

Information Sheet on Ramsar Wetlands (RIS) – 2009-2015 version

Available for download from http://www.ramsar.org/ris/key_ris_index.htm.

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX.22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.
2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 14, 3rd edition). A 4th edition of the Handbook is in preparation and will be available in 2009.
3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

Maurizélia de Brito Silva
Escritório Administrativo da REBIO Atol das Rocas
Av. Alexandrino de Alencar, 1399 – Natal, RN – Cep.
59.015-350 - Tel. (84) 3222-2151 e (84) 96097443
Email: maurizelia.silva@icmbio.gov.br

FOR OFFICE USE ONLY.

DD MM YY

--	--	--

Designation date

--	--	--	--	--	--

Site Reference Number

2. Date this sheet was completed/updated:

August, 2013

3. Country:

Brazil

4. Name of the Ramsar site:

The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

Atol das Rocas Biological Reserve

5. Designation of new Ramsar site or update of existing site:

This RIS is for (tick one box only):

- a) Designation of a new Ramsar site ; or
b) Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

7. Map of site

Refer to Annex III of the Explanatory Note and Guidelines, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

- i) a hard copy (required for inclusion of site in the Ramsar List): ;
- ii) an electronic format (e.g. a JPEG or ArcView image) ;
- iii) a GIS file providing geo-referenced site boundary vectors and attribute tables .

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (natural reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The Biological Reserve of Atol das Rocas, comprising all water reefs, islands and continental shelf, within the limits of the Brazilian territorial sea (Matos, 1996), contained within the isobath 1000, from the Lighthouse Island (Ilha do Farol). The boundaries of the Atol das Rocas Biological Reserve - created in 1979 - is the same of the Ramsar Site. The boundaries is a square with the geographical coordinates Lat 03°45'00" S and 03°56'00" S and Long 33° 37' 00" W and 33°56'00" W -Gr

8. Geographical coordinates (latitude/longitude, in degrees and minutes):

Provide the coordinates of the approximate center of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

- Lat. 03°45'00" S to 03°56'00" S
- Long. 33°37'00" W to 33°56'00" W -Gr
- **Central: 3°51'52" S 33°48'05" W**

9. General location:

Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

It is located at 144 nautical miles (267 km) E - NE of Natal, Rio Grande do Norte, and at 80 nautical miles (148 km) W of the archipelago of Fernando de Noronha, Pernambuco state.

10. Elevation: (in meters: average and/or maximum & minimum)

Three meters (0-3 meters).

11. Area: (in hectares)

35.186,41 ha.

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

The Biological Reserve of Atol das Rocas (REBIO Atol das Rocas) is located on a seamount Ridge belonging to the Mountain Chain of Fernando de Noronha. This chain has a volcanic origin and is characterized by a set of high seamounts that rise above the continental foothills, between 2° S and 4° 30' S, and extends from the base of the continental slope until 31° W. The seamount on the east end emerges above sea level and forms the archipelago of Fernando de Noronha. The other hills, aligned in the direction E - W until the coast of Brazil (Ceara State), ascend to depths below 250 meters, and some almost reach the surface, as is the case of Atol das Rocas (Damuth & Palma, 1979, Duarte, 1938, Gorini *et al*, 1984).

Because the REBIO Atol das Rocas is located in oceanic waters, far from the continent, it is not included in any municipality; however, it belongs to the state of Rio Grande do Norte.

The relative proximity to the archipelago of Fernando de Noronha, belonging to the State of Pernambuco, has a significant influence over the site by strengthening human pressures related to tourism, and by the possible biological contribution caused by the unidirectional flow of the South Equatorial Marine Current.

The inclusion of the Biological Reserve of Atol das Rocas in the UNESCO World Heritage list, in 2001, was because it represents an oceanic island ecosystem with highly productive waters that provide food for tuna, sharks, cetaceans and sea turtles that migrate to the eastern Atlantic coast of Africa. Thus, its importance in the global context is linked to the maintenance of biodiversity, endemism, endangered species protection, as well as a possible tool for monitoring global climate change, justifying the interest of international organizations in investing in environmental programs targeted at this Conservation Unit, that aims towards conservation and research.

Atol das Rocas demonstrates a spectacular seascape at low tide when the reef is exposed and the lagoon and shallow pools can be observed, resembling true natural aquariums. It is a key location for the protection of biodiversity and endangered or threatened species such as sea turtles, particularly the green turtle and it accommodates the largest concentration of tropical seabirds found in the western Atlantic Ocean, including endemic species.

13. Ramsar Criteria:

Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the Explanatory Notes and Guidelines for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Criterion 1 - The REBIO Atol das Rocas is characterized as an oceanic island environment, with the presence of the only atoll in the South Atlantic, predominantly formed by coralline algae and atypical geomorphological features, having characteristics of both the Atlantic and Pacific atolls. The site represents the first record of coralline algae as primary reef builders during the Quaternary period (MMA, 2001). Atol das Rocas is also the only atoll and the only offshore reef that emerges at sea level in the Western South Atlantic (Kikuchi, 1994). In addition, it hosts migratory birds, endangered species, endemic species and a considerable number of species of economic interest, justifying its great ecological significance. It is considered a true "oasis" of marine life in relatively sterile ocean waters, contributing for the reproduction, dispersal and colonization of marine organisms in the tropical South Atlantic.

Criterion 2- Rosa *et al.* (2002) reports the occurrence of "mero" (*Epinephelus itajara*), globally endangered species included in the IUCN Red List 2000, categorized as Critically Endangered. Additionally, the Atol das Rocas is a reproductive site for *Chelonia mydas* (Green turtle) and there is presence of *Eretmochelys imbricata* (hawksbill turtle) (Marcovaldi & Marcovaldi, 1985, Moreira *et al.*, 1995; Bellini *et al.*, 1996 cited in Grossman, 2001), categorized as Endangered and Critically Endangered, respectively, by the IUCN Red List. These species are also listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and in appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Furthermore, *Caretta caretta* (Loggerhead turtle), also categorized as Endangered by the IUCN Red List and listed in appendix I of CITES, and appendices I and II of CMS, has been sporadically recorded at the site.

Criterion 3 – Leal (1991) reports the existence of five endemic species of prosobrânquios gastropods in the REBIO area of the Atol das Rocas (*Lironoba* sp, *Barleeira* sp. 2 *Dendropoma* sp. 1, *Olivella* sp. 2 and *Metaxia* sp. 2), six species endemic of Fernando de Noronha and Atol das Rocas (*Colisella noronhensis*, *Nerita ascensionis deturpensis*, *Emarginula* sp. 2, *Malea noronhensis*, *Cerithiopsis* sp. 3 *Nassarius capillaris*), a species endemic to Trinidad and Atol das Rocas (*Kurtziella* sp. 2), two species endemic to Trindade, Noronha and Atol das Rocas (*Sinezona* sp. 1 *Nodilittorina vermeiji*), plus some endemic species of Atol das Rocas and seamounts: *Victory* (*Rissoina* sp. 1 *Volvarina* sp. 3) and *Montague* (*Volvarina* sp. 3).

At least five species of sponges are probably new to science: *Clathrina* sp, sp *Leucetta*, *Plakortis* sp. 2 *Plakortis* sp. 3 and *Aphysina* sp. Among these, *Clathrina* sp., *Plakortis* sp. 3 and *Aphysina* sp are provisionally considered endemic to Atol das Rocas, not being known in neighboring areas (Moraes, 2000).

Moreover, 15 species of corals have been recorded of which six are endemic to Brazil (MMA, 2001).

Criterion 4 – At high tide, the entire reef flat is covered by water and only the perimeter of the atoll (reef margin) and the two existing islands can be seen. The islands are real nests and serve as a place for rest and relaxation of important migratory birds. The Atol das Rocas and the Archipelago of Fernando de Noronha are considered the most important areas for the breeding of seabirds in Brazil, both in diversity and quantity. The site provides food for tuna, sharks, cetaceans and sea turtles that migrate to the Atlantic coast of eastern Africa.

According to Schulz Neto (1998), in the REBIO Atol das Rocas species can be classified as: breeding, because they nest there; constant foragers, using the atoll as a resting and feeding area; migratory, only land ashore for breeding in their places of origin, passing the rest of the year wandering the oceans of the world, and finally, sporadic visitors.

Five species nest in the atoll, in both the Farol and the Cemitério Islands: “Atobá-mascarado” (*Sula dactylatra*), “Atobá-Marrom” (*Sulaleucogaster*), the “trinta-reis-de-manto-negro” (*Sterna fuscata*), “Viuvinha-marrom” (*Anous stolidus*) and “Viuvinha-negra” (*Anous minutus*) (Antas *et al*, 1990, Schulz Neto, *op cit.*), more information about these is provided in section 22.

The “trinta-réis-pequeno”, another marine species, breeds in the Northern Hemisphere and migrates to the south during winter, being constantly observed in the Atol (Schulz Neto, *op. cit.*).

The last group of birds that can be registered in the Atoll, and one of the most spectacular due to its peculiar features, are the shorebirds such as sandpipers, which takes its name from feeding on the shores of lakes, rivers and beaches. Only 12 species have been observed so far, and this number can easily increase with an increase in studies. Atol das Rocas, along with Fernando de Noronha, is especially important for this group of birds; it is one of the few places in Brazil where species from the Old World can also be observed (Schulz Neto, *op. cit.*).

Criterion 5 - According to studies conducted in the area, the Atol das Rocas and the Archipelago of Fernando de Noronha are considered the most important areas for seabird's reproduction in Brazil, both in diversity and in numbers of individuals. In the REBIO Atol das Rocas lays the largest tropical seabird colony in the country, with an estimate of at least 150,000 birds of 29 different species (Targino, 2001). This includes the largest South Atlantic colonies of sooty terns, brown noddies and masked boobies, based on the diversity and number of individuals, AdRBR is considered the single most important site for tropical seabirds in the whole Atlantic (BirdLife International, 1998 in MMA, 2001).

Criterion 6 – The “trinta-réis-do-manto-negro” (*Sterna fuscata*) has a population of more than 100,000 birds present in Atol das Rocas, which represents more than 1% of its global population. It is the largest in the South Atlantic; however, they also nest in other oceanic islands in Brazil.

Viuvinha-marrom (*Anous stolidus*) has a pantropical distribution, and Atol das Rocas is the main place for their reproduction in Brazil, with a maximum population estimated at 27,000 birds. This species also nests in other oceanic islands.

Criterion 7 - In the REBIO of Atol das Rocas 147 species of fish were identified and cataloged, being two endemic to Atol das Rocas and the Archipelago of Fernando de Noronha, *Thalassoma noronbanum* (“gudião limpador”) and *Stegastes rocasensis* (“donzela-de-rocas”) (Targino, 2001). According to Moura (1998), in addition to the two species above, there are three other endemic species of Atol das Rocas and Fernando de Noronha, citing one of the not yet described, as *Lythrypnus sp.*

Criterion 8 – The lemon shark, *Negaprion brevirostris*, in the Biological Reserve of Atol das Rocas, is a species easily spotted during underwater raids, carried out within the reef. In the inner portion, in tide pools, central lagoon and the “Baia da Lama” (Lama Bay), individuals of varying sizes are seen, from newborns with a total length of 60 cm in average until adult specimens of over 300cm in total length. Newborns and juveniles with total length ranging from 60 to 120 cm, are most frequently found in Lama Bay, solitary or in schools and swimming in circles. These specimens move from the center lagoon and/or barreta NW (barretinha), always accompanying the rising tide, for example, entering the bay during high tide and out at the low-water mark. The Lama Bay, at Atol das Rocas is a shallow area, sheltered and with the presence of small prey, so it is sought by smaller individuals for food and shelter, also serving as primary and secondary nursery site, as newborns and young individuals are always seen in this area. Adult specimens also seek the region to give birth, always during the warmer months.

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region: Atlantic Ocean, Oceanic Islands.

b) biogeographic regionalisation scheme (include reference citation):

Marine Island ecosystem oceanic, characterized by the presence of an atoll of predominantly algae origin. (PAIVA *et al*, 2007; CLOUD, P. E. Jr., 1957; ALLAUX, 1940; BRIAN, 1953).

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Winds -The REBIO Atol das Rocas is in the trade winds zone, which explains the constancy of winds from SE quadrant that may fluctuate between E and S regardless of the season. According to data from DHN, there is a predominance of E winds, above 40%, followed by SE winds with speeds between 4 to 6 knots. During June, November and December, the SE winds predominate. Silva & Alvarenga (1995) confirm this information for the northeastern Brazilian coast.

Rainfall - According to data from the Brazilian Navy, the rainy season of Atol das Rocas is similar to the Archipelago of Fernando de Noronha, reaching 250 mm in April and 6 mm in the month of October. The relative humidity is high in all months, with an average of 80% or more (Teixeira, 1996). According to IBAMA (1989), the annual rainfall varies from 1,250 to 1,500 mm, with the rainy season between March and July (Schulz Neto, 1998).

Air Temperature - Schulz Neto (1998) and MMA 2007 report an annual average temperature of 26° C, with maximum of 32° C and minimum of 18° C.

Kikuchi (1994) found that in the period 1991-1992 in Atol das Rocas, atmospheric temperature fluctuated daily between 25 °C and 32 °C, with a minimum temperature of 12.78 °C in February of 1992 and a maximum of 36.4° C in June of 1992.

Geology - Structure and Composition of the Reef

Coralline algae are the most important building organisms, volumetrically, in Atol das Rocas, with a frequency of occurrence always above 50% in surveys. This important role of coralline algae in reef construction is a widespread feature among Brazilian reefs as the Abrolhos and the coast of Bahia (Hetzl *et al*, 1994).

Despite the fact that Atol das Rocas presents a shallow lagoon, as is characteristic of the atolls in the Atlantic Ocean, it is founded on a volcanic substrate, as occurs in the Pacific atolls. Morphologically it resembles the atolls of the Atlantic, but it is in a tectonic environment more similar to the Pacific atolls, with a history of relative changes in sea level to the observed there. This small depth of its lagoon can be attributed, therefore, to its small dimensions, which would have allowed the filling of the lagoon by the sediment produced by the reef ring (Kikuchi, 1994).

There are two seismic substrates under the reef: the first, immediately below the reef, characterized by a seismic velocity of 2.46 m/s, which corresponds to a cemented carbonate reef, the second is placed below to the previous one and has seismic velocity of 4.71 m/s, being probably the top of the volcanic substrate of the marine sub mount (Kikuchi, 1994).

The main components of the sediment in and around the reef are fragments of encrusting coralline algae, benthic foraminifers and fragments of mollusk shells. The sum of these three components always accounts to more than 70% of the grains that constitute the samples (Kikuchi, 1994).

Overall, the frequencies of coralline algae and benthic foraminifera have an inversely proportional relationship, which exists due to the local production of these components. The production of fragments of coralline algae occurs in the reef ring and the pinnacles that occur in the lagoon and in some pools, the foreheads of benthic foraminifera occurs in a wide range in the submerged portions both outside and inside the reef (lagoon and pools) (Kikuchi, 1994). The dynamic parameters that act on the sediment, giving them their textural characteristics, are the current that drifts towards west, the waves produced by storms in the North Atlantic, the clash of normal waves and tidal currents (Kikuchi, 1994).

In the geomorphological map of Atol das Rocas the following compartments can be identified: fore/front reef, reef flat/plateau and lagoon. On the outside of the reef, adjacent to the reef front, the ocean floor was denominated as adjacent bottom and is described in association with the reef front. The line that defines the outer perimeter of the reef flat is the reef margin. Pools, channels and sandy islands occur in the reef flat/plateau. See annex I for a detailed description of these.

17. Physical features of the catchment area: *Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).*

Marine currents - The REBIO the Atol das Rocas is over the influence of the South Equatorial Current, which crosses the Atlantic parallel to the equator in the E-W direction. It is characterized by having high temperature and salinity.

Waves - Studies show that over 80% of the waves observed that come from the east quadrant and about 15% of the NE quadrant, are characterized by waves of short periods, of 4 to 7 seconds and a height between 1 and 2 meters. These values suggest that the waves are governed by local climate, combined with the trade winds, and that there is little occurrence of waves from storms of the North Atlantic regions or Equatorial Atlantic (Valentini & Rosman, 1993 cited in Kikuchi, 1994). Melo &

Alves 1993 cited in Kikuchi, 1999 note that between December and March this behavior can change with the occurrence of waves with period of 15s to 18s and heights of up to 2m, from the northern hemisphere.

Tides - The tidal regime semidiurnal. The tide tables published by DHN for the archipelago of Fernando de Noronha presents spring tide range of 2.5 m and width of 1.3 m at neap tide. The tidal amplitudes in the REBIO Atol das Rocas are estimated from tide tables of Fernando de Noronha. Kikuchi (1999) states that in sigízia tide, the amplitude can reach 3.2 m.

According to Netto (1999), the environments in the Atol das Rocas significantly differ in relation to hydrodynamic conditions: while the main forces acting on the outside of the atoll are related to ocean currents and waves, inside the atoll water flow is defined by strong tidal currents and a lesser degree by the waves.

Water Temperature - Kikuchi (1994) recorded temperatures at depths greater than 2m ranging from 27 °C to 28.5 ° C and in the most superficial layer the temperature reached 29.5° C. In pools, temperatures of 39 °C were recorded. At depths greater than 10m, there was a gradual reduction of temperature 26.5° C. Ottman (1963) cited in Kikuchi (1994) recorded a temperature close to 43° C in the pools.

Oceanographic surveys conducted by the oceanographic ship (NOc) Almirante Saldanha in 1986 in the region between Fernando de Noronha and Atol das Rocas recorded temperature of 27.7°C and 16° to 20° at depths of 10 to 100 m, respectively. According to Sales (1992), the annual average temperature of the surface water is around 37° C (Teixeira, 1996).

Salinity - The distribution of salinity in the equatorial region presents little seasonal variation, with a slight increase in spring (maximum of 36.2 mg/g) and decreasing from 100m. South of the equator, the distribution of isolines is zonal, with a slight increase from north to south, little seasonal variation, and increases with depth up to 100 m (maximum of 37mg/g) (Silva & Alvarenga, 1995).

pH - occasional pH measurements made by Kikuchi (1994) showed a great range of variation, values close to 5 in measurements performed at night and values near 11 during the day. Araújo (1991), studying zooplankton found quite stable pH values between 8.5 to 8.6, and the measurements were performed during the day at stations located in Barretão, Barretinha, Laguna and the outside area of the atoll.

Water Transparency - Sales (1992) reports visibility from 25 to 40m (Teixeira, 1996). Kikuchi (1994) states that, in good weather conditions visibility during the studied period (1991-1992) was always greater than 20m.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

The Atol das Rocas Biological Reserve is located in the middle of the ocean and hydrological values are not known.

19. Wetland types

a) presence:

Circle or underline the applicable codes for the wetland types of the Ramsar "Classification System for Wetland Type" present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the Explanatory Notes & Guidelines.

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)
Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp • Ts • U • Va •
 Vt • W • Xf • Xp • Y • Zg • Zk(b)
Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

b) Dominance:

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

Environments	Áreas (ha)
C	336.36
G	215.00
A	126.51
E	22.15
Site Limits	35,186.41

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

In the Atol das Rocas there are only two islands of biogenic origin. The soil of the islands are predominantly composed of limestone and is heavily fertilized by the seabirds' excrement which, along with the lack of fresh water - except for the rain - leads to the existence of a small variety of plant species, highly adapted to this hyper saline environment and intense light. A small range of herbaceous species and the presence of some coconuts, introduced by man, characterize the vegetation. The marine vegetation is characterized, to date, by the existence of 121 strains of algae, much of which consists of epiphytic algae, hardly observed by the naked eye.

Teixeira (1996) mentions that the terrestrial flora is very poor and the Cemitério Island has an even smaller number of species. This author reported the existence of six species in six families: Amaranthaceae (*Iresine portulacoide*), commonly known as pirrichil; Cyperaceae (*Cyperus ligularis*), called razor grass or manibu; Portulaca (*Portulaca oleracea*) or beldroega; Palmae (*Cocos nucifera*), with eight plants well grown; Casuarinaceae (*Casuarina sp.*), and Gramineae (Poaceae) without identification. This author also reports that the razor grass is associated with pirrichil and beldroega.

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.

Terrestrial vegetation

According to MMA, 2007, the genera occurring in the islands of the atoll are *Blutaparon* sp. (Amaranthaceae), *Portulaca* sp. (Portulaca), *Cyperus* sp. (Cyperaceae) and *Hymenocallis* sp. (Amaryllidaceae). In addition to these, also occurs Gramineae (in confirmation of species), another Cyperaceae (to be confirmed) as well as *Cocos nucifera* (Arecaceae), introduced by fishermen.

Melo (1999), in his report on the scientific visit carried out in Atol das Rocas in September 1999 indicates through partial data the existence of *Portulaca oleracea*, *Cyperus ligularis*, *Sesuvium portulacastrum* (Aizoaceae), *Festuca* sp. (Poaceae), *Hymenocallis caribea*.

Targino (2001) reports (without disclosing the source), the existence of vegetation typically of herbaceous species with *Blutaparon portulacoides*, *Cyperus ligulares*, *purslane Portulaca*, *Eragostris sp.* *Chloris sp.* belonging to the families Aizoaceae, Portulaca, Cyperaceae, Amaranthaceae, Gramineae and Amaryllidaceae, and a few coconut trees, *Cocos nucifera*, as the only large ones.

Marine vegetation -

Oliveira Filho and Ugadim (1976) recorded the occurrence of 93 macroalgae taxa for Atol das Rocas, where almost half consisted of epiphytic algae, hardly observed by the naked eye. Subsequently, Gherardi (1996) identified four kinds of coralline algae. Villaça (2001) recorded over 24 new taxa of macroalgae: *Bryopsis plumosa*, *Caulerpa cupressoides var. cupressoides*, *Caulerpa mexicana*, *Caulerpa verticillata*, *Cladophora dalmatica*, *Codium repens*, *Neomeris annulata*, *Dictyota cervicornis*, *Dictyota mertensii*, *Botryocladia pyriformis*, *Centroceras clavulatum*, *Champia parvula*, *Haliptilon cubense*, *Jania adhaerens*, *Nitophyllum punctatum*. Therefore, to date, 117 algae have been recorded for Atol das Rocas.

The Chlorophyceae *dictyospaheria ocelata* and Rodophyceae *Digeniasimplex* are the most frequent seaweeds and with greater abundance in the reef plateau, excluding the fact that the entire substrate is constituted by Rodophyceae *Porolithon crustosa cf pachydermum*, mostly dead (Villaça, 2001).

The reef plateau, the crest, the pools and the outer side of the atoll, to leeward, present the best environmental conditions for the development of seaweeds. However, in some areas of the reef, algae grow in soft substrates, forming large masses, as in the case of green algae *Rhizoclonium sp.*, very common in the Lama Bay (Villaça, 1999 and 2001).

On the outer side of the Atol, there are different species of brown algae responsible for the coloration that varies from green to brown. On the protected side (leeward), chlorophyll *Bryopsisplumosa* merges with the *Dictyota pfaffi*, providing a green or blue bottom, respectively. In the front part of the reef, dense populations of *Bryotamnion trichetum* are found (Villaça, 2001).

In the pools, there are distinctions in the macroalgae cover. In the pools located near the reef crest, with connection to the sea, the cloroficea *Caulerpa sp.* is very common, occurring often associated with tufts of *Jania adhaerens* in the shallows. In the deeper parts, the presence of feoficea *Dictyota sp.* can be verified. In pools located in the innermost areas of the reef, the occupation of the limestone substrate usually happens at the reef edges or sides or in reef structures within the pools. In the shallowest sites, *Gelidiella sp.* is common, while in the deepest, the pool walls are predominantly occupied by rodoficea *Galaxaura rugosa* and the feoficea *Lobophaga variegata*. In darker and deeper places, there is the presence of long purple filaments of *Cyanobacteria*, of the *Lyngbia* genera (Villaça, 2001).

22. Noteworthy fauna

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.

Terrestrial Fauna

Mastofauna -

The only representative species of mammals found in Atol das Rocas is the Muridae, *Mus musculus*, very well adapted to the conditions of the Atoll. Its introduction, in Atol das Rocas, probably occurred through shipwrecks and/or by vessels that have traveled to the site. They colonized the two islands, where they make their nests among the roots of the vegetation (Rocha, 1993). According to Moojen (1952), these rodents are found virtually everywhere in the Brazilian territory and islands (Trinidad), even in less populated places.

Avifauna -

Breeding birds:

Atobá-mascarado (*Sula dactylatra*) prepares their nests on the ground in areas devoid of vegetation. The female lays two eggs, and only one chick reaches young age. Their reproductive peak occurs between April and July. It is a species with a pantropical distribution and has the Atol das Rocas as their main reproductive area (Murphy, 1936, Antas *et al*, 1990). The species also nests in the archipelago of Fernando de Noronha and Abrolhos. Its population is estimated as 5,000 birds, in the Atol das Rocas (Schulz Neto, 1998).

Atobá-marrom (*Sula leucogaster*), also has a pantropical distribution. Their nests are located also in the soil, where two eggs are laid and only one chick reaches young age. Reproducing in several Brazilian coastal and oceanic islands, from the coast of Santa Catarina to the Archipelago of São Pedro and São Paulo, this species has a small population in Atol das Rocas, of approximately 300 individuals. Although nesting throughout the year, their reproductive peak occurs between April and July, along with the Atobá-mascarado. Performs long journeys, and birds marked in the Moleques do Sul Islands/SC were recovered in the islands of Fernando de Noronha and Abrolhos, suggesting that individuals from different parts of the Brazilian coast arrive at Atol to establish themselves (Schulz Neto, op. cit.).

The “trinta-réis-do-manto-negro” (*Sterna fuscata*), usually lays one egg directly on the ground or vegetation, often at less than 7.5 cm from others. Many chicks do not reach adulthood due to the high mortality rate. This species can be registered reproducing throughout the year, with the highest number recorded in the last and first months of each year. This species remains wander on the oceans of the world, returning to their places of origin only to reproduce, often 6 years later, after reaching sexual maturity. There is a record of an individual marked on Atol das Rocas and recovered off the coast of Bahia (Schulz Neto, op. cit.).

“Viuvinha-marrom” (*Anous stolidus*), predominantly lays an egg in nests made on the herbaceous vegetation. It reproduces almost all year round, but it has the largest number of breeding individuals in the last and first months of the year, along with the previous species (Schulz Neto, op. cit.).

“Viuvinha-negra” (*Anous minutus*) is restricted to the tropical Pacific and Atlantic oceans. Despite having less than a dozen nests, made of calcareous algae on a ledge of the ruins of the lighthouse keeper's house, its population in the Atoll is estimated at 1,750 individuals. It is the most abundant species in Fernando de Noronha, the main nesting area for the species in Brazil (Schulz Neto, op. cit.).

Constants foraging birds: two species of seabirds can be recorded throughout the year, coming from Fernando de Noronha, which use the coconut trees, bushes and dry ruins of Atol das Rocas as landing sites for resting, and adjacent areas to catch their prey. Both reproduce only over trees and/or rocky cliffs in Fernando de Noronha, which is virtually impossible in the Atoll, due to the large concentration of birds for the small amount of perches (Schulz Neto, op. cit.).

Atobá-do-pé-vermelho (*Sula sula*), with a pantropical distribution, has Fernando de Noronha as its only reproduction site in Brazil. The number of individuals in Atoll varies during the year, reaching an estimated maximum of 350 birds (Schulz Neto, op. cit.).

The frigate (*Fregata magnificens*), finds in the Atoll, abundance of food, once its main food source consists of stolen prey from other seabirds. Restricted to the Atlantic and Pacific coast of the Americas, it is widely distributed along the Brazilian coast, where it reproduces in several coastal and oceanic islands, with a maximum population in Atol das Rocas, of 50 individuals (Schulz Neto, op. cit.).

Migratory Birds and Sporadic Visitors: So far, five migratory oceanic species of birds have been recorded in Atoll das Rocas, three from the North and two from the South (Schulz Neto, op. cit.)

The “garça-vaqueira”, considered an aquatic bird, predominantly inhabits freshwater environments, and is not considered a migratory species, but visits the atoll sporadically, probably coming from the Old World. It is noteworthy that this bird colonized Brazil only in the mid 20th century and may have used our oceanic islands as places to rest and feed (Schulz Neto, op. cit.).

Two marine species that are not considered migratory, the “rabos-de-junco” (*Phaethon sp.*) reproduce in Fernando de Noronha and use the Atol sporadically, as a feeding area.

There is also the sporadic presence of an introduced species, the house sparrow (*Passer domesticus*), with only six individuals, who probably came to the Atoll with vessels that have been there (Schulz Neto, op. cit.).

Herpetofauna - The only reptiles recorded in the REBIO Atol das Rocas belongs to the Cheloniidae family, represented by marine turtles. Of the five species that occur in the Brazilian waters, reproducing and/or feeding: *Chelonia mydas* (green turtle) and *Eretmochelys imbricata* (hawksbill turtle) are the most frequent.

In Brazil, besides the Trinidad Island, Atol das Rocas is another important breeding site of the species *C. mydas*, which also spawns in the archipelago of Fernando de Noronha and sporadically along the Brazilian coast, from the state of Rio de Janeiro to the north (Marcovaldi & Marcovaldi, 1985, Moreira *et al.*, 1995; Bellini *et al.*, 1996 cited in Grossman, 2001).

According to Grossman (2001), on the 11 years of studies made by the Tamar project, there were 623 females of *C. mydas* nesting in the REBIO of the Atol das Rocas, and this population is characterized by presenting a reproductive activity for lasting about six months a year. The beginning of the reproduction season occurs from the second half of December and lasts until May, with few lasting until June. The reproductive peak occurs between February and March. The turtles that nest in the Atol das Rocas have a preference for nesting above the tide line, and the parts of the beach above the high tide line harbor 89.29% of the nests and the remaining nest in the open portion of the beach. The largest turtles prefer nesting in the highest portion in the vegetation, while the smaller turtles nest on the open beach. Turtles with intermediate size spawn on the edge of the vegetation.

Ichthyofauna - Rosa *et al.* (2002), in a paper on the lemon shark (*Negaprion brevirostris*) reports the occurrence of 4 species not yet mentioned in the Atol das Rocas: *Epinephelus itajara* (mero), *Cephalopholis cruentata*, *Canthidermis sufflamen*, and *Cantherbines macrocerus*.

In a research on elasmobranchs of the Atol das Rocas, Oliveira (2001) points out the lemon shark as the most sighted species in different types of environments.

Stingray Shark, *Ginglymostoma cirratum* was the second most abundant species in REBIO. The occurrence of pregnant females associated with the presence of embryonic capsules in the beach, in August, suggests that the area inside the atoll can be used as a delivery area for this species (Oliveira, 2001).

The “prego” ou “manteiga” rays, *Dasyatis spp.* were the most commonly found species of rays, mostly adults, with higher occurrence in enclosed environments. Females were more common in the NE Barreta (Barretão), in the pools of “Tartarugas” and “Âncoras” (Turtles and Anchors), and males in NE Barreta and “Âncoras”.

According to Rosa *et al.* (2002), the most common species of elasmobranchs observed in Atol das Rocas and Fernando de Noronha were *Carcharhinus perezii*, *Ginglymostoma cirratum* and *Dasyatis americana*. It was also reported the observation of an unidentified species of Carcharhinus, a manta ray, *Manta birostris*, a tiger shark (*Galeocerdo cuvier*) and the “raia-chita”, *Aetobatus narinari*.

Entomofauna - In the survey for the entomofauna of the Atol das Rocas performed by Almeida *et al.* (1999), 1606 insects and 112 arachnids were collected, which enables to verify the presence of at least 22 morphospecies belonging to the class Insecta and 17 families belonging to Arachnida.

According to Lourenço (1982), the scorpion *Isometrus maculatus* is the only species of its genus to have reached the American and African continents, and the occurrence of this species in island environments already was recorded in several islands of Antilla and islands of the Pacific Ocean. The presence of *Isometrus maculatus* in Atol das Rocas is particularly interesting because of the small surface of the two dry areas of the Atoll, the islands of Farol and the Cemitério. However, the absence of fresh water is not a problem for these arachnids, which have a very small ecological demand, being satisfied with the rainwater (Lourenço, 1982).

Isometrus maculatus occurs in several localities of the Northeast coast of Brazil (Bücherl, 1959) and was probably introduced into the Atol das Rocas by fishing boats or other vessel types (Lourenço, 1982).

Marine Fauna

Echinoderms- Targino (2001) in his project to create a collection of ex-situ species of Atol das Rocas records the occurrence of seven species of echinoderms: *Ophioderma rubicundum* (“ofiúro vermelho”), *O. appressum* (“ofiúro marrom”), *Diadema antillarum* (black sea urchin), *Echinometra lucunter* (blue sea urchin), *Tripneustes ventricosus* (White Sea urchin), *Eucidaris tribuloides* (satellite sea urchin) and *Linckia guildingii* (starfish).

Crustaceans - Atol das Rocas has a very large variety of crustaceans, but few scientific studies have been conducted. Coelho (1965) described twelve species, eight of which were not studied by Teixeira (1992, 1996). Fausto-Filho (1967) in his work on the Northern and Northeastern Calapídeos in Brazil cites only one male of the species *Calappa ocellata* captured in Atol das Rocas.

The infraorders found by Teixeira (op. cit.) were Brachyura, Caridea and Paguridea. Near eleven families were found Alpheidae, Diogenidae, Dromiidae, Xantidae (dominant), Majidae, Galappidae, Gonodactylidae, Pseudosquillidae, Grapsidae, Ocypodidae and Gecarcinidae. The locations of the samples were in reefs and pools, and particularly in the Atoll lagoon, making it an exception to the terrestrial crab, *Gecarcinus lagostoma* found in the drier areas of the islands of the Farol and Cemitério.

The genus *Gecarcinus* is distributed on both sides of America, but the species *Gecarcinus lagostoma* is restricted to the South Atlantic Ocean, particularly in the islands of Trinidad, Rocas Atoll, Fernando de Noronha, Trinity and Ascension Island.

The terrestrial *Gecarcinus lagostoma* of the Atol das Rocas feed on turtle eggs and sea birds, insects, scorpions, mouse *Mus musculus* and vegetations. Predators of this species were not observed in Rocas. In Atol das Rocas and surroundings there is the lobster *Panulirus sechinatus*, which was quite captured by the fishing fleet of Rio Grande do Norte (Lins Oliveira *et al.*, 1993).

Malacofauna - Few studies make reference to the molluscs of the Atol das Rocas. Mathews & Kempf (1970) in a survey on the marine molluscs of north and northeast of Brazil, present the mollusc fauna of the archipelago of Fernando de Noronha with some references to the Atol das Rocas. The work reported the existence of a total of 77 species of molluscs in Atol das Rocas and the surrounding area; 75 new cases were registered at the time, 22 of which were not found in the Archipelago Fernando de Noronha. Eight species constitute of new records for Brazil (*Arca zebra*, *Isognomon cf. Alatus*, *Lima scabra*, *Liotia bairdii*, *Murex cf. pulcher*, *Octopus hummelincki*, *Dentalium amaliense*, *Asaphis deflorata*) and it was observed the existence of two new species to science (*Bursa aff. thomae*, *Malea noronhensis*), 14 Pelecipoda, 20 gastropods, 1 Cephalopod, 1 Escafópoda and 1 Anfineura were recorded. The authors state that certain species common to the whole archipelago of Fernando de

Noronha/Atol das Rocas and the mainland, find in the first, favorable conditions for their development, allowing them to present a large number of individuals, calling attention to the bivalve species *Codakia orbicularis*, whose dead shells of large size were found in abundance in the Laguna of Atol das Rocas.

Endemic (or potentially endemic) species were found in relatively high frequency in the four islands, and the Atol das Rocas had a highest rate of endemism (14%) than Fernando de Noronha (9%), suggesting that this may be the result of physical differences between these islands. Atol das Rocas has a larger island platform, with probably a more constant bottom and habitats in more stable conditions, favoring the processes of adaptation and speciation (Leal, 1991).

Pinto *et al.* (n.d.) analyzing pateliforme fauna in the islands of Fernando de Noronha and Atol das Rocas by collecting 464 specimens stated that these are divided into three families, Fissurellidae, Lottiidae and Siphonariidae, represented by species: *Fissurella clenchi*, *F. rosea*, *F. nimboza*, *F. emmanuelae*, *Diodora mirifica*, *D. arcuata*, *D. dysoni*, *D. sayi*, *D. cayenensis*, *Emarginula aff. phrixodes*, *Lucapina aegis*, *Lucapinella limatula*, *Collisella noronhensis*, *Lottia leucopleura*, *Siphonaria lessoni*, *S. hispida*, and *S. pectinata*.

Benthic meiofauna and macrofauna - The results presented below are based on the study "of benthic macrofauna and meiofauna of the REBIO the Atol das Rocas" performed by Netto (1999).

For this study, samples were collected at 50 stations located in the REBIO Atol das Rocas and the main taxons were recorded, 14 meiobenthos and 15 macrobenthos. Among the meiobenthos, copepods and nematodes were numerically dominant.

Macrobenthic invertebrates were largely dominated by oligochaetes, nematodes and polychaetes.

The number of species, the density and diversity varied significantly among habitats, but the differences are dependent on the faunal group analyzed.

Similarity analysis of meiobenthos and macrobenthos showed that among the 109 recorded species, variations in the relative abundance of *Chromaspirinia* sp.1, *Metoncholaimus* sp.1 and *Gomphonema* sp.1 contributed to a greater discrepancy of the similarity between habitats. The important species for the characterization of the sublittoral belong to the families Epsilonematidae (16%) and Draconematidae (12%), while the distinctions between sandy deposit samples were mainly due to *Chromaspirinia* sp.1 (13%) and *Metoncholaimus* sp.1 (12.5 %). The pools and lagoon were characterized by high-density *Metoncholaimus* sp.1 (12%) *Paralimbomoeus* sp.2 (10%) and *Thalassironus* sp.1 (9%). A total of 34 species of macrobenthic nematodes was recorded, and *Anticoma* sp.1 (37%) and *Cylicholaimus* sp.1 (29%) characterized the sublittoral area. Large nematodes of sandy deposit were distinguished by the abundance of *Thalassironus* sp. 1 (56%) and *Metoncholaimus* sp.1 (24%), while the lagoon and pools the abundance of *Paralimbomoeus* sp.2 (33%) and *Halichoanolaimus* sp.1 (16 %).

A total of 72 polychaete species were recorded, including 45 species of meiobenthic polychaete. Analyses of similarity of macrobenthic polychaete showed that many species contributed to the differences between habitats, but differences in the abundance of *Saccocirrus papillocercus*, *S. cornuta*, *Eteone heteropoda*, and, to a lesser extent, *Hermodice carunculata* are important in characterizing each habitat in terms of fauna. Samples of the outer subtidal area were differentiated from samples of more internal habitats because of *E. heteropoda* (17%), *Protodrilus* sp. 1 (15 %) and *Pionosyllis gesae* (12%). A small number of species and density of macrobenthic polychaetes (43%) and, to a lesser extent, *H. carunculata* (23 %) were the main aspects of the intertidal area, while high densities of *S. cornuta* (22.7 %), *Spio pettioboneae* (22.2 %) and *Taryx* sp. 1 (9 %) characterized the pools and lagoon.

In all studied habitats in Atol das Rocas, oligochaetes, nematodes and polychaetes numerically dominated the macrofauna, while molluscs, crustaceans and echinoderms represent less than 4% of the

total density. This dominance is due in part to data collection techniques employed in most studies (mesh > 0.5 mm), underestimating the diversity and abundance of wormlike organisms.

The relatively small size of the fauna and its opportunistic distribution probably indicate a low detritus "input" and may suggest that the macrobenthos could quickly respond to local physical instability.

In contrast to the variable model shown by macrofauna, meiofauna showed an increase in the number of species and abundance leeward to the atoll. The progressive change in the meiobenthic community is particularly evident for the nematodes. Wolanski & Hamner (1988) suggest that such improvements in density of organisms are mainly caused by topographically controlled fronts. An interaction between currents, topography and reef channels result in convergence zones and vortex where debris and organisms pile up and affect the distribution of sediments, eggs, larvae, phytoplankton and zooplankton, and consequently influence the density and distribution benthic assemblies.

Cnidofauna -

Echeverría *et al.* (1997) studied the distribution of the cnidarians of Atol das Rocas and recorded the occurrence of twenty species belonging to 6 orders: *Millepora alcicornis*, *Millepora braziliensis* (Order Capitata), *Plexaurella dichotoma*, *Phyllogorgia dilatata* (Order Gorgonacea), *Telmatactis rufa*, *Aiptasia pallida*, *Bellactis ilkahyseae*, *Phyllactis correae* (Order Actiniaria), *Zoanthus sociatus*, *Palythoa caribbaeorum* (Zooanthidae), *Madracis decactis*, *Agaricia agaricites*, *Siderastrea stellata*, *Porites astreoides*, *Porites branneri*, *Favia gravida*, *Montastrea cavernosa*, *Mussismilia hispida* (Scleractinia), and a species not identified belonging to Order Ceriantharia.

According to these authors, the fauna of cnidarians of Atol das Rocas has a smaller species diversity compared to Fernando de Noronha, being the most notable difference the occurrence of a few species of hydroids, only two in the Atoll (*Millepora alcicornis* and *M. braziliensis*) against 13 in Fernando de Noronha. On the other hand, the species of octocorals (*Plexaurella dichotoma* and *Phyllogorgia dilatata*) are found in both locations, as well as zoanthids, except *Isaurus tuberculatus*, found only in Fernando de Noronha. Only 4 species of Actinias occur in the atoll, in contrast with 7 registered to Fernando de Noronha. The actinarians *Telmatactis rufa*, *Aiptasia pallida* and *Bellactis ilkahyseae* are common to the two localities, while *Phyllactis correae* was recorded only for the Atol das Rocas. The restricted distribution of this species is probably due to the specific habitat where they occur, which is composed of coarse gravels carbonate, absent in Fernando de Noronha (Echeverría *et al.*, 1997).

Coral cover is extremely low in Atol das Rocas, with occasional variations, outstanding *Siderastrea stellata* as the most abundant species, followed by *Porites* spp. The zoanthid *Zoanthus sociatus* showed a dense cover on the west side of the lagoon and west canal, with a constant occurrence in reef flat. The *Palythoa caribbaeorum* occurs in patches scattered over the entire reef, but with greater coverage in pools located in the northwestern part of the atoll (Echeverría *et al.* 1997, Ginsburg, 1994).

Maida & Ferreira, 1997 did a coral reef monitoring program and describe the health of coral reef by using reef check methodology.

Sponge fauna -

In a survey conducted for porifera of the REBIO Atol das Rocas, Moraes (2000) found 39 species, revealing a community of sponges as rich as in Tamandaré (PE) (36 spp, Muricy & Moraes, 1998), but with less diversity when compared to Fernando de Noronha, with 56 known species of sponges (Mothes & Bastian, 1993; Muricy & Moraes, 1998). The greatest diversity of Fernando de Noronha relates to the higher average depth, environments that are more heterogeneous, the existence of caves and to the fact that the island area is much larger than the atoll. However, it draws attention to the possibility that the amount of sponge species in Atol das Rocas may be higher than reported, since the region outside the reef ring cannot be properly investigated.

Twelve species common to Atol das Rocas and Tamandaré – PE were identified and 13 common species in Atol das Rocas and Fernando de Noronha, suggesting gene flow between these sites. The region of the REBIO is bounded by the South Equatorial Current, with a constant W drift, in the Noronha - Continent direction, passing through the Atol das Rocas and may be responsible for the dispersal of sponge larvae between these sites, explaining the similarity between the communities of these sponges in the three areas (Moraes, 2000).

According to Moraes (2000), Fenda is the environment that has the highest diversity and density of sponges in Atol das Rocas. The Cemitério's pool is the site with the second highest diversity, but low density. The most abundant species at this site were *Spirastrella coccinea*, *Cinachyrella alloclada*, *Amphimedon* aff. *Compressa*, and *A. viridis*.

The most frequent species in Atol das Rocas were *Spirastrella coccinea*, *Cinachyrella alloclada*, *Chondrilla* aff. *nucula*, *Scopalina ruetzleri*, *Plakortis* sp. and *Amphimedon* aff. *compressa*.

Differences in luminosity, wave beating, depth and substrate are noted in the community structure of Porifera and there is a big difference in the diversity and density of sponges between environments. In environments where conditions are more extreme (light, salinity and temperature), only a few species are found, with a predominance of *Chondrilla* aff. *nucula*, the only species observed exposed to air (Moraes, op. cit.).

The dominance of *Spirastrella coccinea* in Atol das Rocas may be related to its incrusting shape, making it a species tolerant to hydrodynamics and abrasion (Alcolado, 1989 *apud* Moraes, 2000).

Atol das Rocas has a low degree of endemism (12%) when compared with other reef environments, probably due to its proximity to Fernando de Noronha, as well as the system of local currents. However, increasing the sampling effort, especially in the deeper and external parts of the reef ring allows more profound taxonomic studies of rare species, and the number of new and/or endemic species may increase.

Zooplankton - REBIO Atoll das Rocas constitutes a site of intense spawning and breeding of fish and shellfish, mainly (Araújo, 1991)

According to Longa (1993), the macrozooplankton was represented by 11 phyla with a very large richness of larval forms, young and adults. Of those 11 phyla, Mafalda-Junior & Araújo (1992) had already recorded 10. According to these studies, the holoplankton comprised Foraminiferida, Hydroida, Calyphorae, Limacinidae, Gymnosomata, Copepoda, Ostrocooda, Hyperiidia, Gammaroidea, mastigopus of Sergestidae, Euphausiacea, Sagittidae, Salpidae and Oikopleuridae.

The meroplankton was represented by: Nemertea, Nematoda, Phoronida, Bivalvia, Gastropoda, Teuthoidea, Pycnogonida, antizoéa and young Stomatopoda, Mysidacea, Isopoda, Cumacea, Caridea post-larvae, Penaeidea post-larvae, phylosoma of Panilura, Porcellanidae zoea, mysis-zoea and glaucothoe of Anomura, zoea and megalopoda of Brachyura, eggs, larvae and young of Teleostomi.

The ichthyoplankton was represented by 6 orders involving 6 families (Ophichthidae, Clupeidae, Hemiramphidae, Atherinidae, Syngnathidae and Blennidae) and 6 species of larvae. Eggs of Anguilliformes, Clupeidae, Hemiramphidae and Perciformes were found. The Clupeidae were the most representative (Longa, 1993).

Rosa *et al.* (1997) found 48 species in 21 genera and 11 families in the area of influence of the Atol das Rocas and Fernando de Noronha.

The most representative family in number of species was Tintinnidae (13 species), represented by:

Amphorides quadrilineata, *Amphorellopsis acuta*, *Dadayella ganymedes*, *Tintinnus apertus*, *T. fraknoii*, *T. baslea*, *T. medius*, *T. stramentus*, *T. tubulosus*, *Salpingella subconica*, *Steenstrupiella gracilis* and *S. steenstrupii* (Rosa et al, 1997).

The species *Codonella nationalis*, *Codonellopsis tuberculata*, *Rhabdonella hydria*, *R. hensensi*, *Coxiella meunieri*, *C. ampla*, *Ascampbelliella urceolata*, *Undella subcaudata*, *Parundella attenuata*, *Undella californiensis* constituted the first record for Brazil (Rosa, op. cit.).

Despite the number of species identified, most of them occurred sporadically, emphasizing in the quantitative terms, only species of *Tintinnus fraknoii* (dominant) and *Rhabdonellopsis apophysata*, *R. elegans*, *R. amor*, *E. apertus* and *Poroecus apicatus* (most abundant). The low densities of Tintinnina recorded for the area confirms the oligotrophic characteristic of the region studied. The high values, calculated for the indices of diversity and equality, suggest high stability for the community of Tintinnina in the region (Rosa, op. cit.).

23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

The currently existing occupation occurs due to the research base of the REBIO, which shelters researchers and staff.

It is stated that in the recent past, before the effective creation of the REBIO, fishers who used nestlings of birds as bait for lobster catch, plus eggs and birds for food, constantly visited the atoll. However, within the limits of REBIO fishing is still practiced, though on a lesser extent, but can be considered a major threat to this conservation unit.

In periods of sail boat racing, especially the Natal-Fernando de Noronha race, sailboats eventually step into the boundaries of REBIO and sometimes reach the atoll intending to visit it, which is dependent on the approval of the Chief of the conservation unit.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box and describe this importance under one or more of the following categories:

- i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:
- ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:
- iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:
- iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

a) within the Ramsar site:

Because they are oceanic islands, they are all under the control of the Federal Government. However, there are areas within the site that are in the possession of the Brazilian Navy, such as the lighthouse on the "Farol" island.

b) in the surrounding area:

The surrounding area is part of the Brazilian Exclusive Economic Zone, under federal Government control (Carvalho, 1999).

25. Current land (including water) use:

a) within the Ramsar site:

There is no use of land or water, except for research purposes.

b) in the surroundings/catchment: The use in the surroundings area area navigation, recreation, commercial small scale fishing and industrial fishing.

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

a) within the Ramsar site:

Atol das Rocas is exposed to other exceptional occurrences of natural order, as heavy storms, associated with meteorological and oceanographic conditions of the northern hemisphere's winter, especially during summer in the southern hemisphere.

During field works a process of erosion was verified in the Lama Bay slope, just behind the research base. If the process continues, it may compromise the building, forcing the change of its location. The causes of this erosion are not yet known. On the sheltered side of the Farol Island (leeward) some evidence of erosion was observed, which is not very common. Low energy places are usually related to sedimentation areas. According to the work of Kikuchi (1994), this island is formed by two stable spurs and one in development, which originate the Lama bay.

One possible explanation for this may be related to the dynamics of the internal circulation of the atoll. When the tide fills, a large volume of water enters the inner area of the atoll through Barretão, heading toward the region of Barretinha, where also lays the Farol Island. Since Barretinha is much narrower, the volume that enters does not get out at the same rate, forcing the excess water to spin behind the Farol Island. This movement can remove sediment from the protected side and move it to the other side of the island, favoring the growth of the spur. This also explains why in the Barretinha, the current direction is always towards the draining of the water out of the atoll, regardless of the tidal regime. Although this hypothesis has been ratified, verbally by professionals of the Institute of the National Research Waterway (INPH) of Rio de Janeiro, it is necessary to perform more studies and mathematical modeling to confirm it or reject it.

Illegal fishing is the main conflicting activity carried out within the REBIO Atol das Rocas. Prior to the almost constant presence of researchers and employees on the research base, fishers aiming to catch lobsters frequently visited the atoll. Currently this issue does not exist inside the atoll, but illegal fishing is still practiced within the conservation unit, which has the limit with the 1000m isobath. The captures performed most often occur in the area corresponding to the adjacent plateau, which declines gently to the 50m isobath and, thereafter, begins a steeper slope where the depth increases rapidly as it moves away from the atoll.

Other impacts on the site are:

-Visits of sailors to the atoll.

-Introduction of exotic/invasive species.

-Visits and/or long stays of researchers in certain areas that are important for feeding and mating of different species.

-Commercial and military flights over the site have a negative impact on birds.

b) in the surrounding area:

Commercial small scale and industrial fishing.

27. Conservation measures taken:

a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:

In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

- Decree of establishment of the Reserve in June 1979;
- Management Plan approved in 2007 and being implemented;
- Considered a World Heritage by UNESCO along with the National Marine Park of Fernando de Noronha forming the complex of the Atlantic Islands Southern Brazilian Coast, in 2001.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ; Ib ; II ; III ; IV ; V ; VI

c) Does an officially approved management plan exist; and is it being implemented:

Management Plan approved in 2007 (MMA, 2007, Galante *et al*, 2002) and being implemented. The Reserve received financial resources from NGO SOS Mata Atlântica to support the implementation of the reserve.

d) Describe any other current management practices:

The Management plan was created in 2007 and the practices that are being implemented are: fiscalization of any type of fishing inside the reserve, conducting marine research such as conservation of endangered species as marine turtle *Cheylonia mydas*, coral reefs, fish such as sharks, sea and migratory birds, etc.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

-Develop a procedures manual for researchers and trainees working in REBIO. This manual should consider the best practices of conduct, areas of higher accident risk, and special areas for feeding and reproduction of some species (considering seasonality), among others. The manual should provide maps/sketches of the areas of greatest accident risk, special areas and routes.

-Conduct surveillance on REBIO fortnightly by IBAMA agents or through partnerships with other institutions.

-Coordinate the establishment of an agreement with the Brazilian Navy, the Brazilian Air Force and other agencies and public enterprises, aiming to collaborate on the supervision of the Unit. The inspection shall act primarily on illegal fishing inside the conservation unit.

-During the sailboat racing (Natal - Noronha), supervision should be intensified in order to restrain the visit of the sailors in the atoll.

-The periodic trips to transport staff and researchers at the atoll must be accompanied by enforcement agents. Liaise with the State Committee for Fisheries and the Ministry of The Fisheries and Aquaculture (MPA) in Rio Grande do Norte strategies guidance on standards and prohibitions for the conservation unit.

-Adopt control measures to prevent the introduction of alien species in conservation unit.

-Food, utensils, clothing and equipment should be cleaned and inspected prior to entering the conservation unit.

-Special attention should be taken towards insects and arachnids.

-Adopt control measures to prevent the proliferation of exotic and/or invasive organisms in the conservation unit.

-The organic waste should have proper disposal in order to avoid the availability of food, especially for mice (*Mus musculus*) and cockroaches.

- If scientific studies demonstrate the alien and/or invasive fauna, they may be eliminated with technical guidance.
- Guide researchers as to the procedures to be adopted in times of reproductive aggregation of turtles and sharks, to prevent possible stress on these animals.
- Except for specific research and exceptional cases, visits and the remaining of researchers should be avoided in the following areas of feeding and mating of turtles:
 - “Braço da Laguna” until “Fendas” (turtle feeding).
 - Around the pools of Tartarugas, Porites, Âncora, Abrolhos, Salãozinho, and Podes Crer e Salão, and part of the sandy deposit (100m).
 - In the islands of Farol and Cemeterio, during period from December to July.
- Except for scientific research and exceptional cases, visits and the remaining of researchers within the Lama Bay in the breeding season of the lemon shark (December to March) should be avoided.
- It will not be allowed to swim in the Lama Bay during the breeding season of the lemon shark (December to March), so Barretinha could be used as the alternate location.
- The researcher who occasionally find these animals in the process of mating or feeding should move away slowly, avoiding sudden movements.
- Ordering the movement of people within the atoll by setting routes:
 - At low tide, walk on the sandy deposit. At high tide, access to the Tartaruga’s pool and surrounding should be on the algaic crest adjacent to sandy deposit.
 - Access to Barretão/Laguna should occur through the sandy deposit at low tide or by boat at high tide.
 - Except in cases of specific searches, the offset should be avoided on the following areas of fragile reefs, defined in the item 3 of this management plan: (1) Path of Sea urchins, (2) area between the islands of Farol, Barretão and algaic crest and (3) surrounding the pools of Cemitério, Mapas, Donzelinha, Cemiteriozinho, and Garoupinha.
- Requesting the Directorate of Hydrography and Navigation of the Navy of Brazil the demarcation of boundaries of the REBIO and its Buffer Zone in nautical charts, as well as information restricting visitation in the Aviso aos Navegantes.
- Ask the Brazilian Air Force and the Air Traffic Control to ban commercial and military flights over the area of the atoll at an altitude below 1000 feet and steer the aircraft transitioning off the atoll, to prevent negative impacts on birds and their nestlings.

29. Current scientific research and facilities:

e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

The uniqueness, beauty and fragility of this ecosystem arouse the interest of many researchers and research institutions, national and international, noticed by the significant number of scientific papers, as well as masters and doctoral dissertations carried out in this conservation area. Generally, the research team and the Head of unit remain around 20 days in the Atoll. After a week on the mainland, the Chief of the unit returns to the Atoll with another group of researchers. This routine, as well as providing an intense research work, inhibits the presence of fishermen on the atoll and its surroundings. The number of researchers generally does not exceed three, and the base of REBIO can accommodate up to four.

The vast majority of previous studies focused inside the atoll; aslack of suitable vesselshave limited research activities outside the atoll.

Therefore, most of the conservation unit is still largely unknown.

An international Reef Check program, conducted by Prof. Dr. Beatrice Padovani Ferreira (UFPE) (Maida and Ferreira, 1996) , coordinator of the program in Brazil is underway. The program aims to identify the conditions of reef environments through underwater visual censuses for fish fauna, invertebrates, corals and other features of the environment.

The research base of the REBIO of the Atol das Rocas is located in the southern part of the Farol

Island, near Barretinha on the back of the Lama bay.

Communication is done via VHF radio with limited range and satellite cell phone (Global Star), with a quota of controlled consumption. In the REBIO, there is a small inflatable boat available (15HP), which aims to make the trip to the interior of the atoll by Barretinha, and vice versa, as well as support the research.

There is no availability of freshwater in the station.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

The great distance of REBIO from the mainland, the inhospitable conditions of the area, transport difficulties, and the small number of employees, impose a number of obstacles that hinders any environmental education within the conservation unit.

There is no program or environmental education project being developed systematically by the conservation unit staff in the schools, but there is a significant participation of the Head of UC in events, scientific meetings and conferences where information about the REBIO Atol das Rocas is disclosed.

The partnership with the Tamar Project in Fernando de Noronha allows performing a work for environmental awareness through lectures that are held regularly to residents and tourists who frequent Fernando de Noronha.

Environmental education with the fishing sector is not conducted in a systematic manner, making fishing a major threat to the conservation unit.

Public Relations/Press Release - in spite of the lack of a public relations service and/or established disclosure in the REBIO Atol das Rocas it is known internationally and nationally. The presentation of research papers at conferences, seminars and symposia allow disclosure of this information among the scientific academy. In addition, several articles published by the media, through magazines, newspapers, television and internet, publicize the REBIO to the general public.

The exuberance and beauty of Atol das Rocas naturally attract media attention, arousing the interest of many to visit it, but few have access. Firstly because of the Conservation Unit's category, secondly because the difficulty to get to the atoll. However, there is pressure by the segment of nautical and underwater tourism in order to open the REBIO for visitation with the argument of an even better preservation by injecting funds, while others try to camouflage tour packages with pseudo environmental educational programs.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Recreation and tourism are not permitted in conservation category 'Biological Reserve'.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

Órgão Ambiental Federal Responsável pela área: REBIO Atol das Rocas/Instituto Chico Mendes de Conservação da Biodiversidade. Av. Alexandrino de Alencar, 1399 – Natal, RN – Cep. 59.015-350, Tel. (84) 3201-4230 ramal 234 / 3608-4716 e 084 96097443

Email maurizelia.silva@icmbio.gov.br

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Unidade de Conservação Federal: Reserva Biológica de Atol das Rocas/Instituto Chico Mendes de Conservação da Biodiversidade.

Órgão Ambiental Federal Responsável pela área: REBIO Atol das Rocas/Instituto Chico Mendes de Conservação da Biodiversidade. Av. Alexandrino de Alencar, 1399 – Natal, RN – Cep. 59.015-350, Tel. (84) 3201-4230 ramal 234 / 3608-4716/084 96097443

Maurizélia de Brito Silva

Escritório Administrativo da REBIO Atol das Rocas

Email: maurizelia.silva@icmbio.gov.br

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

- ALCOLADO, P. M. 1989. Estructura ecológica de lâs comunidades de esponjas Del arrecife de Rincón de Guanabo. Rep. Inv. Inst. Oceanol. Cuba. № 10, p. 3-28.
- ALMEIDA, C. E.; MARCHON-SILVA, V.; RIBEIRO, R.; SERPA-FILHO, A.; ALMEIDA, J. R. & COSTA, J. 1999. Entomological fauna from Reserva Biológica do Atol das Rocas – RN, Brazil: I. Morphospecies composition. XXII Congresso Brasileiro de Zoologia. Recife, 15p.
- ANDRADE, G. O. 1959. O recife anular das Rocas, um registro de recentes variações eustáticas no Atlântico Equatorial. Anais da Associação dos Geógrafos Brasileiros, XI (I): 29-61.
- ANDRADE, G. O. 1960. O recife anular das Rocas, um registro de recentes variações eustáticas no Atlântico Equatorial. DHN, Anais Hidrográficos XVIII (I): 203-234.
- ANTAS, P. T. Z. e J. Azevedo, S. M. 1990. Expedição ao Atol das Rocas - fevereiro/março de 1990. Relatório das atividades com aves. Relatório para a direção da Reserva Biológica do Atol das Rocas. Natal, IBAMA/RN: 2.
- ARAÚJO, A. S. 1991. Zooplâncton da Rebio de Atol das Rocas. Relatório conclusivo da campanha março/90. Universidade Federal da Bahia, Departamento de Zoologia. Salvador, 32p.
- ALLAUX, C. 1940. A formação atoliana de Rocas (trad.) A “A Voz do Mar” XIX(173): 163.
- BELLINI, C.; MARCOVALDI, M. A.; SANCHES, T.M.; GROSSMAN, A. & SALES, G. 1996. Atol das Rocas biological reserve: second largest Chelonia mydas rookery in Brazil. Marine Turtles Newsletter. 72:1-2.
- BRYAN, E. H. 1953. Check list of atolls. Atoll Research Bulletin 19: p. 1-38.
- BÜCHERL, W. 1959. Escorpiões e escorpionismo no Brasil. Memórias do Instituto Butantan, 29: p. 243-253.
- CARVALHO, G. L. C. 1999. O mar territorial brasileiro de 200 milhas: estratégia e soberania, 1970-1982. Univ. de Brasília. 105 p.
- CLOUD, P. E., Jr. 1957. Nature and origin of atolls. Proc. 8th Pacific Sci. Cong. 3a: p. 1009-1024.
- COELHO, P. A. 1965. Crustáceos decápodos do Atol das Rocas. Ciência e Cultura, 17 (2): p. 309- 310.
- DAMUTH, J. & PALMA, J. J. C. 1979. Geomorfologia do fundo atlântico equatorial oeste. In: PETROBRÁS. Geomorfologia da Margem Continental Brasileira e das áreas oceânicas adjacentes. Rio de Janeiro, CENPES/DINTEP. p. 53-88 (Série Projeto REMAC).
- DUARTE, P. J. 1938. O Atol das Rocas. Arquivo de Pesquisas Agronômicas, Recife, 1:p 61-70.
- ECHEVERRÍA, C. A.; PIRES, D. O.; MEDEIROS, M. S. & CASTRO, C. B. 1997. Cnidarian of the Atol das Rocas, Brazil. Proc 8 th Int. Coral Reef Sym. 1:443-446.
- FAUSTO-FILHO, J. 1967. Sobre os calapídeos do norte e nordeste do Brasil. Arquivos de Estudos em Biologia Marinha, Ceará, 7 (1): p. 41-62.
- FISHELSON, L. 1980. Partitioning and sharing of space and food resources by fishes. In: Bardach, J. E., Magnuson, J. J., May, R. C., Reinhart, J M. (eds.) Fish behavior and its use in the capture and culture of fishes. International Center for Living Aquatic Resources Management, Manila, Philippines I CLXRM Conf. Proc. 5: p. 415-44.

- FISHELSON, L. 1977. Sociobiology of feeding behavior of coral fish along the coral reef of the Gulf of Elat (Gulf of Aqaba), Red Sea. *Israel Journal of Zoology*, 26: p. 114-134.
- GALANTE, M.L.V.; BESERRA, M.M.L. e MENEZES, E. O. 2002. Roteiro Metodológico de Planejamento: Parque Nacional, Reserva Biológica e Estação Ecológica. IBAMA. Brasília.
- GHERARDI, D. F. 1996. Recent carbonate sedimentation on the corallina-algal Atol das Rocas, equatorial South Atlantic, Brazil. PhD Thesis, Royal Holloway University of London, 315 pp.
- GINSBURG, R. N., 1994. Proceedings of the colloquium on global aspects of coral reefs: health, hazards and history, 1993. Rosenstiel School of Marine and Atmospheric Sciences. University of Miami. Miami.
- GORINI, m. A. & CARVALHO, J. C. 1984. Geologia da margem continental brasileira e do fundo oceânico adjacente. In: SCHOBENHAUS, D.A.; D.A.; CAMPOS, D.A.; DERZE, G.R.; ASMUS, H.E. eds., *Geologia do Brasil*, DNPM, p. 473-489.
- GREENWOOD R. M., 1992. Some differences between plants of the Chatham Islands and the New Zealand mainland – *N Z J Ecol* 16: p. 51-52.
- GROSSMAN, A. 2001. Biologia reprodutiva de *Chelonia mydas* (Reptilia), na Reserva Biológica do Atol das Rocas. Dissertação de Mestrado (Biociências – Zoologia), Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre, 43p.
- GUILCHER, A., 1988. Coral reef geomorphology. John Wiley and Sons, Bath, 228p.
- HETZEL, B & C.B.CASTRO. 1994. Corais do Sul da Bahia, Ed Nova Fronteira, Rio de Janeiro, 189 p.
- ITZKOWITZ, M. 1979. The feeding strategies of a facultative cleanerfish, *Thalassoma bifasciatum* (Pisces: Labridae). *Journal of Zoology*, London, 187: p. 403-413.
- KIKUCHI, R. K. P. 1994. Geomorfologia, estratigrafia e sedimentologia do Atol das Rocas (Rebio / IBAMA / RN), Atlântico Sul Ocidental Equatorial. Dissertação de Mestrado. Universidade Federal da Bahia.
- KIKUCHI, R. P. K. 1999. Atol das Rocas, Southwestern Equatorial Atlantic, Brazil. SIGEP – Geological and Paleontological Sites of Brazil 033.
- LEAL, J. H. 1991. Marine prosobranch gastropods from oceanic islands off Brazil: composition and biogeography. Oegstgeet: Universal Book Service. 418p.
- LINS OLIVEIRA, J. E., CUNHA, K. M. F., REY, H. A. 1993. Problemática da Pesca de Lagostas no Nordeste do Brasil. *Boletim Técnico Científico do CEPENE*, v.1, n.1, p. 187 - 210.
- LONGA, C.M.O. 1993. Caracterização do macrozooplâncton da Reserva Biológica do Atol das Rocas em maio/92. Monografia (Ciências Biológicas), Universidade Federal da Bahia. Salvador, 39p.
- LOURENÇO, W. R. 1982 (?). Presença do escorpião *Isometrus maculatus* (DeGeer, 1778) na Reserva Biológica de Atol das Rocas.
- MAFALDA-JUNIOR, P. O. & ARAUJO, A. P. 1992. Macrozooplâncton na Rebio de Atol das Rocas, RN. Relatório. Natal. IBAMA, 13p.
- MAIDA M. & FERREIRA, B. P., 1997. Coral reefs of Brazil: an overview. Proc. 8th Int. Coral Reef Symp., Panama 1: p. 263-274.
- MARCOVALDI MA, MARCOVALDI G.G., 1985. Projeto Tamar: área de desova, ocorrência e distribuição das espécies, época de reprodução, comportamento de postura e técnicas de conservação das tartarugas marinhas no Brasil. Brasília: MMA-IBDF, 46p.
- MATHEWS, H. R. & KEMPF, M. 1970. Moluscos marinhos do Norte e Nordeste do Brasil. II – Moluscos do Arquipélago de Fernando de Noronha (com algumas referências ao Atol das Rocas). *Arq. Ciên. Mar.*, 10 (1): p. 1 – 53. Ceará.
- MATOS, 1996. O novo Direito do Mar. Ed. Renascer.
- MELO, M. D. 1999. Caracteres adaptativos de espécies vegetais ocorrentes em Atol das Rocas, RN. Rel. de atividade. Universidade Federal do Rio Grande do Norte.
- MELO, E. F. & Alves, J. H. G. M. 1993. Nota sobre a chegada de ondulações longínquas à costa brasileira. X Simpósio Brasileiro de Recursos Hídricos, Gramado, ABRH.
- MMA, 2001. Fernando de Noronha Archipelago/Rocas Atoll tropical insular complex, Nomination for inclusion as an UNESCO World Heritage Natural Site.
- MMA, Instituto Chico Mendes de Conservação da Biodiversidade. Plano de Manejo da Reserva Biológica de Atol das Rocas. 2007.

- MOOJEN, J. 1952. Os Roedores do Brasil. Rio de Janeiro: Ministério da Educação e Saúde, Instituto Nacional do Livro. 214p.
- MORAES, F. C. 2000. Taxonomia e repartição de Porifera na Reserva Biológica do Atol das Rocas (RN). Monografia apresentada à Universidade Federal do Rio de Janeiro no curso de Ciências Biológicas. Rio de Janeiro. 63p.
- MOREIRA, I.; BAPTISTOTTE, C.; SCALFONE, J.; THOMÉ, J. C. and ALMEIDA, A. P. L. S. 1995. Occurrence of *Chelonia mydas* on the Island of Trindade, Brazil. *Marine Turtle Newsletter* 70:2.
- MOTHESES, B.; BASTIAN MCKA. 1993. Esponjas do Arquipélago de Fernando de Noronha, Brasil (Porifera, Demospongiae). *Iheringia, Zool* 75: p. 15-31.
- MOURA, R. L., 1998. Atividade, distribuição e táticas alimentares de uma comunidade de peixes do Atol das Rocas. Dissertação de Mestrado (Zoologia). Universidade de São Paulo. São Paulo, 85p.
- MURICY, G. & MORAES, F. C. 1998. Marine sponges of Pernambuco State, NE Brazil. *Ver. Bras. Oceanogr.*, 46 (2): p. 213-217. MURICY, G. 1989. Sponges as pollution bio-monitors at Arraial do Cabo, Southeastern Brazil. *Rev Bras Biol* 49(2): p. 347-354.
- MURPHY, R. C. 1936. *Oceanic birds of South America*. Amer. Mus. Nat. Hist. New York: MacMillan. v.I e II.
- NETTO, S. A. 1999. Meiofauna and macrofauna communities of Rocas Atoll, Brazil. PhD Thesis, University of Plymouth, Department of Biological Science. 116p.
- OLIVEIRA, P. G. V., 2001. Levantamento da fauna de elasmobrânquios e estudo da biologia comportamental do tubarão-limão, *Negaprion brevirostris* (Poey, 1868) e tubarão-lixia, *Ginglymostoma cirratum* (Bonnaterre, 1788), na Reserva Biológica do Atol das Rocas – RN – Brasil. Tese de Mestrado apresentada à Universidade Federal de Pernambuco, Programa de Pós-Graduação em Oceanografia. Recife, 114p.
- OLIVEIRA FILHO, E. C. & UGADIM, Y. 1976. A survey of the marine algae of Atol das Rocas (Brazil). *Phycologia*,15(1):41-44.
- OTTMANN, F. 1963. “L’Atoll das Rocas” dans l’Atlantique Sud Tropical, *Revue de Géographie Physique et de Géologie Dynamique*, V(2):101-107.
- PAIVA, P.C, YOUNG, P.S & ECHEVERRIA, C.A. The Rocas Atoll, Brazil: a preliminary Survey of the Crustacea and polychaete fauna. *Arq. do Museu Nacional, Rio de Janeiro*, V.65, nº 3, p. 241-250. Jul/Set 2007
- PINTO, S. D.; SILVA FILHO, G.; FERRAZ, N. P.; BARROS, J. C. N., MELLO, R. O. S. Pateliformes do Arquipélago de Fernando de Noronha (PE) e Atol das Rocas (RN). Depto de Zoologia. UFRPE.
- RIOS, E. C. 1979. Novas ocorrências de moluscos para o Atol das Rocas. *Encontro de Malacologistas Brasileiros*, V, Mossoró, 1977. *Anais...*, Porto Alegre, Fundação Zoobotânica do Rio Grande do Sul, p. 109-112.
- ROCHA, F. M. 1993. Aspectos comportamentais de *Mus musculus* (RODENTIA: MURIDAE) na Reserva Biológica do Atol das Rocas. Universidade Federal do Rio Grande do Norte.
- RODRIGUES, O. A. A., 1940. O Atol das Rocas. *Revista Marítima Brasileira*, ano LIX, Nº 11-12, p.1181-1228.
- ROSA, R. S. & MOURA, R. L. 1997. Visual assessment of reef fish community structure in the Atol das Rocas Biological reserve, of northeastern Brazil. *Proc. 8th Int. Coral Reef Sym.* 1:983- 986.
- ROSA, R. S.; GRUBER, S. H. & WETHERBEE, B. M., 2002. História natural do tubarão-limão, *Negaprion brevirostris* no Atol das Rocas e Fernando de Noronha, Brasil. Relatório final do projeto. Universidade Federal da Paraíba, Depto. de Sistemática e Ecologia. João Pessoa, 40p.
- SALES, G. 1992. Plano de implantação da Reserva Biológica do Atol das Rocas. IBAMA/RN. Natal, 12p.
- SCHULZ NETO, A. 1998. Aspectos biológicos da avifauna marinha na Reserva Biológica do Atol das Rocas, Rio Grande do Norte, Brasil. In: *El Hornero*, (1):8-19.
- SILVA, L. C. F. & ALVARENGA, J. B. R. 1995. Oceanografia Física. In: *Levantamento do Estado da Arte da Pesquisa dos Recursos Vivos Marinhos do Brasil – Programa REVIZEE*. Relatório Consolidado. FEMAR/SECIRM/MMA.

- TARGINO, S. G. 2001. Estruturação da coleção ex-situ de espécies do Atol das Rocas. Projeto de Investigação Científica e Divulgação da Rebio de Atol das Rocas. Convênio 021/99, FNMA/MMA. Natal.
- TEIXEIRA, A. L. 1992. Levantamento dos crustáceos da Reserva Biológica do Atol das Rocas. 30p.
- TEIXEIRA, A.L. 1996. Aspectos biológicos do caranguejo terrestre *Gecarcinus lagostoma* (H. M. Edwards, 1837) no Atol das Rocas – Brasil. Dissertação de Mestrado (Oceanografia Biológica), Universidade Federal de Pernambuco. Recife.
- VALENTINI, & ROSMAN, P. C. C. 1993. Erosão costeira em Fortaleza. Revista Brasileira de Engenharia: Cadernos de Recursos Hídricos, v.10, n.1, p. 373-381.
- VILLAÇA, R. C. 1999. Distribuição e aspectos ecológicos das macroalgas do Atol das Rocas. Relatório parcial de projeto de pesquisa. Universidade Federal Fluminense. Dep. De Biologia Marinha. 22p.
- VILLAÇA, R. C. 2001. Distribuição e aspectos ecológicos das macroalgas do Atol das Rocas. Relatório parcial de projeto de pesquisa. Universidade Federal Fluminense. Dep. De Biologia Marinha. 17p.
- WOLANSKI, E. & HAMNER, W. M. 1988. Topographically controlled fronts in the ocean and their biological influence. Science 241:177-181.

Please return to: **Ramsar Convention Secretariat, Rue Mauverney 28, CH-1196 Gland, Switzerland**

Telephone: +41 22 999 0170 • Fax: +41 22 999 0169 • e-mail: ramsar@ramsar.org

ANNEX I

Complementary information

Section 16: physical features of the site.

Winds: According to Kikuchi (1999), the data on wind direction indicate that the prevailing winds from the ESE blow during the whole year, with a frequency of 45% on the days they were measured. Between June and August (winter) SE winds occur in 35% of the days and the frequency of E winds is of 15%, in the same period. Between December and April (summer), E and SE winds occur in about 20% of days, based on available the data. Wind speeds ranging from 6 to 10 m/s dominate throughout the year, but during the winter, speeds between 11 and 15m/s are common. Wind speeds greater than 20m/s were recorded more frequently during the summer time.

Rainfall: According to Kikuchi (1994), the rainfall in the area REBIO Atol das Rocas is torrential and concentrated in a few hours or days. An average monthly rainfall of around 900 mm occurred in the period 1991-1992, with the largest concentration in January and February 1991, reaching the highest volume of 2551 mm of rain in January. According to Kikuchi (1999), precipitation on the atoll is distributed irregularly throughout the year, with a monthly average of 860 mm, ranging from 183 mm (April/92) to 2.663mm (August/92).

Air temperature: The air temperature distribution shows maximum values in summer and autumn (maximum 27.5° C) in the equatorial region. South of the equator, zonal distribution decreases toward the south with minimum in the winter (minimum 24 °C) (Silva & Alvarenga, 1995).According to data from (Teixeira, 1996), the month of March is the warmest with an average temperature of 29 °C whereas August is the coldest, with an average of 22° C (Teixeira, 1996).

Structure and Composition of the Reef

According to Villaça (1999), the algae that built the Atoll is the rodoficea *Porolithon cf. pachydermum*. According to Kikuchi (1994), coral skeletons were recovered with greater frequency in the range from 2m to 4m. They are fragments of small specimens, with thicknesses between 1cm and 5cm and belong mainly to the species *Favia gravida*. The larger specimens belong to the species *Siderastrea stellata*. Vermetid Gastropods associated with algae also occur, and Ríos (1979) reported the occurrence of only one species, *Petalconchus erectus* in samples from the Atol das Rocas.

The accessory components are fragments of *Homotrema rubrum* and corals, vermetid gastropods, Millepora, of bryozoans, Halimeda, echinoderms and crustaceans, whose medium frequencies are less than 5% of the grains in the samples. Among them, there is a slight predominance of fragments of *H. rubrum* and corals. The fragments of these constituents occur generally in fine or medium sand fractions (Kikuchi, 1994).Trace constituents are serpulid fragments that appear with an average frequency of less than 1% of the sample fragments.

The sum of coralline algae, benthic foraminifers, and mollusks always accounts to more than 70% of the sediment. The fragments of coralline algae occur with a frequency exceeding 70% on the front and reef ring, channels and islands. The reef ring is the environment where these fragments are produced and together with the channels and islands, are preferential environments for their accumulation. In other environments, this frequency varies from 35 to 60% (Kikuchi, 1994).

The higher frequencies of benthic foraminifers, over 20%, occur on the ocean floor and in the lagoon, in places where the water depth is always greater than 4m. Leeward to the reef ring, in sandy deposits, its frequency is slightly lower, about 17%, and in other environments, less than 15% (Kikuchi, 1994).

With the mollusk fragments there is a distinction between the inside and outside of the atoll. In the first, the observed frequencies are above 10%, while in the outside is less than this value. This is

because the rear reef environments (plateau and sandy deposit lagoon) are the most favorable habitats for molluscs (Kikuchi, 1994).

Fore reef – It extends from the outer edge of the reef margin, which at low tide is about 1.5 m above average sea level, until the adjacent bottom, at depths of less than 13m. It is most extensive in the west portion of the atoll and its horizontal extension from the outer edge of the reef margin can reach 600m. Also in the west portion, it has a denting pattern perpendicular to the perimeter of the reef, similar to the feature called "spur-and-grove" described in Indo-Pacific Reef and Caribbean (Guilcher, 1988). On the N - W and also in the N - NE, at certain locations, this denting appears as a series of columns which join into the reef top and get gradually smaller as they moves away from the edge of the reef. In the NE and SE sides, the reef front is abrupt forming a scarp of approximately 10m deep, and from there, until about 15m, coarse sediments accumulate at the foot of the slope.

The reef front in NW and SW sides is characterized spherical features, with decimetric diameters, formed by coral skeletons and covered mostly by green algae. Live corals, mainly *Siderastrea stellata*, which is predominant, *Porites sp.* and *Montastrea cavernosa* occur sparsely.

In the S part of the reef front there is a reentrance of large dimension, more or less in a T shape called "Salão" (hall). It is the place where the highest density of coral was observed around the reef, with almost absolute predominance of the species *Siderastrea stellata*. Features similar to the spur-and-grove occur here. Some of these indents continue into the reef, forming caves where vertical cylindrical columns can be observed, some of them with diameters of 20 to 30 cm, which merge forming the reef ring. The deepest part of the hall, near the outer edge of the reef ring is 12m deep and is covered with gravel sediment (rodoides and small colonies of *Mussismilia hispida*).

Adjacent bottom - On the west side of the atoll, the bottom is characterized by the presence of a sandy surface, where isolated reefs rise with approximately 1.5 m in height. The horizontal dimensions of those reefs may vary from less than 1m to about 5m in length and 10m of width. These reefs are more or less elongated in the direction E - W and are extensions of the fore reef indent feature. The spacing between the reefs is greater than 3m and increases away from the reef. The sandy surface is mobile and wavy bed forms with linear ridges appear on it.

In the E and SE side of the atoll lays a terrace surface more or less flat, horizontal, at a depth of about 15m. Although settled predominantly green and brown algae and low sediment accumulation, it is observed coral of the species *Mussismilia hispida* and hydrocoral species *Millepora alcicornis* specimens, as well as various types of sponges and rodoides. This is probably the top of the platform that serves as the substrate to Atol das Rocas.

Reef Margin – the reef margin is an alignment of convexities accompanying the outer edge of the reef. Its width can reach about 5 m, and height of 0.5 m above the adjoining surface of the reef flat. It is formed by an algae ridge, built by successive crusts of coralline algae and vermetid gastropods and presents an overall massive look. Its color is pink and its texture, slightly rough. It's exposed to the atmosphere during periods of low tide. On the outside is where it dissipates almost all the energy of the waves, which hit the reef, becoming therefore the place of highest energy.

Reef plateau - The plateau surface is more or less flat on the top and inner reef, adjacent to the reef margin and it is also above sea level during periods of low tide. Comprises the reef ring, whose width ranges from about 160m in the west portion, to 700m on the east side of the atoll; and sandy deposits, which occupy virtually the entire inner portion of the reef. In the reef plateau, there are features such as channels, pools and sandy islands.

Reef Ring - the reef ring is a peripheral band of pavement that encloses the inner reef. It is surrounded by reef margin and circumscribes the sandy deposit and the lagoon. This ring can be subdivided into an

arch windward (barlamar), which comprises the whole outline, clockwise, from the “Barreta Grande” to “Barretinha”, and the center leeward (downdrift), which consists in the part where the Farol island is located.

It is conformed mainly by coralline algae and vermetid gastropods. These encrusting organisms associate with geniculate red algae, besides green algae and phaeophytes, non-skeletal. Coralline algae and vermetid gastropods grow in the form of linear algae ridges, with a few inches wide, continuous or segmented. They intertwine forming a lattice that constitutes pools during low tides, where a few specimens of corals grow (*Favia gravida* and *Siderastrea stellata*), in addition to depositing small amounts of coarse to gravelly sandy sediment.

The ring on the E and SE sides of the reef is quite homogeneous considering its morphology and the presence of sediment and colonizing organisms. There are goblets or "rocas", which are remnants of a higher structure of the reef that today reaches about 3-4m high. They are composed mainly of encrusting coralline algae, also occurring vermetid gastropods and encrusting foraminifer *Homotrema rubrum*.

Sandy Deposit - The sandy deposit corresponds to most of the feature known as "very shallow lagoon" by Andrade (1959, 1960) and Ottman (1963). Unconsolidated sediments cover the whole area. Wavy forms and discontinuous arched ridges appear in it, produced by currents that sweep the surface of the deposit during the tides.

The transition from the reef ring to sandy deposits, in terms of depth, occurs in a gradual manner. In the NE part of the reef, however, the sandy deposit does not occur and the reef ring passes directly into the lagoon. This is possibly due to the movement of the tidal ebb leaving the atoll by Barreta Grande sweeping the lagoon and hustling out the sediment that would accumulate in the absence of such currents. On the west side of the atoll, two algal crests develop east of each of the islands. These two algal crests reach heights of 0.5 m above the surface of sandy deposits, creating two confined areas around the two islands.

Channels - The channels are interruptions in the reef ring, which communicate the interior of the atoll with its surroundings. These discontinuities are referred to as strips or passageways. They are located, one on the west part of the Atoll, near the Farol island and another in the north portion of the reef ring. The west channel is lower and is known as Barretinha. The movement of the water flow in the channel always occurs in the direction out of the reef, regardless of the direction of the tide. The channel depth is about 4m and the bottom is covered with sand.

The dimensions of the Barreta Grande (Barretão) are larger, with a width that reaches 100m and depth ranging from 4m in the innermost part (lagoon), up to 10m, in the outer limit of the channel. This “barreta” consists of spaces between reef columns with vertical walls, which give it the appearance of meandering channels. The bottom of the inter-columnar spaces it is covered by sandy-gravelly sediment. There the dynamic process that prevails is the alternation of the current direction with the tides.

Pools - Another type of discontinuity that occurs in the reef plateau are the pools. These openings have average depths of 3 m at low tide and can reach sizes of up to 400m long, such as the “Piscina das Tartarugas” (Turtle Pool). In these regions, the process of coalescence of small isolated pinnacles with approximately circular section suggests how the reef ring was originated.

The pools are connected to the outside of the reef. They are filled with sandy sediments and in the largest ones, like the “Piscina das Tartarugas” and the pools south of the ring, frequently isolated pinnacles occur.

The pools of the REBIO of Atol das Rocas were baptized being the names listed below and are commonly used by ICMBio employees who work at Conservation Unit. Thus, starting from Barretinha in a counterclockwise direction, the pools are: 1) Barreta Falsa, 2) Garoupinha, 3) Donzelinha, 4) Cemiteriozinho, 5) Mapas, 6) Cemitério, 7) Tartarugas, 8) Salãozinho, 9) Âncoras, 10) Abrolhos, 11) Porites, 12) Zulu, 13) Rocas, 14) Dos Tanques, 15) Dos Nove, 16) Naufrágio, 17) Farol 1 e 18) Farol 2. Besides these, there are the pools that communicate with the sea, called “Podes Crer” and “Salão”. Between Laguna and the reef margin, there are the cracks: F1, F2, F3, F4 and F5.

Sandy Islands - There are two islands, “Farol” and “Cemitério”. They are located in the west portion of the reef. The Cemitério Island has the shape of a trapezium with the larger base facing NE. The lower base of the trapezoid measures approximately 400m and its height is 100m. Its boundary is delimited by a sand deposit that faces NW and SW, and an outcropping of beach calcarenite that faces the NE and S.

The top of the island is covered by a layer of about 20 cm of soil, with high content of phosphate and organic matter, where grassy vegetation grows. The maximum height of the island in relation to the medium surface of the top of the reef is just over 3m. The calcarenite of beach rises on the floor of the NW, NE and S faces, and in small escarpments with approximately 1.5 m in height in the NE face. It has similar composition to the sediment of the island beaches, containing fragments of coral and gastropod molluscs.

The Farol Island is more elongated, in the shape of a hook. Its greatest length is about 800m and the maximum width is 300 m. Its surface has three levels of staggered heights decreasing to SE. They are two stabilized spurs, contiguous and a third one in growth. The height of the highest level is 3m, measured with reference to the top surface, equivalent to the medium tide. The second spur, east of the first, is about 0.5 m lower. The third spur, east of the second, is a spur that is currently in the process of growth towards SW. This spur delimits a small cove, which dries during low tides, where a film of green algae grows, known as “Baia da Lama”.

According to the REBIO employees, there is a small sandbar is being formed near the pool called Zulu, on the east side of the reef plateau, which is being called the Zulu island. This bank seems to occur seasonally and has been increasing over time.

Lagoon - Occurs in the NE portion of the central region of the reef adjacent to the reef ring at its northern limit, and the sandy deposit, by S. Differs from the sandy deposit in the persistence of water depth, remaining constantly submerged, and the presence of several pinnacles and mounds of gravel. Its maximum depth, in spring tides, varies from 4m in most central area to about 6m in the innermost part of the “Barreta Grande”. Some regions, especially those closest to the ring reef in the east part of the atoll, have small thickness of sediment and are covered by a mat of green algae.

Section 17: physical features of the catchment area.

Marine currents

Silva & Alvarenga (1995) describe the distribution of surface currents as being mainly westward, with speeds up to 1.5 knots. Below 8°S latitude, in spring and summer, there is a slight inflection to the south in the direction of the currents, indicating the possible position of the bifurcation of equatorial current, forming the Brazil’s Current (Figure 3.23.) According to Rodrigues (1940 apud Teixeira, 1996) higher volumes and speeds are observed in April and June, with speeds of 10, 20 to 80 miles in 24 hours. In the months of May and September currents are uncertain and September to March weaken and sometimes become insignificant.

Water temperature

According to a survey conducted by the REVIZEE Program in the Northeast, the temperature distribution on the surface and at 50 m is similar, except for the northeastern area, where there is a

temperature decrease at 50 m (minimum 25° C), in winter and spring, indicating a decrease in depth of the mixed layer to less than 50 m. For the rest of the area the depth of the mixed layer is greater than 50 m for all seasons. Except for the equatorial strip, temperatures tend to be lower at south of the area, with maximum values in summer and autumn (maximum 27.6°C). In depths of 100m, in the equatorial region, the temperature isoclines are nearly meridionally distributed with values decreasing from west to east. The seasonal variation shows increasing values from autumn, with maximum in spring, and declining thereafter, with a minimum in autumn (minimum 16° C). South of the equator, the zonal distribution has a slight increase towards the south and little seasonal variation.

INPE records for the period 1991-1992 showed minimum water temperature of 18.1 °C in June of 1992 and a maximum of 33.5 °C in December of 1991 and April of 1992. Records of water temperature in Fernando de Noronha show a small seasonal variation of 0.5°C between the periods of summer-autumn and winter-spring (Kikuchi, 1994).

Mafalda Junior & Araújo (1992) studying the zooplankton in Atol das Rocas, registered in March of 1990, surface temperatures of the sea water around 28.8° to 32.2° C. Longa (1993) in a similar study in the same area, recorded temperatures of 26.0° to 28.9° C in the month of May/92. Netto (1999) found average temperatures of 29° C in the subtidal zone, 31 ° C in the sandy deposit, 29.2° C in the pools and 27.6° C in the lagoon.

Salinity

Data from NOc Almirante Saldanha, for depths of 10 to 100m, shows salinities of 36 ppt and 36.6 ppt, respectively. Sales (1992) reports average salinity in the waters of the Atol das Rocas of 36.7 ppt, becoming higher inside the inner pools (Teixeira, 1996).

Mafalda Junior & Araújo (1992) found salinities between 37 and 39 ppt (March/90), while Longa (1993) reported saline range from 36.0 to 38.0 ppt (Maio/92). Netto (1999) recorded salinities averages of 36.9, 37.5, 37 and 36.6 ppt for subtidal, sandy deposit, pools and lagoon, respectively.

ANNEX II

Complementary information on marine fauna

Herpetofauna

Over the past 11 years, green turtles that nest in the REBIO Atol das Rocas have suffered a change in population structure, and the biometric studies have shown a decreasing trend of the hull length of females. This fact may be related to an increase in the recruitment of females to the adult population, a result of the effort of conservation programs for these animals. The smaller influence of anthropogenic effects on the young population would allow a greater number of females to reach sexual maturity and to be incorporated to the portion of turtles nesting in Atol das Rocas, directly influencing the biometric structure of the population. On the other hand, increasing the adult population, intensifies the competition for food, which could lead to an increase in the natural mortality rate, especially older individuals, and therefore larger, justifying the downward trend. However, this theory should be confirmed by other studies (Grossman, 2001).

Besides the green turtles, *Caretta caretta* was recorded in three instances, of which two individuals were found in the lagoon and marked in December 2002 by the REBIO staff and another found in the pool of Mapas and marked in January 2004 by technicians from Tamar.

Ichthyofauna

In a study of dietary tactics and associations of fish of Atol das Rocas, Moura (1998) studied 47 species using a methodology of underwater naturalistic observation. This author, citing Greenwood (1992), states that the zoogeographical Brazilian province has one of the least known reef fish faunas and that the Atol das Rocas is a location of great interest because it is located in this vast and unknown region, besides having endemic elements in its ichthyofauna. The dominant fish families in the community studied, both in number of individuals and biomass, are represented by *Stegastes rocasensis* and *Thalassoma noronhanum*.

Species richness is also reflected in the great diversity of feeding tactics, heterotypic food associations, diets, periods of activity and feeding sites of species coexisting in the pools, which point to a complex system of sharing food resources and space. In this study, at least 10 different feeding tactics and six categories of food associations were detected. Complex interactions, such as cleaning symbiosis and heterospecific feeding associations, are probably very influential in reef communities. Moura (1998) established three categories of feeding tactics according to the basic community trophic levels: herbivores, carnivores and plankton feeders. Some species appear in more than one category.

Herbivores are represented by eleven diurnal species, six of which feed exclusively on plants, using two basic food tactics: pruning and scraping. The pruners, represented by eight species, feed on algae, eating parts without ingesting portions of the substrate; they are *Pomacanthus paru*, *Stegastes pictus*, *S. rocasensis*, *O. atlanticus*, *Scartella cristata*, *Acanthurus chirurgus*, *Acanthurus coeruleus*, *Abudefduf saxatilis*. The scrapers are represented by three species of parrotfish, *Sparisoma aff. chrysopteron*, *S. aff. rubripinne* and *S. aff. viride*. Among the trimmers, omnivorous species are included, whereas all the scrapers are exclusively herbivores (Moura, op cit.).

Carnivores represent the widest trophic level, including 35 species, diurnal and nocturnal, of which only five do not feed exclusively on animals. The carnivores can be divided in five categories according to their feeding tactics: wandering hunters, hunters that prowl, nibblers, “fossadores” and scavengers.

Wandering hunters, represented by nine species that roam in search of their prey, can be subdivided into two categories: 1) active hunters in the water column, including three species of Carangidae and *Sphirena barracuda* (barracuda) and *Platybelone argalus* (needle) 2) hunters explorers of the substrate, hunting close or in contact with the substrate, including *Ginglymostoma cirratum* (shark sandpaper), *Lutjanus jocu* (Dentex red) and Anguilliformes (Moura, 1998).

Hunters that prowl include five species: *Gymnotborax funebris* (Moray-green Caramuru) *Cephalopholis fulva* (coney), *Rypticus saponaceus* (fish-soap), *Malacanthus plumieri* (pirá) *Malacoctenus triangulatus*, all which remain solitary in specific locations. The nibblers, are represented by four diurnal species, *Pomacanthus paru* (cowpeas), *Chaetodon ocellatus* (butterfly), *Abudefduf saxatilis* (sergeant), *Alutera scripta* (Peroá-king), characterized by removing portions of their prey (Moura, op cit.).

The “fossadores”, characterized by seeking prey buried in the substrate, can be active at night or during the day, and are represented by only four species: *Haemulon chrysargyreum* (corcoroca, biquara) *Haemulon parra*, *Dasyatis americana* (Stingray butter) and *Mulloidides martinicus* (mullet). The last two are diurnal “fossadores” represent one of the most important categories in the community, because they are responsible for the initiation of several food associations (Fishelson, 1977 and 1980, Itzkowitz, 1979 apud Moura, 1998).

The scavenger visually locate their prey, capturing them individually, and can be divided according to their feeding place: scavengers in the substrate, represented by *Abudefduf saxatilis* (sergeant), *Stegastes pictus*, *Stegastes rocasensis* (maid-of-rocky), *Halichoeres radiatus* (soap), *Thalassoma noronbanum* (cleanser), *Bathygobius soporator* (Embore) *Coryphopterus glaucofrenum* and *Gnatholepis thompsoni*, and collectors in the water column (plankton), mainly represented by *Chromis multilineata* and *Myripristis jacobus* (fogueira). The other plankton eaters that also exploit benthic resources include *Phaeoptyx pigmentary*, *Abudefduf saxatilis*, *Stegastes pictus* and *Thalassoma noronbanum*. There are no known plankton filter feeders in reef environments (Moura, op cit.).

The dietary associations among fish are related to the location and the capture of food, resource exploitation in areas defended by territorial species, aggressive mimicry and avoidance of predators. Another type of feeding association is cleaning symbiosis where cleaner fish explore the body of other fish, removing ectoparasites, diseased tissue and mucus (Moura, op cit.).

Thalassoma noronbanum is the only species of cleaner fish of the studied community having been recorded in symbiosis with six species, especially herbivores as *Acanthurus*spp. and *Sparisoma* spp. besides hemulídeos and pomacentrídeos. The cleaning activity occurs daily in certain locations, called cleaning stations and client fish request the service by adopting characteristics postures in the presence of scavengers (Moura, op cit.).

Most species of reef community pool does not seem to be involved in cleaning symbiosis, a phenomenon unusual in reef communities that often have more than one kind of cleanser. The absence of fish of the genus *Elacatinus* (Gobiidae), considered the most specialized cleaners on the western Atlantic may be responsible for this unique feature found in Atol das Rocas (Moura, op cit.).

The regions of unconsolidated substrate (sandy plain) in Atol das Rocas are those with the least richness and diversity of fish species, related to the lower structural complexity of this habitat. However, approximately 40% of the pool species use the sandy plain for feeding. The regions of concolidated substratum are those with greater richness and diversity of fish species (Moura, op cit.).

Entomofauna

Analyzing the results of a survey for the entomofauna of the Atol das Rocas, Almeida *et al.* (1999) draw attention to the importance of knowing about the insular fauna, especially invertebrates, and claims that the geographical isolation of Atol das Rocas can favor important genetic differentiations. The authors suggest that the high synanthropic rate is the reason to suppose that the terrestrial fauna is geologically recent and that a large part of the insect fauna has been introduced by human activities. The small size of the islands, as well as the low supporting capacity, implies a reduced number of insects in this ecosystem. Thus, reintroductions of species would have a great influence on the stability of the genetic

"pool" of the Atoll. However, mutations with a low selective rate would have a strong influence on these islands.

The genetic homogeneity derives from a low vegetation diversity, which limits the trophic resources. Furthermore, the environmental conditions with little shade and no source of freshwater impose barriers that maximize the genetic discrepancies between the insect fauna of the atoll and the continent, acting as pressure factors for the selection of genotypes with adaptations for this environment. Therefore, the fact of low entomological diversity represented by 25 morphospecies, including insects and arachnids, derives from the small size of the islands, the environmental hostility and distance of the atoll from the continent (Almeida *et al.*, 1999).

Apparently, the size of the trophic niche of the insect fauna of the Atol das Rocas is closely related to bird's, meaning that a large part of the insect fauna consists of scavengers (Almeida *et al.*, 1999).

Echinoderms

It is very likely that the number of species of echinoderms in the area of REBIO is much greater than the displayed list, needing specific studies on the subject. In a field work carried out in the REBIO Atol das Rocas, in free dives conducted within the pools, few echinoderms were observed, fitting to note the observation of a white sea urchin (*Tripneustes ventricosus*) in the Tartaruga's pool and 90 individuals in a short stretch (100m linear) in the Roca's pool.

During the night, in an area SE of the Cemitério Island, next to tide pools, there is a relative abundance of small star-fish, probably *Linckia spp.*, brittle stars, satellite sea urchin and was observed. According to the Chief of REBIO, Maurizélia Brito, in this area there is the occurrence of a rare species of sea cucumber, the *Euaпта lappa*.

The presence the sea urchin, *Tripneustes ventricosus*, in Atol das Rocas, according to personal information from the Chief of the conservation unit, is recent and of concern, although it's not an exotic species. It is known that this equinoderma has been occupying massively some rocky shores of the archipelago of Fernando de Noronha and its colonization in Atol das Rocas could cause some impact (positive or negative), and deserves a more careful investigation. Currently a study is being developed by Godoy entitled "Geographical distribution and records of echinoderms within the Atol das Rocas".

They are often found in high-energy habitats such as exposed rocky shores and coral reefs, and found associated with sandy bottoms and *Thalassia* banks. They are resistant to turbidity, but succumb quickly if subjected to extreme physical stress, such as exposure to the sun. They feed on leaves of *Thalassia*, encrusting algae and debris.

Malacofauna

Leal (1991) studying the biogeography and species composition of prosobrânquios gastropods in oceanic islands and seamounts of Brazil, recorded a total of 297 species in 4 islands (Trinidad, Vaz Martins, Fernando de Noronha and Atol das Rocas) and 6 submarines hills (Victoria, Montague, Jaseur, Davis, Dogaressa and Columbia). The place that had the highest number of species was Fernando de Noronha, with 121 records. The lowest number was found in seamount Columbia, with 43 species. The observed number represented 40% of the number of prosobrânquios of the Brazilian coast reported by Rios (1979), and may be considered relevant and representative of prosobrânquios assemblies in oceanic islands and seamounts. Carefull Taxonomic identification at specific level suggests that probably a quarter of these species were previously unknown.

The similarity analysis performed in this study showed that the assemblies of Atol das Rocas and Fernando de Noronha, despite some differences in the types of substrates between these locations, are significant, suggesting that geographical proximity between these islands (160km) and the circulation of the water are important in maintaining relatively high affinity between Noronha and Rocas (Leal, 1991).

In his study, Leal (1991) correlating the development mode of gastropods with geographic lines and endemism found, verified that the frequencies of species with planktontrófic development between oceanic islands and seamounts were not significantly different from species with a lecitotrofic development, indicating that the distance is not a selective filter of diffusion and that the dichotomy food/no food for planktonic larvae is correlated. The development planktontrófic did not prevail in isolated localities of this study and the substantial presence of lecitotrofic can be explained by the ease of dispersion by a "degree effect" ("stepping stones") provided by the alignment of seamounts.

Benthic meio and macrofauna

The information presented is based on the study "of benthic macrofauna and meiofauna of the REBIO the Atol das Rocas" conducted by Netto (1999).

The sandy deposit is exposed to a gradient in the water flow generated by different stages of the tide. This tidal current, which is the most effective agent of sediment transport in sandy deposit, causes a steady sediment stream from windward to the leeward side of the reef. This gradient in the flow of water and sediment, parallel to a gradual change in the structure of benthic communities, allows the division of sandy deposit in 4 areas:

Zone I - the arrival area for sediments located upwind and bounded above by the reef ring with sediments composed of large fragments of coral and coralline structures debris. It has high-density meiofauna, especially *Epsilonema sp.1* and *Metoncholaimus sp.1*, with large numbers of taxa. The macrofauna is characterized by high density, especially Tubificidae oligochaetes, nematodes *Metoncholaimus sp.1* and polychaete *Syllis cornuta*. Large number of taxa;

Zone II - mobile sediment deposit, although shifted to windward of the atoll, contiguous to zone I, sediment ripples due to tidal flow. Meiofauna abundance decreases, mainly nematodes. Increase in the abundance of copepods. The macrofauna has relatively high density *Mesacanthion sp.1* (nematode) and the polychaete *Questa caudicirra*.

Zone III - flat, slightly above the other two areas (I and II). Has a relatively high density of meiobenthic nematode *Chromaspirinia sp.1* and *Desmodora sp.1*. Macrofauna with a relatively high density of isopods *Sphaeromopsis mourei*;

Zone IV - located in the lee of the reef plateau, has very fine sediments and connects the inside of the atoll with the outside through Barretinha, characterizing a local runoff for sediment. It has low abundance of meiofauna, with low diversity of nematodes, also low abundance of macrofauna.

High-energy conditions to the windward side of the atoll cause the breakdown of the reef, resulting in the deposit of coarse sediment, nutrients and organic matter in Zone I. During the tide cycle, these sediments are re-deployed to zone II, allowing the formation of ripples in the sediments. This area is characterized by mobile deposits. In this zone, the sediments are thereafter transported to zone III and zone IV finally located downwind of the reef plateau.