

New and Previous Records of Scleractinian Corals from Clipperton Atoll, Eastern Pacific¹

JUAN P. CARRICART-GANIVET² AND HÉCTOR REYES-BONILLA³

ABSTRACT: Clipperton Atoll was visited from 23 to 25 November 1997. A total of 109 specimens of stony corals belonging to two orders, seven families, and 15 species was collected. Five taxa of Scleractinia represent new records for the atoll: *Porites lutea*, *Porites australiensis*, *Psammocora superficialis*, *Astrangia* sp., and *Balanophyllia* sp. With these new records and species previously reported in the literature, the total number of scleractinians now known at Clipperton Atoll is 18 species. Observations on the fossil terraces on the island and on the dead coral fauna of the inner lagoon are presented.

CLIPPERTON ISLAND IS the uppermost portion of a small coral atoll (3.7 km² [Glynn et al. 1996]) located at 10° 8' N and 109° 13' W, approximately 1100 km off the Mexican mainland (Sachet 1962a) (Figure 1). Because of its position it is considered the easternmost atoll in the Pacific Ocean as well as the most remote shallow-water locale in the tropical eastern Pacific biogeographic region (Briggs 1974). Clipperton is characterized by its extreme isolation, small size, and low habitat diversity, which has probably contributed to its greatly impoverished coral fauna (Glynn et al. 1996). Nevertheless, it is a well-developed coral atoll, possessing the characteristic features of Pacific atolls: an interior lagoon and low topographic relief of its emerged portion (Sachet 1962a, González Avelar 1992, Emerson 1994).

Few works dealing with the marine flora and fauna of Clipperton Atoll have been published. Among the most important are those about collections of invertebrates in general (Hertlein and Emerson 1957) and on taxonomy and distribution of terrestrial and

marine vegetation (Sachet 1962b), stony corals (Glynn et al. 1996), mollusks (Salvat and Ehrhardt 1970, Emerson 1994), brachyuran crabs (Garth 1965), fishes (Robertson and Allen 1996, Allen and Robertson 1997), and seabirds (Howell and Webb 1995). In general, it can be said that the species of the atoll are mostly American colonists, with an important component of Indo-Pacific taxa also present (Robertson and Allen 1996).

In this paper, some observations and new records of stony corals from Clipperton Atoll are presented as a result of a visit to the island during the oceanographic expedition SURPACLIP-I (17 November to 3 December 1997) on board the RV *El Puma*, organized by the Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México (México City).

MATERIALS AND METHODS

During the SURPACLIP-I cruise, Clipperton Atoll was visited from 23 to 25 November 1997. Stony corals were collected at the "pocilloporid thicket," the "poritid zone," and along the seaward slope (zonation sensu Glynn et al. 1996) at two stations located in the northeastern sector of the atoll in which divers surveyed the reef at depths from 10 to 40 m (Figure 1). In addition, samples of corals were taken from the inner lagoon and in a series of extruded fossil terraces located

¹ Manuscript accepted 19 February 1999.

² Departamento de Ecología Acuática, ECOSUR, Apdo. Postal 424, Chetumal, Quintana Roo 77000, México (E-mail: jpcarri@ecosur-qroo.mx).

³ Universidad Autónoma de Baja California Sur, Apdo. Postal 19-B, La Paz, Baja California Sur 23080, México (E-mail: hreyes@calafia.uabcs.mx).

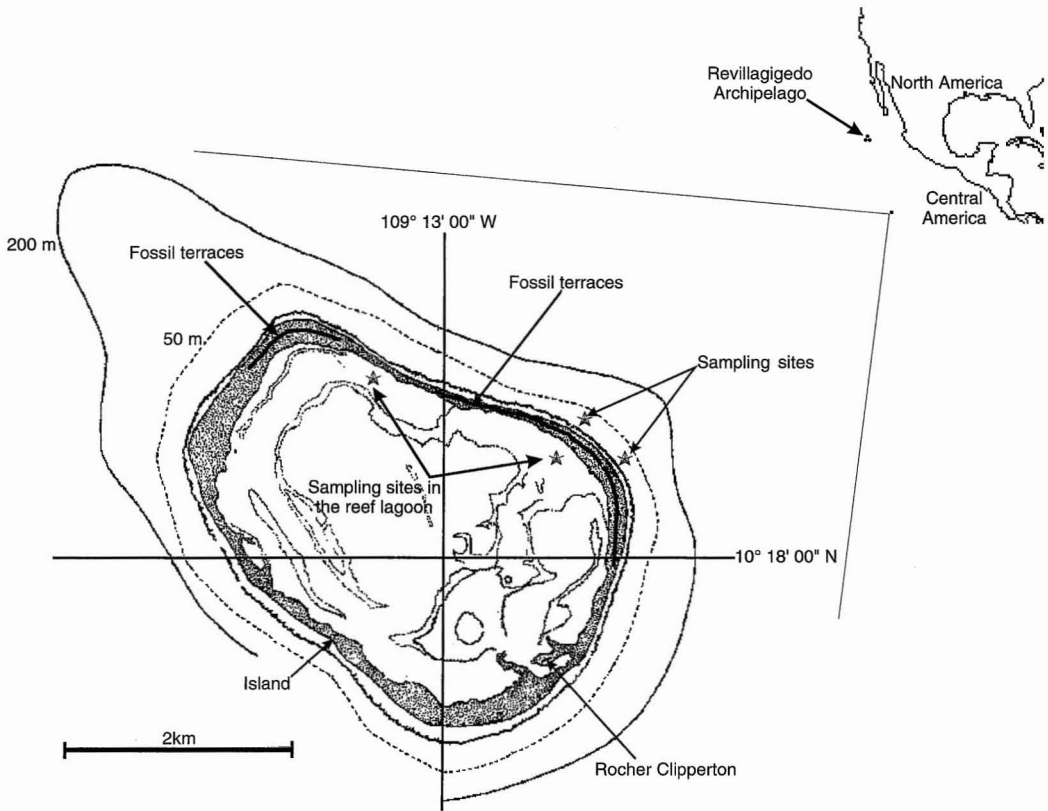


FIGURE 1. Location of Clipperton Atoll (modified from Glynn et al. 1996).

at the northern and eastern sections of the island. All material is currently deposited in the collections of the Museo de Historia Natural of the Universidad Autónoma de Baja California Sur, La Paz (MHNUABCS), and of El Colegio de la Frontera Sur, Chetumal (ECOCHBC), both in México, and of the United States National Museum of Natural History (USNM).

RESULTS AND DISCUSSION

The general morphology and characteristics of the emerged portion of Clipperton were presented in detail by Sachet (1962*a,b*), and although some differences exist in land vegetation cover, the general landscape of the island is still quite similar to that described. On the island there are fossil terraces at ap-

proximately 6 m above sea level. These terraces are composed of colonies of the genera *Porites* Link, 1807 and *Pocillopora* Lamarck, 1816 in growth position forming a framework. The specimens collected in these terraces could not be identified to species because they are eroded. The current elevation of the fossil corals matches the reported sea level in the eastern Pacific about 5000 yr ago (Curry et al. 1969, McIntyre et al. 1992), so, considering other events such as atoll subsidence, this could be the minimum age of the terraces.

The inner reef lagoon of Clipperton is actually a brackish enclosed environment, without channels connecting it to the surrounding sea (Glynn et al. 1996). Nevertheless, since the last century the presence of well-developed dead coral frameworks composed of corals of the genera *Porites* and

Pocillopora has been recognized (Sachet 1962a). We collected several dead specimens of *Pocillopora* sp., *Porites* cf. *lobata*, and *Pavona* cf. *minuta* in the Clipperton lagoon. This evidence of active reef growth in the recent past may be explained by the fact that before 1900 at least two channels, one located in the northeastern part of the atoll and the other one in the southeastern zone, connected the reef lagoon with the surrounding sea (González Avelar 1992, Glynn et al. 1996).

A total of 109 specimens of stony corals belonging to two orders, seven families, and 15 species was collected (Table 1). Five taxa represent new records for the atoll, either at species or at genus level: *Porites lutea*, *P. australiensis*, *Psammocora superficialis*, *Astrangia* sp., and *Balanophyllia* sp. Of these, *Porites lutea*, *P. australiensis*, and *Psammocora superficialis* are hermatypic/zooxanthellate species, and the other two are ahermatypic/azooxanthellate. Only two small colonies of *P. superficialis* were collected, and both appeared encrusting dead portions of the basis of *Leptoseris scabra* coralla at 25 m depth. They presented cerioidlike shallow calices, less than 20 septa, and conspicuous ridges on the coralla, as described by Veron and Pichon (1976).

In the case of the two species of *Porites* found, taxonomic determinations were based on Veron and Pichon (1982) and Veron (1986). The specimens identified as *P. australiensis* presented massive colonies with thick ledges in the periphery, a well-developed columella laterally compressed in the plane of the directive septa, free triplets, and eight pali, all of them higher than the septal denticles. Those considered as *P. lutea* had massive colonies with columniform lobules, joined triplets, and the ventral directive septa shorter than laterals on the triplet.

In Table 1, in addition to the taxa reported by Glynn et al. (1996) and in this paper, we mention the presence of *Pavona gigantea*, which was previously reported by Hertlein and Emerson (1957) for Clipperton. This coral was not observed or collected either by Glynn et al. (1996) or by us. Nevertheless, one of us (H.R.B.), in a visit to the

Museum of Paleontology of the University of California at Berkeley in 1990, saw two specimens of *P. gigantea* from Clipperton, probably those referred in the literature.

Pocillopora meandrina, also previously recorded by Hertlein and Emerson (1957), was relatively frequent from 5 to 10 m depth in the "pocilloporid thicket" of the northeastern side of the atoll in 1997. Glynn et al. (1996:82, 84) recorded no pocilloporid at species level because they considered that the colonies found showed such a wide range of environmentally induced variation that positive identification was not possible. In our case, the *P. meandrina* observed and collected had the diagnostic characters presented by Veron and Pichon (1982), Veron (1986), Hodgson (1995), and Glynn (1999): among them thick branches that are laterally flattened and with meanders on the top portion, verrucae, and an underdeveloped or absent columella. The last character is important because it clearly separates *P. meandrina* from *P. eydouxi*, the most similar species when compared with the *Pocillopora* sp. observed at Clipperton by Glynn et al. (1996).

Ahermatypic corals are not a conspicuous element in the reef community of Clipperton, except *Tubastraea coccinea* (Table 1). *Astrangia* sp. was collected in cryptic areas, such as underneath the ledges around the base of the reef-builders *Porites* spp. and *Pavona varians*. Also, a single specimen of *Balanophyllia* sp. was collected dead and settled on volcanic rock, which was extracted during dredging conducted off Clipperton at 650 m depth. The colony was eroded and turned out to be impossible to identify to species level; however, it presented some diagnostic characters of the genus such as septa arranged in Pourtalès Plan, costae, and spongy columella (Cairns 1991). Finally, Hertlein and Emerson (1957) mentioned the presence of *Paracyathus* sp. and *Cyathoceras* sp. in the atoll (material reputedly deposited in the Museum of Paleontology, University of California, Berkeley).

Considering the new records presented here (five) and those obtained from literature, but overlooked in recent works (five), the total number of scleractinians now known

TABLE 1

SYSTEMATIC LIST AND GEOGRAPHICAL DISTRIBUTION OF THE STONY CORALS RECORDED AT CLIPPERTON ATOLL

TAXA	DISTRIBUTION AND RECORDS FOR CLIPPERTON ^a
Phylum Cnidaria Hatschek, 1888	
Class Hydrozoa Owen, 1843	
Order Milleporina Hickson, 1901	
Family Milleporidae Fleming, 1828	
<i>Millepora exaesa</i> Forskål, 1775	Indo-Pacific (3, 4)
Class Anthozoa Ehrenberg, 1834	
Order Scleractinia Bourne, 1900	
Family Pocilloporidae Lamarck, 1816	
<i>Pocillopora verrucosa</i> (Ellis & Solander, 1786)	Indo-Pacific; México to Ecuador (2)
<i>P. meandrina</i> Dana, 1846	Indo-Pacific; México to Panamá (2, 4)
<i>Pocillopora</i> sp.	Clipperton endemic (3, 4)
Family Poritidae Gray, 1842	
<i>Porites lobata</i> Dana, 1846	Indo-Pacific; México to Ecuador, Easter Island, Chile (3, 4)
<i>Porites lutea</i> Milne Edwards & Haime, 1860	Indo-Pacific (4)
<i>Porites australiensis</i> Vaughan, 1918	Indo-Pacific; the Revillagigedo Archipelago, México (4)
<i>Porites</i> sp.	Clipperton and the Revillagigedo Archipelago, México (3, 4)
Family Siderastreidae Vaughan & Wells, 1943	
<i>Psammocora superficialis</i> Gardiner, 1898	Indo-Pacific; México to Ecuador (4)
Family Agariciidae Gray, 1847	
<i>Pavona maldivensis</i> (Gardiner, 1905)	Indo-Pacific; México, Costa Rica, and Ecuador (3, 4)
<i>Pavona minuta</i> Wells, 1954	Indo-Pacific; the Revillagigedo Archipelago, México (3, 4)
<i>Pavona varians</i> Verrill, 1864	Indo-Pacific; México to Ecuador (1, 2, 3, 4)
<i>Pavona gigantea</i> Verrill, 1869	México to Ecuador; central Pacific islands (1, 2)
<i>Leptoseris scabra</i> Vaughan, 1907	Indo-Pacific; Costa Rica to Ecuador (3, 4)
Family Rhizangiidae D'Orbigny, 1851	
* <i>Astrangia</i> sp.	(4)
Family Caryophylliidae Gray, 1847	
* <i>Paracyathus</i> sp.	(2)
* <i>Cyathoceras</i> sp.	(2)
Family Dendrophylliidae Vaughan & Wells, 1943	
* <i>Tubastraea coccinea</i> Lesson, 1836	Indo-Pacific; México to Ecuador (3, 4)
* <i>Balanophyllia</i> sp.	(4)

NOTE: Classification in agreement with Boschma (1956) for Milleporina and Veron (1995) for Scleractinia.

^aRecords for Clipperton: 1, Durham and Barnard (1952); 2, Hertlein and Emerson (1957); 3, Glynn et al. (1996); 4, this paper. Distribution data from Cairns (1991), Glynn (1997), and Reyes-Bonilla (in press).

*, Ahermatypic coral.

at Clipperton Atoll totals 10 genera and 18 species (Table 1).

ACKNOWLEDGMENTS

We thank Vivianne Solís-Weiss, researcher of the Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, for inviting us to participate in the SURPACLIP-I cruise. We also thank

the research team of the expedition for field assistance and the crew of the RV *El Puma* for their excellent work. The manuscript was notably improved by the comments of Peter Glynn. The Government of France granted permission for the expedition to land and dive in Clipperton. We especially thank Bruno Delaye, Ambassador of France to México; Alain Fohr, cultural adviser; Jean Pierre Tihay, scientific adviser; and Christian Jost, researcher of the University of French Poly-

nesia, observer and member of the expedition. Juan C. Silva Mendoza drew the figure.

LITERATURE CITED

- ALLEN, G. R., and D. R. ROBERTSON. 1997. An annotated checklist of the fishes of Clipperton Atoll, tropical eastern Pacific. *Rev. Biol. Trop.* 45:813–843.
- BOSCHMA, H. 1956. Milleporina and Stylasterina. Pages 90–106 in R. C. Moore, ed. *Treatise on invertebrate paleontology. Part F. Coelenterata.* Geological Society of America and University of Kansas Press, Lawrence, Kansas.
- BRIGGS, J. C. 1974. *Marine zoogeography.* McGraw-Hill, New York.
- CAIRNS, S. D. 1991. A revision of the ahermatypic Scleractinia of the Galápagos and Cocos Islands. *Smithson. Contrib. Zool.* 504:1–32, pls. 1–12.
- CURRAY, J. R., F. J. EMMELL, and P. J. S. CRAMPTON. 1969. Holocene history of a strand plain lagoonal coast, Nayarit, México. Pages 63–100 in A. Ayala-Castañares, ed. *Memorias del Simposio Internacional de Lagunas Costeras.* Universidad Nacional Autónoma de México, México City.
- DURHAM, J. W., and J. L. BARNARD. 1952. Stony corals of the eastern Pacific collected by the *Velero III* and *Velero IV*. *Allan Hancock Pacific Expeditions* 16:1–110.
- EMERSON, W. K. 1994. A zoogeographic summary of the marine mollusks of Clipperton Island (tropical eastern Pacific Ocean). *The Festivus* 26:62–71.
- GARTH, J. S. 1965. The brachyuran decapod crustaceans of Clipperton Island. *Proc. Calif. Acad. Sci., 4th Ser.* 33:1–46.
- GLYNN, P. W. 1997. Eastern Pacific reef coral biogeography and faunal flux: Durham's dilemma revisited. *Proc. 8th Int. Coral Reef Symp., Panamá* 1:371–378.
- . 1999. *Pocillopora inflata*, a new species of scleractinian coral (Cnidaria: Anthozoa) from the tropical eastern Pacific. *Pac. Sci.* 53:168–180.
- GLYNN, P. W., G. M. WELLINGTON, and J. E. N. VERON. 1996. Clipperton Atoll (eastern Pacific): Oceanography, geomorphology, reef-building coral ecology and biogeography. *Coral Reefs* 15:71–99.
- GONZÁLEZ AVELAR, M. 1992. Clipperton, isla mexicana. Fondo de Cultura Económica, México, D.F.
- HERTLEIN, L. G., and W. K. EMERSON. 1957. Additional notes on the invertebrate fauna of Clipperton island. *Am. Mus. Novit.* 1859:1–9.
- HODGSON, G. 1995. Corales pétreos marinos (Tipo Cnidaria, Orden Scleractinia). Pages 83–97 in W. Fischer, F. Krupp, W. Schneider, C. Sommer, K. E. Carpenter, and V. H. Niem, eds. *Guía FAO para la identificación de especies para los fines de la pesca. Vol. 1. Algas e invertebrados.* FAO, Rome.
- HOWELL, S. N. G., and S. WEBB. 1995. *A guide to the birds of Mexico and northern Central America.* Oxford University Press, Oxford, U.K.
- MCINTYRE, I., P. W. GLYNN, and J. CORTÉS. 1992. Holocene reef history in the eastern Pacific: Mainland Costa Rica, Caño Island, Cocos Island and Galápagos Islands. *Proc. 7th Int. Coral Reef Symp., Guam* 2:1174–1184.
- REYES-BONILLA, H. In press. Corals and coral reefs of the Pacific coast of México. in J. Cortés, ed. *Coral reefs of Latin America.* Elsevier, Amsterdam.
- ROBERTSON, D. R., and G. A. ALLEN. 1996. Zoogeography of the shorefish fauna of Clipperton Atoll. *Coral Reefs* 15:121–131.
- SACHET, M. H. 1962a. Geography and land ecology of Clipperton Island. *Atoll Res. Bull.* 86:1–115.
- . 1962b. Flora and vegetation of Clipperton Island. *Proc. Calif. Acad. Sci., 4th Ser.* 31:249–307.
- SALVAT, B., and J. P. EHRHARDT. 1970. Mollusques de L'île Clipperton. *Bull. Mus. Natl. Hist. Nat. Paris, 2^e Sér.* 42 (1): 223–231.
- VERON, J. E. N. 1986. *Corals of Australia and the Indo Pacific.* Angus & Robertson Publishers, Sydney.

- . 1995. Corals in space and time. Comstock/Cornell, Ithaca, New York.
- VERON, J. E. N., and M. PICHON. 1976. Scleractinia of eastern Australia. Part I. Families Thamnasteriidae, Astrocoeniidae, Pocilloporidae. Aust. Inst. Mar. Sci. Monogr. Ser. 1: 1–56.
- . 1982. Scleractinia of eastern Australia. Part IV. Family Poritidae. Aust. Inst. Mar. Sci. Monogr. Ser. 5: 1–159.