

Selection of Species in the Reservoir Ecosystem for Area of the Boca Do Rio Neighborhood in Salvador- BA, Brazil

Maria do Carmo Filardi Barbosa¹, Manoel Jerônimo Moreira Cruz²,
César Ernesto Detoni³

¹ IGEO/UFBA. Jardim Botânico do Salvador, Prefeitura Municipal de Salvador.

²Instituto de Geociências da UFBA.

³ EBDA/CLA.

Abstract: *Considering the importance of the dune ecosystems for the protection of areas and aquifers, this study was carried out presenting the selection of some plant species of the restinga ecosystem that could compose a coastal stretch of the neighborhood of Boca do Rio in the city of Salvador, Bahia, Brazil. The area to be recovered is changed. The decharacterization of the environment is due to the intense depletion of its natural resources caused by the disordered occupation. In this sense, it becomes a challenge to the selection of plant species that associate or that adapt to the existing conditions in this environment. In this way nineteen plant species of arboreal extract were selected (19), seven (07) seven shrubs and (06) six shrubs. However, in view of this scenario, it is pertinent to caution, recommend planting plant species that adapt to the adverse conditions of coastal zones and accompany them for assessments and possible corrections. Thus, we will have a greater control of the anatomical and physiological conditions of the vegetal species planted in this place.*

Keywords: *restinga, vegetation, adaptation*

I. INTRODUCTION

Coastal dune systems are characterized as one of the most important ecosystems, since besides presenting a landscape of great scenic beauty they have important functions. Among the many functions, we can mention the protection of adjacent areas (fields, wetlands, marshes, watercourses and urban areas) against the effects of high tides, winds and invaded unconsolidated sand (OLIVEIRA et al. 2010) avoid the contamination of continental aquifers by salt water. They serve as deposit of sands for natural regeneration of beaches (OLIVEIRA et al., 2010). In addition, although coastal dunes have low yielding soils due to nutrient-poor substrates, they are habitat for numerous species of insects, reptiles, small mammals and nesting sites of some seabirds (SEELIGER et al., 2004). Thus, although recognized for their environmental qualities and functions, and even protected in many parts of the world, these areas continue to be degraded by anthropic actions.

It has been observed that coastal dune systems around the world are under enormous pressure (WILLIAMS, 2001). Furthermore to the predictions of many scientists on the future scenario where climate change, global warming, sea level rise and others will occur (IPCC, 2001, ANDRADE et al., 2002, BAINDOFF et al., 2007 apud MARTINS et al., 2013). These areas are being abruptly disturbed, many coastal ecosystems are vulnerable to disturbances caused by various anthropogenic sources. According to Williams (2001), these environments are losing areas for industry building, military use, golf courses, and so on. All this may contribute to the reduction of biodiversity, changes in the chemical composition of the substrate, and absence of key species in certain communities, in these environments, in various places of the world. (SIMONELLI & FRAGA, 2007; MARTINS et al., 2013).

According to Portz et al., (2010), due to the great attraction that people feel towards the sea, urban development in Brazilian coastal municipalities ends up as close to the beach as possible, altering its original structure. Regarding legal protection, CONAMA Resolution n°. 004 of September 18, 1985 Art. 3 this areas are of permanent preservation, also considered Ecological Reserves, is the forests or other forms of vegetation located: in the *restingas*, in strip Minimum of 300 (three hundred) meters from the maximum waterline; In the dunes, like fixing vegetation. Failure to comply with this Resolution has resulted in numerous animal and plant losses in coastal areas. It is important to establish a more restrictive public use and occupation of these coastal areas due to the fragility and instability that configure these ecosystems

It is observed, on the Brazilian coast, a disordered occupation generating negative environmental impacts (SOUZA, 2010). In these areas, development policies are linked to the "logic of economic rationality" where they incorporate unbalanced management practices without concern for the conservation of the biodiversity and socio-cultural of local communities (OLIVEIRA et al., 2010). The discussions inherent in the production of the coastal space are regulated by interests that turn the coast into a space of disputes. Therefore, the conflicts of use and occupation of the area arise within the framework of the current economic production,

where these environments with their natural ecosystems are being harshly exploited according to the relevant economic interests.

In the coastal area of Boca do Rio neighborhood, the situation is not different from the described scenario, located in the city of Salvador-Bahia, the dune systems were replaced by disorderly urban fronts. According to Mota (2008), at the end of the 1960s, the coastal area of Boca do Rio, which was initially occupied by fishermen's families, became of interest to real estate capital with a high middle income population. This occupation was illegal and disorderly and where houses were built. Currently, this neighborhood, being limited to the north with the set GuilhermeMarback Residential, to the south with the Atlantic ocean, to the east with the neighborhood of Pituauçu and to the west with the districts of Armação and Costa Azul (MOTA, 2008), is taken by houses, subdivisions, hotels, making it the scene of great transformations. In relation to the coastal dunes of this environment, the establishment of human installations associated with continuous real estate speculation makes them uncharacterized by virtue of the use and occupation of the soil of these systems (Figure 01).

In this sense, it is necessary to plant seedlings of *restingain* a stretch in the coastal area of Boca do Rio neighborhood (former Aeroclub Plaza Show) with the purpose of recovering the degraded environment with approximately 250 thousand m² (ATARDE, 2015). This planting will contribute, at least in part, to the ecological and socio-cultural functions of this coastal area that has been weakened due to changes in the morphodynamic balance of this environment. This planting may also favor the presence of seabirds and aquatic birds that live in these coastal environments. Thus, this work, proposing to rescue the biological life of this environment, will provide the well-being of the community living in this region.

II. CHARACTERIZATION OF BOCA DO RIO BEACH

The Boca do Rio beach is located in the coastal area of Boca do Rio neighborhood and is located in the municipality of Salvador-Bahia, Brazil (Figure 01).



Figure 01. Geographic location of Boca do Rio Beach. The white polygon in the image delimits the studied area- (Cartographic Base: satellite image of Boca do Rio Beach, 2016).

The beach of Boca do Rio (located in the neighborhood of Boca do Rio), where it sits on the watershed of the Rio das Pedras and Pituauçu, maintains close connection with the Rio das Pedras hydrographic sub-basin (MOTA, 2008; SANTOS et al., 2010). According to Mota (2008), this river basin has as its sub-basin Rio das Pedras river where its waters flow into this beach (Figure 01). Mota (2008) also states that this river, which forms part of the junction between the Rio Pituauçu and Cachoeirinha rivers, between the neighborhoods of Imbuí and Boca do Rio, despite having little extension, receives the waters of all the rivers that form part of this Basin (Figure 02). The waters of this river carries the wastewater was used by the local population. Therefore, Boca do Rio beach, which is located on the banks of the mouth of the Rio das Pedras, suffers a direct influence of the waters of this river, making this beach "improper" for use during most of the year (MOTA, 2008).

Based on this, it can be noticed that on this beach, when improperly presented to the bath, they begin to appear in the first vegetative formations due to the non-trampling of the vegetation in these sands (Figure 01).

According to Braga (2014), this first vegetation also known as halophytes and halopsamophiles occurs between the medium and high beach (embryonic zone) (Figure 01) and that is crucial for the development of other dune formations. The stability of these sands is considerably benefited by their vegetation coverage (MENEZES & ARAUJO, 1999 apud BRAGA, 2014). Based on this, the vegetation (Embryonic Zone), existing in Boca do Rio Beach (Figure 01), may be avoiding the migration of the sands to the lands adjacent to this beach.

The vegetation is a determining factor in the formation of the coastal dune features, but in this environment, large changes prevail that interfered in the process of dune evolution (Figure 01). It is observed that the destruction of these features is closely related to the anthropogenic actions (MOTA, 2008). The accelerated urban growth, without proper territorial planning, together with the deficiency of the sanitary sewage system, can be considered the main factors responsible for this devastation, which also contributed to the degradation conditions observed in the Rio das Pedras and Pituaçu basin, negatively influencing in the bathing conditions of the ocean beaches of Boca do Rio.

III. CHARACERIZATION OF SPACE FOR PLANTATION OF VEGETABLE SPECIES

The area is located in a stretch of the Boca do Rio (formerly Aeroclub Plaza Show) and is much altered by anthropogenic activity (Figure 01).



Figure 02. Geographic location of the (former Aeroclub Plaza Show) and space for landscaping (Cartographic base: satellite image of Boca do Rio 2016 beach).

It is possible to consider the occurrence of a de-characterization of the whole environment where the suppression of dune dynamics for the civil construction is observed (Figure 01). According to the satellite field and image observations, it appears that this region is located on land belonging to the fluvial-marine and post-beach environmental systems (Figure 01). This type of occupation alters the availability of sediments by modifying the natural course of dune evolution, which may lead to changes in the environmental system essential for the maintenance of a regulating contribution of sand along the coastline. Furthermore, it was observed, in many places of the area where the landscaping will be done, remains of construction material which may render the site unsuitable for planting (Figure 03).



Figure 03 Gravel and other materials used in construction. (Source, BARBOSA, M.C.F.) B. Geographic location of the space for planting (Cartographic base: satellite image of the Boca do Rio 2016 beach).

According to the Housing and Urban Development Company - CDHU (2008), it is necessary for root system growth and consequently better development of plant species, especially tree, to clear the land of debris, garbage and debris as well as Remove invading stones, roots and herbs. According to this body, it is recommended to leave a space for the plant to develop. It is also recommended an analysis of this material for possible diagnoses regarding the degree of fertility of this environment. In coastal regions, the work of revitalizing coastal areas is not an easy task, since the environment with sandy soils, high salinity, low organic matter, high temperature and other factors (JOLY, 1970; KUHLMANN, 1977 apud CUNHA et al. (2003) and Martins et al. (2002) require specialized plants for this environment. These specialized plant species for the work of re-colonization of these environments must have adaptation mechanisms to withstand the adverse conditions characteristic of these areas (Martins et al., 2013). The recovery of degraded areas can be defined as a process of reversion of such areas in productive and self-sustaining lands (IBAMA, 1990 apud SILVA, 2008). Thus, it is possible to reach the level of a recovery of biological processes, which is called "rehabilitation" - or even close to the original ecological structure - "restoration" (CUNHA et al., 2003 apud SILVA, 2008).

IV. RECOMMENDATIONS OF VEGETABLE SPECIES FOR PLANTING

It was observed that the area where the seedlings will be planted corresponds to a zone of great influence of the salinity and prevailing winds and whose chosen plant species have to have adaptation mechanisms that allow their permanence in that environment. The choice of suitable plants will facilitate the maintenance and conservation of these species. The use of not adapted plants can lead to serious problems ranging from exotic invasion to abusive maintenance, water and fertilizer, among others. Therefore, the communities of plants chosen for planting are those that colonize near the beach line or those that support marine influence.

4.1 Planting of tree *restinga*

According to Schmidlin et al. (2005), although *restinga* tree plants are more internalized in the continent, there are tree species that support the marine influence more, since they are in zones of pioneering species of marine influence. In this context, *Tapiraguianensis*, *Schinusterebinthifolius* and *Ilex theezans*. They

are part of this zone (SCHMIDLIN et al, 2005). In addition, these species occur, also in the restinga of Bahia, mainly in the dunes of Abaeté (BRITTO et al., 1993; VIANA et al, 2006; QUEIROZ, 2007; SANTOS, 2013).

Other arboreal species of restinga (occur in Bahia) that can also be selected, since some are having good adaptation, although they colonize more distant areas of the sea. The species are:

Anacardium occidentale (cashew) (QUEIROZ, 2007);-

Vitex cymosa (BRITTO et al., 1993; VIANA et al., 2006);-

Protium heptaphyllum (MARTINS, 2012; SANTOS, 2013);-

Miconia holosericea (SANTOS, 2013);-

Protium bahianum, (VIANA et al., 2006)-

Coccoloba laevis Popular name Cavaçú, Cipó-cavaçú (SANTOS, 2013);-

Coccoloba cordifolia (VIANA et al., 2006);-

Guapira laxa, Schefflera morototoni, Ingacapitata, Simarouba amara, Garcinia-

Gardneriana, Trichillia hirta, Ocotea notata, which are found in the Restinga de Trancoso and Caravelas south coast in dune areas possessing height of approximately 20 meters (SANTOS, 2013);

Coccoloba rosea (MARIANO, 2006);-

Coccoloba uvifera occurs in Bahia - It has tolerance to saline soils and sea salt, has made it an excellent choice for ornamental plantings and coastal windbreaks. Specimens were found in culture in Salvador (MELO, 1996). When properly pruned, it allows an attractive hedge to be made (GILMAN & WATSON, 1993; PARROTTA, 1994 apud RAMOS, 2008). The genus Coccoloba was observed in an area close to the space chosen for planting (Figure 04).

4.2 Contributions to the planting of restinga palm

Syagrus romanzoffiana (Jerivá) is the species with the widest distribution of the genus, occurring from Bolivia and the Brazilian state of Bahia to Uruguay and Argentina, being more abundant in the south and east of Brazil (GLASSMAN 1987 apud BERNACCI et al. , 2008). According to Schmidlin et al. (2005), it has a wide distribution in the pioneering formation with Marine Influence.

4.3 Contributions for the planting of some shrub-trees of resting

Recommended shrub-tree species occurring in Bahia, the recommended species are:

Pisidium. Guajava, *Clethra scabra* var. *scabra* (SANTOS, 2011; PERDIZ et al., 2015). They are species that support high salinity and strong winds, because they are located in the zone of pioneer formation with marine influence (SCHMIDLIN et al, 2005). According to this author, these shrubs are closer to the sea; *Guapira pernambucensis* (Casar) Lundell - north of the coast of the State of Bahia (QUEIROZ, 2007; MENEZES et al., 2012);

Chrysobalanus icaco L (guajiru) (QUEIROZ, 2007; BRITO, 1993);

Lantana camara L, *Comolia ovalifolia* (QUEIROZ, 2007);

Maritime Suriana occurs in the Bahian coast (BRITO, 1993).



Figure 4 presents the genus *Coccoloba* with well-developed green leaves in an area close to the space chosen for planting (Source: BARBOSA, M.C.F.).

4.4 Contribution for the planting of some *restinga* forage

Forage plants are adapted to higher incidence of sunlight, higher salinity and substrate mobility (BRAZ et al, 2013). These grasses depend physiologically and morphologically on the deposition of sand. The burial increases the total area of mesophyll cells per unit of leaf area, thus increasing the plant's capacity to absorb more CO₂ and to have active photosynthetic radiation causing a higher energy content in roots, rhizomes and subterranean stems (PERUMAL AND MAUN, 2006)

Recommended forage species occurring in Bahia. The species are:

Blutaparonportulacoides (BRITO, 1993);-

Ipomea caprae feet (Figure 04). They were found in the dunes of Abaeté (BRITO, 1993);-

Panicumracemosum, (DIAS-& MENEZES, 2007);

Sporobolusvirginicus (MENEZES et al. 2012);-

Alternantheramaritime (Mart) (abaeté dunes) (BRITO, 1993);-

Sesuvimportulacstrum (L), (BRITO, 1993).-

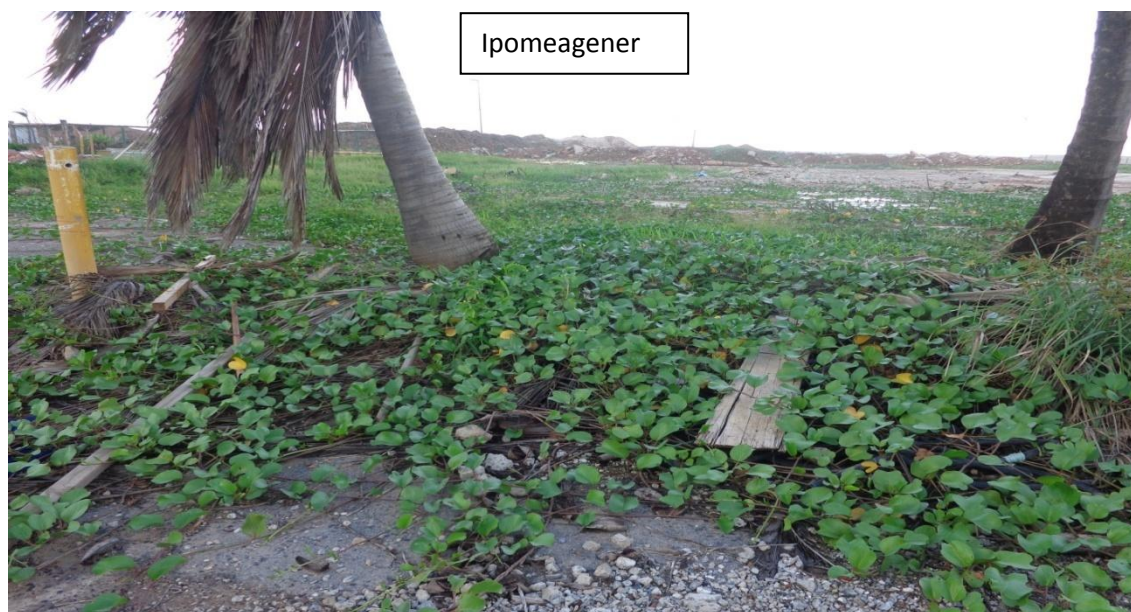


Figure 05. The genus *Ipomea* well developed taking the whole area near the area chosen for planting (Source: BARBOSA, M.C.F.)

V. SPECIES NOT INDICATED IN LITORAL AREAS (BEACH)

The tree species, which were selected in this article are indicated in many coastal areas and many develop naturally in these coastal regions. However, knowing more about each one and its adaptability to edaphoclimatic conditions, it was found that many of these species felt the effects of

The *Caesalpineaechinata* Lam (Brazil-wood) is a species of Brazilian domain.

However, according to Dantas et al. (2009), this species did not show good growth in areas with dominant winds. *Hibiscus pernambucensis* Arruda (Malvaceae) is a 4 m high shrub (JOLY, 1976) and can be found in the restinga and mangrove (ROCHA & NEVES, 2000). Schmidlin et al. (2005) also found this species in estuarine areas, a pioneer formation with fluvial-marinha Influence. According to this author, although this environment has salt fields, it is further away from the sea in the transition areas.

The species of *Calophyllumbrasilienis* Cambess (Guanandi), according to Duffecky & Fossati (2009), *guanandi* is a perennial plant, or diffuse light, characteristic and exclusive of rain forests. It may be that there is adaptation, however, although it is physiologically heliophite, withstand intense light, it is a kind of moist and swampy soil (DUFFECKY & FOSSATI, 2009).

The species *LambramiaBojeri* Lam, *Plumeriarubra* (Jasmine mango) exotic species that have presented a good development in urban area (MORO & WESTERKAM, 2011). There are few studies on the behavior of these species in the urban area and mainly in the area of marine influence. These species were not found in the researched literature on the Bahia restinga flora. It is interesting the biological study of these species before afforestation in coastal areas.

Terminaliacatappa L. (Combretaceae) is an arboreal species originating in coastal areas of Malaysia (MABBERLEY 2008, TANG 2012 apud PLUCÊNIO et al, 2013) and has also adapted very much to coastal lands. There are records of invasion of the species in Central America, South America and Caribbean islands In

the Pacific Islands, the species is invasive in Hawaii (the United States), the Mariana Islands, the Cook Islands and the Galapagos archipelago (Ecuador) (Moreno et al., 2009), and in the case of Brazil, (INSTITUTO HÓRUS 2011; RICHARDSON & REJMÁNEK 2011; LEÃO et al., 2011 apud PLUCÊNIO et al., 2013)

Terminaliacatappa L. is able to invade restinga ecosystems, its seeds support long periods of immersion in the tidal waters, where they remain floating until they are thrown on the beach (GUNN et al., 1997, Thomson & Evans 2006 apud PLUCÊNIO et al. 2013). According to Baratelli, 2006 apud Plucênio et al., 2013) this species is of easy germination, and widespread in the Brazilian coast and the interior, due to ornamental use. Despite tolerance to salinity, the species is able to thrive with the same vigor in clay soil (PLUCENIO, 2013). Baratelli, 2006 apud Plucênio et al., 2013 states that many studies suggest that *T. catappa* competes with native vegetation in the process of natural succession and may impair the development of natural regeneration due to the shading caused by its canopy and allelopathy

Palm trees (*Elaeisguineensis*) can be mentioned, although they have good dissemination in the coastal areas and develop in several types of soil, it has a better development in well drained and deep soils with good aeration and retains moisture (DUARTE, 1988). In the place of this species can be planted *Syagrusromanzoffiana* which is a genus *Syagrus* (Arecaceae) is endemic to South America, has a center of diversity between the Brazilian states of Bahia and Minas Gerais, consists of about 42 species and eight natural hybrids, Of which seven inter-specific and one inter-generic (NOBLICK 1996 apud BERNACCI et al., 2008). According to Schmidlin et al. (2005), it has a wide distribution in the pioneer formation with Marine Influence. Other species were introduced and led to invasion processes, such as species of the genus *Pinus*, species of the genus *Agave*, *Carpobrotus*, *Tecoma*, *Acacia* and *Casuarina* introduced for stabilization of coastal dunes for reforestation with economic purposes (BECHANO & PUGNAIRE, 2004). (2011), and in the literature,

VI. CONCLUSION

Coastal ecosystems are the ones that are most subject to anthropogenic actions. These environments have been suffering degradation ranging from trampling to building houses, hotels and etc in these areas. The result is the shortage of botanical material in many Brazilian coastal areas which may have led to the extinction of many endemic and pharmacological species throughout Brazil. In addition, few studies have been done with these plants in the landscape area, which leads to the planting, in these places, of exotic species. Therefore, this reality shows that there is a need to carry out many studies on these plants and to protect the species that still remain in some coastal locations in Brazil, especially in Bahia.

Landscaping work in coastal areas has not been an easy task. The difficult environmental conditions of coastal zones require species adapted to these environments. Despite the great diversity of native plants in coastal ecosystems, and the existence of a vast literature on this environment, few studies have been done in the landscape area, which leads to a lack of knowledge about the choice of species suitable for planting in these areas. Thus, exotic species have been used in many places. Therefore, this reality demonstrates that there is still much to be researched in order to provide greater technical knowledge for the indication of native plants in landscaping projects in the coastal areas.

In this context, the state of Bahia, despite having the largest coast in the Northeast, still has little knowledge about the restingas mainly on tree species of this ecosystem that support strong winds. Based on this, this work was concerned with selecting both native species and those occurring in the State of Bahia. However, because they do not find literature on the subject, many that occur in Bahia are native to other Brazilian states and many from other countries. Thus, it is essential the biological monitoring of the species recommended for planting.

REFERÊNCIAS

- [1]. AGUIAR, F. F. A.; KANASHIRO, S.; TAVARES, A. R.; PINTO, M. M.; STANCATO, G. C.; AGUIAR, J. de; NASCIMENTO, T. D. R. do. Germinação de sementes e formação de mudas de *caesalpiniaechinatalam.* (pau-brasil): efeito de sombreamento1. *Árvore*, Viçosa-MG, v.29, n.6, p.871-875, 2005.
- [2]. AGUIAR, F. F. A.; KANASHIRO, S.; TAVARES, A. R.; NASCIMENTO, T. D. R. DO; ROCCO, F. M. Crescimento de mudas de pau-brasil (*caesalpiniaechinatalam.*), submetidas a cinco níveis de sombreamento. *Rev. Ceres* vol.58 no.6 Viçosa Nov./Dec. 2011.
- [3]. ATARDE. Projeto de novo shopping na orla está parado <disponível> <http://atarde.uol.com.br/bahia/salvador/noticias/1702898-projeto-de-novo-shopping-na-orla-esta-parado>. 2015 acesso no dia 12 de agosto de 2016.
- [4]. BERNACCI, L. C.; MARTINS, F. R. SANTOS, F. A. M. dos. Estrutura de estádios ontogenéticos em população nativa da palmeira *Syagrusromanzoffiana* (Cham.) Glassman (Arecaceae). *Acta bot. bras.* 22(1): 119-130. 2008.
- [5]. BRAGA, L. G. Riqueza e Estrutura de uma Comunidade halófila-psamófila de restinga no município de Kennedy, ES. Monografia apresentada ao Departamento de Ciências Florestais e da Madeira da Universidade Federal do Espírito Santo. Restinga de Praia das Neves, ES, 2014.
- [6]. BRAZ, D.M., JACQUES, E.L., SOMNER, G.V., SYLVESTRE, L.S., ROSA, M.M.T., PEREIRA-MOURA, M.V.L., GERMANO FILHO, P., COUTO, A.V.S. & AMORIM, T.A. Restinga de Praia das Neves, ES, Brasil: caracterização fitofisionômica, florística e conservação. *Biota Neotrop.* 2013, 13(3): 315-331.

- [7]. BRITTO, I. G.; Queiroz, L. P. de ;Guedes, M. L. S.; Oliveira, N.C. de &Silva, L. B. de. Flora Fanerogâmica das Dunas e Lagoas do Abaeté, Salvador, Bahia. Sitientibus, Feira de Santana, n^o11, p31-46. 1993.
- [8]. CDHU Companhia de Desenvolvimento Habitacional e Urbano. Manual de Poda. <disponível><http://www.cdhu.sp.gov.br/download/manuais-e-cadernos/manual-de-paisagismo.pdf> 2008. cesso no dia 12 de maio de 2015.
- [9]. CONAMA . Conselho Nacional de Meio Ambiente. Crítica aos parâmetros, definições e limites para as áreas de preservação permanente de reservatórios artificiais <disponível>http://www.conpedi.org.br/manaus/arquivos/anais/brasil/11_69.pdf. Acesso no dia 10/04/2015.
- [10]. CORDEIRO, S.Z. Composição e distribuição da vegetação herbácea em três áreas com fisionomias distintas na Praia do Peró, Cabo Frio, RJ, Brasil. Acta Botanica Brasilica 19: 679-693. 2005.
- [11]. CUNHA, L. O.; FONTES, M. A. L.; OLIVEIRA, A. D. de; OLIVEIRA-FILHO, A. T. de. Análise multivariada da vegetação como ferramenta para avaliar a reabilitação de dunas litorâneas mineradas em Mataraca, Paraíba, Brasil. Rev. Árvore vol.27 no.4 Viçosa July/Aug. 2003.
- [12]. DANTAS, H. G. R., LIMA, H. C. & BOHRER, C. B. A. Mapeamento da vegetação e da paisagem do município dearmação dos Búzios, Rio de Janeiro, Brasil. Rodriguésia 60 (1): 025-038. 2009.
- [13]. DUARTE, F. R. A mais Bela Flora Tropical do Mundo. Três Ltda, São Paulo-Br Enciclopedia de Plantas Brasileiras. Três Ltda, São Paulo-Br Brasil. v.3 il, 431p, 1988.
- [14]. DUFFECKY, M. D.; FOSSATI, Luiz Cláudio Fossati Avaliação da adaptação de Calophyllum brasiliensis Cambess. (guanandi), família Clusiaceae, no planalto norte catarinense. revista Ágora de divulgação científica v.16 n 2009.
- [15]. FRACASSO, P. Sistemas de dunas do Parque das Dunas e barreira do inferno/Natal (RN): Levantamento Geológico/ Geofísico, elaboração do Modelo Determinístico e avaliação da vulnerabilidade frente às pressões antrópicas. Dissertação apresentada a Universidade Federal do Rio Grande do Norte, como requisito parcial para a obtenção do Título de Mestre em Geodinâmica e Geofísica 176 p. 2005.
- [16]. HESP, P. A. Foredunes and blowouts: initiation and dynamics. Geomorphology. 48:245-268, 2002.
- [17]. JOLY, A.B. Botânica - introdução à taxonomia vegetal. São Paulo: Editora Nacional. 1976.
- [18]. MARIANO, K. R., S. Dinâmica Ecofisiológica da Cocoloba rósea Meisn e Cocoloba ramosissima Wedd. (Polygonaceae: fenologia, ciclagem, biogeoquímica de nutrientes e área foliar em um fragmento de restinga na região de Alagoinhas, BA, 2006.
- [19]. MARTINS, C. M. COSTA, C. J. The meaning of mainland Portugal beaches and dunes' psammophilic plant communities: a contribution to tourism management and nature conservation J Coast Conserv 17:279-299. 2013.
- [20]. MARTINS, M. L. L. Fitofisionomia das formações vegetais da Restinga da Área de Proteção Ambiental (APA) de Guaibim, Valença, Bahia, Brasil. R. bras. Bioci., Porto Alegre, v. 10, n. 1, p. 66-73, jan./mar. 2013.
- [21]. MELO, E. Levantamento de espécies de Cocoloba (Polygonaceae) da restinga do Estado da Bahia, Brasil Sitientibus, Feira de Santana, n 15, p 49-59. 1996
- [22]. MENEZES, C. M. SANTANA, F. D. SILVA, V. S. A. SILVA, V. I. S. ARAÚJO, D. S. D. Florística e fitossociologia em um trecho de restinga no Litoral Norte do Estado da Bahia. Biotemas, 25 (1), 31-38, março de 2012.
- [23]. MORO, M. F.; WESTERKAMP, C. A. arborização alienígena de fortaleza (nordeste do Brasil): observações qualitativas e um levantamento em dois bairros ci. Ciência florestal, Santa Maria, v. 21, n. 4, p. 789-798, out.-dez., 2011.
- [24]. MOTA, Raimundo Brito. Crescimento urbano na bacia hidrográfica de Pituçu e suas repercussões nas condições de balneabilidade das praias oceânicas da Boca do Rio e dos Artistas. Salvador, 191 f.: il. 2008.
- [25]. OLIVEIRA, A. C. C. A., SOUZA, R. M. Ecodinâmica dos sistemas dunares do município de Pirambu, Litoral Norte de Sergipe. Sociedade e Território, Natal, v. 23, n^o 2, p. 2 - 20, jul./dez. 2011.
- [26]. OLIVEIRA, A. C. de A.; SANTOS, S. S. C dos; SOUZA, R. M.; Dinâmica ambiental das dunas costeiras da praia de jatobá, barra dos coqueiros, Sergipe frente às formas de uso e ocupação In: Anais XVI Encontro Nacional dos Geógrafos: Crise, práxis e Autonomia: espaços de resistência e de esperanças. Espaços de diálogos e práticas. Porto Alegre 2010.
- [27]. PERDIZ, R. de O. GIULIETTI, A. M. & OLIVEIRA, R. P. Flora da Bahia: Clethraceae. Sitientibus: série Ciências Biológicas V.15, 1- 4p. 2015.
- [28]. PERUMAL, V. Jand. MAUN, M. A. Ecophysiological response of dune species to experimental burial under field and controlled conditions. Plant Ecology. 184:89-104. 2006.
- [29]. PLUCÊNIO, Renata Martins; Michelle de Sá Dechoum & Tânia Tarabini Castellani. Invasão Biológica em Restinga: O Estudo de caso de Terminalia catappa L. (Combretaceae) Biodiversidade Brasileira, 3(2); 118-136, 2013
- [30]. PORTZ, L. C.; MANZOLLI, R. P.; GRUBER, N. L. S.; CORREA, I. C. S. Turismo e degradação na orla. Desenvolvimento e Meio Ambiente, n. 22, p. 153-166, jul./dez. Editora UFPR, 2010.
- [31]. QUEIROZ, E. P. Levantamento Florístico e Georeferenciamento das espécies com potencial econômico e ecológico em restinga de mata de São João, Bahia, Brasil. Biotemas, 20 (4): 41-47, dezembro de 2007.
- [32]. WILLIAMS, A. T., ALVEIRINHO-DIAS, J., GARCIA-NOVO, F., GARCÍA-MORA, M. R., CURR, R., PEREIRA, A. Integrated Coastal Dune Management: Checklists. Continental Shelf Research. 21: 1937-1960, 2001.
- [33]. RAMOS, P. C. de O. Efeito de diferentes fontes de nitrogênio no crescimento de *coccolobauiferal*. Monografia apresentada ao Curso de Engenharia Florestal, como requisito parcial para a obtenção do Título de Engenheiro Florestal, Instituto de Florestas da Universidade Federal Rural do Rio de Janeiro. 18p. 2008.
- [34]. ROCHA, F. J.; NEVES, L. J. Anatomia Foliar de Hibiscus tiliaceus L. e Hibiscus pernambucensis Arruda (Malvaceae) Revista **Rodriguésia** Rio de Janeiro 51(78/79): 113-132. 2000
- [35]. SANTOS, C. X. Caracterização físico-química e análise da composição química da semente de goiaba oriunda de resíduos agroindustriais. Dissertação apresentada à Coordenação do Programa de Pós-Graduação em Engenharia de Alimentos da Universidade Estadual do Sudoeste da Bahia (UESB), Itapetinga/BA. 61p 2011.
- [36]. SANTOS, E.; PINHO, J. A. G. de; MORAES, L. R. S. FISCHER, T. O Caminho das Águas em Salvador: Bacias Hidrográficas, Bairros e Fontes, organizadores. – Salvador: CIAGS/UFBA; (Coleção Gestão Social) SEMA. 486p. :il.; 2010.
- [37]. SANTOS, V. de J. Restingas do Estado da Bahia: riqueza, diversidade e estrutura. Tese apresentada a universidade Federal de Pernambuco. Recife., 145 f. : il. 2013.
- [38]. SEELIGER, U.; CORDAZZO, C. V.; BARCELLOS, I. Um guia ecológico ilustrado do litoral no extremo sul do Brasil. G, Rio Grande, Brasil, 96p. il, 2004.
- [39]. SCHMIDLIN, L. A. J.; ACCIOLY, A.; ACCIOLY, P.; KIRCHNER, F. F. Mapeamento e caracterização da vegetação da ilha de superagüi utilizando técnicas de geoprocessamento instituto de pesquisas ecológicas, ipe Floresta, Curitiba, pr, v. 35, n. 2, mai./ago. 2005

- [40]. SILVA, S. S, L. ZICKEL, C, S. e CESTARO, L, A. Flora vascular e perfil fisionômico de uma restinga no litoral sul de Pernambuco, Brasil1 Acta bot. bras. 22(4): 1123-1135. 2008.
- [41]. SIMONELLI, M.; FRAGA, C. N. Espécies da Flora Ameaçadas de Extinção no Estado do Espírito Santo. Vitória: Ipema, 144p, 2007,
- [42]. SOUZA, C. V. P.: Vulnerabilidade dos Sistemas Dunares da praia do Meco. Dissertação apresentada na Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa para obtenção do grau de Mestre em Engenharia do Ambiente, perfil de Engenharia Ecológica, 105p. 2010.
- [43]. VIANA, B.F., SILVA, F.O. & KLEINERT, A.M.P. A flora apícola de uma área restrita de dunas litorâneas, Abaeté, Salvador, Bahia. Revista Brasileira de Botânica29:13-25. 2006.