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Vegetation Assessment in Management Plans of Brazilian Conservation Units in Restinga Areas

Análise de vegetação em planos de manejo de Unidades de Conservação em áreas de restinga

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Resumo

Objetivou-se analisar os estudos de diagnóstico da vegetação nos planos de manejo (PM) de Unidades de Conservação (UCs), dos Parques, em áreas de restinga no país, visando identificar que metodologias são utilizadas e obter um panorama destes diagnósticos. A conservação da restinga brasileira é de suma importância devida à alta pressão antrópica sofrida nessas áreas, que realizam serviços ecológicos vitais. Uma estratégia utilizada para a conservação de áreas ecologicamente relevantes é a criação de UCs, porém, muitas dessas ainda enfrentam dificuldades em sua efetiva implementação e gestão, principalmente pela falta de um plano de manejo para nortear seu correto manejo. A categoria Parque foi escolhida para este estudo por ser a mais frequente em áreas de restinga. A metodologia consistiu na análise dos PM disponíveis nos sites dos órgãos gestores das UCs. Foram encontrados 24 Parques (8 Nacionais, 13 Estaduais e 3 Municipais), na qual 18 possuem PM. A maioria dos PMs (15) realizou o diagnóstico via dados secundários e com a coleta de dados primários. Entre os métodos para coleta de dados primários, o de Avaliação Ecológica Rápida foi o mais utilizado, por 60% dos PMs. Em 77% dos planos, utilizou-se o sensoriamento remoto e geoprocessamento. Os PMs apresentaram diagnósticos da vegetação, com dados consolidados em campo, com preferência por uma metodologia rápida e acessível aos gestores.

Palavras-chave: Parque; áreas protegidas; diagnóstico de vegetação.

Abstract

This paper analyzes vegetation-assessment studies in Management Plans (MPs) of Conservations Units (CUs) – Parks – in Brazilian restinga (open thicket vegetation on marine sand deposits) to find out which methodologies are used the most to obtain an overview of those assessments. Protecting Brazilian open thicket vegetation on marine sand deposit areas is of paramount importance because of the high anthropic pressure found in these areas, which perform critical ecological roles. One strategy used in the protection of ecologically-relevant areas is the creation of CUs. However, many of them still undergo issues in their actual implementation and management, mostly due to the missing management plan to steer proper management. The Park category was chosen for this study because it is the most frequent in restinga areas. The used methodology consisted of analyzing the MPs found on the web site of CUs management bodies. Eighteen (18) out of the 24 analyzed Parks (8 National, 13 State and 3 local) had a MP. In most of them (15)

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assessment was performed using secondary data and primary data was collected. The Rapid Ecological Assessment was the most often used primary-data collection method, reported in 60% of the MPs. Remote sensing and geoprocessing were used in 77% of them. The vegetation assessments were grounded on data collected in the field, with a preference for the rapid, manager-friendly methodology.

Keywords: Park; protected sites; vegetation assessment.

I. INTRODUCTION

The restinga (open thicket vegetation on marine sand deposits) is an ecosystem associated to the Brazilian Atlantic Forest Biome having a peculiar vegetation with a high ecological diversity (SOUZA, 2004). This vegetation is composed of pioneer formations with marine influence, including arboreal, shrub and herbaceous types. It shows physiognomic variations from the beaches to the innermost points of the coastal plain (VELOSO et al., 1991, ASSUMPÇÃO; NASCIMENTO, 2000).

The protection of the restinga is critical because they play the role of dune and sand-sediment fixers and also of nurseries for some species, among other ecosystem services (LAMÊGO, 1974; COSTA et al., 1984; SANTOS, SILVA, 2012). However, this valuable ecosystem has undergone high anthropogenic pressure. Because it is located in privileged areas on the Brazilian coastline, it is the target of massive real-estate speculation and disordered occupation (SANTOS et al., 2004; CUNHA, 2005).

Creating Consevation Units (CUs) has been a tool used in the protection of the restinga areas in Brazil. There are roughly 85 CUs on the Brazilian coastline (CNUC, 2016). However, even after the Brazilian Conservation Units System or SNUC (Sistema Nacional de Unidades de Conservação) was created, there have been problems in establishing and managing CUs. This can be confirmed by the large number of CUs lacking a management plan – the major document steering the management of a CU (BRAZIL, 2000; SOUZA et al., 2011).

SNUC was established to regulate the creation, implementation and management of CUs throughout Brazil. Its goals include the protection of the biodiversity, the genetic resources and natural ecosystems, the rational and sustainable use of natural resources by traditional populations, among others (BRASIL et al., 2000; SOUZA et al., 2011). According to more recent data released by the Brazilian Ministry of the Environment, SNUC is currently composed of 2.146 conservation units, 959 of which are federal-run (44.7%), 905 are state-run (42.2%) and 282 are local (13.1%), covering an area of 1.582.861 km² of the Brazilian territory (CNUC / MMA, 2018).

The Brazilian Atlantic Forest is the biome having the highest number of CUs. It is home to 1.224 protected sites, covering an area of 115.431 km² (CNUC/MMA, 2018). The Brazilian Atlantic Forest is also the biome having

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the second largest number of federal CUs (76), second only to the Amazon (106). This biome is the most protected by 405 federal officers in charge of protecting 2.953.419,65 ha, that is, 1 officer has to oversee 7.292.39 ha of Federal CUs (MATTAR et al., 2018).

Despite the sophistication of the SNUC, the effective CU implementation and management is marked by a number of issues. A large number of protected sites still lack a Management Plan, which makes them difficult to be managed. According to SNUC, the management plan is a "technical document that, based on the general objectives of a protected site, establishes its zoning and the regulations that will steer its use and the natural resource management, including the building of the physical facilities required for the management of said area". SNUC also establishes that all CUs must have a management plan, affording a time frame of 5 years to design one in case they do not have one already (BRASIL, 2000).

In 2010, 78% of the federal and state-run CUs did not have a management plan. The situation of state-run CUs is more worrisome - only 15% of them have a management plan (SOUZA et al., 2011). The situation of the Parks is not any different – only 37% of the existing Parks in Brazil, including National, State and Local ones, have a management plan (CNUC, 2016). CUs are ineffectively managed in Brazil and throughout the world, which explains why they are being called "paper-made" CUs because they literally exist only on paper, since many of them rely only on their law of creation (TERBORGH; SCHAIK, 2002; LIMA et al., 2005; SANTOS et al., 2013).

Lima et al. (2005) highlight that the non-existing management of protected sites results in non-compensated expropriations and attrition in the relationship between the local community and the conservation unit.

A lot of data is collected to design a management plan, including the biotic and abiotic assessments that can be performed based on primary or secondary data (GALANTE et al., 2002). For vegetation assessment, a diversity of methodologies is reported in literature. However, because management decisions must be made on an urgent basis and resources are limited, agile and low-cost methodologies like remote sensing and rapid surveys are preferred to assess and manage vegetation (MULLER DOMBOIS; ELLENBERG, 1974; DURIGAN, 2003; SAYRE et al., 2003; FERNANDES et al., 2013; de SOUZA, et al., 2014; SALAZAR-GASCÓN; FERREIRA, 2016; LAWLEY, et al., 2016).

Primary questions emerge when addressing this subject, some of which can be highlighted: 1) Do the methodologies used in the design of a management plans match reality? 2) Do these methodologies afford data

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on the quality and quantity required to manage the CU? 3) Are they accessible methodologies for CUs management?

This way, this work examined the vegetation assessment studies used in the management plans of Brazilian National, State and Local Parks, located in restinga areas throughout Brazil. Our purpose is to identify and systematize which methodologies were most used and obtain an overview of the vegetation studies in those management plans.

II. MATERIAL AND METHODS

The present study is the result of a bibliographical review of the management plans of Conservation Units having the Fully Protected status of category Park (National, State and Local). These parks include those located in open thicket vegetation on marine sand deposit areas and those at least partially located in restingas. We examined which methods were used in the vegetation assessment. The park category was chosen because it is the most often used in these areas.

After consulting the Brazilian Registration of Conservation Units or CNUC (Cadastro Nacional de Unidades de Conservação), we listed the CUs having restinga within their domains whose management plan was already effective (Table 1). To complement this list, we carried out a web search of parks located in restinga areas having a management plan, because some existing CUs could be off CNUC's list.

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Table 1: List of selected CUs for the analysis of vegetation-assessment. S = State; F = Federal government; L = Local.

Run by	State	Conservation Unit	Phytophysiognomy	Management Plan issue date	Creation of the Conservation Unit	Conservation units area (ha)
S	SC	Acaraí State Park	Dense ombrophilous forest, mangrove and restinga (open thicket vegetation).	2008	2005	6.667
S	SP	Ilha Anchieta State Park	Dense ombrophilous forest, mangrove and restinga (open thicket vegetation).	1989	1977	828
S	SP	Ilha do Cardoso State Park	Dense ombrophilous forest, mangrove and restinga (open thicket vegetation).	1997	1962	13.500
S	PR	Ilha do Mel State Park	Dense ombrophilous forest, mangrove and restinga (open thicket vegetation).	2011	2002	337
S	RJ	Ilha Grande State Park	Dense ombrophilous forest and restinga (open thicket vegetation).	2011	1971	12.052
S	SP	Serra do Mar State Park	Dense Ombrophilous Forest, Mixed Ombrophilous Forest, altitude fields, steppe, mangrove swamp and restinga.	2008	1977	315.390
S	SP	Ilhabela State Park	Dense ombrophilous forest and resting.	2010	1977	27.025
S	RS	Itapeva State Park	Restinga.	2006	2002	1.000
S	ES	Itaúnas State Park	Tableland forest, mangrove swamp and restinga.	2004	1991	3.481
S	ES	Paulo César Vinha State Park	Restinga.	2007	1990	1.520
S	SP	Xixová-Japuí State Park	Dense ombrophilous forest and restinga.	2010	1993	901
F	RS	Lagoa do Peixe National Park	Restinga.	1999	1986	36.721
F	RJ, SP	Serra da Bocaina National Park	Dense Ombrophilous Forest, Mixed Ombrophylous Forest, high altitude fields and restinga.	2002	1971	104.000
F	CE	Jericoacoara National Park	Mangrove swamp and restinga.	2011	2002	8.850
F	AP	Cabo Orange National Park	Open Ombrophilous Forest, Flood plain forests, mangrove swamp, savanna and restinga.	2010	1980	657.318
F	RJ	Restinga de Jurubatiba National Park	Restinga.	2007	1998	14.860
L	RJ	Prainha Natural Local Park	Dense Ombrophilous Forest and restinga.	2012	1999	147
L	RJ	Grumari Natural Local Park	Dense Ombrophilous Forest, mangrove swamps and resting.	2012	2001	805

The following keywords were used in the research on the Internet: management plan, conservation units, park, restinga and pioneer formations of marine influence.

Once the list was finished, we examined the park management plans on the website of the respective managing bodies of the CUs.

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III. RESULTS AND DISCUSSION

Methods of vegetation analysis used in Park Management Plans in open thicket vegetation areas on marine sand deposits

As already mentioned, the design of management plans is a great challenge for CU managers. More than half of them do not have a designed and approved plan. Among those having a management plans, many are out of date and incomplete (SANTOS, 2011; SOUZA et al., 2011). In our survey of Parks in restinga areas (or those partially situated in such areas), using CNUC's database, as well as data resulting of web searches, 24 Parks (8 National, 13 State and 3 Local) were found (Table 2). This number may be higher since some CUs are not registered with CNUC, have no website and are not anyhow publicized.

Eighteen (18) or 75% of the surveyed Parks have a management plan – a result exceeding the national average (37%). The average number of Parks with management plans outranking the national average can be explained by the high average age of these CUs (28 years). However, this data should be considered as still worrisome. Creating CUs and designing management plans for them is not enough to ensure ecosystem and natural-resource protection. It is critical that these CUs' management be effective enough and steered by the management plan (BELLINASSI et al., 2011, SOUZA et al., 2011).

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Table 2: List of CUs of the Park category having areas of restinga (resting). S = State; F = Federal government; L = Local; PM = Management Plan; Y = has a designed management plan; N = does not have a designed management plan.

Run by	State	Conservation units	Creation of the Conservation Unit	Management Plan	Management Plan issue data
S	SC	Acaraí State Park	2005	Y	2008
S	SP	Ilha do Cardoso State Park	1962	Y	1997
S	SP	Ilha Anchieta State Park	1977	Y	1989
S	PR	Ilha do Mel State Park	2002	Y	2011
S	RJ	Ilha Grande State Park	1971	Y	2011
S	SP	Serra do Mar State Park	1977	Y	2008
S	SP	Ilhabela State Park	1977	Y	2010
S	RS	Itapeva State Park	2002	Y	2006
S	ES	Itaúnas State Park	1991	Y	2004
S	SC	Rio Vermelho State Park	2007	N	-
S	ES	Paulo César Vinha State Park	1990	Y	2007
S	SP	Restinga de Bertioga State Park	2010	N	-
S	SP	Xixová-Japuí State Park	1993	Y	2010
F	RS	Lagoa do Peixe National Park	1986	Y	1999
F	RJ, SP	Serra da Bocaina National Park	1971	Y	2002
F	CE	Jericoacoara National Park	2002	Y	2011
F	AP	Cabo Orange National Park	1980	Y	2010
F	BA	Monte Pascoal National Park	1961	N	-
F	PR	Superagui National Park	1989	N	-
F	PE	Fernando de Noronha National Marine Park	1988	N	-
F	RJ	Restinga de Jurubatiba National Park	1998	Y	2007
L	RJ	Prainha Natural Local Park	1999	Y	2012
L	RJ	Darke de Mattos Local Park	1975	N	-
L	RJ	Grumari Natural Local Park	2001	y	2012

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To ease the design of Management Plans in Brazilian National Parks, Biological Reserves and Ecological Stations, the Brazilian Ministry of the Environment's administrative arm, IBAMA, wrote and made available the "Roteiro Metodológico de Planejamento: Parque Nacional, Reserva Biológica e Estação Ecológica" (Methodological Planning Roadmap: National Parks, Biological Reserves and Ecological Stations). This document addresses the management plan design process step by step, thus assisting in planning CUs. As per the roadmap, Management Plans should be structured in inserts covering several aspects related to the CUs, including their contextualization in the Brazilian scene, the assessment of the region where the CU is located up to its planning (GALANTE et al. 2002).

To design the management plans, the roadmap recommends raising information on the abiotic (climate, geology, relief, soil, speleology, hydrography / hydrology / limnology and oceanography) and biotic (vegetation and fauna) environments, as well as information on the material and immaterial cultural heritage, socioeconomic aspects, land tenure status and the environmental impact history (GALANTE et al., 2002).

In the case of vegetation assessment in particular, the roadmap sets the minimum scope to be followed (Table 3).

The collection of data on the vegetation is of paramount importance to manage the CU, because these data enables assessing the protection state of the main plant formations on the site, based on its zoning. These data will steer the decisions on the zones of the CUs and their respective uses (GALANTE et al., 2002).

In the assessment of the vegetation, both primary and secondary data can be obtained. Early in the design stage of the management plan the available information is surveyed and collected, including a bibliographical and a cartographic survey and satellite images on the site area. In this stage, information on the local vegetation can be obtained from papers published in scientific journals, technical reports, dissertations and theses.

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Table 3: Minimum scope of vegetation assessment in a Management Plan

	Minimum Approach Scope:
First Management Plan	Field scouting to characterize the main plant formations in the Protection Area and how they are distributed, listing the most representative species in each formation, the endangered species, the rare species, bioindicators, endemic species, economically-relevant species, invasive species and the reappearance of previously-found species and new species. If an aquatic vegetation that is considered important is identified, it must be reported; Describe the protection condition in which the main plant formations are found, in order to ground the zoning; Describe the regeneration condition of the degraded areas; Analyze the effect of fire on vegetation; To design a map, in the most appropriate scale, showing the main vegetation formations and describing their conservation condition, to ground the zoning. The Brazilian classification by IBGE (the Brazilian Institute of Geography and Statistics) must be used and a correlation with local classifications must be provided; In marine areas, prepare a floristic inventory, including the phytoplankton.
Management Plan Revisions	Check the information in previous plans and perform the outstanding recommended studies. Discuss the effects of ecosystem fragmentation on the vegetation.

Source: (GALANTE et al., 2002)

A secondary-data collection in the vegetation assessment was observed in all the 18 analyzed management plans in this paper. Some were a complement to the primary data (15) and others were the single basis for the vegetation assessment (3). One example is the management plan of the Restinga de Jurubatiba National Park (RJ) which is based on studies carried out by the Federal University of Rio de Janeiro (UFRJ) on the characterization of the vegetation of the towns and cities covered by the CUs using satellite images and floristic and phytogeographic analyzes by Araújo (2000), (ICMBio, 2007). This information proves the importance of the partnership between CUs and universities and other research institutions, since the secondary data collected in the literature generally derives from researches carried out in the CUs and their surroundings and publicized in monographs, dissertations, theses and projects.

These secondary data are critical for those CUs not having skilled and/or limited technical staff. This lack of qualified staff can cause designing a management plan undoable given the complexity and efforts required for on-site surveys, and the need for highly-experienced technicians (MULLER DOMBOIS; ELLENBERG, 1974; DURIGAN, 2003; WALTER; GUARINO, 2006; FREITAS; MAGALHÃES, 2012). This fact is evidenced by the fact that 10 out of the 15 management plans that carried out on-site surveys were authored by professionals who were neither part of the CU technical staff or its management body. Checking where the authors of Ilha Anchieta State Park's Management Plan came from was not possible.

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Literature describes a variety of different vegetation-assessment approaches that one can use for the data collection needed to design the management plan, such as the quadrants, plot and line-intercept methods (MULLER DOMBOIS; ELLENBERG, 1974; GILLISON, 2002; DURIGAN, 2003; MORO; MARTINS, 2011).

The Rapid Ecological Assessment (AER) was the most often used methodology in the analyzed management plans. It was reported in 9 out of the 15 management plans whose design was based on primary data. Short-term methodologies requiring few human resources are suitable to management plan design, given the assigned time frames for their design, and logistics and cost issues that play a key role in choosing which methodology best suits vegetation studies (WALTER, 2000).

AER was created in 1992 by Sobrevilla & Bath and perfected 11 years later by SAYRE et al. (2003) for NGO The Nature Conservancy (TNC). TNC defines it as "a flexible process used to raise and rapidly apply biological, ecological information to make effective protection decisions" (SAYRE et al., 2003).

Therefore, the EAR is adequate for rapid, flexible surveys of species and vegetation types in large and little known areas; these surveys combine data types and sources, such as remote sensing images, recognition flyovers and field collections.

Six management plans did not use the AER methodology. One MP used the transect method and the plot method (the Acaraí State Park). Another one used the plot method along with the centralized quadrant point method (Ilha do Cardoso State Park) and a third one used field observations as secondary data complement (Ilha Grande State Park). The remaining three MPs do not describe the used methodology, only stating that field surveys were performed (Ilha Anchieta State Park, Ilha do Mel State Park and Itapeva State Park). All the plans that used primary data also used secondary data as a complement.

Using secondary data, even when primary data is collected and used, is critical, since they complement information and point out knowledge gaps. Secondary data help to plan the field surveys and consolidate the resulting collected data (GALANTE et al., 2002).

Many management plans use remote sensing and interpretation of satellite images to map out the phytophysiognomies present in the CUs and to plan field data collections, an important phase of the AER (SAYRE et al., 2003), FLORESTAL INSTITUTE / SP, 2008; FOUNDATION FLORESTAL / SP, 2010; SMAC / RIO DE JANEIRO CITY COUNCIL, 2012).

This trend was observed in the management plans analyzed in this study, where the vast majority (77%) used remote sensing or satellite images interpretations in the vegetation assessment. These techniques as a

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vegetation assessment tool have been used since 1980. They are a valuable tool to identify phytophysiognomies, detect deforestation, stages of forest protection, and other purposes (ARAÚJO; DI PACE, 2010; CUNHA et al., 2012; FERNANDES et al., 2013; de SOUZA et al., 2014; COELHO et al., 2016; SALAZAR-GASCÓN; FERREIRA, 2016; LAWLEY et al., 2016).

The presentation of vegetation assessment data was different in the analyzed management plans. These qualitative and quantitative variations can be explained by the different times these plans were designed. The latest ones were designed using methodological guidelines and more advanced assessment and geoprocessing tools. Advances in geotechnology allow phytophysiognomy mapping and vegetation assessment using satellite images, greatly reducing the time spent on field trips and more detailed and complete maps (OKIN et al., 2001; NASCIMENTO; SANO, 2010; NUNES et al., 2011; LAURIN et al., 2013; GALVANIN et al., 2014; SILVA et al., 2014).

The management plans for the Ilha Bela State Park, Itaúnas State Park and Paulo César Vinha State Park stood out as models because they present a thorough, detailed assessment. They cover a number of aspects regarded as critical in the IBAMA methodological roadmap, such as maps showing the major plant formations and their protection status, approaching the most representative species of each formation and a description of the protection state of each formation. These three management plans were put together after the publication of the IBAMA methodological roadmap and after the creation of SNUC. The high quality of these plans may be the result of great support provided to their design, at least in terms of vegetation assessment.

IV. CONCLUSIONS

The research carried out by universities and other research institutions in protected sites are critical and should be encouraged by environmental bodies by promoting research, internships and scholarships. These research projects generate information that fosters management plans and reduce expenses with management plan design and revision, mainly of those CUs that neither have a technical staff that is fully qualified to carry out such surveys nor the resources to hire technical advice.

The most widely used methodology for the vegetation assessment in CUs in the Park category in restinga areas is the Rapid Ecological Assessment (AER), a valuable, easy-to-implement tool in environmental assessments. AER was the preferred methodology because it is easy to implement, has a lower cost compared against other methodologies, and because it generates satisfactory data to design the management plans requiring reliable data, in a fast and low-cost way. Another important complementary tool that was used in

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vegetation mapping is remote sensing. Remote sensing allows rapidly assessing large areas, with some field validations which would require large amounts of time and resources to be performed in on-site surveys.

Despite the worrying situation of Brazilian CUs management plan design, the existing management plans were designed mostly on vegetation assessments grounded on secondary data and data collected in the field.

The strong preference for AER in the assessment of vegetation in management plans shows that rapid methodologies are suitable to manage the CUs depending on these data to act in time in their demands and in their proper management.

V. REFERENCES

ARAÚJO, D. S. D. Análise Florística e Fitogeográfica das restingas do estado do Rio de Janeiro. 2000. Tese (Doutorado em Ecologia) - Programa de Pós-Graduação em Ecologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

ARAÚJO, T. L.; DI PACE, F. T. Valores instantâneos da temperatura da superfície terrestre na Cidade de Maceió-AL utilizando imagens do satélite TM/Landsat 5. Revista Brasileira de Geografia Física, Recife, v. 3, n. 2, p. 104-111, 2010.

ASSUMPÇÃO, J.; NASCIMENTO, M. T. Estrutura e composição florística de quatro formações vegetais de restinga no complexo lagunar Grussaí/Iquipari, São João da Barra, RJ, Brasil. Acta Botânica Brasílica, São Paulo, v. 14, n. 3, p. 301-315, 2000.

BELLINASSI, S.; PAVÃO, A.C.; CARDOSO-LEITE, E. Gestão e uso público de unidades de conservação: um olhar sobre os desafios e possibilidades. Revista Brasileira de Ecoturismo, São Paulo, v. 4, n. 2, p. 274-293, 2011.

BRASIL, PRESIDENCIA DA REPÚBLICA. Lei nº 9.985, de 18 de julho de 2000. Institui o Sistema Nacional de Unidades de Conservação da Natureza. Disponível em: <http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=322>. Acesso em 14 jul. 2017.

CNUC/MMA, 2016. Cadastro Nacional das Unidades de Conservação. Disponível em: <http://www.mma.gov.br/areas-protegidas/cadastro-nacional-de-ucs>. Acesso em 27 jul. 2017.

CNUC/MMA, 2018. Cadastro Nacional das Unidades de Conservação. Dados Consolidados. Disponível em: http://www.mma.gov.br/areas-protegidas/cadastro-nacional-de-ucs/dados-consolidados. Acesso em 20 jul. 2017.

COELHO, I.D.A.M.; DUARTE, S.M.A.; COELHO, O.D.A.M. Estudo da dinâmica da cobertura vegetal no município de Floresta/PE através de processamento digital de imagens. Revista Geama, Recife, v. 2, n. 1, p. 7-24, 2016.

COSTA, C. S. B.; SEELIGER, U.; CORDAZZO, C. V. Aspectos da ecologia populacional do Panicum racemosum (Spreng) nas dunas costeiras do Rio Grande do Sul, Brasil. In: LACERDA, L.D.; ARAUJO, D.S.D.; CERQUEIRA, R.; TURCQ, B. (Ed.) Restingas: Origem, Estrutura e Processos. CEUFF, Niterói - RJ, p. 395-411. 1984.

CUNHA, I. Desenvolvimento sustentável na costa brasileira. Revista Galega de Economia, Santiago de Compostela - Espanha, v. 14, n. 1-2, p. 1-14, 2005.

ISSN eletrônico 2177-2738
RA'EGA, Curitiba, PR, V.51, p. 3–16, 8/2021
DOI: http://dx.doi.org/10.5380/raega.v51i0.66295

CUNHA, J. E. de B. L.; RUFINO, I. A. A.; SILVA, B. B. da; CHAVES, I. de B. Dinâmica da cobertura vegetal para a Bacia de São João do Rio do Peixe, PB, utilizando-se sensoriamento remoto. Revista Brasileira de Engenharia Agrícola e Ambiental, Campina Grande, v. 16, n. 5, p. 539-548, 2012.

DURIGAN, G. Métodos para análise de vegetação arbórea. In: CULLEN JUNIOR, L.; RUDRAN, R.; VALLADARES-PADUA, C. (Org.). Métodos de estudos em biologia da conservação e manejo da vida silvestre. Curitiba, PR: Editora da UFPR, 2003. Cap. 17. p. 455-479.

FERNANDES, R. R.; NUNES, G. M.; FANTIN-CRUZ, I.; SILVA, T. S. F.; da CUNHA, C. N. Uso de geotecnologias na análise da ocorrência de unidades fitofisionômicas na região do Médio Araguaia. Revista Brasileira de Cartografia, Monte Carmelo, v. 5, n. 65/5, p. 853-867, 2013.

ICMBio/MMA. Plano de Manejo do Parque Nacional da Restinga de Jurubatiba. Rio de Janeiro, 801p., 2007.

FREITAS, W. K.; MAGALHÃES, L. M. S. Métodos e parâmetros para estudo da vegetação com ênfase no estrato arbóreo. Floresta e Ambiente, Seropédica, v. 19, n.4, p. 520-540, 2012.

FUNDAÇÃO FLORESTAL/SP. Plano de Manejo do Parque Estadual de Ilhabela. São Paulo: 835 p., 2010.

GALANTE, M. L. V.; BESERRA, M. M. L.; MENEZES, E. O. Roteiro metodológico de planejamento de parques nacionais, reservas biológicas e estações ecológicas. Brasília, DF: Ministério do Meio Ambiente, 2002.

GALVANIN, E. A. S.; NEVES, S. M. A. S.; CRUZ, C. B. M.; NEVES, R. J.; JESUS, P. H. H.; KREITLOW, J. P. Avaliação dos Índices de Vegetação NDVI, SR e TVI na discriminação de fitofisionomias dos ambientes do Pantanal de Cáceres/MT. Revista Ciência Florestal, Santa Maria, v. 24, n. 3, p. 707-715, 2014.

GILLISON, A. N. Manual de campo para levantamento rápido da vegetação e classificação para objetivos gerais. Pronatura/Centro Internacional de pesquisa em Silvicultura, 2002.

INSTITUTO FLORESTAL/SP. Plano de Manejo do Parque Estadual da Serra do Mar. São Paulo: 433 p., 2008.

LAMÊGO, A. R. O Homem e a Restinga. Rio de Janeiro, RJ: 2 ed. Editora Lidador, 1974.

LAURIN, G. V.; FRATE, F. D.; PASSOLI, L.; NOTARNICOLA, C.; GEURRIERO, L.; VALENTINI, R. Discrimination of vegetation types in alpine sites with ALOS PALSAR-, RADARSAT-2-, and lidar-derived information. International Journal of Remote Sensing, UK, v. 34, n. 19, p. 6898-6913, 2013.

LAWLEY, V.; LEWIS, M.; CLARKE, K.; OSTENDORF, B. Site-based and remote sensing methods for monitoring indicators of vegetation condition: An Australian review. Ecological Indicators, Netherlands, v. 60, p. 1273-1283, 2016.

MATTAR, E. P. L.; BARROS, T. T. V.; CUNHA, B. B.; de SOUZA, J. F.; SILVA, A .M. C. Federal Conservation Units in Brazil: The Situation of Biomes and Regions. Floresta e Ambiente, Seropédica, v. 25, n. 2, p. 1-10, 2018.

MORO, M. F.; MARTINS, F. R. Métodos de levantamento do componente arbóreo-arbustivo. In: FELFILI, J. M.; EISENLOHR, P. V.; MELO, M. M. R. F.; ANDRADE, L. A.; MEIRA-NETO, J. A. A. (Eds.) Fitossociologia no Brasil: Métodos e estudos de casos. Viçosa, MG: Editora da Universidade Federal de Viçosa, 2011. p. 175-208, 2011.

MUELLER-DOMBOIS, D.; ELLEMBERG, H. Aims and methods for vegetation ecology. New York: John Wiley & Sons, 1974.

NASCIMENTO, E. R. P.; SANO, E. E. Identificação de cerrado rupestre por meio de imagens multitemporais do Landsat: proposta metodológica. Sociedade e Natureza, Uberlândia, v. 22, n. 1, p. 93-106, 2010.

ISSN eletrônico 2177-2738
RA'EGA, Curitiba, PR, V.51, p. 3–16, 8/2021
DOI: http://dx.doi.org/10.5380/raega.v51i0.66295

NUNES, G. M.; SOUZA FILHO, C. R. D.; FERREIRA, L. G. Discriminação de fitofisionomias de floresta de várzea a partir do algoritmo Iterated Conditional Modes aplicado aos dados SAR/R99 (QUAD-POL/Banda L). Acta Amazônica, Manaus, v. 41, n. 4, p. 471-480, 2011.

OKIN, G. S.; ROBERTS, D. A.; MURRAY, B.; OKIN, W. J. Practical limits on hyperspectral vegetation discrimination in arid and semiarid environments. Remote Sensing of Environment, New York, v. 77, n. 2, p. 212-225, 2001.

SALAZAR-GASCÓN, R.; FERREIRA, C. D. C. M. Focos de queimadas na Gran Sabana - Parque Nacional Canaima. Venezuela, uma análise desde 2003 até 2010. GEOSABERES - Revista de Estudos Geoeducacionais, Fortaleza, v. 6, n. 3, p. 181-189, 2016.

SANTOS, A. A. Parques nacionais brasileiros: relação entre planos de manejo e a atividade ecoturística. Revista Brasileira de Ecoturismo, São Paulo, v. 4, n.1, p. 141-162, 2011.

SANTOS, M. G.; SYLVESTRE, L. S.; ARAUJO, D. S. D. Análise florística das pteridófitas do Parque Nacional da Restinga de Jurubatiba, Rio de Janeiro, Brasil. Acta Botânica Brasílica, São Paulo, v. 18, n. 2, p. 271-280, 2004.

SANTOS, R. C.; SILVA, I. R. Serviços ecossistêmicos oferecidos pelas praias do município de Camaçari, litoral norte da Bahia, Brasil. Cadernos de Geociências, Salvador, v. 9, n. 1, p. 47-56, 2012.

SAYRE, R.; ROCA, E.; SEDAGHATKISH, G.; YOUNG, B.; KEEL, S.; ROCA, R.; SHEPPARD, S. Natureza em foco: avaliação ecológica rápida. Arlington, EUA: The Nature Conservancy, 2003.

SMAC/PREFEITURA DO RIO DE JANEIRO. Plano de Manejo do Parque Natural Municipal da Prainha e Parque Natural Municipal de Grumari. Rio de Janeiro: Detzel Consultores Associados S/S EPP, 397 p., 2012.

SILVA, S. T. da; MELLO, J. M. de; ACERBI JÚNIOR, F. W.; REIS, A. A. dos; RAIMUNDO, M. R.; SILVA, I. L. G.; SCOLFORO, J. R. S. Uso de imagens de sensoriamento remoto para estratificação do cerrado em inventários florestais. Pesquisa Florestal Brasileira, Colombo, v.34, n. 80, p.337-343, 2014.

SOBREVILLA, C.; BATH, P. "Evaluación Ecológica Rápida. Programa de Ciências para América Latina." Madrid, ES: The Nature Conservancy, 1992.

SOUZA, E. R., VICENS, R. S., CRUZ, C. B. Estágios de conservação da vegetação em área de mata atlântica, utilizando sensoriamento remoto hiperespectral. GEOgraphia, Niterói, v. 16, n. 31, p. 101-122. 2014.

SOUZA, M. T. R. O litoral Brasileiro. Revista de Cultura do IMAE, São Paulo, v.5, n. 11, p. 63-67, 2004.

SOUZA, N. O. de M.; SANTOS, F. R. P.; SALGADO, M. A. S.; ARAÚJO, F. F. S. Dez anos de história: avanços e desafios do Sistema Nacional de Unidades de Conservação da Natureza. In: MEDEIROS, R.; ARAÚJO, F. F. S. (Org.) Dez anos do Sistema Nacional de Unidades de Conservação da Natureza: lições do passado, realizações presentes e perspectivas para o futuro. Brasília, DF: Ministério do Meio Ambiente, 2011. Cap. 1, p. 9-19.

VELOSO, H. P., RANGEL FILHO, A. L. R.; LIMA, J. C. A. Classificação da vegetação brasileira adaptada a um sistema universal. Rio de Janeiro, RJ: Instituto Brasileiro de Geografia e Estatística, 1991.

WALTER, B. M. T.; GUARINO, E. S. G. Comparação do método de parcelas com o "levantamento rápido" para amostragem da vegetação arbórea do Cerrado sentido restrito. Acta Botânica Brasílica, São Paulo, v. 20, n. 2, p. 285-297, 2006.