

## Octocorals (Coelenterata: Anthozoa: Octocorallia) of Isla del Coco, Costa Rica

Odalisca Breedy<sup>1, 2</sup> & Jorge Cortés<sup>1</sup>

1. Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), Universidad de Costa Rica, San José 11501-2060, Costa Rica; odalisca@racsa.co.cr
2. Smithsonian Tropical Research Institute, PO Box 0843-03092, Balboa, Ancon, Republic of Panama.

Received 04-II-2008. Corrected 29-IV-2008. Accepted 11-VI-2008.

**Abstract:** The published literature on Isla del Coco (Cocos Island), Costa Rica reveals that until recent years the octocorals were among the least known marine invertebrates. Two of the three orders within the subclass Octocorallia, the Pennatulacea (sea pens) and Alcyonacea (soft corals, gorgonians and telestids) occur in Isla del Coco. From recent collections and research, the total octocorallian fauna presently accounts to three pennatulaceans, seven gorgonians, a soft coral, and one telestid. A sea pen, a telestid, and three of the gorgonians have been collected recently, and two of them are probably new species. The genus *Pacifigorgia* includes one species: *P. curta*, presently considered as endemic. There are two species of the genus *Leptogorgia*, one which presents a large distributional range along the Pacific coast of Costa Rica, *L. alba*, and another which is a new species only found in Isla del Coco and is yet to be described. Finally, an undescribed species related to the genus *Rhodelinda* was found attached to rodoliths. The other species cited in the literature, the gorgonian, *Psammogorgia variabilis*, and the pennatulacean, *Ptilosarcus undulatus*, need to be corroborated since we have not found them yet. Other species, including alcyoniids (soft corals), have been observed by submarine submersibles from 50 m down to 450 m. Some deep water species were collected during a Harbor Branch Oceanographic Institution expedition in 1986 with their research submersible the Johnson Sea Link, and four of them have been identified to genera. Several are expected to represent species new to science. Twelve species of octocorals are recorded here. *Rev. Biol. Trop.* 56 (Suppl. 2): 71-77. Epub 2008 August 29.

**Key words:** Isla del Coco, Cocos Island, Costa Rica, eastern Pacific, octocorals, gorgonians, soft corals, Octocorallia.

Oceanic islands have fascinated explorers and scientists since the earliest times because of their spectacular geological settings and the extravagant and exotic life forms found there. Isla del Coco, Costa Rica, is one of the oceanic islands in the eastern tropical Pacific. The marine faunas of these islands have been the subject of scientific interest especially for the biogeographic relevance (e.g. dispersal patterns, endemism) and biodiversity. Islands are bounded ecosystems and serve as excellent laboratories for assessing changes in community structure and biodiversity (Sadler 1999), and evolutionary tendencies might be understood through comparisons to the mainland faunas (Quammen 1996).

Isla del Coco has been the target of numerous expeditions to explore the island's species richness (Cortés 2008); nevertheless the octocorals were virtually unknown until recent years. This paper summarises the present knowledge of the octocoral fauna at Isla del Coco, showing both achievements and needs in this field to be considered in future comprehensive biodiversity studies.

**Characteristics of octocorals:** Octocorals, known as soft corals, sea fans and sea pens are sedentary, mostly colonial marine animals. Octocorals belong to the anthozoan subclass Octocorallia; which is comprised of colonies of

polyps that bear eight tentacles, almost always pinnate, and eight mesenteries in the gastro-vascular cavity. The colonies present skeletal elements of calcium carbonate, called sclerites, embedded in their tissue. Many taxa also have proteinaceous and calcified axial skeletons.

Octocorallia is composed of three orders: Helioporacea (blue coral), Pennatulacea (sea pens), and Alcyonacea (soft corals, gorgonians and telestids) (Fabricius & Alderslade 2000, Daly *et al.* 2007). Pennatulaceans and alcyonaceans are found in Isla del Coco. Their diversity and abundance is at present being studied.

The pennatulaceans are colonies that show bilateral symmetry and polyp dimorphism. They are formed by a very large polyp called the oozoid, on the wall of which the coenenchyme spreads with numerous small (secondary) polyps; the large primary polyp may be additionally supported by a horny or calcium carbonate axis. Part of the oozoid forms the peduncle that anchors the colony in sand or soft substrates. The other part of the oozoid forms the rachis, which bears other kinds of polyps: autozooids and siphonozooids. In some species the emergent part looks like a feather (thus the name sea pens) (Williams 1990, Fabricius & Alderslade 2000).

The alcyonaceans include the soft corals in the group Alcyoniina, stoloniferous octocorals in the group Stolonifera and the gorgonians in the suborder Holaxonia. Alcyonians (soft corals) form fleshy colonies characterized by having polyps aggregated or concentrated into polyparies. An internal medulla or axis is absent and the polyps are embedded into a soft coenenchymal tissue, which may or may not contain sclerites (Williams 1992).

Stolonifera include a group of octocorals that consist of individual tubular polyps that arise separately from ribbon-like stolons. They present a series of transitional forms, from those where the polyps are not united to those where they are joined at their bases in a common coenenchyme (Williams 1993, Fabricius & Alderslade 2000).

Gorgonians include sea rods, sea whips, sea candelabra, sea feather plumes, and sea

fans. They present very diverse growth forms: incrusting colonies, upright fans, bushes with slender branches, and simple whips. Gorgonian colonies have a central axial skeletons composed of a collagenous matrix, called gorgonin, and calcifications within the collagen interstitial spaces (Jeyasuria & Lewis 1987). A layer of coenenchyme with sclerites and polyps surrounds it.

Species of octocorals are identified according to colony and sclerite morphology. A combination of characteristics of the colony: branching pattern, color and shape, and of the sclerites: sizes, colors, forms and abundance of the different types of sclerites in the samples, determine the species. Even though these characteristics can be modified by the environment, they are sufficiently consistent to diagnose a species (Breedy & Guzman 2003, 2007).

Bayer (1981) estimated that there are 3,000 valid species of octocorals worldwide, although new species and even genera continue to be described at a rapid rate. In the Isla del Coco three shallow water (<50 m) octocoral species, and one from deep waters have been reported in the literature and eight more are reported herein (Table 1).

**Octocoral diversity:** The first octocoral report for Isla del Coco came from the collection gathered by dredging during the “*Albatross Expedition*” in 1891 (Studer 1894), the plexaurid (gorgonian octocoral) species *Psammogorgia variabilis* Studer, 1894, that was described with two specimens from localities around the island at 95 and 183 m in depth. Deichmann (1941) mentioned that Studer’s specimens in some way fitted *Muricea galapagensis* Deichmann, 1941, but she could not find the specimens to corroborate the identification. Beebe (1926) mentioned a big purple sea fan in his book, which does not match anything seen recently in the island. As a matter of fact, with the exception of *L. alba*, the octocoral species presently recorded for Isla del Coco do not reach more than 5 cm in height. However, it is interesting to notice that in some other time, less than a century ago, the octocoral

TABLE 1

*Octocorals known from Isla del Coco: \* = new records (this publication), \*\* = deep-water species >50 m*

Subclass Octocorallia	
Order Pennatulacea	
Family Pennatulidae	
<i>Ptilosarcus longate</i> (Verrill, 1865)	
Family Virgulariidae	
<i>Stylatula cf. longate</i> (Gabb, 1862)*	
<i>Stylatula</i> sp.*	
Order Alcyonacea	
Alcyoniina group	
Family Alcyoniidae	
<i>Anthomastus</i> sp. *. **	
Suborder Holaxonia	
Family Gorgoniidae	
<i>Pacificorgia curta</i> Breedy & Guzman, 2003	
<i>Leptogorgia alba</i> (Duchassaing & Michelotti, 1864)	
<i>Leptogorgia</i> sp. (a new species)*	
Family Plexauridae	
<i>Psammogorgia variabilis</i> Studer, 1894**	
<i>Paramuricea</i> sp. *. **	
Suborder Calcaxonia	
Family Isididae	
<i>Isidella</i> sp. *. **	
Family Primmoidae	
<i>Narella</i> sp. *. **	
Stolonifera group	
Family Clavulariidae	
<i>Rhodelinda</i> sp.*	

fauna could have been different. Bakus (1975) reported the occurrence of *L. alba* in small patches from 9 to 30 m deep.

The sea pen (pennatulacean octocoral), *Ptilosarcus* “*guerneyi*” Boone, 1933 (not *P. guerneyi* Gray, 1860) was mentioned from shallow waters (as a footnote in Deichmann 1941). This was later identified by Deichmann (1941) as *Ptilosarcus undulatus* (Verrill, 1865). Deichmann did not have access to Boone’s specimen from Isla del Coco but she assumes the record as valid. Cortés (1996-1997) based on published accounts, listed two species, a pennatulid and a gorgonian. Breedy and Guzman (2003, 2007) report the following records of gorgonians from shallow waters (12-40 m in depth): *Pacificorgia curta* Breedy & Guzman, 2003 (Fig. 1) and *Leptogorgia alba* (Duchassaing & Michelotti, 1864) (Fig. 2).

Two other species of pennatulids in the genus *Stylatula* were observed during the first (2006) and second (2007) “*Proteus*” expeditions (Cortés 2008). One was collected from 14 m deep, and identified as *Stylatula cf. elongata* (Gabb, 1862), and the other was just photographed (Fig. 3). A new species of gorgoniid in the genus *Leptogorgia* Milne Edwards & Haime, 1857 was collected during the “*Proteus*” expeditions, which is currently under study. Finally, a species of a genus related to *Rhodelinda* (stoloniferous octocoral) was collected by dredging (40-45 m in depth) and was found attached to rodoliths.

Deep water collections from the 1986 Expedition to the Galápagos Islands, Cocos Island, and Pearl Islands by the Harbor Branch Oceanographic Institution (HBOI) (Cortés 2008) contain a number of octocorals collected using the Johnson Sea Link research submersible. This collection will probably yield new records and new species. We include in Table 1 the genera that have been presently identified from fragments loaned by the HBOI.

A total of eight species of octocorals are presently reported for the island (Table 1), five were recently observed and collected by us from shallow waters, the other two come from other expeditions’ reports and one from deep water. But there are more species, including alcyoniids (Fig. 4), which have been observed and filmed from 50 m down to 450 m, though not collected, by submarine (Cortés & Blum 2008). Some of the images of those species are consistent to species collected by the HBOI cruise (Table 1). Several of them are expected to represent species new to science.

The occurrence and distribution of Isla del Coco species is shown in Table 2, but more exploration is required, thus this list constitutes a preliminary report. Currently, *Leptogorgia alba* is the species with the widest distribution around the island.

Studies of octocoral diversity at other eastern Pacific oceanic islands are scarce; the majority of research has been done in the Galápagos Islands (Studer 1894, Williams & Breedy 2004, Breedy & Guzman 2005, Breedy



Fig. 1. *Pacifigorgia curta*, Roca Sucia, 22 m deep. Photograph by Odalisca Breedy.

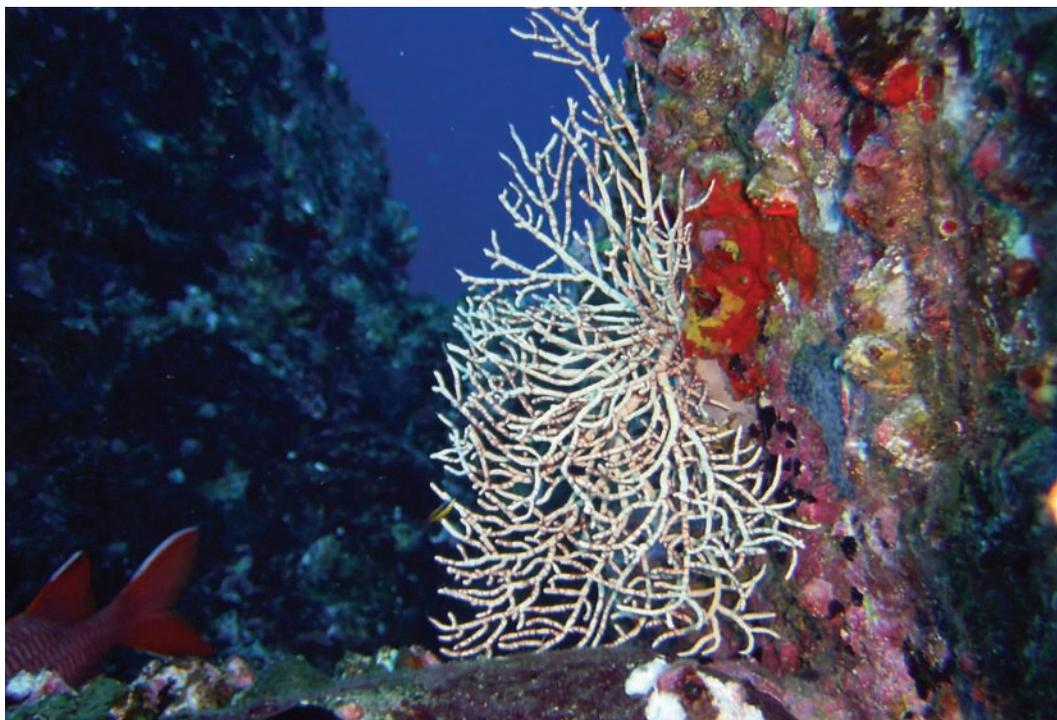


Fig. 2. *Leptogorgia alba*, Punta Maria, 20 m deep. Photograph by Odalisca Breedy.



Fig. 3. *Stylatula* sp., Bahía Wafer, 20 m deep. Photograph by Graham Edgar.



Fig. 4. *Anthomastus* sp., Orden Alcyonacea, Family Alcyoniidae (identified by Leen van Ofwegen, Leiden Museum, The Netherlands), north side of Isla del Coco, depth between 280 and 330 m. Photograph by UnderSea Hunter Group.

TABLE 2  
Distribution of octocoral species at Isla del Coco

Species	Sites	Depth (m)
<i>P. undulates</i>	unknown	>27
<i>Stylatula cf. elongata</i>	Bahía Wafer	14
<i>Stylatula</i> sp.	Bahía Wafer	20
<i>L. alba</i>	Manuelita, Islote Muela, Aleta de Tiburón, Punta Turrialba, Isla Cónica, Isla Pájara, Roca Sucia, Punta Maria	12-42
<i>Leptogorgia</i> sp. <sup>+</sup>	Manuelita, Roca Sucia	14-18
<i>P. curta</i> <sup>+</sup>	Islote Muela, Isla Pájara, Aleta de Tiburón, Roca Sucia, Punta Maria	12-25
<i>P. variabilis</i>	5°32.75'N, 86°55.03'W 5°31.58'N, 86°52.5'W	95-183
<i>Paramuricea</i> sp.	05°24.49'N, 87°09.83' W	755
<i>Anthomastus</i> sp.	1.5 NM from Punta Barreto, 05°33.42'N, 87°06.28' W	317
<i>Narella</i> sp.	05°34.60'N, 87°04.25' W	626
<i>Isidella</i> sp.	05°34.60'N, 87°04.25'W	607
<i>Rhodelinda</i> sp.	Punta Ulloa, Bahía Chatham	39-44

<sup>+</sup> = Reported only for Isla del Coco

*et al.* 2008) where the diversity and abundance of species is very high in comparison to Isla del Coco, even taking into account the larger extension of the Galápagos Islands. More studies are needed to enhance assessment of the diversity of octocorals in Isla del Coco, including deep water exploration, and also oceanographic and ecological research to determine reasons for diversity and abundance in shallow waters.

of soft corals and the telestid, Frederick Bayer (Smithsonian Natural History Museum) in the identification of the deep water octocoral collection. We thank John Reed (Harbor Branch Oceanographic Institution) for facilitating the samples of deep water octocorals in 1999, and Graham Edgar for the photograph in Figure 1, and the UnderSea Hunter Group for photograph in Figure 4.

#### ACKNOWLEDGMENTS

We are grateful to Gary Williams (California Academy of Sciences) and Stephen Cairns (Smithsonian Natural History Museum) for a critical review of the manuscript, to the Captain and crew of the RV *Proteus* for unconditional assistant and support in recent expeditions to Isla del Coco and to the MarViva Foundation. We thank Gary Williams for helping in the identification of pennatulids, Leen van Ofwegen (National Museum of Natural History Naturalis, Leiden) in the identification

#### RESUMEN

La literatura publicada sobre Isla del Coco, Costa Rica demuestra que los octocorales están dentro de los grupos de invertebrados marinos menos conocidos. Dentro de la subclase Octocorallia hay tres órdenes de los cuales dos se encuentran en la Isla del Coco: Pennatulacea (plumas de mar) y Alcyonacea (corales suaves, gorgonias y teléstidos). Con información obtenida de investigaciones y recolecciones recientes, la fauna de octocorales de la Isla del Coco incluye actualmente tres pennatuláceos, ocho gorgonias, un coral suave y un teléstido. De estos, un pennatuláceo, un teléstido y tres gorgonias han sido recolectados recientemente, y dos de ellos son, probablemente, especies nuevas. En el género *Pacifigorgia* hay una especie: *P. curta*, que hasta el momento se considera endémica. Hay dos especies

en el género *Leptogorgia*, una que tiene un amplio ámbito de distribución a lo largo de la costa pacífica de Costa Rica, *L. alba*, y otra que es una especie nueva que solo se ha encontrado en la Isla del Coco y está siendo estudiada. Finalmente, se ha encontrado una especie sin describir, relacionada con el género *Rhodelinda* que aparece adherida a rodolitos. Las otras especies que se citan en la literatura, la gorgonia, *Psammogorgia variabilis*, y el penatulaceo, *Ptilosarcus undulatus*, necesitan ser corroboradas ya que no han sido vistas ni recolectadas todavía. Otras especies, incluyendo alcionias (corales suaves), han sido observadas de 50 m a 450 m de profundidad por medio de inmersiones en submarinos y algunas muestras fueron recolectadas durante un crucero del Instituto Oceanográfico de Harbor Branch en 1986 con el sumergible Jonson Sea Link hasta unos 700 m de profundidad. De estas se han identificado cuatro géneros, dentro de los cuales se espera que se incluyan algunas especies nuevas para la ciencia.

**Palabras clave:** Isla del Coco, Costa Rica, Pacífico oriental, octocorales, gorgonias, corales suaves, Octocorallia.

## REFERENCES

- Bakus, G.J. 1975. Marine zonation and ecology of Cocos Island, off Central America. *Atoll Res. Bull.* 179: 1-11.
- Bayer, F.M. 1981. Status of Knowledge of Octocorals of World Seas. Seminários de Biologia Marinha, Academia Brasileira de Ciências, Rio de Janeiro 1-102 pp.
- Beebe, W. 1926. The *Arcturus* Adventure: An Account of the New York Zoological Society's First Oceanographic Expedition. G.P. Putman, New York. 439 p.
- Breedy, O. & H.M. Guzman. 2003. The genus *Pacifigorgia* (Octocorallia: Gorgonacea) in Costa Rica (Coelenterata: Octocorallia: Gorgoniidae). *Zootaxa* 281: 1-60.
- Breedy, O. & H.M. Guzman. 2005. A new species of alcyonacean octocoral from the Galápagos Archipelago. *J. Mar. Biol. Assoc. U.K.* 85: 801-807.
- Breedy, O. & H.M. Guzman. 2007. A revision of the genus *Leptogorgia* Milne Edwards & Haime, 1857 (Coelenterata: Octocorallia: Gorgoniidae) in the eastern Pacific. *Zootaxa* 1407: 1-90.
- Breedy, O., C.P. Hickman & G.C. Williams. 2008. Octocoral research in the Galapagos Islands. *Galapagos Res. J.*: in press.
- Cortés, J. 1996-1997. Biodiversidad marina de Costa Rica: Filo Cnidaria. *Rev. Biol. Trop.* 44/45: 323-334.
- Cortés, J. 2008. Historia de la investigación marina de la Isla del Coco, Costa Rica. *Rev. Biol. Trop.* 56 (Supl. 2): 1-18.
- Cortés, J. & S. Blum. 2008. Life down to 450 m at Isla del Coco, Costa Rica. *Rev. Biol. Trop.* 56 (Supl. 2): 189-206.
- Daly, M., M. Brugler, P. Cartwright, A.G. Collins, M.N. Dawson, D.G. Fautin, S.C. France, C.S. McFadden, D.M. Opresko, E. Rodriguez, S.L. Romano & J.L. Stake. 2007. The phylum Cnidaria: A review of phylogenetic patterns and diversity 300 years after Linnaeus. *Zootaxa* 1668: 127-182.
- Deichmann, E. 1941. Coelenterates collected on the Presidential Cruise of 1938. *Smithsonian Misc. Collec.* 99 (10): 1-17.
- Jeyasuria, P. & J.C. Lewis. 1987. Mechanical properties of the axial skeleton in gorgonians. *Coral Reefs* 5: 213-219.
- Fabricius, K. & P. Alderslade. 2000. Soft Corals and Sea Fans: A Comprehensive Guide to the Tropical Shallow Water Genera of the Central-West Pacific, the Indian Ocean and the Red Sea. Australian Institute of Marine Sciences, Townsville, Australia. 264 p.
- Quammen, D. 1996. The Song of the Dodo: Island Biogeography in an Age of Extinctions. Simon and Schuster, New York. 702 p.
- Sadler, J.P. 1999. Biodiversity on oceanic islands: a palaeoecological assessment. *J. Biogeogr.* 26: 75-87.
- Studer, T. 1894. Note préliminaire sur les alcyonaires. Reports on the dredging operations carried on by the U.S. Fish Commission Steamer «Albatross», during 1891. *Bull. Mus. Comp. Zool.* 25: 53-69.
- Williams, G.C. 1990. The Pennatulacea of southern Africa (Coelenterata, Anthozoa). *Ann. South African Mus.* 99: 31-119.
- Williams, G.C. 1992. Biogeography of the octocorallian coelenterate fauna of southern Africa. *Biol. J. Linnean Soc.* 46: 351-401.
- Williams, G.C. 1993. Coral reef octocorals - an illustrated guide to the soft corals, sea fans and sea pens inhabiting the coral reefs of northern Natal. *Durban Natur. Sci. Mus.* 64 p.
- Williams, G.C. & O. Breedy. 2004. The Panamic genus *Pacifigorgia* (Octocorallia: Gorgoniidae) in the Galápagos Archipelago. *Proc. California Acad. Sci.* 55: 54-87.

