodiversity (Cervera *et al.*, 2004).

The Mediterranean Sea is one of the best known marine areas regarding this group of marine gastropods, with over 600 species known (Costello *et al.*, 2001; Trainito & Doneddu, 2014; Prkić *et al.*, 2018). In the recent decades several identification guides have been published, filled with excellent photographs that have placed the «opisthobranch» within the reach of naturalists and divers (Schmekel & Portmann, 1982; Vicente, 2008; Bielecki *et al.*, 2011; Trainito & Doneddu, 2014; Martínez-Chacón, 2018; Prkić *et al.*, 2018; Salvador, 2019; Ballesteros *et al.*, 2019). Gosliner *et al.* (2008) produced an excellent compilation of the history of knowledge of the Mediterranean «opisthobranch» and their biodiversity.

The knowledge of the «opisthobranch» of the Catalan coasts was first summarized in the work by Ballesteros (2007), where a total of 205 different species are listed. A later update of this catalogue (Ballesteros *et al.*, 2016) raises the number of known species to 257. These results are the consequence of a recent and increasing interest of biologists, naturalists and non-professional divers searching for these animals along the Catalan coast, helped by the technical advances in digital underwater photography and by the recent web sites specialized on «opisthobranch» (GROC, 2020; OPK, Ballesteros *et al.*, 2020) and by several specialized social networks discussion groups. A recently published field guide (Ballesteros *et al.*, 2019) indicates the presence of a total of 153 species of nudibranchs for the Catalan coast.

There are not many studies on the fauna and flora that inhabit the bottoms of heavily anthropized areas in the vicinity of large coastal cities or in the interior of commercial ports and marinas. For example, Elgharsalli *et al.* (2015) studied the malacofauna of the Hammamet Marina, a very important tourist area in the coast of Tunisia, and only found 14 different mollusc species, including a single «opisthobranch» (*Felimare picta*).

There are also very few studies on the «opisthobranch» fauna of ports, marinas or areas with strong anthropic pressure. One of them was made in the Pantano Piccolo (or Faro Lake), a brackish water closed lagoon in northeast Sicily (Italy), connected with the sea by an artificial channel and with the also brackish Lago di Ganzirri through another channel. This lagoon is subjected to high anthropic pressure due to the density of people living along its banks, but also because of the bivalve cultivation facilities inside. It is worth noting that this lagoon stands out for its shallow depth, with a maximum of 3.5 m in its western zone and 29 m in its eastern zone, with anoxic waters below 10 m. Vitale *et al.* (2016) conducted monthly samplings since 2010 using both breath-hold and scuba diving and found a total of 47 «opisthobranch» species, both inside the lagoon and in the channel connecting to the sea. Muñoz *et al.* (2018) have studied the continental and marine malacological fauna of another rather anthropized area such as the field of Gibraltar, citing 120 species of «opisthobranch» (including pelagic ones).

Siro de Fez, professionally a medicine doctor and hobby malacologist, collected and studied algae and other sessile organisms at very shallow depth inside the Valencia (Spain)

harbour between 1943 and 1947. He managed to collect 31 species of «opisthobranch», a very little known group in Spain at that time. The results of his work were published after his death in 1974 in the book: «Ascoglossos y Nudibranchios de España y Portugal» (Fez, 1974), recently reviewed by Ballesteros (2014). Fez's work is the only one, as far as we know, that has studied the fauna of «opisthobranch» inhabiting the interior of a harbour. Subsequently, Ros (1975) did much of his work on the Iberian «opisthobranch» on the coast of the city of Blanes (NE Spain).

Here we present the results of the «opisthobranch» visual samplings and collections performed by the authors and many collaborators within the bathing area of the Forum of Barcelona, a marine area relatively protected from the open sea by some breakwater structures. Also recorded are the visual observations made by divers, confirmed by pictures, on beaches and breakwaters of the 3 harbours within the territorial limits of the city of Barcelona, between the mouths of the Besós river to the North and the Llobregat river to the South.

Materials and methods

Study areas

Within the coastal limits of the city of Barcelona the following points have been sampled (Fig 1), ordered from N to S: Barcelona Forum bathing area, Mar Bella beach, Nova Icària beach, Gregal dock of the Olympic harbour, Hotel W breakwater, Llevant dock of the commercial harbour, Attached dock breakwater and Liquids Terminal dock. In all these points, visual samplings of «opisthobranch» have been carried out in breath-hold and/or scuba diving and photographs have been taken to confirm the presence of every species. The Forum bathing area deserves special mention because a general study of fauna and flora biodiversity has been carried out with monthly quantitative and qualitative samplings for more than one year (from May 2018 to October 2019) (Parera, 2019). Also, we include some «opisthobranch» species reported many years ago, that were collected as bycatch of commercial trawlers in grounds at depths between 70-100 m off the city of Barcelona, and preserved for future studies like the present work.

Data collection and underwater photography

The visual samplings were done in breath-hold and/or scuba diving. Numerous photographs of all observed species were taken in order to perform later analysis of the pictures that led to the positive identification of the animal. Some additional data were recorded by handwriting on a PVC slate, such as animal size, substrate, depth, mating behavior, presence of egg-spawns, etc. Photographic equipment consisted on digital cameras in appropriate underwater housings and external lighting systems: cameras Nikon D90, D7200 and D7500 with 60mm Nikon macro lenses, Sony a6300 with external macro wet lens and Olympus E-PM1, TG4 and TG5, all of them capable of providing high resolution digital pictures.

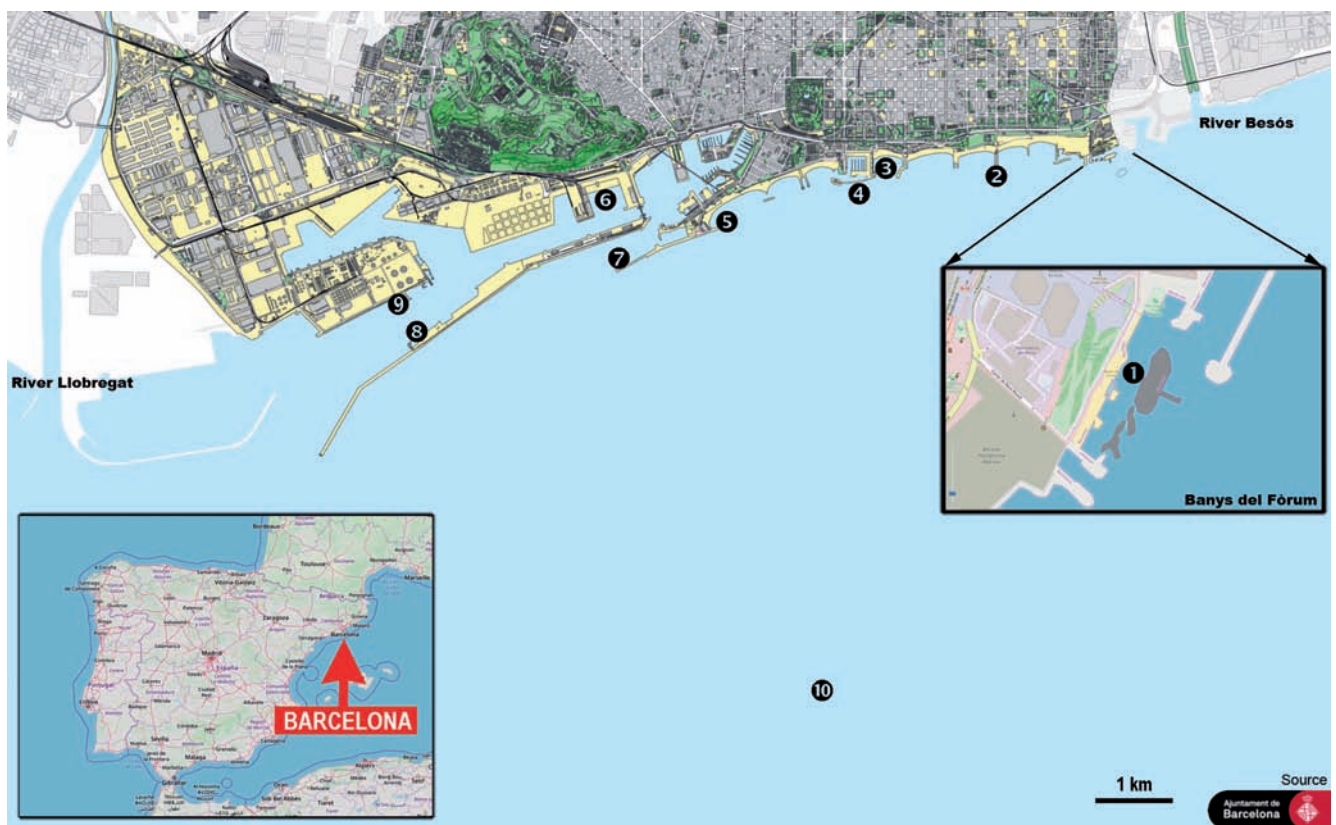


Figure 1. City of Barcelona (Spain) waterfront. Sampling locations: 1) Barcelona Forum bathing area; 2) Mar Bella beach; 3) Nova Icaria beach; 4) Olympic harbour, Gregal dock breakwater; 5) Hotel W breakwater; 6) Morrot dock; 7) Llevant dock breakwater; 8) Attached dock breakwater; 9) Liquids Terminal dock; 10) Commercial trawling grounds off Barcelona harbour.

During the general fauna and flora biodiversity study conducted in the Forum bathing area, quantitative samples were also taken by scraping concrete surfaces of 20×20 cm that were hermetically sealed in zip bags during the dive. These quantitative samples were collected quarterly in two zones: on the walls of the bathing area itself and on the vertical pylons that are located about 15 m away from the walls, taking 3 replicas from each zone, in every quarterly sampling dive. These quantitative samples were then studied in the Laboratory of the Department of Evolutionary Biology, Ecology and Environmental Sciences of the Faculty of Biology of the University of Barcelona. This method allowed us to obtain some «opisthobranch» that are very difficult to observe on the substrate where they live due to their small size, for instance: *Placida dendritica*, *Placida verticilata*, *Doto rosea* and several species of *Runcina*.

Apart from using the pictures for identification purposes, we geolocated the findings to plot species' distribution maps by using GPS coordinates. During the sampling dives, a Holux M-1000C GPS tracker in a waterproof housing was attached to the diver by a bungee line, so it followed the observer and recorded his location every 3 seconds. By synchronizing the digital camera clock with the GPS it was possible to establish the exact location where every picture was taken. These location coordinates were then recorded in the proper EXIF header fields of each picture file, and plotted on

local maps by using the software BT747 v2.1.3 by Mario De Weerd (accessible at <https://www.bt747.org/>).

Information on the presence of some species has also been obtained from other sources, such as web sites with free access databases like OPK (<https://opistobranquis.info>), GROG (<https://opistobranquis.org>) or Buceo Hispania Barcelona (Cobo, 2020: <https://buceohispaniabarcelona.com>), and some records from scientific literature like Arias & Morales (1963), and other records from «opisthobranch» pictures and videos posted in social networks such as Instagram. The presence of these species in the shores of the city of Barcelona has been confirmed, whenever possible, by analyzing these photographs.

Results

In the waterfront of the city of Barcelona (Spain) we have found 73 species of sea slugs (Mollusca: Gastropoda: Heterobranchia) belonging to 5 orders: 4 Aplysiida, 5 Cephalaspidea, 3 Runcinida, 47 Nudibranchia and 4 Pleurobranchida, and 1 superorder: 10 Sacoglossa (Table 1). The nomenclature and taxonomy of the species generally follows the indications by WoRMS, which are also used in the last sea slugs catalog of Catalan waters by Ballesteros *et al.* (2016) and some taxonomic updates published after this date have also been included.

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Table 1. Taxonomic list of the sea slugs found in the Barcelona waterfront. Location codes: 1) Barcelona Forum bathing area; 2) Mar Bella beach; 3) Nova Icaria beach; 4) Olympic harbour, Gregal dock breakwater; 5) Hotel W breakwater; 6) Morrot dock; 7) Llevant dock breakwater; 8) Attached dock breakwater; 9) Liquids Terminal dock; 10) Commercial trawling grounds off Barcelona harbour.

Order / Species	Location codes	Order / Species	Location codes
Aplysiida			
<i>Aplysia depilans</i> Gmelin, 1791	1-2-4	<i>Diaphorodoris luteocincta</i> (M. Sars, 1870)	8
<i>Aplysia fasciata</i> Poiret, 1789	1	<i>Diaphorodoris papillata</i> Portmann & Sandmeier, 1960	2-7-8
<i>Aplysia punctata</i> (Cuvier, 1803)	1-7	<i>Ancula gibbosa</i> (Risso, 1818)	6
<i>Bursatella leachii</i> Blainville, 1817	1	<i>Goniodoris castanea</i> Alder & Hancock, 1845	1
Cephalaspidea			
<i>Bulla striata</i> Bruguière, 1792	1	<i>Okenia longiductis</i> Pola, Paz-Sedano, Macali, Minchin, Marchini, Vitale, Licchelli et Crocetta, 2019	1
<i>Haminoea</i> sp.1	1	<i>Trapania maculata</i> Haefelfinger, 1960	7
<i>Haminoea</i> sp.2	1	<i>Knoutsodonta neapolitana</i> (Delle Chiaje, 1841)	2
<i>Aglaja tricolorata</i> Renier, 1807	1	<i>Dendrodoris</i> sp.	1-4
<i>Camachoaglaja africana</i> (Pruvot-Fol, 1953)	1	<i>Limacia clavigera</i> (O.F. Müller, 1776)	4
Runcinida			
<i>Runcina africana</i> Pruvot-Fol, 1953	1	<i>Polycera quadrilineata</i> (O.F. Müller, 1776)	2
<i>Runcina brenkoae</i> T. E. Thompson, 1980	1	<i>Polycerella emertoni</i> A. E. Verrill, 1880	1
<i>Runcina</i> sp.	1	<i>Aeolidiella alderi</i> (Cocks, 1852)	1
Sacoglossa			
<i>Caliphylla mediterranea</i> A. Costa, 1867	1	<i>Berghia coerulea</i> (Laurillard, 1832)	1
<i>Elysia flava</i> Verrill, 1901	1	<i>Berghia verrucicornis</i> (A. Costa, 1867)	1-2
<i>Elysia timida</i> (Risso, 1818)	1	<i>Spurilla neapolitana</i> (Delle Chiaje, 1841)	1
<i>Elysia viridis</i> (Montagu, 1804)	1-7	<i>Cratena peregrina</i> (Gmelin, 1791)	1-2-3-4-8-10
<i>Thuridilla hopei</i> (Vérany, 1853)	1-2-4-7	<i>Facelina auriculata</i> (Müller, 1776)	1-2
<i>Placida cremoniana</i> (Trinchese, 1892)	1	<i>Facelina quatrefagesi</i> (Vayssière, 1888)	1-2-3
<i>Placida dendritica</i> (Alder & Hancock, 1843)	1	<i>Favorinus branchialis</i> (Rathke, 1806)	1-2
<i>Placida tardyi</i> (Trinchese, 1874)	1	<i>Dondice banyulensis</i> Portmann & Sandmeier, 1960	4-8
<i>Placida verticilata</i> Ortea, 1982	1	<i>Calma gobioophaga</i> Calado & Urgorri, 2002	1
<i>Placida viridis</i> (Trinchese, 1874)	1	<i>Calmella cavolini</i> (Vérany, 1846)	1-4
Nudibranchia			
<i>Aldisa banyulensis</i> Pruvot-Fol, 1951	1	<i>Calmella gaditana</i> (Cervera, García-Gomez & García, 1987)	1
<i>Felimare bilineata</i> (Pruvot-Fol, 1953)	2-4	<i>Edmundsella pedata</i> (Montagu, 1816)	1-2-4-7-10
<i>Felimare picta</i> (Philippi, 1836)	1-2-3-4-7-9	<i>Flabellina affinis</i> (Gmelin, 1791)	4-7-8-10
<i>Felimare tricolor</i> (Cantraine, 1835)	4-8	<i>Luisella babai</i> (Schmekel, 1972)	4
<i>Felimida binza</i> (Ev. Marcus & Er. Marcus, 1963)	4	<i>Trinchesia morrowae</i> Korshunova, Picton, Furfaro, Mariottini, Pontes, Prkić, Fletcher, Malmberg, Lundin & Martynov, 2019	2
<i>Felimida krohni</i> (Vérany, 1846)	1-4	<i>Doto koeneckeri</i> Lemche, 1976	2
<i>Felimida purpurea</i> (Risso, 1831)	4	<i>Doto paulinae</i> Trinchese, 1881	2
<i>Geitodoris planata</i> (Alder & Hancock, 1846)	1	<i>Doto rosea</i> Trinchese, 1881	1
<i>Jorunna evansi</i> (Eliot, 1906)	1	<i>Tritonia nilsodhneri</i> Marcus Ev., 1983	7
<i>Jorunna tomentosa</i> (Cuvier, 1804)	1	<i>Armina maculata</i> Rafinesque, 1814	7
<i>Tayuva lilacina</i> (Gould, 1852)	1	<i>Antiopeella cristata</i> Delle Chiaje, 1841	1-5
<i>Doris pseudoargus</i> Rapp, 1827	10	Pleurobranchida	
<i>Doris sticta</i> (Iredale & O'Donoghue, 1923)	10	<i>Berthella perforata</i> (Philippi, 1844)	1
<i>Doris verrucosa</i> Linnaeus, 1758	1	<i>Berthella stellata</i> (Risso, 1826)	1
		<i>Berthellina edwardsii</i> (Vayssière, 1897)	1
		<i>Pleurobranchus testudinarius</i> Cantraine, 1835	2
		Total 73 species	

Data on the presence of these species at the different sampled points, their abundance, the observers' names and sampling dates, as well as some taxonomic or biological observations are provided below.

Codes for Observers: AP: Àlex Parera; EC: Eugeni Canals; CE: Carlota Escarré; CP: Creu Palacín; GA: Guillermo Álvarez; MB: Manuel Ballesteros; MP: Miquel Pontes; MT: Mario Tirador; OC: Oriol Cortés; PER: Marc Peralta; SF: Sara Fuertes; XS: Xavier Salvador; VR: VIMAR database; GR: GROC database; BH: Bucoo Hispania Instagram feed. When combined both observers recorded the same specimen.

Order Aplysiida

Family Aplysiidae Lamarck, 1809

Aplysia depilans Gmelin, 1791 (Fig 2a)

Confirmed reports: 139 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 23/12/2017, 3/02/2018, 27/04/2018, 18/05/2018; AP & MP: 15/06/2019), 50 in Mar Bella beach (XS: 27/06/2018) and 1 specimen at the Gregal dock (BH: 24/05/18).

Remarks: Inhabits shallow hard or soft bottoms, covered with photophyllic algae from which it feeds.

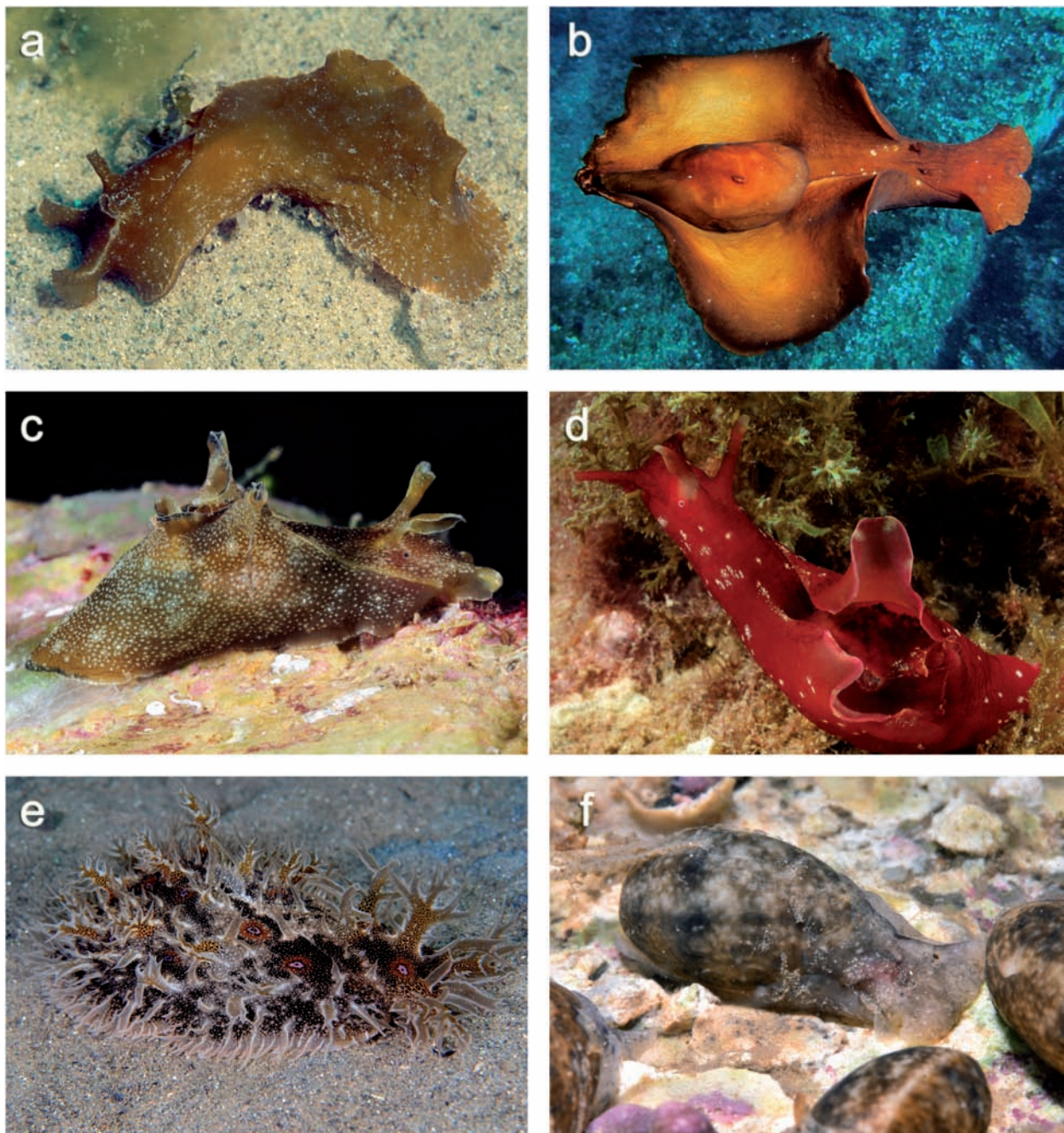


Figure 2. Aplysiida: a) *Aplysia depilans*; b) *Aplysia fasciata*; c) *Aplysia punctata* (brown form); d) *Aplysia punctata* (red form); e) *Bursatella leac-hii*. Cephalaspidea: f) *Bulla striata*. Pictures: M. Pontes (a,c,d); X. Salvador (b,e,f).

***Aplysia fasciata* Poirlet, 1789 (Fig 2b)**

Confirmed reports: 3 specimens in the Forum bathing area (XS: 23/11/2017, 27/04/2018; GR: 5/12/2017)

Remarks: It is the largest sea hare in the Mediterranean Sea; its parapodia are not joined on the rear side allowing it to make long swimming movements, something that the other sea hares, with parapodia more or less joined in the rear side, are not so able to do.

***Aplysia punctata* (Cuvier, 1803) (Fig 2c brown form; Fig 2d reddish form)**

Confirmed reports: more than 200 specimens in the Forum bathing area (XS: 27/04/2018; GA: 16/05/2018; MB: 16/05/2018, 12/07/2018; AP: 02/04/2019, 13/05/2019, 15/06/2019, 13/07/2019, 18/07/2019; CE: 13/07/2019) and 1 specimen at the Llevant dock breakwater (VR: 25/06/2013)

Remarks: Gregarious and very abundant species in the breeding season under stones and on the vertical walls of the Forum bathing area, where up to 5 individuals can be found under the same stone (May 2018) with numerous egg spawns. Several reddish coloured juveniles of 10-15mm were collected in qualitative samples of the red algae *Sphae-*

rococcus coronopifolius Stackhouse, 1797. Until the recent work by Golestani *et al.* (2019) these small Mediterranean reddish specimens were considered as *A. parvula* Mörch, 1863 (Ballesteros *et al.*, 2016), a species considered to have a very wide geographical distribution. However, after molecular studies, the mentioned authors have proven that these are juvenile forms of *A. punctata* and that the reports of *A. parvula* in the Mediterranean should refer to *A. punctata*. But there are still some doubts to be resolved as the small reddish specimens are able to reproduce and lay eggs (Ballesteros & Templado, 1987) and they feed on the red algae *Sphaerococcus coronopifolius* (from which they probably incorporate the red pigment), while the «brown forms» of *A. punctata* feed on green algae.

Bursatella leachii Blainville, 1817 (Fig 2e)

Confirmed reports: 121 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 23/12/2017, 3/02/2018, 27/04/2018, 18/05/2018, 20/11/2019; GA & MB: 16/05/2018; AP: 21/08/2018; SF & MP: 15/09/2018)

Remarks: An exotic species of circumtropical distribution that since 1940 has been reported in the Mediterranean Sea (O'Donoghue & White, 1940) and since 2007 in the Catalan coast (Weitzmann *et al.*, 2007). It is a species that prefers soft bottoms in shallow and calm waters where it feeds on cyanophytes and diatoms, so it lives in coastal lagoons like the shallow bays of the Ebro Delta, inside ports and marinas, and in shallow calm water areas like the Barcelona Forum bathing area.

Order Cephalaspidea

Family Bullidae Gray, 1827

Bulla striata Bruguière, 1792 (Fig 2f)

Confirmed reports: 44 specimens in the Forum bathing area (XS: 3/02/2018, 27/04/2018, 2/02/2019; GA: 1/11/2018, 22/12/2018; AP: 24/11/2018, 15/06/2019, 24/07/2019; MP: 15/06/2019)

Remarks: Primarily active at night, specimens remain buried in the sediment during the day. On February 2, 2019 an aggregation of 27 mating specimens was observed at dusk. Some of the reports correspond to empty shells found on the sand.

Family Haminoeidae Pilsbry, 1895

***Haminoea* sp. 1** (Fig 3a)

Confirmed reports: 3 specimens in the Forum bathing area (XS: 5/12/2017)

Remarks: Of nocturnal habits, it lives on calcareous rocky bottoms with algae from the surface down to 15 m depth, hiding among the algae during the day. It can be distinguished from *Haminoea* sp. 2. by having a darker mantle, white bands lining the sides and upper part of the face, shell usually with reddish reflections and a tight, small translucent «C» shaped egg spawn with large yellow eggs. The European *Haminoea*

species are not well studied and it is necessary to carry out complete morphological, anatomical and molecular studies to definitively characterize them (Malaquias, com. pers.).

***Haminoea* sp.2** (Fig 3b)

Confirmed reports: 21 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 3/02/2018, 27/04/2018, 20/11/2019)

Remarks: Of nocturnal habits, it lives on rocky shallow water communities, on bottoms with a great load of sediments and simple algae between the surface down to 5 m depth, where it hides during the day. It can be distinguished from *Haminoea* sp.1 by a lighter coloured body, a pigmented eye area, clear bands (not white) on the face, that do not reach the borders, and a translucent egg spawn with small white eggs. The European *Haminoea* species are not well studied and it is necessary to carry out complete morphological, anatomical and molecular studies to definitively characterize them (Malaquias, com. pers.).

Family Aglajidae Pilsbry, 1895 (1847)

Aglaja tricolorata Renier, 1807 (Fig 3c)

Confirmed reports: 2 specimens in the Forum bathing area (AP & EC: 24/07/2019)

Remarks: Specimens found at night. This species lives on soft sand and mud bottoms, where it can bury itself searching for food.

Camachoaglaja africana (Pruvot-Fol, 1953) (Fig 3d)

Confirmed reports: 1 specimen in the Forum bathing area (XS: 2/2/2019)

Remarks: A voracious flatworm predator (Ballesteros *et al.*, 2020), it has nocturnal habits and is usually found among algae.

Order Runcinida

Superfamily Runcinoidea H. Adams & A. Adams, 1854

Family Runcinidae H. Adams & A. Adams, 1854

Runcina africana Pruvot-Fol, 1953 (Fig 3e)

Confirmed reports: 12 specimens in the Forum bathing area (XS: 20/11/2019)

Remarks: Of nocturnal habits, it lives on rocky substrates at very shallow depths, even occasionally out of water. It feeds on biofouling. The specimens are coloured black with two white lines (sometimes very degraded) located near the front side and the back side of the body, respectively. Adults have white dots all over the back.

Runcina brenkoe T. E. Thompson, 1980 (Fig 3f)

Confirmed reports: 3 specimens in the Forum bathing area (AP & MB: 2/04/2019, 18/07/2019)

Remarks: An easily identified species because of its brown colour body covered with dark brown ramified spots. The collected specimens appeared in brown algae samples.

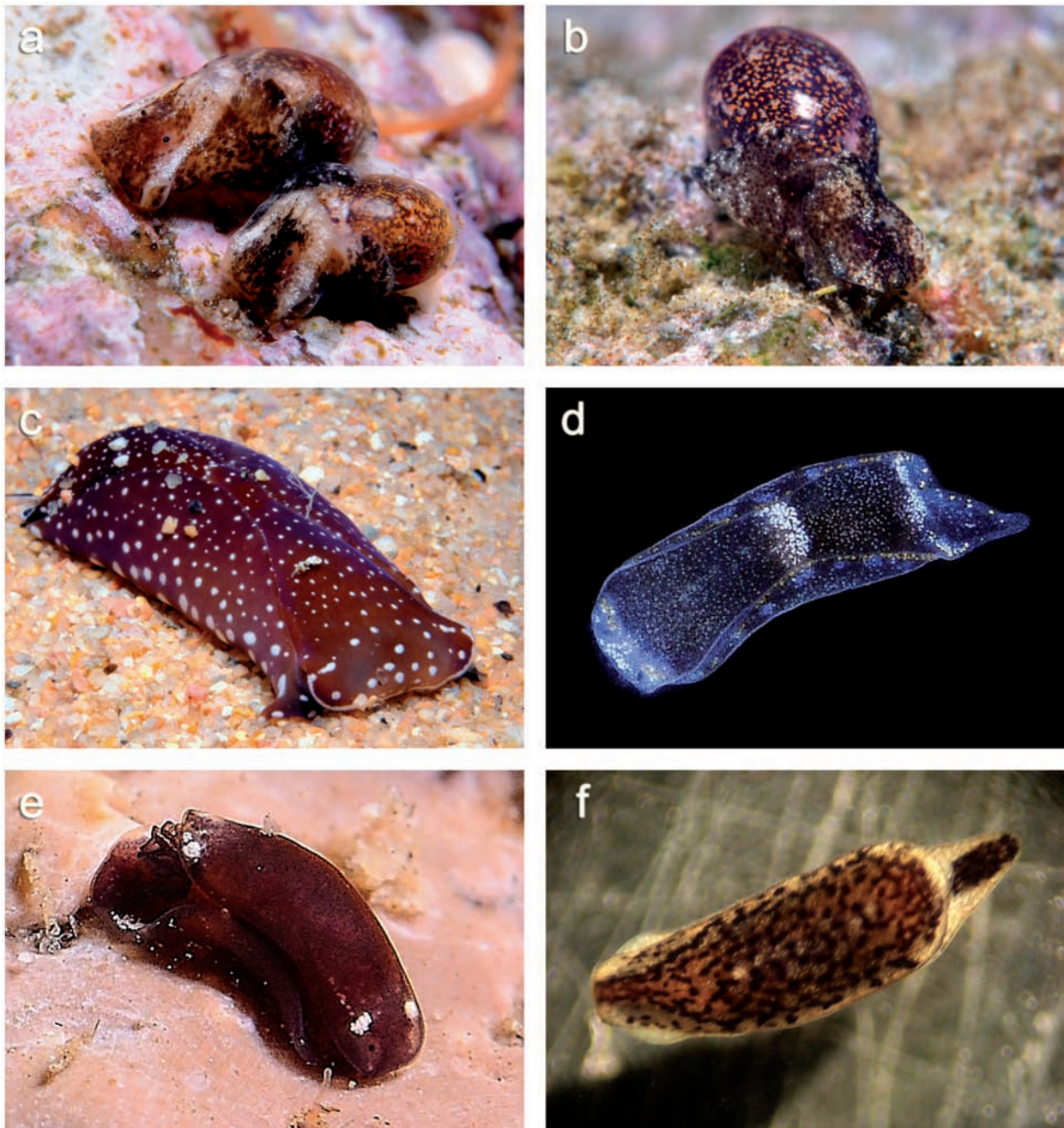


Figure 3. Cephalaspidea: a) *Haminoea* sp.1; b) *Haminoea* sp.2; c) *Aglaja tricolorata*; d) *Camachoaglaja africana*; Runcinida: e) *Runcina africana*; f) *Runcina brenkoae*. Pictures: X. Salvador (a-e); À. Parera (f).

Runcina marcosi Araujo, Pola, Malaquias & Cervera, 2019 (Fig 4a)

Confirmed reports: 1 specimen in the Forum bathing area (AP: 2/04/2019)

Remarks: With a small sized body, coloured dark brown / black. Found among dyctiotal algae. Initially, the only collected specimen could not be specifically identified; however, a recent work by Araujo *et al.* (2019) who studied specimens of *R. brenkoae* and others of similar morphology has allowed the description of two new *Runcina* species for the Iberian Peninsula. One of them is *R. marcosi* whose distribution area, according to the aforementioned work, is the

western Mediterranean, including the Catalan coast and the Cádiz coast (Southwest Spain). Our specimen matches the morphological description of *R. marcosi* and it is the second confirmed record of the species for the coasts of Catalonia.

Superorder Sacoglossa

Superfamily Plakobranchoidea Gray, 1840

Family Hermaeidae H. Adams & A. Adams, 1854

Caliphylla mediterranea A. Costa, 1867 (Fig 4b)

Confirmed reports: 13 specimens in the Forum bathing area (XS: 23/11/2017, 5/12/2017, 23/12/2017)

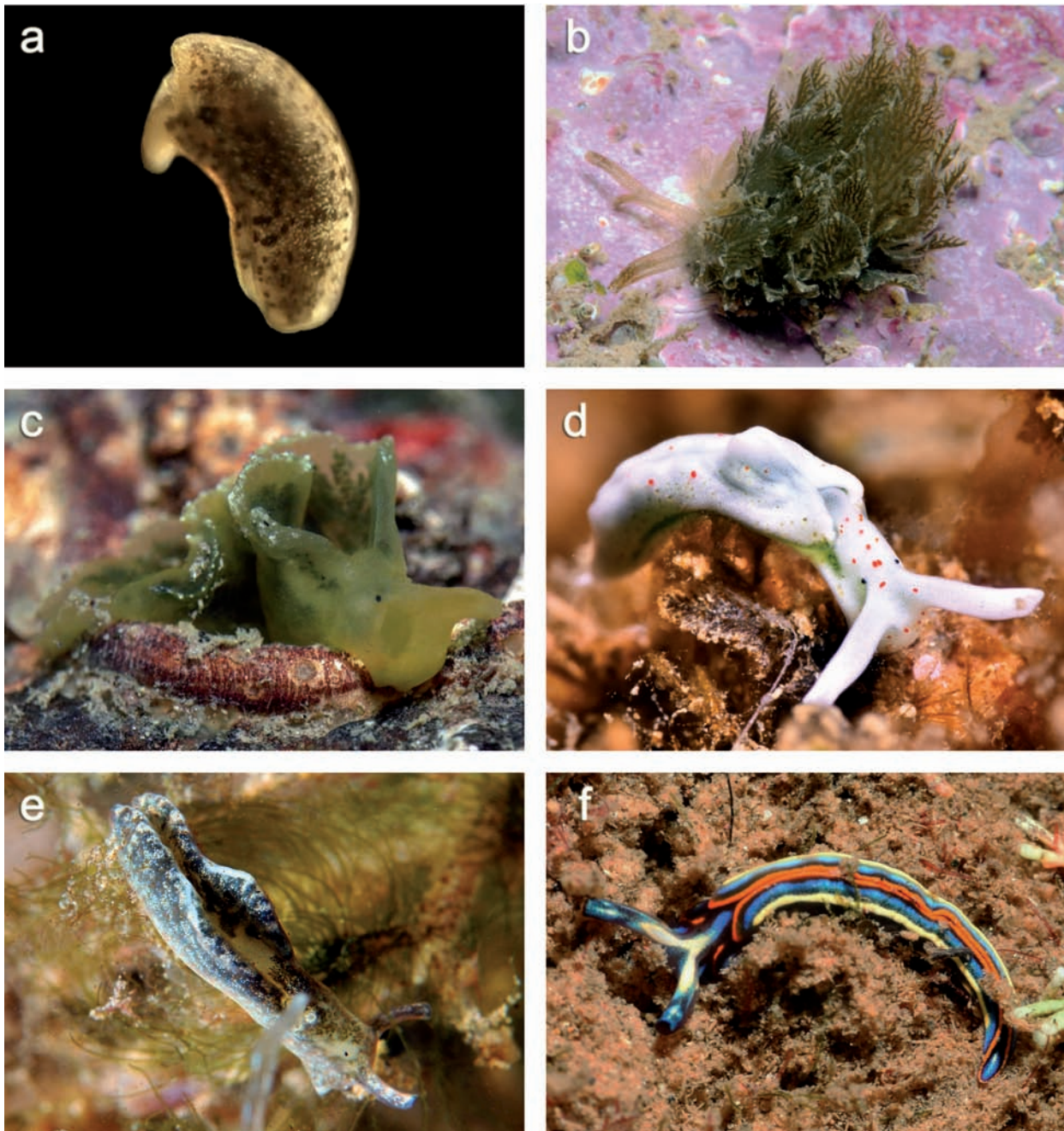


Figure 4. Runcinida: a) *Runcina* cf. *marcosi*. Sacoglossa: b) *Caliphylla mediterranea*; c) *Elysia flava*; d) *Elysia timida*; e) *Elysia viridis*; f) *Thuridilla hopei*. Pictures: À. Parera (a); X. Salvador (b,d,e); M. Peralta (c); M. Pontes (f).

Remarks: A nocturnal habits sacoglossan, in this location it hides and feeds on *Bryopsis* green algae (authors' personal observations), on which it is very cryptic.

Family Plakobranchidae Gray, 1840

Elysia flava Verrill, 1901 (Fig 4c)

Confirmed reports: 8 specimens in the Forum bathing area (XS: 2/2/2019; PER: 27/4/2019; AP: 24/7/2019)

Remarks: Of nocturnal activity, collected specimens were in very shallow depth among green algae and encrusting bryozoans.

Elysia timida (Risso, 1818) (Fig 4d)

Confirmed reports: 3 specimens in the Forum bathing area (XS: 5/12/2017; AP: 27/02/2019)

Remarks: Very active during the day, they move while rhythmically swinging the rhinophores back and forth. They feed on simple algae like the single celled *Acetabularia acetabulum* (Marín & Ros, 1992). It is known to sequester chloroplasts from the algae it feeds on, incorporating them into its tissues and keeping them functional with photosynthetic activity for a long time (Schmitt *et al.*, 2014). This species is capable of biosynthesizing *de novo* secondary metabolites of the polypropionates type with a defensive mission (Marín & Ros, 2004).

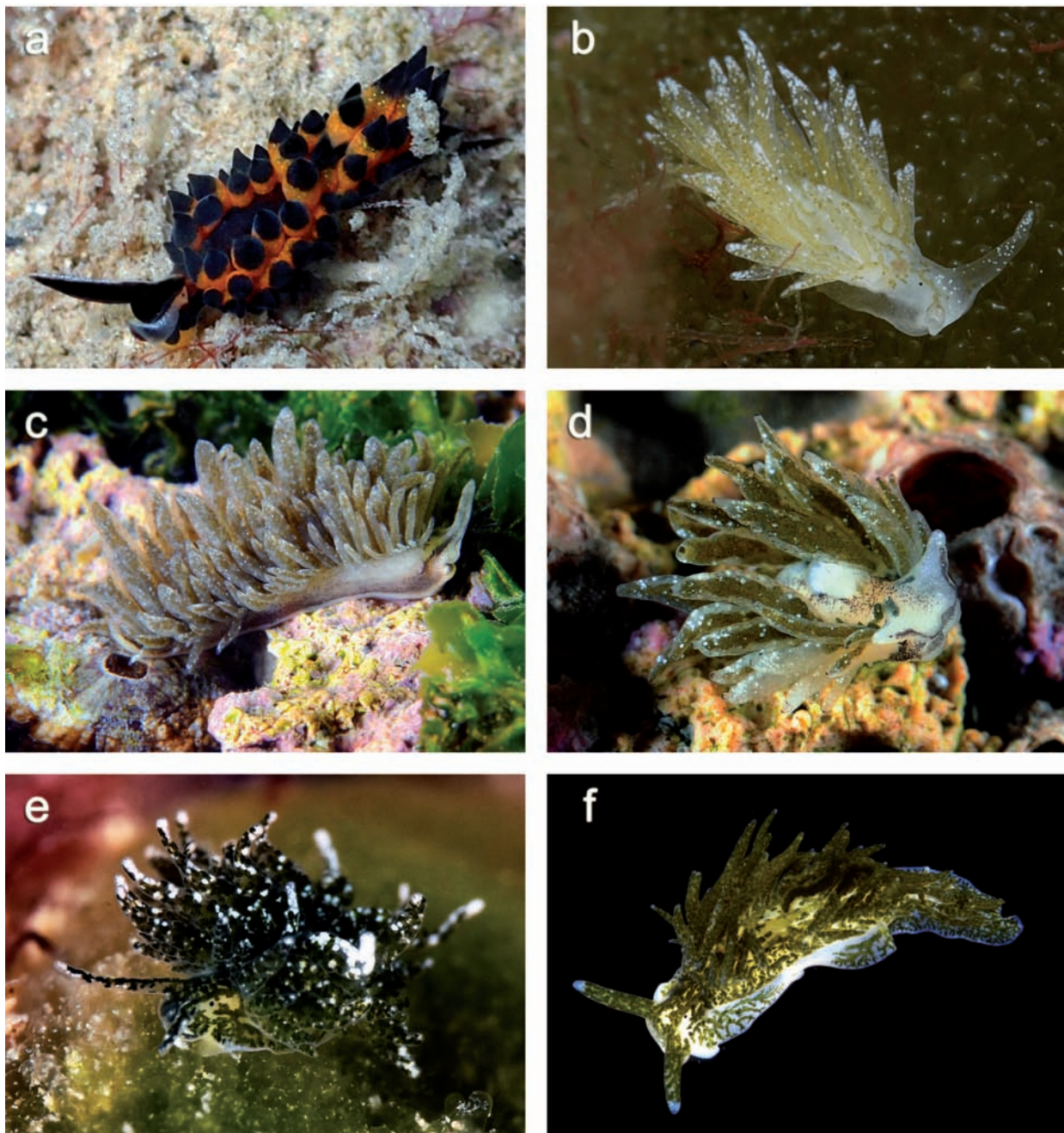


Figure 5. Sacoglossa: a) *Placida cremoniana*; b) *Placida dendritica*; c) *Placida tardyi* (adult); d) *Placida tardyi* (juvenile); e) *Placida verticillata*; f) *Placida viridis*. Pictures: C. Escarré (a); M. Pontes (b); X. Salvador (c-f).

Elysia viridis (Montagu, 1804) (Fig 4e)

Confirmed reports: 13 specimens in the Forum bathing area (XS: 23/11/2017, 2/2/2019; AP: 27/2/2019) and 1 at Llevant dock breakwater (VR: 25/6/2013)

Remarks: Lives among photophyllic algae, mainly the green algae *Codium vermilara* and *Flabellia petiolata*, on which it feeds and where it is extremely cryptic (Ballesteros *et al.*, 2020). It is known to sequester chloroplasts from the algae, incorporating them into its own tissues, which acquire a greenish hue, and keeping them functional with photosynthetic activity for some time (Trench *et al.*, 1973). This species is capable of biosynthesizing *de novo* secondary metabo-

lites of the polypropionates type with a defensive mission. (Marín & Ros, 2004).

Thuridilla hopei (Vérany, 1853) (Fig 4f)

Confirmed reports: 39 specimens in the Forum bathing area (XS: 25/11/2017, 23/12/2017; SF: 15/09/2018; MP: 22/12/2018, 2/03/2019, 11/05/2019; MT: 2/03/2019; AP: 06/04/2019, 10/04/2019, 11/05/2019; CE: 11/05/2019, 13/07/2019), 3 specimens in Mar Bella beach (XS: 27/06/2018), 3 specimens in Gregal dock (BH: 17/10/2016, 2/08/2017, 6/07/2019) and 1 specimen in Llevant dock breakwater (VR: 25/06/2013)

Remarks: It is a very common species that lives well in both photophyllic and sciophyllic habitats. Its bright colours make it very apparent. It feeds on different algae and incorporates the chloroplasts into its tissues, keeping them functional with photosynthetic activity for some time (Marín & Ros, 1989). This species has secondary sesquiterpenoid metabolites of dietary origin with a defensive mission. (Marín & Ros, 2004).

Family Limapontiidae Gray, 1847

Placida cremoniana (Trinchese, 1892) (Fig 5a)

Confirmed reports: 47 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 20/11/2019; AP: 22/12/2018, 11/5/2019; MP: 22/12/2018; CE & MP: 28/09/2019)

Remarks: Its orange and black colouration makes it unmistakable. It lives on different algae, but in our samplings it was found on the species *Bryopsis duplex*.

Placida dendritica (Alder & Hancock, 1843) (Fig 5b)

Confirmed reports: 7 specimens in the Forum bathing area (XS: 2/02/2019; AP: 27/02/2019)

Remarks: It feeds on different species of green algae of the genus *Codium*, such as *C. fragile* and *C. bursa*, in the latter scraping the surface layer and eating it from the inside. Also found on feathery algae *Bryopsis*. It sequesters the chloroplasts from its food and incorporates them into its tissues in the form of dendritic ramifications that give this animal the specific name (Ballesteros *et al.*, 2020).

Placida tardyi (Trinchese, 1874) (Fig 5c adult; Fig 5d juvenile)

Confirmed reports: 74 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 23/12/2017, 20/11/2019)

Remarks: Lives on green algae, in our case it was found on *Bryopsis duplex*. It has been commonly confused with *P. viridis*, of which it can be distinguished by the purple sides of the body and the tips of the reddish or dark cerata (Cervera *et al.*, 1988). This species has been observed in some localities of the Costa Brava and is not mentioned in the update of the catalog of the «opisthobranchia» of Catalonia (Ballesteros *et al.*, 2016)

Placida verticillata Ortea, 1982 (Fig 5e)

Confirmed reports: 9 specimens in the Forum bathing area (XS: 2/2/2019)

Remarks: Frequently confused with *P. dendritica*, it differs by the verticillate ramifications of the digestive gland within the cerata. It feeds mainly on *Codium coralloides*, where it was found in the present study.

Placida viridis (Trinchese, 1874) (Fig 5f)

Confirmed reports: 2 specimens in the Forum bathing area (GR: 23/12/2017; XS: 3/2/2018)

Remarks: This species is difficult to find because it lives in the eulittoral zone, it feeds mainly on the algae *Bryopsis mucosa* (authors' personal observations).

Order Nudibranchia

Suborder Doridina

Superfamily Doridoidea Rafinesque, 1815

Family Cadlinidae Bergh, 1891

Aldisa banyulensis Pruvot-Fol, 1951 (Fig 6a)

Confirmed reports: 1 specimen in the Forum bathing area (PER: 27/04/2019)

Remarks: Lives under stones and feeds on the sponge *Hemimycale columella* (Ballesteros *et al.*, 2020).

Family Chromodorididae Bergh, 1891

Felimare bilineata (Pruvot-Fol, 1953) (Fig 6b)

Confirmed reports: 5 specimens in Mar Bella beach (XS: 27/06/2018) and 2 at Gregal dock (BH: 13/06/2017, 23/04/2018)

Remarks: Lives on rocky bottoms with the sponges it feeds on.

Felimare picta (Philippi, 1836) (Fig 6c)

Confirmed reports: 12 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017; GR: 23/12/2017; AP: 21/08/2018, 20/09/2018; GA: 29/08/2018; MB: 29/08/2018; MP: 13/09/2019), 2 in Mar Bella beach (XS: 27/06/2018), 6 in Nova Içària beach (GR: 27/09/2014, 10/01/2016), 11 on the Gregal dock (BH: 1/06/2018, 1/11/2016, 12/07/2018, 12/08/2018, 17/10/2016, 2/09/2016, 24/08/2018, 25/05/2018, 27/07/2018, 5/09/2016), 1 on the Llevant dock (GR) and 1 at the Liquids Terminal dock (XS: 26/05/2016).

Remarks: One of the largest nudibranchs in the Mediterranean, it can reach more than 10 cm in length. Inhabits on poorly lit bottoms feeding on sponges of the genus *Dysidea*, *Ircinia* and *Pleraplysilla* (McDonald & Nybakken, 1997).

Felimare tricolor (Cantraine, 1835) (Fig 6d)

Confirmed reports: 1 specimen on the Attached dock breakwater (XS: 26/5/2016)

Remarks: One of the most frequent doridacean nudibranchs of the Catalan coast. It feeds on sponges of the genus *Dysidea*, from which it extracts metabolites such as the longifoline that it uses to defend itself from predators (Ballesteros *et al.*, 2020).

Felimida binza (Ev. Marcus & Er. Marcus, 1963) (Fig 6e)

Confirmed reports: 3 specimens on Gregal dock (BH: 13/07/2018, 18/08/2017, 23/07/2018)

Remarks: Lives on sciophyllic rocky substrates along with sponges from which it feeds and extracts defensive metabolites that are stored in the animal's MDFs. It is not a very common species. In European waters this species was known as *Felimida britoi* (Ortea & Pérez, 1983). Its status has been discussed by some authors, like Gosliner (1990), who considered it a synonym of the Caribbean species *F. clenchi* (Russell, 1935). Valdés (2000) suggested that *F. binza* and *F. britoi* probably were the same species, subsequently confirmed by molecular analysis (Padula *et al.*, 2016).

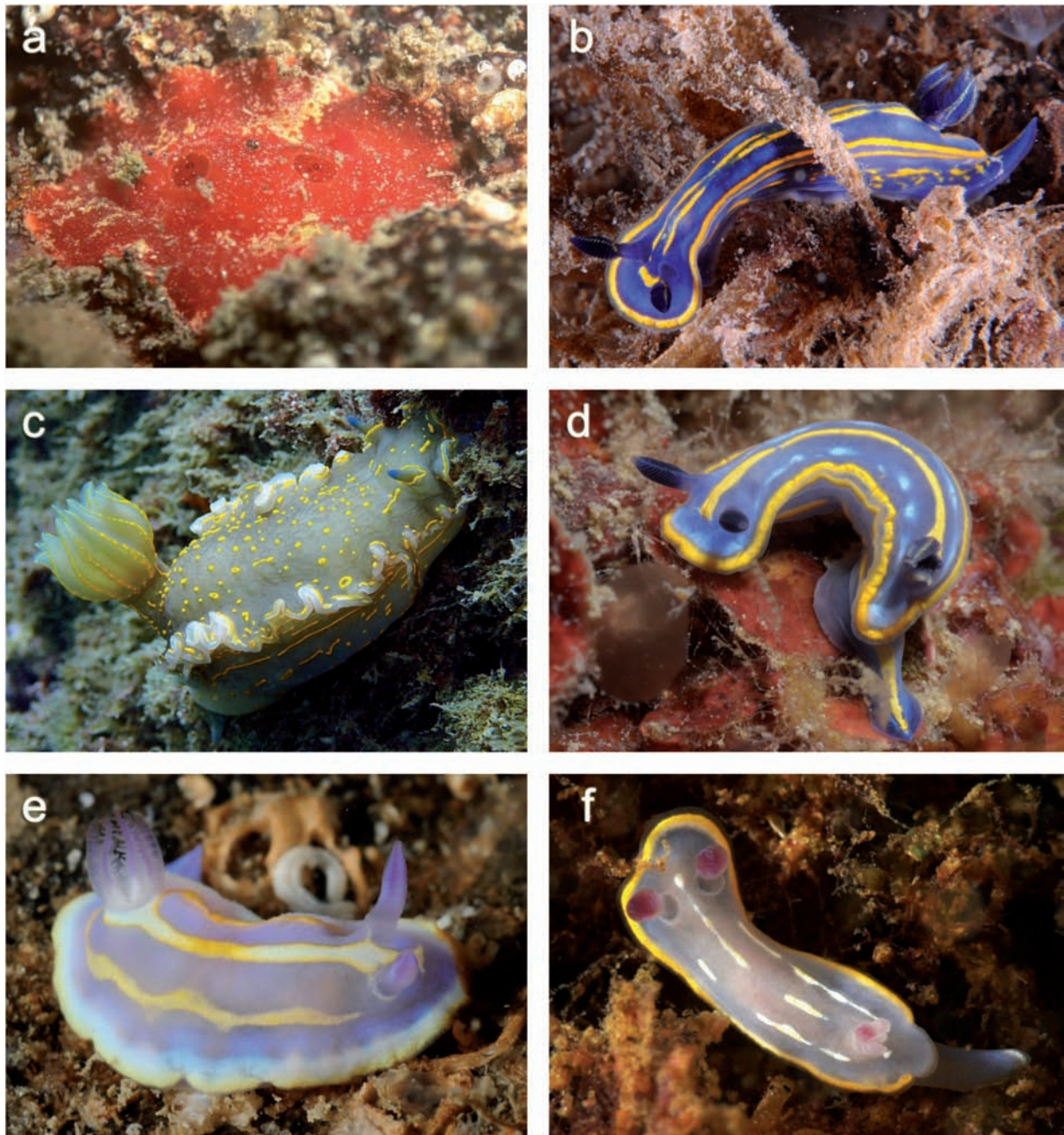


Figure 6. Nudibranchia: a) *Aldisa banyulensis*; b) *Felimare bilineata*; c) *Felimare picta*; d) *Felimare tricolor*; e) *Felimida binza*; f) *Felimida krohni*. Pictures: M. Peralta (a); X. Salvador (b); C. Escarré (c); M. Pontes (d-f).

Felimida krohni (Vérany, 1846) (Fig 6f)

Confirmed reports: 5 specimens in the Forum bathing area (XS: 27/4/2018, 18/5/2018; MP: 22/12/2018; AP, CE: 13/7/2019) and 3 on Gregal dock (BH: 13/08/2018, 28/07/2018, 30/07/2017)

Remarks: It lives in sciophyllic environments, often under stones close to the sponge *Hymeniacidon sanguinea*, but it's not clear if it feeds on it.

Felimida purpurea (Risso, 1831) (Fig 7a)

Confirmed reports: 1 specimen on Gregal dock (BH: 2/08/2018)

Remarks: Lives in infralittoral rocky bottoms, under stones or on sponges. It is believed to feed on several species of sponges such as *Phorbas tenacior* or *Spongionella pulchella* (McDonald & Nybakken, 1997). It is not a very common species.

Family Discodorididae Bergh, 1891

Geitodoris planata (Alder & Hancock, 1846) (Fig 7b)

Confirmed reports: 1 specimen in the Forum bathing area (XS: 5/12/2017)

Remarks: It is usually found under stones from very shallow water. It feeds on sponges such as *Mycale rotalis*, an or-

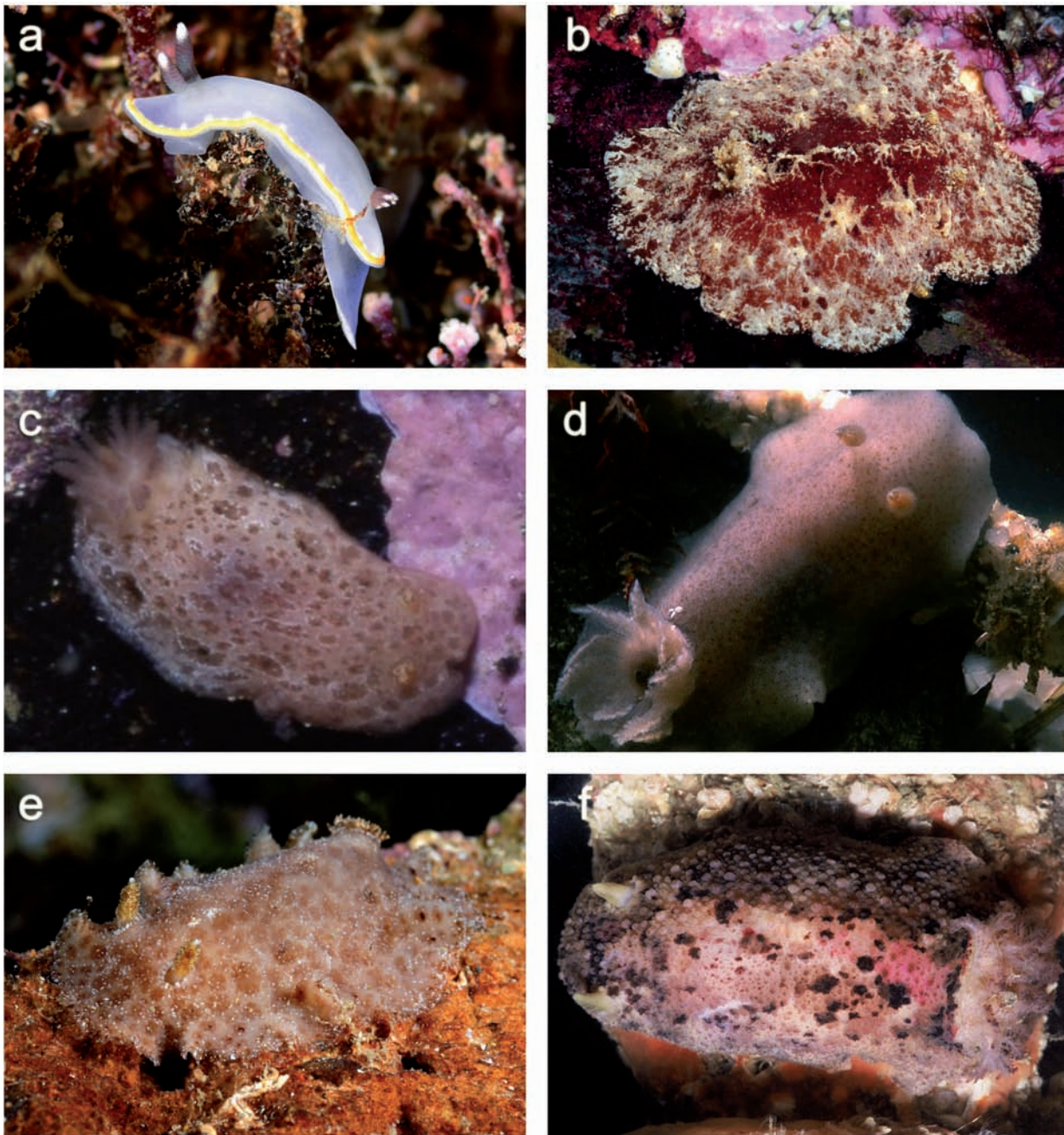


Figure 7. Nudibranchia: a) *Felimida purpurea*; b) *Geitodoris planata*; c) *Jorunna cf. evansi*; d) *Jorunna tomentosa*; e) *Tayuva lilacina*; f) *Doris pseudoargus*. Pictures: M. Pontes (a,b,e); M. Ballesteros (c,d,f).

ange sponge that usually lives under stones (Ballesteros et al., 2020). Historically confused with *Discodoris stellifera*, which like *G. planata* has white star-shaped spots on the back. Our experience has shown us that *G. planata* is larger than *D. stellifera*, it is much more flattened, its outline is rounded and is more leathery in consistency, and it is much more frequent than *D. stellifera*. They can also be differentiated by a radular analysis, as *D. stellifera* has the marginal radular teeth finely denticulate while in *G. planata* these are smooth and spatulate (author's personal observations). Although the only specimen observed in our work has not been dissected, its appearance matches with our data on *G. planata*.

Jorunna cf. evansi (Eliot, 1906) (Fig 7c)

Confirmed reports: 1 specimen in the Forum bathing area (AP: 20/9/2018)

Remarks: Body with grayish coloration with a lattice of rounded spots of different shades delimited by white and darker lines near the edge of the mantle. The presence of chitinous rods in the labial cuticle is distinctive. Of nocturnal habits, it spends the day under stones. The status of some species of the *Jorunna* genus has always been highly controversial. In the Mediterranean, *J. evansi* has been cited as *J. luisae* (Schmekel & Portmann, 1982; Ballesteros, 2007; Ballesteros et al., 2016). Camacho-García & Gosliner (2008)

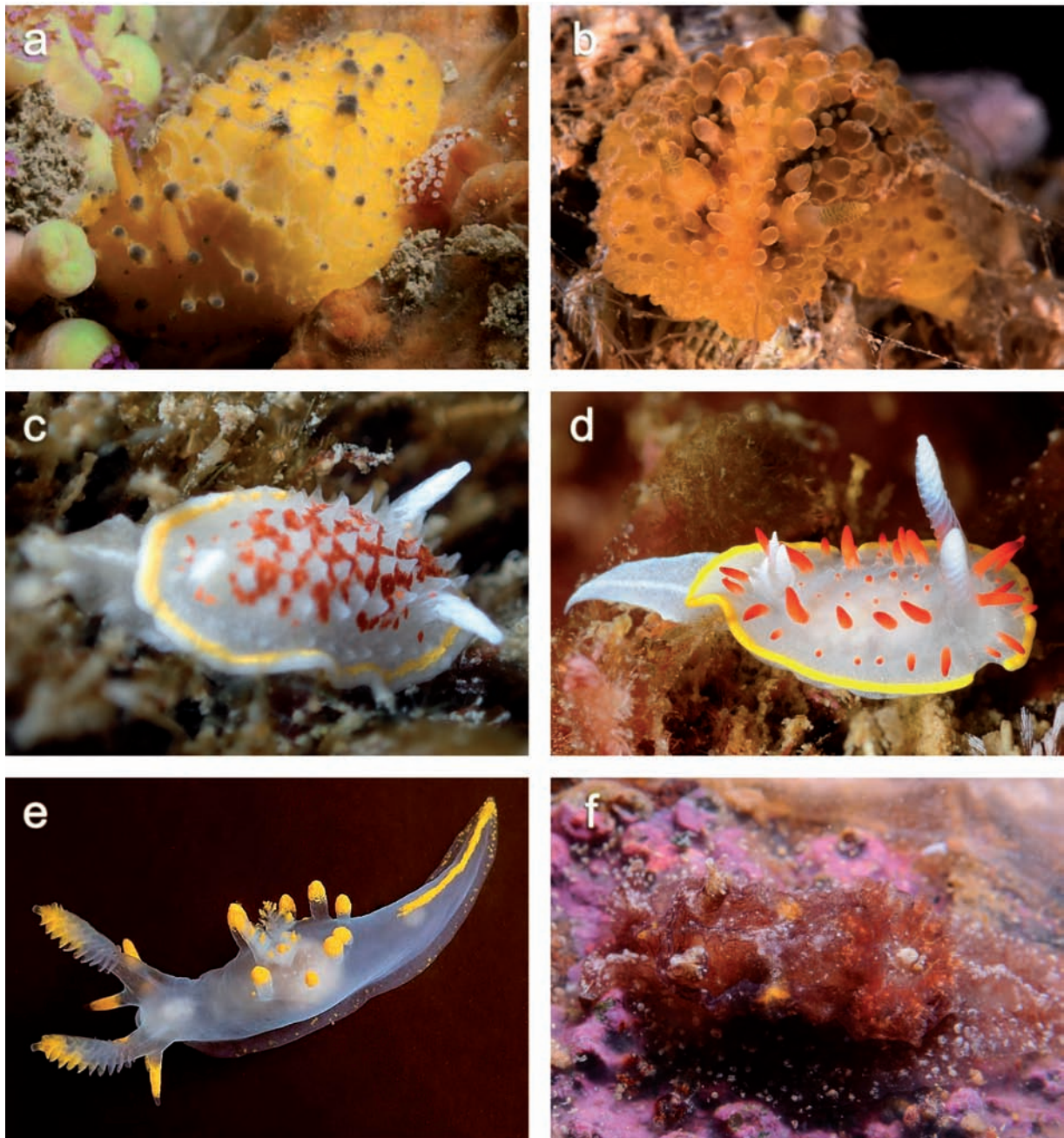


Figure 8. Nudibranchia: a) *Doris sticta*; b) *Doris verrucosa*; c) *Diaphorodoris luteocincta*; d) *Diaphorodoris papillata*; e) *Ancula gibbosa*; f) *Goniodoris castanea*. Pictures: B. Picton (a); Xavier Salvador (b,f); M. Pontes (c,d); K. Malmberg (e).

consider *J. luisae* synonym of the Brazilian species *J. spazzola* and they detail that these one is also very similar morphologically and anatomically to *J. evansi* of the Cape Verde archipelago. Alvim & Pimenta (2013) consider *J. spazzola* and *J. luisae* as different species. Later, Ortea & Moro (2016) studied specimens of *Jorunna* from the Macaronesia and the Caribbean, and compare especially two species, *J. onubensis* based on specimens from the Canary Islands and *J. evansi* with specimens collected in Cape Verde. We have studied anatomically specimens of *Jorunna* captured on the Costa Brava (NE Spain) previously identified as *J. luisae* and in a recent work (Ballesteros *et al.*, 2019) we have assigned them to *J.*

evansi, considering this species geographically closer to the Mediterranean than *J. spazzola*. The specimen captured in the bathing area of the Forum coincides in its general morphology with the specimens from the Costa Brava. The only observed specimen has not been dissected, so its identification cannot be exactly determined. It would be necessary to carry out a molecular study of the Atlantic and Mediterranean species of *Jorunna* to definitively clarify all these uncertainties.

Jorunna tomentosa (Cuvier, 1804) (Fig 7d)

Confirmed reports: 1 specimen in the Forum bathing area (XS: 27/04/2018)

Remarks: Of nocturnal habits, it hides under stones during the day. It feeds on sponges living on dark walls or under stones.

Tayuva lilacina (Gould, 1852) (Fig 7e)

Confirmed reports: 7 specimens in the Forum bathing area (XS: 25/11/2017, 3/02/2018, 27/04/2018, 20/11/2019; AP: 24/10/2018, 18/07/2019; MB: 24/10/2018)

Remarks: Widely distributed in circumtropical zones and temperate seas, where it is found under shallow stones during the day, as it has nocturnal habits. Until recently, Mediterranean specimens were identified as *Discodoris maculosa*, a species which is now considered synonym of *T. lilacina*.

Family Dorididae Rafinesque, 1815

Doris pseudoargus Rapp, 1827 (Fig 7f)

Confirmed reports: 1 specimen collected on muddy bottom in 70 m of water by a commercial trawler off Barcelona (MB: 17/10/1979).

Remarks: This large doridacean is considered rare in the Mediterranean, where it usually lives on the upper continental shelf; in the Galician coasts it is known to feed on sponges *Halichondria panicea* and *Myxilla incrustans* (Urgorri & Besteiro, 1984).

Doris sticta (Iredale & O'Donoghue, 1923) (Fig 8a)

Confirmed reports: 1 specimen collected on muddy bottom in 80 m of water by a commercial trawler off Barcelona (MB: 20/03/1984)

Remarks: This is a rare species in the Mediterranean, living in deeper water than in the Atlantic. It is supposed to feed on sponges as *Ciocalypa penicillus* (Ballesteros *et al.*, 2020).

Doris verrucosa Linnaeus, 1758 (Fig 8b)

Confirmed reports: 2 specimens in the Forum bathing area (AP: 13/05/2019)

Remarks: It feeds on sponges. It has been observed in samples obtained by scraping the Forum port walls and in lagoon areas, feeding on the sponge *Halichondria panicea*. It is capable of biosynthesize *de novo* defensive metabolites called «verrucosines» (Àvila *et al.*, 1990; Ballesteros *et al.*, 2020).

Superfamily Onchidoridoidea Gray, 1827

Family Calycidorididae Roginskaya, 1972

Diaphorodoris luteocincta (M. Sars, 1870) (Fig 8c)

Confirmed reports: 1 specimen in the Attached dock breakwater (XS: 26/05/2016)

Remarks: Frequent species in the Atlantic but rare in the Mediterranean, where it is found in rocky dark walls close to the bryozoans *Smittoidea reticulata* and *Cellepora pumicosa* from which it feeds (Ballesteros *et al.*, 2020).

Diaphorodoris papillata Portmann & Sandmeier, 1960 (Fig 8d)

Confirmed reports: 1 specimen in Mar Bella beach (XS: 27/06/2018), 1 in the Llevant dock breakwater (VR: 25/6/2013) and 7 in the Attached dock breakwater (25/06/2016)

Remarks: Lives on rocky dark walls with algae and bryozoans like *Smitina reticulata* that it feeds on (Ballesteros *et al.*, 2020).

Family Goniodorididae H. Adams & A. Adams, 1854

Ancula gibbosa (Risso, 1818) (Fig 8e)

Confirmed reports: 1 specimen on the tunicate *Ciona intestinalis* growing on a ship's hull in the Barcelona harbour (Arias & Morales, 1963).

Remarks: Lives under stones and on surfaces with invertebrates that allow entoprocta to grow on them. This species seems to feed on entoprocta such as *Pedicellina cernua* growing on bryozoans, hydrozoans and tunicate colonies (Picton & Morrow, 2016). Cited by Arias & Morales (1963), this species has not been observed again, so Ballesteros *et al.* (2019) consider its presence in Catalonia to be doubtful.

Goniodoris castanea Alder & Hancock, 1845 (Fig 8f)

Confirmed reports: 15 specimens in the Forum bathing area (XS: 3/02/2018, 27/04/2018, 18/05/2018, 2/02/2019, 20/11/2019)

Remarks: Lives under shallow stones where it feeds on colonial tunicates like *Botryllus schlosseri* or individual tunicates such as *Ascidia mentula* (Ballesteros *et al.*, 2020). Extremely cryptic on the substrate, it moves actively at night.

Okenia longiductis Pola, Paz-Sedano, Macali, Minchin, Marchini, Vitale, Licchelli & Crocetta, 2019 (Fig 9a)

Confirmed reports: 11 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017)

Remarks: Until its recent description this species was known in the Mediterranean as *Okenia zoobotryon*, a morphologically very similar species described on the island of Bermuda, in the Caribbean, with which it has a genetic distance of 18.3% (Pola *et al.*, 2019). Both species live on colonies of the bryozoan *Amathia verticillata*, which has a wide geographical distribution.

Trapania maculata Haefelfinger, 1960 (Fig 9b)

Confirmed reports: 1 specimen in the Llevant dock breakwater (VR: 25/06/2013)

Remarks: Species living in sciophyllic grounds where it feeds on entoprocta growing on sponges (Picton & Morrow, 2016).

Family Onchidorididae Gray, 1827

Knoutsodonta neapolitana (Delle Chiaje, 1841) (Fig 9c)

Confirmed reports: 1 specimen in Mar Bella beach (XS: 27/6/2018)

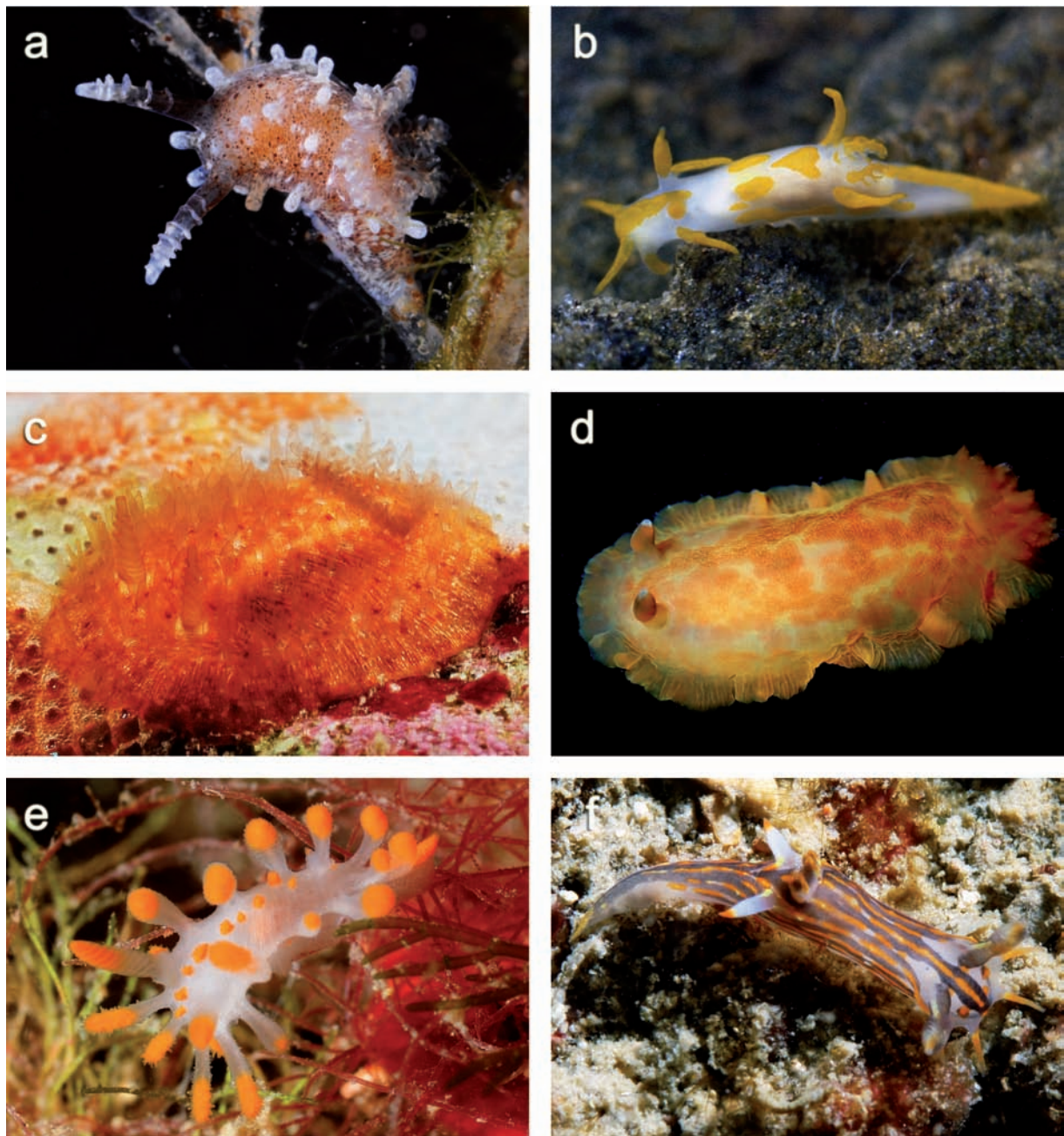


Figure 9. Nudibranchia: a) *Okenia longiductis*; b) *Trapania maculata*; c) *Knoutsodonta neapolitana*; d) *Dendrodoris* sp.; e) *Limacia clavigera*; f) *Polycera quadrilineata*. Pictures: X. Salvador (a); M. Ballesteros (b,d); M. Pontes (c,e,f).

Remarks: Feeds on the encrusting bryozoan *Schizobrachiella sanguinea* (Ballesteros *et al.*, 2020; pers. obs.) on which it is perfectly cryptic. Until the work of Hallas & Gosliner (2015) this species was included in the genus *Onchidoris*.

Superfamily Phyllidioidea Rafinesque, 1814

Family Dendrodorididae O'Donoghue, 1924 (1864)

***Dendrodoris* sp.** (Fig 9d)

Confirmed reports: 15 specimens in the Forum bathing area (XS: 27/04/2018, 02/02/2019, 20/11/2019; AP: 27/02/2019, 02/04/2019, 11/05/2019; 18/07/2019; GA:

27/02/2019; CE: 11/05/2019; MP: 11/05/19; OC: 11/05/19), 3 on the Gregal dock of the Olympic harbour (BH: 16/05/2018, 21/05/2018, 31/07/2018) and 1 in the Hotel W breakwater (MB: 16/05/1978)

Remarks: Orange coloured animals with a very scalloped mantle edge, which live under stones during the day. They have been found on sponges, but considering they don't have a radula, it is unknown if they feed on the sponges or on the epibiont microflora instead. It is probably a new species that is being studied, both anatomically and molecularly, to differentiate it from the other two *Dendrodoris* species of the Mediterranean: *D. grandiflora* and *D. limbata*.

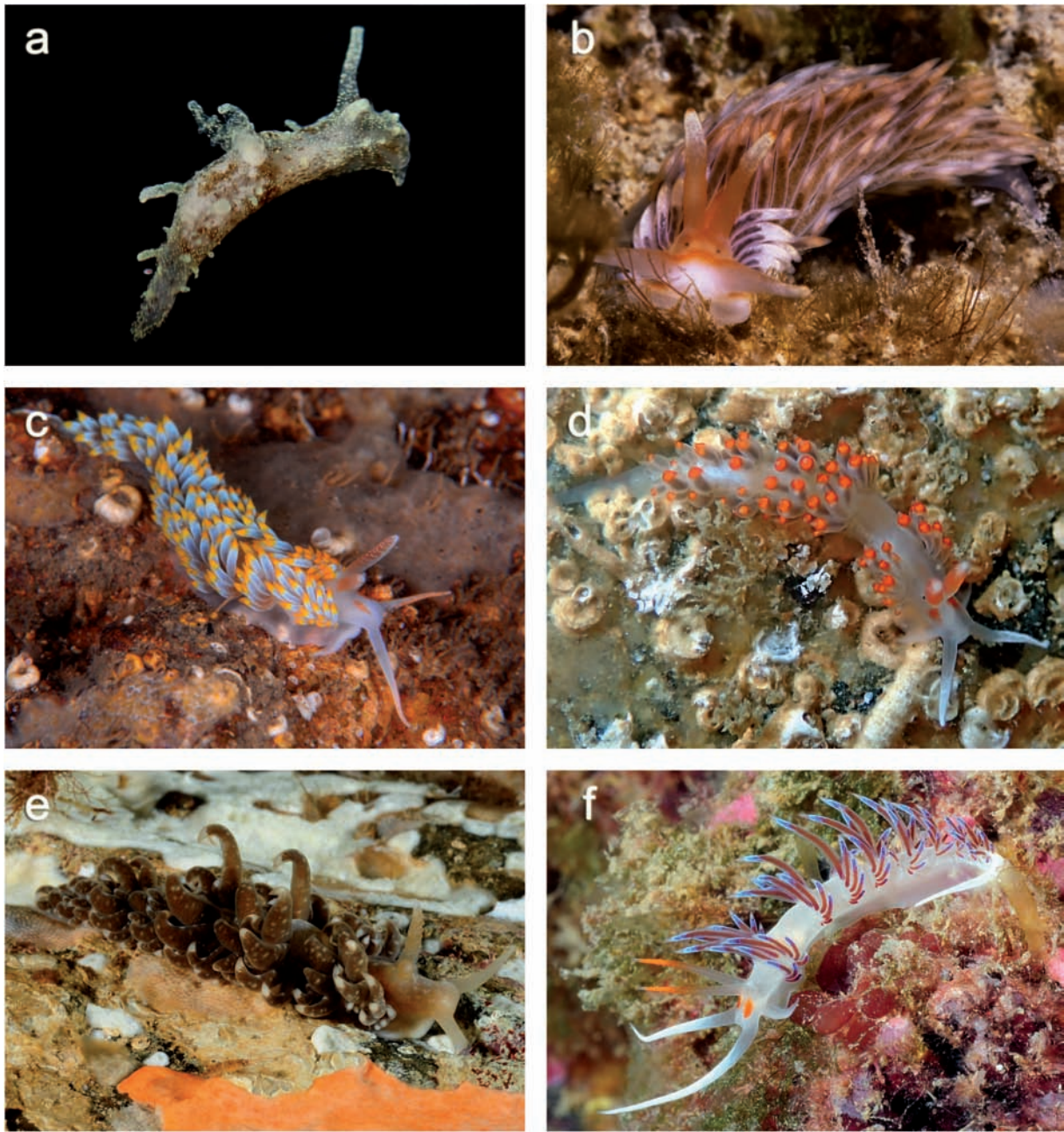


Figure 10. Nudibranchia: a) *Polycerella emertoni*; b) *Aeolidiella alderi*; c) *Berghia coerulescens*; d) *Berghia verrucicornis*; e) *Spurilla neapolitana*; f) *Cratena peregrina*. Pictures: M. Ballesteros (a,d); X. Salvador (b,c); M. Pontes (e,f).

Superfamily Polyceroidea Alder & Hancock, 1845

Family Polyceridae Alder & Hancock, 1845

Limacia clavigera (O.F. Müller, 1776) (Fig 9e)

Confirmed reports: 1 on the Gregal dock of the Olympic harbour (BH: 8/01/2017)

Remarks: Lives on dark rocky walls with an abundance of sessile invertebrates, also under stones and on *Posidonia oceanica* leaves with bryozoans, on which it feeds on (Ballesteros *et al.*, 2020).

Polycera quadrilineata (O.F. Müller, 1776) (Fig 9f)

Confirmed reports: 1 specimen on Mar Bella beach (XS:

27/06/2018)

Remarks: Common on sciophyllic areas and under stones. Juvenile specimens frequently appear among algae. It feeds on bryozoans; this specific specimen was observed feeding on *Bicellariella ciliata*.

Polycerella emertoni A. E. Verrill, 1880 (Fig 10a)

Confirmed reports: 12 specimens in the Forum bathing area (AP & MB: 18/07/2019)

Remarks: Small sized species whose origin is found in the North American Atlantic coasts but which has been also reported in the Eastern Atlantic coasts and in the Mediterranean. Closely linked to the soft bryozoan colonies of *Amathia*

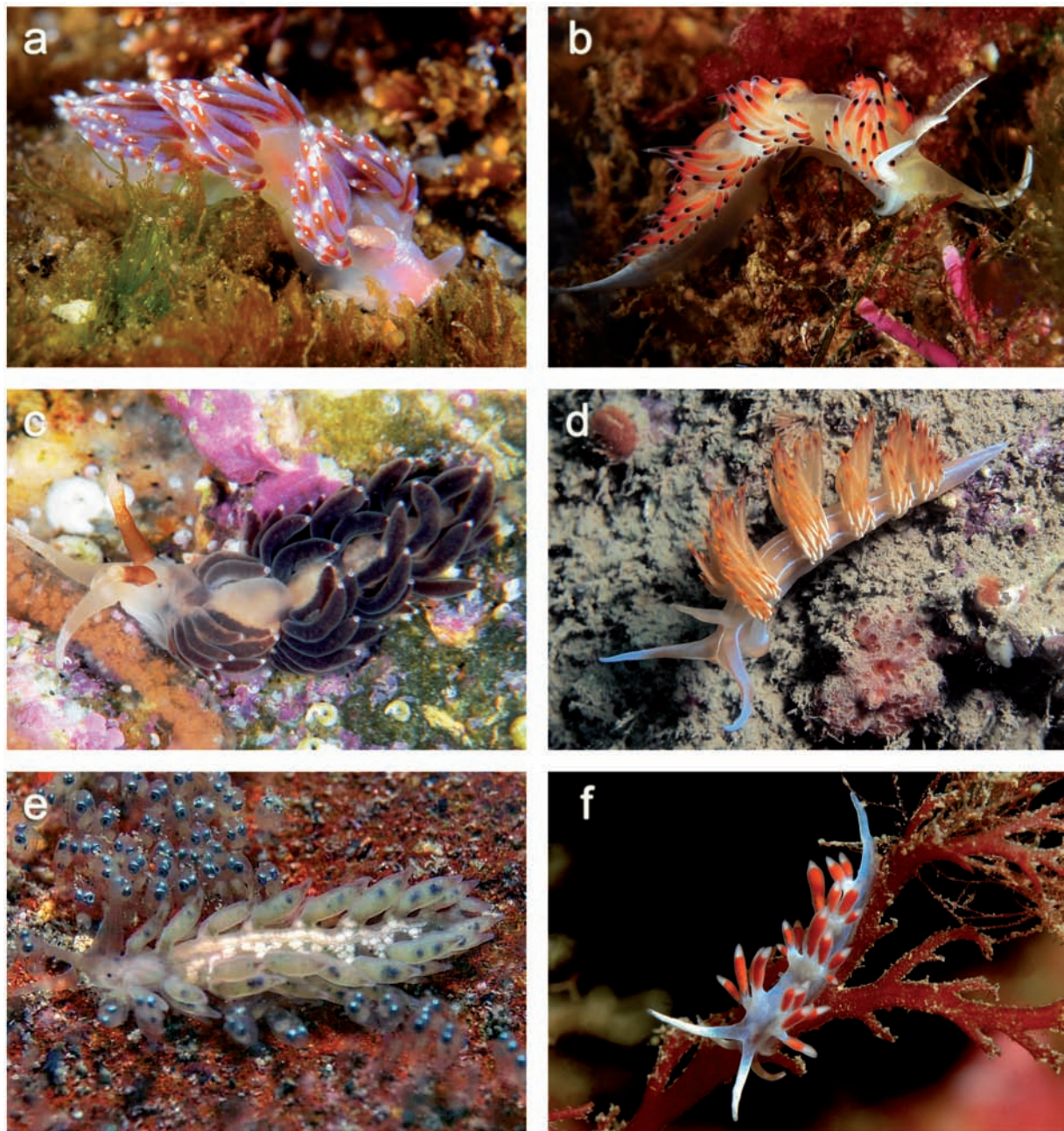


Figure 11. Nudibranchia: a) *Facelina auriculata*; b) *Facelina quatrefagesi*; c) *Favorinus branchialis* feeding on *Aplysia* sp. eggs; d) *Dondice banyulensis*; e) *Calma gobiophaga*; f) *Calmella cavolini*. Pictures: X. Salvador (a-d); M. Peralta (e); M. Pontes (f).

verticillata where it lives practically unnoticed because of its color and small size. In the bays of the Ebro River Delta (NE Spain) an abundant seasonal population is known living on *A. verticillata* (Camps & Prado, 2018).

Suborder Cladobranchia

Superfamily Aeolidioidea Gray, 1827

Family Aeolidiidae Gray, 1827

Aeolidiella alderi (Cocks, 1852) (Fig 10b)

Confirmed reports: 1 specimen in the Forum bathing area (XS: 3/02/2018)

Remarks: Relatively common in Catalan waters, it has

nocturnal habits, living under stones during the day. It feeds on different anemone species such as *Anemonia viridis*, *Aulactinia verrucosa* and *Aiptasia mutabilis* (Ballesteros *et al.*, 2020).

Berghia coerulescens (Laurillard, 1832) (Fig 10c)

Confirmed reports: 4 specimens in the Forum bathing area (XS: 3/2/2018, 18/5/2018; EC: 27/4/2019; AP & CE: 11/5/2019)

Remarks: Spectacularly coloured species that lives on rocky bottoms with seaweeds and marine invertebrates, or under stones, with the presence of anemones of the genera *Aiptasia* or *Sagartia*, on which it feeds (Ballesteros *et al.*, 2020).



Figure 12. Nudibranchia: a) *Calmella gaditana*; b) *Edmundsella pedata*; c) *Flabellina affinis*; d) *Luisella babai*; e) *Trinchesia morrowae*; f) *Doto koenckeri*. Pictures: X. Salvador (a,b,e); M. Pontes (c,d,f).

Berghia verrucicornis (A. Costa, 1867) (Fig 10d)

Confirmed reports: 7 specimens in the Forum bathing area (XS: 18/05/2018; AP: 18/07/2019) and 1 in Mar Bella beach (GR: 2/08/2015)

Remarks: Of nocturnal habits, during the day it hides among seaweeds or under stones, from a very shallow depth. It feeds on small anemones like *Sagartiogeton laceratus* or *Aiptasiogeton hyalinus* (Ballesteros *et al.*, 2020).

Spurilla neapolitana (Delle Chiaje, 1841) (Fig 10e)

Confirmed reports: 14 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 3/02/2018, 27/04/2018, 2/02/2019; AP: 11/05/2019, 13/07/2019; CE: 13/07/2019)

Remarks: Species that can reach more than 4 cm in length and has nocturnal habits, living under stones during the day. It feeds on anemones such as *Anemonia viridis*, *Aiptasia mutabilis* and *Bunodactis rubripunctata* (Ballesteros *et al.*, 2020). Its egg spawn is very characteristic; a very scalloped spirally wound narrow cord with white eggs. Frequently parasitized by copepods of the genus *Splanchnotrophus*.

Family Facelinidae Bergh, 1881

Cratena peregrina (Gmelin, 1791) (Fig 10f)

Confirmed reports: 3 specimens in the Forum bathing area (XS: 5/12/2017), 6 in Mar Bella beach (27/06/2018), 3 in Nova Içària beach (GR: 10/01/2016), 13 at the Gregal dock,

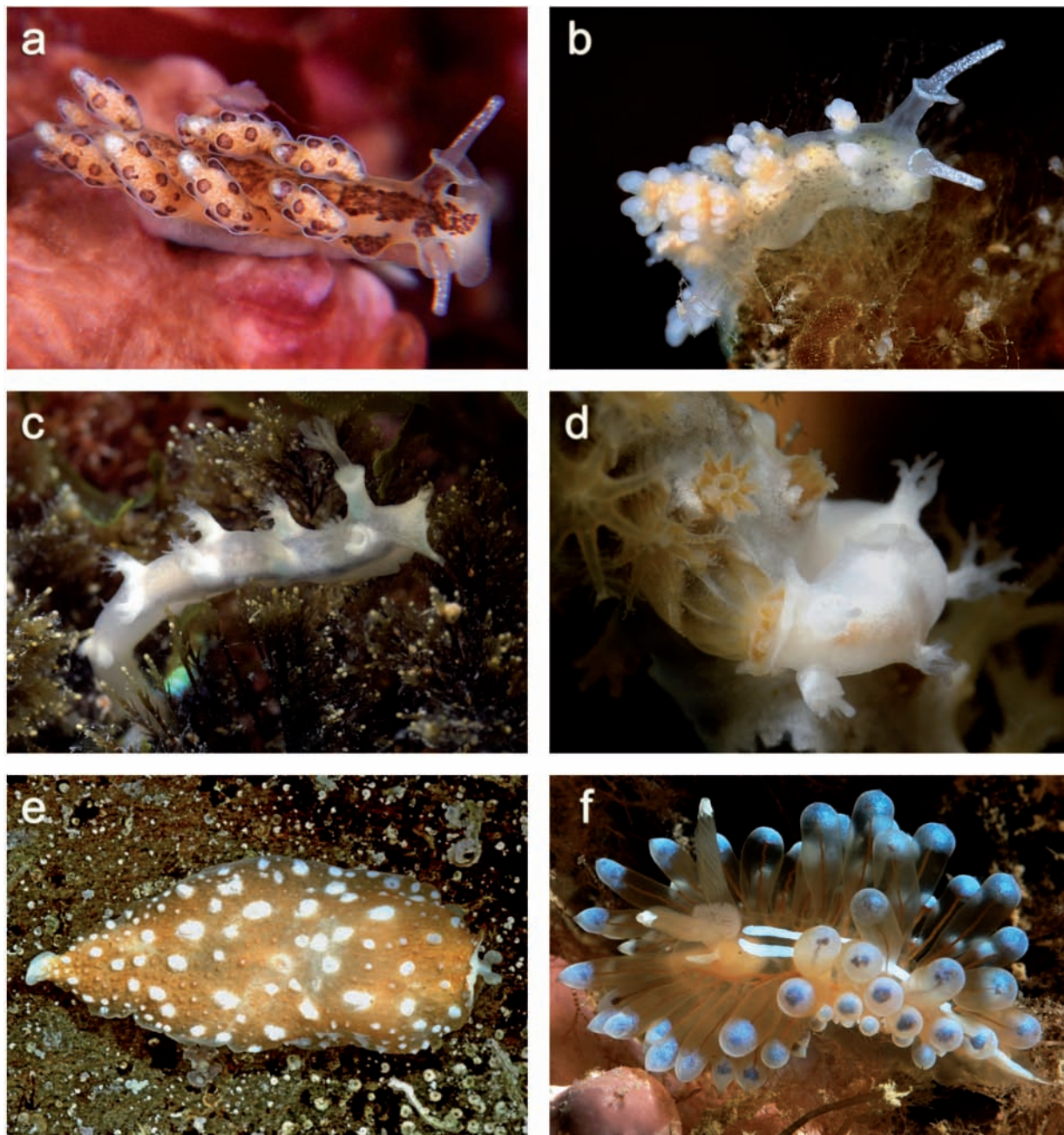


Figure 13. Nudibranchia: a) *Doto paulinae*; b) *Doto rosea*; c) *Tritonia nilsodhneri*; d) *Tritonia nilsodhneri* feeding on polyp of *Eunicella singularis*; e) *Armina maculata*; f) *Antiopella cristata*. Pictures: X. Salvador (a); M. Pontes (b,c,d,f); A. Domènech (e).

Olympic harbour (BH: 1/07/2019, 10/07/2018, 13/10/2016, 16/04/2017, 17/10/2016, 19/03/2018, 9/09/2018, 21/09/2017, 25/04/2018, 27/08/2019, 5/03/2017, 7/04/2018, 7/09/2018), 1 on the Hotel W Breakwater (MB: 16/05/1978) and 3 on the Attached dock breakwater (XS: 26/05/2016)

Remarks: Usually living at shallow depths in dark rocky areas close or on athecate hydrarians of the genus *Eudendrium* that serve both as food and substrate for the egg spawns (Ballesteros *et al.*, 2020).

Facelina auriculata (Müller, 1776) (Fig 11a)

Confirmed reports: 7 specimens in the Forum bathing area (XS: 27/04/2018) and 1 in Mar Bella beach (XS: 27/6/2018)

Remarks: Lives on dark rocky bottoms where it feeds on hydrarians of the genera *Podocoryne*, *Tubularia*, *Obelia*, *Dynamene* and *Laomedea*, despite it can feed on stauromedusae, polychaete worms or other «opisthobranch» (Ballesteros *et al.*, 2020).

Facelina quatrefagesi (Vayssière, 1888) (Fig 11b)

Confirmed reports: 29 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 5/12/2017, 3/02/2018, 27/04/2018), 2 in Mar Bella beach (XS: 27/06/2018), and 3 in Nova Icària beach (GR: 10/1/2016)

Remarks: A very active species that lives on rocky bottoms and feeds on hydrarians. When disturbed, the animal extends

its cerata in a way resembling a stinging anemone (Ballesteros *et al.*, 2020). This species has historically been confused with *Caloria elegans*, very similar in shape and colours but with smooth rhinophores.

Favorinus branchialis (Rathke, 1806) (Fig 11c)

Confirmed reports: 23 specimens in the Forum bathing area (XS: 25/11/2017, 27/04/2018, 18/05/2018) and 1 in the Mar Bella beach (XS: 27/06/2018)

Remarks: This species feeds almost exclusively on egg spawns of other heterobranchs, but it can feed on hydrozoans of the genera *Obelia* and *Sertularia* if necessary (Ballesteros *et al.*, 2020). All observations in the study area were made on egg strings of sea slugs of the genera *Aplysia*, *Goniodoris* and *Haminoea*. Specimens are perfectly mimicked with the substrate by acquiring the colour of the eaten eggs in their cerata.

Family Myrrhinidae Bergh, 1905

Dondice banyulensis Portmann & Sandmeier, 1960 (Fig 11d)

Confirmed reports: 1 specimen at the Gregal dock (BH: 20/08/2018) and 1 in the Attached dock breakwater (XS: 26/05/2016)

Remarks: It is the largest aeolidacean nudibranch in the Mediterranean since it can reach 7 cm in length. It can be found in many different habitats and is able to feed on hydrarians of the genus *Eudendrium*, polychaete worms and even other aeolidaceans (Ballesteros *et al.*, 2020). If disturbed it extends its cerata in a clear defensive reaction, and it can also autotomize them, as they are quickly regenerated if necessary. Recently, Furfaro & Mariottini (2020) have described a new species of *Dondice*, *D. trainitoi* from the Italian Tyrrhenian Sea, very similar to *D. banyulensis*, from which it is distinguished by its semi-transparent body, the presence of two dark spots on both sides of the head and its smaller size (maximum 16 mm); the genetic distance between both species is 18 %. Until the work by Martynov *et al.* (2019) *D. banyulensis* was included in the family Facelinidae.

Superfamily Fionoidea Gray, 1857

Family Calmidae Iredale & O'Donoghue, 1923

Calma gobiophaga Calado & Urgorri, 2002 (Fig 11e)

Confirmed reports: 1 specimen in the Forum bathing area (PER: 27/04/2019)

Remarks: Lives under stones, occasionally found in large numbers, and feeds on eggs of fishes of the family Gobiidae, especially *Gobius niger*, very abundant in the area.

Family Flabellinidae Bergh, 1889

Calmella cavolini (Vérany, 1846) (Fig 11f)

Confirmed reports: 2 specimens in the Forum bathing area (XS: 5/12/2017, 27/04/2018) and 1 on Gregal dock (BH: 13/09/2016)

Remarks: Quite frequent in dark rocky areas next to hydrarians such as *Halecium pusillum* and *Eudendrium racemosum* on which it feeds (Ballesteros *et al.*, 2020).

Calmella gaditana (Cervera, García-Gómez & García, 1987) (Fig 12a)

Confirmed reports: 1 specimen in the Forum bathing area (XS: 23/11/2017)

Remarks: Lives on vertical walls with abundant algae, sponges and hydrarians of the genus *Eudendrium*. Very similar to *C. cavolini* but for the presence of white spots on the surface of the cerata of *C. gaditana*.

Edmundsella pedata (Montagu, 1816) (Fig 12b)

Confirmed reports: 8 specimens in the Forum bathing area (XS: 27/4/2018), 3 in Mar Bella beach (XS: 27/06/2018), 1 at Gregal dock (BH: 3/11/2016), 1 at Hotel W breakwater (MB: 16/05/1978) and 1 at Llevant dock breakwater (VR: 25/6/2013).

Remarks: This aeolidacean lives on walls and rocky bottoms along with hydrarians of the genera *Obelia* and *Eudendrium* which it feeds on (Ballesteros *et al.*, 2020).

Flabellina affinis (Gmelin, 1791) (Fig 12c)

Confirmed reports: 6 specimens at Gregal dock (BH: 1/10/2018, 11/05/2018, 12/09/2018, 13/10/2017, 29/09/2018, 5/09/2016), 1 at Hotel W breakwater (MB: 16/05/1978), 2 at the Attached dock breakwater (XS: 26/5/2016)

Remarks: It has a conspicuous pink or purple coloration and lives at depths between 5-20m., feeding on athecate hydrarians of the genus *Eudendrium* (Ballesteros *et al.*, 2020).

Family Samlidae Korshunova, Martynov, Bakken, Evertsen, Fletcher, Mudianta, Saito, Lundin, Schrödl & Picton, 2017

Luisella babai (Schmekel, 1972) (Fig 12d)

Confirmed reports: 1 specimen at Gregal dock (BH: 18/11/2017)

Remarks: A very active species that lives on rocky bottoms. It has been cited with several hydrozoan species (*Campanularia*, *Eudendrium*, *Bougainvillia*...) (McDonald & Nybakken, 1997) but its real food source is unknown.

Family Trinchesiidae F. Nordsieck, 1972

Trinchesia morrowae Korshunova, Picton, Furfaro, Mariottini, Pontes, Prkić, Fletcher, Malmberg, Lundin & Martynov, 2019 (Fig 12e)

Confirmed reports: 3 specimens at Mar Bella beach (XS: 27/06/2018)

Remarks: Very similar to *Trinchesia caerulea*, in fact they were historically confused. *T. morrowae* has a dorsal white band and 3 colour bands on cerata (yellow, blue and yellow) (Korshunova *et al.*, 2019). It feeds on hydrarians of the genus *Sertularella*.

Superfamily Dendronotoidea Allman, 1845

Family Dotidae Gray, 1853

Doto koenneckeri Lemche, 1976 (Fig 12f)

Confirmed reports: 3 specimens in Mar Bella beach (XS: 27/6/2018)

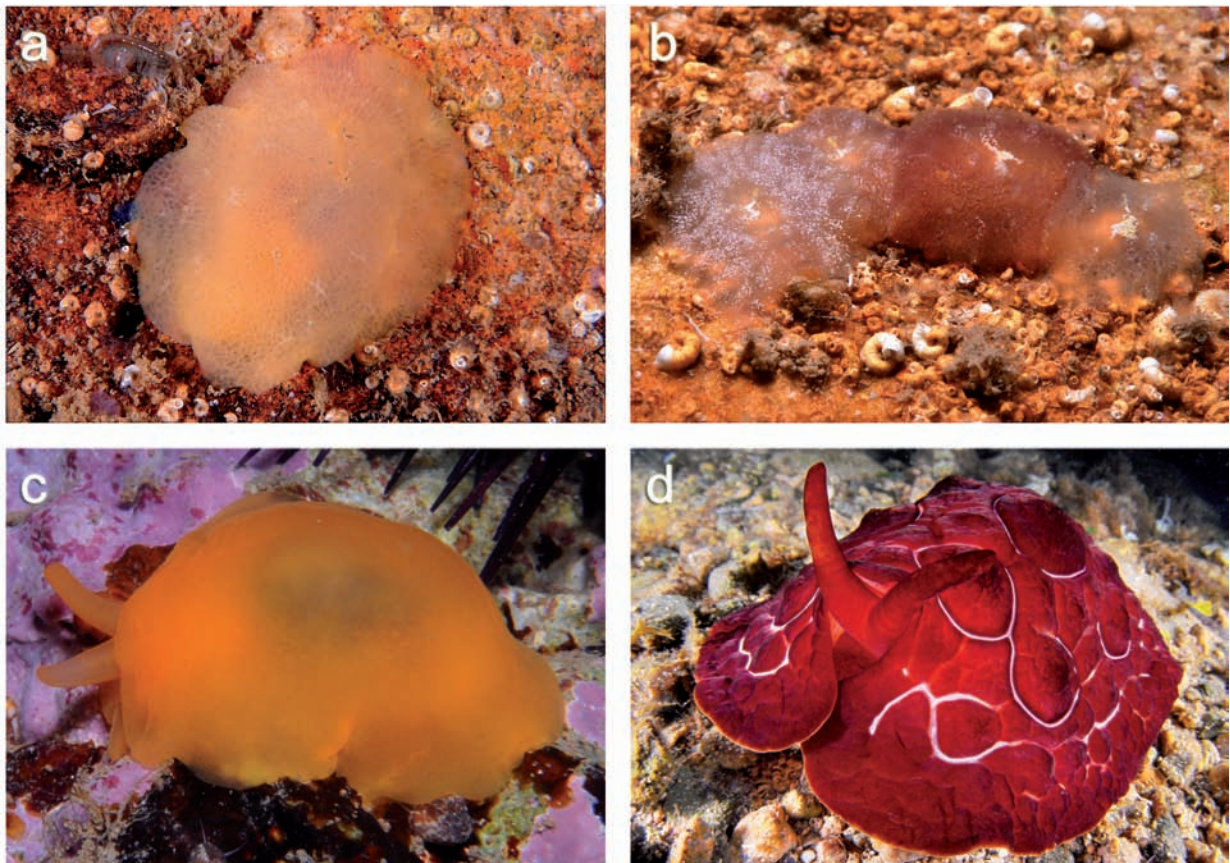


Figure 14. Pleurobranchida: a) *Berthella perforata*; b) *Berthella stellata* mating; c) *Berthellina edwardsii*; d) *Pleurobranchus testudinarius*. Pictures: X. Salvador (a-d).

Remarks: Species closely related to hydrarians of the genus *Aglaophenia*, on which it feeds (Ballesteros *et al.*, 2020). It also uses the colonies as substrate to lay its egg spawns on.

Doto paulinae Trinchese, 1881 (Fig 13a)

Confirmed reports: 1 specimen in Mar Bella beach (XS: 27/06/2018)

Remarks: It lives in dark and shallow communities or in cave roofs where it feeds on hydrarians of the genus *Aglaophenia*. Its egg spawn is an «S» shaped short white cord.

Doto rosea Trinchese, 1881 (Fig 13b)

Confirmed reports: 2 specimens in the Forum bathing area (AP & MB: 27/02/2019) collected in a qualitative scraping of algae and invertebrates in the North wall.

Remarks: A rare species that lives on rocky walls with the hydrarians it feeds on.

Superfamily Tritonioidea Lamarck, 1809

Family Tritoniidae Lamarck, 1809

Tritonia nilsodhneri Marcus Ev., 1983 (Fig 13c and Fig 13d, feeding on a polyp)

Confirmed reports: 3 specimens at Hotel W breakwater (MB: 16/05/1978)

Remarks: Lives on gorgonians such as *Eunicella singularis* and *Leptogorgia sarmentosa*, where it also lays a cord-shaped egg string, wrapping it around the gorgonian's branch.

Superfamily Arminoidea Iredale & O'Donoghue, 1923 (1841)

Family Arminidae Iredale & O'Donoghue, 1923 (1841)

Armina maculata Rafinesque, 1814 (Fig 13e)

Confirmed reports: 1 specimen collected in a muddy bottom by a commercial trawler off Barcelona at 70 m depth (MB: 15/03/1978)

Remarks: Of nocturnal habits, it lives on soft substrates of sand or mud in which it remains buried during the day helped by its cephalic shield. It feeds on pennatulaceans like *Veretillum cynomorium* (Ballesteros *et al.*, 2020).

Superfamily Proctonotoidea Gray, 1853

Family Janolidae Pruvot-Fol, 1933

Antiopella cristata (Delle Chiaje, 1841) (Fig 13f)

Confirmed reports: 3 specimens in the Forum bathing area (XS: 27/04/2018; CP & MB: 16/05/2018) and 1 at Hotel W breakwater (GR: 11/05/2019).

Remarks: It lives in dark rocky walls close to soft or slightly calcified bryozoans of the genera *Alcyonidium*, *Bugula*

and *Cellaria* (McDonald & Nybakken, 1997). If disturbed it might autotomize some cerata to defend itself.

Order Pleurobranchida

Superfamily Pleurobranchoidea Gray, 1827

Family Pleurobranchidae Gray, 1827

Berthella perforata (Philippi, 1844) (Fig 14a)

Confirmed reports: 3 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017; PER: 27/04/2019)

Remarks: Of nocturnal habits, it hides under stones during the day and it is believed that it feeds on sponges and tunicates. Until the very recent work of Ghanimi *et al.* (2020), the Mediterranean reports of this species were considered belonging to *B. plumula*, however, these authors confirm by molecular evidence that both species are different and that the individuals of the European Atlantic coasts belong to *B. plumula* while their Mediterranean counterparts correspond to an ancient species already described by Philippi in 1844: *Pleurobranchus perforatus*, which was considered synonym with *B. plumula*. Now *P. perforatus* should be referred to as *B. perforata*.

Berthella stellata (Risso, 1826) (Fig 14b)

Confirmed reports: 52 specimens in the Forum bathing area (XS: 23/11/2017, 25/11/2017, 23/12/2017, 3/02/2018, 27/04/2018, 18/05/2018, 2/02/2019, 20/11/2019; MB: 16/05/2018; PER: 27/04/2019)

Remarks: Of nocturnal habits, it lives under stones during the day, it is not clear if it feeds on homoscleromorpha sponges of the genus *Oscarella* or on colonial tunicates that are frequent in its habitat. Until the recent work by Ghanimi *et al.* (2020) this species was considered to have a wide geographical distribution, however these authors have verified by molecular analysis that this species really is a constellation of different cryptic species. The specimens living in the Mediterranean belong to *B. stellata*.

Berthellina edwardsii (Vayssière, 1897) (Fig 14c)

Confirmed reports: 2 specimens in the Forum bathing area (XS: 5/12/2017, 20/11/2019)

Remarks: Of nocturnal habits, it lives under stones during the day. It feeds on sponges and has been historically confused with *Berthella aurantiaca*, from which is almost impossible to differentiate visually. Only by studying its inner shell and its anatomy, especially the radula and the labial cuticle denticles, can they be differentiated without mistake. One of the authors of this work has dissected numerous orange *Berthella* / *Berthellina* specimens collected in different locations of the Catalan coast and has been able to verify that they all belonged to *B. edwardsii*. For this reason, and despite the two observed specimens were not collected, we believe they belong to *B. edwardsii*.

Pleurobranchus testudinarius Cantraine, 1835 (Fig 14d)

Confirmed reports: 1 specimen in Mar Bella beach (XS: 27/6/2018)

Remarks: Large species that can reach up to 20 cm in length. Of nocturnal habits, it hides under stones or in caves during the day.

Discussion

The coasts and waterfronts of many coastal cities have been substantially modified for decades due to the new needs of commercial, tourist and social activities. As a result, there has been a profound change in the intertidal and shallow subtidal seabeds resulting in a substitution of soft sandy bottoms for hard surfaces, a loss of natural habitats, also a considerable increase in artificial substrates (marinas, piers, floating pontoons, pylons, underwater barriers) and a degradation of the abiotic conditions of water (temperature, chemical, organic and urban waste contaminants, etc.) (Bulleri & Chapman, 2010).

All this has brought important changes in the marine communities thriving in the vicinity of coastal cities around the world. For example, the proliferation of seaweed species on new artificial rocky substrates, the disappearance of soft-bottom species sensitive to chemical and anthropogenic contamination, an increase in fouling species, the proliferation of opportunistic species and even the arrival of non-native and invasive species (Tyrrel & Byers, 2007; Ferrario *et al.*, 2017; Ulman *et al.*, 2017). The coast of the city of Barcelona has been profoundly modified in the last three decades, mainly with the works to prepare the 1992 Olympic Games, which deeply transformed the city waterfront and opened it to the citizens. No coastal biodiversity global studies were known before these changes and only studies conducted in soft bottoms on some groups such as polychaetes and bivalve mollusks are known (Méndez *et al.*, 1998).

Marine heterobranchs, with some exceptions, are rather typical of clean and well-oxygenated waters, which is why they have generally been studied in open coastal areas far away from large cities. The few studies on heterobranchs in or near coastal cities in the Mediterranean were carried out at the end of the XIX century, like the magnificent work by Trinchese (1881) dedicated to the aeolidaceans and related families of the port of Genoa. Vayssière (1888) developed his great work on «opisthobranch» on the coast of the Gulf of Marseille, while Schmekel (1968) worked on the species in the Gulf of Naples. It was already mentioned the pioneering work by Siro de Fez in waters of the Valencia (Spain) harbour, carried out in the late 1940s, work recently reviewed and updated by Ballesteros (2014). Our study shows a surprising heterobranch biodiversity in the waters of the city of Barcelona: 73 different species found on just over 11 km of coastline, with about 75 % of the coastline artificially constructed.

Among the species found, those of the genus *Aplysia*, and in particular *A. punctata*, have found in the shallow and calm waters of the bathing area of the Forum, an ideal habitat for their reproduction, where in the months of April to June numerous individuals were found under the stones (up to 6 individuals under a medium-sized stone) and on the walls of the pier, mating and laying eggs.

Two suspected non-native species have been found in our study: the sea hare *Bursatella leachii* and the polycerid nudibranch *Polycerella emertoni*, both with a very wide distribution area, that Zenetos *et al.* (2011) consider as established species in the western Mediterranean. The presence of *B. leachii* in Catalan waters has been reported since 2007 (Weitzmann *et al.*, 2007; Ballesteros & Weitzmann, 2016; Córdoba & Ballesteros, 2019) and it seems well established in the bays of the Ebro Delta and in the bathing area of the Forum, where it has daytime activity and many individuals tend to concentrate at night. Selfati *et al.* (2017) provide a series of highly illustrative maps that indicate the progression of colonization of this species in the Mediterranean from the eastern to the western basin, that would explain a Lessepsian migratory origin from the Red Sea, as the first report for this species in the Mediterranean was on the coasts of Israel (O'Donoghue & White, 1940). This species would have spread across the Mediterranean until it reached the Spanish coasts, where it was first reported in the Andalucía shores (Ibáñez-Yuste *et al.*, 2012). However, Bazzicalupo *et al.* (2018), by comparing molecular sequences of Atlantic, Mediterranean and Indo-Pacific specimens, postulated that the majority of *B. leachii* populations in the Mediterranean came from Atlantic populations whose larvae would have colonized the Mediterranean by entering the Straits of Gibraltar and later distributed along the eastern basin, washed away by the warm current of Algeria. This hypothesis needs to be confirmed, and for this reason, all specimens collected in the Catalan shores are being molecularly analyzed right now. A recent work (Bazzicalupo *et al.*, 2020) has discovered that *B. leachii* is actually a complex of two sympatric species being *B. leachii* the species that is distributed in the Atlantic-Mediterranean region and in some areas of the Indo-Pacific and *B. ocelligera*, which would only live in the Indo-Pacific. Rizgalla & Crocetta (2020) also indicate that the type locality of *B. leachii* is unknown, so this species should be considered as cryptogenic.

The case of the nudibranch *Polycerella emertoni* is closely linked with that of the colonies of the bryozoan on which it lives, *Amathia verticillata*, a fouling species widely distributed in commercial ports, sport marinas and calm water shallow bays of warm and temperate seas. *P. emertoni*, whose origin is the North American Atlantic coasts, has been very recently reported in Catalan waters (Camps & Prado, 2018) and we have located it inside the Forum bathing area, on *A. verticillata* colonies, where it is extremely cryptic due to its small size and morphology. In a recent work, Camps-Castellà *et al.* (in press), discuss the geographical distributions of both species and, as suggested by other authors (Floerl *et al.*, 2009; Galil & Gevili, 2014), consider them as cryptogenic species. *A. verticillata* was first described by delle Chiaje (1822) in the waters of the Gulf of Naples (Western Mediterranean) and has been recorded since then in temperate and tropical waters of the eastern coasts of America, in the Pacific and Indian Oceans, in the eastern Atlantic and in the Mediterranean (Jebakumar *et al.*, 2017). In contrast, *P. emertoni* was initially described by Verrill (1880) on the Atlantic coast of

North America on filamentous algae growing on the mooring buoys and wharves pylons where possibly colonies of the bryozoan also grew, and since then it has been reported many times in the eastern Atlantic, Ocean Pacific and the Mediterranean, where it was first recorded by Schmekel (1965) in the Gulf from Naples. It is possible that *P. emertoni* was already present in the Mediterranean in 1822, when the bryozoan *A. verticillata* was described, and that due to its small size and its crypticism on the bryozoan, its presence was not detected until almost a century and a half later, but this hypothesis could never possibly be confirmed. Schmekel's painstaking work on the «opisthobranch» in the Gulf of Naples made it possible to know their presence for the first time in Mediterranean waters.

The samplings carried out in our study area have been very shallow (up to 4-5 m depth in general). The sampled rocky surfaces are relatively recent and colonized by poorly diversified and not very structured seaweed communities and opportunistic marine invertebrates. For this reason, it stands out the large number of nudibranch species found: 47, almost one third of all known species in the entire Catalan coast (Ballesteros *et al.*, 2019). Due to our experience, with decades of research on «opisthobranch», these data are very surprising. To observe and photograph certain specimens on the strongly anthropized coast of Barcelona, for example, of the chromodorid doridacean *Felimare picta*, or the relatively rare *F. bilineata*, or *F. tricolor*, or the also rare *Felimida binza*, *Felimida krohni* and *F. purpurea* and the proctonotid *Antiopella cristata* would be unthinkable only a few years ago. These species are known to live mainly in marine communities with clean and open waters, on well structured and stable on rocky sciophyllic and precoraligenous habitats, so their presence on the Barcelona shores is somewhat surprising. However, considering the quality of the bathing waters of the city of Barcelona, the Catalan Water Agency (ACA) in their reports of the summers of the years 2018 and 2019 (which coincide with those of our studies), rate most of the 11 areas in which they divide the coastline of the city of Barcelona as of excellent or good water quality and only a few of them are of insufficient quality, which coincide with the bathing area of the Forum (zone 1 in our study). This last area is the most immediate to the mouth of the Besós river and the most affected by anthropogenic discharges of the Forum water treatment plant after heavy rain episodes.

In the last decades, certain works are verifying that due to the modifications that global warming is producing in the physical characteristics of the planet, some species are increasing their distribution area towards the North (Parmesan & Yohe, 2003; Perry *et al.*, 2003; Sorte *et al.*, 2010). It has also been verified that some nudibranch species on the North American Pacific coast have expanded their distribution to the North not only due to thermal anomalies of seawater such as those detected during the period 2014-2015 or the strong 2015-2016 El Niño event, but also to longer-lasting climatic changes (Goddard *et al.*, 2011, 2016, 2018).

It is true that citizen interest in the marine environment has exponentially increased in the recent years. There is

also more contact between researchers and amateurs, as evidenced by some of the recently created web sites (CIB, <https://www.cibsub.cat>; Observadores del Mar <https://www.observadoresdelmar.es/>; VIMAR - Vida Marina, <https://vidamarina.info>). The rising of SCUBA diving and the easy access to digital underwater photography, with compact cameras and underwater housings within the reach of most divers, have also contributed to a better understanding of marine life (Salvador, 2019). Despite all this, our opinion is that we are possibly witnessing a progressive modification of the marine communities, particularly along the coast of the city of Barcelona, fostered not only by the human species but also by the effects of the global climate change in the oceans. All the structural modifications to the Barcelona coastline, the new marine communities created, together with the increasing interest of citizens, divers and scientists, may have jointly contributed to the increase in marine biodiversity records, and in particular of «opisthobranch» molluscs.

Acknowledgements

Many volunteer divers of the VIMAR research group have participated in the different samplings: Albert Francisco, Carlota Escarré, Cristina Aldana, Ian Omedes, Jepi Pasqual, Marina Biel, Mario Tirador, Oriol Cortés, Oscar Prats, Pere Monràs and Sara Fuertes. We thank all of them for their enthusiasm in sampling and their contribution to biodiversity study. Creu Palacín, Eugeni Canals, Marc Peralta, Darío Córdoba and Carles Galià have helped us occasionally in the samplings, so we also give them our sincere thanks. We also thank Anna Domènech, Bernard Picton and Klas Malmberg always willing to help with their pictures on very rare species. We also thank the unconditional support of the Federació Catalana d'Activitats Subaquàtiques (FECIDAS) and especially that of its President, Mr. Guillermo Álvarez. Also thanks to Saita Diving Center and its president, Mr. Vicenç Vega for providing us with the necessary diving equipment and logistics. This work has benefited from funds from the Generalitat de Catalunya granted to the Grup de Recerca Consolidat en Biologia i Ecologia Bentòniques (SGR2017-1120) to which two of the authors of this work belong. Finally, we appreciate the suggestions and advice from the two anonymous reviewers who have helped us to notably improve the quality of this work.

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