



Park Profile – Brazil Restinga de Jurubatiba National Park

Date of last onsite field evaluation: December 2003

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Location: Rio de Janeiro state, in the southeastern region of Brazil

Year created: 1998

Area: 14,860 hectares

Ecoregions: Atlantic Coast Restingas NT 0102

Habitats:



A. Terrestrial habitats:

1. *Formações Pioneiras de Influência Marinha* (early formations of marine influence):

- *formação herbácea graminóide de praia* (beach grass formation)
- *formação arbustiva fechada de pós-praia* (dense shrubby post-beach formation)
- *formação arbustiva aberta de Clusia* (sparse shrubby *Clusia* dominated formation)
- *formação arbustiva aberta de Ericaceae* (sparse shrubby Ericaceae dominated formation)
- *formação aberta de Arecaceae* (sparse Arecaceae dominated formation)
- *formação de mata de cordão arenoso* (sandbanks arboreal formation)

2. *Formações Pioneiras de Influência Fluvial* (early formations of fluvial influence):

- *formação brejosa herbácea graminóide com arbustos e palmeiras* (marsh grass formation with shrubs and palms)
- *formação de mata de restinga periodicamente inundada* (seasonally flooded restinga formation)
- *formação de mata de restinga permanentemente inundada* (permanently flooded restinga formation)

B. Aquatic habitats:

1. *ambientes lagunares com formação vegetal herbácea aquática* (lagoons with macrophyta)

C. Inter-tidal habitats:

1. *Formações Pioneiras de Influência Flúvio-marinha* (early formations of fluvial and marine influence)

- *formação de mata paludosa* (riparian tree formations)



Regional location of the Restinga de Jurubatiba National Park

Summary

Description

The Restinga de Jurubatiba National Park is located in the southeastern region of Brazil, on the northeastern coast of the state of Rio de Janeiro. A great variety of restinga (sandbank environments) are found inside the park, with vegetation formations ranging from herbaceous aquatic types to arboreal types, and these are interspersed by a large number of lagoons with differing biotic and abiotic characteristics. The objective of this conservation unit is to protect stretches of restinga (sandbanks), which are part of an ecosystem associated with the Atlantic Forest, and are under critical threat along the entire Brazilian coastline. Because of the high biological diversity, large numbers of endemic species, and threat level that the Atlantic Forest is subjected to, this biome is classified as a *hotspot* according to Conservation International's classification (Conservation International, 2005).

Biodiversity

Among the rich fauna and flora the park protects, approximated to total 870 species, some benefit particularly well from the protection of the area, such as the endemic zooplankton species that are present in the lagoons of the national park. These are the microcrustacean *Diaptomus azureus* and the rotifers *Hexarthra longicornicula* and *Macrochaetus kostei*. The red-browed Amazon parrot (*Amazona rhodocorytha*) and the

“Fluminense” swallowtail (*Parides ascanius*), which are under critical threat, also benefit a great deal. In addition to these two threatened species, another thirteen fauna and flora species are subject to varying degrees of threat according to the red lists of the State of Rio de Janeiro, Brazil, IUCN and CITES. However, many species, especially larger ones, have already become extinct on these *restingas*, such as the jaguar (*Panthera onca*) and the red brocket deer (*Mazama americana*). Considering that the biodiversity of the park is not entirely known, it is estimated that the number of species under threat may be even larger.

Threats

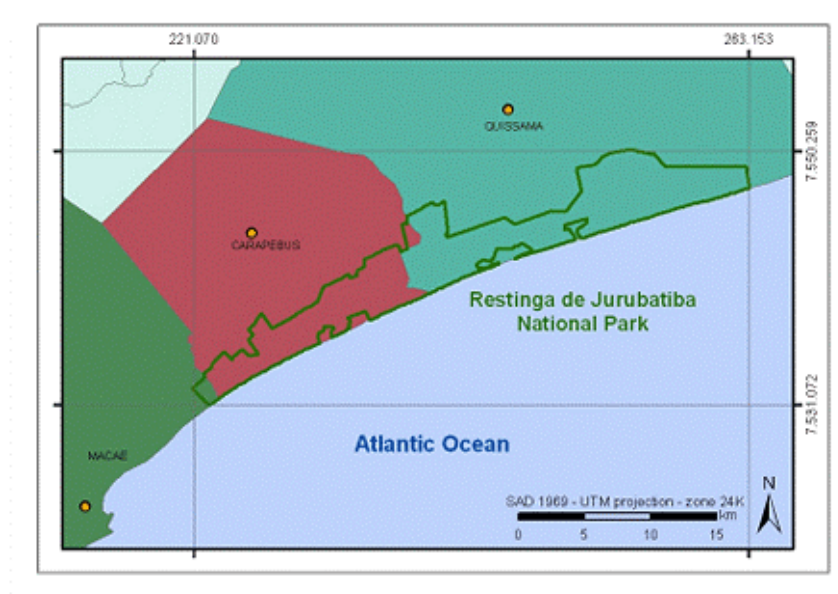
The Restinga de Jurubatiba National Park is considered to be **critically threatened** and there is a great risk that this conservation unit may fail to protect and maintain its biodiversity and natural ecological processes in the near future. The conflicts present need to be resolved as quickly as possible.

The most significant threat to the park is the deficient management plan (which is still in the preparation phase) and park staff. The infrastructure and management team are insufficient for the protected area to fulfill its objectives, and consequently there are problems created by human influence, a lack of regularization of land ownership, poor shaping of the park’s boundaries, and intense occupation of the buffer zone around the area.

Description

Geography

Restinga de Jurubatiba National Park (RJNP) was created by Federal Decree without number, on April 29, 1998, and encompasses 14,860 hectares. The park is located in the southeastern region of Brazil, on the northeastern coast of the State of Rio de Janeiro. Just 1.4% of its area forms part of the municipality of Macaé, 36% is in the municipality of Carapebus, and the remaining 63% is in the municipality of Quissamã. It is situated between the lines of the UTM coordinates 7,531,072 and 7,550,259 south for the Y-axis and 221,070 and 263,153 for the X-axis, in the reference zone 24K (datum SAD 69).



Distribution of the area of the Restinga de Jurubatiba National Park in the municipalities of Quissamã, Carapebus, and Macaé

The climate of the region is very homogeneous, and is classified as sub-humid-dry. The moist winds coming from the ocean easily penetrate the coast and cause heavy rainfall along the coastal mountain range, but lighter rain in the RJNP, which receives an annual average of 1,300 mm that is concentrated in the spring and summer months (Radambrasil 1983, cited by ESTEVES *et al.*, 2002). The average minimum temperature is 18.7°C, with an absolute minimum of 6.4°C, and the average maximum temperature is 27.7°C, with an absolute maximum of 39°C. The relative humidity of the air varies between 82 and 84%. The strongest winds come from the east, followed by those from the northeast (Fiderj 1977, cited by ESTEVES *et al.*, 2002).

According to Dinerstein *et al.* (1995), the RJNP forms part of the Atlantic Coast Restingas ecoregion (NT 0102). It has 44 km of coastline and has little elevation above sea level. Thus, the park is composed of a sandy coastal plain that is popularly known as restinga, or sandbank, and is comprised of a set of differentiated ecosystems formed by sandy soil that creates extreme ecological conditions of great fragility (little water and high temperatures) (Santos & Bozelli, 2003).

The ancient processes of regression and transgression caused by the varied oscillations between glacial and interglacial eras, when the sea level reached 8 m above the present level, were responsible for forming the great diversity of ecosystems that exists in the RJNP. In addition to the dry-land environments, there are approximately 18 lagoons (Soffiati, 1998; APAJ, 2003).

The lower areas were the first to be inundated, and thus these lagoons are the oldest ones, dating back more than 5,000 years. Today the lagoons are isolated from the sea and are formed by freshwater. The lagoons that are associated with shallow water bottoms are approximately 4,000 years old, and are constantly transforming into marshes. The lagoons between the strings of the sandbanks are a little more recent, with an age of around 3,500 years old. These are formed by water flowing down from higher regions that are covered by vegetation. There are also lagoons that originate from river deltas, which have partially artificial abandoned river channels. Other lagoon formations have channels connecting them with the sea, and lagoons such as these are constantly varying in depth (Soffiati, 1998).

Because the lagoons vary so widely in terms of type and relationship with the surrounding environments, such as rivers, seas and various vegetation, they have quite varied conditions and characteristics, particularly regarding depth, salinity, pH level, water temperature, and nutrient concentration. Thus, all the flora and some specific fauna, including endemic species, have become adapted to each type of lagoon (Araújo *et al.*, 1998; Branco, C. W. C., 1998; Esteves, F. de A., 1998; Farjalla, V. F., 1998; Fernandes, V. de O., 1998; Melo & Suzuki, 1998; Petrucio, M. M., 1998; Petrucio & Faria, 1998; Petrucio & Furtado, 1998; Roland, F., 1998.).

Interspersed between these lagoons there is also a great variety of vegetation which can be divided into ten types, according to Araújo *et al.* (1992):

- Three types have a forest structure: seasonally flooded restinga formation, permanently flooded restinga formation, and sandbanks of arboreal formation. The first two can be classified as early formations of fluvial influence and the last one as early formations of marine influence, according to the IBGE (1992);

- Three have an open appearance made up mostly of bushes: sparse shrubby *Clusia*-dominated formation, sparse shrubby Ericaceae-dominated formation, and sparse Arecaceae-dominated formation. This last one can also be classified as pioneering formations of marine influence with a bushy appearance;
- One has a closed bushy appearance, located behind the beach, which can also be classified as dense shrubby post-beach formation;
- Two have a herbaceous appearance (beach grass formation and marsh grass formation with shrubs and palms), which can be classified as pioneering formations of marine influence, and of fluvial influence with a herbaceous appearance;
- One has an aquatic herbaceous appearance.



Clusia hilariana - Clusiaceae



Sparse Arecaceae dominated formation



Beach grass formation



Lagoon with macrophyta (aquatic herbaceous formation)

It is these variations in both dry land and aquatic restinga environments that give rise to the existence of great diversity of life forms, from Algae, phytoplankton, and zooplankton to large-sized mammals and trees that reach 23 meters in height.

Although the park is not officially open to visitors, the main tourist attraction is the Comprida Lagoon with its shallow, crystal-clear water and deserted beaches, from which various plant and bird species can be seen.

Biodiversity

Because the restingas of the RJNP are located between those of humid climate and the dry restingas of the northeastern coast, they are biologically and geographically differentiated from the others. Although there are no conclusive results regarding the biodiversity protected by the park, it is estimated that there are hundreds of species within its borders. The heterogeneity of both the aquatic and dry land environments provides this species richness.

In the aquatic environments, the differences in combinations of physicochemical (abiotic) properties between the lagoons result in differentiated structures for the biological communities. Endemic zooplankton has already been found in the lagoons, and some of these had never been seen before, such as the microcrustacean *Diaptomus azureus* and the rotifers *Hexarthra longicornicula* and *Macrochaetus kostei*, which are very small animals (approximately 1 millimeter long) and serve as food for young fish like the two-spot astyanax (*Astyanax bimaculatus*) and the pearl cichlid (*Geophagus brasiliensis*) (Santos & Bozelli, 2003).

According to surveys conducted by Melo & Suzuki (1998), Fernandes (1998), and Branco (1998) in the two principal lagoons of the RJNP (Cabiúnas and Comprida), around 257 species of phytoplanktonic algae and 130 zooplankton species can be found. These species are closely interlinked through within- and between-species relationships, and small alterations in the physicochemical (abiotic) properties of the lagoons may have damaging effects on these and other communities, and on the aquatic environment as a whole.

Despite the few surveys on insects that have been performed, the threatened “Fluminense” Swallowtail butterfly (*Parides ascanus*) has been registered in the park (APAJ, 2002).

Reis *et al.* (1998) and APAJ (2002) cite the occurrence of approximately 35 fish species in the lagoons of the RJNP. However, in a survey carried out by the Federal University of Rio de Janeiro, more than 60 species were detected (<http://www.ecoviagem.com.br/meioambiente/>).

There is also little specific data available about amphibians, but 29 species have already been recorded. Seventeen reptile species are represented, of which nine are lizard species (Hatano *et al.*, 2001), including the endemic small sand lizard (*Liolaemus lutzae*), five snake species, the threatened loggerhead sea turtle (*Caretta caretta*), and the threatened broad-snouted caiman (*Caiman latirostris*) (APAJ, 2002).

Seventy-six bird species have been recorded, as well as a large number of migratory species, which are attracted principally by the large number of lagoons. One of the species under a high level of threat is the red-browed Amazon parrot (*Amazona rhodocorytha*), a beautiful bird that is hunted and traded illegally.

APAJ (2002) describe the occurrence of 22 mammal species, despite lacking data to strongly support this number. Among the mammals in the park are the threatened southern tamandua (*Tamandua tetradactyla*) and the neotropical river otter (*Lontra longicaudis*).

Some large mammals, such as the jaguar (*Panthera onca*), ocelot (*Felis pardalis*), collared peccary (*Tayassu tajacu*), and red brocket deer (*Mazama americana*), are now extinct in this area.

According to the red lists of fauna species under threat in the State of Rio de Janeiro (1998), IBAMA (1989), IUCN (2003), and CITES, claim approximately eight species of fauna are under threat, and these are listed in Table 1.

Table 1 - Species of fauna listed with some significant degree of threat, according to the red lists of the State of Rio de Janeiro, IBAMA – MMA, IUCN, and CITES

Species	Common name	Taxa	Rio de Janeiro Red List (1998)	Brazilian Red List (MMA <i>et al.</i> , 2003)	IUCN Red List (IUCN, 2003)	CITES*
<i>Mimus gilvus</i> Vieillot	sábia-da-praia	Aves, Passeriformes, Mimidae	Endangered			
<i>Amazona rhodocorytha</i> Salvadori	papagaio-chauá	Aves, Psittaciformes, Psittacidae	Vulnerable	Endangered	Endangered EN B1ab (i, ii, iii, v); C2a (i)	Annex I
<i>Lontra longicaudis</i> Olfers	lontra	Mammalia, Carnivora, Mustelidae				Annex I
<i>Tamandua tetradactyla</i> Linnaeus	tamanduá-mirim	Mammalia, Xenarthra, Myrmecophagidae				Annex II
<i>Parides ascanus</i> Cramer	borboleta-da-praia	Insecta, Lepidoptera, Papilionidae	Critically Endangered	Endangered		
<i>Caiman latirostris</i> Daudin	jacaré-de-papo-amarelo	Reptilia, Crocodylia, Alligatoridae	Endangered			Annex I
<i>Phrynops hoguei</i> Mertens	cágado-do-brejo	Reptilia, Testudines, Chelidae	Vulnerable	Endangered	Endangered B1+2c	
<i>Caretta caretta</i> Linnaeus	tartaruga-marinha	Reptilia, Testudines, Cheloniidae	Vulnerable	Vulnerable		Annex II

*CITES: Species in danger of extinction, for which trading is permitted only under exceptional circumstances (Annex I); and species that are not necessarily in danger of extinction, but for which trading is controlled (Annex II).

According to studies on the vegetation in the RJNP by Araujo *et al.* (1998), the varieties of plant associations enables a large number of species to be found inside the park. In beach grass formation, which generally has a width of five to ten meters from the edge of the beach, 16 herbaceous species have been described, among which are *Blutaparon portulacoides*, *Panicum racemosum*, and *Mariscus pedunculatus*.

The dense shrubby post-beach formation is constituted by around 40 herbaceous and woody species, which are densely grouped together and sometimes have thorns. Prominent among these are *Scutia arenicola*, *Bromelia anticantha*, *Cereus fernambucensis*, *Schinus terebenthifolius*, and *Jacquinia brasiliensis*. This latter is classified as a vulnerable species.

The sparse shrubby *Clusia*-dominated formation consists of isolated dense thickets that are between 1.8 and 5 meters in height, distinguished by 141 species. The most important of these are *Erythroxylum sessile*, *Allagoptera arenaria*, and *Clusia hilariana*. This last one has an interesting and differentiating characteristic: it fixes carbon from the atmosphere at night.

In the sparse, shrubby Ericaceae-dominated formation, in which the height does not exceed six meters, 44 species are found, particularly the woody species *Protium icicariba*, *Ocotea notata*, and *Clusia hilariana*, and the herbaceous species *Cuphea flava* and *Pilosocereus arrabidae*.

The seasonally flooded restinga formation occurs in the depressions formed between the sandy strings, in which the water table is subject to rising above ground level, a characteristic that retards the decomposition of organic matter. Ninety-one species are found here, and some reach a height of 23 meters. *Tapirira guianensis*, *Symphonia globulifera*, *Calophyllum brasiliense*, *Andira flaxinifolia*, *Sloanea guianensis*, and the palm trees *Euterpe edulis*, *Geonoma shottiana*, and *Bactris setosa* are the most prominent species.

With regard to the permanently flooded restinga formation, which is subject to frequent rising of the water table above ground level, some of the species described are *Tabebuia cassinoides*, *Myrsine umbellata*, *Tibouchina trichopoda*, *Alchonea triplinervia*, *Annona glabra*, and *Sapium glandulatum*.

The sandbanks arboreal formations are located on the highest parts of the sandbanks that are free from flooding. Today, because of wood extraction in the past, the canopy only reaches a height of 12 to 15 meters, though it was previously higher. There, the species *Aspidosperma parvifolium*, *Copaifera langsdorffii*, and *Couepia schotti* are found.

The sparse Arecaceae-dominated formation generally occurs where the forest and bushes have been burned, and the dwarf palm tree *Allagoptera arenaria* predominates. Its area of occupation is related to the frequency of burning. Around 70 species of this type have been observed.

The marsh grass formation with shrubs and palms occurs at the extremities of the arms of the lagoons and in the depressions intercalated between the beach crests. Sixty-seven species are found, and the most common of these are *Typha domingensis*, *Cladium jamaicense*, and *Blechnum serrulatum*.

Lastly, Araújo *et al.* (1998) describe the vegetation in the aquatic habitats as very diversified, depending on the lagoon. The Cabiúnas lagoon has the greatest richness. Here, *Nymphaea ampla*, *Nymphaea rudgeana*, *Nymphoides humboldtiana*, and *Eichhornia azurea* are common.

According to the red lists of flora under threat of extinction, from IBAMA – MMA and IUCN, six species are under some level of threat, and these are described in Table 2

Table 2 - Flora species under threat of extinction, according to the Brazilian and IUCN red lists

Species	Common name	Taxa	Brazilian Red List (MMA <i>et al.</i> , 2003)	IUCN Red List (IUCN, 2003)
<i>Couepia schottii</i> Fritsch	oiti-boi	Magnoliopsida, Rosales, Chrysobalanaceae	Vulnerable	Vulnerable A1c+2c
<i>Ficus pulchella</i> Schott.	figueira	Magnoliopsida, Urticales, Moraceae		Vulnerable B1+2bc
<i>Jacquinia brasiliensis</i> Mez.		Magnoliopsida, Primulales, Theophrastaceae	Vulnerable	
<i>Melocactus violaceus</i> Pfeiffer	Coroa-de-frade	Magnoliopsida, Caryophyllales, Cactaceae		Vulnerable A3c
<i>Mollinedia glabra</i> Perkins		Magnoliopsida, Laurales, Monimiaceae	Endangered	Vulnerable B1+2c
<i>Pavonia almifolia</i> St. Hil.	Guêta	Magnoliopsida, Malvales, Malvaceae	Vulnerable	

Thus, around 229 fauna species and 241 flora species have been accounted for in the RJNP, plus 130 species of zooplanktonic algae and 257 phytoplanktonic species. It is worth emphasizing that the surveys are not definitive, especially those concerning the fauna, and for many groups there is still no data covering all species. These surveys are expected to be supplemented with the construction of the management plan, which is now being drawn up.

Management

The process of creating RJNP began when restinga researchers saw that these environments were being devastated along the Brazilian coastline, mainly due to real estate occupation. From this, an organized movement emerged, formed mostly by these researchers, who, armed with recent studies carried out on the Jurubatiba restingas, drew up proposals and convinced IBAMA, the Ministry of the Environment, and the federal government to create the national park.

After some discussion caused by divergent interests, the Federal Decree was signed on April 29, 1998, creating the Restinga de Jurubatiba National Park. The park is the only conservation unit created solely to protect this type of environment, even though the restingas have been suffering a high degree of degradation all along the Brazilian coastline.

Because it is a federal conservation unit, its management is under the responsibility of IBAMA. However, the park still does not have a management plan or zoning. The park's administration is currently based on the law for the National System of Conservation Units

(Federal Law No. 9.985/2000) and on the decree that regulates the Brazilian national parks (Federal Decree No. 84.017/1979). Other laws, such as the Brazilian Forest Code (Federal Law No. 4.771/1965) and the Environmental Crimes Law (Federal Law No. 9.605/1998), are also used for imposing rules on activities in the park and its surrounds.

According to the law for the National System of Conservation Units (SNUC), “the National Park has the basic objective of preserving natural ecosystems of great ecological relevance and scenic beauty, thereby enabling and encouraging the performing of scientific research and the development of activities of education and environmental interpretation, recreation in contact with nature, and ecological tourism,” or in other words, only activities that indirectly use the natural resources.

At present, the management plan is still being developed by a team at the Federal University of Rio de Janeiro, and is expected to be completed in July 2005. The management plan will direct and describe all the actions required to achieve the specific objectives of the conservation unit. However, to achieve these objectives, infrastructure such as personnel are needed to implement the plan.

At the time of this evaluation, the team creating the management plan has only five employees. Three are IBAMA employees and perform administrative functions. One of them heads the team. The other two are park guards, assigned by the municipal authorities of Macaé, and are not IBAMA employees.

At present, the Association of Friends of the Restinga de Jurubatiba National Park (APAJ) and the Macaé Ecological Research Center (NUPEM) are the main partners of RJNP, and these bodies perform research, monitoring, and environmental education.

The infrastructure of the park is precarious, and there is no main office for IBAMA. However, there is a guardhouse lent by Petrobras on the southwestern edge of the unit, where the park guards are stationed during the day. The house, which serves as an office, is extremely uncomfortable and precarious, located outside the park limits, in the municipality of Macaé, around 7 km from the southwestern guardhouse. This provisional main office has been lent by the municipal authorities of Macaé to IBAMA



*Guardhouse of Restinga de Jurubatiba National Park
at the southwestern entrance, in the municipality of Macaé*



Administrative office for Restinga de Jurubatiba National Park

For transportation, the park has available three small 4x4 trucks and three boats: one launch, one aluminum boat, and one inflatable raft. However, at the time of our visit, only two of the trucks were serviceable, and the credit facility at the local refueling stations had been suspended due to lack of payment.

The annual budget for the park has varied. For the years 1998, 1999, 2000, 2001 and 2002, the estimated expenditures were: R\$ 2,600 (US\$ 888), R\$ 7,300 (US\$ 2,491), R\$ 220,000 (US\$ 75,085), R\$ 25,000 (US\$ 8,532), and R\$ 50,000 (US\$ 17,065), respectively (IBAMA's website www.ibama.gov.br). These funds are administered by the resources administration unit, which is the National Park of Serra dos Órgãos, and receives funds from the federal government, passing them on to other units located in the State of Janeiro, including RJNP.

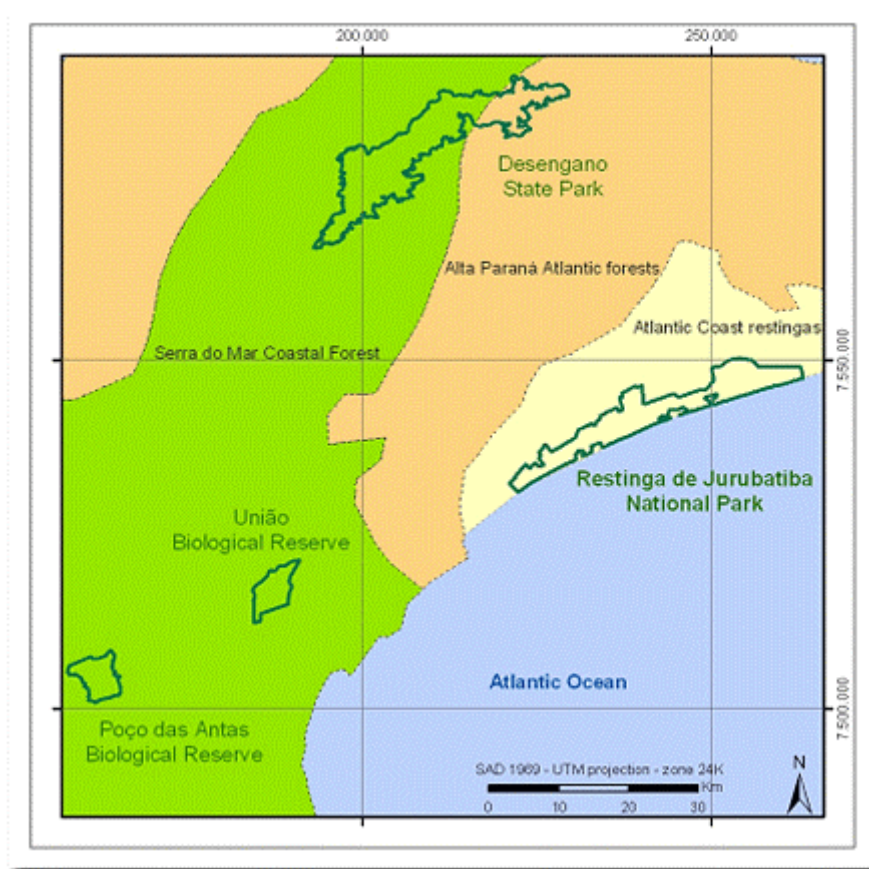
The park is not yet formally open for the public to visit. However, people do visit, especially the lagoons and 44 km of deserted beach. The existence of bathing resorts bordering the park limits and the lack of control over the area facilitate this tourism.

Despite the law governing Brazilian conservation units (SNUC Law), which prohibits natural resource extraction, the park does not have its own preventative team so illegal fishing occurs in some lagoons and firewood is illegally extracted.

In August 2002, the consultative council of RJNP was created, in compliance with the Law for the National System of Conservation Units. The council's purpose is to contribute to the park management action planning, through provisions established in its internal bylaws (IBAMA, 2002).

Unlike other protected areas, the park is not safeguarded by a conservation unit such as an Environmental Protection Area that would provide restrictions on certain types of land use and would thus serve as a buffer zone for the impacts that are directly and indirectly generated on the conservation unit. The closest units are the União Biological Reserve, at a distance of around 32 km, and the Desengano State Park, at a distance of around 39 km from RJNP. In addition to the relatively large distances between the RJNP and these other conservation units, they do not protect similar environments. In other words, while RJNP protects restinga environments, the Desengano State Park and the Union Biological Reserve

protect environments of semi-deciduous seasonal forest and dense ombrophilous forest, respectively.



Proximity of the Restinga de Jurubatiba National Park to other conservation units and ecoregions

Human Influence

The restinga environments and the coastal lagoons of Brazil have suffered a growing process of degradation over the course of time, especially in the State of Rio de Janeiro, where there is a large concentration of both ecosystems. Thus, they are among the environments under greatest threat in Brazil (Esteves, 1998).

This degradation process within the park began in the 17th century, when a small canal was opened to allow rapid water drainage from the lagoons into the sea, thereby enabling the implementation of agriculture and livestock-rearing in the adjacent areas (Soffiati, 1998).

Lavrado (1863 and 1915), cited by Soffiati (1988), described that, in the 18th century, reports showed that the alluvial plain was undergoing an increasing process of deforestation and occupation, with occupation by agriculture and livestock-rearing, in which there was cultivation of sugar cane, maize, beans, rice, manioc, cotton, indigo, coffee, wheat, cacao, tobacco, and green vegetables, among others, and the rearing of mules, donkeys, goats, pigs, etc (Soffiati, 1998).

However, the transportation of the products was difficult on the sandy soil, with trails in extremely poor condition. Thus, in 1861, a channel was inaugurated and opened up by slaves, which interlinked the basins of the Paraíba do Sul River, the Feia lagoon, and Macaé, thereby resulting in the drainage and extermination of dozens of marshes and freshwater lagoons. What followed was a multiplication of the channels, which served to bring out hardwood and agricultural products. However, a few years later, these channels became obsolete because of the construction of the Campos--Macaé railroad (Soffiati, 1998) and were consequently abandoned.



Former fluvial navigation channels, now abandoned. Detail showing the colonization of exotic herbaceous species in the beds of the abandoned channels

Then, in the 1960s, drainage works carried out by the National Public Works and Sanitation Department exterminated a large number of lagoons, especially the smaller ones. With the objective of preventing flooding in areas adjacent to some lagoons, various diversion channels were opened into the sea, always attending to the interests of the economic activities of the dominant classes (Soffiati, 1998).

Today, the restingas are free from impacts caused by the opening of channels, at least within RJNP, but other factors have come to degrade the area.

Garbage disposal, indiscriminate use of recreational vehicles, and irregular extraction of sand as a result of the expansion of civil construction consequent to the installation of Petrobras plants in the Campos sea basin and thus the creation of the municipalities of Quissamã and Carapebus have also accelerated the process of ecological degradation in Restinga de Jurubatiba National Park (Esteves *et al.*, 2002).

Conservation and research

One of the primary objectives of a national park is to enable and encourage scientific research. Up to the present, many research projects with prior authorization from IBAMA have been accomplished in Restinga de Jurubatiba National Park. More than 82 research

works have now been recorded in books, scientific journals, and internet sites, 29 of which focus on the area's flora, 7 on management, 29 on the ecology of the lagoons, and 17 on the fauna.

The principal institutions responsible for carrying out these research projects are the Federal University of Rio de Janeiro (UFRJ), especially through the Macaé Ecological Research Center (NUPEM) and the National Museum, with approximately 46 studies; the University of the State of Rio de Janeiro (UERJ); the "Fluminense" Federal University (UFF); the State University of Rio de Janeiro; the Rural University of Rio de Janeiro (UFRRJ); and the Association of Friends of the Restinga de Jurubatiba National Park (APAJ).

The majority of these studies have sought to understand the environments through comprehension of their structure and functioning and, from the knowledge generated, to develop a capacity to predict and control the effects of certain human actions on the environment. Thus, studies on animals (vertebrate and invertebrate), plants, and the interactions between each and with the physical environment, can be highlighted (Santos & Bozelli, 2003).

The groups studying the dry-land vegetation are now seeking to put forward a model that may explain how changes in the restingas take place over space and time, by attempting to understand different processes that occur in the plant community. The tools utilized involve analyses of the flora, plant communities, and some specific groups. They are also identifying rare and threatened species, thereby contributing to the knowledge of the threatened diversity of the region (Santos & Bozelli, 2003).

Researchers in the field of aquatic ecology, especially in the Macaé Ecological Research Center (NUPEM), are studying the effects of nutrient cycling on the lagoons and on the interactions between animal and plant populations. They are also monitoring the organisms and the variation in factors that these have relationships with, such as the water quality, nutrient concentration, pH level, conductivity, and salinity in the different lagoons in the park. In the Cabiúnas lagoon this monitoring has now spanning almost a decade (Santos & Bozelli, 2003). A good example of these studies can be viewed in a publication by Francisco Esteves, of NUPEM (Esteves, 1998a), in which different studies by various scientists have been compiled.

The insect ecology groups are studying the biology of many of these species, with regard to their behavior, population dynamics, and the relationships within and between species (Santos & Bozelli, 2003).

The groups of researchers that are working on the ecology of vertebrates (fish, amphibians, reptiles, birds, and mammals) are making an inventory of the groups of these species that occur in the Jurubatiba restingas, thereby seeking new knowledge of some population aspects of these communities (Santos & Bozelli, 2003).

There is also a group that has been performing environmental education activities, making it possible for many students in different schools to gain knowledge about the park and its importance.

Another project relating to the management of the park is the Sustainability Plan for the Surrounds of the RJNP, which is carried out by the APAJ (Association of Friends of the

Restinga de Jurubatiba National Park). This project's objective is to generate proposals aimed at developing the existing and potential economic activities, so as to achieve compatibility between the economy and conservation of the natural resources (APAJ, 2002).

Many of these activities are financially and logistically supported by public and private institutions, such as the municipal authorities of Macaé, Petrobras, Brazilian and foreign universities, the National Council for Scientific and Technological Development (CNPq), the Coordination Office for Improvement of Higher Education Personnel (CAPES), the National Environmental Fund (FNMA), and the Fundação O Boticário de Proteção à Natureza (O Boticário Foundation for Nature Protection).

Threats

Current threats

- Insufficiency of the team
- Presence of petroleum processing pipelines
- Lack of control over the area
- Design of the conservation unit, human occupation in the immediate surrounds, and contamination of the lagoons
- Lack of structure for visitor attendance and control
- Extraction of natural resources
- Fires and burning
- Lack of a management plan

The threats to Restinga de Jurubatiba National Park can be generalized into two large groups: problems relating to the level of implementation of the conservation unit and problems relating to the design of the conservation unit. Permeating these matters, various threats are related to the consequent human influence on the area.

Insufficiency of the team

The lack of a well-dimensioned team directly compromises the effectiveness of the protection of the restinga environments in the national park. Five people alone, of whom two are not IBAMA employees, does not correspond to the minimum standards required for managing and protecting an area of more than 14,000 hectares.

RJNP's park guards have been assigned by the Macaé municipal authorities and have not been trained in the same way as IBAMA employees. IBAMA employees theoretically receive the best and most specific training for working in supervision within the public use organization, and in the protection of a conservation unit.

Another problem is that the manager of the team changes frequently so there is no consistency, thus creating difficulties regarding the continuity of the work.

Presence of petroleum processing pipelines

The park was created subsequent to the installation of a petroleum processing center belonging to Petrobras, called the Cabiúnas Terminal, which is only 1000 meters from the park. The center receives petroleum from the Campos Basin and prepares it for refining. The residues from this operation are treated and sent through outfall pipes into the sea. Up to the

time of this evaluation, these outfall pipes were buried below ground and passed through a large area of the park, following the line of the beach.



Leakage from the Petrobus outfall pipeline discovered during the evaluation in the field, showing the soil drenched with petroleum processing effluent



Sign showing the location of the Petrobras outfall pipeline

Constant pipeline ruptures and consequent leakages, with 49 detected by RJNP administrative personnel between 1998 and 2003), have caused contamination of the water table and consequently the lagoons. These have caused Petrobras to prepare studies for new outfall pipelines, which will be on the surface and more modern. This strategy, as well as theoretically reducing the possibility that leakages might occur, would also allow faster detection in the event of accidents.

However, among the three alternative routes drawn up for the new outfall pipelines, the one chosen was a route passing through the park, and IBAMA did not have the political power to interfere. This route will greatly affect the appearance of the landscape, passing through the connection channel of the Cabiúnas lagoon with the sea and along a large portion of the length of the beach, thereby greatly harming any possibility of utilizing a large area that would have a calling for public use by visitors.

Moreover, the simple existence of this pipeline within the limits of RJNP represents a potential contamination risk through accidents or leakages of a chronic nature, like those that have been seen over recent years.

Lack of control over the area

In addition to the conflict caused by the responsible body's lack of autonomy in deciding whether the effluent-conducting pipelines should be present inside the conservation unit or how they should be designed, a generalized lack of control over the area can be noted. Some cases are extreme, and there are even sectors within the park that the team responsible for the park cannot access because of lacking security.

With regard to the land ownership question, the has not had its situation regularized, despite already having had its limits demarcated.

Land ownership within Restinga de Jurubatiba National Park has not yet been normalized, even though the park's limits are already demarcated, thus making it difficult for IBAMA to have effective control over the unit, and also making it practically impossible to undertake and apply sanctions such as fines for illegal or unauthorized activities. Some areas of RJNP are utilized for coconut and pineapple cultivation (Santos & Bozelli, 2003), livestock-rearing, or as pasture for horses and cattle. The existence of these activities causes contamination of the soil and water resources, and also the deforestation of large areas of the park, resulting in a loss of biodiversity (Santos & Bozelli, 2003).



Livestock grazing and coconut planting in areas of Restinga de Jurubatiba National Park that have not been barred yet



Contamination of the soil by cattle dung

The population living in the surrounding areas does not have precise knowledge of the park's limits, and there are only a few indicator signs, leading to direct outside interference of the environs of the park.

The constant increase in disordered human occupation of areas adjacent to the park can also be noticed. This is due mainly to the absence of any urban planning processes, and it threatens the integrity of environments within the unit in various ways. The discharge of sewage into lagoons, collection of firewood and plants, occurrence of fires, and extraction of sand have been observed.



Disordered irregular occupation of areas immediately surrounding the park

This utilization conflicts directly with what the law permits and with the logic of a conservation unit for full protection. The resolution of land tenure problems and the demarcation of park limits will require resources and political will.

Design of the conservation unit, human occupation in the immediate surrounds, and contamination of the lagoons

According to IBAMA's digital file (*shapefile*), the total area of the park is 14,880 hectares, with a perimeter of 129.5 km. If the border between RJNP and its surroundings is assessed as a proportion of its total surface area, a relationship of 8.7 m of perimeter per hectare protected is obtained. This value is considered to be unfavorable, given that the theoretical ideal value for a conservation unit with this area would be 2.9 m/ha. In practical terms, this means that the management team will have to expend a great effort in controlling the borders.

Because of its narrow shape and extensive borders, it will be geographically challenging to manage the park and minimize the effects originating in its surrounds. Another problem with the park's layout is that the bathing resorts built outside the limits, with roads inside enabling access to them. This strategy was designed to facilitate the creation of the park and diminish conflicts from the regularization of land ownership, in order to keep the people living in the area happy as well as the municipal public authorities, who wanted bathing resort areas. This

design causes great pressure both inside the park, where animals are more likely to be run over, among other problems, and also in the immediate surroundings where the bath houses are located.

Additionally, the bathing resorts presents a large threat to the lagoon ecosystems. The sewage systems discharge directly into the adjacent lagoons and, during the rainy season, in order to prevent the collapse of the sewage systems through the overflowing of the lagoons and consequent flooding of the public roads and houses in these bathing resorts, outflow channels into the sea have been opened (Esteves, F. de A. 1998; Ferreira, C. L. 1998; Melo & Suzuki, 1998; Petrucio, M. M. 1998).

Not only does the chemical changes in the lagoons reduce species richness, but the opening of outflow channels to the sea causes even more serious problems, by altering the physicochemical properties even more (depth, temperature, salinity, pH, conductivity, and nutrient concentration) in these environments. Many of the organisms cannot tolerate these variations. Also these openings have allowed marine species to contaminate the lagoons, which also has serious consequences on the organisms (Frota & Caramaschi, 1998).

Another threat generated by these bathing resorts involved introduction of species to the park. Visitors plant species like *Pinus* and *Casuarina*, which will come to dominate the environment within a short time, thereby rapidly exterminating species native to the restingas and defacing the natural landscape of the location.

One of the more recent impacts to the park has been the increasing quantity of irregular housing close to the geographical limits of the parking areas that have not undergone any urban planning processes. Thus, in addition to the impact of the drainage, the sewage produced in this new housing is not collected by an appropriate sewer network and may cause eutrophication of the waters in the lagoons, such as the Cabiúnas lagoon, which is within the limits of RJNP.

Lack of structure for visitor attendance and control

Up to the time of this evaluation, RJNP did not have any appropriate structure for conducting its management, especially in relation to public use and protection of the unit. With the exception of a few demarcation plaques, there is no physical evidence to indicate that visitors are in a protected area, under a special management regime.

Although the park is not formally open to visitors, there are people inside the conservation area everyday, usually to use the beaches and lagoons for recreational activities. In effect, there is no type of control over the presence of these visitors in the park. And more delicate questions, like the risk that bathers might drown, could come to cause great trouble to IBAMA, which could be liable for the visitors' safety in the park.



Casual visitors uncontrolled by IBAMA

There is not even a main office for IBAMA, either inside or close to the park. The house that functions as the administrative main office was assigned to the park administration by the municipal authorities of Macaé. It is emphasized that this IBAMA office is in a totally precarious condition. It leaks when it rains, thus compromising the equipment and files. In addition, because of its structure, on sunny days the office reaches very high temperatures, and it is impossible to work efficiently under such conditions. Moreover, the fact that this office is located outside of the unit, at a distance of several kilometers, places difficulties on the activities related to this office.

There are also no IBAMA guardhouses spread out strategically so as to facilitate protection, control, and supervision activities. The only guardhouse that exists belongs to Petrobras, and its purpose is only to regulate and circulate car traffic on the beach.

Tourism also exerts strong pressure on the park, since it occurs in a disordered manner. Water sports impact the fauna of the lagoons in which they are practiced. Vehicles along the beach also present danger to the fauna, especially the procreation of turtles such as the threatened loggerhead sea turtle. The accumulation and dumping of garbage by visitors, as well as hurting the scenic beauty, causes contamination of animal species (Santos & Bozelli, 2003; IBAMA).

Extraction of natural resources

Illegal extractive activities, such as fishing and collecting plants and animals, is another problem that presents large risks to the environment, with a direct influence on the populations of some species like bromeliads and the threatened Turk's cap cactus (*Melocactus violaceus*) (Santos & Bozelli, 2003). Even the municipal authorities of Macaé have removed bromeliads from the park for urban decoration.

The illegal capturing of fauna specimens for illegal animal trading, together with hunting for both consumption and commercialization, also takes place in a generalized manner

throughout the region, and not solely in the park. This has put strong pressure on the populations of red-browed Amazon parrots (*Amazona rhodocorytha*) and may lead to their extinction.

Other types of natural resource extraction, such as the removal of heart-of-palm trees (*Euterpe edulis*), sand, and firewood also directly threaten the integrity of the environments.

Various types of fishing in the lagoons, such as by casting a net, is done both by tourists and by the region's inhabitants, and this exerts strong pressure on the particular fishing resources, thereby unbalancing the relationships between species in these lagoon ecosystems.

According to Federal Law No. 9.985/2000, the direct use of natural resources within a national park is prohibited.

Fires and burning

Fires are another serious problem within the park, and they occur more than once a year. They are very often associated with illegal extraction activities, such as the removal of honey, in which the people use torches to drive away the bees. These fires are also derived from stubble-burning in the sugar cane fields that neighbor the park (Santos & Bozelli, 2003; IBAMA).

Lack of a management plan

In summary, the lack of a management plan to cover the important points and provide norms for activities in the park and its buffer zone make efficient protection of the area extremely difficult. This plan is now being drawn up, but in order for it to be implemented, there will be a requirement for personnel and budget resources.

Some actions for controlling threatening activities, although obvious, are not performed by the park administration. The management plan will provide the technical justification for creating norms for the activities that take place in the unit.

Future threats

- Growth in the number of holiday houses in the bathing resorts
- Increase in tourism without infrastructure
- Lack of implementation of the conservation unit
- Contamination due to accidents from petroleum industry activities
- Biological contamination

Growth in the number of holiday houses in the bathing resorts

Although the bathing resorts are outside of the conservation unit, they are within its immediate surroundings, and a tendency exists for some of them to grow toward the park limits because they are bound by the sea on the other flank.

As well as invading the park limits, this may cause a significant increase in the pressure on natural resources and worsening of the pollution, both due to sewage in the lagoons and

exotic species' introductions. These threats could affect the continuity of ecological processes, thus resulting in the loss of endemic and threatened species in the region.

Increase in tourism without infrastructure

If tourist activity should significantly increase in the future, without the installation of the infrastructure needed for visits to take place in an orderly manner, there is a risk that the known problems may increase, such as the collection of ornamental plants (especially orchids and bromeliads) and pollution from abandoned garbage.

The presence of tourists may also encourage the illegal trade of wild animals and plants. Also, real estate speculation would certainly be a direct consequence of such an increase in tourism.

Lack of implementation of the conservation unit

The delay in drawing up and implementing the management plan may be extremely harmful to the efficient protection of the area, thereby postponing the performance of certain activities, such as protection and public use, among others. This situation may even lead to discreditation among the local population, who will notice the fragility that the park presents in its capacity for controlling conflicting processes.

Contamination due to accidents from petroleum industry activities

Although impossible to predict, there is a risk of contamination of the coastline due to oil leakages from the oil extraction platforms located in the Campos Basin, just a few kilometers from the coast. Likewise, it needs to be considered that there is a risk of acute and significant contamination from some event related to the existence and proximity of the Cabiúnas terminal, at a distance of no more than 1.5 km from the park limits, and from its pipelines and outfall pipes.



Cabiúnas plant viewed from Restinga de Jurubatiba National Park

Biological contamination

Occupation by invading exotic species such as *Pinus* sp. and *Casuarina* sp., and their dispersion, is another source of threat to the biodiversity, harming the natural ecological processes through direct impact on the native species of the park. These exotic species are being introduced into the area for landscaping purposes and for protection against the wind. Considering the enormous potential for colonization presented by species of the genus *Pinus* in restinga environments, such as, for example, the serious problem on the Island of Santa Catarina or even in the Lagoa do Peixe National Park (Gatti *et al.*, 2003), it can be expected that RJNP may also come to present serious problems of biological contamination over the medium-term future. Immediate measures for eradication and control must be adopted.



Plantations of Casuarina sp. and consequent spontaneous colonization of restinga environments

Recommended Solutions

Size and format of the conservation unit

RJNP is located in a region with intense land use (understood as human occupation, public infrastructure, agriculture, livestock-rearing, and industrialization). There remains little of relevance to be thought of in the way of expansion that could imply resolution to the problem of the small surface area presently protected. However, from analysis of satellite images of the region, it can be seen that there are five fragments that could be integrated into the conservation unit.



Areas suggested for expansion of the Restinga de Jurubatiba National Park

In area 1, the expansion would protect a fragment of restinga forest and other string and between-string areas, as well as improve the shape of the unit. This area is 417 ha. Areas 2 and 3, with 96 and 80 ha respectively, would facilitate the control of an undesired expansion of the Carapebus bathing resort that could cause an even more significant impact on the Carapebus lagoon, through contamination by effluents generated from the human presence in the location. It is worth emphasizing that the proposal preserves the existence of the Carapebus bathing resort as it is at present, and only limits its expansion. The proposal to include area 4 is essentially aimed at preserving the health of the Carapebus lagoon, given that within the present limits, only one part of the lagoon is protected, which does not resolve much in terms of contamination and changes in the physicochemical and biological characteristics of the lagoon. Area 4 brings 2,750 ha into the area of the unit. Lastly, the proposal to include area 5 aims at increasing the surface area protected by the national park and improving the shape of the unit. Although the 4,862 ha included in area 5 have already been altered to differing extents (including some parts in which the natural environmental character has been totally lost), it can be seen that this area greatly resembles what is already contained within the present limits of RJNP.

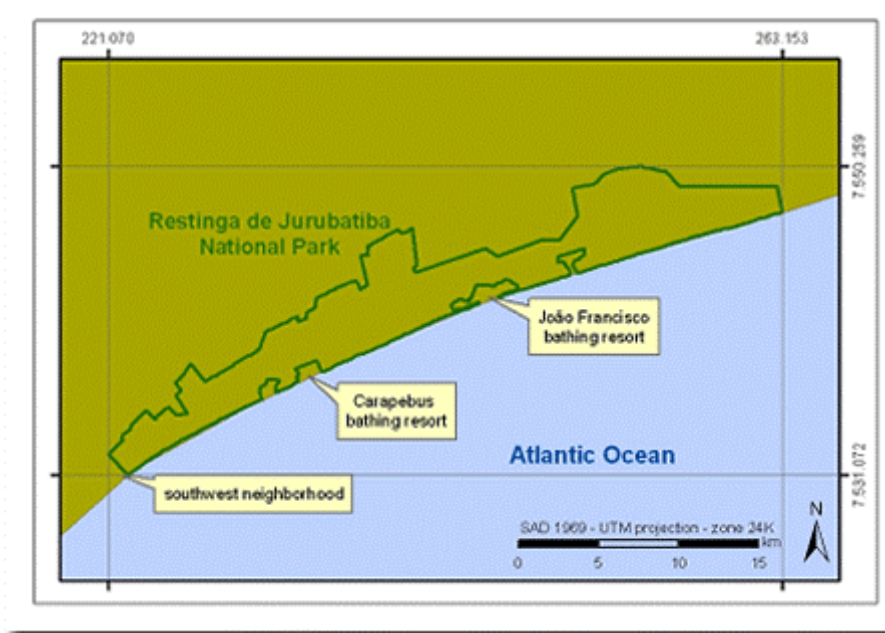
These five proposed areas would add an surface of a little over 8,200 ha to RJNP, thus doubling its size, resulting in a total area of around 23,000 ha.

Insufficiency of the team

It is necessary to structure a team of a good size, with the right skills and well-defined functions that immediately ensure the minimum acceptable protection for the conservation unit, until such time that the ideal composition of the team has been defined in the management plan. It is also fundamental that the team be politically stable within their positions, so as to allow long-term work, skills acquisition, and consequent increases in the efficiency with which their activities are performed.

Lack of infrastructure

While there is no detailed and thought-out definition regarding the implementation of the infrastructure for the unit, IBAMA should move as close as possible to the unit, so as to be in daily contact with the parks and its problems. For this, three houses could be rented as a temporary and emergency matter to serve as a base office and information and control post. The bathing resorts of João Francisco and Carapebus are suggested for the installation of the information and temporary control posts and the district neighboring the southwestern entrance for the provisional administrative headquarters.



Possible locations for installing emergency provisional structures

Increase in tourism without infrastructure

Minimum criteria for visiting the restingas should be established as an emergency matter, to regularize the public use of the park, until the management plan has been concluded, approved, and implemented. In the same way, both the installation of guardhouses and indication plaques should be immediately installed at strategic points with the greatest flows of people, with the aim of regulating the use of the park, and communicating its existence and location, and clarifying the fragility of the environments within the park.

RJNP's administrators should perform immediate work to block off the internal access roads in areas that would not significantly affect the owners of properties not yet been formally expropriated. This would help diminish the impacts caused by casual human presence in areas that might in the future be zoned as areas with restricted access (primitive or restoration zones).

Pressure on the civil construction and growth of vacation house areas

The park administration should continuously perform monitoring and norm imposition work regarding the occupation of the surrounds of the park, by expanding productive partnerships with other institutions that have powers over related matters, such as the Superintendancy of the Nation's Patrimony. By using the existing instruments, such as the regulations for land subdivision, the Forest Code, and the registration of land as Nation's Patrimony, it would be

possible to argue against growth in the occupation of these new urban areas formed by the bathing resorts that border the park. The management plan should deal very incisively and clearly with this question, considering that it is of fundamental importance for the functioning of the unit.

Petroleum royalties

The resources generated from granting petroleum exploration rights is a source of funds that could be partially reverted to the conservation unit, thereby attending to urgent requirements, such as the installation of infrastructure (main office, guardhouses, and indicator plaques) and the regularization of land ownership.

Compensatory measures from performing construction work inside the unit, as in the case of the Petrobras outfall pipes, should also be reverted for attending to the requirements of the park.

Contamination from accidents relating to petroleum activities

It seems to be fundamentally important that the institutions involved in petroleum operations in the region should not only be aware of their responsibilities regarding accident prevention, but should also maintain emergency contingency programs for such possibilities. Considering the nature of petroleum activities, with regard to the impact potential and also the resources involved, it is not admissible to have anything less than the best for such plans dealing with accident prevention and control.

Given the implementation of the new outfall pipeline, Petrobras and IBAMA should maintain a close partnership in order to promptly detect new leakages and the immediately apply containment measures. This means the teams must be adequate training and equipping of the teams.

Biological contamination

The administration of RJNP should adopt urgent measures for eradicating and controlling exotic species with invasive potential. A first step would be to eradicate individuals of *Pinus* spp. and *Casuarina* spp., not only from within the unit, but also from the lands immediately surrounding it, particularly from the bathing resorts bordering the park.

In the case of areas that have not been expropriated and the bathing resorts in the surrounding area, an educational campaign needs to be planned and implemented with the aim of making local residents aware of the problem of biological contamination. This would assist in obtaining local support for the eradication of individuals with a potential for contamination and, in a certain way, would facilitate authorization from owners regarding the felling of such individuals within their properties.

It is important to emphasize that biological contamination is an extremely serious problem in natural environments, and that the costs of preventive measures are exponentially cheaper than the costs of corrective actions. RJNP can still go for the cheaper option, but its managers must act soon.

As well as dealing with the potential and evident problem of *Pinus* and *Casuarina*, studies on the matter of biological contamination must be conducted, covering a variety of life forms

and ecosystems (including aquatic environments), and then a detailed diagnosis and an action plan should be put in place.

Conclusions

In summary, Restinga de Jurubatiba National Park has a fundamental role in the preservation of one of the last remnants of restingas and coastal lagoons in a reasonable state of conservation. It represents a refuge that allows for the continuity of ecological processes and the survival of various species, some of which are threatened and/or endemic to the region.

However, according to our analysis, this park would be better served a state unit than a federal one, given that it does not have enough attractive scenic features available or even environmental significance that would make it unmatched on a national level. Nonetheless, although it lacks attractive features, it can no longer be thought of as anything other than a park, since there is some demand for public use of parks to of the area. The presence of bathing resorts just outside its limits would also make it unviable to declare a more restrictive category regarding public use, such as biological reserve or ecological station.

According to the analysis performed, the Restinga de Jurubatiba National Park is today classified as **critically threatened**, or in other words, there is a great risk that the park may fail to protect the biological diversity within the immediate future.

There is an urgent need for improvement of the infrastructure, the structuring of a team, the finalization and implementation of the management plan, and the regularization of land ownership, so that the national park can be effectively protected. In this way, the park can be recognized, valued, and respected. The plan should indicate and specify exactly the size of the structure needed for fulfilling the objectives set when it was created.

IBAMA should take incisive measures to immediately resolve the problems that are causing such damage to the ecosystems that the park was meant to protect, thereby ensuring the perpetuation of these environments and the organisms that depend on them.

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