Arquivos do Museu Nacional, Rio de Janeiro, v.65, n.3, p.241-250, jul./set.2007
ISSN 0365-4508

THE ROCAS ATOLL, BRAZIL: A PRELIMINARY SURVEY OF THE CRUSTACEA AND POLYCHAETE FAUNA [1]

(With 4 figures)

PAULO CESAR PAIVA [2]
PAULO SECCHIN YOUNG [3]
CARLOS ALEJANDRO ECHEVERRÍA [4]

ABSTRACT: Among the oceanic islands in the Brazilian coast, Rocas Atoll is special since it is the only atoll in the Southern Atlantic and is the first Marine Biological Reserve of the Brazilian Coast. The atoll elliptical ring (3.7 to 2.5km) has a shallow central lagoon surrounded by a large reef plateau flat composed mainly of coralline algae. Despite its ecological importance the crustacean and polychaete fauna of Rocas Atoll is still poorly known with only 34 and 17 species, respectively, recorded. For this reason, an integrate effort with the aim of assessing the marine biodiversity of this Atoll was developed, through samples of reef and sedimentary environments. Results of this effort are here presented.

Key words: Rocas Atoll. Crustacea. Polychaeta. Oceanic Islands. Brazil.

RESUMO: O Atol das Rocas, Brasil: análise preliminar da fauna de crustáceos e poliquetas.

Entre as ilhas oceânicas da costa brasileira, o Atol das Rocas se destaca por ser o único atol do Atlântico Sul e a primeira Reserva Biológica Marinha da costa brasileira. O anel elíptico do atol (3,7 a 2,5km) apresenta uma laguna central circundada por um grande platô recifal composto principalmente de algas calcárias. Apesar de sua importância ecológica, a fauna de crustáceos e poliquetas do Atol das Rocas ainda é pouco conhecida, com apenas 34 e 17 espécies, respectivamente, registradas. Por essa razão, foi realizado um esforço integrado com o objetivo de avaliar a biodiversidade marinha deste Atol através de coletas em ambientes recifais e sedimentares. Os resultados deste esforço são aqui apresentados.

Palavras-chave: Atol das Rocas. Crustacea. Polychaeta. Ilhas Oceânicas. Brasil.

INTRODUCTION

Oceanic islands are remarkable environments owing to their high diversification (Margalef, 1980) usually having a higher endemism when compared with nearby environments. Such endemism is more pronounced in nearshore areas since these islands are geographically isolated from the adjacent continental shelves. Variations in the degree of endemism are a function of life history strategies, mainly the duration of the larval phase and dispersion capacity (Scheltema, 1992). In this way, several polychaete species with short-phase larvae and brooding crustaceans, mainly peracaridans (*e.g.* amphipods, isopods, tanaidaceans, and cumaceans) from shallow water are more likely to present a high degree of insular endemism. Furthermore, oceanic islands presents lower levels of species richness owing to their geographic isolation and the restricted area of their near shore zones, as predicted by the theory of island biogeography (McArthur & Wilson, 1967). Nevertheless, some tropical oceanic islands have a high cover of reefs in their subtidal and intertidal habitats, an environment that can hold a great diversity of associated fauna, mainly cryptic organisms (Bouchet *et al.*, 2002). Furthermore, oceanic islands environments, especially those from tropical regions, are much vulnerable to human impacts owing to their low resilience capacity (Chown *et al.*, 1998). Besides, such environments are many times subjected to predatory tourism and others economical-industrial activities.

The composition of the Brazilian marine benthic fauna, mainly regarding the northern and eastern coast, is still poorly known. Moreover, records are restricted to surveys conducted in the intertidal zone, inner continental shelf and some coastal

[1] Submitted on February 9, 2007. Accepted on August 16, 2007.
[2] Universidade Federal do Rio de Janeiro, CCS, IB, Depto. de Zoologia. Ilha do Fundão, 21941-590, Rio de Janeiro, RJ, Brasil. E-mail:pcpaiva@biologia.ufrj.br.
[3] *In memoriam*.
[4] Universidade Federal do Rio de Janeiro, Laboratório de Pesquisas Costeiras e Estuarinas – LabCoEst – UFRJmar – CT - UFRJ.

islands (Lana, *et al.* 1996). Hence, owing to the restricted knowledge, nothing can be said about previous environmental impacts in Brazilian oceanic islands and, for future assessments, more studies of their fauna are required.

Among the Brazilian oceanic islands, *i.e.*, Fernando de Noronha, Trindade, Rocas Atoll, and São Pedro & São Paulo Archipelago, Rocas Atoll has a special interest since it is the only atoll in the Southwestern Atlantic and was the first Marine Biological Reserve in the Brazilian Coast. Nowadays, besides scientific research, no activities are allowed in the Atoll.

Study Area

The Rocas Atoll is located approximately 250km off the Brazilian northeastern coast between 03°45' and 03°56'S and 33°37' and 33°56' W and 145km west of Fernando de Noronha Archipelago. It is located at the top of a seamount which reaches a depth of ca. 25 meters from the surface, and belongs to the Fernando de Noronha Chain, part of the Fracture Zone of Fernando de Noronha.

The Atoll frame is composed mainly of coralline algae (over 60%), being mainly *Porolithon* cf. *pachydermum* (Gherardi & Bosence, 2005), vermetid gastropods and hermatypic corals, the latter represented mainly by *Siderastrea stellata* (Kikuchi, 1994), although with a relatively small contribution (less than 10% of the reef frame). Gherardi & Bosence (1999) showed the contribution of several genera of encrusting coralline algae in the atoll construction and latter described the reef growth patterns during the late Holocene sea-level changes (Gherardi & Bosence, 2005). Among the massive corals that contributed to the atoll formation, *Siderastrea stellata* strongly dominates, however, nowadays this species is restricted to wave protected areas. Present patterns of distribution of hermatypic corals and other cnidarians can be assessed in Echeverria *et al.* (1997).

The Atoll elliptical ring has the largest diameter of 3.7km and the smallest about 2.5km, with a large and shallow inner lagoon and a large plateau or reef flat (Fig.1) surrounding it (Kikuchi, 1994). Predominant winds and currents runs from east to west direction almost all the time, and in this way the atoll presents a constantly wave exposed side (east side) and a protected side (west side). On the west side there are two sandy islands (Cemitério Island and Farol Island; Figs.1-2). The distribution of cnidarian's species are clearly influenced by these patterns probably due to sediment and detritus accumulation on the west side (Echeverria *et al.*, 1997).

During the high tide, the entire Atoll is covered by the sea water except the two islands mentioned before. During the low tide, the reef top flat is uncovered, and several pools are exposed. These pools are constituted by depressions on the reef flat, and vary from few meters to more than 150m in length, varying from 0.5m to more than 7m in depth. Usually its bottoms are constituted by carbonatic sand. The lateral walls of these pools constitute an interesting habitat, and usually bear a relatively high diversity, including cnidarians (Echeverría *et al.*, 1997), sponges (Moraes *et al.*, 2006), macroalgae (Villaça *et al.*, 2006) and mollusks (Gomes *et al.*, 2006). Names and localization of these pools are presented in table 1.

Water temperature inside the atoll may increase up to 39°C during low tides and sunny days in small pools, and the median temperature outside of atoll is 27°C (25,5° to 28°C) (Kikuchi & Leão, 1997). Precipitation is irregularly distributed along the year varying from 183mm to 2663mm per month (Kikuchi, 2002), with no other source of fresh water in the whole Atoll. The Rocas Atoll region receives the South Equatorial current originated from west coasts of Africa with a velocity varying from 30cm/s to 60cm/s (Richardson & McKee, 1984; Silveira *et al.*, 1994). Tides are semi-diurnal reaching maximum amplitude in neap tides of 2.4m (Kikuchi, 1994).

In order to assess the marine biodiversity fauna of the Brazilian oceanic islands, especially of Crustacea and Polychaeta, we developed the project 'Biodiversity of the Brazilian Oceanic Islands: Crustacea and Polychaeta.' This project was conducted with the financial and logistic support of the Federal University of Rio de Janeiro (UFRJ) and the Brazilian Environmental Agency (IBAMA) by means of the Biological Reserve of Rocas Atoll, which is coordinated by Maurizélia de Brito Silva.

Hence, for both taxonomic groups (Crustacea and Polychaeta), the present study will improve the number of species referred for the Rocas Atoll. Besides the new records, new taxa are likely to be discovered and a rise in the degree of endemism is also expected after these surveys.

Main goals of this project are:
(1) To provide a preliminary inventory of the crustacean and polychaete fauna of the Rocas Atoll.

(2) Assess the degree of endemism of these taxa for the Rocas Atoll and, secondarily, for the Brazilian oceanic islands.

(3) Provide detailed descriptions of crustaceans and polychaetes species, which will help on species identification for ecological and biological studies.

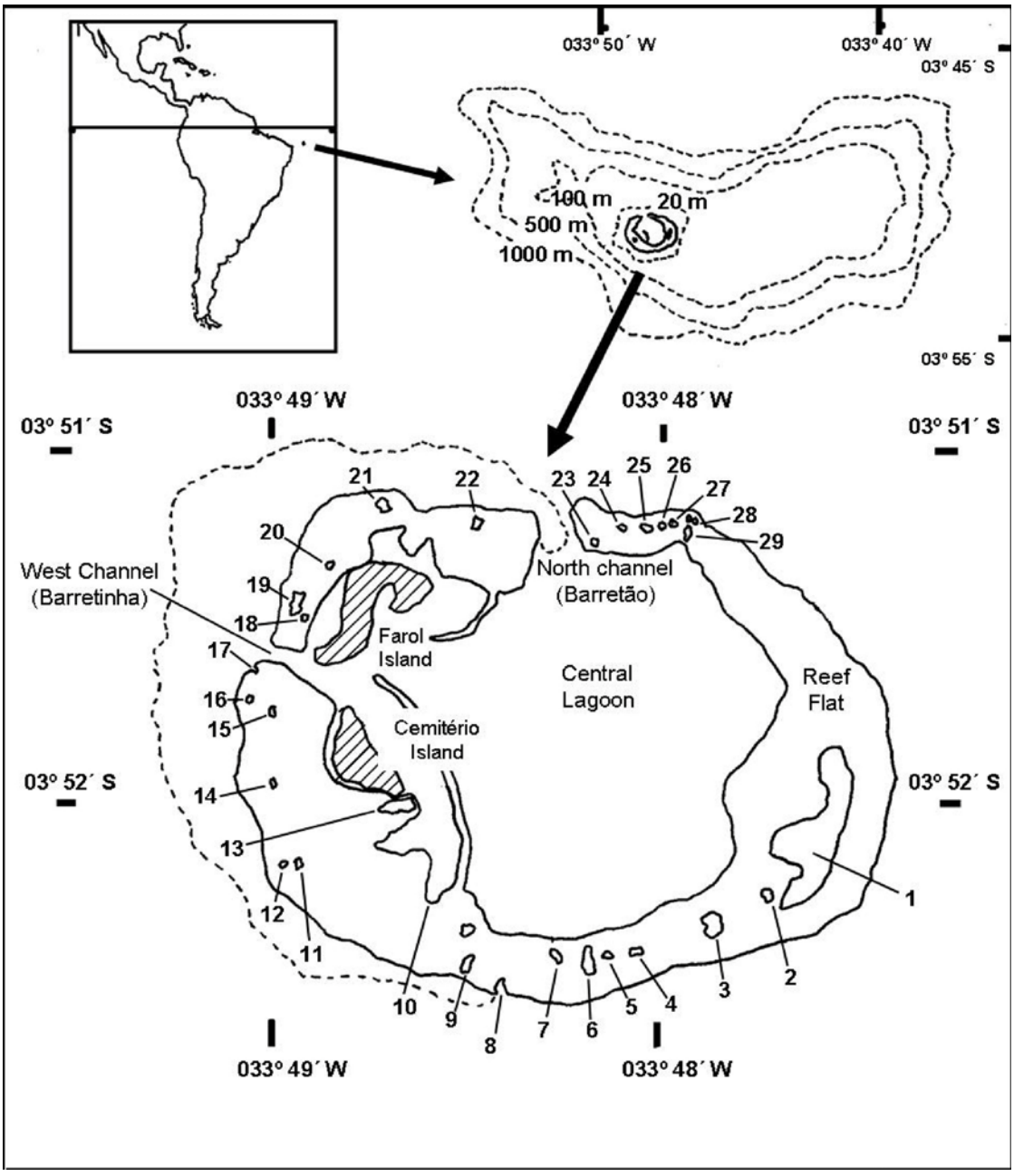

Fig.1- Map of the Rocas Atoll localized in the Southwestern Atlantic, showing general morphology of the reef, localization of the two islands, the central lagoon, channels and the principal pools over the reef flat. Number refers to the pools, where the geographic coordinates can be found in table 1 (redrawn from Echeverría *et al.*,1997).

Fig.2- View of Farol Island from the Lighthouse.

MATERIAL AND METHODS

Surveys

Collections of crustaceans and polychaetes under the scope of the project were obtained in three expeditions to the Biological Reserve of Rocas Atoll with the duration of ca. 40 days each. Two or three persons were involved in collecting benthic samples of crustacean and polychaetes during field work. All expeditions occurred during the years of 2000 and 2001 in: (1) September/October 2000; (2) December, 2000 and January 2001, and (3) November/ December 2001.

Expeditions to Rocas Atoll initiated with a 24 hours boat trip (260km) from Natal (Rio Grande do Norte State) to Rocas Atoll. The trip aboard of the 40 feet sailing boat 'Delícia' as well as lodging in Rocas Atoll (Fig.3) were both provided by IBAMA, responsible for the Marine Biological Reserve of Rocas Atoll.

Sampling

Samples were taken at three different environments as (1) main lagoon (0-2m depth), (2) tidal pools (0-7m depth), and (3) external sublitoral area (10-18m depth) (Fig.1). Localization and names of individual tidal pools are given in figure 1 and table 1. In each of these locations, both hard and soft-bottom were sampled. Biological substrates as algae and sponges (Fig.4) were sampled for assessing its associated fauna.

In coralline bottoms, two procedures were used: (1) directly removal of specimens after manual fragmentation of the coralline mass, or (2) extraction by suffocation after maintaining coralline fragments in closed dark buckets under sunlight for ca. 2 hours. Floating specimens were them removed using forceps and hand nets, being fixed in 10% formalin (polychaetes) or 70% alcohol (crustaceans) and further preserved in 70% alcohol (polychaetes and crustaceans).

TABLE 1. Geographic coordinates of the reef flat pools from Rocas Atoll cited in figure 1 (GPS measured).

POOL NUMBER	LAT. / LONG.	UNOFFICIAL NAME
01	03º 52,28' S / 033º 47,65' W	Piscina das Rocas
02	03º 52,28' S / 033º 47,68' W	-
03	03º 52,31' S / 033º 47,87' W	-
04	03º 52,42' S / 033º 48,06' W	-
05	03º 52,45' S / 033º 48,16' W	-
06	03º 52,43' S / 033º 48,24' W	Piscina das Âncoras (Anchors Pool)
07	03º 52,42' S / 033º 48,30' W	Piscina das Tartarugas (Turtles Pool)
08	03º 52,46' S / 033º 48,43' W	Salão
09	03º 52,46' S / 033º 48,55' W	-
10	03º 52,30' S / 033º 48,48' W	Piscina das Correntes
11	03º 52,18' S / 033º 49,08' W	-
12	03º 52,17' S / 033º 49,07' W	-
13	03º 51,96' S / 033º 49,14' W	-
14	03º 51,94' S / 033º 49,10' W	-
15	03º 51,74' S / 033º 49,09' W	-
16	03º 51,70' S / 033º 49,50' W	-
17	03º 51,61' S / 033º 49,14' W	Falsa Barreta Channel
18	03º 51,50' S / 033º 48,10' W	-
19	03º 51,39' S / 033º 48,40' W	-
20	03º 51,32' S / 033º 48,60' W	-
21	03º 51,17' S / 033º 48,75' W	-
22	03º 51,30' S / 033º 48,56' W	-
23	03º 51,25' S / 033º 48,19' W	-
24	03º 51.26' S / 033º 48.11' W	-
25	03º 51.29' S / 033º 48.01' W	-
26	03º 51.20' S / 033º 48.00' W	-
27	03º 51.19' S / 033º 47.96' W	-
28	03º 51.28' S / 033º 47.91' W	-
29	03º 51.18' S / 033º 47.92' W	-

Names included are not exhaustive.

Sediment samples were taken using cylindrical cores (diameter=100mm, 250mm depth, *ca.* 0.008m^2). Core samples were taken manually (8 to 10 replicates) in tidal-pools and main lagoon or diver-operated in the outside part of the Atoll. Sediment was then submitted to an elutriation procedure in a 15 L bucket with the suspension being sieved in a 0.5mm mesh-size, fixed in 10% formalin and transferred posteriorly to 70% ethanol. All collected material where subsequently sent to specialists with a compromise of studying and publishing results in a special volume dedicated exclusively to this project. All the Crustacea material is deposited at Museu Nacional/UFRJ and the Polychaeta material is deposited at the Instituto de Biologia/UFRJ.

RESULTS AND DISCUSSION

CRUSTACEA OF ROCAS ATOLL

All the records of crustaceans from Rocas Atoll are

3

4

Fig.3- Lodging in Rocas Atoll; fig.4- Paulo Secchin Young with a collected sponge of the genus *Ircinia*.

from scattered samples at the region without any general sampling program. Most of the records are from common large-bodied decapods that are found mostly on intertidal areas found in the surveys of Coelho (1965, 1967), Coelho & Ramos (1972), Coelho & Koening (1972), and Fausto-Filho (1980). Besides decapods, only two amphipods (Krapp-Schickel & Ruffo, 2000; Serejo, 2004), and one cirriped were recorded (Young, 1998). Up to this survey, a total of 34 crustacean species were recorded to the whole Rocas Atoll (Tab.2). Since there is a clear bias toward intertidal large-bodied decapods it is likely that this number is underestimated regarding the actual biodiversity of crustaceans from Rocas Atoll. This

underestimation was circumvented through a specific program for collecting also small-bodied crustaceans in subtidal and cryptic intertidal environments for both soft and coralline bottoms. Results from this survey increased the number of referred crustaceans species to 55 (Tab.2), an increment of 62%. It must be stated that such increment did not represent all collected crustaceans in this survey since some speciose groups, such as Alpheidae and Brachyura (except Majiidae), were not still studied.

TABLE 2. Crustacean species recorded for the Rocas Atoll according to Coelho (1965, 1967) Coelho & Ramos (1972), Coelho & Koening (1972), Fausto Filho (1980), Young (1998), Krapp-Schickel & Ruffo (2000), Serejo (2004), Senna & Serejo (2005, 2007), and this survey. Species in bold are those referred for the first time to Rocas Atoll.

Taxa
Class Maxillopoda
Infraclass Cirripedia
Superorder Thoracica
Order Sessilia
Family Poecilasmatidae
Ceratoconcha floridana (Pilsbry, 1931)
Family Lepadidae
***Lepas anatifera* Linnaeus, 1758**
Family Pyrgomatidae
***Octolamis lowei* (Darwin, 1852)**
Superorder Hoplocarida
Order Stomatopoda
Family Gonodactylidae
Gonodactylus austrinus Manning, 1969
Gonodactylus oerstedii Hansen, 1895
Gonodactylus spinulosus Schmitt, 1924
Family Pseudosquillidae
Pseudosquilla ciliata (Fabricius, 1787)
Superorder Eucarida
Order Decapoda
Infraorder Caridea
Family Alpheidae
Alpheus amblyonyx Chace, 1972
Alpheus bouvieri A. Milne Edwards, 1878
Alpheus cristulifrons Rathbun, 1900
Alpheus floridanus Kingsley, 1878
Alpheus normanni Kingsley, 1878
Synalpheus sanctithomae Coutière, 1909
Synalpheus townsendi Coutière, 1909
Family Palaemonidae
***Periclimenaeus caraibicus* Holthuis, 1951**
***Brachycarpus biunguiculatus* (Lucas, 1846)**
***Leander tenuicornis* (Say, 1818)**
Family Processidae
Processa brasiliensis Christoffersen, 1979
Processa fimbriata Manning & Chace, 1971
Family Disciadidae
***Discias serratirostris* Lebour, 1949**
Family Rhynchocinetidae
***Cinetorhynchus rigens* (Gordon, 1936)**
Infraorder Palinura
Family Palinuridae
Panulirus echinatus Smith, 1869
Infraorder Anomura
Family Galatheidae
Munida spinifrons Henderson, 1885
Family Diogenidae
Dardanus venosus H. Milne-Edwards, 1848
Clibanarius antillensis Stimpson, 1859
Clibanarius tricolor (Gibbes, 1850)
***Calcinus tibicen* (Herbst, 1791)**
***Paguristes tortugae* Schmitt, 1933**
Family Porcellanidae
***Pachycheles riisei* (Stimpson, 1858)**
Infraorder Brachyura
Family Majidae
Aepinus septemspinosus (A. Milne-Edwards, 1879)
***Chorinus heros* (Herbst, 1790)**
***Macrocoeloma concavum* Miers, 1886**
***Microphrys bicornutus* (Latreille, 1825)**
Mithraculus forceps (A. Milne-Edwards, 1875)
Mithrax hemphilli Rathbun, 1892
Mithrax verrucosus H. Milne-Edwards, 1832
***Nemausa acuticornis* (Stimpson, 1871)**
***Pitho lherminieri* (Schramm, 1867)**
Podochela brasiliensis Coelho, 1972
Family Xanthidae
Actaea acantha (A. Milne-Edwards, 1834)
Banareia palmeri (Rathbum, 1894)
Cataleptodius floridanus (Gibbes, 1850)
Family Grapsidae
Grapsus grapsus (Linnaeus, 1758)
Plagusia depressa (Fabricius, 1775)
Family Gecarcinidae
Gecarcinus lagostoma H. Milne-Edwards, 1835
Family Cryptochiridae
Troglocarcinus corallicola Verrill, 1908
Family Calappidae
Calappa gallus (Herbst 1803)
Superorder Peracarida
Order Amphipoda
Family Melitidae
Quadrimaera cristianae Krapp-Schickel & Ruffo, 2000
***Quadrimaera chaelata* Senna & Serejo, 2007**
***Quadrimaera rocasensis* Senna & Serejo, 2007**
Family Talitridae
Talorchestia tucurauna (Müller, 1864)
Family Ingolfiellidae
***Ingolfiella rocaensis* Senna & Serejo, 2005**
Superorder Peracarida
Order Isopoda
Family Olibrinidae
***Olibrinus antennatus* (Budde-Lund, 1902)**
Family Philosciidae
Littorophiloscia culebrae (Moore, 1901)
Family Platyarthridae
***Niambia squamata* (Budde-Lund, 1885)**
Family Porcellionidae
***Porcellionides pruinosus* (Brandt, 1833)**

Polychaeta of Rocas Atoll

Polychaetes from Rocas Atoll were also referred from scattered samples from large oceanographic expeditions that sampled mainly off Rocas Atoll, such as the Calypso Expedition of 1966 (Rullier & Amoureux, 1979). More recently, some surveys conducted specifically on the Biological Reserve also recorded some polychaetes species (*e.g.,* Netto *et al.* 1999; Neves & Omena, 2003). Despite the ecological approach of the majority of these studies, new records were given for both the Rocas Atoll, Brazilian oceanic islands or even for the whole Brazilian coast. New species and detailed descriptions were also provided for specific taxa from Rocas Atoll (Santos & Lana, 2001, 2003). Even though Netto *et al.* (1999) recognized 38 species of 22 families for the whole Atoll, only five were nominated in the paper. Thus, besides all above effort, up to now only 17 species of polychaetes were recorded to the Rocas Atoll (Tab.3). This number is far from what should be expected for an environment composed of both reef and sedimentary habitats, which is likely to support a much higher diversity of polychaete species (Paiva, 2005). This survey increased the number of refered species to 26, an increment of 53%. Only three families of polychaetes were still studied from the collection of this survey, a taxonomic effort that represents only 13% of the families already recorded by Netto *et al.* (1999) for the whole Atoll. Thus an exponential increase in the number of polychaetes referred to the whole Atoll is expected after studying all collected families.

TABLE 3. Polychaete species recorded for the Rocas Atoll according to Netto *et al.* (1999), Neves & Omena (2003), Rullier & Amoureux (1979), Santos & Lana (2001, 2003), and this survey.

Taxa	
Class Polychaeta	***Nereis panamensis* Fauchald, 1977**
Subclass Palpata	*Nereis trifasciata* (Grube, 1878)
Order Aciculata	***Nereis* sp.**
Suborder Amphinomida	***Perinereis floridana* Ehlers, 1868**
Family Amphinomidae	*Platynereis magalhaensis* Kinberg, 1866
Eurythoe complanata (Pallas, 1766)	Order Canalilpalpata
Hermodice carunculata (Pallas, 1766)	Family Saccocirridae
***Linopherus* cf. *canairensis* (Langerhans, 1881)**	*Saccocirrus papillocercus* Bobretzky, 1872
Suborder Phyllodocida	Suborder Spionida
Family Phyllodicidae	Family Spionidae
Eteone heteropoda Hartman, 1951	*Spio pettiboneae* Foster, 1971
Family Syllidae	Suborder Cirratulida
Branchiosyllis oculata (Elhers, 1887)	Family Cirratulidae
Haplosyllis spongicola (Grube, 1855)	*Caulleriella* cf. *alata* (Southern, 1914)
Pionosyllis gesae Perkins 1981)	Suborder Flabelligerida
Syllis (Ehlersia) cornuta Rathke, 1843	Family Acrocirridae
Typosyllis variegata (Grube, 1860)	*Macrochaeta clavicornis* (Sars, 1835)
Family Nereididae	Suborder Sabellida
Ceratocephale rocaensis Santos & Lana, 2001	Family Sabellidae
Ceratonereis mirabilis Kinberg, 1866	***Bispira melanostigma* (Schmarda, 1861)**
***Ceratonereis* cf. *singularis* Treadwell, 1929**	***Bispira* sp.**
***Ceratonereis* longicirrata Perkins, 1980**	*Notaulax occidentalis* (Baird, 1865)
***Neanthes acuminata* Ehlers, 1868**	?*Hypsicomus elegans* (Webster, 1884)

Species in bold are those referred for the first time to Rocas Atoll.

REFERENCES

BOUCHET, P.; LOZOUET, P.; MAESTRATI, P. & HEROS, V., 2002. Assessing the magnitude of species richness in tropical marine environments: exceptionally high numbers of molluscs at a New Caledonia site. **Biological Journal of the Linnean Society**, **75**(4):421-436.

CHOWN, S.L.; GREMMEN, N.J.M. & GASTON, K.J., 1998. Ecological biogeography of southern ocean islands: species-area relationships, human impacts, and conservation. **American Naturalist**, **152**(4):562:575.

COELHO, P.A.,1965. Crustáceos decápodos do Atol das Rocas. **Ciência e Cultura**, **17**(2):309-310.

COELHO, P.A. & KOENING, M.L., 1972. A distribuição dos crustáceos pertencentes às ordens Stomatopoda, Tanaidacea e Isopoda no norte e nordeste do Brasil. **Trabalhos Oceanográficos da Universidade Federal de Pernambuco**, **13**:245-260.

ECHEVERRIA, C.A.; PIRES, D.O.; MEDEIROS, M.S. & CASTRO, C.B., 1997. Cnidarians of the Atol das Rocas, Brazil. INTERNATIONAL CORAL REEF SYMPOSIUM, 8, 1996, Panamá. **Proceedings of the 8th International Coral Reef Symposium.** Panama City: Smithsonian Tropical Research Institute. p.443-446.

FAUSTO FILHO, J., 1980. Crustáceos estomatópodos e decápodos dos substratos de cascalho do nordeste brasileiro. **Ciência Agronômica**, **10**(1):109-124.

GHERARDI, D.F.M. & BOSENCE, D.W.J., 1999. Modeling of the ecological succession of encrusting organisms in recent coralline-algal frameworks from Atol das Rocas, Brazil. **Palaios**, **14**:145-158.

GHERARDI, D.F.M. & BOSENCE, D.W.J., 2005. Late Holocene reef growth and relative sea-level changes in Atol das Rocas, equatorial South Atlantic. **Coral Reefs**, **24**: 164-272.

GOMES, R.S.; COSTA, P.M.S.; MONTEIRO, J.C.; COELHO, A.C. & SALGADO, N.C., 2006. Moluscos das Ilhas Oceânicas Brasileiras In: ALVES, R.J.V. & CASTRO, J.W.A. (Eds.) **Ilhas Oceânicas Brasileiras: da Pesquisa ao Manejo**. Brasília: MMA. p.179-198.

KIKUCHI, R.K.P., 1994. **Geomorfologia, estratigrafia e sedimentologia do Atol das Rocas (Rebio – IBAMA/ RN)**. 144p. Dissertação (Mestrado em Geologia). Programa de Pós-Graduação em Geologia, Universidade Federal da Bahia, Salvador.

KIKUCHI, R.K.P., 2002. Sítios geológicos e paleontológicos do Brasil. In: SCHOBBENHAUS, C.; CAMPOS, D.A.; QUEIROZ, E.T.; WINGE, M.; BERBET-BORN., M.L. (Eds.) **Sítios Geológicos e Paleontológicos do Brasil**. Brasília: DNPM/CPRM. p.379-389.

KIKUCHI, R.K.P. & LEÃO, Z.M.A.N., 1997. Rocas (Southwestern Equatorial Atlantic, Brazil): an atoll built primarily by coralline algae. In: INTERNATIONAL CORAL REEF SYMPOSIUM, 8., 1996, Panamá. **Proceedings of the 8th International Coral Reef Symposium.** Panama City: Smithsonian Tropical Research Institute. p.731-736.

KRAPP-SCHICKEL, T. & RUFFO, S., 2000. The *Maera quadrimana* - complex (Crustacea Amphipoda, Melitidae) demands a new concept: *Quadrimaera* n.gen. (with description of three new species from Western Atlantic). **Bollettino del Museo Civico di Storia Naturale di Verona**, **24**:193-214.

LANA, P.C.; CAMARGO, M.G.; BROGIM, R.A. & ISAAC, V.J., 1996. O **bentos da costa brasileira - avaliação crítica e levantamento bibliográfico.** Rio de Janeiro: FEMAR. 432p.

MacARTHUR, R.H. & WILSON, E.O., 1967. **The theory of island biogeography**. New Jersey: Princeton University Press. 203p.

MARGALEF, R., 1980. **Ecologia**. Barcelona: Omega. 951p.

MORAES, F.; VENTURA, M.; KLAUTAU, M.; HAJDU, E. & MURICY, G., 2006. Biodiversidade de esponjas das ilhas oceânicas brasileiras. In: ALVES, R.J.V & CASTRO, J.W.A. (Eds.) **Ilhas Oceânicas Brasileiras: da Pesquisa ao Manejo**. Brasília: MMA. p.147-177.

NEVES, G. & OMENA, E.P., 2003. Influence of sponge morphology on the composition of the polychaete associated fauna from Rocas Atoll, Northeast Brazil. **Coral Reefs**, **22**:123-129.

NETTO, S.A.; WARWICK, R.M. & ATTRILL, M.J., 1999. Meiobenthic and macrobenthic community structure in carbonate sediments of Rocas Atoll (North-east, Brazil). **Estuarine, Coastal and Shelf Science**, **48**:39-50.

PAIVA, P.C., 2005. Chapter 7 - Soft-bottom polychaetes of the Abrolhos Bank. In: DUTRA, G.F.; ALLEN, G.A.; WERNER, T. & MCKENNA, S.A. (Eds.) **A Rapid Marine Biodiverstity Assessment of the Abrolhos Bank, Bahia, Brazil**. Washington D.C.: Conservation International. p.87-90.

RICHARDSON, P.L. & McKEE, T.K., 1984. Average seasonal-variation of the Atlantic Equatorial currents from historical ship drifts. **Journal of Physical Oceanography**, **14**:1226-1238.

RULLIER, F. & AMOUREUX, L., 1979. Annélides polichètes. Campagne de la Calypso au large des côtes atlantiques de l´Amérique du Sud (1961-1962). **Annales de l'Institut océanographique**, **44**:10-206.

SANTOS, C.S.G. & LANA, P.C., 2001. Nereididae (Annelida, Polychaeta) from the northeastern coast of the Brazil: II. Genera *Namalycastis*, *Ceratocephale*, *Laeonereis* and *Rullierinereis*. **Iheringia**, **Série. Zoologia**, **91**(1):137-149.

SANTOS, C.S.G. & LANA, P.C., 2003. Nereididae (Polychaeta) da costa nordeste do Brasil. III. Gêneros *Ceratonereis* e *Nereis*. **Iheringia, Série. Zoologia**, **93**(1):5-22.

SCHELTEMA, R.S., 1992. Passive dispersal of planctonic larvae and the biogeography of tropical sublittoral invertebrates species. In: COLOMBO, G. G.; FERRARI, V. U.; CECCHERELLI & ROSSI, R. (Eds.) **Marine eutrophication and population dynamics**. Fredensborg: Olsen & Olsen. p.195-202.