

Opisthobranch fauna from the National Park Arrecife Alacranes, southern Gulf of Mexico

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Abstract: The opisthobranch mollusks recorded in the National Park Arrecife Alacranes, a marine protected area and the largest coral reef in the southern Gulf of Mexico, were studied during three survey periods in 2009-2010. Several substrate types: rocks, sponges, corals, sand, *Thalassia* beds and drifting *Sargassum* were analyzed. A total of 32 species, belonging to 22 genera, 15 families and four orders were registered. The most diverse order was the Nudibranchia, probably due to the variety of habitats and the feeding resources they exploit. The species *Elysia crispata*, *E. tuca*, *Aplysia dactylomela*, *Phyllaplysia engeli* and *Phidiana lynceus* were recorded during the three sampling seasons, suggesting that they are common in the reef system. The ecological success of the *Elysia* species is due to their ability of incorporate and maintain chloroplasts photosynthetically active, providing the species with extra energy in the case of limited feeding resources. Our own and previous records of *Elysia* cf. *timida*, *Ercolania* cf. *coerulea*, *Polycera herthae*, *Aeolidiella stephanieae*, *Spurilla sargassicola*, *Doto pygmaea* and *Learchis evelinae* suggested that these organisms are not frequent species in the western Atlantic. Finally, the geographical range of *S. sargassicola* is extended southwards, and that of *L. evelinae* towards north.

Résumé : Faune opisthobranche du Parc National Arrecife Alacranes, sud du Golfe du Mexique. Cette étude porte sur les mollusques opisthobranches récoltés au cours de trois différentes expéditions (2009-2010) dans le Parc National Arrecife Alacranes, le plus grand des récifs coralliens du sud du Golfe du Mexique. Divers types de substrats ont été analysés : roches, éponges, coraux, sables, prairies de *Thalassia* et mattes de *Sargassum* à la dérive. Au total, 32 espèces appartenant à 22 genres, 15 familles et quatre ordres ont été identifiées. L'ordre le plus diversifié est celui des Nudibranches, probablement en raison de la variété des habitats ainsi que des ressources qu'il peut exploiter. Les espèces *Elysia crispata*, *E. tuca*, *Aplysia dactylomela*, *Phyllaplysia engeli* et *Phidiana lynceus* ont été récoltées au cours des trois échantillonnages, ce qui porte à croire qu'elles sont très communes dans ce système récifal. Le succès écologique des espèces d'*Elysia* est dû à leur habileté à incorporer et maintenir des chloroplastes photosynthétiquement actifs, ce qui leur donne de l'énergie supplémentaire dans le cas de limitation des ressources alimentaires. Nos signalements actuels et antérieurs de *Elysia* cf. *timida*, *Ercolania* cf. *coerulea*, *Polycera herthae*, *Aeolidiella stephanieae*, *Spurilla sargassicola*, *Doto pygmaea* et *Learchis evelinae* font penser que ces espèces ne sont pas fréquentes dans l'Atlantique occidental. Finalement, cette étude permet d'élargir la distribution géographique de *S. sargassicola* vers le sud, et celle de *L. evelinae* vers le nord.

Keywords: Sea slugs • Coral reefs • Biodiversity • Species richness • Mollusks • Marine protected areas

Introduction

In the Mexican Atlantic coast, coral reefs are extensively found in the Caribbean, whereas in the Gulf of Mexico they occur only in areas where appropriate substrate is suitable to reef growth. Despite the global ecological and economical relevance of coral reefs, in Mexico they were not a priority concern until the 1970's and, from that time onwards, there has been a growing interest of the government agencies, as well as of the social and scientific communities, in the knowledge of their biota in order to protect and conserve them (Jordán-Dahlgren & Rodríguez-Martínez, 2003).

In the southern Gulf of Mexico, Alacranes reef represents the largest coral reef system. It is located 140 km north of the Yucatan Peninsula and is approximately 25 km long and 14 km wide. This reef area was recognized as a "Biosphere Reserve" in 1994 by the United Nations and as a National Park by the Mexican government. The system is half-moon shaped with five small sandy islands, known as Pérez, Pájaros, Chica, Muertos and Desterrada, which are included within its coral structure. Alacranes reef exhibits a large variety of microhabitats and morphological structures differentiated according to the degree of wave exposure, depth and bottom type (Aguilar-Perera et al., 2008).

The National Park Arrecife Alacranes (NPAA) is characterized by a high biological diversity and represents an important fishery area for the coastal population. Most studies in the area focus on potential fisheries resources, such as lobsters and fishes. As a result, a management plan has been implemented in which a certain level of sustainable use is allowed (SEMARNAT, 2006). Compared to fishes or macrocrustaceans, studies about mollusks in the NPAA are very scarce (Rice & Kornicker, 1962; Hicks et al., 2001), and no surveys aimed solely at the opisthobranch fauna have been made so far in the Park. These small animals, also known as 'sea slugs', are the most structurally diverse group among the mollusks. While their body has evolved towards the reduction, internalization or loss of the shell, very specialized defensive systems have been developed to balance the lack of shell (Faulkner & Ghiselin, 1983). A common defense system used by the sea slugs includes chemical deterrents synthesized *in situ* or even obtained from their prey. Moreover, in a recent pharmaceutical research it was discovered that these chemical compounds have an anti-cancer activity (Shubina et al., 2007). Thus, due to the ecological and potential biomedical relevance of these animals, as well as the lack of studies in Alacranes reef, the aim of this study is to provide the first attempt to know the opisthobranch fauna in the NPAA, to which we have added detailed information about its worldwide distribution.

Material & Methods

Three field surveys were carried out in the NPAA (Fig. 1) during December 2009, April and September 2010. The organisms were collected by means of direct and indirect sampling methods (brushing, suction collectors, and a sledge net), with snorkel and SCUBA diving. Samplings were made from the shoreline to 12 m depth, including a variety of habitats (under rocks or dead corals, sand, sponges, algae) and *Thalassia* beds as well as drifting *Sargassum* found close to the shore. Most sampling stations were located around Pérez island (22°23'N-89°41'W), the largest island in the area. Most of the specimens were identified in the field, mainly using the Valdés et al. (2006) field guide, known as the most extensive and complete available for the area. Photographs of species whose identity was uncertain were sent to a specialist to confirm the identification. The information provided in the diagnoses of the species was taken from several authors (Redfern, 2001; Collin et al., 2005; Valdés et al., 2006; Malaquias & Reid, 2008; Tunnell et al., 2010).

Results

A total of 32 species belonging to 22 genera and 15 families of opisthobranchs were recorded in the NPAA during the three surveys of the study (Table 1). The most diverse order was the Nudibranchia, represented by eight families and 13 species. Only five species: *Elysia crispata*, *E. tuca*, *Aplysia dactylomela*, *Phyllaplysia engeli* and *Phidiana lynceus* were present in all the sampling periods, whereas most species appeared in one season only. Information on the habitat where the specimens were recorded, a brief diagnosis and the worldwide distribution of the 32 species studied is presented following the same sequence of Table 1.

Order Cephalaspidea

Family Aglajidae

Chelidonura hirundinina (Quoy & Gaimard, 1833)

Material examined

12 specimens.

Habitat

Thalassia testudinum, *Halimeda* sp, *Penicillus* sp.

Diagnosis

Posterior end of the body with two unequal elongate projections, the left lobe larger than the right. Body color variable: orange, red or dark brown. Dorsum with blue,

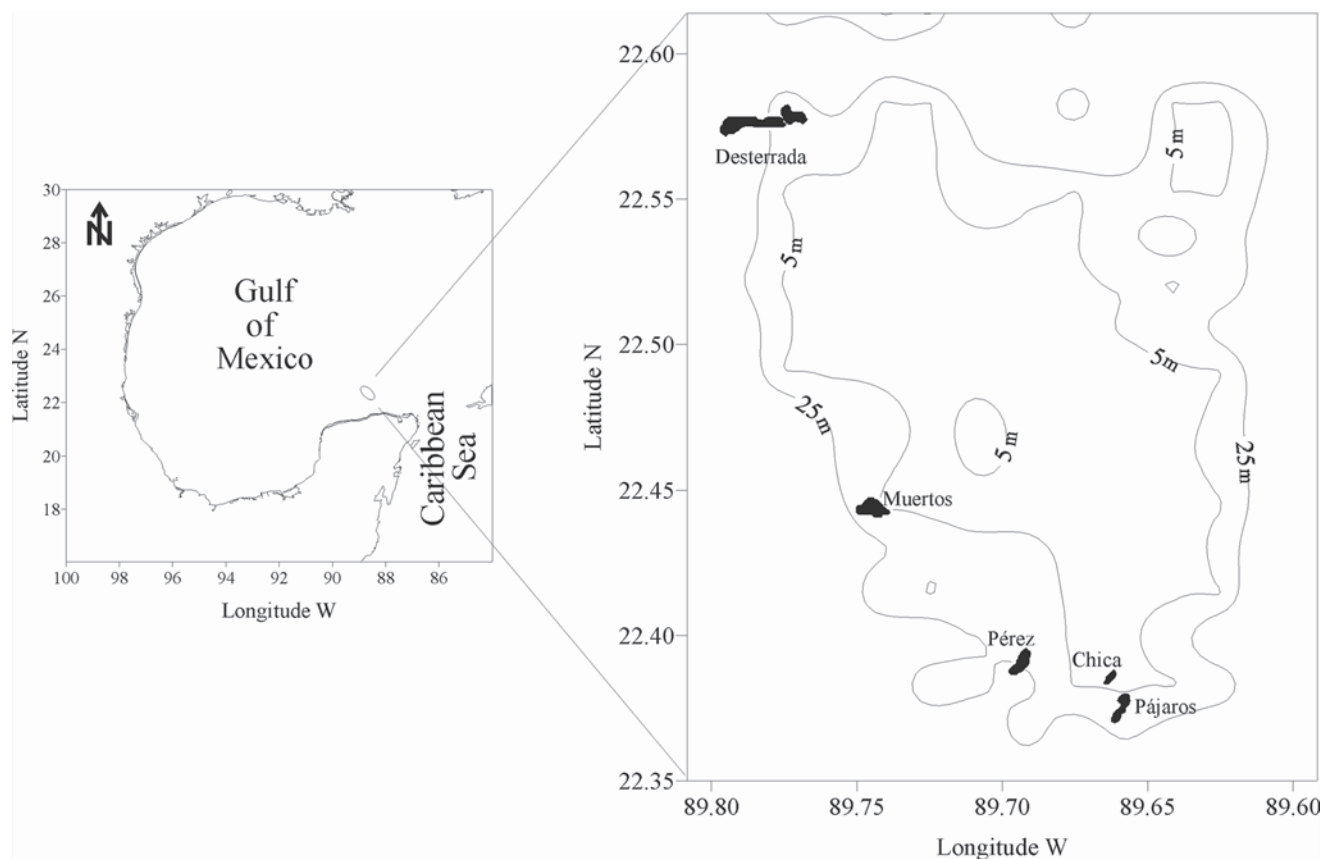


Figure 1. Geographical location of the National Park Arrecife Alacranes, southern Gulf of Mexico.

Figure 1. Position géographique du Parc National Arrecife de Alacranes, au sud du Golfe du Mexique.

orange and black stripes, and a large white patch behind the cephalic shield.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Mexico (Yucatan), Belize, Colombia; Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Guadeloupe, St. Vincent and the Grenadines, Grenada, Curaçao). Indo-Pacific: from South Africa, Aldabra Atoll, and Madagascar to Hawaii (Gosliner, 1987; Redfern, 2001; Valdés et al., 2006; Gosliner et al., 2008; Ortigosa-Gutiérrez, 2009).

Navanax aenigmaticus (Bergh, 1894)

Material examined

1 specimen.

Habitat

Under coral fragments.

Diagnosis

Characteristic blue-turquoise spots along the edge of the parapodia. Body color usually yellowish to brown with white patches. Two unequal lobes at the posterior end of the body, the left one with a thin projection. Shell calcified.

Distribution

Amphiameric. Western Atlantic: United States (Florida), Mexico (Veracruz), Belize, Honduras, Costa Rica, Colombia, Venezuela, Brazil; Bahamas, Greater Antilles (Jamaica), and Lesser Antilles (Virgin Islands, St. Bathélemy, Barbuda, Guadeloupe, Martinique, St. Vincent and the Grenadines, Barbados, Grenada, Curaçao). Eastern Pacific: from Baja California, Mexico to Peru; Galapagos Islands (Camacho-García et al., 2005; Ortigosa-Gutiérrez, 2005; Hermosillo et al., 2006; Valdés et al., 2006; Zamora-Silva & Naranjo-García, 2008).

Table 1. Species of opisthobranch mollusks collected in the National Park Arrecife Alacranes, Mexico, during December 2009, April and September 2010.

Tableau 1. Espèces de mollusques opisthobranches récoltées dans le Parc National Arrecife de Alacranes, Mexico, en décembre 2009, en avril et septembre 2010.

Species	December	April	September
Order Cephalaspidea			
Family Aglajidae			
<i>Chelidonura hirundinina</i> (Quoy & Gaimard, 1833)		X	X
<i>Navanax aenigmaticus</i> (Bergh, 1894)	X		
Family Bullidae			
<i>Bulla occidentalis</i> A. Adams, 1850	X	X	X
Family Haminoeidae			
<i>Haminoea antillarum</i> (d'Orbigny, 1841)	X		
<i>Haminoea elegans</i> (Gray, 1825)	X		
Order Sacoglossa			
Family Caliphyllidae			
<i>Cyerce antillensis</i> Engel, 1927	X		
Family Limapontiidae			
<i>Costasiella ocellifera</i> (Simroth, 1895)	X	X	
<i>Ercolania cf. coerulea</i> Trinchese, 1892	X		
Family Plakobranchidae			
<i>Elysia</i> (= <i>Tridachia</i>) <i>crispata</i> (Mörch, 1863)	X	X	X
<i>Elysia patina</i> Ev. Marcus, 1980	X		
<i>Elysia subornata</i> Verrill, 1901	X		
<i>Elysia cf. timida</i> (Risso, 1818)			X
<i>Elysia tuca</i> Ev. Marcus & Er. Marcus, 1967	X	X	X
Order Anaspidea			
Family Aplysiidae			
<i>Aplysia brasiliiana</i> Rang, 1828		X	
<i>Aplysia dactylomela</i> Rang, 1828	X	X	X
<i>Aplysia parvula</i> Guilding in Mörch, 1863	X	X	
<i>Dolabrifera dolabrifera</i> (Cuvier, 1817)	X	X	
<i>Phyllaplysia engeli</i> Er. Marcus, 1955	X	X	X
<i>Stylocheilus striatus</i> (Quoy & Gaimard, 1832)			X
Order Nudibranchia			
Family Aeolidiidae			
<i>Aeolidiella stephanieae</i> Valdés, 2005			X
<i>Spurilla neapolitana</i> delle Chiaje, 1823			X
<i>Spurilla sargassicola</i> Kröyer in Bergh, 1861			X
Family Dendrodorididae			
<i>Dendrodoris krebsii</i> (Mörch, 1863)	X	X	
Family Doridae			
<i>Doris bovena</i> Er. Marcus, 1955	X	X	
Family Dotidae			
<i>Doto pygmaea</i> Bergh, 1871			X
<i>Doto</i> sp1			X
<i>Doto</i> sp2			X
Family Facelinidae			
<i>Learchis evelinae</i> Edmunds & Just, 1983		X	
<i>Phidiana lynceus</i> Bergh, 1867	X	X	X
Family Polyceridae			
<i>Polycera herthae</i> Ev. Marcus & Er. Marcus, 1963		X	
Family Scyllaeidae			
<i>Scyllaea pelagica</i> Linnaeus, 1758	X		X
Family Tritoniidae			
<i>Tritonia bayeri</i> Ev. Marcus & Er. Marcus, 1967		X	

Family Bullidae***Bulla occidentalis* A. Adams, 1850***Material examined*

457 specimens (empty shells).

Habitat

Sand.

Diagnosis

Shell barrel-shaped, thick, smooth, rounded at both ends. Spire sunken. Faint growth lines all over the shell. Posterior spiral grooves usually absent, faint when present. Color cream to brownish, with brown and white marks.

Distribution

United States (Florida, Texas), Mexico (Veracruz, Yucatan, Quintana Roo), Belize, Honduras, Costa Rica, Panama, Colombia, Venezuela, Surinam, Brazil, Uruguay; Bermuda, Bahamas, Greater Antilles (Cuba, Jamaica, Puerto Rico), and Lesser Antilles (Virgin Islands, St. Martin, Barbuda, Antigua, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Tobago, Trinidad) (Moore, 1958; Redfern, 2001; Valdés et al., 2006; Malaquias & Reid, 2008).

Family Haminoeidae***Haminoea antillarum* (d'Orbigny, 1841)***Material examined*

2 specimens.

Habitat

Rhizomes of *Penicillus* sp., sand.

Diagnosis

Body translucent gray with numerous black and white dots and conspicuous orange spots visible throughout the shell. Cephalic shield short and wide. Lateral tentacles well-developed. Foot broad and rounded at the posterior end. Shell very thin, translucent, smooth, with faint growth lines.

Distribution

United States (Florida, Texas), Mexico (Veracruz, Yucatan, Quintana Roo), Honduras, Panama, Colombia, Venezuela, Brazil; Bermuda, Greater Antilles (Cuba, Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Guadeloupe) (Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Ortigosa-Gutiérrez, 2009).

Haminoea elegans* (Gray, 1825)Material examined*

1 specimen (empty shell).

Habitat

Sand.

Diagnosis

Body translucent yellow gray, with black and white dots all over the body. A notch on the cephalic shield. Tentacles short. Parapodia large, partially covering the shell. Shell lightly calcified, globose, translucent and smooth, except for numerous fine axial striae running parallel on the shell.

Distribution

United States (Florida, Texas), Mexico (Veracruz, Yucatan), Belize, Honduras, Costa Rica, Colombia, Venezuela, Brazil; Bermuda, Bahamas, Greater Antilles (Cuba, Jamaica, Puerto Rico), and Lesser Antilles (Virgin Islands, Martinique, St. Lucia, St. Vincent and the Grenadines, Tobago, Trinidad, Curaçao, Bonaire) (Vokes & Vokes, 1983; Hicks et al., 2001; Redfern, 2001; Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Ortigosa-Gutiérrez, 2009).

Order Sacoglossa**Family Caliphyllidae*****Cyerce antillensis* Engel, 1927***Material examined*

4 specimens.

Habitat

Penicillus sp.

Diagnosis

Cerata inflated, translucent, scattered by minute opaque white dots, usually a longitudinal dark pigmentation; the upper border irregular, with numerous white glands. Digestive system yellowish or greenish visible throughout the translucent body, but no digestive branches into the cerata. Dorsum with an opaque patch, head with brown pigmentation. Teeth short, 12-20 denticles in each side.

Distribution

United States (Florida), Mexico (Quintana Roo), Belize, Honduras, Costa Rica; Bermuda, Bahamas, Greater Antilles (Cuba, Jamaica, Cayman Islands, Puerto Rico),

and Lesser Antilles (Virgin Islands, Barbados, Tobago, Curaçao) (Redfern, 2001; Valdés et al., 2006).

Family Limapontiidae
Costasiella ocellifera (Simroth, 1895)

Material examined

23 specimens.

Habitat

Thalassia testudinum.

Diagnosis

A characteristic blue spot behind the rhinophores bordered with a black, brown or orange thin line. Eyes conspicuous, dark, placed close together. Body usually translucent green with white and black spots.

Distribution

United States (Florida), Mexico (Yucatan, Quintana Roo), Belize, Honduras, Costa Rica, Brazil; Bermuda, Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Virgin Islands, St. Martin, Martinique, St. Lucia, St. Vincent and the Grenadines, Grenada) (Jensen, 1996; Gavagnin et al., 2000; Redfern, 2001; Valdés et al., 2006; Ortigosa-Gutiérrez, 2009).

Ercolania cf. coerulea Trinchese, 1892

Material examined

1 specimen.

Habitat

Thalassia testudinum.

Diagnosis

Digestive glands green with ducts entering the head, rhinophores and cerata, visible throughout the transparent background color. Cerata short, globose, narrowing into an elongate apix. Numerous opaque white spots covering the rhinophores and cerata, clustered on the tip of each ceras.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Venezuela, Brazil; Bahamas, Greater Antilles (Jamaica), and Lesser Antilles (Virgin Islands, St. Kitts, St. Lucia, Curaçao). Eastern Atlantic: Spanish Levant, from Cape Gata to Catalonia; Azores, Madeira, Canary and Selvagens islands. Indo-Pacific: Tanzania, Hong Kong, and Philippines (Redfern, 2001; Cervera et al., 2004; Valdés et al., 2006; Gosliner et al., 2008).

Comments

The species was first described from the Mediterranean. While Grzybowski et al. (2007) stressed that *E. coerulea* is the only species of the genus worldwide; other specialists argue that the Caribbean and Indo-Pacific populations need further taxonomic revision.

Family Plakobranchidae
Elysia (=Tridachia) crispata (Mörch, 1863)

Material examined

108 specimens.

Habitat

Thalassia testudinum, green, red and brown algae, under coral fragments.

Diagnosis

Parapodia prominent, fused behind the head, very frilly at the edge, even with secondary folds. Rhinophores wide and short. Body color highly variable, from greenish white to bright blue. Lateral sides of body generally green with large, oval yellow spots.

Distribution

United States (Florida), Mexico (Veracruz, Yucatan, Quintana Roo), Belize, Honduras, Costa Rica, Panama, Colombia, Venezuela; Bermuda, Bahamas (including Turks and Caicos), Greater Antilles (Haiti, Jamaica, Cayman Islands, Puerto Rico) and Lesser Antilles (Virgin Islands, St. Martin, Antigua, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Tobago, Trinidad, Aruba, Curaçao, Bonaire) (Hicks et al., 2001 as *Tridachia crispata*; Redfern, 2001; Ortigosa-Gutiérrez, 2005; Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Zamora-Silva & Naranjo-García, 2008).

Elysia patina Ev. Marcus, 1980

Material examined

3 specimens.

Habitat

Halimeda sp., green, red and brown algae.

Diagnosis

Pericardium white, small. Dorsal vessels conspicuous, derived from the pericardium. Parapodial margins thick and irregular. Rhinophores elongate, usually with a brown patch at the middle. Rhinophores and body covered by papillae.

Body color yellowish or greenish. Head and rhinophores with numerous opaque white dots.

Distribution

United States (Florida), Mexico (Yucatan, Quintana Roo), Costa Rica; Bahamas and Lesser Antilles (Martinique, St. Vincent and the Grenadines) (Gavagnin et al., 2000; Valdés et al., 2006; Ortigosa-Gutiérrez, 2009).

Elysia subornata Verrill, 1901

Material examined

3 specimens.

Habitat

Thalassia testudinum, *Halimeda* sp, green, red and brown algae.

Diagnosis

Parapodial margins irregular and thick with a dark line at the edge. Large papillae on rhinophores. Body color highly variable, from yellow to green olive or reddish covered with white papillae. Sometimes a white “Y” shaped patch over the head and rhinophores.

Distribution

United States (Florida), Mexico (Veracruz, Yucatan, Quintana Roo), Belize; Bermuda, Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico) and Lesser Antilles (Virgin Islands, Martinique, Grenada, Tobago, Trinidad, Aruba) (Gavagnin et al., 2000; Redfern, 2001; Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Ortigosa-Gutiérrez, 2009).

Elysia cf. timida (Risso, 1818)

Material examined

2 specimens.

Habitat

Penicillus sp.

Diagnosis

Color white opaque with characteristic red spots. Body covered by papillae. Parapodia low, with higher projections at the middle line giving the animal a hump-shape outline when viewed from the side.

Distribution

Amphiatlantic. Western Atlantic: United States (Florida),

Mexico (Yucatan); Bahamas and Greater Antilles (Cuba, Cayman Islands). Central and eastern Atlantic: Portugal; São Tomé Island; Mediterranean Sea (Spain and France) (Cervera et al., 2004; Valdés et al., 2006; Ortigosa-Gutiérrez, 2009; Wirtz & Anker, 2009; Carmona et al., 2011).

Comments

In a recent molecular analysis, Carmona et al. (2011) indicated that previous records of *E. timida* in the western Atlantic may belong to four different species (*Elysia* sp, *E. cornigera*, *E. papillosa* or *E. timida*).

Elysia tuca Ev. Marcus & Er. Marcus, 1967

Material examined

106 specimens.

Habitat

Halimeda sp., green, red and brown algae, under coral fragments.

Diagnosis

A characteristic opaque white “Y” shaped patch on the head, entering the rhinophores. Lower part of rhinophores with green or brown dots, the upper half opaque white. Body color from pale to dark green or brown. Notorious and rounded papillae on the rhinophores, more intermittent on the parapodia. When parapodia are joined up, two open areas are visible, in the middle and posterior parts of the body.

Distribution

United States (Florida), Mexico (Yucatan, Quintana Roo), Honduras, Costa Rica, Panama, Colombia, Brazil; Bermuda, Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Virgin Islands, St. Martin, St. Lucia, St. Vincent and the Grenadines, Barbados, Grenada, Curaçao) (Redfern, 2001; Valdés et al., 2006; Krug, 2009; Ortigosa-Gutiérrez, 2009).

Order Anaspidea

Family Aplysiidae

Aplysia brasiliana Rang, 1828

Material examined

1 specimen.

Habitat

Red algae.

Diagnosis

Parapodia well-developed not fused neither anteriorly nor posteriorly. Body color variable, yellow, green, brown, gray or black, normally irregular greenish or brownish patches, and sometimes scattered by lighter yellow or white spots.

Distribution

Western Atlantic: United States (New Jersey, Florida, Texas), Mexico (Veracruz, Campeche, Yucatan), Costa Rica, Colombia, Venezuela, Brazil, Uruguay; Bermuda and Lesser Antilles (Aruba) (Arechavaleta & Formica-Corsi, 2004; Valdés et al., 2006; Zamora-Silva & Naranjo-García, 2008; Ortigosa-Gutiérrez, 2009).

Comments

Some studies consider this species a junior synonym of *A. fasciata* from the eastern Atlantic. Further studies are needed to determine the taxonomic status of the species.

Aplysia dactylomela Rang, 1828*Material examined*

8 specimens.

Habitat

Red algae, under rocks.

Diagnosis

Background color generally greenish brown with irregular dark rings and reticulations. Parapodia well-developed, almost folded. The rough texture of the foot contrasts with the smooth surface of the rest of the body.

Distribution

Circumtropical. Western Atlantic: United States (Florida, Texas), Mexico (Veracruz, Campeche, Yucatan, Quintana Roo), Belize, Honduras, Costa Rica, Panama, Colombia, Venezuela, Brazil; Bermuda, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Virgin Islands, San Martin, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Grenada, Tobago, Trinidad, Aruba, Curaçao, Bonaire). Eastern Atlantic: Madeira, Canary and Selvagens islands, and central and eastern Mediterranean. Eastern Pacific: Costa Rica and Panama. Indo-Pacific: from the Red Sea and South Africa to Hawaii, including Japan (Moore, 1958; Vokes & Vokes, 1983; Gosliner, 1987; Hicks et al., 2001; Redfern, 2001; Cervera et al., 2004; Camacho-García et al., 2005; Ortigosa-Gutiérrez, 2005 & 2009; Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Gosliner et al., 2008; Schembri, 2008; Zamora-Silva & Naranjo-García, 2008).

Aplysia parvula Guilding in Mörch, 1863*Material examined*

19 specimens.

Habitat

Green, red and brown algae.

Diagnosis

Parapodia moderately developed with a distinct dark or navy blue border, fused at the end. Body color variable, usually brown, reddish or green mottled with white spots. Foot narrow. Siphon well developed. Tips of tentacles and rhinophores black or navy blue.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Mexico (Veracruz, Quintana Roo), Belize, Honduras, Costa Rica, Brazil; Bermuda, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Virgin Islands, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Tobago, Trinidad, Aruba, Curaçao, Bonaire). Eastern Atlantic: Portugal and Spain (northern, western and Mediterranean coasts), including Atlantic archipelagos (Azores, Madeira, Selvagens and Canary islands). Eastern Pacific: San Clemente Island, California, Costa Rica, Panama, Galapagos Islands. Indo-Pacific: from the western Indian Ocean to Hawaii (Gosliner, 1987; Redfern, 2001; Cervera et al., 2004; Hermosillo, 2004; Camacho-García et al., 2005; Valdés et al., 2006; Vicencio-de la Cruz & González-Gándara, 2006; Gosliner et al., 2008).

Dolabrifera dolabrifera (Cuvier, 1817)*Material examined*

3 specimens.

Habitat

Under rocks and coral fragments.

Diagnosis

Body dorso-ventrally compressed, the posterior half usually broad and rounded narrowing towards the head. Low tubercles all over the body. Cryptic coloration, usually mottled green or light brown, varying from chocolate, to orange, to olive-green or pink. Parapodia unequal, fused (excepting a short region in the posterior midline), closely pressed to the body.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Costa Rica, Colombia, Venezuela, Brazil; Bermudas, Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico), and Lesser Antilles (Virgin Islands, Saba, Antigua, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Grenada, Aruba, Curaçao, Bonaire). Eastern Atlantic: Madeira, Selvagens and Canary islands. Eastern Pacific: from the Gulf of California to Galapagos Islands. Indo-Pacific: from the Red Sea and South Africa to Hawaii, and eastern Pacific tropics (Rodríguez-Sevilla et al., 2003; Cervera et al., 2004; Valdés et al., 2006; Gosliner et al., 2008).

Phyllaplysia engeli* Er. Marcus, 1955Material examined*

85 specimens.

Habitat

Thalassia testudinum.

Diagnosis

Body flattened, covered by low papillae. Cryptic coloration on the seagrasses leaves where it lives. Body color translucent, usually olive-green, sometimes with white longitudinal lines. Rhinophores and oral tentacles mottled with white spots.

Distribution

United States (Florida), Mexico (Yucatan, Quintana Roo), Costa Rica, Colombia, Brazil; Bahamas, Greater Antilles (Jamaica, Puerto Rico) and Lesser Antilles (St. Martin, Barbados, Curaçao) (Redfern, 2001; Valdés et al., 2006; Ortigosa-Gutiérrez, 2009).

Stylocheilus striatus* (Quoy & Gaimard, 1832)Material examined*

1 specimen.

Habitat

Reddish filamentous substratum *Lyngbya*-like.

Diagnosis

Body color greenish-yellow, brown or gray, with typical longitudinal black striations. Brown patches with blue-turquoise or orange bright spots. Body elongate with ramified papillae. Rhinophores with papillae. Oral tentacles narrow and long. Parapodia small.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Mexico (Yucatan), Belize, Panama, Colombia, Venezuela, Brazil; Bermudas, Bahamas, Greater Antilles (Jamaica, Cayman Islands, Puerto Rico) and Lesser Antilles (Virgin Islands, Martinique, St. Vincent and the Grenadines, Barbados, Grenada, Aruba, Curaçao, Bonaire). Eastern Atlantic: Azores, Madeira, Selvagens and Canary islands. Eastern Pacific: from the Gulf of California to Galapagos Islands. Indo-Pacific: from the Red Sea and South Africa to Hawaii (Rodríguez-Sevilla et al., 2003; Cervera et al., 2004; Hermosillo, 2004; Valdés et al., 2006; Gosliner et al., 2008; Ortigosa-Gutiérrez, 2009).

Order Nudibranchia**Family Aeolidiidae*****Aeolidiella stephanieae* Valdés, 2005***Material examined*

1 specimen.

Habitat

Thalassia testudinum.

Diagnosis

Body opaque translucent gray with an opaque white patch on the dorsum. Upper half of rhinophores and oral tentacles opaque white, the basal half same color of the body. Cerata arranged in four clusters at each side of the body; color grayish, the upper third opaque white.

Distribution

United States (Florida), Mexico (Yucatan) (Valdés et al., 2006; Ortigosa-Gutiérrez, 2009).

Spurilla neapolitana* delle Chiaje, 1823Material examined*

1 specimen.

Habitat

Thalassia testudinum.

Diagnosis

Cerata quite flattened, curled distally. Rhinophores with lamellae and white apices. Color variable, usually pink to orange. Oral tentacles long, the same color as the body. Cerata translucent with ducts of digestive gland gray to brown. Some specimens with white spots over the dorsum and cerata.

Distribution

Circumtropical. Western Atlantic: United States (Florida, Texas), Mexico (Veracruz, Yucatan), Belize, Honduras, Costa Rica, Colombia, Venezuela, Brazil; Bermuda, Bahamas, Greater Antilles (Jamaica, Puerto Rico), and Lesser Antilles (Virgin Islands, St. Vincent and the Grenadines, Barbados, Curaçao). Eastern Atlantic: Portugal and Spain (northern, western and Mediterranean coasts), including Atlantic archipelagos (Azores, Madeira, Selvagens and Canary islands). Eastern Pacific: Gulf of California, Panama. Indo-Pacific: from Japan, Hong Kong, Australia to Hawaii (Rodríguez-Sevilla et al., 2003; Cervera et al., 2004; Hermosillo, 2004; Ortigosa-Gutiérrez, 2005 & 2009; Valdés et al., 2006; Gosliner et al., 2008).

Spurilla sargassicola Kröyer in Bergh, 1861

Material examined

1 specimen.

Habitat

Thalassia testudinum.

Diagnosis

Cryptic coloration with *Sargassum* leaves. Body, cerata and rhinophores light brown with opaque white spots. Cerata curved. Rhinophores lamellated.

Distribution

Bahamas; Sargasso Sea (Valdés et al., 2006).

Family Dendrodorididae

Dendrodoris krebsii (Mörch, 1863)

Material examined

5 specimens.

Habitat

Under rocks and coral fragments.

Diagnosis

Body oval or elongate, lacking tubercles. Margin of the mantle ruffled. Color highly variable, from whitish with black and brown spots to black with lighter patches; greenish, reddish or grayish forms are common. Rhinophores and gill usually same color as rest of body, typically with white tips.

Distribution

United States (Georgia, Florida), Mexico (Quintana Roo), Belize, Honduras, Costa Rica, Panama, Colombia, Venezuela, Brazil; Bahamas, Greater Antilles (Cuba, Dominican Republic, Jamaica, Cayman Islands) and Lesser Antilles (Virgin Islands, St. Martin, Antigua, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Grenada, Aruba, Curaçao, Bonaire) (Redfern, 2001; Valdés et al., 2006).

Family Dorididae

Doris bovena Er. Marcus, 1955

Material examined

2 specimens.

Habitat

Under rocks.

Diagnosis

Dorsum with small rounded tubercles. Rhinophores with lamellae, retractable into small sheaths. Gill with up to 12 leaves. Body color yellowish-gray with brown patches over the dorsum.

Distribution

United States (Florida), Mexico (Yucatan), Honduras, Brazil; Lesser Antilles (Aruba, Curaçao) (Valdés et al., 2006; Ortigosa-Gutiérrez, 2009 as *D. cf. bovena*).

Family Dotidae

Doto pygmaea Bergh, 1871

Material examined

22 specimens.

Habitat

Sargassum sp.

Diagnosis

Body translucent gray with dark spots over the dorsum. Large cerata with club-shaped tubercles. Digestive gland red to white, penetrating the cerata.

Distribution

Bahamas, Cuba; Sargasso Sea (Valdés et al., 2006).

Doto* sp1Material examined*

1 specimen.

Habitat

Sargassum sp.

Diagnosis

Body translucent, almost transparent, with some opaque white dots on the tip of the tail. Digestive gland white, visible throughout the dorsum. Cerata rounded, arranged in three pairs (the second one less developed), covered by white tubercles. Rhinophores smooth with opaque white dots on the tip. Rhinophoral sheaths translucent with opaque white spots at the edge.

Comments

Valdés et al. (2006) recognized at least 14 species of *Doto* in the Caribbean Sea; however, the group requires additional studies due to disagreement among specialists on the identity of species.

Doto* sp2Material examined*

5 specimens.

Habitat

Sargassum sp.

Diagnosis

Body color brown to pink, dorsum white translucent with some opaque brown, blue and white spots. Digestive gland pale brown, penetrating the cerata. Five to seven pairs of translucent cerata with brown spots, some cerata with white dots. Rhinophores large and smooth with small white and blue spots clustered at the base. Rhinophoral sheaths absent.

Family Facelinidae

Learchis evelinae Edmunds & Just, 1983

Material examined

6 specimens.

Habitat

Thalassia testudinum.

Diagnosis

Body translucent clear orange with white marks on the dorsum. Distinctive orange patch or line on each side of the head, from the oral tentacle to the rhinophore. Oral tentacles color opaque white at the upper three quarters. Rhinophores smooth with a translucent band at the base, an orange middle region, and an opaque white upper part. Branches of the digestive gland reddish, visible through the translucent cerata.

Distribution

Belize; Lesser Antilles (Martinique, Barbados) (Valdés et al., 2006).

Phidiana lynceus Bergh, 1867*Material examined*

9 specimens.

Habitat

Under rocks and coral fragments.

Diagnosis

Color variable with a dorsal white or blue line entering the head and oral tentacles. Rhinophores and oral tentacles with an orange band. Cerata large with white tips. Rhinophores annulated.

Distribution

Circumtropical. Western Atlantic: United States (Florida), Mexico (Quintana Roo), Costa Rica, Panama, Colombia, Venezuela, Brazil; Bahamas, Greater Antilles (Jamaica), and Lesser Antilles (Virgin Islands, St. Martin, Guadeloupe, Martinique, St. Lucia, St. Vincent and the Grenadines, Barbados, Aruba, Curaçao, Bonaire). Eastern Atlantic: Ghana; Azores, Selvagens and Canary islands. Eastern Pacific: Panama (Marcus & Hughes, 1974; Redfern, 2001; Cervera et al., 2004; Valdés et al., 2006; Wirtz, 2009).

Family Polyceridae

Polycera herthae Ev. Marcus & Er. Marcus, 1963

Material examined

1 specimen.

Habitat

Under rocks.

Diagnosis

Conical papillae in both sides of the body. Velum bearing eight to 10 slim appendages, white and yellow. Gill over the dorsal hump, composed of five leaves, the larger tripinnate. Two large knobs, one in the midline in front of the gills and the other on the notal ridge. Color variable, from pale to dark gray, with brown shades.

Distribution

United States (Florida), Costa Rica; Bahamas, Greater Antilles (Cuba), and Lesser Antilles (Antigua, Curaçao) (Redfern, 2001; Valdés et al., 2006).

Family Scyllaeidae***Scyllaea pelagica* Linnaeus, 1758***Material examined*

62 specimens.

Habitat

Sargassum sp.

Diagnosis

Body irregular in outline resembling the *Sargassum* leaves. Body color yellowish with brown and white patches. Two pairs of lateral lobes with fine dendritic gills on their inner surface and on the dorsum. A flattened vertical crest at the posterior end of the body. Rhinophoral sheaths broad and flattened.

Distribution

Cosmopolitan, including Antarctica. Western Atlantic: United States (Massachusetts, North Carolina, Georgia, Florida, Texas), Costa Rica; Bermudas, Bahamas, Lesser Antilles (Bonaire). Eastern Atlantic: southern Britain, Gulf of Biscay, western Portugal and Mediterranean Sea; Azores. Indo-Pacific: from Chagos Archipelago, Japan, and Papua New Guinea to Australia (Thompson & Brown, 1981; Redfern, 2001; Yonow et al., 2002; Cervera et al., 2004; Burn, 2006; Valdés et al., 2006; Gosliner et al., 2008; Poursanidis et al., 2009).

Family Tritoniidae***Tritonia bayeri* Ev. Marcus & Er. Marcus, 1967***Material examined*

1 specimen.

Habitat

Under coral fragments.

Diagnosis

Translucent gray color with a conspicuous white reticulate network. Oral veil with four long finger-like appendages. Cerata small and branched.

Distribution

United States (Georgia, Florida), Belize, Honduras; Greater Antilles (Cayman Islands), and Lesser Antilles (Virgin Islands, Guadeloupe, Barbados) (Valdés et al., 2006).

Discussion

This is the first study about the opisthobranch fauna from the National Park Arrecife Alacranes, the major coral reef system in the southern Gulf of Mexico. A number of molluscan studies have been carried out in Mexican Atlantic waters (Vokes & Vokes, 1983; Hicks et al., 2001); however, most of them address large, easily sampled or economically important species (Pérez-Pérez & Aldana-Aranda, 2003). In the molluscan taxonomic lists, only a minimal percentage corresponds to the opisthobranchs, which are mostly registered as associated fauna (Zamora-Silva & Naranjo-García, 2008). Due to the inherent difficulties in sampling this kind of animals, their small size, the nocturnal behavior or cryptic habits of many species and the need of *in situ* identifications in most cases, the studies targeting sea slugs are highly relevant in the study of the aquatic communities' biodiversity.

The most diverse order was the Nudibranchia, represented by eight families and 13 species (Table 1). Nudibranchs are free-living animals inhabiting a variety of habitats, even the plankton and neuston, and their diet includes a wide spectrum of food items, such as sponges, bryozoans, crustaceans, gorgonians, colonial ascidians and other small mollusks (McDonald & Nybakken, 1999; Wägele & Willan, 2000). The variety of habitats and feeding resources may account for their biodiversity.

The species *Elysia crispata*, *E. tuca*, *Aplysia dactylomela*, *Phyllaplysia engeli* and *Phidiana lynceus* were recorded during the three sampling periods, suggesting that they are common in the study area. Valdés et al. (2006) also found these species widely distributed in tropical waters of the western Atlantic coast, from Florida to Brazil, including the Greater and Lesser Antilles. Excepting the nudibranch *P. lynceus*, these are herbivorous species, the aplysiids inhabiting and feeding upon a variety of algae (Valdés et al., 2006). Also, Clark (1994) registered *E. crispata* and *E. tuca* as common species over a large number of habitats. A successfully ecological adaptation to the environment of the *Elysia* species is the 'kleptoplasty'. This phenomenon consists in the incorporation of chloroplasts from algae in the animals' digestive cells through phagocytosis (Clark et

al., 1990). Particularly, *E. crispata* is able to keep these chloroplasts photosynthetically active for more than a week, thus providing extra energy at the primary level of their metabolism to compensate for limited feeding resources (Clark et al., 1990; Giménez-Casalduero & Muniain, 2008).

Some species, such as *Elysia* cf. *timida*, *Ercolania* cf. *coerulea*, *Polycera herthae*, *Aeolidiella stephanieae*, *Spurilla sargassicola*, *Doto pygmaea* and *Learchis evelinae*, were registered in one season only (Table 1) with few specimens. In the same way, Valdés et al. (2006) also found these species with low records in the western Atlantic, indicating that they are species with low frequency in the area. Moreover, the geographical range of *S. sargassicola* is here extended southward, and that of *L. evelinae* northward. In previous studies, *S. sargassicola* was recorded in the Bahamas and the Sargasso Sea, and *L. evelinae* in Belize, Martinique and Barbados (Valdés et al., 2006).

In this study, 32 species were recorded in the coral reef protected area of the NPAA. In the northern coast of the Yucatan peninsula, Ortigosa-Gutiérrez (2009) reported 41 sea slug species, from which only 14 are the same as in the NPAA. Over 17 years of field work covering nearly all the Caribbean islands and the tropical coast of America from Florida to Brazil, Valdés et al. (2006) recognized nearly 250 opisthobranch species. In accordance with Roberts et al. (2003), understanding how well the marine protected areas represent the diversity of species within the biogeographic regions where they occur can be a useful tool to implement programs for conservation and to identify gaps in the protection of those species. To be sure, the number of species registered here is certainly an underestimation of the total number of species in the area, but this study represents the first step in the knowledge of the opisthobranch fauna in Alacranes reef. Further studies are needed in the area to complement our knowledge of the biodiversity in the NPAA and to provide additional support for the protection of vulnerable species in this marine national park.

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