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ARTÍCULO ORIGINAL

SOFT CORALS (ANTHOZOA: CORALLIMORPHARIA, ACTINARIA AND ZOANTHARIA) FROM SOUTHEASTERN OF CUBA, AND ITS DISTRIBUTION IN MARINE PROTECTED AREAS

Corales blandos (Anthozoa: Corallimorpharia, Actinaria y Zoantharia) del suroriente de Cuba y su distribución en Áreas Marinas Protegidas

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ABSTRACT

The Caribbean cnidarians are well studied, mainly the builders of reefs (Scleractinea). Cuban marine biodiversity is representative of the Caribbean Sea. However, many localities remain understudied to this moment. In this work, we present the checklist of 22 species of soft corals from the southeastern coast of Cuba. The specimens were collected or observed in shallow waters up to 25 m depth, in 11 localities in Granma, Santiago de Cuba and Guantánamo provinces. The studied ecosystems include rocky, sandy and muddy bottoms, coral reefs, seagrass and mangroves. The number of recorded species of soft corals in the southeastern coast represent the highest richness in the Cuban platform. *Bunodosoma cavernatum* is a new record to Cuba. Eighteen species are represented in Marine Protected Areas. It is necessary to assess the conservation status of the populations of these animals, and their use for monitoring the status of MPAs.

KEY WORDS: anemones, *Bunodosoma*, Caribbean Sea, Cnidaria, coral reef

RESUMEN

Los cnidarios del Caribe están bien estudiados, en mayoría los formadores de arrecifes (Scleractinea). La biodiversidad marina cubana es representativa del Mar Caribe. No obstante, muchas localidades no han sido suficientemente estudiadas hasta el momento. En este trabajo se presenta la lista de 22 especies de corales blandos de la costa suroriental de Cuba. Los especímenes fueron recolectados u observados en aguas someras hasta 25 m de profundidad, en 11 localidades de las provincias Granma, Santiago de Cuba y Guantánamo. Los ecosistemas estudiados incluyeron los fondos rocosos, arenosos y fangosos, arrecifes coralinos, praderas de angiospermas y manglares. El número de especies de corales blandos registrado en la costa suroriental representa la mayor riqueza en la plataforma cubana. Bunodosoma cavernatum *es un nuevo registro para Cuba. En las Áreas Marinas Protegidas están representadas 18 especies. Es necesario evaluar el estado de conservación de las poblaciones de estos organismos y su uso para monitorear el estado de las AMP.*

PALABRAS CLAVE: *anémonas,* Bunodosoma*, Mar Caribe, Cnidaria, arrecife coralino*

INTRODUCTION

In the last 10 years, a number of researches in the eastern coasts of Cuba has been conducted, supervised by the Universidad de Oriente and the Centro Oriental de Ecosistemas y Biodiversidad (BIOECO). These studies included microalgae (*e.g.*, Gómez *et al*., 2001), macroalgae (*e.g.*, Jover y Lake, 2008; Jover *et al*., 2012; Diez *et al*., 2013), gorgonians (*e.g.*, Olivera *et al*., 2010a, 2010b), molluscs (*e.g.*, Espinosa *et al*., 2012; Diez y Jover, 2013b), and other invertebrates (*e.g.*, Gómez *et al*., 2009; Diez, 2013; Diez y Jover 2013a). The phylum Cnidaria is one of the best represented in tropical seas (Calder, 2013; Fautin *et al*., 2013; Fernandez *et al*., 2014), mainly corals have been studied (Scleractinea) (*e.g.*, Anderson and Pratech, 2014; Edmunds and Wall, 2014; Palumbi *et al*., 2014).

Anthozoa includes the soft corals (sea anemones *sensu latus*), divided in four orders: Actinaria, Ceriantharia, Corallimorpharia and Zoanthidea, all represented in Cuba. Actinaria contains the highest richness (1,120 species), followed by Zoanthidea (169), Ceriantharia (141), and Corallimorpharia (46) (Crowther, 2011). Since the 80s, numerous papers cite this group in Cuban waters (Herrera, 1981; Varela *et al*., 2001, 2002; Varela, 2002; Pérez-Hernández y Varela, 2003). Recently, Ocaña *et al*. (2007) presented the illustrated catalogue of anemones from Península de Guanahacabibes. The checklist of sea anemones in Cuba includes 33 species: 19 actinarians, 5 corallimorphs, 8 zoanthids, and 1 ceriantharia. In addition to the systematics studies, Rodríguez *et al*. (2012, 2014) investigated the biochemist properties of Cuban anemones. In the eastern platform of Cuba, no studies have been conducted on richness and composition of soft corals. The representativeness of this group has not been considered for conservation purposes in the Marine Protected Areas (MPAs) of the Caribbean region.

In this paper, we present the checklist of the soft corals of the southeastern coast of Cuba, and its distribution in the MPAs of this region.

MATERIALS AND METHODS

Observations and collections of specimens were done in the southeastern coast of Cuba during 2013-2014. One locality was studied in Granma province: National Park Desembarco del Granma, eigth in Santiago de Cuba: Mar Verde, Fauna Refuge San Miguel de Parada, Aguadores, Sardinero and Siboney in the Ecological Reserve Siboney-Juticí, Natural Reserve El Retiro, Cazonal, and Baconao, and two in Guantánamo: Natural Prominent Element Caleta and Ecologic Reserve Maisí (Fig. 1). Maisí and Caleta are considered as one locality because there are continuous small areas.

We collected the specimens from intertidal zone up to 25 m depth, in rocky, sandy and muddy bottoms, seagrasses, mangroves and coral reefs. The specimens were photographed in the laboratory for identification and preserved in alcohol (70%). Some specimens from the coral reefs were identified *in situ*. Specimens were collected during snorkeling or SCUBA diving, using a hammer and chisel, and were deposited in the zoological collection at Tomás Romay Museum of BIOECO (TRM). To the identification, we used the literature of the group in the Caribbean Sea (Humann, 2003; González-Muñoz *et al*., 2013, 2016) and Cuba (Varela *et al*., 2001, 2002; Varela, 2002; Ocaña *et al*., 2007). The checklist has been arranged according to Daly *et al*. (2007).

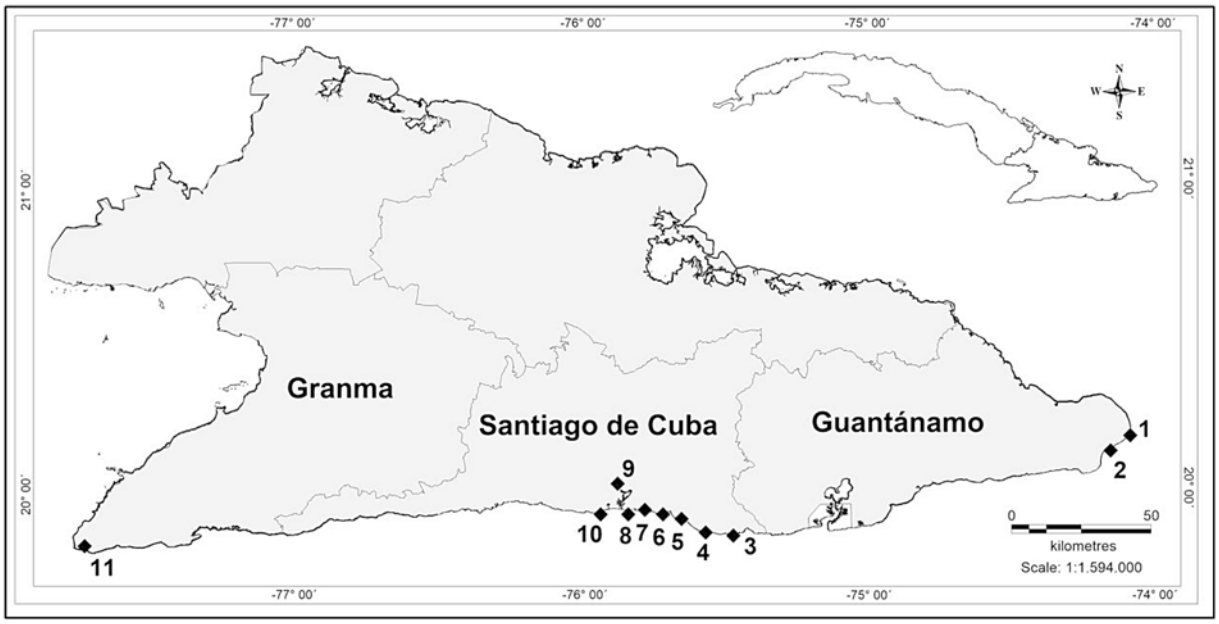


Fig. 1. Map of localities and Marine Protected Areas studied in the southeastem coast of Cuba. 1: Ecologic Reserve Maisí, 2: Natural Prominent Element Caleta, 3: Baconao, 4: Cazonal, 5: Natural Reserve El Retiro, 6: Siboney, 7: Sardinero, 8: Aguadores, 9: Fauna Refuge San Miguel de Parada, 10: Mar Verde and 11: National Park Desembarco del Granma.

RESULTS

List of species

Class Anthozoa Ehrenberg, 1834

Subclass Hexacorallia Haeckel, 1866

Order Actiniaria Hertwig, 1882

Family Actiniidae Rafinesque, 1815

Genus *Anemonia* Risso, 1826

Anemonia sargassiensis Hargitt, 1908 (Fig. 2)

Examined material: Seven specimens collected in San Miguel de Parada.

Habitat: Under rocks in shallow waters.

Genus *Anthopleura* Duchassaing de Fonbressin & Michelotti, 1860

Anthopleura krebsi Duchassaing de Fonbressin & Michelotti, 1860 (Figs. 3-4)

Examined material: Four specimens collected in Aguadores (October 2013) and San Miguel de Parada (December 14, 2013).

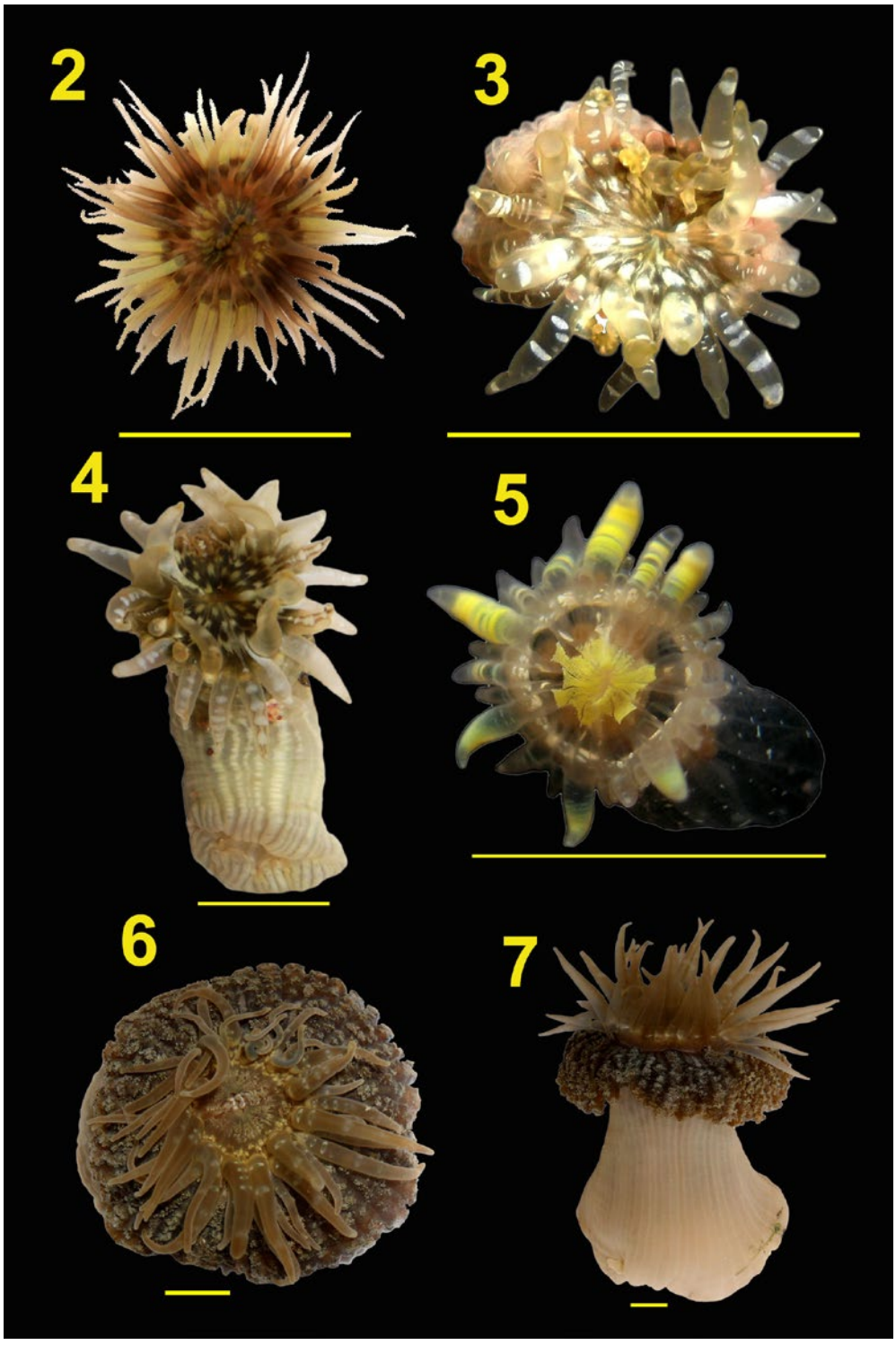
Habitat: Under rocks in shallow waters.

Genus *Bunodosoma* Le Sueur, 1817

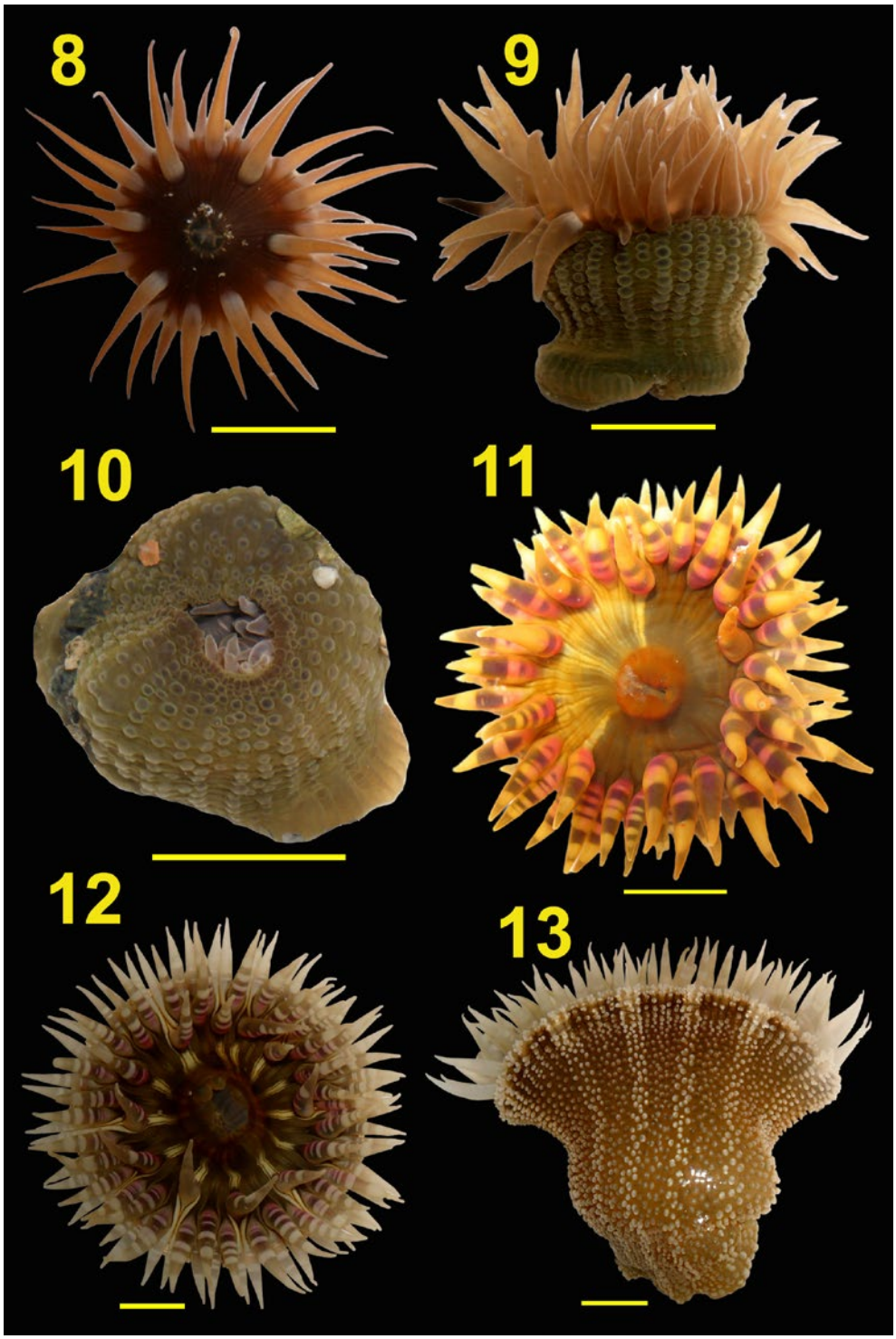
Bunodosoma cavernatum (Bosc, 1802) (Figs. 8-10)

Examined material: Four specimens collected in Siboney (east side of the beach) (January 18, 2014), first record in Cuba. Voucher material in TRM.

Identification: The oral disc of the biggest specimen collected was about 2 cm in diameter, and 4.5 cm in full-expanded oral disc and tentacles. Tentacles hexamerously arranged in five cycles, smooth, simple, conical, reddish or pale-orange, often with white spots. Forty-eight endocoelic rounded marginal projections forming acrorhagi with holotrichs and basitrichs. Column cylindrical, 1.5 cm in height, densely covered with rounded vesicles, arranged in longitudinal rows. Column and pedal disc light brown or olive-green. This species is differentiated of *B. granulifera* by



Figs. 2-7. Soft corals from Cuban southeastern platform. 2: *Anemonia sargassiensis*, 3–4: *Anthopleura krebsi* (3: young specimen in oral view and 4: adult specimen un lateral view), 5: *Isoaulactinia stelloides* (young specimen) and 6–7: *Phyllactis flosculifera* (6: specimen in oral view and 7: specimen in lateral view). Each bar equal 1 cm.



Figs. 8-13. Soft corals from Cuban southeastern platform. 8-10: *Bunodosoma cavernatum* (8: specimen in oral view, 9: specimen in lateral view and 10: specimen in oral view hiding the tentacles) and 11-13: *Bunodosoma granulifera* (11: oral view of a very purple colored specimen from Siboney, 12: oral view of an opaque colored specimen from Aguadores and 13: specimen in lateral view showing the alternate stripes of the column). Each bar equal 1 cm.

the general coloration of tentacles and column, and the arrangement of vesicles in longitudinal rows. In *B. granulifera*, tentacles are white, pink and yellow spotted, about 12 by cycle; the column is yellow-brown with the vesicles white, yellow or brown-yellow, alternating pale and dark longitudinal bands; longitudinal rows are more numerously.

Habitat: Under rocks on sandy bottoms, shallow waters between 0.2 m up to 1 m depth, estuarine area with detritus.

Distribution: In the Western Atlantic: North Caroline to Barbados, along the Caribbean Sea and Gulf of Mexico, in Veracruz Reef System, Mexico, Venezuela. Pacific Ocean: Caroline Islands, Micronesia (González-Muñoz *et al*., 2013, 2016).

Bunodosoma granulifera (Le Sueur, 1817) (Figs. 11-13)

Examined material: Eight specimens collected in Santiago de Cuba coast, between Mar Verde and Baconao, two specimens collected in Maisí-Caleta.

Habitat: Rocky and rocky-sandy bottoms, in corallines and estuarine areas.

Genus *Condylactis* Verril, 1899

Condylactis gigantea (Weinland, 1860)

Examined material: Many specimens observed in all littoral of Granma, Santiago de Cuba, and Guantánamo.

Habitat: Coral reefs, rocky and rocky-sandy bottoms, in seagrasses.

Genus *Isoaulactinia Belém,* Herrera-Moreno & Schlenz, 1996

Isoaulactinia stelloides (McMurrich, 1889) (Fig. 5)

Examined material: A specimen collected in Aguadores (October 2013).

Habitat: Rocky bottoms, under rocks in shallow waters.

Genus *Phyllactis* Milne Edwards & Haime, 1851

Phyllactis flosculifera (Le Sueur, 1817) (Figs. 6-7)

Examined material: A specimen collected in Aguadores (March 13, 2014) and many observed in Sardinero and Maisí-Caleta.

Habitat: Sandy and sandy-muddy bottoms, angiosperms prairies, estuarine areas and in the mouth of rivers.

Genus *Pseudactinia* Carlgren, 1928

Pseudactinia melanaster (Verrill, 1901) (Figs. 14-16)

Examined material: Five specimens collected in Siboney.

Habitat: Mesolittoral rocky shore pools, with strong waves.

Family Aliciidae Duerden, 1895

Genus *Lebrunia* Duchassaing & Michelotti, 1860

Lebrunia danae (Duchassaing de Fonbressin & Michelotti, 1860) (Fig. 17)

Examined material: A specimen collected, and many observed in Aguadores (March 13, 2014).

Habitat: Rocky and corallines bottoms.

Genus *Bartholomea* Duchassaing & Michelotti, 1864

Bartholomea annulata (Le Sueur, 1817)

Examined material: Two specimens collected in Sardinero and one in Mar Verde, many specimens observed in Aguadores, Siboney, Verraco, Natural Reserve Maisí-Caleta, and the National Park Desembarco del Granma.

Habitat: Rocky bottoms and in mangroves roots.

Genus *Heteractis* Duchassaing & Michelotti, 1864

Heteractis lucida (Duchassaing & Michelotti, 1860)

Examined material: Many specimens observed in Maisí-Caleta.

Habitat: Rocky and coral reefs.

Family Aiptasiidae Carlgren, 1924

Figs. 14-19. Soft corals from Cuban southeastern platform. 14–16: *Pseudactinia melanaster* (14: two specimens in oral view and 15–16: different specimens in oral view hiding the tentacles), 17: *Lebrunia danae* (oral view of a young specimen) and 18–19: *Aiptasia pallida* (18: specimen in oral view and 19: specimen in lateral view). Each bar equal 1 cm.

Genus *Aiptasia* Gosse, 1858

Aiptasia pallida (Agassiz in Verril, 1864) (Figs. 18-19)

Examined material: Five specimens collected in San Miguel de Parada.

Habitat: Rocky bottoms and in mangroves roots, very common on estuarine areas.

Family Capneidae Gosse, 1860

Genus *Actinoporus* Duchassaing, 1850

Actinoporus elegans Duchassaing, 1850

Examined material: Many specimens observed in coral reef areas in Siboney-Juticí.

Habitat: Rocky bottoms and coral reef.

Family Phymanthidae Andres, 1883

Genus *Phymanthus* Milne Edwards, 1857

Phymanthus crucifer (Le Sueur, 1817) (Figs. 20-24)

Examined material: A juvenile collected in Mar Verde (September 2013), and three specimens in Aguadores (February 2014). Many specimens observed and identified *in situ* along the coast of Santiago de Cuba.

Habitat: Rocky and rocky-sandy bottoms, and coral reefs.

Family Stichodactylidae Andres, 1883

Genus *Stichodactyla* Brandt, 1835

Stichodactyla helianthus (Ellis, 1768)

Examined material: A specimen collected in Baconao, many specimens observed along the littoral of Santiago de Cuba and Guantánamo.

Habitat: Rocky bottoms and coral reefs, shallow waters, in intertidal pools.

Order Corallimorpharia Carlgren, 1940

Family Discosomatidae Duchassaing & Michelotti, 1864

Genus *Discosoma* Rüppell & Leuckart, 1828

Discosoma carlgreni (Watlz, 1922)

Examined material: Many specimens observed in Cazonal and Desembarco del Granma.

Habitat: Rocky bottoms and coral reefs.

Discosoma sanctithomae (Duchassaing & Michelotti, 1860)

Examined material: Many specimens observed in Maisí-Caleta.

Habitat: Rocky bottoms and coral reefs.

Family Ricordeidae Watzl, 1922

Genus *Ricordea* Duchassaing & Michelotti, 1860

Ricordea florida Duchassaing & Michelotti, 1860

Examined material: Many specimens observed in El Retiro and Maisí-Caleta.

Habitat: Rocky bottoms and coral reefs.

Order Zoanthidea

Family Sphenopidae Hertwig, 1882

Palythoa caribaeorum (Duchassaing & Michelotti, 1860)

Examined material: Many colonies observed in Desembarco del Granma, Siboney, Cazonal and Maisí-Caleta.

Habitat: Rocky bottoms and coral reefs.

Pa1ythoa grandis (Verrill, 1898)

Examined material: Many colonies observed in Aguadores.

Habitat: Rocky bottoms and coral reefs.

Family Zoanthidae Rafinesque, 1815

Genus *Zoanthus* Lamoroux, 1816

Zoanthus pulchellus Duchassaing & Michelotti, 1863 (Fig. 25)

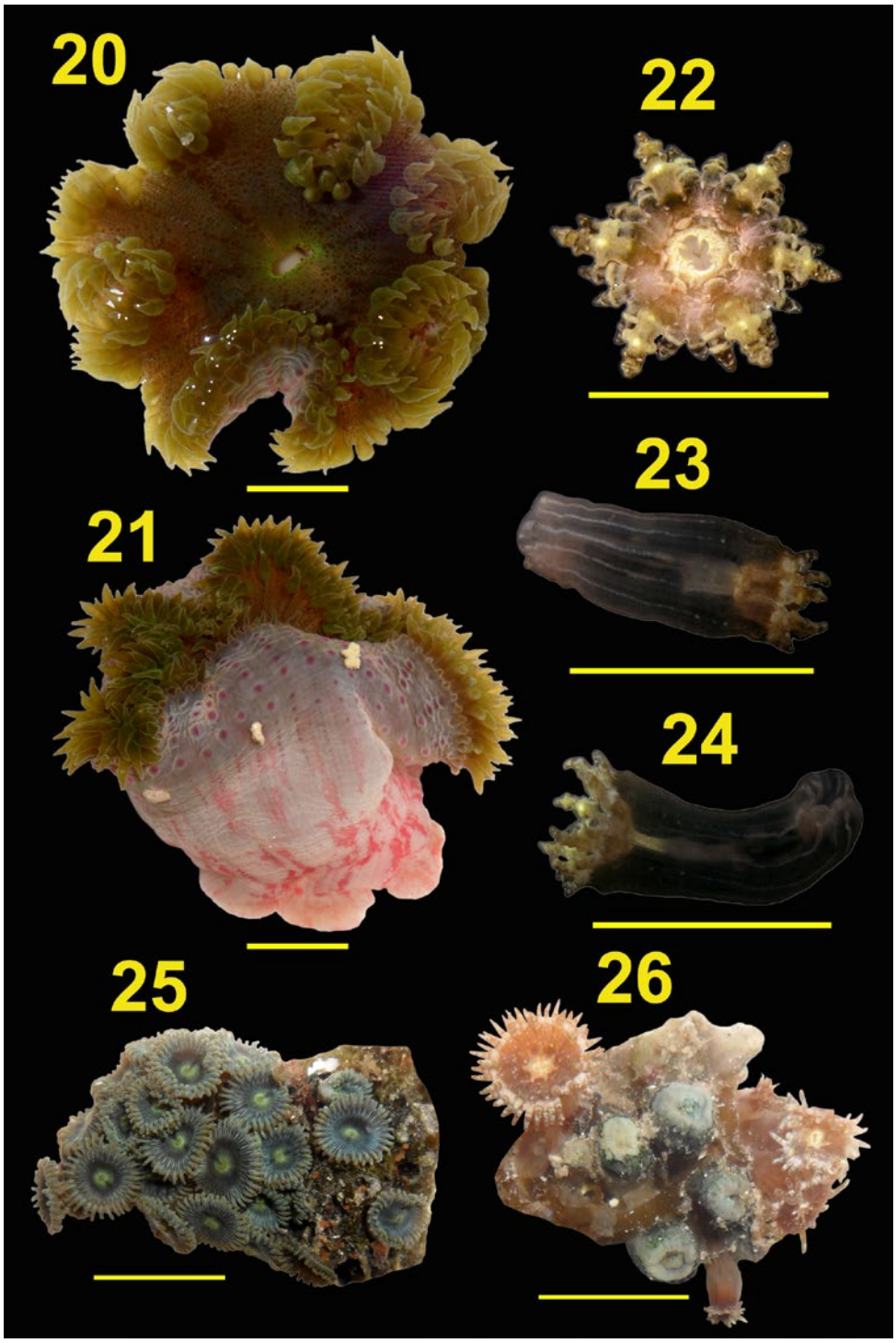
Examined material: A colony collected in Aguadores (March 13, 2014), many colonies observed in Siboney and El Retiro.

Habitat: Rocky bottoms and coral reefs.

Zoanthus sociatus (Ellis & Solander, 1786) (Fig. 26)

Examined material: A colony collected in Aguadores, associated to *Z. pulchellus* colonies (March 13, 2014). A colony collected in the Maisí-Caleta. Many colonies observed in Desembarco del Granma.

Habitat: Rocky bottoms and coral reefs.



Figs. 20-26. Soft corals from Cuban southeastern platform. 20–24: *Phymanthus crucifer* (20: adult specimen in oral view, 21: adult specimen in lateral view, 22: young specimen in oral view and 23–24: young specimen in lateral view), 25: a colony of *Zoanthus pulchellus* and 26: a colony of *Zoanthus sociatus* embedded in a colony of *Z. pulchellus*. The bars in the figures 20, 21, 25 and 26 equal 1 cm, in 22–24 equal 0.3 cm.

Distribution in Marine Protected Areas

Six Protected Areas with marine sectors are in the southeastern platform of Cuba, all represented in this inventory. Eighteen of the 22 recorded species, occurring in the MPAs (Table 1), except *Anthopleura krebsi*, *Bunodosoma cavernatum, Isoaulactinia stelloides*, and *Palythoa grandis*. The highest species richness was found in Siboney-Juticí and Maisí-Caleta (11 species), and the lowest in Desembarco del Granma and San Miguel de Parada (4 and 3 species respectively).

DISCUSSION

The 22 species of anemones found in the southeastern coast represent the 67% of the 33 consigned in Cuban (Varela, 2002; Varela *et al*., 2002; Pérez-Hernández y Varela, 2003). The fauna of anemones best known in the Cuban archipelago to this moment is from Península de Guanahacabibes (western end of the main island), with 20 species (Ocaña *et al*., 2007), exceeded in this inventory. The high species richness of the group on the southeastern coast follows the pattern of other groups such as molluscs (Diez y Jover, 2013b) and algae (Diez *et al*., 2013).

Other species of anemones recorded from Cuba are *Lebrunia coralligens* (Wilson, 1890), *Bunodeopsis globulifera* (Duchassaing & Michelotti), *Homosticanthus duerdeni* Carlgren, 1900, *Calliactis tricolor* (Lesueur,

Table 1. Distribution of the Cuban soft corals (Anthozoa: Corallimorpharia, Actinaria and Zoanthidea) in Marine Protected Areas of the southeastern coast.

	Marine Protected Areas				
Species	Desembarco del Granma	San Miguel de Parada	Siboney-Juticí	El Retiro	Maisí-Caleta
Ricordea florida				x	x
Discosoma carlgreni					x
Discosoma sanctithomae					x
Anemonia sargassiensis		x			
Bunodosoma granulifera	x	x	x	x	x
Condylactis gigantea			x	x	x
Phyllactis flosculifera			x	x	x
Pseudactinia melanaster			x		
Lebrunia danae			x		
Aiptasia pallida		x			
Bartholomea annulata	x		x		x
Heteractis lucida					x
Actinoporus elegans			x		
Phymanthus crucifer			x	x	
Stichodactyla helianthus			x	x	x
Palythoa caribaeorum	x		x		x
Zoanthus pulchellus			x	x	
Zoanthus sociatus	x				x

1817), *Telmatactis cricoides* (Duchassaing, 1850), *Pseudocorynactis caribaeorum* Hartog, 1980, *Discosoma neglecta* (Duchassaing & Michelotti, 1860), *Parazoanthus parasiticus* (Duchassaing & Michellotti, 1859), *P. swiftii* (Duchassaing & Michelotti, 1860), *Isaurus tuberculatus* Gray, 1828, *Palythoa variabilis* (Duerden, 1898), and *Isarachnanthus maderensis* (Johnson, 1861).

The biodiversity of sea anemones in the Cuban southeastern coast is greater than in other localities of the Caribbean Sea. Herrera-Moreno and Betancourt (2002) reported 20 species from Hispaniola, all occurring in Dominican Republic and 13 from Haiti. The same trend occurs respect to the Caribbean coast of Costa Rica and Panama, from which 10 species have been reported (Acuña *et al*., 2013). González-Muñoz *et al*. (2013) reported 17 species of Actiniaria from southern Gulf of Mexico, greater richness than the 15 actinians considered in the present work. The Zoantharia are poorly inventoried in this study, whereas in the Caribbean Sea are reported 30 species (Acosta *et al*., 2005). This species number is very variable and is necessary a more thorough taxonomic revision. Recently, numerous zoanthids have been described in the Atlantic (Swain, 2009) and the Pacific (Philipp and Fautin, 2009).

The fauna of many MPAs in Cuba has been poorly inventoried, especially invertebrates. The majority of researches only consider scleractinean corals, molluscs and fishes (*e.g*., Pina-Amargós *et al*., 2012; Hernández-Fernández *et al*., 2013; Hernández-Fernández y Salvat-Torres, 2014). Although the highest species richness in the world are in others groups, these organisms are considered economically important for tourism and fisheries (Costello *et al*., 2010, Miloslavich *et al*., 2010). Sea anemones *sensu latus* include 1,476 valid species of the 6,142 Anthozoa (Crowther, 2011), and 1,300 of them are Scleractinea. This diversity is a reason to include anemones in the inventories and conservation programs of MPAs. Anemones are very well represented in studied MPAs and is necessary an evaluation of their population status and conservation.

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