Informações disponíveis de algumas Unidades de Conservação Federais para ampliar a rede de Sítios Ramsar Brasileiros

Produto 3.

Fichas Informativas de Áreas Úmidas de Ramsar para três UCs Federais Marinho-Costeiras em Inglês.

Mauro Luis Ruffino

Brasília, DF

Dezembro/2013 – Versão 1.2

O Autor

Mauro Luis Ruffino é consultor independente baseado em Brasília, DF, com experiência nas áreas Gerenciamento de Projetos; Gestão Ambiental; Fortalecimento Institucional; Desenvolvimento Local e Participação; Avaliação de Estoques Pesqueiros; Gestão Compartilhada de Recursos Pesqueiros, Conservação de Biodiversidade e Gestão de Áreas Protegidas.

Graduado em Oceanologia (1988) e Mestre em Oceanografia Biológica pela Fundação Universidade Federal do Rio Grande (1991).

De maio/1992 a dezembro/1998 foi consultor da GOPA Consultants GmBH quando coordenou o Projeto IARA - Administração dos recursos Pesqueiros do Baixo Amazonas, executado pelo IBAMA com a Cooperação Técnica Alemã através da GTZ.

De janeiro/1999 a julho/2000 foi consultor do Banco Mundial e GTZ na preparação do Projeto Manejo dos Recursos Naturais da Várzea (ProVárzea)

De agosto/2000 a junho/2007 coordenou o Projeto Manejo dos Recursos Naturais da Várzea (ProVárzea) executado pelo IBAMA no âmbito do Programa Piloto para a Proteção das Floretas Tropicais do Brasil (PPG7) coordenado pelo Ministério do Meio Ambiente.

De junho/2007 a julho/2009 foi Diretor de Ordenamento, Cadastro e Estatística de Aquicultura e Pesca da Secretaria Especial de aquicultura e Pesca da Presidência da República (SEAP/PR).

De agosto/2009 a janeiro/2011 exerceu a função de Diretor do Departamento de Monitoramento e Controle da Aquicultura e Pesca do Ministério da Pesca e Aquicultura (MPA).

Desde agosto/2010 é Presidente da Associação Brasileira para as Ciências da Pesca (ABCPesca).

De julho/2011 a fevereiro/2013 foi consultor da GOPA Consultants GmBH prestando assistência ao Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) no contexto do Projeto de Cooperação Técnica Brasil-Alemanha "Desenvolvimento de Capacidades para a Gestão Ambiental na Amazônia", segunda fase da "Proteção e Manejo Sustentável das Florestas Tropicais", no contexto de Cooperação Técnica entre os Governos da Alemanha (GIZ) e Brasil (MMA) através de assistência de otimização e Gestão de Áreas Protegidas, especialmente em indivíduos 1) Gestão por Resultados, 2) Sustentabilidade Econômica de Áreas Protegidas e 3) Planejamento e Governança de Unidades de Conservação. Brasília, DF, Brasil.

De julho a agosto/2012 foi Consultor do FUNBIO para Elaboração de Plano de Negócios, enfocando o levantamento de informações e a identificação de barreiras e oportunidades para a atuação do setor privado na criação, ampliação e consolidação de áreas marinhas protegidas no Brasil, no âmbito do Projeto Nacional de Ações Integradas Público-Privadas para Biodiversidade – Probio II

Possui mais de 100 artigos científicos publicados em periódicos e revistas nacionais e internacionais, assim como livros e capítulo de livros.

LISTA DE ABREVIAÇÕES

APA- Área de Proteção Ambiental

ARIE - Área de Relevante Interesse Ecológico

ARPA - Programa Áreas Protegidas da Amazônia

CDB - Convenção da Diversidade Biológica

CNUC – Cadastro Ncional de Unidades de Conservação

CNZU – Comitê Nacional de Zonas Úmidas

ESEC - Estação Ecológica

FAUC – Ferramenta de Avaliação de Unidades de Conervação

FIR - Ficha Informativa Ramsar

FLONA - Floresta Nacional

FUNBIO - Fundo Brasileiro para a Biodiversidade

ICMBio - Instituto Chico Mendes de Conservação da Biodiversidade

IUCN - União Internacional para a Conservação da Natureza

MMA - Ministério do Meio Ambiente

PARNA - Parque Nacional

PNUD – Programa das Nacções Unidas para o Desenvolvimento

RBMA – Reserva da Biosfera da Mata Atlântica

REBIO - Reserva Biológica

RESEX - Reserva Extrativista

RPPN - Reserva Particular do Patrimônio Natural

RVS - Reserva de Vida Silvestre

SBF – Secretaria de Biodiversidade e Florestas

SFB - Serviço Florestal Brasileiro

SNUC - Sistema Nacional de Unidades de Conservação da Natureza

UC – Unidade de Conservação

UNESCO - Organização das Nações Unidas par a Educação, a Ciência e a Cultura

SUMÁRIO

1. Introdução

A Convenção sobre Zonas Úmidas, mais conhecida como Convenção de Ramsar, é um tratado intergovernamental que estabelece marcos para ações nacionais e para a cooperação entre países com o objetivo de promover a conservação e o uso racional de zonas úmidas no mundo. Essas ações estão fundamentadas no reconhecimento, pelos países signatários da Convenção, da importância ecológica e do valor social, econômico, cultural, científico e recreativo de tais áreas.

Estabelecida em fevereiro de 1971, na cidade iraniana de Ramsar, a Convenção de Ramsar está em vigor desde 21 de dezembro de 1975, e seu tempo de vigência é indeterminado. No âmbito da Convenção, os países membros são denominados "partes contratantes"; até junho de 2013, a Convenção contabiliza 167 adesões.

O Brasil - que, por suas dimensões, acolhe uma grande variedade de zonas úmidas importantes - assinou a Convenção de Ramsar em setembro de 1993, ratificando-a três anos depois. Essa decisão possibilita ao país ter acesso a benefícios como cooperação técnica e apoio financeiro para promover a utilização dos recursos naturais das zonas úmidas de forma sustentável, favorecendo a implantação, em tais áreas, de um modelo de desenvolvimento que proporcione qualidade de vida aos seus habitantes.

Para aderir ao tratado, cada país deve depositar um instrumento de adesão junto à Unesco - instituição que opera como depositária da Convenção - e, ao mesmo tempo, designar ao menos uma zona úmida de seu território para ser reconhecida como Sítio Ramsar para ser incluída na Lista de Zonas Úmidas de Importância Internacional, mais conhecida como Lista de Ramsar.

A Lista de Ramsar é o principal instrumento adotado pela Convenção para implementar seus objetivos. É composta por áreas caracterizadas como ecossistemas úmidos importantes, selecionados pelos países e aprovadas por um corpo técnico especializado da Convenção. Uma vez aceitas, essas áreas recebem o título de "Sítios Ramsar".

As partes contratantes têm a seu dispor dois tipos de apoio financeiro: o Fundo de Pequenas Subvenções (Ramsar Small Grants Fund) e o Fundo Zonas Úmidas para o Futuro (Wetlands for the Future Fund), cujos recursos podem ser solicitados para financiar a implementação de projetos de conservação e uso sustentável em zonas úmidas, especialmente dos Sítios Ramsar.

O Brasil adota como diretriz a indicação de somente Unidades de Conservação como zonas úmidas a serem incluídas na Lista de Ramsar, o que favorece a adoção das medidas necessárias à implementação dos compromissos assumidos pelo país perante a Convenção.

Desde sua adesão à Convenção, o Brasil promoveu a inclusão de 11 zonas úmidas à Lista de Ramsar, totalizando 6.568.359 hectares de áreas passíveis de serem beneficiadas (Figura 1). A introdução dessas zonas úmidas na Lista de Ramsar faculta ao Brasil a obtenção de apoio para o desenvolvimento de

pesquisas, o acesso a fundos internacionais para o financiamento de projetos e a criação de um cenário favorável à cooperação internacional.

Figura 1. Localização dos Sítios Ramsar Brasileiros (Fonte: www.mma.gov.br).

Em 2010, o MMA criou no âmbito do Comitê Nacional de Zonas Úmidas (CNZU), a Comissão Sobre Critérios para Designação de Sítios Ramsar (Portaria nº 186/2010). A Comissão foi criada com vistas a estudar e propor critérios nacionais para a seleção de Áreas Protegidas a serem indicadas como potenciais Sítios de Importância Internacional - Sítios Ramsar. Por dois anos, a Comissão elencou critérios adicionais aos já estabelecidos pela Convenção de Ramsar, critérios esses que serviriam para dirigir a política de seleção e indicação de novos sítios.

O relatório final da Comissão foi concluído em maio de 2012 e culminou com a aprovação, pelo CNZU, da Recomendação No. 05, 25 de junho de 2012 que dispõe sobre critérios para designação de Sítios Ramsar e indica as Áreas Protegidas a serem indicadas como potenciais Sítios de Importância Internacional – Sítios Ramsar. A referida recomendação apresenta dois anexos:

- Anexo A que lista os critérios nacionais que deverão ser adotados como metodologia para a seleção de Áreas Protegidas a serem indicadas como potenciais Sítios de Importância Internacional - Sítios Ramsar;
- Anexo B, que apresenta as Unidades de Conservação (UC), listadas segundo as notas obtidas pelos critérios descritos no Anexo A. Com base nos critérios foram produzidas duas listas de áreas protegidas prioritárias

para designação como Sítio Ramsar, conforme sua localização em ambiente continental ou em ambiente marinho e na zona costeira.

Assim, a presente consultoria foi contratada pelo Programa das Nações Unidas para o Desenvolvimento (PNUD) através do Projeto BRA/11/001 da Secretaria de Biodiversidade e Florestas (SBF) do Ministério do Meio Ambiente (MMA), o qual tem como objetivo cooperar com o empenho nacional de implementar dispositivos das Convenções sobre a Diversidade Biológica, sobre Zonas Úmidas de Importância Internacional, entre outras.

Acordada por um período de 12 meses a partir de 18 de janeiro de 2013, a presente consultoria objetiva organizar e coordenar atividades relativas a identificação da disponibilidade de informações técnicas sobre biogeografia, hidrologia e geomorfologia, informações sobre as características físicas e ecológicas e sobre fatores adversos e ameaças, bem como demais informações relevantes para 17 Unidades de Conservação federais listadas no Anexo B da Recomendação Nº 05 de 25/06/2012 do Comitê Nacional de Zonas Úmidas – CNZU. E, destas 17 UCs, selecionar 6 e elaborar documento com informações adequadas aos moldes exigidos pela Convenção de Ramsar, o qual será submetido à apreciação da Convenção, com vistas ao título de Sítios Ramsar.

Sob o status de Sítio Ramsar, os ambientes úmidos passam a ser objeto de compromissos a serem cumpridos pelo país e, ao mesmo tempo, a ter acesso a benefícios decorrentes dessa condição. Tais benefícios podem ser financeiros e/ou relacionados à assessoria técnica para o desenho de ações orientadas à sua proteção. Ao mesmo tempo, o título de Sítio Ramsar confere às áreas úmidas prioridade na implementação de políticas governamentais e reconhecimento público, tanto por parte da sociedade nacional como por parte da comunidade internacional, o que contribui para fortalecer sua proteção.

No caso do Brasil, onde somente são designados Sítios Ramsar locais legalmente protegidos (Unidades de Conservação), e o reconhecimento internacional reforça a necessidade de valorização destas UCs. Nestas áreas, as características ecológicas devem ser mantidas obrigatoriamente, de modo a garantir suas funções e serviços ambientais.

As vantagens do reconhecimento de uma Unidade de Conservação brasileira como Sítio Ramsar são:

- Posicionamento político: reflete uma preocupação do Governo Brasileiro em espelhar os reclamos da sociedade com a conservação de grande parte de seu território, no que se refere à flora, à fauna e à água.
- Reconhecimento internacional: com a designação, as possibilidades de negociações internacionais voltadas para o apoio ao desenvolvimento de pesquisa podem ser ampliadas, além do acesso as fontes internacionais de financiamento e criação de um cenário mais amplo para a cooperação regional e internacional.
- Novas perspectivas para o desenvolvimento: o País insere-se nas visões modernas de desenvolvimento que têm como premissa básica a promoção da qualidade de vida, obtida por meio da utilização

sustentável – considerado sinônimo do conceito de uso racional da Convenção de Ramsar – aqui incluídos os aspectos econômicos e os sociais.

- Dimensão estratégica: projeta a importância do Brasil na região Neotropical, no âmbito da Convenção de Ramsar, no que se refere aos valores e benefícios derivados das Zonas Úmidas.

Como se percebe, este instrumento precisa ser melhor explorado no Brasil por garantir maior visibilidade das zonas úmidas. Podemos citar o fato do selo "Sítio Ramsar" poder ser utilizado como estímulo ao turismo sustentável. Para ilustrar este fato, o Secretariado de Ramsar disponibilizou uma série de estudos de caso que mostram a compatibilização da conservação nas zonas úmidas com a atividade turística. O Brasil, por exemplo, apresentou a experiência do Parque Nacional Marinho de Abrolhos, que pode ser acessado pelo sítio eletrônico: http://www.ramsar.org/pdf/case_studies_tourism/Brazil/Brazil_Abrolhos_SP.pdf

2. Objetivos

O objetivo desta consultoria é levantar informações disponíveis e fornecer embasamento técnico necessário para ampliar a rede de Sítios Ramsar Brasileiros por meio de indicação e do desígnio das Unidades de Conservação federais listadas no Anexo B da Recomendação Nº 05 de 25/06/2012 do Comitê Nacional de Zonas Úmidas – CNZU.

2.1. Objetivos específicos

- Realizar levantamento de informações técnicas sobre biogeografia, hidrologia e geomorfologia, informações sobre as características físicas e ecológicas e sobre fatores adversos e ameaças, bem como demais informações relevantes para 17 Unidades de Conservação Federais listadas no Anexo B da Recomendação No 05 de 25/06/2012 do Comitê Nacional de Zonas Úmidas – CNZU;
- Selecionar 6 UCs e elaborar documento com informações adequadas aos moldes do exigido pela Convenção de Ramsar (Fichas Informativas Ramsar preenchidas) em uma das línguas oficiais da Convenção que serão submetidas à apreciação da Convenção para receberem o título de Sítios Ramsar.

3. Metodologia

Assim, considerando a disponibilidade de informações, existência de Plano de Manejo e Conselho Gestor, foi recomendado por este consultor e acatado pelo MMA e ICMBio as 6 UCs abaixo relacionadas para serem submetidas a Sítios Ramsar:

1) UCs federais marinhas:

- APA Fernando de Noronha + PN Marinho de Fernando de Noronha
- ESEC Taim
- REBIO Atol das Rocas

2) UCs federais continentais ou costeiras:

- PARNA Viruá
- REBIO Guaporé
- PARNA Ilha Grande

Assim, procedemos ao preenchimento da Ficha Informativa dás Áreas Úmidas para Ramsar para as 3 UCs Federais Marinhas em português, objeto do 2º Produto constante no Termo de Referência.

No caso da Reserva Biológica de Atol das Rocas e da Áreas de Proteção Ambiental e Parque Nacional Marinho de Fernando de Noronha, as fichas preenchidas forma encaminhadas por correio eletrônico aos Chefes das referidas UCs para revisão e complementação de informações (partes destacadas em amarelo) e anexos que não foram possíveis de serem obtidos por este consultor.

4. **Resultados**

Apresentamos a seguir as Fichas Informativas dás Áreas Úmidas para Ramsar em Inglês para:

- ✓ APA Fernando de Noronha + PN Marinho de Fernando de Noronha
- ✓ REBIO Atol das Rocas
- ✓ ESEC Taim

FERNANDO DE NORONHA

Information Sheet on Ramsar Wetlands (RIS) – 2009-2012 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.

FOR OFFICE USE ONLY.

DD MM YY

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

Lisângela Aparecida Pinheiro Cassiano. Avenida Eurico Cavalcante, nº 174, Bairro do Boldró. CEP: 53.990-000. Fernando Noronha/PE. E-mail: fernandodenoronha@icmbio.gov.br;

Fone PARANAMAR/FN: 0055 81 3619-1220, Fone APA/FN: 0055 81 3619-1220

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.

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 (nature 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.

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

Provide the coordinates of the approximate centre 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.

Arquipélago de Fernando de Noronha – 03° 54' S latitude and 32° 25' W longitude, and Arquipélago de São Pedro and São Paulo – 00° 55' N latitude and 29° 21' W longitude.

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.

The archipelago of Fernando de Noronha (FN) is part of an alignment of underwater mountains, distributed along a trail in the EW direction that stretches from the Dorsal

Atlantic to the Brazilian continental shelf, at the coast of Ceará, towards Fortaleza. The highest mountains emerge from the sea surface, delineating islands and archipelagos, such as Atol das Rocas and the archipelago of Fernando de Noronha itself, which is 545 km distant from Recife (1,536,934 inhabitants - IBGE/2010), capital of the state of Pernambuco, and 360 km from Natal (803 739 inhabitants - IBGE/2010), capital of the Rio Grande do Norte state, cities that have commercial flights routes, which are the main access to the largest island of the archipelago, also called Fernando de Noronha. It is also where State district of the same name is located, belonging to the State of Pernambuco/Brazil, with a population of 2,629 inhabitants (IBGE/2010) and as far as 710 km from the city of Fortaleza, capital of Ceará (2,452,185 inhabitants - IBGE/2010).

The archipelago of São Pedro and São Paulo, on the other hand (without permanent residents) is formed by a group of 15 small rocky islands, located over the tectonic fracture of São Paulo just above the equator, and lies about 1010 km from the coast of the Rio Grande do Norte state. It is occupied by a group of at least four (4) people 365 days a year, preferably formed by researchers, that receives support from a program conducted by the Brazilian Navy.

It should be noted that Decree No. 92,755 created the Environmental Protection Area ("Área de Proteção Ambiental – APA) of Fernando de Noronha - Rocas - São Pedro and São Paulo, June 5th, in 1986, covering an area of 79,706 ha, including the archipelago of Fernando de Noronha, Atol das Rocas and the Archipelago of São Pedro and São Paulo. On the other hand, the National Marine Park of Fernando de Noronha, created by Decree Nº. 96,693, September 14th, in 1988, occupies 70% of the archipelago of Fernando de Noronha, covering an area of approximately 11,270 ha.

However, Article nº 4, sections I and II, of the Decree that creates the National Marine Park of Fernando de Noronha – PARNAMAR, excludes the APA Fernando de Noronha, Rocas and São Pedro and São Paulo from the corresponding area of the PARNAMAR, as well as the area corresponding to the Biological Reserve of Atol das Rocas, created by Decree nº 83,549, June 5th, in 1979. As a result there was a reduction of the original APA Fernando de Noronha - Rocas - São Pedro and São Paulo, which ends up being composed only by Archipelago of São Pedro and São Paulo e by part of the Archipelago of Fernando de Noronha, in its terrestrial and marine portions, excluding the area of the National Marine Park of Fernando de Noronha.

---

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

Islands of irregular landscape, with its peak reaching 321m in its uppermost portion (Peak Hill), in the archipelago of Fernando de Noronha, and reaching 23m above sea level in the archipelago of São Pedro and São Paulo.

11. Area: (in hectares)

The area of the APA/FN is 33,250 ha and the PARNAMA/FN has 11,270ha.

---

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 archipelago of Fernando de Noronha consists of 21 islands, islets and rocks of volcanic origin. The main island has an area of 18.4 km^2, the major axis has around 10 km, with a maximum width of 3.5 km and a perimeter of 60 km. The base of this enormous volcanic formation is more than 4,000 meters deep. The main island, that has the same name as the archipelago, constitutes 91% of the total area, and has patches of the Atlantic rain forest with the only known oceanic mangrove in the South Atlantic; and along with the islands of São Pedro and São Paulo, areas with high productivity and biological diversity, become areas of great importance for the maintenance of local communities, as well as being one of the locations of greatest relevance in the South Atlantic for resting, breeding, and feeding for migratory species, as both the Nearctic (North America) and the Palaearctic species (Europe, Asia, and North Africa) (MMA/IBAMA, 2005).

Both archipelagos are parts of the Atlantic Rain Forest Biosphere Reserve, but in this case, we consider the whole archipelago of Fernando de Noronha, and not only what corresponds to the APA. They are also listed on the UNESCO's list as a Natural World Heritage site and are areas of study of the REVIZEE Program (Program for the Evaluation of the Sustainable Potential of Living Resources in the Exclusive Economic Zone) created in 1995 and replaced in 2006 by REVIMAR (Action for Evaluation, Monitoring, and Conservation of Marine Biodiversity)[1].

The marine ecosystem of Noronha - another component of the insulate ecosystem – presents a greater stability compared to the biological evolution of the natural terrestrial environment, although small variations and increase in species richness and density of fauna and flora occur. Of unparalleled beauty, the colors of the sea surrounding the islands enchant their visitors: turquoise blue and emerald tones foreshadow an amazing underwater world in its variety of colors and species.

---

1 "In 1988, Brazil ratified the United Nations Convention on the Law of the Sea (UNCLOS), on December 12, 1982, assuming a series of rights and duties, among which those related to determine the allowable catch of the living resources in the Exclusive Economic Zone (EEZ) and ensure the preservation of living resources in the EEZ and that are not threatened by overfishing effort.

The Ministry of Environment - MMA has been promoting initiatives towards an integrated and participative management of the marine zone in Brazil. Among the initiatives, highlights the REVIZEE Program, which began in 1995 and was officially closed in September, 2006, through the Action for Evaluation, Monitoring and Conservation of Marine Biodiversity (REVIMAR) with an ecosystem approach, aiming at the establishment of scientific and integrated actions capable of supporting policies and actions for the conservation and co- management strategies for sustainable use of living resources. The Executive Committee of REVIMAR was established by Ordinance N^o. 233/MB of September 14th, 2005, by the Navy Commander and Coordinator of CIRM" (https://www.mar.mil.br/secirm/p-revimar.html).

However, in the APA Fernando de Noronha there are several activities being developed that cause direct or indirect impacts on the local fauna and flora. Tourism (occurring disorderly, with some activities becoming incompatible with the conservation of biodiversity), marine pollution (poor sanitary and port infrastructures), diving (disorderly occurring), fishing (predatory), urban growth (in disorder) and livestock and agriculture (alien species) are among these activities. The long historical process of human occupation noticeably influenced the current characteristics of the vegetation of the APA Fernando de

Noronha and extensive agricultural activities played an important role in this process (MMA/IBAMA, 2005).

---

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 - Has the only oceanic mangrove of the South Atlantic Ocean.

Criterion 2 – Of the species with ecological interest, one terrestrial invertebrate species that deserves special attention is the crab *Gecarcinus lagostoma*, endemic of the Brazilian oceanic islands (Fernando de Noronha, Rocas Atoll and Trindade). Its populations are greatly reduced due to illegal catches practiced by the islanders. This species can have a high commercial value because of its meat, which is well appreciated by islanders and visitors (MMA/IBAMA, 2005).

Fernando de Noronha has three endemic taxa: *Zenaidaauriculata Noronha*, *Vireogra cilirostris* and *Elaenia spectabilisridleyana*, and these last two are considered vulnerable in the Brazilian endangered species list (MMA/IBAMA, 2005).

Fernando de Noronha also presents three species of threatened sharks: the lemon shark *Negaprion brevirostris*, the sandpaper shark *Ginglymostoma cirratum* and the whale shark *Rhincodon typus* (Machado *et al*., 2008).

Criterion 3 – Due to its oceanic nature, the archipelago of Fernando de Noronha is a refuge for a considerable number of endemic species in Brazil, because it has been isolated from other biomes for millennia. It presents a high local abundance and important ecological functions, especially in relation to plants and terrestrial organisms and is therefore of paramount importance to the preservation of its natural resources.

The gastropods *Colisella noronhensis* and *Fissurella emmanuelae* are the only species of molluscs confirmed as endemic to the archipelago of Fernando de Noronha.

The endemic species of corals in Fernando de Noronha include *Astrangia braziliensis*, *Favia gravid, Mussismili aharti, Mussismilia hispida* and *Siderastre astellata, Thalassoma noronhanum, Elacatinus randalli* and *Segastes rocacensis.*

The endemic bird species are *Zenaidaauriculata Noronha, Vireo gracilirostris* and *Elaenias pectabilisridleyana.*

Criteria 5 and 6 - The Archipelago of Fernando de Noronha was considered an area of extreme biological importance for the conservation of coastal and marine birds in a study conducted in 2002 by the Ministry of Environment (MMA/SBF, 2002). These areas have high productivity and biological diversity, and are of extreme importance for the maintenance of local communities, as well as being one of the locations of major relevance in the South Atlantic for the for resting, reproduction and feeding of migratory species, both Nearctic (North America) and Palaearctic birds.

In addition, the Archipelago has a high primary production, which comprises high richness and density of birds. This benefits mainly birds during breeding season, since that it is in this stage that the birds usually require high food availability (MMA/IBAMA, 2005).

Of the 15 species of seabirds and shorebirds that nest on oceanic islands, 11 (or 73.3 % of the total) use Fernando de Noronha, since out of Brazilian waters, the Equatorial and South Tropical Atlantic Oceans have only three sites for the nesting of nine of these species (Vooren and Brusque, 1999). From these data, one can realize the importance of Fernando de Noronha for the preservation of birds both regionally, and globally.

Criteria 7 and 8 – In relation to its fish populations, it was believed for a long time on the similarity between Brazil and the Caribbean populations. However, despite having similar Caribbean species, many Brazilian species have been identified as endemic to the southwestern Atlantic. In this context, the archipelago of Fernando de Noronha serves as a refuge for a considerable number of endemic species in Brazil, which have high local abundance and important functions. In the archipelago of Fernando de Noronha, 79 species of reef fishes were recorded, belonging to 31 families (Floeter *et al.*, 2001).

The side of the "Mar de Dentro" ("Inner Sea") is used as an area for resting, reproduction, parental care and refuge from sharks during 90% of the days in the year. The side of "Mar de Fora" ("Outer Sea") of the Archipelago is used as a feeding area every day of the year (MMA/IBAMA, 2005).

---

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:

South Atlantic Ocean, oceanic islands.

b) biogeographic regionalisation scheme (include reference citation):

Coastal Marine biome of northeastern Brazil. The archipelago of Fernando de Noronha has a unique ecological and genetic richness, because has been isolated from other biomes for millennia, possessing several endemic species. According to the characteristics of the landscape, the archipelago resembles the Atlantic rain forest Biome.

---

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.

The formation of islands and islets of the archipelago of Fernando de Noronha resulted from volcanic activity along lines of weakness associated with the Fernando de Noronha Fracture Zone. The volcanism was processed through periods of intense activity alternated with calm tectonic periods, when part of the submerged volcanic building was submitted to erosion and sedimentation (MMA/IBAMA, 2005).

The eruptive rocks originated from the early magmatic episodes responsible for the appearance of the archipelago have been removed by erosion, leaving testimony layers of ash and volcanic tuff, corresponding to the oldest rocks preserved on the islands. This pyroclastic material was introduced by alkali-basalts, dated from 12.3 million years.

After the last magmatic event, the archipelago has been subjected to various processes of erosion and sedimentation, which have lasted to the present years and were responsible for the current model of the archipelago, allowing the accumulation of restricted alluvial deposits, aeolian and beachy.

The climate is tropical, hot oceanic, of well-defined seasons. The average annual rainfall is 1,300 mm, with the highest between March and May and dry season between August and January. The average temperature is 25.4 °C. The winds are predominant from the SE direction, average speed of 6.6 m/sec, with higher intensities between July and August. The average annual relative humidity is 81%. The average insolation maximum occurs in November (312.5 h) and minimum in April (216.8 h) (MMA/IBAMA, 2005; Teixeira, 2011).

The region of the archipelago of Fernando de Noronha suffers the influence of the South Equatorial Current, which influences the distribution of the isotherms in this water mass, with the induction of upwellings that reach the euphotic layer in the deepest areas of the banks (Travassos *et al.* 1999).

Evaporation is generally higher than rainfall, providing high values of surface temperatures and salinities, averaging 24°C and range of 4°C and salinity above 35.0%, inhibiting convection in the water column.

The lithological units of the APA Fernando de Noronha fall into two major groups of 1st order, according to their origin, which correspond to the volcanic rocks and sedimentary rocks.

The rocks of volcanic origin are grouped into three distinct geological formations, which consist, in descending order of age, in the formations of Remédios, Quixaba and São José. All of them are of a highly alkaline-sodium nature, sub-saturated in silica, whose levels range from 34.4% in melilita ankaratrites, to 60.8% nlitoquímica, gives volcanism characteristics that put the archipelago of Fernando de Noronha between the most alkaline oceanic islands on the Planet.

The Remédios formation is the oldest one existing in the APA and corresponds to the volcanic activity of the Miocene, which occurred 12.3 million years ago. It occupies the entire central part of the APA, a strip with a width ranging from 800m in the center, to 1,500m in the wider portions. This range extends in a meridian direction, from the northern slopes of the Morro Boa Vista and Atalaia, until the north face of Morro do Pico, plunging vertically into the sea between the shores of Boldró and Conceição (MMA/IBAMA, 2005).

The rocks of the Remédios formation correspond, essentially, of eruptive alkaline rocks and pyroclastic material. The pyroclastic material is the oldest of the APA and consists of conglomerates, breccias and volcanic tuffs, often containing lapillis and volcanic bombs. Their age corresponds to 12.3 million years, which is obtained by geochronological age dating of an alkali-basalt introduced into pyroclastic rocks. These pyroclastic rocks of the Remédios formation surround cores of alkaline rocks in the central part of the APA and border the Cachorro beach, in a narrow strip form, limited to the south by younger lava flows, and by the beach to the north.

The Archipelago of São Pedro and São Paulo, is located in the Intertropical Convergence Zone (ZCIT), characterized by having weak winds, intense cloud cover, high rainfall and low evaporation rate, leaving the surface layer less dense. The Archipelago of São Pedro and São Paulo suffers the influence of the South Equatorial Current throughout the year, with approximate speed of 20 cm/s and lower limit at 200m of depth. The presence of a subsurface current can also be observed, called Submerged Equatorial Current (CES), originated from a strong seasonal component of the Equatorial Current System, and associated with the regime of Southeast Trade Winds, heading to the Equator.

The Equatorial Submerged Current (CES) is the fastest of all the equatorial currents, speeds up to 100 cm/s at the top, flowing from west to east, as opposed to the South Equatorial Current. It can be detected throughout the year, with strong seasonal variations.

The thermocline, as occurs for the entire Northeast of Brazil, is permanent and is between 50 and 120m depth, occurring transient thermoclines that rise near the Archipelago, probably by the influence of the bottom.

Studies about ocean currents, as well as the interactions between them and the submarine bottom, justify some assumptions, such as convergence and divergence of currents and vertical turbulence, when there is a presence of banks and islands, which results in a complex system of circulation, size and shape of these banks and islands, that may result in a phenomenon known as upwelling. The upwelling consists in the nutrient input from deeper layers to the upper layers, causing an increase in primary production and zooplankton, and consequently an enrichment of these waters and an increase in fish populations.

For the Archipelago of São Pedro and São Paulo, there is no clear evidence of the interference of topography on the composition and biomass of phytoplankton communities, nor on the enrichment of the surface layers of the sea, but it is believed that fish populations should concentrate on this region due to the supply of substrate for their eggs, benthic community as food and nutrient upwelling events at certain times of the year (Travassos *et al*., 1999).

The Archipelago of São Pedro and São Paulo is located at the intersection of the transversal northern chain of the São Paulo fracture zone, with mid-Atlantic ridge. It consists of solitary islet in the middle of the Equatorial Atlantic, which rise only 23m above sea level, and represent the top of a large seamount that rises to 3,500 m from the ocean floor (MMA/IBAMA, 2005).

The Brazilian Commission Biological and Palaeobiological Sites approved the Archipelago of São Pedro and São Paulo as a geological marine-submarine and igneous type site. Situated in active transformant fault, it is a unique case of exposed peridotite on oceanic islands.

The rocks of the Archipelago of São Pedro and São Paulo have anomalous features in relation to the rocks (volcanic) from the other islands that appear along the dorsal Atlantic.

They are mylonitizated plutonic rocks of ultrabasic composition, representatives of the oceanic upper mantle. Its outbreak is due to the actions of tectonic force correlated with the basalt flows that form the oceanic ridges and with the oceanic expansion.

The islands consist of peridotitic rocks showing mylonitic and cataclistic foliation, being represented by peridotite mylonite, hornblende mylonite and pyroxene-plagioclase mylonite. Mineralogical analyzes assume that mylonitization occurred during the positioning of the peridotite intrusion at temperatures above 500°C, in a solid state (protrusion), as suggested by mineral paragenesis, that is a characteristic conditions of high temperature and pressure.

The serpentinization of peridotites was partial, indicating the action of a differential process along the ultrabasic intrusion. The mylonitic foliation has a N-S direction, rather than it would be expected, EW, suggesting that there was rotation of the original structures during protrusion of the serpentitic-peridotite body.

The epicenters of earthquakes recorded in the area suggest that the pedestal of rocks have a young age, contrary to the values determined by isotopic age of these rocks, which indicated ages from 835 Million years to 4500 Million years. These data lead us to believe the presence of rocks brought to the surface from ancient and deep portions of the upper mantle, through tectonic event, is rather recent.

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

We propose here the inclusion of the archipelago of Fernando de Noronha, São Pedro and São Paulo as a whole. In this case item 17 is contemplated in item 16.

---

18. Hydrological values:

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

The clayey nature of the soils in Fernando de Noronha, combined with its small thickness, hinders the infiltration and the accumulation of water in the subsoil, disadvantaging the underground water storage. The modest aquifers of Fernando de Noronha related to intensely fractured volcanic rocks and in the case of pyroclastic rocks, with higher porosity. In the valleys with the presence of dialyzed rocks, it is possible much greater accumulation of groundwater upstream of intrusive dykes, forming small underground reservoirs.

In sedimentary deposits, porous and permeable, hydrogeological resources are not expected, because of the reduced thickness of these deposits and their small area of occurrence, not occupying more than 7.5% of the total area of the island of Fernando de Noronha, an area that proportionally decreases further more in reference to the APA.

Even if the storage capacity of the fractured aquifers is relatively large, it should be taken into account that the infiltration of surface water is very small, and whit the annual average precipitation being of around 1,300 mm, it is possible that fewer than 10% would supply the underground reservoir.

The water supply in Fernando de Noronha has been undertaken, since the early times of human occupation, through the capture of rainwater, according to its regime. The existing dams to capture surface water are subject to silting and overflow during periods of intense rainfall, due to the reduced ability of preservation, caused by the increased load.

All streams and drainage lines that exist in the APA, as well as in the island of Fernando de Noronha as a whole, are intermittent due to the lack of an evolution of the drainage conditions in such a small sized surface, in which, moreover, water infiltration that could generate springs is hampered by the small thickness and low permeability of soils (MMA/IBAMA, 2005).

The watercourses are conditional upon the geological substrate, and the most significant within the limits of the APA, correspond to the streams of Boldró, Praia da Conceição, Mulungu and the Bay of Caieira, besides the headwaters of the streams that flow into the Sueste Bay, as the stream of Maceió and the "Saco da Atalaia", as the Atalaia stream. The Maceió stream is biggest drainage on the island of Fernando de Noronha. The lack of vegetation in the springs makes the waters of the precipitation during the rainy season quickly run off under torrential regime, contributing to the acceleration of soil erosion on the surface. The basins, consequently, are small, with low slopes of the order of 15% in the flat areas. The Maceió stream is an example of this type of drainage, being responsible for supplying the Xaréu dyke. The valley of the Atalaia stream is steeper, carving more deeply into deposits from the springs at the foot of the "Morro do Meio" (MMA/ IBAMA, 2005).

---

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.

---

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.

Fernando de Noronha has a submarine volcanic structure, which is a physical barrier on the ocean floor for the passage of deep, nutrient-rich currents, which end up rising to the surface. Thus, organic productivity and the amount of fish are higher. The marine ecosystem is more stable than the terrestrial one, when comparing the biological evolution of both natural environments, although variations occur and increases in species richness and density of its flora and fauna.

Of unparalleled beauty, the colors of the sea surrounding the islands in shades of turquoise and emerald foreshadow an amazing underwater world in its variety of colors and species. However, the small size of the island's ecosystem provides a rare visibility of the nature's reaction to changes or interventions promoted on their environmental stability and like any other ecosystem boundary, the preservation of the marine ecosystem is directly related to the preservation of the terrestrial ecosystem.

Noronha is the only island in the Atlantic that has a mangrove with special features. The vegetation extends over 15,000 m^2 or 1.5 ha, and is considered one of the smaller mangroves in Brazil. The size of the trees also draws attention, since they reach up to 10 meters high, while in other places the average height is around 6 meters. Another peculiarity is to be composed of a single species *Laguncularia racemosa*, known as the white-mangrove. In reality, what the island has is a forest mangrove, not an actual mangrove, since it is composed of only one type of tree.

The white-mangrove in Noronha has the same characteristic as the red-mangrove from other mangroves with aerial roots that help the fixation and balancing of the plant, and this adjustment should be related to the characteristics of the water and soil of Noronha.

---

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*.

Of the marine flora, apparently the vast majority of species of algae found in the archipelago of Fernando de Noronha has a wide geographic distribution or is typically from tropical regions that resembles the flora of the Caribbean, with a large proportion of red algae and large number of Caulerpales, Dyctiotales and Fucales, with low probability of occurrence of benthic marine algae species endemic to the archipelago. This probably happens because of the easy dispersion by the ocean currents and high resistance of the propagules of tropical algae. The diversity of algae is lower in Fernando de Noronha when compared to nearby continental locations, which is common among oceanic islands.

The Dyctiotales, brown algae, are the most abundant on the rocky shores of Fernando de Noronha and this dominance is probably due to the presence of secondary metabolites that inhibit predation by fish. The family Caulerpaceae is the most abundant among the Chloroficeae, and this may also be attributed to the production of secondary metabolites that can poison fish and avoid predation by sea urchins.

The identified algal flora of the archipelago of São Pedro and São Paulo is represented by 14 species, four (04) green algae, six (06) red algae, three (03) feofícea and one (01) cyanophyceae, among which *Caulerpa racemosa* var. *peltata* represents the most frequent and the clorofícea *Chaetomor phabrachygon*, the less frequent of the species, occurring only on the

rocky shores on the southern portion of the Belmonte island. Among the classes of algae, the red algae must be highlighted, since they represent, according to their morphology and texture, a major fixation area for other species that develop on the rhodophytes, as the epiphytes, as is the case of *Ectocarpus breviarticulatus* (feofícea) that has as a host, the algae *Laurencia sp*.

Considering that most of the APA has slopes of less than 10 degrees, favoring human occupation and that these slightly rugged terrains occur throughout the APA, except on the slopes of the main elevations, such as the "Morro do Pico" and "Morro do Meio", these constraints define the vegetation cover of the APA. In particular, the greater or lesser exposure to the South/South-East trade winds creates situations that define the ecological niches for dominant plants.

The heterogeneity of the physical environment ends up imposing certain determinism for the vegetation that covers the terrain. However, in the APA, the present landscape is the result of profound change by a history of five centuries of occupation and anthropogenic activities, reducing the importance of the diversity of geological substrates and soil associations as determinants for vegetation cover.

Of the plant formations, the classes with arboreal canopy cover about 59% of the area, despite the herbaceous vegetation predominance in most of the APA. The dense arboreal vegetation canopy covers 33% of the area, occurring mainly in Quixaba, the headwaters of the Maceió River, the slopes of "Morro do Pico", the edges of the "Planalto dos Remedios", in the river valley of Mulungu and on the way to the Atalaia beach. These portions of the APA deserve special attention for conservation initiatives, since it includes a Permanent Preservation Areas (APPs) and the vegetation is relatively preserved.

The open arboreal vegetation canopy covers 26% of the area, occurring in areas adjacent to dense arboreal vegetation canopy, on the edges of the Planalto Quixaba, leading to the "Cacimba do Padre", Bode and Boldró beaches, in the valley of the Maceió river, in strands connecting the lower slope of "Morro do Pico" and the edge of the "Planalto dos Remédios", in the areas between the edge of this plateau and the dunes of Santo Antônio and the path to the Atalaia beach. These areas should also be subjected to conservation initiatives because they form a buffer zone between the more intensively occupied area of the APA and more preserved vegetation cover or PARNAMAR itself.

The herbaceous/shrubby dense vegetation only covers 5% of the area, near the area of the use and occupation of the "Planalto Quixaba" and "Planalto dos Remédios", and modified areas in "Ponta de Santo Antônio" (Air France). In the slopes that lead to the beaches of "Cacimba do Padre", Bode, Boldró, Conceição and Cachorro, this vegetation is dominated by *Leucaena leucocephala*, better known as "linhaça". These sites need to go through a recovery process, since despite the "linhaça" being a shrubby species of great importance for the protection of the soil and steep areas subjected to erosion, it is also an introduced species, used by cattle and goats for foraging, but not belonging to the natural terrestrial flora of the archipelago.

The herbaceous/shrubby more open vegetation covers 19% of the area, and predominates mainly at the edges of "Planalto da Quixaba" and "Planalto dos Remédios", with extensive areas around the airport runway. The herbaceous vegetation predominantly covers 8% of the area, and is, in general, associated with agricultural activities in the "Planato da Quixaba", as in the area northeast of "Morro do Meio", but it can also occur as grasslands, psamófilas vegetation (as in the contiguous area of the Santo Antonio dunes), and communities of "jitiranas" or invasive. About 9% of the area has sparse or no vegetation, that occur throughout the coastline, beaches, cliffs and headlands. These areas are also

represented by the dunes, rocky outcrops, dams and other artificial areas with no vegetation.

The long process of human occupation noticeably influenced the current characteristics of the vegetation in the archipelago of Fernando de Noronha. The primitive tree species was reduced as man introduced numerous plants for agricultural, forage, medicinal and ornamental use. The extensive agricultural activity has an important role in the history of the archipelago's occupation, as did cattle raising during the period when the island was quarantine area for imported animals. Goats, sheep, cattle and horses still remain from that period. Rarely confined, these animals graze in certain areas of the APA, clearly causing influence over the vegetation.

Studies allowed the identification of 52 dominant species in Fernando de Noronha, including:

Bumeliasartorum Mart. - Sapotaceae. Possibly native of Fernando de Noronha, its edible fruits may have contributed to its spreading; it is among the most common species of trees in the archipelago. Its resistance to marine influence is demonstrated by its spatially dominance both leeward to the Quixaba and "Morro do Forte", as upwind in areas near Sueste Bay.

Cappariscynophallophora L. - Capparaceae: Known popularly as "feijão bravo", occurs in secondary forest formations. Its presence is more expressive windward facade, although it also occurs in the most preserved areas downwind (mainly Quixaba hills and slopes of Pico and Forte) and in the central portion of the APA.

Erythrina velutina Willd. - Fabaceae: It is one of the tallest trees of the APA, possessing a trunk up to 12 m high. The "mulungu" occurs in all areas of the APA, either spontaneously (Quixaba), or cultivated by man for ornamental purposes (Boldró and Vila dos Trinta, for example). Remarkable in the Noronha landscape, this impressive deciduous tree probably had its population reduced throughout history. From proven cases of escaped prisoners who tried to sail on rafts of "mulungu" (Melo, 1916), several personalities have positioned themselves in favor of its eradication from the Archipelago (Lima, 1857 and Rohan, 1865apud Lins e Silva, 1989). Despite this, *Erythrina velutina* Willd remains one of the main dominant species among the tree communities of the APA and has excellent potential for reforestation in degraded areas. The characteristic budding also enables further uses.

Ficusnoronhae oliver - Moraceae: even though it occurs as the dominant species among the arboreous stratum in only some areas of the APA, this exuberant Moraceae plays an important role in the landscape, mainly due to its size and coverage. It presents an undifferentiated spatial distribution, usually associated with rocky substrates, both in most the modified areas, as in isolated locations.

Jatrophacurcas L. - Euphorbiaceae: the "pinhão branco" as it is known throughout the northeast, is a shrub rich in milky white latex. It is a short ligneous quite frequent in APA. Although their spatial distribution presents a tendency to windward, it is also found in other mesological conditions. Along with other representatives of the genus Jatropha, "pinhão branco" is associated with pioneering stages of ecological succession or herbaceous/shrubby formations.

Lantanacamara L. - Verbenaceae: distributed throughout tropical America, this shrub is popularly known as "chumbinho". It is very common among short ligneous of the APA and occurs as a dominant species in many sectors, and its expansion is largely favored by human activity. A proof of this is their absence in areas with more preserved vegetation. In the dry season, they lose their leaves, produce seeds and their twigs form an almost

impenetrable barrier in areas where its density is noticeably high. These biotopes occupy extensive portions of the APA and are easily recognized.

Leucaenaleucocephala (Lam) DeWit-Fabaceae: they are trees and shrubs of discussed source, probably native from Mexico and northern Central America. This species is currently found in all tropical regions. In the APA it's dominant in areas with an average degree of artificiality. Very conspicuous in the valleys of the Maceio River, which drains into the Sueste Bay; the Mulungu River, near the "Vila dos Remedios"; Boldró River and in a strand connecting the beaches of Conceição and Cachorro, usually occurring in populations with significant density of individuals, generally exceeding 2m in height. Introduced in Fernando de Noronha by man, it occurs inland usually in abandoned areas with poorly drained soils, besides in all the beaches of the APA. It's an invasive alien species whose distribution has been increasing dramatically in the main island of Fernando de Noronha.

Jatrophagossypifolia L. - Euphorbiaceae: a milky shrub found in the West Indies and tropical Continental America. In the APA of Fernando de Noronha, the "pinhão roxo" is easily recognized in the landscape where it is dominant, like in modified areas of the "Planalto Quixaba" and "Planalto dos Remédios".

JatrophamolissimaBaill. - Euphorbiaceae: milky bush generally less than 2m tall, common throughout the Northeast of Brazil, this other kind of "pinhão branco" is quite different from *Jatrophacurcas L.* in relation to their spatial distribution. It only occurs in the APA area, in sectors clearly far from the coast. The islanders often use it to build fences.

Capparis flexuosa L. - Capparaceae: "Erva glabra", this plant is known among islanders by the name of "jito". It is quite conspicuous in forested areas of the APA, occurring only in the sub-forest, in places with little modifications, especially in the "Morros do Meio", "Pico" and in Quixaba.

Guettardaangelica Mart. Ex Muell. Arg. - Rubiaceae: a tall ligneous, its distribution ranges from Piauí to São Paulo. This Rubiaceae occurs as a dominant species in the APA, especially near the "Vila dos Trinta", "Três Paus" and "Morro do Forte". As the *Erythrina velutina* Willd. var. *aurantiaca*, the Tabebuia roseo-alba (Ridl.) *Sandwith* and *Ficus noronhae* Oliver, it could be used in the reforestation of areas in APA.

Tabebuia roseo-alba (Ridl.) Sandwith-Bignoniaceae: a tree with 7 to 16 m in height and trunk of around 40-50 cm in diameter. It occurs in the states of São Paulo, Minas Gerais, Mato Grosso do Sul and Goiás, in the semi-deciduous broadleaf forests. It is also sparsely found in the caatinga. This "ipê" is dominant in some modified sectors of the APA, like the Quixaba forest. In these areas the forest formation reaches a higher size. Perhaps because of the difficult access of certain terrains where the slope is very high or because of the physiographic isolation, the vegetation in these places usually exceed 10 m in height.

Calotropisprocera (Ait.) R. Br - Asclepiadaceae: Mentioned by Joly (1983) as an African plant found in East and Northeast Regions of Brazil, also called "lã de seda" it is a twiggy shrub, evergreen. Its vernacular name refers to its famous kapok seeds, used in the manufacture of various products. In the Archipelago, it reaches a maximum height of 2 m. With the appearance of a gigantic herbaceous (Britton & Millspaugh, 1962), it is dominant only in the dune formations in the APA, specifically the Santo Antonio dune. Its presence is a indicative of sandy substrate.

Cleomediffusa Banks ex DC. - Capparaceae: Is a very branched herb, found in the valleys throughout Brazil, the "mussambê" as it is known in the Northeast, is a herb that can reach up to 2 m tall. In the APA, it is dominant in the line of drainage leading to the Sancho Bay.

MalachrafasciataJacq. - Malvaceae: this is the only Malvaceae among the dominant plant species in the archipelago of Fernando de Noronha. It's an herbaceous plant, about 1m high. Distributed throughout tropical America and known in some parts of the Northeast as "quiabo bravo", it is dominant in the APA just next to the path leading to the Atalaia beach.

ManihottripartitaMuell. Arg. - Euphorbiaceae: a plant rich in latex, light and porous wood, can reach more than 15 m in height. In the archipelago, however, is not bigger than 5 m. Native of Ceara, the roots are dried in the sun and usually used to feed the cattle. The "maniçoba", as it is called by the islanders, belongs to the same genus as the "mandioca" and occurs as a dominant species in specific areas of the APA, near the "Forte dos Remédios" and the valley of the Mulungu River.

Phyllanthusniruri L. - Euphorbiaceae: an annual plant, pantropical, herbaceous. In Fernando de Noronha is dominant only in the Santo Antonio dunes and adjacent areas. This species of the same genus as the famous "quebra-pedras", occurs associated with dune formations and sandy soils, analogously to *Calotropisprocera* (Ait.) R. Br.

Pistiastratiotes L. - Araceae: belongs to the only floating genus of the Araceae family, the " alface d'água " is a small herb without stems. Cosmopolitan in the calm waters of tropical and subtropical regions, in Fernando de Noronha this species is dominant in the pond near the entrance of the "Vila dos Trinta", completely covering the surface. It can also occur in other lentic environments such as the dike of Xaréu and the lake formed by the Sueste quarry ("açude da pedreira").

Turneraulmifolia L. - Turneraceae: Herbaceous or a sub shrubby plant, erect, always less than 1m tall. Has a pantropical distribution and found primarily in humid rocky or sandy places of the coast. In the APA, occurs as dominant only in the area close to the dunes of Santo Antonio.

In the archipelago of São Pedro and São Paulo, the only terrestrial vegetation found is composed by algae (*Lyngbya sp.* and a kind of non-identified species of Clorofícea) found in soil or associated with the deposits of guano from birds.

---

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.*

Initially, it is important to note that all aspects that are presented below refer to areas of the continental shelf of the APA Fernando de Noronha, but will always be linked in some way to the reality of the PARNAMAR, due to lack of boundary between the waters of the APA and its National Marine Park of Fernando de Noronha.

Marine Fauna

Phyla Porifera and Mollusca are most the studied in taxonomic terms, but still have many doubts in relation to identification. The Porifera of Fernando de Noronha were always addressed in studies of taxonomic matter.

Around 40 species have already been identified, but this number represents only a small fraction of the true diversity of sponges in Fernando de Noronha. Most species found so far also occur in the northern portion of the Caribeana province, with some species being endemic of this biogeographic province. Cnidarians were studied only up to a depth of 30 meters, and about 37 species were found so far. Most of the Cnidaria fauna of the Anthozoa class found in Fernando de Noronha presents a caribeana distribution or is endemic to Brazilian waters, whereas the hydroids are cosmopolitan or circuntropical. The fauna of cnidarians found so far in Fernando de Noronha are also common in northeastern Brazil. However the species present in Fernando de Noronha, but that has not been recorded in the northeastern coast, can be the result of an insufficient number of samples in this region.

The mollusc fauna of Fernando de Noronha closely resembles that of other tropical regions presenting mainly species of the Caribeana province. Most molluscs of Fernando de Noronha belong to the Antillean fauna that extends along the Brazilian coast. The most abundant species and that are also found on the continent, as well as in the archipelago of Fernando de Noronha are: *Brachidontes exustus* Linnaeus; *Petaloconchus cf. varians* Orbigny; *Dendropoma cf. irregulare* Orbigny; *Stramonitahaemastoma* (=*Thais haemastomaLinnaeus*); *Stramonita rustica* (=Thais rustic Lamarck); *Coralliophilac aribeae* Abbott; *Leucozonia nassanassa* Gmelin, *Leucozonia ocellata* Gmelin; *Conus regius* Gmelin, and *Siphonaria hispida* Smith.

This fauna has been well studied on rocky shores of Fernando de Noronha, which present, macroscopically, high availability of the common substrate for zonation and a greatly simplified diversity when compared to the shores of the northeastern Brazilian coast. However, areas of intertidal gastropods are much wider in Fernando de Noronha than on the mainland. Another feature that deserves attention on the shores of Fernando de Noronha is a low abundance of filter feeding shellfish, which was also recorded in other oceanic islands, with the exception of *B. exustus*, which is most abundant Pecelypoda in Fernando de Noronha. In addition, there is a large presence of the vermetids *Dendropoma irregulare* and *Petaloconthus varians* in the infralittoral fringe.

Finally, what is clear about the scientific research on the benthic fauna of the APA Fernando de Noronha is that it is still at a preliminary stage and purely taxonomic, requiring a much greater effort to increase the number of ecological studies, as well as genetic and on biogeography on benthic communities for a better foundation for future mitigation measures regarding potential impacts.

Endemic Species of Economic Importance, Endangered and Rare

There are probably several species of endemic porifera in the archipelago of Fernando de Noronha, but most of them still need to be identified. The vast majority of Demonspongiae species occurring in Fernando de Noronha is widely distributed in the Northern Caribeana Province, except *Xestospongiagrayi* (= Prianusgrayi Hetchel 1983) that, so far, seems to be confirmed as the only endemic species to the island. In 1998, seven (07) sponge species were cited as apparently endemic, but still should be described: *Plakortis spp* 1, 2 and 3; *Oscarella spp*. 1 and 2; *Gastrophanella sp*. and *Haliclona sp*. Among the crustaceans, few species have been cited as possibly endemic, all of which still need to have their distribution and identification confirmed, in order to confirm this endemism. The crustacean species most likely to be endemic are *Upogebia noronhensis* and *Munida spinifrons* but still more biogeographic studies are needed to confirm this finding.

The Gastropods *Colisella noronhensis* and *Fissurella emmanuelae* are the only species of molluscs confirmed as endemic to the archipelago of Fernando de Noronha, being very common on the island. Other species may also be considered as exclusive of Brazilian oceanic islands:

Malea noronhensis (endemic to Brazilian oceanic islands), *Thais nodosa meretricula* (Ascension Island and Fernando de Noronha), *Nassarius capillaris* (Atol das Rocas and Fernando de Noronha) and *Arene venusta* (Atol das Rocas and Fernando de Noronha), the species *C. noronhensis* covers large areas on rocks, especially in the intertidal zone, and is one of the most abundant molluscs of the island.

The Prosobranchia fauna of Fernando de Noronha is apparently very rich and diverse, but has few endemic species. However, the presence of some endemic species of micro prosobranchia already has been registered (for example *Parviturbo sp*. and a kind of Barleeidae). With regard to the species of marine invertebrates that may be endangered, very little can be said, since until now the official list of IBAMA has only one species of endangered marine invertebrate (fire coral - Milleporanitidae). It can be assumed that there are species in Fernando de Noronha, which must already be suffering with anthropogenic pressures and in the future may be threatened with a risk of extinction. However, at the present days, it is impossible to say with certainty which species are at risk due to lack of more detailed studies regarding the marine ecosystem of the archipelago.

Mollusks comprise the most studied group of benthic invertebrates in Fernando de Noronha, although many studies are still required in areas with sandy bottoms. It is possible to name at least 32 species of molluscs that occur in Fernando de Noronha, that are considered rare or uncommon: *Barbatia cancellaris , Pinna carnea , Atrina seminuda , Lyropecten nodosus , Codakia costata , C. inbricatula Flame florida* (Métivier 1967)*, Ventricolaria listeroides , Callistaeu cymata, Tellina aequistriata, Diodora draft, Calliostoma gemmosum, Petaloconchus cf . varians, Hipponix subrufus subrufus, Strombus raninus, Morum dennisoni, Cymatium caribbaeum, C. labiosum, C. rubeculum, C. sarcostomum, Conmus dominicanus, Bursacubaniana, Thais nodosa ascenciones, Olivella cf .watermani, Pusiaalbonsicta, Lyriaguildingi, Conusdaucus, Daphnella lymneiformes, Micromellaundata, Cyclina noronhensis* (probably endemic)*, Ischnochiton roseus* and *Acanthochitona spiculosa astriger*. It should be noted that many species (about ten) have not yet been identified to the specific level and were not mentioned in this list, but are probably endemic or rare also.

Undoubtedly, the benthic fauna of the archipelago of Fernando de Noronha is very rich, with most species concentrating in the northern portion of the archipelago (APA), probably due to the formation of reefs of Vermetids and Melobesídeos, which provide shelter for a wide variety of associated fauna and flora that, in turn, serve as food for crustaceans, molluscs and echinoderms.

The endemic species of Brazilian corals that occur in Fernando de Noronha are *Astrangia braziliensis, Favia grávida, Mussismili aharti, Mussismilia hispida* and *Siderastre astellata*. The coral reefs of Fernando de Noronha present economic importance related to tourism.

There are no inventories about rare or endangered species of coral. It was believed for a long time on the similarity between the Brazilian and Caribbean fish fauna. However, despite having similar Caribbean species, many Brazilian species have been identified as endemic to the South West Atlantic.

The Muraenidae family contains the largest number of species in Arquipélago of Fernando de Noronha (eight species). Followed by Gobiidae family (with six species in both locations) and Labridae, which has seven species in the archipelago. The Pomacanthidae family characteristic of reef environments is represented by a few species in the Atlantic Ocean, possessing seven species occurring in the Brazilian coast, and with only four occurrences reported for oceanic islands: *Holocanthus ciliaris*, *Holocanthus tricolor*, *Pomacanthus paru* and *Centropygeau rantonota*. However, in the oceanic island of Fernando de Noronha there is the occurrence of the four species mentioned for this family, contrary to what

happens on the island of Trinidad, where the species *Holocanthus ciliaris* and *Pomacanthus paru* do not occur.

The species *Thalassoma noronhanum* of the Labridae family has an important ecological function, due to its characteristics, acting as a cleaner fish. Only this species and *Elacatinus randalli*, that are endemic to the archipelago of Fernando de Noronha, perform this function in the archipelago.

Two new species of the genera Malacoctenus and Elacatinus were identified from specimens collected in the archipelago of Fernando de Noronha and Atol das Rocas. A new species of *Elacatinus* was observed at depths of 3 to 53 m on reefs and scleractinian corals (*Montastrea cavernosae Siderastreastellata*), performing cleanup activities on "customers" of various species.

The Pomacentridae family has five endemic Brazilian species, of which *Segastes rocacensis* is considered endemic to the archipelago of Fernando de Noronha and Atol das Rocas. It was reported that the species *Thalassoma noronhanum* and *Stegastes rocacensis*, both endemic to the archipelago of Fernando de Noronha and Atol das Rocas, represent 42.84% of the total number of reef fish observed.

Besides the species *Stegastes rocacensis* (Pomacentridae), *Thalassoma noronhanum* (Labridae) and *Elacatinus randalli* (Gobiidae), there are other species with reported endemism for the archipelago of Fernando de Noronha and Atol das Rocas. In a study carried out in the archipelago of Fernando de Noronha, Mendes (2000) mentions the possibility that there are three new species for the genera *Elacatinus* (Gobiidae), *Scartella* (Bleniidae) and *Malacoctenus* (Labrisomidae), which would have had individuals erroneously identified as *Elacatinus randalli*, *Scartella cristata* and *Malacoctenus triangulatus*.

In the archipelago of Fernando de Noronha, it was also reported the occurrence of fourteen species of elasmobranchs, ten species of shark and four species of ray. The only species with the presence of juvenile reported was *Negaprion brevirostris* (lemon shark), seen in the "Buraco da Raquel" Bay and in the pool of Atalaia. There are no records of endemic elasmobranchs (sharks and rays) species in the archipelago of Fernando de Noronha, and these, along with other fish and aquatic invertebrates were not included in the List of Threatened Brazilian Species, for different reasons, including legal and because some are species with commercial interests. However, it is known that in Fernando de Noronha four species of rays and nine sharks are endangered.

The archipelago of Fernando de Noronha is used in every day of the year by a population of over 5000 spinner dolphins, living in a radius of 500 km around the archipelago. The "Mar de Dentro" (inner sea) area is used as a resting spot, for reproduction, parental care and refuge of sharks in 90% of days in the year. The "Mar de Fora" (outter sea) is used as a feeding area every day of the year.

Regarding turtles, the Brazilian legislation initiated the protection of sea turtles in 1967, but only in 1986 the protection came to encompass all five species that occur in Brazil, as well as Fernando de Noronha: *Caretta caretta, Chelonia mydas, Dermochelys coriacea, Eretmochelys imbricata* and *Lepidochelys olivacea*. Because sea turtles are migratory animals, exercising their activities on beaches of different countries, there must be a global effort for their conservation.

Terrestrial Fauna

Of the species with ecological interest, a terrestrial invertebrate species deserves special attention, the crab *Gecarcinus lagostoma*, which is endemic to the Brazilian oceanic islands

(Fernando de Noronha, Atol das Rocas and Trindade). Their population has been greatly reduced due to poaching practiced by the islanders. This species may have a high commercial value because of its meat, which is well appreciated by islanders and visitors.

There are no inventories or a list of species and little is known about the origins of the invertebrates that occur in the islands. The conduction of faunal surveys and inventories of terrestrial invertebrates in the archipelago is of great importance, plus the investigations on the origin of animals found in the area, classifying species as native, endemic, rare or invasive.

The latest list of vertebrate species that occur in Fernando de Noronha is presented in Ecological Cartography for the archipelago of Fernando de Noronha. In this study, there were three species of amphibians, eight of reptiles and five of mammals. The vertebrates of Fernando de Noronha are better studied than the invertebrates, and two listings were made for this group of species, one in the Management Plan of the Marine National Park of Fernando de Noronha, in 1988, and, the second one was the Ecological Cartography of the archipelago of Fernando de Noronha, in 1993. The herpetofauna includes specific studies on two species: the endemic lizard *Euprepisatlanticus* (used to be *Mabuyamaculata*), and the lizard *Tupinambis merianae*, which was introduced and is being studied in order to control their population in the archipelago.

As for terrestrial mammals of Fernando de Noronha, there are no native species; all have been introduced by man (*Kerodonrupestris, Rattusrattus, Rattusnorvegicus* and *Mus musculus*, plus goats, sheep, cattle, dogs, horses and cats).

Some endemic species of terrestrial fauna with ecological interest can be found in Fernando de Noronha, like the lizard *Euprepisatlanticu* and amphisbaena *Amphisbaenaridleyi*. Two animals were introduced including the "teiú" (*T. merianae*) and "mocó" (*K. rupestris*), and may be used commercially. The meat of the two species is a resource that can be exploited, since it is well appreciated.

Avifauna

It is known that this region represents a landing, feeding and reproduction site for many species of migratory birds, such as Charadriiformes and Ciconiiformes. The archipelago is home to "the best seabird colonies among oceanic islands in the tropical Atlantic." This fact is due to its location, relatively far from the coast, but inserted in a important migration route, of both Palaearctic and Nearctic species, which makes it a strategic point to rest and feed.

In the South Atlantic Ocean, few islands have endemic terrestrial birds. In contrast, Fernando de Noronha has three endemic taxa: *Zenaidaauriculata Noronha*, *Vireogra cilirostris* and *Elaeniaspectabilis ridleyana*, being these last two species categorized as vulnerable in the Brazilian endangered species list.

A large area of the archipelago is contained in the PARNAMAR area, which guarantees the protection for species that are present in this area. This is especially important for small islands around the main island. All of them are part of the Park, and many of them shelter important colonies of birds that reproduce in this area. However, the birds are highly mobile animals, and we cannot neglect the importance of the area of the APA as a feeding and resting place, even for those species that breed only in areas of the Park. In the APA, we must emphasize the "Morro do Pico", the weir of Xaréu and the airport region, as areas of high occurrence of birds.

The families with greatest richness in the archipelago are Ardeidae and Scolopacidae, both with 10 species, followed by Procellaridae, with five species. These families are usually well represented in coastal and marine areas.

Of a total of 10 resident marine species present in Fernando de Noronha, 4 were recorded in the area of the APA. Among the migratory and visitor species, 22 (or 58% of the total) occur in the APA and all of the resident terrestrial species in the island are present in the area of APA.

Among the species present on the island, at least 10 (*P. aethereus, S. dactylatradactylatra, S. sula sula, S. leucogasterleucogaster, F. magnificens, E. thulathula, N. phaeopus, Z. auriculatanoronha, E. spectabilisridleyana* and *V. gracilirostris*) are hunted by the islanders for food, including three endemic species of Noronha: *Z. auriculatanoronha, E. spectabilisridleyana* and *V. gracilirostris.*

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:

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:

Tourism has great economic importance in the archipelago of Fernando de Noronha; this is undoubtedly the most popular destination in Brazil, receiving an average of 60,000 visitors annually, attracted by the archipelago's natural beauty. Currently it is the main economic activity on the island and caused huge changes in the population's way of life in many ways. From changes in existing economic activities (agriculture, livestock and fisheries), daily living, the island's appearance (farms and constructions), the structure of the houses (hostels residences), the relationship among people (commercial) and the type people who live and pass through the island (new immigrants, tourists, researchers, partners, and others).

With a rich history, which begins with the discovery of Brazil, we can find along the main island, several archaeological sites that are records of the island's history of occupation: refueling port for ships travelling to the old world; a common jail, a prison for political prisoners, a military base, and others.

Fish production in Fernando de Noronha was suffocated by tourism. It is extremely significant in the archipelago of São Pedro and São Paulo, being one of the main fishing areas in northeastern Brazil nowadays.

---

24. Land tenure/ownership:

a) within the Ramsar site:

All oceanic islands are under the control of the Union, however in the main island of the archipelago of Fernando de Noronha, there are areas within the site that have private ownership or belong to public institutions. These are all cataloged and are generally concentrated in the Urban Zone of APA or in the Zone of Special Use.

b) in the surrounding area: Not applicable.

---

25. Current land (including water) use:

a) within the Ramsar site:

The use and occupation of land in the area of the APA of Fernando de Noronha - Rocas – São Pedro and São Paulo, is established by the zones in its management plan, published in June 2005, and in general, aims to meet the following objectives: to contribute towards the proper preservation of areas that represent patrimonial scenery, as well as biological and cultural-historical patrimony; ensure that the land use in the State District of Fernando de Noronha is compatible with the goals of the APA and its Management Plan; provide guidelines for use and occupation of the land in alignment with the environmental constraints and in order to contribute to sustainable economic and social development; contribute so that the future use of land and natural resources meet the standards proposed in the Management Plan, with the institutionalization of legal and institutional procedures that to submit activities to a prior licensing and subsequent supervision and control; contribute so that the land use and natural resources are properly supervised and controlled using management and conservation techniques that will improve the environmental quality of the APA as a whole; and, therefore, it is essential that the management by zones becomes dynamic and participatory.

This zoning established 10 zones, which aim towards the preservation, conservation, recovery of degraded areas, agricultural activities, protection of the archaeological, historical and cultural heritage, conservation of natural resources reconciled to the activities of public use, the sustainable development of fishing activities and, finally, the use and occupation of land regarding the urban activities.

The degree of human intervention indicates the expected level of human intervention in each Zone. This was defined by criteria, being classified as: high, medium and low. The evaluation criteria used were: richness and/or species diversity, environmental variability, degree of conservation/artificiality of vegetation, degree of fragility of the physical environment, presence of historic and cultural heritage (archaeological sites and real estate);

potential for visiting use; potential for environmental awareness, presence of infrastructure, conflicting uses, and the presence of people.

The Zones are: Protection of Wildlife Zone, Conservation Zone, Recovery Zone, Historical and Cultural Zone, Agricultural Zone, Special Use Zone, Urban Zone, Marine Recreational Zone, Exclusive Zone, Artisanal Fishing Zone and Fishing Zone.

There is no Director Plan or a Law of Use and Occupation of the Land approved. This should be elaborated by ADEFN based on the Zoning guidelines of the APA. These instruments will be detailed in a proper scale, the use and occupation of the Urban Zone, with coefficients of utilization, recovery rates, template and retreats.

In relation to the use and occupation of the areas of the National Marine Park of Fernando de Noronha, except for about eight families, it is totally regularized and destinated for the conservation of marine and terrestrial ecosystems. It allows leisure, scientific, educational, recreational and tourist activities. The access to the park as well as its visiting structure recently increased, especially in terms of support and visitation structures and the reduction of impacts, due to "public-private partnerships" established by concessions through a competitive bidding processes.

b) in the surroundings/catchment:

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:

Historically the island was deforested, since for a long period it served as a prison (200 years). It was a place to supply ships, which withdrew water, timber, fish, turtles, lobsters, birds and terrestrial animals, especially a rodent (*Noronhomys vespucci*), that was extinct. Another serious problem in Islands is the introduction of exotic species, which was no different in Fernando de Noronha, possessing numerous invasive species dominating the landscape, a highlight among these alien species is the "Linhaça" or *Leucaena* (*Leucaena leucocephala*) and Jitiranas (*Ipomoea sericophylla*).

b) in the surrounding area:

Currently the fishing industry throughout the exclusive economic zone of Brazil, including around these archipelagos, exerts a strong pressure on fisheries resources, even with the improvement of environmental and fisheries legislation, and it has already put at risk of over exploitation some commercial species. Another factor is global warming that has endangered coral reefs.

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.

The proposed site is contained in the National Marine Park of Fernando de Noronha and the APA (Environmental Protection Area) of Fernando de Noronha, Rocas, São Pedro and São Paulo.

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?:

There is a Management Plan for the APA of Fernando de Noronha, Rocas, São Pedro and São Paulo, published on June 6th, of 2005. There is also a Management Plan for the Marine National Park of Fernando de Noronha, published in 1990. These plans are the legal basis for the management of these Conservation Units. In the case of this APA it also provides the basis for the district administration.

d) Describe any other current management practices:

The surveillance occurs every day of the year. Several environmental education activities are also conducted (as detailed in item 30).

---

28. Conservation measures proposed but not yet implemented:

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

Such measures can be found in the Management Plan, as follows:

Hire team of experts for the preparation of a booklet containing the environmental legislation applicable to the APA, to be distributed to the local population and used as a working tool for managers and other institutions of the APA.

Promote and implement an Integrated Management of Solid Waste.

Study guidelines for the adequacy of the road system, integrated with solutions that protect the landscape and other protected areas. The development of these guidelines should take into account the sanitary sewer system designed and installed, once this has the greatest impact on the overall urban design. Likewise, the drainage system must be integrated into the system.

The recovery of the terrestrial vegetation: establish partnerships to define a team of technicians, researchers and specialists responsible for the recovery of terrestrial vegetation in the APA; Identify other areas in addition to those that already comprise the Recovery Zone, and that also demand recovery actions; Implement recovery actions for the vegetation, such as isolation for natural recovery, management and/or eradication of exotic species, enrichment of the vegetation cover and stratification, among others, according to the peculiarities of each area to be recovered; Monitoring of the recovery process of these managed areas.

Monitoring of degraded coastal regions: develop a diagnostic of degraded coastal regions, especially between the Santo Antonio Bay and the Cachorro beach; develop studies to define benthic bio-indicator species; develop a monitoring strategy, using selected bio-indicator species; continuously monitor the marine and coastal environments, taking into account the pollution from garbage, effluent discharge, the divers behavior, boat traffic, among others.

Check for exotic and/or invasive marine species and create guidelines for the prevention of new introductions and towards the management and monitoring of the identified species.

Create a database and a mailing list to facilitate interaction among researchers.

Conduct inventories and surveys on the terrestrial invertebrate fauna of the APA, with identification of endemic, rare, threatened and bio-indicators; prepare and train a local team to monitor the terrestrial invertebrate fauna of the APA; disseminate the results among local community and tourists, through flyers, posters, CD-ROM and other media, lectures and documentaries.

Conduct demographic, reproductive and ecological studies on the land crab *Gecarcinus lagostoma*.

Implement population control and sustainable use of the lizard "teiú" (*Tupinambis merianae*) and "mocó" (*Kerodon rupestris*).

Manage and monitor the populations of the predators of seabirds and their eggs;

Take measures to prevent the capture of seabirds in fishing vessels;

Disclose to cattle raisers, the need to adopt management techniques that will minimize impacts (eg, soil erosion, siltation of drainages, spread of exotic species, among others) arising from animal husbandry.

---

29. Current scientific research and facilities:

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

An international Reef Check program is being conducted in the archipelago of Fernando de Noronha and Atol das Rocas by the Federal University of Pernambuco, in partnership with the ICMBio and MMA, the program coordinator in Brazil. 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.

Continuous long-term surveys are conducted by Tamar regarding sea turtles, which has offices, visitor center, auditorium and shop. There is also a research related regarding spinner dolphins that also has a headquarters.

The residential, commercial and services infrastructures of the island of Fernando de Noronha is inserted in the APA. Several historic sites, beaches, lookouts and other areas of high natural beauty, indispensable for visitation are also part of the APA. Thus, all visitors must visit the APA of Fernando de Noronha.

---

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

There are every day lectures that teach about various subjects of environmental nature like Sharks, Dolphins, Turtles, Reforesting Noronha, among others, that are linked directly with the conservation of the site and carried out at the visitor center of the TAMAR Project in Fernando de Noronha.

The Protected Areas (APA and National Marine Park) prepare a biweekly newspaper that covers some important environmental issues and circulates for locals and tourists.

There is an environmental education program at the Archipelago School (the only elementary and high school in Fernando de Noronha) conducted in a partnership between ICMBio (APA National Park and Center for Aquatic Mammals - CMA) and a environmental NGO: Spinner Dolphin Centre .

The partnership between the Spinner Dolphin Center and ICMBio also promotes training courses for guides, plus training for masters of vessels, diving instructors, taxi drivers and other services related to tourism with a focus on environmental education and legislation.

The Tamar Project conducts environmental education activities for tourists and the community that involves the opening of turtle nests, to see the monitoring effort of Tamar in relation to the spawning, biometrics and the capture of sea turtles is carried out.

Other research groups that have a more continuous work on the island (eg the Shark project and Octopus Project) perform activities of awareness and environmental education for the community, linked to the target species in their studies.

---

31. Current recreation and tourism:

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

The diving and snorkeling activities along the coral reefs are among the main attractions of the island, as well as several trails along the island that stand out for topics such as ecology, geology, history and culture and adventure. In addition, there is a wide variety of activities such as boating, towed diving, surfing, windsurfing, abseiling, fishing, among others.

---

32. Jurisdiction:

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

State District of Fernando de Noronha: Administration District of Fernando de Noronha-ADEFN - Pernambuco. Address - Palácio São Miguel, Vila dos Remédios - CEP. 53.990-000/FN.

Federal Environmental Agency responsible for: PARNAMAR Fernando de Noronha and APA Fernando de Noronha, Rocas, São Pedro and São Paulo / Chico Mendes Institute for Biodiversity Conservation - ICMBio. Address - Avenida Eurico Cavalcante, n ° 174, Boldró - CEP. 53.990-000/FN.

---

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: APA de Fernando de Noronha, Rocas São Pedro e São Paulo/Instituto Chico Mendes de Conservação da Biodiversidade.

Unidade de Conservação Federal: PARNAMAR de Fernando de Noronha/ Instituto Chico Mendes de Conservação da Biodiversidade.

---

34. Bibliographical references:

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

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA-IBGE. Censo. 2010.http://www.censo2010.ibge.gov.br

IBAMA/FUNATURA. **Plano de Manejo do Parque Nacional Marinho de Fernando de Noronha.** Brasília: Funatura/Ibama, 1990, 533p.

FLOETER, S.R., GUIMARÃES, S.Z.P., ROCHA, L.A., FERREIRA, C.E.L., RANGEL, C.A. GASPARINI, J.L. 2001. **Geographic variation in the reef fish assemblages along the Brazilian coast**. Global Ecology and Biogeography. 10 (4): 423-431.

MACHADO, A.B.M.; DRUMMOND, G.M. & PAGLIA, A.P. 2008. **Livro vermelho da fauna brasileira ameaçada de extinção**. - 1.ed. - Brasília, DF: MMA; Belo Horizonte, MG: Fundação biodiversitas. 2v. 1420 p.

MMA/IBAMA **Plano de Manejo da APA de Fernando de Noronha, rocas, São Pedro e São Paulo.** Brasília: PNUD/ARCADIS TETRAPLAN S.A**.** 2005. 1200p.

SZPILMAN, M. 2000. **Peixes marinhos do Brasil – Guia prático de identificação.** Instituto Ecológico Aqualung. Rio de Janeiro.

TEIXEIRA, W. CORDANI, U. G.; MENOR, E. A.; TEIXEIRA, M. G.; LINSKER, R. **Arquipélago de Fernando de Noronha: o paraíso do vulcão** (Séries Tempos do Brasil). Terras Virgens, São Paulo. 2011. 168p.

TRAVASSOS, P. HAZIN, F.H.V., ZAGAGLIA, J.R., ADVINCULA, R. e J. SCHOBER. 1999. **Thermohaline structure around seamounts and islands off North-Eastern Brazil.** Archive of Fishery and Marine Research, 47(2-3): 211-222.

VOOREN, C. M. e L. F. BRUSQUE. 1999. **As aves do ambiente costeiro do Brasil: biodiversidade e conservação**. FURG, Rio Grande.

Site do ICMBio na Internet: www.icmbio.gov.br

ATOL DAS ROCAS

Information Sheet on Ramsar Wetlands (RIS) – 2009-2012 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.

FOR OFFICE USE ONLY.

DD MM YY

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) 9134-0164

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.

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 (nature reserve or 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.

Biological Reserve of Atol das Rocas, comprising all water reefs, islands and continental shelf, within the limits of the Brazilian territorial sea, contained within the isobath 1000, from the Lighthouse Island (Ilha do Farol).

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. 03º45º a 03º56'S;
- Long. 33º37'W' a 33º56'W-Gr

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 metres: average and/or maximum & minimum)

Three hundred feet (1.000 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 unitl 31º 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 unitl the coast of Brazil (Ceara), ascend to depths below 250 meters, and some almost reach the surface, as is the case of Atol das Rocas (Damuth & Palma, 1979).

Atol das Rocas is located in Brazilian waters, 144 nautical miles (267km) E-NE of the city of Natal, Rio Grande do Norte, and at 80 nautical miles (148km) W of the archipelago of Fernando de Noronha, State of Pernambuco, in the area defined by the coordinates 03º 45' and 03 º 56' south latitude and 33º 37' and 33° 56' west longitude.

Because the REBIO Atol das Rocas is located in oceanic waters, far from the continent, it is not included in any municipality. However, the Atol das Rocas 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, enables a significant influence over the REBIO, wether by strengthening human pressures related to tourism, whether by the possible biological contribution related to the unidirectional flow of the South Equatorial Marine Current.

The justification before UNESCO for the inclusion of the Biological Reserve of Atol das Rocas in the World Heritage list is based on the fact that it represents an oceanic island ecosystem with highly productive waters, providing food for tuna, sharks, cetaceans and sea turtles that migrate to the Atlantic coast of eastern Africa. 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.

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.

Atol das Rocas is a key location for the protection of biodiversity and endangered or threatened species such as sea turtles, particularly the green turtle. 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. In addition, it hosts migratory birds, endangered species, endemic species and a considerable number of species of economic interest, justifying its great ecological significance.

Criteria 2, 3 and 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 quantitity.

The soil of the islands are predominantly composed of limestone and heavily fertilized by the seabirds excrements, and along with 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 hypersaline 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.

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.

The Atol das Rocas is a reproductive site for *C. mydas*, and there is also the presence of *Eretmochelys imbricata* (hawksbill turtle) (Marcovaldi & Marcovaldi, 1985, Moreira et al., 1995; Bellini et al, 1996 cited in Grossman, 2001). The International Union for Conservation of Nature (IUCN) has classified the marine turtles as "vulnerable" animals and in danger of extinction. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) prohibits international trade in all species, their eggs, parts or products (Grossman, 2001).

Criteria 5 and 6 - According to these surveys, 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 lies the largest tropical seabird colony in the country, with an estimate of at least 150,000 birds of 29 different species (Targino, 2001).

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.

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. Featuring distribution in tropical and subtropical regions, the population of more than 100,000 birds present in Atol das Rocas, is the largest in the South Atlantic. However, they also nest in other oceanic islands in Brazil. This species can be be registered reproducing throughout the year, with the highest number recorded in the last and first months of each year. This species remains wandering 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 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 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. 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 (Schuz Neto, op cit.).

Criteria 7 and 8 - 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 noronhanum* ("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.* 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 sighted, 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 120cm, 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 area, as neeborns and young individuals are always sighted 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.

---

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.

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.

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 mesured. 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 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).

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 ºC) (Silva & Alvarenga, 1995).

According to data from the Brazilian Navy (1957), the month of March is the warmest with an average temperature of 29 ºC whereas August is the coldest, with an average of 22° C (Teixeira, 1996). Schulz Neto (1998) however, reports an annual average temperature of 26º C, with maximum of 32º C and minimum of 18º C.

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

Geology – didactically, an atoll can be defined as a ring-shaped island encircling a central lagoon, characterized by a reef built organically through a biological association of animals and plants.

Along the corals, frequently calcareous algae, shells of molluscs, foraminifera, among others occur, and in many cases the calcareous reef corals are not the most common organisms, but the calcareous algae (Leinz, op cit.). This last condition fits the Atol das Rocas, consisting predominantly of calcareous algae.

According to Bryan (1953), there are 425 atolls on the planet, and of these, 27 are in the Atlantic Ocean with the majority (26) in the Caribbean Sea. Atol das Rocas is the only atoll and the only offshore reef that emerges at sea level in the Western South Atlantic (Kikuchi, 1994).

Structure and Composition of Recife

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. According to Villaça (1999), the algae that built the Atoll is the rodofícea *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 Rivers (1979) reported the occurrence of only one species, *Petaloconchus erectus* in samples from the Atol das Rocas.

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 submount (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).

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 serpulids fragments that appear with an average frequency of less than 1% of the sample fragments.

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 laguna) are the most favorable habitats for molluscs (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 W, 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.

Fore reef - 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 W portion of the atoll and its horizontal extension from the outer edge of the reef margin can reach 600m. Also in the W 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 Caribean (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 (rodóides and small colonies 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, lies 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 rodóides. 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. Its 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 in reef.

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 theW portion, to 700m on the E side of the atol; 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 a 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 contructed mainly by coralline algae and vermetid gastropods. These incrusting 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 algaic crests develop E of each of the islands. These two algaic 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 W part of the Atoll, near the Farol island and another in the N portion of the reef ring. The W 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 intercolumnar spaces it is covered by sandy-gravelly sediment. There the dynamic process that prevails is the alternatition 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 Biological Reserve of Atol das Rocas were baptized being the names listed below and are commonly used by IBAMA 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 island's, "Farol" and "Cemitério". They are located in the W 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, at E of the first, is about 0.5 m lower. The third spur, and the second at E 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 E side of the reef plateau, which is being called the Zulu island. This bank seems to occur seasonally and has been increasing over time.

Laguna - 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 E part of the atoll, have small thickness of sediment and are covered by a mat of green algae.

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.

Silva & Alvarenga (1995) describe the distribution of surface currents as being mainly westward, with speeds up to 1.5 knots. Below 8ºS 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.

Waves - Studies show that over 80% of the waves observed that come from the E 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.

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 25º 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 isolines are nearly meridionaly 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 16º C). South of the equator, the zonal distribution has a slight increase towards the south and little seasonal variation.

Oceanographic surveys conducted by the oceanographic ship (NOc) Almirante Saldanha (1986) in the region between Fernando de Noronha and Atol das Rocas recorded temperature of 27.7ºC and 16º to 20º at depths of 10 to 100 m, respectively. According to Sales (1991), the annual average temperature of the surface water is around 37º C (Teixeira, 1996).

Kikuchi (1994) recorded temperatures at depths greater than 2m ranging from 27 ºC to 28.5ºC, and in the most superficial layer the temperature reached 29.5° C. In pools, temperatures of 39 ºC 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 43º C in the pools.

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 (DHN, 1993) 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 28.8º to 32.2º C. Long (1993) in a similar study in the same area, recorded temperatures of 26.0º to 28.9º C in the month of May/92. Netto (1999) found average temperatures of 29º C in the subtidal zone, 31 º C in the sandy deposit, 29.2º C in the pools and 27.6º C in the lagoon.

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).

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 Long (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.

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.

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)
A	126.51
C	336.36
E	22.15
G	215.00
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.

The existence, in the Atol das Rocas, of only two islands of biogenic origin, where the soil is predominantly composed of limestone and heavily fertilized by the excrements of seabirds, conditions the existence of a small variety of plant species, highly adapted to this environment, supporting high salinity and intense luminosity.

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: Amaranthacea (*Iresine portulacoide*), commonly known as pirrichil; Cyperaceae (*Cyperus ligularis*), called razor grass or manibu; Portulaca (*Portulaca oleracea*) or beldroega; Palmae (*Cocus nucifera*), with eight plants well grown, being the shortest with 2m height in the Farol Island and one plant 1.5 m in height in the Cemitério Island; Casuarinaceae (*Casuarina sp*), with two dead specimens on the Farol Island and Gramineae (Poaceae) without identification. This author also reports that the razor grass is associated with pirrichil and beldroega.

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 occur Gramineae (in confirmation of the species), another Cyperaceae (to be confirmed), as well as *Cocus nucifera* (Arecaceae) introduced by fishermen.

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

Targino (2001), on the structuring of the an ex-situ collection project of species of Atol das Rocas, reports (without disclosing the source), the existence of vegetation typically of herbaceous species with *Blutaparon portulacoydes, Cyperus ligulares, purslane Portulaca, Eragostris sp. Chloris sp.* belonging to the families Aizoaceae, Portulaca, Cyperaceae, Amaranthaceae, Gramineae and Amaryllidaceae, and a few coconut trees, *Cocus nucifera*, as the only large ones.

In fieldwork carried out in Atol das Rocas, the herbaceous bulbifera identified as *Hymenocallis caribea* by Mello (1999) was found near the cluster of palm trees, in high tide, restricting them to a small clump quite battered by the action of the sea, contradicting the situation presented by Mello by photographs.

Marine vegetation - Macroalgae - In 1999, Villaça started a work in order to study the distribution of benthic algae in coralline environments through multidisciplinary studies of taxonomy, descriptive ecology, chemical ecology and chemistry of natural products. The results presented here were based on reports of campaigns conducted in July/99, Junho/00, November/00, June/01.

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, Guerarde (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, dalmatica Cladophora, 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 Chlorophycea *dictyospaheria ocelata* and Rodophyceae *Digenia simplex* 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 *Bryopsis plumosa* 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 clorofícea *Caulerpa* sp. is very common, occurring often associated with tufts of *Jania adhaerens* in the shallows. In the deeper parts, the presence of feofícea *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, *Gelidiela* sp. is common, while in the deepest, the pool walls are predominantly occupied by rodofícea *Galaxaura rugosa* and the feofícea *Lobophaga variegata*. In darker and deeper places, there is the presence of long purple filaments of *Cyanobacteria*, of the *Lyngbia* genera (Villaça, 2001).

---

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

The existence, in Atol das Rocas, of only two islands of biogenic origin, where the soil is predominantly composed of limestone and heavily fertilized by excrements of seabirds provides conditions for the existence of a small variety of plant species, highly adapted to this environment, supporting high salinity and intense luminosity.

Records on the vegetation of Atol das Rocas were possible since the first expeditions made to this location in order to install the lighthouse. At this time, several fruit trees were planted aiming to give more visibility to the atoll as well as a food supply to the lighthouse keepers who were there.

According to Andrade (1960), Lieutenant Lee (1852) planted some coconut trees on the Cemitério island, as did Captain Parish in 1856. The expedition of the ship "Vital de Oliveira" in 1858 also planted many coconut trees on both islands (Teixeira, 1996).

However, Duarte (1938) on his visit to the atoll indicates the existence of a very sparse vegetation, composed of one coconut (*Cocus nucifera*), one papaya (*Ricinus communis*), both close to the second lighthouse, amaranthus vegetation (*Portulaca communis*) and a grass (*Eleusina indicates*). According to Rodrigues (1940), in 1938 several fruit trees were planted, in the two islands, including 30 coconut trees, and also reports the existence of a kind of pigweed (*Amaranthus* sp.).

Vallaux (1940th) reports the existence of a single coconut and castor tree, next to the second lighthouse, probably the same recorded by Duarte, in 1938. It was also reported the existence of a vegetation of chard next to the first lighthouse and large tufts of grass across the Farol island (Teixeira, 1996).

Sales (1992) noted that on the two islands there was a vegetation belonging to the families Crassulacea and Liliacea, nine coconut trees, which did not exceed 3m in height, and two plants of casuarinas (*Casuarina equisetifolia*) planted by sailors (Teixeira, 1996).

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: Amaranthacea (*Iresine portulacoide*), commonly known as pirrichil; Cyperaceae (*Cyperus ligularis*), called razor grass or manibu; Portulaca (*Portulaca oleracea*) or beldroega; Palmae (*Cocus nucifera*), with eight plants well grown, being the shortest with 2m height in the Farol Island and one plant 1.5 m in height in the Cemitério Island; Casuarinaceae (*Casuarina sp*), with two dead specimens on the Farol Island and Gramineae (Poaceae) without identification. This author also reports that the razor grass is associated with pirrichil and beldroega.

In Ibama`s internet site, about the Atol das Rocas, it is stated that by the year 1990 the two plants of casuarina were green, serving as points of support for seabirds, especially *Fregata magnicicensis* and *Sula sula*. However, they were slowly dying probably due to the large amount of bird excrements, the guano.

According to the same source of information, the genera occurring in the islands of the atoll are *Blutaparon* sp. (Amaranthaceae), *Portulaca* sp. (Portulaca), C*yperus* sp. (Cyperaceae) and *Hymenocallis* sp. (Amaryllidaceae). In addition to these, also occurs Gramineae (in confirmationof species), another Cyperaceae (to be confirmed) as well *Cocus 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), on the structuring of the an ex-situ collection project of species of Atol das Rocas, reports (without disclosing the source), the existence of vegetation typically of herbaceous species with *Blutaparon portulacoydes, Cyperus ligulares, purslane Portulaca, Eragostris sp. Chloris sp.* belonging to the families Aizoaceae, Portulaca, Cyperaceae, Amaranthaceae, Gramineae and Amaryllidaceae, and a few coconut trees, *Cocus nucifera*, as the only large ones.

An analysis of the above, allows making some considerations. It is obvious that attempts to introduce coconut probably did not achieve full success due to the environmental conditions prevailing on the atoll. However, the existence of one coconut tree in the period 1938 - 1940 in the Farol Island increased the number to nine young coconut trees 1991 and eight adult specimens in 1993. In a field exploration of REBIO the presence of six adult coconut trees was found on the Farol Island, two young coconuts near the headquarters building and a cluster of young coconuts, including seedlings, near the ruins of the

lighthouse keeper's house. This suggests that, from the year 1940 new coconut trees were planted or, that despite the austere environmental conditions, the coconut palms have been able to live and reproduce.

As far as the other vegetables, excluding cases of synonymy, it is possible that some taxonomic mistakes had occurred to justify the differences between the authors above. In fieldwork in Atol das Rocas, the herbaceous bulbifera identified as *Hymenocallis caribea* by Mello (1999), was found near the cluster of palm trees, in the high tide line, restricting them to a small clump, quite damaged by the action of the sea, contradicting the situation presented by Mello by photographs.

Marine vegetation

In 1999, Villaça started a work in order to study the distribution of benthic algae in coralline environments through multidisciplinary studies of taxonomy, descriptive ecology, chemical ecology and chemistry of natural products. The results presented here were based on reports of campaigns conducted in July/99, Junho/00, November/00, June/01.

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, Guerarde (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, dalmatica Cladophora, 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 Chlorophycea *dictyospaheria ocelata* and Rodophyceae *Digenia simplex* 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 *Bryopsis plumosa* 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 clorofícea *Caulerpa* sp. is very common, occurring often associated with tufts of *Jania adhaerens* in the shallows. In the deeper parts, the presence of feofícea *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, *Gelidiela* sp. is common, while in the deepest, the pool walls are predominantly occupied by rodofícea *Galaxaura rugosa* and the feofícea *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 geological genesis of the atoll and its geographic isolation, theoretically, did not allow the irradiation, dispersal and perpetuation of mammals in their fields before the discovery of man. It is known that throughout human evolution some animals have synanthropic habits, directly or indirectly benefited by human activities, being called "associated fauna."

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.

Many were the factors that led the species to succeed in its dissemination. According to Brown (1971), its small size and the need for little amount of food contributed to its faster spread if compared to others Muridae. However, to Orr (1940), one of the reasons why it has been successful, is its amazing reproductive capacity. In his studies, Brown (1971) points that the selection of food depends largely on the environment in which the rodents live. In the Atol das Rocas, the existing vegetation plays a key role on the survival of mice, serving as shelter, as well as food and it is also the only source of fresh water available for these rodents.

Another source of available food is organic waste produced in the camp, which may act as a factor that interferes with the "balance" of the population. According to Brown (1971), the size of the rodent population is limited by the amount of available water and food. Once the environment of the rodent is not modified, this population is likely to remain more or less on the same level, which is the reason why the staff and researchers of the REBIO Atol das Rocas follow strict procedures to control the waste generated in the unit.

Rocha (1993) describes that *Mus musculus* has an omnivorous diet, and that there is a need to verify its predation on bird eggs that inhabit the atoll, since it's an area that seabirds use to feed and reproduce.

Avifauna

According to surveys, the Atol das Rocas and the archipelago of Fernando de Noronha are considered the most important areas for seabirds to breed in Brazil, both in diversity and in numbers of individuals. The REBIO Atol das Rocas concentrates the largest tropical seabird colony in the country, with an estimate of at least 150,000 birds of 29 different species (Targino, 2001).

According to Schulz Neto (1998), in the REBIO Atol das Rocas the species can be classified as: reproducers, because they nest there; constant foragers, using the atoll as a resting and feeding area; migratory, only land ashore for reproduction in their places of

origin, passing the rest of the year wandering the oceans of the world; and finally, sporadic visitors.

Breeding birds: five species nest in the atoll, in both the Farol and the Cemitário Islands: "Atobá-mascarado" (*Sula dactylatra*), "Atobá-Marrom" (*Sula leucogaster*), the "trinta-reis-de-manto-negro" (*Sterna fuscata*), "Viuvinha-marrom" (*Anous stolidus*) and "Viuvinha-negra" (*Anous minutus*) (Schulz Neto, op cit.).

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. 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 op cit.).

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. Featuring distribution in tropical and subtropical regions, a population of more than 100,000 birds is present in Atol das Rocas, and is the largest in the South Atlantic. However, they also nest in other oceanic islands in Brazil. 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 wandering 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 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. 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 (Schuz 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 (Schuz 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 (Schuz 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 (Schuz 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 (Schuz 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 (Schuz 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 (Schuz 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. 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 (Schuz 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. They are birds that predominantly breed in Arctic Regions in the months of June and July, and after this period migrate south, fleeing from the harsh winter in the Northern Hemisphere. After long journeys, with some species travelling more than 5,000 km without rest, only feeding and resting to have enough energy to change feathers and return to their nesting areas in the next northern summer. 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 (Schuz Neto, op cit.).

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 (Schuz Neto, op cit.).

Prior to the installation of the REBIO Atol das Rocas, fishermen who landed on the islands, collected eggs of the seabirds for food and decorations, as well as the use of nestlings and chicks as bait in traps to catch lobsters. After the establishment of the REBIO, these problems no longer occur, and the only factors that affect nesting and bird population are of natural origin, except for mortality occurring by fishing gears (Antas *et al*, 1990 cited in Schulz Neto, 1998).

During the fieldwork, Schulz Neto (1998) noted on several occasions nestlings *Sula fuscata, Anous stolidus S.leucogaster*, living or dead, being preyed upon by the land crab *Gecarcinus lagostoma* as well as young *S. leucogaster* feeding of nestlings of *S. fuscata.* It was also observed

that during the nesting season of turtles, *Chelonia mydas*, between December and April, turtles trample many eggs and nestlings of birds that nest in the area.

This author found predation of eggs of *S. fuscata* by mice *Mus musculus*. He also mentions Moors *et al.* (1989) who argues that there was no reported extinction of small birds species attributed to predation of eggs by mice, but their effects on island environments are unknown and should not be regarded to as harmless colonizers.

Entomofauna - In the survey for the insect fauna 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.

Analyzing the results, Almeida *et al.* (1999) draws 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 differenciations.

These 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).

According to Lourenço(1982), the scorpion genus *Isometrus* has its center of dispersion in Asia where there are several distinct species, being *Isometrus maculatus* the only species 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 (Lawrence, 1982).

The scorpion's food consists of live prey, especially of certain insects such as Orthoptera (cockroaches) and spiders. Apparently, these animals could represent potential prey, however, besides the fact of not having a sufficient population density, spiders would be hard to catch, since the Salticidae have a distinct biology from scorpions. These spiders are very fast and have diurnal activity, while the scorpions have nocturnal activity (Lawrence, op cit.).

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 (Lawrence, 1982).

Marine Fauna

Reptiles/Turtles - 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).

The International Union for Conservation of Nature (IUCN) has classified the marine turtles as "vulnerable" animals and in danger of extinction. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) prohibits international trade of all species, their eggs, parts or products (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.

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 the REBIO the Atol das Rocas, 147 species of fish were identified and cataloged, two are endemic of Atol das Rocas and Fernando de Noronha Archipelago, the "Gudiao", *Thalassoma noronhanum* and the "donzela-das-rocas" *Stegastes rocasensis* (Targino, 2001). According to Moura (1998), in addition to the above two species, there are 3 more

endemic species of Atol das Rocas and Fernando de Noronha, citing a species not yet described, *Lythrypnus sp*, as one of them.

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 *Cantherines macrocerus*. The author points out that the Mero is a globally endangered species, included in the IUCN Red List 2000 in the category of Critically Endangered (Rosa *et al*., 2002).

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, and the young individuals were observed more frequently in shallow, enclosed and protected areas, being the Lama Bay a primary and secondary nursing area.

The concomitant presence of young individuals, newborns and adults with bite marks, in the same time of year, in the months of December, February and March, seems to indicate that in the REBIO Atol das Rocas, the birth of the lemon shark occurs at the beginning of the year, with mating occurring in the same period, suggesting a period of pregnancy of 10 to 12 months (Oliveira, 2001).

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 (Olive, 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 Rose *et al.* (2002), the most common species of elasmobranchs observed in Atol das Rocas and Fernando de Noronha were *Carcharhinus perezi, Ginglymostoma cirratur* 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.*

In a recognition study carried out in the REBIO, two young lemon shark were sighted in the Lama Bay (Farol Island) and an adult in Laguna. Outside of the atoll, leeward, a manta ray was sighted. Two sandpaper sharks were sighted in the pools "Podes Crê" and one individual in the Rocas pool.

In his 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 species with restricted distribution to the Atol das Rocas and Fernando de Noronha, as *Stegastes rocasensis* and *Thalassoma noronhanum*, or endemic to the Brazil Province (part of Labridae and most Scaridae).

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).

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. chrysopterum, 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 5 do not feed exclusively on animals. The carnivores can be divided in five categories according to their feeding tathics: 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: *Gymnothorax funebris* (Moray-green Caramuru) *Cephalopholis fulva* (coney), *Rypticus saponaceus* (fish-soap), *Malacanthus plumieri* (pirá) *Malacoctenus triangulatus*, all which remain solitary in specific locations. The nibbleres, 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 *Mulloides 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 noronhanum* (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 noronhanum.* 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 noronhanum 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: tropical reef community where a large number of species is not involved in cleaning symbiosis (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.).

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. apressum* ("ofiúro marrom"), *Diadema antillarum* (black sea urchin), *Echinometra lucunter* (blue sea urchin), *Tripneustes ventricosus* (White Sea urchin), *Eucidaris tribuloides* (satelite sea urchin) and *Linckia guildingii* (starfish).

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 *Euapta 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. 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".

According to the literature, the distribution of *Tripneustes ventricosus* occurs in Florida and Bermuda, southern Brazil, the west coast of Africa, Ascension, Fernando de Noronha and Trinity islands. Therefore, it is not an exotic species.

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.

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 (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.

Burggren and McMahon (1988) reported that the land crabs exhibit peculiar behavior, morphology, physiology or biochemical adaptations, which allows independence from the aquatic environment. To avoid dissecation, they live in humid microhabitats and their activities are nocturnal.

The Gecarcinidae Family is within the fourth degree of terrestriality, are active outside of the water, but need it for spawning and larval development. 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 was not observed in Rocas.

In Atol das Rocas and sorroundings there is the lobster *Panulirus echinatus*, which was quite captured by the fishing fleet of Rio Grande do Norte (Oliveira Lins et al, 1993).

Malacofauna - Few studies make reference to the mollusks of the Atol das Rocas. Mathews & Kempf (1970) in a survey on the marine molluscs of north and northeast of Brazil, present the molluscan fauna of the archipelago of Fernando de Noronha with some references to the Atol das Rocas.

The work consisted of manual collection and dredging with NOc Almirante Saldanha, reporting 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 bairdi, Murex cf. Pulcher, Octopus hummelinckii, 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.

These 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.

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 (1985), 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. This author 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).*

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).

Endemic species (or potentially endemic) were found in relatively high frequency in the four islands, and the Atol das Rocas had a highert rate of endemicity (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).

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 plankctontrofic 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 efect" ("stepping stones") provided by the alignment of seamounts. Pinto *et al.* (---) 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 Shiphonariidae, represented by species: *Fissurella clenchi , F. rosea , F. nimbosa , F. emmanuelae , Diodora mirifica , D. arcuata , D. dysoni , D. sayi , D. cayenensis , Emarginula aff. phrixodes, Lucapina aegis , Lucapinella limatula , Collisalla noronhensis , Lottia leucopleura , Siphonaria lessoni , S. hispida* and *S. pecinata.*

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

The atolls, as well as other reef formations, influence and interfere in the physical and biological processes of the surrounding areas, and the massive reef structures are constantly converted into sand, physicaly and biologicaly. An atoll comprises highly heterogeneous habitat, but it's the sediments and not the reef itself, which covers most of the area of the system. These sediments derived from the reef are usually found in places with permanent and intense hydrodynamic motion. Therefore, physical disorders, which control the movement of sediment, probably are a constant and an important aspect of these tropical ocean systems.

The intensity and frequency of physical disturbance on oceanic atolls can be of significant importance for invertebrates of unconsolidated bottom. In the marine domain, two components of the benthic fauna have been most frequently studied: the meiofauna and macrofauna.

The meiobenthos can be distinguished from the macrobenthos not only by the mesh size used in the sampling process (63 μm for meiofauna and 500 μm for macrofauna) but by the size of the fauna spectrum that separates the two groups, and the different mechanisms used for the maintenance of biodiversity through the use of natural resources.

Accordins to Netto (1999), samples were collected at 50 stations located in the REBIO Atol das Rocas, 16 in depths ranging from 5.2 to 24.1 m, in the sublittoral outside the atoll (reef front and adjacent background), 19 stations located in sandy deposits, 12 stations within 4 pools and 3 in the lagoon.

The main taxons were recorded, 14 meiobenthos and 15 macrobenthos. Among the meiobenthos, copepods and nematodes were numerically dominant in all habitats studied, reaching more than 80% of the total. In the subtidal and lagoon, copepods comprised, on average, 51% of population density, whereas the nematodes were more abundant in sandy deposit and the pools, where they represent about 44% of the total density of meiofauna.

Macrobenthic invertebrates were largely dominated by oligochaetes, nematodes and polychaetes. While polychaetes were the most abundant group of macrofauna in the sublittoral of the atoll, the oligochaetes were more abundant in sandy deposit, pools and lagoon. The densities of macrobenthic nematodes were particularly higher in reef pools.

The number of species, the density and diversity varied significantly among habitats, but the differences are dependent on the faunal group analyzed. The number of species of nematodes in the meiobenthos and the number of polychaete (meio and macrobenthos) were smaller in the sandy deposit, while the number of species of larger nematodes was lower in the sublitoral.

The densities of nematodes in both categories of size were lower in the sublitoral, while polychaete densities were lower in sandy deposits. The diversity of large polychaete worms and nematodes were lower in the sandy deposits, whereas the diversity of nematodes of the meiobenthos was smaller in the sandy deposit and pools. The regularity and richness of species showed significant interaction between the habitat and faunal group, and their values were lower in the sandy deposit. However, significant interactions between habitat and faunal group indicated that variations in species richness, abundance and diversity between meiobenthos and macrobenthic nematodes and polychaetes are not independent froms the analyzed habitat.

The analysis of meiofauna and macrofauna of Atol das Rocas indicated that all models of the structures of communities are similar for different taxonomic levels and faunal groups, revealing a clear difference in community structure between habitats, particularly the subtidal and inner areas of the atoll. Differences among habitats were variable, and the meiofauna and macrofauna of sandy deposit and pools were different, except for the trophic groups of meiobenthic nematodes.

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 *Gomphionema* sp.1 contributed to a greater discrepancy of the similarity between habitats. The important species for the characterization of the sublitoral 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%) *Paralinhomoeus 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 sublitoral 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 *Paralinhomoeus* sp.2 (33%) and *Halichoanolaimus sp.*1 (16 %).

A total of 72 polychaete species were recorded, including 45 species of meiobenthic polychaete. While sublitoral samples were discriminated by the number of large species (16%), the sandy deposit was characterized by the number of small species (42%) and abundance of meiobenthic polychaete (30 %). A higher density of meiobenthic polychaete particularly *Syllis* (*Ehlersia*) *cornuta* (20 %) characterized samples in the pools and lagoon. Analyses of similarity of macrobenthic polychaete showed that many species contributed to the differences between habitats, but differences in the abundance of *Saccocirrus papilocerus, 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 pettiobonea* (22.2 %) and *Taryx* sp. 1 (9 %) characterized the pools and lagoon.

In the sublittoral, disregarding the size of the analyzed group, nematodes showed no significant predominance of feeding groups. The meiobenthic nematodes in sandy deposit did not show any kind of feeding dominance, but the macrobenthic were largely dominated by omnivores/predators. In the pools and lagoon, omnivores or predators dominated the nematodes.

The environments studied 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. The community structure is clearly related to this gradient in the physical environment of the atoll, where the biggest differences are between the internal and external habitats.

Subtidal sediments of the outer area of the atoll (reef front and adjacent background) were significantly coarse and better selected, showing high environmental energy. The abundance and composition of benthic invertebrates in this area reflected the degree of disorders to which this community is subjected. Meiofauna and macrofauna were characterized by low density and high diversity. Likewise, Epsilonematidae and Draconematidae nematodes, known to be adapted to the extreme instability of the substrates, along with a diverse community of meiobentic polychaetes were characteristic of the Roca's sublittoral.

In all studied habitats in Atol das Rocas, oligochaetes, nematodes and polychaetes numerically dominated the macrofauna. However, most of the literatures on the macrofaunal communities in tropical reef sediments have emphasized the importance of molluscs, crustaceans and echinoderms that in Rocas are less than 4% of the total density of the macrofauna. 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 result of this study shows the presence of a disturbed benthic assemblage. Another evidence is the presence of dense aggregations of macrobenthic nematodes in carbonate

sediments of the atoll, particularly *Metoncholaimus sp.1*, which are often abundant in organically polluted areas or systems physically disturbed. In Rocas, there are no anthropogenic disturbances, which suggest that the local hydrodynamics is likely to influence the composition and abundance of macrofauna.

The number of meiobenthic taxa varied on the subtidal, being smaller in stations located upwind and larger in downwind stations of the atoll. The total number of macrobenthos decreased from the windward stations to leeward.

The results showed a gradual change in the structure of macrobenthic and meiobenthic communities from windward to leeward of the atoll, which were correlated with environmental variables. The characteristics of carbonate deposits with coarse sediments, poorly to medium and well selected, and the enrichment process towards leeward, shown by the gradient of organic content, suggest a strong link with the hydrodynamic regime.

The average density of macrofauna in sublittoral Rocas is similar to other habitats of tropical sediments; however, the fauna has characteristics that reflect a strict environmental regime. The macrobenthos is largely dominated by small surface polychaete, oligochaetes and large nematodes. Abundance of crustaceans, bivalves, gastropods and other groups is small and relatively important only in a few places to windward. 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. While the currents and waves can prevent the deposition of organic particles in the sediment windward to the atol, as well as the establishment of a rich meiobênthic assembly, there is a clear increase of organic matter in the sediment on the lee side of the atoll. 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. This aggregation affects the distribution of sediments, eggs, larvae, phytoplankton and zooplankton, and consequently influence the density and distribution benthic assemblies.

Meiobenthic communities are known to be subjected to the same erosion/suspension that acts in the diversity of meiobenthos and nematodes toward the leeward side of the atol, which can be a result of two main processes that cause topographically controlled front: passive transport of fauna and active aggregation in areas of greater abundance of food particles.

In sandy deposits, the properties of carbonate sediments change significantly along the windward to leeward area, where the average grain size of the sediment decreases from coarse (windward) to medium (leeward).

The sandy deposit is exposed to a gradient in the water flow generated by different stages of the tide. The direction of water movement, in all stages, is always windward to the NW openning (Barretinha) and to a lesser extent, to the lagoon. 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. Increases 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. Low abundance of meiofauna, with low diversity of nematodes. Macrofauna with low abundance.

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.

Cnidofauna - Organisms belonging to the Phylum Cnidaria are represented by jellyfish, sea anemones, octocorals, stony corals, fire corals, among others. They are divided into two groups, according to their life cycle: the meduzoários and antozoários. One of the traits that distinguish them is the possible presence of a stage in the life cycle called "Jellyfish". Jellyfish usually live free, drifting or swimming actively, and have the mouth on the lower surface of the body. The antozoans are always sessile, living fixed to the sea bottom and have the mouth facing upward. They are called polyps (Hetzel & Castro, 1994).

The term coral is used generically to designate marine animals of the group of cnidarians that have corneous or calcareous skeleton.

Coral reef inhabitants, as well as several other cnidarians, have within the tissues one unicellular algae named zooxantela. This symbiotic association between corals and algae is of fundamental importance in the nutrition of many corals. The coral uses part of organic compounds and oxygen produced by algae through photosynthesis and, in return, the algae use up the metabolites excreted by the coral (Hetzel & Castro, 1994).

The increase in the production of skeletons associated with the presence of zooxanthellae is considered one of the main factors restricting the presence of coral reefs to shallow places, up to about 50m. The algae require light for photosynthesis.

Environmental changes can affect the zooxantela cnidarians. Under stress, the zooxanthellae can be eliminated or lose its pigment. As the color of the animal originates largely from the pigment of these algae, the coral flesh becomes transparent. This phenomenon is known as "bleaching" and is associated with various types of environmental changes, particularly temperature increases, the incidence of ultraviolet rays and reduction in salinity.

Echeverria *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 ilkalyseae, Phyllactis correae* (Order Actiniaria) *Zoanthus sociatus, Palythoa caribaeorum* (Zhoantidae) *Madracis decactis*, *Agaricia agaricites, Siderastrea stellata, Porites astreoides, branneri Porites, 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 acontiarios *Telmatactis rufa, Aiptasia pallida* and *Bellactis ilkalyseae* 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 caribaeorum* 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).

The spatial distribution of Actinias, mileporinas, gorgonians and ceriantídeos were recorded in restricted areas. The Actinias occur more in the lee side of the reef flat and lagoon, depending on the specific preferences. Mileporinas occur mainly in the windward side, and *Millepora braziliensis* in the margin reef and *M. alcicornis* at the bottom of the reef front. The gorgonians were observed at the same sites of occurrence of *M. alcicornis*. The cerantídeos were more frequently observed in the lee side of the lagoon (Echeverría, op cit.).

The number of scleractinian and zoanthids species varied in the reef plain. *Siderastrea stellata* occurs in all the pools of the atoll. The area of greatest diversity often includes *Porites* spp., *Montastrea cavernosa* and *Mussismilia hispida*. The poorest area is mainly characterized by the occurrence of *Zoanthus sociatus*. The transition area has a diversity gradient, from poor in the west side to rich on the east side. The area outside the reef plain is also characterized by distribution models. *Porites branneri* was not observed in any of the points sampled on the outside, however, the area of the south- southwest side is very similar to adjacent pools, with a frequent presence of *Siderastrea stellata* , *Porites astreoides* and *Mussismilia hispida*, and small patches of *Palythoa caribaeorum*, this last one wasn't observed in adjacent pools. The areas on the north-northwest sides and Barretão are quite poor, with regular occurrence of *Siderastrea stellata* and two records of *Porites astreoides* in the channel. The Barretinha is characterized by a dense coverage of *Zoanthus sociatus* (Echeverria, op cit.).

According Echeverria *et al.* (1997), Kikuchi (1994) in his work in Atol das Rocas, mentions the occurrence of *Millepora alcicornis, Mussismilia hispida* and gorgonians on the area outside windward of the reef. This suggests that this area may have different characteristics than described, but it could not be properly studied due to weather conditions prevailing at the time of the survey.

Several authors discussed the influence of environmental conditions on the reef fauna, especially corals. These factors may influence the distribution of species in the Atol das Rocas. The model of water circulation inside the atoll is basically conditioned by the prevailing wind in the region and the change of the tide, creating a flow of hot water to the leeward side of the atoll, which is also responsible for carrying sediments and debris. This water is heated in the lagoon and because it flows over the heated reef plain (Echeverría, op cit.).

On the windward side of the atoll, the action of strong waves is probably the most significant factor limiting in the distribution of corals. On the leeward side, the transport of sediment and nutrients associated withthe heated water may constitute significant limiting factor. The largest transport of nutrients and sediments can promote algae growth at the expense of corals. Thus, in the windward side of the atoll, the limiting factors are mitigated within the pools, which have the highest diversity of corals. On the leeward side, the limiting factors mentioned explain the lower diversity found in these pools. In the lateral pools (southwest and northeast), the temperature of the water may be greater than the variations of the windward side, but sedimentation is much less than in pools leeward, explaining their relative richness (Echeverría, op cit.).

The same factors may explain the similarity between the pools to windward and external locations on the southwest side of the atoll, where the mentioned limiting factors are also attenuated. The low diversity outside to leeward is explained by heavy sediment transport and by the high temperature of the water flowing through the channels north and west (Large Barreta and Barretinha). The dominance of *Siderastrea stellata* can be explained by its tolerance to shifts while their colonies are still small; for their resistance to temperature variations and by its common presence in environments with high sedimentation and turbidity, as seen on the reefs on the Brazilian coast (Echeverría, op cit).

Sponge fauna - The sponges (Porifera) participate in important interactions within the benthic communities, competing directly with various groups with marine flora and fauna, serving as shelter and food for many invertebrates, fish and turtles. They also contribute significantly to primary production by cyanobacteria and act in the processes of reefs construction and erosion. Therefore, constitute a major component of benthic communities in various marine environments. From an economic standpoint, the sponges come out to be an important source of new compounds of pharmacological interest (Wilkinson, 1987; Rützler, 1990; Sarà & Vacelet, 1973; Berquist, 1978 apud Moraes, 2000).

The use of sessile reef communities as biological indicators of the environment is recognized as useful for monitoring of environmental disturbances, both natural and anthropogenic. The sponges are good bioindicators, which can be used in monitoring programs (Alcolado & Herrera, 1987; Murky, 1989 and 1991).

In a survey conducted for porífera of the REBIO Atol das Rocas, Moraes (2000) found 39 species, revealing a community of sponges as rich as in Tamandaré (PE) (36 spp, Murky & Moraes, 1998), but with less diversity when compared to Fernando de Noronha, with 56 known species of sponges (Mothes & Bastian, 1993; Murky & 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.

At least five species of sponges are probably new to science: *Clathrina sp, sp Leucetta, Plakortis sp. 2 Plakortis sp. 3* and *Aplysina sp.* Among these*, Clathrina sp., Plakortis sp*. 3 and

Aplysina sp are provisionally considered endemic to Atol das Rocas, not being known in neighboring areas (Moraes, 2000).

Twelve species common to Atol das Rocas and Tamandaré – PE were identified, and 13 species common 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. *compress* and *A. viridis*.

The pools generally showed homogeneity in respect to the diversity and density of sponges, highlighting only the pools of Rocas (diversity and density) and Cemitério (density) slightly above the rest. The Pool of the Farol has values of density and diversity intermediate between "Poças de Maré" and "Fendas". The pools of Southwest, "Âncoras"of "Tartarugas" and "Fendas" have high diversity. In the region of Laguna near Barretão, the community of sponges is much richer than the one on the inside; it is common to find specimens of *Agelas clathrodes* and *Aiolochroia crassa*. In the inner most region, sponges are less frequent, with a prevalence of *Chondrilla aff. nucula* and *Cliona varians*. The "Poças de Marés" have low diversity and density on the outside, in front of Barretinha, *Leucetta sp* was the only species found. In Barretão, sponges are diverse and represented by developed organisms (Moraes, 2000).

The most frequent species in Atol das Rocas were *Spirastrella coccinea*, *Cinachyrella alloclada, Chondrilla aff. nucula, Scopalina ruetzleri, Plakortis sp.* and *Amphimedon aff. compressa*. *Spirastrella coccinea* was the most frequent and dominant, being found primarily in semi-iluminated places. *Chondrilla aff. nucula* was the dominant sponge in the "Poças de Maré" (Tide Pools) and the only one found fully exposed to air during low tide. It is also the second most abundant species. *Leucetta* sp. was most abundant in the "Salão" and *Haliclona sp*. was found more frequently in the pool "Podes-Crer". Well-developed specimens of *Ectyoplasia ferox* and *Aiolochroia crassa* were observed in the northern portion outside the reef ring. In the Cemiterio's Pool, the sponge *Cliona varians* dominated the shallower and bright parts, piercing the sandstone, although it was not present at high density on the site (Moraes, 2000).

The sponges colonized more intensively on less exposed environments such as walls and holes, these species depend directly on the hard substrate for attachment and no species was found attached directly on the sand (Moraes, 2000).

Atol das Rocas hosts a variety of environments with distinct characteristics in terms of luminosity, wave beating, depth and substrate. These differences are noted in the community structure of Porifera and there is a big difference in the diversity and density of sponges between environments, eg, "Fendas" e "Poças de Marés". In these last ones, where environmental 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 - There are few studies on the zooplankton of the Biological Reserve of Atol das Rocas. Mafalda Júnior & Araujo (1992) and Long (1993), in similar work on the macrozooplankton, with sampling points located on the Barreta Grande, Barretinha, Laguna and the outside area of the atoll, found similar results, concluding that REBIO Atoll das Rocas constitutes a site of intense spawning and breeding of fish and shellfish, mainly.

According to Long (1993), the macrozooplankton was represented by 11 animal 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 Foraminíferida, Hydroida, Calycophorae, Limacinidae, Gymnosomata, Copepoda, Ostrocoda, Hyperiidea, 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 (Ophchthidae, 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 (Long, 1993).

According to Mafalda Junior & Araújo (1991), the occurrence and density of macrozooplankton indicate secondary production, in an intertidal environment, located in the oceanic region, and the most common organisms were fish eggs, zoea of Brachyura, zoea of Caridea, fish larvae, Polychaeta (larvae) and zoea of Anomura and the organisms of higher relative densities were fish eggs, zoea of Brachyura, zoea of Caridea and zoea of the Anomura. Longa (1993) partially corroborates these results, showing that the highest frequencies were observed for fish eggs, larvae of Brachyura, Decapoda larvae and other copepods, and higher relative densities for Euphausiacea, Brachyura larvae, larvae of other Decapoda, fish eggs and copepods. Longa (1993) points out the high density of Euphausiacea found in his study, which was not seen in previous work on the REBIO Atol das Rocas and ocean areas. According to the author, at a fixed station in the Pacific Ocean, Euphausiacea larvae were found, contributing to the greater numerical composition in May (same month of their study), surpassing the Copepoda. It is also reported that the highest relative densities found in their study were observed in samples collected in the early hours of the day or night, in the full moon period, suggesting a vertical migration of zooplankton influenced by the lunar phase.

Rosa *et al.* (1997), in order to study the natural history of the lemon shark, on board of the NOc. R/V Seward Johnson, held vertical hauls from 200m in depth in order to study the biodiversity of Tintinnina occurring in the area of influence of the Atol das Rocas and Fernando de Noronha. As a result, 48 species in 21 genera and 11 families were found.

The most representative family in number of species was Tintinnidae (13 species), represented by: *Amphorides quadrilineata, Amphorellopsis acuta, Dadayella ganymedes, Eutintinnus apertus, E. Fraknoi, E. haslea, E. medius, E. stramentus, E. tubulosus, Salpingella subconica, Steenstrupiella gracilis* and *S. steenstrupii* (Rose *et al,* 1999).

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

Dispite the number of species identified, most of them occurred sporadically, emphasizing in the quantitative terms, only species of *Eutintinnus fraknoi* (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:

In the REBIO Atol das Rocas, despite the existence of the ruins of the lighthouse, the keepers' house and ruins of wrecks (ship engines, chains, anchors, carcasses, among others), these are not registered as cultural heritage in IPHAN.

Due to lack of human occupation in Atol das Rocas, except for the families of lighthouse keepers who went there, there are no records of intangible assets.

Great distances from urban centers and inhospitable conditions of Atol das Rocas do not allow a process of occupation of the islands. Except for the time of the lighthouse keepers who lived on the site to give maintenance to the lighthouse, 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?

The justification before UNESCO for the inclusion of the Biological Reserve of Atol das Rocas in the World Heritage list 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. Constitutes a true "oasis" of marine life in a relatively esteril ocean, contributing to reproduction, dispersal and colonization of marine

organisms in the tropical South Atlantic. 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 the protection, conservation and research.

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 Union. However, there are areas within the site that are in the possession of the Brazilian Navy - the lighthouse on the "Farol" island.

b) in the surrounding area: not the case

---

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: Not the case.

---

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, associatesd 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 most often captures performed 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.

b) in the surrounding area:

---

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.

• Decreet 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.

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 and being implemented

d) Describe any other current management practices:

---

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 considered the best practices of conduct, areas of higher risk of accidents, special areas for feeding and reproduction of some species (considering seasonality), among others. The manual should provide maps/sketches of the areas of greatest risk of accidents, 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 Special Secretariat of Aquaculture and Fisheries (SEAP-PR) 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 in the conservation unit.

The organic waste should have properly 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).

Except for scientific research and exceptional cases, visits and the remaining of researchers should be avoided in the turtle breeding areas 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) and 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 atol 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, Garoupinha.

To request the Directorate of Hydrography and Navigation of the Navy of Brazil 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.

Despite the difficulties imposed by their location, associated with limited financial resources, limited infrastructure, lack of fresh water and geographic isolation, the REBIO Atol das Rocas can be considered as one of the most successful marine conservation units in terms of research. 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, masters and doctoral dissertations carried out in this conservation area. The operational feasibility of this research is associated with the presence of periodic and regular employees in the REBIO, especially the Head of Unit. 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. This fact is associated with lack of proper and autonomous sea vessels to carry out works in the vicinity of the farthest atoll. The existence of only a small inflatable boat powered with a 15HP engine imposes serious limitations on research activities outside the atoll.

Knowledge production in the REBIO Atol das Rocas, despite being held continuously, faces some difficulties. The lack of a Scientific Council to direct the research, deficiencies in logistics, lack of suitable vessels, among other things, result in knowledge gaps especially in the outer area of the atoll. As a result, there has been a significant amount of research in the area of the atoll and very little research in adjacent areas, which correspond to the largest portion of REBIO. Therefore, most of the conservation unit is still largely unknown.

An international Reef Check program, conducted by Prof. Dr. Beatrice Padovani Ferreira (UFPE), 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. Consists of a wooden house pre-fabricated, with two rooms (bedroom and kitchen), having an outdoor balcony in front of the house and a balcony on the back. It has no bathroom.

Considering the balconies, the building area is about 54 m2, measuring 6 m in length by 9 m wide. The house itself measures 6 x 3m (18 m2) mounted on pylons of concrete coated with PVC pipe about 1 m high , which hinders access of animals such as crab and rat inside the building, and protect it against strong storms (water flows beneath the house).

The furniture of the house consists of stove, refrigerator, table, cabinet, fruit bowl, chairs, which are in the kitchen, and in the room, there are two bunk beds, a small table, cabinets. Inside the house there are also wall clock, fire extinguishers, VHF radio, and utensils.

Externally, the area under the house acts as a deposit, where the bottles of drinking water brought from the mainland, gas cylinder (7 spare and 1 in use) and batteries. On the front porch, two wooden boxes serve as food pantry.

Electrical power is provided by two solar panels with 9 plates, which charges the batteries, which feed four fluorescent lights, VHF radio and other appliances that may be necessary and compatible with the low voltage.

This structure is strategically located, since it is located at the periphery of the REBIO emerged area, minimizing possible impacts (particularly on birds) near the entrance (Barretinha) which facilitates the movement of people and materials and is located at the bottom the bay mud, which consists of a sheltered place conducive to anchoring the boat.

However, it is experiencing a process of erosion of the slope of the Bay Mud, behind the house, threatening it. Perhaps there is a need to build a new base or relocate the existing elsewhere.

The REBIO does not have a marine vessel, thus access from the mainland to the Atoll and vice versa is done through the rental boat, usually a medium sized sailboat. However, the vessel is not anchored in the reserve, at disposal, which requires planning for a safe trip, the stay and the return to Atol das Rocas.

Generally, the boat leaves the city of Natal towards the Atol das Rocas with a travel route of approximately 20 hours, depending on weather conditions.

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.

All inorganic waste generated in the reserve returns to the mainland. Thus, about 40m from the main office toward Barretinha, there is a small cover under which are two wooden boxes that act as a dump. It is under this cover that they also store the boat's fuel (gasoline).

The organic waste is reduced to small pieces and these are thrown into the sea at low tide, avoiding the risk of the return of the atoll and its seeds to germinate.

As in the atoll there is no availability of freshwater, the dishes are washed in seawater.

---

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, 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 are 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. 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 9134-0164.

---

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

---

34. Bibliographical references:

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

Plano de Manejo da Reserva Biológica de Atol das Rocas

ALCOLADO, P. M. 1989. Estructura ecológica de lãs comunidades de esponjas Del arrecife de Rincón de Guanabo. Rep. Inv. Inst. Oceanol. Cuba. № 10, p. 3-28.

ALCOLADO, P. M.; HERRERA A. 1987. Efectos de La contaminación sobre las comunidades de esponjas em el Litoral de La Habana, Cuba. Rep Invest Inst Oceanol Acad Cien Cuba. 68: p. 1-17.

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. Morphoespecies 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.

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.

BERQUIST, P. R. 1978. Sponges. Huctchinson & CO. London.

BROWN, F. A., 1971. Some orientational influences of nonvisual, terrestrial electromag netic fields. Ann. N. V. Acad. Sci., 188: p. 224-241.

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.

BURGGREN, W., MCMAHON, B. 1988. Biology of the Land Crabs. New York: Cambridge University Press.

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.

COUTINHO, R. 1995. Avaliação Critica das Causas da Zonação dos Organismos Bentônicos em Costões Rochosos. Ecologia Brasilienses, Volume I: Estrutura, Funcionamento e Manejo de Ecossistemas Brasileiros, p. 259-271.

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, 1:61-70. 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.

FAIRBRIDGE, R. W. 1950. The geology and geomorphology of Point Peron, Western Australia. J. Roy. Soc. W. Austr. 34: p. 35-72.

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.

GOREAU. T.J. 1992. Bleaching and reef community change in Jamaica: 195 1-1991. Am. Zoo/. 32, p. 683-695.

GORINI, m. A. & CARVALHO, J. C. 1984. Geologia da margem continental brasileira e do fundo oceânico adjacente. In: SCHOBBENHAUS, 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.

HOFFMEISTER, J. E. & LADD, H. S. 1944. The antecedent platform theory. J. Geol. 52: p. 388- 502.

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.

LEINZ, V. & AMARAL, S. E. 1978. Geologia geral. Ed. Nacional. São Paulo. 397p.

LINS OLIVEIRA, J. E., CUNHA, K. M. F., REY, H. A. 1993. Problemática da Pesca de Lagostas no Nordeste do Brasil. Boletim Técnico Cientifico do CEPENE, v.1, n.1, p. 187 - 210.

LONGA, C.M.O. 1993. Caracterização do macrozooplancton 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 GG., 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.

MARTIN L, SUGUIO K, DOMINGUEZ J. M. L & FLEXOR J-M. 1997. Geologia do Quaternário costeiro do litoral norte do Rio de Janeiro e do Espírito Santo. CPRM/FAPESP, Belo Horizonte - MG, 112p.

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.

MOOJEN, J. 1952. Os Roedores do Brasil. Rio de Janeiro: Ministério da Educação e Saúde, Instituto Nacional do Livro. 214p.

MOORS, P. J. et al. 1989. Prohibited immigrants: ter rat threat to island conservation. Wellington: World Wide Fund for Nature, 32p.

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 Biologicas. Rio de Janeiro. 63p.

MOREIRA, l.; 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.

MOTHES, B.; BASTIAN MCKA. 1993. Esponjas do Arquipélago de Fernando de Noronha, Brasil (Porífera, 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.

MURICY, G. 1991. Structure des peuplements de spongiaires autour de l'égout de Cortiou (Marseille, France). Vie et Milieu 41(4): p. 205-221.

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-lixa, Ginclymostoma 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.

ORR, J. W. 1940. The Histology of the Rat's Liver during the Course of Carcinogenesis by Butter Yellow (p-Dimethylaminoazobenzene). J. Pathol. Bacteriol., 5:393-408.

OTTMANN, F. 1963. "L'Atoll das Rocas" dans I'Atlantique Sud Tropical, Revue de Géographie Physique et de Géologie Dinamique, V(2):101-107.

OTTMANN, F. 1963. "L'Atoll das Rocas" dans I'Atlantique Sud Tropical, Revue de Géographie Physique et de Géologie Dinamique, V(2):101-107.

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, № 11-12, p.1181-1228.

ROSA, R. S. & MOURA, R. L. 1997. Vissual 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.

RÜTZLER, K. 1990. Associations between Caribbean sponges and photosynthetic organisms. In: Rützler, K. (ed). New perspectives in sponge biology. Smithsonian Institution Press, Washington DC.

SALES, G. 1992. Plano de implantação da Reserva Biológica do Atol das Rocas. IBAMA/RN. Natal, 12p.

SALVAT. B. 1992. The 1991 bleaching event in the Society Islands. French Polynesia. Prm: 7th Int. Coral ReefSytnp. Guam.

SARA, M. VACELET, J. 1973. Ecologie des Demosponges: influence des facteur physicochimiques. In: Grassé PP (ed). Traité de Zoologie, Anatomie, Systematique, Biologia. 3(1) Masson et Cio, Paris. pp. 462-576.

SAZIMA, I. 1986. Similarities in feeding behaviour between some marine and freshwater fishes in two tropical communities. Journal of Fish Biology, 29:53-65.

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.

STODDART, D. R. 1962. Three Caribbean atolls: Turneffe Islands, Lighthouse Reef, and Glover's Reef, British Honduras. Atoll Research Bulletin 87:1-151.

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.

ALLAUX, C. 1940a. A formação atoliana de Rocas (trad.) A "A Voz do Mar" XIX(173):163.

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.

WILKINSON, C. R. 1987. Interocean differences in size and nutrition of coral reef sponge populations. Science, vol. 236, p. 1654-1657.

WOLANSKI, E. & HAMNER, W. M. 1988. Topographically controlled fronts in the ocean and their biological influence. Science 241:177-181.

ZEMBRUSCKI, S. G.; BARRETTO, H. T.; PALMA, J. C. e MILLIMAN, J. D. 1972. Estudo preliminar das províncias geomorfológicas da margem continental brasileira. XXVI Congr. Bras. Geol. da SBG, v.2. p. 187-210.

Information Sheet on Ramsar Wetlands (RIS) – 2009-2012 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.

FOR OFFICE USE ONLY.

DD MM YY

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

Ana Carolina Cotta de Mello Canary – Analista Ambiental da ESEC Taim

Estação Ecológica do Taim – BR 471, km 536 - Caixa Postal 28 – Avenida Rio Grande n°45 – AC Cassino/Rio Grande – RS – CEP 96207-970

2. Date this sheet was completed/updated:

July, 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.

Estação Ecológica do Taim

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 (nature 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 area of 33,815 ha, occupying part of the coastal plain of the municipalities of Rio Grande and Santa Vitória do Palmar, between the Mirim Lagoon and the Atlantic Ocean, was decreed by the President in 1978, as of public utility with the objective of protecting wetland systems (Annex 1). On July 21, 1986 the wetland of Taim was promoted to a Federal Conservation Unit (Decree n ° 92.96.3) (Annex 2), creating the Taim Ecological Station, whose primary goal is to protect samples from Southern Wetlands and endangered Wildlife, besides preserving an area used by several migratory birds (IBAMA, 2003).

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

Provide the coordinates of the approximate centre 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.

- 32° 33' S - 32° 50' S
- 52° 32' W - 52° 38' 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.

The Taim Ecological Station is located in the state of Rio Grande do Sul, 309 km from the state capital, Porto Alegre and 90 km from the city of Rio Grande, which has a population of 197228 inhabitants (IBGE 2010). This conservation area is located at the southern end of the coastal plain of Rio Grande do Sul, between the Atlantic Ocean and Mirim lagoon, covering part of the municipalities of Rio Grande and Santa Vitória do Palmar (Carvalho & Rizzo, 1994). The coastal plain is inserted into the largest lagoon complex in South America, constituted by the Laguna dos Patos, Mirim and Mangueira (Fagundes & Bager, 2007).

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

Mínimo 5.37 m

Máximo 9.08 m

11. Area: (in hectares)

10.764 hectares.

---

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 region where the Taim Ecological Station is characterized by a broad coastal plain, where the marshes, ponds and associated wetlands are the dominant landscape. In this region lays the Mirim lagoon and other smaller lagoons such as Mangueira, Flores, Caiubá, Nicola and Jacaré, which together comprise the Taim wetland system, being part of the Atlantic Forest Biosphere Reserve, which highlights the ecological relevance of this ecosystem (UNESCO, 1999; Burge , 2002). ESEC Taim stands as one of the richest areas for aquatic birds in South America, with residents, breeding and wintering at the southernmost areas of the Nearctic. We should also emphasize their value as genetic and landscape heritage, due to the great biological diversity and ecosystems present, and for being one of the remnants of this type of ecosystem. The Taim wetland has a very important role in maintaining the ecological balance of the area. Among its functions it should be cited, food production, biodiversity conservation, containment of flooding and pollution control. The most important processes in this ecosystem are the generation of soil, plant production and nutrient, water and biodiversity storage (NEMA, 2008).

---

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 Coastal Plain of Rio Grande do Sul is a unique environment in Brazil. Some of its most striking features are its very recent geological formation, caused by marine transgressions and regressions of the Holocene, and a peculiar geographical position, which submits it to the Subtropical Convergence and a climate with strong marine influence. Macroenvironmental characteristics demonstrate that this is a unique environment in Brazil, combining the recent coastal plain with coastal subtropical climate. The coastal plain of Rio Grande do Sul has 640 km long, from the city of Torres to La Coronilla in Uruguay, with 37,000 km^2, being 22,740 (61%) submerged and 14,260 km2 (39%) of aquatic systems. This large extension has two large lagoons (Patos and Mirim) and

the longest streak of lagoons in Rosario parallel to the Brazilian coastline. The process of formation of sandbanks and lagoon environments resulted in different characteristics between the northern and southern coast of the state, including regions with large typological differences of aquatic ecosystems, indicating that studies conducted on the north shore cannot be applied directly in the region farther south. Within this biogeographical unit, Coastal Plain, wetlands inserted in the Taim Ecological Station are the most representative of this unique wetland ecosystem.

Criterion 2 - The Taim Ecological Station shelters important populations of reptiles and mammals that are endangered on a global scale, these species being *Wilfredomys oenax, Ctenomys flamarioni* and *Liolaemus occipitalis*. Moreover, due to the large reduction of wetlands in Rio Grande do Sul, the Ecological Station of Taim is very important to maintain this type of environment and the flora and fauna that live in this ecosystem area. This unit shelters a large number of species that can be easily viewed along the BR 471.

Criterion 3 - The areas where there are wetlands in Rio Grande do Sul have suffered rapid decline. In the past, the Provárzea Program of the Federal Government (Socio-Environmental Institute, 2005) drained much of the wetlands for agricultural use. Currently, it can be considered as vulnerable ecosystems, threatened due to urban growth, silting, pollution and drainage. According to the Foundation Zoobotânica (2002), the state had originally 5.3 million acres of wetlands, including wetlands and floodplains (Klamt et al., 1985). In 1986, through a flight over the wetlands of the State, it was noticed that, except in specific locations, the environments of floodplains and wetlands were strongly altered and degraded (Foundation Zoobotânica, 2002). However, it appears that the Rio Grande do Sul also has important and significant remnants of these systems (Carvalho & Ozorio, 2007). Stands out among the current areas of swamps, the Coastal Plain (East and South region), associated with coastal lagoons and coastal fields. The Taim Ecological Station, in this context, harbors a high biodiversity (hotspot) in the region, providing a haven for species typical of this type of environment. In addition, it shelters a unique environment of the coastal plain.

Criterion 4 - In Rio Grande do Sul, in the last thirty years, the great expansion of rice in wetland fields contributed to the degradation of wetlands in a frightening proportion. There are several examples of aggression and drainage of wetlands in the state. Currently it lost much of what it was due to developmental model adopted. It is known that without the reeds of the marshes, migratory birds like the cisne-do-pescoço-preto, and coscoroba, among many others that nest only in these ecosystems may have their future compromised. However, the wetlands of ESEC Taim still are preserved and serve as shelters for resting, breeding and feeding of various migratory birds. According to Nascimento *et al* (2006), one of the places with the highest concentration of *Anasgeorgica* species in coastal areas was in the Taim Ecological Station, considered among the most representative areas. In a study by Nascimento *et al* (2005) one of the places with the highest concentration of *Anasflavirostris* was in Taim (n = 561). According Calabuig and colleagues (2010) records of nests, chicks and juveniles of species *Coscoroba coscoroba* in the area of ESEC Taim during the years 2005-2008 confirms the data reported by other researchers (Belton 1994 Day & Fontana 2001) and allow us to state that the area's surrounding and within the ESEC Taim would be the most important breeding ground for population belonging to Argentina, Uruguay and Brazil (Seijas, 2001). Miño & Del Lama (2007) investigated a large breeding colony of *Plataleaajaja*. According to Serrano (2010) ESEC Taim is one of the critical areas for biodiversity, for the species of migratory aquatic birds of the Northern Hemisphere. Being extremely important for the species: *Pluvialisdominica, Tringasolitaria, Bartramialongicauda, Calidriscanutus , Calidris alba, Limosa haemastica* and *Tryngitessubruficollis*. Still, according to the same author by applying the criteria of the Ramsar Convention, 69 Critical Areas for

Conservation of Charadridea and Escolopacidea were identified, being one of these areas the Taim Ecological Station, in Rio Grande do Sul.

Criterion 7 – the Taim Ecological Station has a diversity of 63 fish species (Garcia *et al*, 2006; Correa *et al*, 2011) known. However, few studies have been conducted in the area. A study of *Odentesthes humensis* recorded the highest occurrence of this species within coastal lagoons of Mirim and Mangueira, which includes the area of the ESEC Taim (Bemvenuti, 2002). In the ESEC Taim, there are some endemic fish species of the Coastal Plain, such as *Odentesthes mirinensis, Odontesthes aff, Perugiae, Odontesthes retropinnis, Austrolebias wolterstorffi* and *Hisonotus taimensis*. Furthermore, there is the presence of *Austrolebias cf. charrua*, endemic and threatened species according to the Brazilian list of threatened species.

Criterion 9 - Due to the large reduction of wetlands in Rio Grande do Sul, the Ecological Station of Taim is very important to maintain this type of environment for the flora and fauna that live in this ecosystem. This unit shelters a large number of species that can be easily viewed along the BR 471. In this environment, there is a considerable amount of *Caiman latirostris, Hydrochaeris Hydrochoerus, Trachemys dorbigni, Myocastor coypus, Lontra longicaudis, Cerdocyon thous Lycolopex gymnocercus, Leopardus geoffroyi*, in addition to several other species. However, despite the easy viewing of the great abundance of this fauna, there are still no studies on population abundance. The only existing study is about the abundance of *Hydrochaeris Hydrochoerus*, in which it was observed an average population density of 7 individuals/ha and an annual population increase of 43% (Garcias & Bager 2009).

---

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: coastal plain

b) biogeographic regionalisation scheme (include reference citation):

Universidade Federal de Santa Maria. Relevo (em português). Inventário Florestal Contínuo. Página visitada em 16 de outubro 2012. http://w3.ufsm.br/ifcrs/frame.htm

Federal University of Santa Maria. Relief (in Portuguese). Continuous Forest Inventory. Accessed on October 16, of 2012. http://w3.ufsm.br/ifcrs/frame.htm

---

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.

The Taim Ecological Station is located on the coastal plain of Rio Grande do Sul, and has its geological structure formed by the deposition of sediments of marine, wind, and lake origins. Its geological formation is recent, with its current form resulting from events occurring in quaternary.

The formation of the coastal plain occurred in the Quaternary period, comprising the Pleistocene and Holocene, ie, in the last 2 million years. During this period advances (transgressions) and retreats (regressions) of the sea occurred, caused by freezing and thawing times of the poles and deposition of sediment erosion from the Escudo Cristalino

and Planalto Meridional, and freshwater outflow (Schwarzbold & Schafer, 1984). These processes generated 4 formations of lagoon-barrier type, present in the Taim region, depositional systems types II, III and IV (Tomazelli *et al.* 2000). Due to their genesis, these bodies of water are typically shallow, with its largest diameter parallel to the shoreline, being long and narrow and tending to segment, by the wind, turning into smaller bodies of water or wetland areas, with ephemeral life and quite vulnerable to the action of man. Channels, forming long trails, very close to the sea (Lanzer, 2005), often interconnect these lagoons. The landscape of this region is characterized by a plain with micro-landscapes of little altimetry expression, highlighting the dune features and terraces with lagoon barriers.

The climate is subtropical (Cfa; Koöppen, 1936), which makes this region different from other existing wetlands in Brazil due to climate characteristics in this region, with well-distributed four seasons throughout the year (Lima, 2011). The annual rainfall varies between 1000-1500 mm (Tomazelli & Villvock, 2000), and may vary significantly between consecutive years and may be related to the pattern and frequency of the passage of cold fronts (Peace, 1985). The average annual temperature is 18 °C and relative humidity remains high throughout the year, around 80%, because of the fact that both mT and mP have high levels of water vapor (IPH 1996). The prevailing winds in the south coast are the northeast, coming from the St Helena anticyclone, throughout the year, while southwestern winds are the second predominant direction, which are due to the penetration of migratory polar cyclones (IPH, 1996).

The regional hydrology resents the lack of a well-defined drainage network, depending on its geological evolution. This fact is reflected upon the existence of several wetlands and lagoons, which makes the system very complex and broad, being its main feature in hydrological terms (IPH, 1996).

According to the Institute of Hydraulic Research-UFRGS (1996), the water entry in the system is provided only by rainfall, and a significant contribution provided by a concentrated stream flow does not occurr in the system area.

The variation of the water regimes in Taim (IPH, 1996) may be related to the species of the wetland macrophytes, determining not only the presence/absence as well as its distribution (Motta Marques et al., 1997).

The region of ESEC Taim is within the sedimentary low plain level (deposition of the Holocene period, where floods are caused by rivers and ponds). This area was formerly occupied by a gulf linking Mirim Lagoon to the ocean, which by sedimentation processes was being clogged, leading to the current configuration. When the old gulf closed, the sedimentation processes occurring in the area happened through extravasation of Mirim and Mangueira Lagoons, ie, the processes of sedimentation became thereafter-lacustrine (IPH, 1996). The entire area has a certain diversity in terms of soils, with common impermeability characteristics in a greater or lesser degree, hydromorphism (poor draining), and very high groundwater, or even above the surface, and salinity (BRAZIL, 1973 HPI 1996).

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

The area covered by the hydrologic system of Taim cannot be considered, strictly speaking, a watershed, the best conceptualize is that it is a Non- Typical Hydrological System (SHNT), as proposed by Fertonani and Prendes (1983). The complexity of the system is

because the regional flow occurs mainly along ponds and marshes, where an extensive network of creeks and channels (IPH 1996) interconnects and the damping processes predominate.

According to Motta - Marques & Villanueva (2001) the Taim Hydrological System (SHT) is divided into several subsystems:

1 - North Subsystem: Composed by Caiubá Lagoon, Flores Lagoon, Maçarico Wetlands and the latter with turnout for the Lagoa das Flores. The output of this system toward Taim is limited by a small channel capacity that is often closed during the drought. In practical terms, the influence of this subsystem on Taim is null.

2 – Swamp Subsystem: Consisting of the Jacaré Lagoon and Nicola in its northern part, close to the point of lowest elevation of the Taim System. This area consists of wetlands, and there is a slight positive gradient of bottom topography in the direction west east. Its total area is 270 km2. Low surface velocities due to the existence of aquatic weeds and biomass characterize the flow.

3 - Southern Subsystem: Composed of Mangueira Lagoon and its contribution basin. The union between the South subsystem and the swamp is performed by:

(a) The channel along the BR 471 by concentrated flow;

(b) The pond bathed in diffuse interface flow.

Several factors contribute to the definition of water levels within the Taim (Motta-Marques & Villanueva, 2001):

• Precipitation and evapotranspiration on the tributary basin;

• Drainage capacity of channels;

• Storage capacity of the ponds and the surrounding areas;

• Levels of Mirim lagoon;

• The flow characteristics of the output structure's set of conduits;

• Withdrawal of water for irrigation.

---

18. Hydrological values:

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

According to a study by Tassi (2008), the main functions of Taim were identified:

1 - Providing habitat for many species of fauna and flora.

In the case of fauna, there are species that depend on Taim throughout their lifetime and there are also migratory species that need the same area for a short period of their life cycle. The loss of habitat for any of these species may lead to population reduction or even extinction.

Regarding the local flora, it can be said that there is plenty of emerging macrophytes, which play important role in the removal of nitrogen and phosphorus entering the area, mainly through the water from the rice fields. The vegetation also plays an important role in the hydrodynamics of the water, reducing the flow velocity, allowing more sediment deposition and reduction of water turbidity, essential for the maintenance of life for some aquatic species found at the site.

2 - Supply of water for rice irrigation.

The structure of Taim (vegetation, topography, canals, etc.) controls the exchange of water between this system and the Mangueira Lagoon. Indirectly, Taim regulates the amount of water stored in the Mangueira Lagoon, the latter being the main point of water capitation for irrigation in the region.

3 - Control of the dynamics of the communities who live and/or depend on the Lagoa Mirim.

The point of lowest elevation of the Taim is Lagoa Mirim (shared water management), and it exercises vital influence on the chemical, physical and biological processes that control the dynamics of the communities who live and/or rely on this lagoon. The Taim is responsible for the export of organic matter and nutrients to this lagoon, and seasonal variations, both of natural or anthropogenic origins, on the nutrient export patterns, can significantly influence the ecology of the lagoon (PELD, 2002).

According to Tassi (2008), the following values derive from the functions mentioned above:

1 - Ecological Value - The ecological value associated with the preservation of the species present in Taim and with all the knowledge that can be acquired through research. Unfortunately, this value is difficult to quantify, since there are not available elements for predicting the monetary loss with population reduction or extinction.

2 - Economic Value - The economic value associated with rice production. This value can be quantified monetarily from an economic analysis based on the planted area.

3 - Service value to society - Reducing the flow velocity, provided by the vegetation attenuates flow, controlling erosion and hence reducing the amount of sediment transported downstream. The process of removing nutrients and pollutants through "filtering" of the water inside Taim also returns better quality water to the environment.

---

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 • **<u>K</u>** •Zk(a)

Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp • Ts • **<u>U</u>** • Va •

Vt • W • **<u>Xf</u>** • 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.

Tp, L, P, K, Xf

---

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.

The Taim Ecological Station is recognized worldwide as one of the most important conservation areas, preserving wetlands and lagoons, fields, dunes and forests, and sheltering a great diversity of species of plants and animals. Its birdlife draws attention, part from the migratory northern hemisphere countries, part from the Southern Cone and other species that live here all year round. The exuberante and easy viewing wildlife is a differential offered by the region. There are over 230 species of birds, among billed pochards, white swans (*Coscoroba coscoroba*) and black - neck - swans (*Cygnus melanocoryphus*), tarrãs (*Chauna torquata*), sandpipers and passerines. Typical site for reptiles and amphibians found in swamps, the jacaré-do-papo-amarelo (*Caiman latirostris*) and the Tiger Turtle (*Trachemys dorbigni*), are easily found in these swamps. The capivara (*Hydrochaeris hydrochoerus*) is extremely abundant and the graxaim-do-campo is more visible at dusk. Endangered species such as the otter (*Lontra longicaudis*) and gavião-cinza (*Circus cinereus*) are found in more remote areas of the Unit. The flora of Taim is adapted to this coastal region. From the reeds and sedges of wetlands, grasslands and shrubs of the fields and dunes to the clumps of forest sandbank, a wide variety of plants are found. Many species are considered medicinal, others have their ornamental value, such as orchids, and their distributions respond to climatic factors, soil, presence of water and stress caused by wind and temperature, typical of the region. Samples of the pampa ecosystem can be seen in its most exuberant, preserved and kept away from the pressure of cattle raising on this type of ecosystem.

This conservation unit is noted for its value as genetic and landscape heritage, due to its high biological and ecosystem diversity, and for being one of the remnants of this type of ecosystem. The Taim has a very important role in maintaining the ecological balance of the area. These functions include food production, biodiversity conservation, and flooding prevention and pollution control. The most important processes in this ecosystem are the generation of soil, plant production and storage of nutrient, water and biodiversity (NEMA 2008).

In addition, the conservation unit is a core zone of the Biosphere Reserve of the Atlantic forest and of great importance due to the presence of endangered and endemic species (Programme "Man and the Biosphere" (Man and the Biosphere Programme) (UNESCO 1998 NEMA 2008).

---

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*.

The Taim region presents is like a mosaic whose matrix is characterized by herbaceous vegetation covering plains and swamps in its various forms of presentation and evolution (Ferrer, 2004). In ESEC Taim, there are over 200 species of Flora.

A study by Motta Marques (1997) identified the presence of 49 species of emergent and floating macrophytes, distributed in 28 families, in Taim (Annex 3). Among the species identified, standout for relative and absolute frequency, floating macrophytes:

Salviniaherzogii, Azollacaroliniana, Lemna valdiviana, Pistiastratiotes, Wolffiella oblonga, Altermanthera philoxeroides, Spirodela intermédia and *Limnobium laevigatum.* The group of emerging macrophytes include *Scirpus californicus, Zizaniopsis bonariensis* and *Scirpus giganteus.*

The presence of *Pavoniaro sengurttii* was recorded within the reserve, being found only in three other places in the state of Rio Grande do Sul (Grings, 2011).

Ferrer (2004) recorded the presence of some endangered species in the State of Rio Grande do Sul, which are *Rollinia marítima, Butia capitata, Ephedra twediana, Myrcianthes cisplatensis, Acanthosyris spinescens, Iodinar hombifolia* and *Bumeliao btusifolia.*

Among the flora in the Coastal Plain of Rio Grande do Sul, the predominance of the field vegetation and the lack of endemic species occurs because this plain is geologically recent. The coastal flora did not originate through processes of local speciation, but rather, from the migration of geologically older neighboring regions (Schäfer, 2009).

According to Schäfer (2009), the salt marsh vegetation is quite complex, ranging from herbaceous to shrubby and arboreal types. This variability results not only from changes in climate and soil conditions, but also by succession. The gradients of moisture and salinity determine a vegetation zonation in the ocean-continent direction and mosaics in smaller areas. The existence of extreme environments, nutrient and water, determines the types of pioneer vegetation, in early stages of primary succession, characterized by low diversity and by ecological adaptations of plants. This can be observed on the vegetation of dunes. On the other hand, dry and sandy woods, in well-drained soils, and swamp forests, related to poorly drained soil, represent the most complex and advanced stage of vegetation succession (Schäfer, 2009).

---

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.*

The Taim Ecological Station is a place of shelter, feeding and reproduction of many species, being one of the greatest breeding areas in terms of ecological significance of southern Brazil, home to endangered and endemic species.

In ESEC Taim, there are records of 220 species of birds (Mähler *et al.*, 1996) (Appendix 4). Among these, there are species considered as threatened in the national list of endangered species like *Circus cinereus, Larus atlanticus, Diomedea sanfordi, Thalas seusmaximus, Procellaria conspicillata, Thalassarche chlororhynchos, Diomedea dabbenena, Procellaria aequinoctialis, Thalassarche melanophris, Diomedea exulans, Diomedea epomophora.*

Although the fish fauna is poorly investigated in ESEC Taim, 63 fish species were recorded (Garcia *et al*, 2006; Correa *et al* 2011 Appendix 5 and 6.). Recently two species of killifishes also listed as threatened on the national list of endangered species (unpublished data) were recorded.

Regarding the presence of reptiles, 21 species were recorded (Gomes & Krause, 1982) (Appendix 7). There is the presence of six species considered threatened in the national list of endangered species, these being: *Liolaenus occipitalis, Caretta caretta, Lepidochelys oliveacea, Eretmochelys imbricata, Chelonia mydas* and *Dermochelys coriacea.*

The presence of 18 species of amphibians were recorded (Gayer *et al*., 1988) (Appendix 8). According to Gayer *et al* (1988), the characteristic of the region enables the development and migration of amphibians with variety of shapes and great number of specimens. Amphibian species found so far in the studied area, make up 27% of the already known species throughout the state of Rio Grande do Sul. Among these, four had not been cited for the region and therefore should be considered as new occurrences to Taim, namely: *Siphonopsannulatus, Physalaemusbiligonigerus, Ololygonberthae* and *Ololygon x-signataeringlophila* (Gayer *et al*., 1988).

There is still no quantitative study of the mammalian species covering all the environments present within the unit. Currently there are small studies covering some environments (Azambuja, 2010; Sponchiado et al, 2011.). However, it is believed that there are 40 species of mammals. It is known that there are species that are threatened according to the national list of endangered species, such as *Ctenomys flamarioni* and *Wilfredomys oenax* (this being the first record into the conservation unit). There is also the presence of the species: *Mazama gouazoubira* (veado-catingueiro), *Leopardus geoffroyi* (gato-do-mato-grande) and *Lontra longicaudis* (Otter), which are on the endangered fauna of the State of Rio Grande do Sul.

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:

Within the limits of the Taim Ecological Station, there is the presence of "Cerritos". According to Schäfer (2009), a Cerrito or landfill is an artificial elevation of the ground in the middle of wetlands of the Laguna dos Patos, Mirim and Mangueira. The Indians would rise them in order to take shelter from the waters. The Cerrito has an ellipsoid or circular shape, measuring 15-100 m in diameter and 0.5 to 6.0 m tall. It consists mainly of land, or large amount of human food leftovers, lying alone or in groups 2-5 Cerritos. Over them, houses were built that seem to have had circular or oval shapes. These were built probably during successive occupations of the indigenous groups of hunters and gatherers who lived in this region for at least 4,000 B.P.

The area of ESEC Taim was also the scene of the Neutral Fields. The Portuguese signed with the Spanish the Treaty of San Ildefonso (1777) mediated by the pope, under which the Neutrals Fields were constituted, as an uninhabited strip of land stretching from the marshlands of the Taim to Chuí creek, to avoid a direct confrontation among the settlers. Information on the historical process of colonization in the Neutral Fields is scarce and currently studies employing archaeological methods are providing exceptional data that can be analyzed and compared to the existing documentation (Oliveira, 2010). According to Oliveira (2010), the dynamics of the first inhabitants of the Neutral Fields left traces of great importance and but were little preserved. The vestiges are mainly found in areas of rice cuktivation. This requires production techniques that compromise the Cultural Heritage.

Moreover, artisanal fishers that have been in the activity for generations form the communities that live around this 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:

The Ecological Station of Taim has the tenure regime and public domain.

b) in the surrounding area:

In the area around the proposed site, there are certain properties that exert agriculture and cattle raising activities and there are also lands that belong to the Union.

25. Current land (including water) use:

a) within the Ramsar site:

Inside the ESEC Taim, there is no type of land use.

b) in the surroundings/catchment:

Around the proposed site, there are different land uses. The main occurs through farming, mostly rice cultivation in large areas, which is irrigated by flooding. This type of farming uses, in the summer months, a large amount of water, thus a significant reduction in the level of ponds in a period of low rainfall, which ultimately affects the water level within the Taim (Motta Marques & Villanueva, 2001). In the surrounding area, there are also fishing, livestock, and pasture and reforestation activities.

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:

Within the proposed area there is no adverse factor affecting the ecological characteristics of the site.

b) in the surrounding area:

In the surrounding area there are many adverse factors affecting the ecological characteristics, among them it can mentioned:

• Agriculture: large areas of rice cultivation, using flood irrigation. For this, water is gathered from the lagoons in the summer period (time of low rainfall), which ultimately affects the water level within Taim. The use of pesticides can contaminate soil and watercourses.

• Reforestation: the existence of two large reforestation companies who work with exotic species with high scattering power.

• Artisanal Fisheries: The increase in fishing pressure in the region ultimately affects quantitatively and qualitatively the fish fauna of ESEC Taim.

• Livestock: Cattle prevents or retards the natural plant succession through trampling and grazing. Due to agriculture and livestock in the fields are increasingly rarer, since these human activities have prevented the succession of one type to another (Hentshel, 2009). Moreover, it can also spread disease to wild species.

• Wind Energy: The installation of wind farms near the unit may come to affect it directly because there are many migratory species of birds, which may have their routes intercepted by structures that are part of this complex with variable minimum and maximum height.

• Roads: Federal Highway BR 471, cuts the unit area of approximately 17 km in length, causing the trampling of many taxa (Bager, 2003).

---

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.

Aiming at the protection of wetland systems, an area of 33,815 ha was decreed in 1978 as of public utility, by the President, occupying part of the coastal plain of the municipalities of Rio Grande and Santa Vitória do Palmar, between Lagoa Mirim and Atlantic ocean. On July 21, 1986 the Taim was promoted to a Federal Conservation Unit (Decree n ° 92.96.3), creating the Ecological Station of Taim (Annex 2).

In addition, this conservation unit is a core zone of the Biosphere Reserve of the Atlantic and of great importance due to the presence of endangered and endemic species (Programme "Man and Biosphere"(UNESCO 1998 NEMA 2008).

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?:

The management plan is being prepared.

d) Describe any other current management practices:

Currently, the management practices used in the unit are performed in accordance with guidelines outlined in the Protection Plan of the Ecological Station of Taim and the Operational Plan for Prevention and Control of Forest Fires in the Ecological Station of

Taim. In addition, the Unit has the support of an Advisory Board of the Unit, which is very active.

28. Conservation measures proposed but not yet implemented:

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

Several proposals are being drawn up by the Management Unit that are at different levels of implementation (process nº 02070.001768/2011-63, ATAS 01-2011, 02-2011, 01-2012, 02-2012 and 01-2013). These being:

• Expansion of the Ecological Station of Taim from 11,000 ha to 33,000 ha. This proposal was discussed and built by a working group formed by members of the Advisory Council of ESEC Taim, and approved by the same (Annex 9);

• Construction of a Visitation Center to welcome the visitors. (Annex 10);

• Green Seal to qualify environmentally agricultural and livestock activities, in and around the buffer zone of the Unit. This proposal is aimed at more sustainable and in balance with the environment production;

• Stimulate the production of Organic Rice in the surroundings and in the buffer zone of the unit, making cultivation practices compatible with the conservation objectives of ESEC Taim;

• Unified Licensing;

• Creation of RPPNs by the reforestation companies located in the buffer zone of ESEC Taim;

• Management of the BR 471 highway stretch that cuts the ESEC Taim. Conduct studies and proposals that reduce the rate of road kills of wild animals.

29. Current scientific research and facilities:

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

The Ecological Station of Taim has as one of its main objectives to perform scientific research. This unit has 20 beds for researchers and 04 bases located in different environments, which are also used by researchers. Management of the Unit has focused its efforts in order to boost scientific research, and there are currently 60 ongoing research projects (Annex 11).

The Unit has worked with scientific researchers since its inception and has already authorized over 100 surveys (Annex 12) which generated over 450 publications (Annex 13). This high number of publications resulting from research conducted at ESEC Taim demonstrates its environmental importance and training of new researchers.

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

The Taim Ecological Station has in the area of its Administrative Headquarters, a museum that is open to public. This museum gives visitors greater contact and knowledge about this wetland environment. In addition to this museum, it is the management's intention to build an Interpretation Center of the Ecological Station of Taim (Annex 10), which is in preparation. The Unit receives annually a large amount of visitors, including tourists, students from schools and universities. During the visit a presentation on the conservation is performed.

Unit managers always attend events and seminars, conferences and other academic or community activities that can bring the society awareness about the importance of conservation.

Every year there is an event to celebrate its anniversary with several activities, including environmental education activities with schools, photographic exhibitions etc.

31. Current recreation and tourism:

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

According to Law No. 9.985/2000, establishing the National System of Conservation Units in Ecological Stations public visitation is prohibited, except for educational purposes, according to the Unit's Management Plan. However, four trails surrounding the unit are open for visitation (Annex 14) and can be guided by local monitors. Furthermore, the Headquarters of the Unit is open to visitors and offers visitors, as scheduled, a presentation with video about the Conservation Unit, distribution of booklets (Appendix 15) and the visit to its small museum. The unit receives the visitation of over 2000 people annually, which visit the Headquarters and roam the surrounding trails.

32. Jurisdiction:

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

Ecological Station of Taim is located in the state of Rio Grande do Sul, and is under the jurisdiction of the Federal Government through the Chico Mendes Institute for Biodiversity Conservation (ICMBio)/Ministry of Environment.

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.

The authority responsible for managing the Ecological Station of Taim is ICMBio/MMA.

34. Bibliographical references:

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

Azambuja, N.R., 2010. Estrutura de comunidade e uso de habitat por mamíferos de médio porte da estação ecológica do Taim, RS, Brasil. Trabalho de Conclusão de Curso. Ciências Biológicas. Santa Maria, UFSM.

Bemvenuti, M. A., 2002. Diferenciação morfológica das espécies de peixes-rei, Odontesthes Evermann & Kendall (Osteichthyes, Atherinopsidae) no extremo sul do Brasil: morfometria multivariada. Revista Brasileira de Zoologia 19(1): 251-287.

Bager, A., 2003. Avaliação da fauna afetada por atropelamento na Estação Ecológica do Taim e no seu entorno. Laboratório de manejo e conservação ambiental. Relatório Técnico, Pelotas, UCPEL: 24.

Belton, W., 1994. Aves do Rio Grande do Sul: distribuição e biologia. Unisinos, São Leopoldo, Brasil.

Calabuig, C. P., Green, A. J., Menegheti, J.O., Abad, R.M., Patino, J., 2010. Fenología del coscoroba (Coscorobacoscoroba) en el sur de Brasil y sus movimentos hacia Argentina. Ornitologia Neotropical 21: 555-566.

Carvalho, V.C., Rizzo, H.G., 1994. A zona costeira brasileira: subsídios para uma avaliação ambiental. Brasília, Ministério do Meio Ambiente e da Amazônia Legal, 211p.

Carvalho, A. B. P., Ozorio, C.P., 2007. Avaliação sobre os banhados do Rio Grande do Sul. Revista de Ciências Ambientais 01(02): 83-95.

Correa, F., Garcia, A.M., Bemvenuti, M.A., Vieira, J.P., 2011. Pisces, Gymnotiformes, Hypopomidae, Brachyhypopomus gauderio Giora and Malabarba, 2009: New species record at Taim Ecological Reserve, south Brazil. CheckList 7(1): 19-20.

Dias, R. A., Fontana, C. S., 2001. Distribución, biología, ecología y conservación para el Cisne de Cuello Negro y Coscorobaen Brasil. Pp. 1– 20 em Seijas, S. M. (ed.). Censo Neotropical de Cisnes, período 1998–2000. Literatura of Latin America, Buenos Aires, Argentina.

Fagundes, C. K., Bager, A., 2007. Ecologia reprodutiva de Hydromedusa tecifera (Testudines: Chelidae) no sul do Brasil. Biota Neotropica 07(02): 179-184.

Ferrer, R., Salazar, E., 2004. Diagnóstico da flora e da vegetação do entorno da Estação Ecológica do Taim (ESEC Taim). Relatório Técnico, Rio Grande.

Fundação Zoobotânica do Rio Grande do Sul, 2002. Mapeamento, Diagnóstico e Gerenciamento de Ambientes de Áreas Úmidas na Bacia do Guaíba, tendo em vista sua Preservação ou Conservação. Pró-Guaíba – Subprograma Parques e Reservas – Projeto II. Estudos para consolidação do Sistema de Parques e Reservas Naturais no Bacia do Guaíba. Porto Alegre. 189p.

Garcia, A. M., Hoeinghaus, D.J., Vieira, J.P., Wineliller, K.O., Motta Marques, D.M.L., Bemvenuti, M.A., 2006. Preliminary examination of food web structure of Nicola Lake (Taim Hydrological System, south Brazil) using dual C and N stable isotope analyses. Neotrop. Ichthyol. 04(02): 279-284.

Gayer, S. M. P., Krause, L., Gomes, N., 1988. Lista preliminar dos anfíbios da Estação Ecológica do Taim. Revista Brasileira de Zoologia 5(3): 419-425.

Gomes, N., Krause, L., 1982. Lista preliminar de répteis da Estação Ecológica do Taim, Rio Grande do Sul. Revista Brasileira de Zoologia 1(1): 71-77.

Grings, M., 2011. O gênero Pavonia Cav. (Malvaceae) no Rio Grande do Sul, Brasil. Dissertação de Mestrado em Botânica. Porto Alegre, UFRGS: 193.

Hentschel, R.L., 2009. Relatório de diagnóstico sobre o reflorestamento de exóticas no entorno da ESEC do Taim. Relatório técnico PNUD: 36.

IBGE, 2010. WWW.IBGE.GOV.BR/CIDADESAT/TOPWINDOW.HTM, VISTO EM 01/03/2013

Instituto Socioambiental, 2005. Almanaque Brasil Socioambiental. 1. ed. São Paulo: 479p.

Klamt, E., Kampf, N., Schneider, P., 1985. Solos de várzea no Estado do Rio Grande do Sul. Porto Alegre: Bol. Téc. 04. UFRGS, Fac. de Agronomia, Depto. De Solos, 42p.

Lanzer, R., 2005. Lagoas Costeiras: Patrimônio Ambiental do Rio Grande do Sul. Cadernos do LEPAARQ II (3): 103-110.

Mähler, J., J, K, Kindel, A., Kindel, E.A.I., 1996. Lista comentada das espécies de aves da Estação Ecológica do Taim, Rio Grande do Sul, Brasil. Acta Biologica Leopoldensia 18(01): 69-103.

Ministério da Agricultura, 1973. Levantamento de reconhecimento dos solos do Estado do Rio Grande do Sul. Recife: Ministério da Agricultura. Boletim Técnico n° 30. 431 p.

Miño, C.C., Del Lama, S.N., 2007. Genetic structure in Brazilian breeding colonies of the Roseate Spoonbill (Plataleaajaja, Aves: Threskiornithidae). Genectics and Molecular Research 06(02): 338-347.

Motta Marques, D.M.L., Irgang, B., Giovannini, S.G.T., 1997. A importância do hidroperíodo no gerenciamento de água em terras úmidas (wetlands) com uso múltiplo: O caso da Estação Ecológica do Taim. XII Simpósio Brasileiro de Recursos Hídricos, Vitória, novembro, Vol 3, 1-8. 1997.

Motta Marques, D., Villanueva, A.O.N., 2001. Regime hidrológico de banhados e sua conservação. Caderno de Pesquisa sér. Bio. 13(1): 63-79.

Nascimento, J.L.X., Koch, M., Efe, M.A., Scherer, S.B., 2005. Censos, anilhamentos e recuperações de duas marrecas no Rio Grande do Sul. Ornithologia 1(1): 65-74.

Nascimento, J.L.X., Koch, M., Efe, M.A., Scherer, S.B., 2006. Monitoramento da marreca-parda, Anasgeorgica (Gmelin, 1781) (Anseriformes, Anatidae) no Rio Grande do Sul. Ornithologia 1(2): 115-120.

NEMA, 2008. Núcleo de Educação e Monitoramento Ambiental – NEMA. Projeto "Comunidades do Taim Educação Ambiental e Sustentabilidade". Relatório Técnico Final. Rio Grande, out. 2008.

Oliveira, O.A., 2011."Os protagonistas da história dos campos neutrais. Biblos 1(1): 69-80.

Paz, R.S., 1985. Fatores meteorológicos e sua influência ecológica: um exemplo no sistema estuarial da Lagoa dos Patos, RS. Anais, III Encontro Brasileiro de Gerenciamento Costeiro. UFC. Fortaleza. PP. 301-311.

PELD, 2002. Pesquisas Ecológicas de Longa Duração. In: Sistema Hidrológico do Taim, Universidade Federal do Rio Grande do Sul. Disponível: http://www.peld.ufrgs.br/. Acesso 2003.

Santos, M.H., 2005. Estudo de haplótipos de DNA mitochondrial de colhereiros (Aves, Ordem Ciconiiformes, Plataleaajaja). Dissertação de Mestrado, Universidade Federal de São Carlos, São Carlos.

Seijas, S.M., 2001. Censo Neotropical de Cisnes, período 1998–2000. Literature of Latin America, Buenos Aires, Argentina.

Sponchiado, J., Melo, J.L., Cáceres, N.C., 2012. Habitat selection by small mammals in Brazilian Pampas biome. Journal of Natural History 46(21-22): 1321-1335.

Serrano, I.L., 2010. Distribuição e conservação de aves migratórias neárticas da ordem Charadriiformes (Famílias Charadriidae e Scolopacidae) no Brasil. Tese de doutorado. Belém, UFCPA: 193.

Tassi, R., 2008. Gerenciamento hidroambiental de terras úmidas. Recursos hídricos e saneamento ambiental. Tese de Doutorado, Porto Alegre, UFRGS: 257.

Tomazelli, L.J., Dillenburg, S.R., Villwock, J.A., 2000. Late quaternary geological history of Rio Grande do Sul Coastal Plain, Southern Brazil. Revista Brasileira de Geociências 30(03): 474-476.

Tomazelli, L.J., Villwock, J. A., 2000. O cenozóico no Rio Grande do Sul: Geologia da Planície Costeira. In: Geologia do Rio Grande do Sul. Edição CIGO/UFRGS, 444p.

UNESCO, 1998. Organização das Nações Unidas para a Educação, a Ciência e a Cultura. Educação Ambiental: As grandes orientações da Conferência Tbilisi. (Coleção meio ambiente. Série Estudos educação ambiental; edição especial). Brasília: IBAMA, 1998. 158p.

UNESCO, 1999. United Nations Educational, Scientific and Cultural Organization. Topicos sobre Humedales Subtropicales Y Templados de Sudamerica. Oficina Regional de Ciencia y Tecnologia de La Unesco Para America Latina y El Caribe. Oficina Regional de Ciencia y Tecnología de la UNESCO para América Latina y el Caribe: ORCYT-Montevideo/Uruguay.

Universidade Federal de Santa Maria. Regiões Fisiográficas. Inventário Florestal Contínuo. Página visitada em 7 de abril de 2012.

Universidade Federal de Santa Maria. Relevo (em português). Inventário Florestal Contínuo. Página visitada em 16 de outubro 2012.

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**