Brazilian Coastal and Marine Protected Areas

Importance, Current Status and Recommendations

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ABSTRACT

Brazil's maritime region holds an extraordinary biodiversity with more than 7,400 km of coastline and 3.6 million km² of exclusive economic zone. This area includes 3,000 km of coral reefs and 12% of the world's mangroves. These areas and their natural resources are extremely important for the economy of the country. Around 18 % of Brazilian population lives on the coast and economic activities in this areas account for about 70% of the country's GDP, resulting in pressures on coastal resources and negative impacts on the biodiversity. The main Brazilian strategy for biodiversity conservation *in situ* is the establishment and the maintenance of the National System of Protected Areas. Despite efforts to create Protected Areas, the Marine Biome has the smallest percentage of area under protection in Brazil, with about 1.5%. Moreover, the few designated marine protected areas have not been well implemented and managed. Historically, public and political ignores economic benefits of ecosystem services and non-utilitarian benefits, instead considering only the immediate values obtained from direct exploration. Currently, the politics and social context in Brazil are unfavorable to the establishment of new Protected Areas and the fuller implementation and better management of the existing ones.

This paper provides an overview of the Brazilian legal framework for protected areas and current governmental plans and actions. The MPAs' current situation was analyzed, in terms of number, area, and ecosystems representativeness. Procedures, challenges, and difficulties to the establishment and implementation of MPAs are presented. The paper argues that early stakeholder engagement in planning and enhanced public awareness about MPAs benefits are necessary if more MPAs are to be established and well managed. Concluding, coastal and marine spatial planning and other related strategies that include meaningful public participation, increased financial resources for planning and implementation, and the subsequent increased political support are essential to ensure environmental protection for costal and marine biomes in Brazil.

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ACRONYMS

APP	Permanent Preservation Area
CBD	Convention on Biological Diversity
CCC	Convention on Climate Change
CIRM	Inter-ministerial Commission for Marine Resources
CLCS	Commission on the Limits of the Continental Shelf
CNUC	Brazilian National Protected Areas Register
CONABIO	Brazilian National Biodiversity Commission
COP	CBD Conference of the Parties
DETER	Real Time Deforestation Detection
EBSMA	Ecologically or Biologically Significant Marine Area
EEA	European Environment Agency
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FUNAI	National Indian Foundation
GCRMN	Global Coral Reef Monitoring Network
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GIS	Geographic Information Systems
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IBGE	Brazilian Institute of Geography and Statistics
ICMBio	Chico Mendes Institute of Biodiversity Conservation
IL	Indigenous Land
ISA	Socio-Environmental Institute
IUCN	International Union for Conservation of Nature
KFW	German Financial Cooperation
MMA	Brazilian Ministry of Environment
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NEAFC	Northeast Atlantic Fisheries Commission
NGO	Non-governmental Organization
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic

PA	Protected Area
PNAP	National Strategic Plan on Protected Areas
PNGC	National Coastal Management Plan
PNMA	National Environmental Policy
PNRM	National Policy for Marine Resources
PRODES	Brazilian Amazon Forest Satellite Monitoring
PSRM	Brazilian Sector Plan for the Resources of the Sea
RAPPAM	Rapid Assessment and Prioritization of Protected Areas Management
REMPLAC	Mineral Potential Assessment of the Brazilian Continental Shelf
RFT	Rain Forest Trust Fund
SAMGe	Management Monitoring and Evaluation System
SBSTTA	CBD Subsidiary Body for Scientific, Technical and Technological Advice
SISNAMA	National Environmental System
SNUC	Brazilian National System of Protected Areas
TNC	The Nature Conservancy
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
US	United States
VAT	Value-Added Tax (ICMS, in Brazil)
WDPA	World Database on Protected Areas
WWF	World Wildlife Fund

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INTRODUCTION

Located in South America, Brazil (Federative Republic of Brazil) is the world's fifth largest country both by geographical area (8.5 million km²) and by population (around 204 million people). It is the largest Portuguese-speaking nation in the world. The country occupies nearly half of South America and cover some climatic zones, such as the humid tropics in the North, the semi-arid in the Northeast and temperate areas in the South. These climatic differences lead to a wide ecological variation with distinct biogeographic zones or biomes: The Amazon rainforest, the largest tropical rainforest in the world; the Pantanal, the largest floodplain; the Cerrado savannas and woodlands; the Caatinga semi-arid forests; the fields of the Pampas; and the tropical rainforest of the Atlantic. In addition, Brazil has a marine coast of 3.56 million km², which includes ecosystems such as coral reefs, dunes, mangroves, lagoons, estuaries and marshes (see more details above).

The variety of biomes reflects the enormous wealth of flora and fauna of the country: Brazil is home to the greatest biodiversity on the planet. This abundant variety of life represents more than 20% of the total number of species on Earth. Therefore, Brazil is the principal nation among the 17 mega-diverse countries (or greater biodiversity)[1]. The country owns 3,000 km of coral reefs and 12% of mangroves in the world.

The country is also home to a rich social diversity, represented by over 200 indigenous peoples and other traditional communities, such as quilombolas[2], caiçaras[3], and rubber tree tappers. These traditional peoples have a priceless collection of traditional knowledge on biodiversity conservation.

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[1] See http://www.mma.gov.br/biodiversidade/biodiversidade-brasileira

[2] Quilombolas are descendants of black slaves who in the slavery resistance process originated social groups occupying a common territory and sharing cultural characteristics. That slaves founded small villages called quilombos. Currently there are more than 2,600 quilombos in the national territory recognized by Brazilian government. See more at http://www.palmares.gov.br/?page_id=37551

[3] According to Bergossi (2006), caiçaras are rural native inhabitants of the Atlantic Forest coast, descendants of Tupinambá *Indians*, the first inhabitants of the Brazilian coast of Native Indians and Portuguese. Alpina Bergossi, "The Ethnoecology of Caiçara Metapopulations (Atlantic Forest, Brazil): Ecological Concepts and Questions", *J Ethnobiol Ethnomed*, Vol. 20 (29 September 2006). Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1592541/

The Brazilian coastline is washed by cold water in the southern and southeastern coast and warm waters in the north-east and north coasts, supporting a wide variety of ecosystems that include sandy beaches, cliffs and rocky shores, dunes, restingas, swamps and wetlands, estuaries, lagoons, mangroves, and marshes, that are home to numerous species of flora and fauna, many of which are endemic and some endangered. [4, 5] For this document, the Country's main coastal ecosystems are following defined[6]:

Beaches are sand or other particles deposits brought by rivers or by the sea, along the coast or the edge of a river or lake, with a variable width as a function of the tide. Brazil holds 828 km² of beaches in all 17 coastal states.

Cliffs and rocky shores are environments formed by rocks located at the transition between terrestrial and aquatic areas. They are considered a marine extension, because most organisms that inhabit rocky shores are related to the ocean. In Brazil, part the cliffs are formed by rocks of volcanic origin and part are extensions of mountains, near the coast, which reach the seabed, thus constituting highly heterogeneous environments. The extension of the cliffs and rocky shores is about 1,400 km².

Coastal dunes are hills of sand formed from the interaction between marine origin sediments; the wind and/or water flow, which carries such sediments toward the mainland; and vegetation, which acts as a physical barrier to sediment transported. They are associated with beaches and salt marshes, often in the form of extensive fields generated by wind action, such as Lençois Maranhenses. The dunes cover 1,850 km² distributed in 11 states.

Restingas or fixing dunes or stabilizing mangroves vegetation are characterized by medium-sized trees and shrubs adapted to the drier and nutrient-poor conditions, from a set of distinct vegetation types that reflect soil and climate differences existing in the Brazilian coast. Restingas form on bands of sand deposited parallel to the coast. The total area of restinga is 4,700 km² in

[4] Brazil, Ministry of Environment, *Avaliação e Ações Prioritárias para a Conservação da Biodiversidade das Zonas Costeira e Marinha* (Brasilia, DF, 2002)

[5] Brazil, Ministry of Environment, *Avaliação e Ações Prioritárias para a Conservação da Biodiversidade das Zonas Costeira e Marinha* (Brasilia, DF, 2002)

[6] Definitions based on Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

15 states.

Swamps and wetlands cover 48,500 km² of national territory in 13 states, including swamps, wetlands, savannahs, periodically flooded forests and fields, freshwater or water brackish or salt ponds, with or without it direct marine influences. A swamp gets formed because of floods with shallow water remaining in the area permanently. Swampy areas have dry land, and that is covered with thick vegetation. This vegetation tolerates water when it comes in the shape of a flood.

Marshes are brackish coastal environments, lagoon or estuarine, swampy, plan, and shallow water levels which develop in the intertidal zone, remained partially flooded the majority of high tides. These areas have small plants in the form of grasses and moss growing over the wetland, of the genus *Spartina* spp. March areas receive frequent floods and the water does not get drained away. Marshes occur only in south of Brazil, covering 120 km² in 2 states.

Estuaries are bodies of water and surrounding habitats formed where rivers meet the sea. These areas are permanently connected to the sea ecosystem, where salt water mixes with fresh water from the continental drainage. Nutrient-rich water from is one of the most important elements responsible for high primary productivity in these environments. This productivity is even higher when there are areas of mangroves. Almost 67,000 km² of the national territory are estuaries.

Lagoons and ponds are bodies of water generally narrow, connected to sea by bars that remain closed by reefs or sandbanks during a certain period. Tropical lagoons may present seasonal variations of salinity due to the rains. Lagoons along the Brazilian coast are particularly important for fishing, leisure activities and tourism. The area covered by this ecosystem is over 15,000 km², and 97% is concentered in the southernmost state (Rio Grande do Sul).

Mangrove is a coastal forest located in the transition between terrestrial and marine environments, subject to tidal regime, occurring in tropical and subtropical regions. Mangroves cover over 12,000 km² in almost whole Brazilian coast, from the Oiapoque to Laguna in Santa Catarina, forming areas of high biological productivity.

In 1988, Brazil ratified the United Nations Convention on the Law of the Sea, UNCLOS, the main international agreement on the use of the oceans and their natural resources. This international convention establishes the concepts of territorial sea, exclusive economic zone (EEZ) and continental shelf and gives coastal states sovereignty rights and duties about the maritime zones. The decisions established by UNCLOS have been incorporated into Brazilian legislation in 1993[7], thus making the Brazilian maritime boundaries consistent with those recommended by the Convention. Under the terms of this treaty, the country has taken a series of rights and duties, among which those related to determine the allowable catch of the living resources in the EEZ and ensure the conservation of living resources in the EEZ are highlighted.

Marine areas under national jurisdiction include: The Territorial Sea, which extends from the baseline to the limit of 12 nautical miles; the EEZ, from 12 to 200 nautical miles measured from the baseline; and the Continental Shelf, comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines. Brazil's EEZ is almost 3.6 million km². The country has claimed another 963,000 km² of continental shelf beyond 200 nautical miles at some points, which according to some national scientific institutions represents the natural extension of the continental shelf (Figure 1). The U.N. Convention's Commission on the Limits of the Continental Shelf (CLCS) has approved part of the Brazilian's request, adding 712,000 km² to its continental shelf. The resulting area is 4.3 million km², which is equivalent to half of the country's land territory. The decision on the rest is still pending. The continental shelf can grant economic benefits from exploitation of living and non-living resources.

[7] Law 8617/1993. Available from http://www.planalto.gov.br/ccivil_03/LEIS/L8617.htm

Figure 1. Brazilian Territorial Sea, EEZ and Continental Shelf extension required ("Blue Amazon")[8]

Brazil holds more than 7,400 km of coastline (around 9,200 km considering its curves and indentations) facing the Atlantic Ocean, located between the Oiapoque River (04°52'45" N) and Chuí River (33°45'10" S). The Coastal Zone was defined by the Decree

[8] Extracted from http://cenegri.org.br/portal/?p=817 Sorce: Instituto Igarapé See http://www.igarape.org.br/pt-br/?s=blue+amazon

5300/2004 for management purposes as the geographic space of interaction among air, sea and land including its renewable resources, covering a maritime and a terrestrial portion. The Territorial Sea stated in UNCLOS is considered the maritime portion. [9] This Decree defines the terrestrial portion as the range of the continent formed by municipalities that are influenced directly from the coastal phenomena, as follows: a) Municipalities located on the coastline; b) Non-coastal municipalities located in metropolitan coastal areas; c) Non-coastal municipalities contiguous to coastal big cities and coastal state capitals; d) Non-coastal municipalities up to 50 km from the coastline, which participate in its territory activities, infrastructure or environmental impact on the coastal zone, or coastal ecosystems of high relevance; e) estuarine-lagoon municipalities, even if not directly on the coastline; and f) Non-coastal municipalities which have all their limits with the municipalities referred above[10]. According to the Article 3, Paragraph 1 of the Decree 5300/2004, the list of coastal zone municipalities should be published annually by MMA. Thus, the terrestrial portion of the coastal zone has variable width, currently comprising 395 municipalities from 17 coastal states. The coastal zone covers about 514,000 km², including approximately 324,000 km² terrestrial and 190,000 km² equivalent to the marine portion (territorial sea).

The Coastal Zone is connected with two important and biodiverse biomes, the Amazon and the Atlantic Rainforest, with a significant overlap. Coastal areas are regions of ecological transition, with essential liaison and genetic exchanges function between terrestrial and marine ecosystems. Therefore, these environments are classified as complex, diverse and fundamental for sustaining life at sea. The high concentration of nutrients and other environmental conditions, such as thermal gradients and varying salinity, as well as the diversity of shelters and support for offspring of the most species that inhabit the oceans breeding and feeding, makes the coastal habitats on one of the main focuses attention with respect to environmental and biodiversity conservation. Concern about the health and environmental balance of the coastal regions stem from the fact that they are the most threatened ecosystems

[9] Brazil, Decree 5300/2004, Article 3. See http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2004/Decreto/D5300.htm

[10] Brazil, Decree 5300/2004, Article 4. See http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2004/Decreto/D5300.htm

on the planet, and also because they represent a link to intense exchange of goods for human societies. Coastal habitats have suffered by disordered and often predatory exploitation of its natural living and non-living resources. These areas have become the main site of leisure, tourism or housing of large masses of urban populations. The Marine Zone, corresponding to the EEZ and continental shelf, is less environmentally vulnerable by offering greater resistance to human interventions due to great depths and currents, storms and distance of densely populated land areas.

Coastal and marine biomes are extremely important for the Brazilian economy. Approximately 43 million people, about 18% of the Country's population, live in the Coastal Zone and 16 of the 28 metropolitan areas are on the coast. Coastal economic activities account for about 70% of GDP[11]. The major activities are tourism, industry, agriculture, fisheries, and mineral exploration, but there is a big potential in the biotechnology and energy fields. The negative impacts on coastal and marine ecosystems caused by the increase of people living and working in the coastal zone and using their resources should be understood and monitored aiming the environmental conservation and to maintain the quality of human life. The adverse effects of human pressures include the loss of habitats, such as marshes, mangroves, and coral reefs, lower quality of coastal water and ground water, algal blooms, declining commercial and artisanal fisheries, decrease in living and non-living resources, pollution of beaches, increased erosion and coastal flooding, among others. The coastal areas are among the most threatened on the planet due to pressure suffered on their integrity, environmental balance, and conflicts of use. Thus, conserving coastal and marine resources tends to be increasingly challenging and costly, in political, financial and environmental perspectives. [12]

With reference to fishing production, one of the major concerns of professionals and institutions that work with conservation of marine and coastal biodiversity is the collapse and the threat of extinction of fish stocks. Several authors indicate the establishment of no-take

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[11] Brazil, Ministry of Environment, *Programa Nacional de Gerenciamento Costeiro- GERCO* (Brasilia, DF, 2007). Available from http://www.mma.gov.br

[12] Brazil, Department of Biodiversity Conservation, Secretariat for Biodiversity and Forests, Ministry of Environment, *Áreas Prioritárias para Conservação, Uso Sustentável e Repartição de Benefícios da Biodiversidade Brasileira* (Brasilia, DF, 2007). Available from http://www.mma.gov.br/estruturas/chm/_arquivos/biodiversidade31.pdf

zones[13] as an effective instrument to recover overexploited, collapsed or threatened stocks because these areas can function as nurseries or as export sources of mature individuals for adjacent areas.

The main Brazilian strategy for biodiversity conservation *in situ* is the establishment and the maintenance of the National System of Protected Areas (SNUC, in Portuguese is Sistema Nacional de Unidades de Conservação da Natureza). Brazil ratified the Convention on Biological Diversity (CBD) in 1994[14], and in 2000 the Government approved Law 9985/2000, implementing the SNUC. In 2010, the CBD Global Biodiversity Outlook 3[15] reported that global targets set to prevent biodiversity loss have not been accomplished, reinforcing the urgency in establishing concrete actions for the conservation and sustainable use of ecosystems, especially in coastal and marine areas. In this scenario, although Brazil has advanced significantly to achieve its biodiversity targets, especially in Amazon Biome, the country is faced with a long way to ensure the conservation of its biological diversity, especially in the marine environment. According to the Aishi Biodiversity Target 11, by 2020 at least 17% of terrestrial and inland water, and 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, shall be conserved through effectively and equitably managed. Despite efforts to create Protected Areas, the Marine Biome is the smallest percentage under protection in Brazil, with about 1.5%. Currently, the politics and social context in Brazil are unfavorable to the establishment of new Protected Areas and the implementation of the existent ones.

The maintenance of essential ecological processes of great importance to society depends of the appropriate establishment and management of ecosystems. Historically, the policy ignores the aggregate value of the maintenance of the ecosystem balance, considering only the straight and immediate values obtained from direct exploration. The few marine protected areas that have been created do not guarantee their implementation through transversal policies. Some of them are being *biological islands* and *sanctuaries* for the

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[13] No-take zones are MPAs where extractive activities, such as fishing, mining, drilling, hunting, logging, and others are prohibited.

[14] Brazil, Legislative Decree 02/1994. See http://www2.camara.leg.br/legin/fed/decleg/1994/decretolegislativo-2-3-fevereiro-1994-358280-publicacaooriginal-1-pl.html

[15] Secretariat of the Convention on Biological Diversity, *Global Biodiversity Outlook 3*, (Montreal, 2010), 94p.

preservation of species and this isolation does ensure neither their existence nor their purposes. Others are just *paper parks*, i.e. MPAs designated but not providing the levels of protection needed by enforcement and management actions.

OVERALL OBJECTIVES:

In order to establish guidelines and tools that help the Brazilian government to reach its conservation goals for Coastal and Marine ecosystems' protection, the objectives of this work are:

- ✓ Describe the Brazilian National System of Conservation Units with a proposition of translation the names of Conservation Units categories for English considering IUCN categories;
- ✓ Update the information about the current situation of the Brazilian marine and coastal protected areas and research the actual status in terms of number and size of the Brazilian Conservation Units;
- ✓ Investigate and evaluate the challenges and difficulties to establish and implement MPAs and search for solutions adopted by other experiences and discuss about the processes and challenges in establishing and implementing Protected Areas in Brazil; and
- ✓ Recommend strategies and actions to ensure environmental protection for costal and marine biomes in Brazil.

CHAPTER 1 – BIODIVERSITY, HUMAN ACTIVITIES, AND IMPACTS ON COASTAL AND MARINE BIOMES

1.1. The Importance Of Coastal And Marine Biodiversity

The term Biodiversity or biological diversity, created in 1980 by environmentalist Thomas Lovejoy, refers to the degree of variation of species on a certain location. In its original concept it relates to the number of different species on an area of a certain size (species number/land size). There are several definitions for biodiversity in the current literature with reasonable consensus on its meaning.

Most definitions of the term refer to genes, species, and ecosystems. According to the U.S. Office of Technological Assessment, "Biological diversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequency. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the chemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, genes, and their relative abundance."[16]

The concept of biodiversity has been politicized since the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The Convention on Biological Diversity (CBD) defines biodiversity as: "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."[17] Brazilian government ratified the CBD in 1998 by Decree 2,519/1998[18], and the same concept of biodiversity was also adopted in Law 9,985/2000[19], that instituted the National System of Protected Areas.

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[16] United States, U.S. Office of Technological Assessment, *Technologies to Maintain Biological Diversity* (Washington, D.C., 1987)

[17] Article 2 of the CBD, available from https://www.cbd.int/doc/legal/cbd-en.pdf

[18] Available from http://www.planalto.gov.br/ccivil_03/decreto/D2519.htm

[19] Available from http://www.planalto.gov.br/ccivil_03/LEIS/L9985.htm

Species diversity varies across the globe with latitude, longitude, and altitude (or its equivalent, depth, in the oceans). Considering the species scale, the humid tropics have the greatest biodiversity, while the biodiversity decreases towards the north and south as the temperatures decrease. The trend toward higher species diversity in the tropics is perhaps the most conspicuous biogeographic pattern in nature, and is sufficiently general to have been considered a "rule"[20]. Also, less humidity is associated with decreasing species density. Furthermore, stress is reversely related to biodiversity, e.g.: poor drainage, waterlogging and seasonal flooding; fire; very eutrophic and oligotrophic conditions; estuarine conditions with fluctuating salinity and/or great tidal difference; long seasonal draughts. All tend to lower species densities. However, such stress conditions all have species that are well adapted to the stress factors, and ecological variant leads to the occupation of a different assemblage of species. In most marine groups, diversity is maximal in the Indo-West Pacific.

Estimates of the total number of species found on the planet Earth vary widely, largely because most living species are microorganisms and tiny invertebrates, but most estimates fall between 3 million and 30 million species[21]. Roughly 1.75 million species have been formally described and given official names[22]. The number of undescribed species is undoubtedly much higher, however.

The oceans cover over 70% of the planet's surface and dominate the living space, accounting for 98% of the potentially habitable volume. This habitat is critical to the health of the planet as it holds more than 10 times the carbon of all terrestrial plants and soil combined[23], about 50 times greater than the amount in the atmosphere, and is exchanged with the atmosphere on a time-scale of several hundred years[24]. It also has a moderating influence on Earth's temperature and atmosphere. The diverse habitats of the oceans support 31 phyla of

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[20] See http://www.eoearth.org/view/article/150560/

[21] Har Darsan Kumar, *Biodiversity and Susteinable Conservation* (Enfield, New Hampshire, Science Publishers, 1999)

[22] See http://www.eoearth.org/view/article/150560/

[23] See http://www.mbari.org/news/publications/ar/chapters/08_MarineBiodiversity.pdf

[24] See http://science.nasa.gov/earth-science/oceanography/ocean-earth-system/ocean-carbon-cycle/

animals, 12 of them endemic to the marine realm[25].

Biological diversity is of fundamental importance to the functioning of all natural and human-engineered ecosystems, and by extension to the ecosystem services that nature provides to human society. Living organisms play central roles in the cycles of major elements as carbon and nitrogen, and water in the environment, and diversity specifically is important in that because these cycles require numerous interacting species. Coastal and marine biomes are the likely repositories for even greater variation. Retention of diverse biota is important, since intact ecosystems are thought to be essential for provision of ecosystem services to humans, including maintenance of a diverse foodbank, pollination, clean water, flood control, pest control, waste decomposition, biomass energy resources and climate stability.[26]

Every ecosystem performs certain functions that are critically important for organisms. One of the most important functions of marine ecosystems is the production of plant biomass from sunlight and nutrients (primary productivity), which represents the basic food source for all life in the ocean, and ultimately also for humans. Around half of the worldwide primary productivity is achieved by microscopically small plants, the phytoplankton, which live in the ocean. Marine biodiversity plays a key role through ecosystem services. They provide economic wealth and resources that range from active ingredients for pharmaceuticals and medicine to products from fisheries and aquaculture, as well as contributing to cultural well-being and supplying relevant biological models for research[27].

Scientists have addressed the question of whether the dramatic decline in biological diversity has consequences for the stable functioning of ecosystems. Experiments in coastal ecosystems, particularly seagrass meadows and kelp forests, have shown that biological diversity in the oceans is essential for maintaining the ecosystem functions. Some results indicate that a decrease in biological diversity has a negative impact on the structure of the habitat, regardless of whether the number of species of producers (macroalgae) or consumers

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[25] Philippe Goulletquer and others, *Biodiversity in the Marine Environment* (Orvault, France, Springer, 2014)

[26] See http://www.eoearth.org/topics/view/51cbfc78f702fc2ba8129e70/

[27] Philippe Goulletquer and others, *Biodiversity in the Marine Environment* (Orvault, France, Springer, 2014)

(grazers) is reduced.[28]

Because of rapid changes in water temperature, salinity and nutrient concentrations, and due to overfishing, habitat destruction and the introduction of foreign species, global biological diversity in the oceans is rapidly declining. There is no doubt about this: the disruptive forces are cumulative and will cause further species to disappear. This will then cause a decrease in the stabilizing function of the formerly diverse communities, with potentially hazardous results – habitats that cannot perform their ecosystem functions, or that lose their resilience.[29]

Considering its importance, general interest in biodiversity and concern about nature conservation has grown rapidly in recent decades. At the same time, the rates of natural habitat loss, habitat fragmentation and degradation has accelerated, resulting extinctions of species. The IUCN Red List estimates that 13-40% of species within well-studied higher taxa such as vertebrates and vascular plants are endangered[30]. Based on data on recorded extinctions of known species over the past century, scientists estimate that current rates of species extinction are about 100 times higher than long-term average rates based on fossil data[31]. Other plausible estimates suggest that present extinction rates now may have reached 1000 to 10,000 times the average over past geologic time.

Biological diversity in the oceans has decreased dramatically since industrialization began in the 19th century. The primary causes for the losses include the destruction of habitats by trawler fishing, pollution and eutrophication of the seas, as well as the steady progress of climate change. Biological diversity is probably declining more rapidly than ever before in the history of the Earth. But at the same time, only a small fraction of the species in the deep sea and polar oceans have so far been identified, making the loss of species in the oceans much

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[28] See http://worldoceanreview.com/en/wor-1/marine-ecosystem/biodiversity/

[29] See http://worldoceanreview.com/en/wor-1/marine-ecosystem/biodiversity/2/

[30] See http://www.iucnredlist.org/about/summary-statistics#How_many_threatened and http://cmsdocs.s3.amazonaws.com/summarystats/2015_2_Summary_Stats_Page_Documents/2015_2_RL_Stats_Table_1.pdf

[31] See http://www.eoearth.org/view/article/150560/

more difficult to record and evaluate than on land[32]. Thus, reduction in biodiversity undermines the sustainability of the environment, the availability of natural resources and hence life on Earth itself. On the other hand, conservation and sustainable use of the species result in incalculable benefits to humanity.

Besides providing substantial part of the food consumed on the planet, the marine biomes are site for exploration of different mineral resources, mainly oil. The biodiversity of oceans is huge and poorly investigated. However, it is widely recognized the threat to marine turtles and mammals, especially certain species of whales, as well as overfishing that affects a large proportion of fish stocks.

The coast is the interface area between the terrestrial and the marine ecosystems. This zone is dominated by river drainage basins processes and also by oceanographic and atmospheric processes. Because of the high concentration of nutrients and of other environmental factors (such as temperature gradients, variable salinity and exceptional conditions for breeding and for feeding of young individuals of most species that inhabit the oceans), the coast performs an important function enabling genetic exchanges and connecting terrestrial and marine ecosystems.

The coastal ecosystems are responsible for a wide range of ecological functions, such as prevention of flooding, saline intrusion and coastal erosion; protection against storms; recycling of nutrients as well as pollutants; and providing habitats and resources for a variety of species[33]. The biodiversity plays a fundamental role in most of these regulatory mechanisms, contributing to the characterization of the entire coastal area as a *finite resource*, resulting from a complex and sensitive system, with extraordinary interrelation of processes and pressures[34]. The coastal zone should be one of the major targets for environmental and biodiversity

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[32] See http://worldoceanreview.com/en/wor-1/marine-ecosystem/biodiversity/

[33] Brazil, Ministry of Environment, *Avaliação e Ações Prioritárias para a Conservação da Biodiversidade das Zonas Costeira e Marinha* (Brasilia, DF, 2002)

[34] Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment, *Biodiversidade Brasileira* (Brasilia, DF, 2002)

conservation, both terrestrial and aquatic[35].

Biological diversity is not equally distributed over the various coastal ecosystems. For example, sandy and muddy beaches are low diversity systems, harboring specialized organisms, because of the absence of surface for fixation and of limited food supply; salt marshes and rocky shores have intermediate biodiversity, while coastal lagoons and estuaries are rich systems, functioning as a shelter, breeding and nursery areas for many species. Mangroves have high structural functional diversity acting as biomass exporters for adjacent systems[36]. Finally, coral reefs contain high species diversity, elaborate specializations of component species, and co-evolved associations between species, similar to that observed in tropical rainforests[37].

The coast presents a mosaic of ecosystems, and marine contiguous area includes all the diversity derived from coastal variation as well as different masses of water from continental platform and slope. Regarding biogeography, it is not limited to only one specific biome.

1.2. Brazilian Coastal And Marine Biodiversity

Despite the dominant tropical and subtropical characteristics throughout the coast of Brazil, oceanographic and climatological conditions of each region generate distinctive features and biodiversity. In the north, at the estuary of Amazon river, the dumped material and the energy parameters (i.e. tides, currents, waves, winds) produce multiple interdependent and complex oceanographic processes that have a strong influence on the distribution of living resources in the region[38]. In the states of Pará and Maranhão, the Marajoara and Maranhense gulfs represent highly dynamic estuarine complexes, and they are a natural way for large solid

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[35] Brazil, Ministry of Environment, *Áreas Prioritárias para a Conservação, Uso Sustentável e Repartição de Benefícios da Biodiversidade Brasileira* (Brasilia, DF, 2007)

[36] Robert R. Twilley and others, "Biodiversity and Ecosystem Processes in Tropical Estuaries: Perspectives of Mangrove Ecosystems", *in Functional Roles of Biodiversity: A Global Perspective*, Harold A. Mooney and others, eds. (Chichester, John Wiley & Sons Ltd, 1996)

[37] Marjorie L. Reaka-Kudla, "The Global Biodiversity of Coral Reefs: A Comparison with Rain Forests*", in Biodiversity II: Understanding and Protecting Our Biological Resources*, Marjorie L. Reaka-Kudla, Don E. Wilson, and Edward O. Wilson, eds. (Washington, D.C., Joseph Henry Press, 1997)

discharge. Estuaries, coastal lagoons and mangroves are present along the entire northern coast, where turtles, mammals (particularly the marine manatee), birds (occurrence and reproduction of endangered species, such as the scarlet ibis - *Eudocimus ruber*, and corridors for migratory species), and several fish species are found. [39]

In the northeast region, the absence of large rivers and the predominance of warm waters from the South Equatorial Current determine enabling environment for the formation of coral reefs. The reefs are rich in natural resources and they have great ecological, economic and social importance. They harbor fish stocks and contribute to the livelihoods of several traditional coastal communities. The coral reefs are distributed for about 3000 km of the northeast coast, from Maranhão state to the south of Bahia state, being the only reef ecosystems in the South Atlantic. There are two Oceanic Archipelagos (Fernando de Noronha; and San Peter and San Paul) and one atoll (Rocas Atoll) in this region. Rocas Atoll is the only one in the South Atlantic Ocean. They are very important nesting areas for tropical sea birds and breeding and feeding sites for sea turtles.

The Southeast and South shores have the presence of the South Atlantic Central water on the continental shelf and its eventual resurgence along the coast contribute to increase productivity. Further south, in the winter, the subtropical convergence between current of Brazil and the Falklands current provides climatic characteristics closest to temperate, deeply influencing the composition of the local fauna.

Regarding coastal and marine biodiversity, there are numerous fish stock species (fishes, mollusks, crustaceans, and algae) and other species from other groups, such as corals, mammals, birds, and turtles, in both coastal and marine environments. The marine biodiversity present in the Brazilian coastal zone is relatively little known, becoming deficient in the marine area, getting worse as is far from the coast. For benthic invertebrates, more than 1,300 species

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[38] E. A. Costa and A. G. Figueiredo Jr, “Echo-Character and Sedimentary Processes on the Amazon Continental Shelf”, *Anais da Academia Brasileira de Ciências*, V. 70, N° 2, (1998) p. 187-200. Cited from: Ana Paula L. Prates and Luis Henrique de Lima, “Biodiversidade Costeira e Marinha”, in *Macrodiagnóstico da Zona Costeira e Marinha do Brazil,* Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment (Brasilia, DF, 2008)

[39] Ana Paula L. Prates and Luis Henrique de Lima, “Biodiversidade Costeira e Marinha”, in *Macrodiagnóstico da Zona Costeira e Marinha do Brazil,* Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment (Brasilia, DF, 2008)

were recorded on the southeast coast of Brazil, with a high degree of endemism; however, many regions and environments still need to be properly inventoried[40]. Define the state of threat of marine invertebrates is very challenging due to the inconspicuousness of most organizations and, especially, the lack of population studies and fauna monitoring. Despite this limitation, 65 species of marine invertebrates were considered endangered in Brazil[41], 10 were considered over-exploited or in danger of over-exploitation.[42]

About well-known groups, 1233 fish species were reported in Brazil, including 1209 currently present in the country and 24 possibly present in the country (considering estuarine species). Fish diversity is relatively uniform along the Brazilian coast, with few endemic species.[43]

The Brazilian coast is home to 61 species of known mammals. One species of sirenian, 7 pinnipeds, and 53 cetaceans were registered. There are 4 species of the order Sirenia worldwide, two of them occur in Brazil and one is marine, the marine manatee (*Trichechus manatus*). This is the most endangered aquatic mammal in the planet, with estimate population of a few hundred individuals. In Brazil there are residual populations inhabiting from the state of Alagoas to Amapá. As for pinnipeds, from the 7 known species 2 are residents and others occasionally occur in Brazilian waters. Only 3 are relatively common: the sea lion (*Otaria flavescens*), the southern fur seal (*Arctocephalus australis*), and the sub-Antarctic fur seal (*Arctocephalus tropicalis*). Between cetaceans, 3 species inspire concern for their preservation: the right whale (*Eubalaena australis*); the toninha or porpoise (*Pontoporia blainvillei*); and the gray dolphin (*Sotalia fluviatilis*). Four other cetaceans are considered endangered, the sei-whale (*Balaenoptera borealis*), the blue whale (*Balaenoptera musculus*), the fin whale (*Balaenoptera physalus*), and the sperm whale (*Physeter macrocephalus*). Seven mammal species are in the

[40] Brazil, Division of Aquatic Biodiversity and Fishing Resources, Secretariat for Biodiversity and Forests, Ministry of Environment, *Panorama da conservação dos ecossistemas costeiros e marinhos no Brasil*, (Brasilia, DF, 2010)

[41] Brazil, Ministry of Environment Ordinance 445/2014 (National Official Endangered Species of Fauna - Fish and Aquatic Invertebrates). Available from http://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2014/p_mma_445_2014_lista_peixes_ameaçados_extinção_altrd_p_98_2015.pdf

[42] Antônia Cecília Z. Amaral and Sílvio Jablonski, "Conservação da Biodiversidade Marinha e Costeira no Brasil", *Megadiversidade*, Vol. 1, N° 1 (Julho 2005) p. 43-51

[43] See http://www.fishbase.org

National Official Endangered Species of Fauna list, but currently the humpback whale (*Megaptera navaeangliae*) was removed from the list due to its recovery in the country's sea.

More than 100 bird species associated with Brazilian coastal and marine ecosystems were registered. Some of them are residents, others are migratory coming from the northern hemisphere and further south regions. The north region is migration corridor and shelter for Charadriiforms and colonial breeding area for Ciconiiforms. Some coastal areas are important sites to the breeding and feeding of endangered species, such as scarlet ibis (*Eudocius ruber*). The coastal islands of the Southeast and South regions are nesting sites of terns (Sterna spp.), Audubon's shearwater (*Puffius lherminieri*), Magnificent Frigatebird (*Fregata magnificens*), brown booby (*Sula leucogaster*) and kelp gull (*Larus dominicanus*).[44]

With regard to turtles, from the seven sea turtle species known in the world, five live in Brazilian waters: loggerhead or yellow turtle (*Caretta caretta*), green turtle (*Chelonia mydas*); giant, black or leather turtle (*Dermochelys coriacea*); hawksbill turtle (*Eretmochelys imbricata*) and olive ridley sea turtle (*Lepidochelys olivacea*). These species seek coastal beaches and oceanic islands for spawn, shelter, feed and growth.

Brazil has the only reef-building corals of the South Atlantic[45]. At least 20 species (of true and hydrocorals corals) were registered in the country, including eight endemic species, i.e. found only in Brazilian waters. The endemic species are *Favia gravida*, *Favia leptophylla*, *Mussismilia brasiliensis*, *Mussismilia harti*, *Mussismilia hispida*, and *Siderastrea stellata* among the species of scleractinian corals and *Millepora braziliensis*, and *Millepora nitida* of hydrocorals.[46] Coral reefs extend for 3000 km in the northeast coast of Brazil, since the parcel Manoel Luís in the state of Maranhão to Viçosa in the Espírito Santo state and on oceanic islands (Rocas Atoll and Fernando de Noronha and São Pedro e São Paulo Archipelagos).

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[44] Carmen L.D.B. Rossi-Wongtschowski and others, "O Ambiente Marinho", *in: Programa REVIZEE: avaliação do potencial sustentável de recursos vivos da Zona Econômica Exclusiva do Brasil – relatório executivo*, Ministry of Environment (Brasilia, DF, 2006)

[45] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

[46] Mauro Maida and Beatrice P. Ferreira, "Coral Reefs of Brazil: An Overview*", in: Proceedings of the 8th International Coral Reef Symposium*, Vol. 1, (1997), p. 163-174

The mangroves are home of a great diversity of plants, arthropods, mollusks, fishes, mammals, and birds, totaling at least 776 related species. Angiosperms of the Brazilian coast mangrove belong to 3 genera, with a total of 6 species.[47]

The large extension and great diversity of the Brazilian coastal and marine ecosystems constitute a distinctive situation in which the local biodiversity and the numerous endemic species overlap migratory species routes, feeding and spawning sites[48]. Thus, the effect of the preservation or the degradation of certain ecosystems is not purely local. The loss of endemic species implies the impoverishment of the global biodiversity, and the devastation or fragmentation habitats can generate various effects on the amplified populations and their migratory routes, affecting the dynamics of ecosystems often distant from the affected areas.

1.3. Human Activities And Impacts On Coastal Ecosystems

Coastal and marine ecosystems have been exposed to excessive and accelerating threats from human activity and environmental change. Impacts caused by pollution (air and land based); nutrient inputs; eutrophication; over-exploitation; biological invasions; mining and dredging; and waste disposal bring about changes in the abundance and distribution of species, functional groups and waterscapes[49] as well as localized extinctions[50], resulting in ecosystem processes and services alteration. Marine areas near centers of dense population and commerce are often over-fished, exposed to repeated introduction of invasive exotics, and serve as the receiving waters for both nutrients and contaminants[51]. The forms occupancy and

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[47] Yara Schaeffer-Novelli, *Situação Atual do Grupo de Ecossistemas: "Manguezal, Marisma e Apicum" Incluindo os Principais Vetores de Pressão e as Perspectivas para sua Conservação e Uso Sustentável* (Brasilia, DF, 2002, ProBio, MMA)

[48] Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment, *Biodiversidade Brasileira* (Brasilia, DF, 2002)

[49] Mark Chandler, Les Kaufman and Sandor Mulsow, “Human Impact, Biodiversity and Ecosystem Processes in the Open Ocean”, in *Functional Roles of Biodiversity: A Global Perspective*, Harold A. Mooney and others, eds. (West Sussex, England, John Wiley and Sons Ltd, 1996)

[50] Philippe Goulletquer and others, *Biodiversity in the Marine Environment* (Orvault, France, Springer, 2014)

[51] Denise L. Breitburg and Gerhardt F. Riedel, “Multiple Stressors in Marine Systems”, in *Marine Conservation Biology*, Eliot A. Norse and Larry B. Crowder, eds. (Washington, D.C., Island Press, 2005)

use of the coast, territorial sea and EEZ determine the pressures on biodiversity.

The unique location of coastal sites in a transitional environment between the mainland and the sea conditioned the occupation and the densification increasingly. The urbanization of the last decades has significantly expanded the use of natural resources, which tends to undermine the environmental and landscape quality, taking into account the fragile nature of the coastal zone. Among the most significant anthropogenic effects are those associated with the development and pressure vectors, such as port activities, oil, chemical, aquaculture, livestock, fisheries, agriculture, tourism, urban development, and others. These vectors associated to population growth cause environmental changes.[52]

Over the past 50 years, the Brazilian population increased from 60 to 200 million people, the urbanization rate increased from 45% to around 85%, and the number of municipalities almost tripled, rising to 5,565[53]. The occupation of the coastal area in Brazil has intensified in recent decades due to three priority vectors of development: urbanization, industrialization and tourism activities[54]. With big migration flows to coastal locations, often population groups are not absorbed by the formal labor market, increasing the periphery slums processes and occupation of inappropriate areas to urban settlements.

The urbanization of the coastline is a trend due to the appreciation of the coast for historical, economic and, more recently, cultural and environmental reasons. The historical and economic background enhanced the urban concentration on the coast. Within a decade, the number of metropolitan areas in the Brazilian coastal zone increased from 5 to 16. This growth indicates a trend of expansion of metropolitan infrastructures, providing greater human pressure on natural environments, and increase in basic sanitation needs, housing, transport and public services.

Considering cultural and environmental aspects, coastal zone is identified as a place

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[52] Brazil, Ministry of Environment, *Macrodiagnóstico da Zona Costeira e Marinha do Brasil* (Brasilia, DF, 2008)

[53] Tânia M. Strohaecker, "Dinâmica Populacional", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

[54] Antonio C. R. Moraes, *Contribuições para a Gestão da Zona Costeira do Brasil: Elementos para uma Geografia do Litoral Brasileiro* (São Paulo, SP, Annablume, 2007)

of leisure, recreation and, in some cases, preservation. In this sense, the process of urbanization is consolidated spatially, with the implementation of settlements, vertical and horizontal condominiums for the purpose of second homes in the vicinity of major urban centers, and hotels and resorts to domestic and international tourist market in areas privileged by scenic beauty.[55]

The coastal area holds the most valued areas and concentrates several interests of use and occupation. The high demand for homes in coastal areas increased the performance of different agents that depend of the real estate development (owners, real estate developers, brokers, liberal professionals, traders, service providers, workers and entrepreneurs in the construction industry). Besides tourism, the complexity of the productive chain of the oil and gas industry attracts hand labor and specialized suppliers, leading to growing appreciation of land in the coastal zone and the consequent movement of traditional communities. The real estate speculation increases pressure on natural areas, sensitive environments, and traditional communities.

Tourist exploitation and property development of privileged coastal sectors, particularly in the northeastern states, mainly because of the beautiful scenery and numerous warm water beaches, initially diversified the economy of the main northeastern capitals. Later the areas of tourist interest reached neighboring cities, attracting even more people. This process causes spatial repercussions, such as soil sealing, the occupation of natural and sensitive areas, water and soil pollution, impairment of bathing beaches, and other environmental problems. Thus, mass tourism boosts local and regional economy, improve contingents in the formal and informal labor market, but also contributes to the process of social segregation and affects the environmental quality of coastal ecosystems. [56]

The existence and availability of a sewage system is critical to the health of the environment as well as the community, because its absence causes pollution of water

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[55] Tânia M. Strohaecker, "Dinâmica Populacional", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

[56] Cláudio Egler, "Potencial de Risco Tecnológico", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

resources, bring waterborne diseases, and increase human mortality, especially to infants. According to the National Sanitation Survey - PNSB 2008, just over half of the municipalities (55.2%) had sewage service for collection network, which is the appropriate system. Note that the statistics of access to sewage collection system refers only to the existence of the service in the city, regardless of the extent of the network, the quality of treatment, the number of households served, or if the collected sewage is treated. The proportion of households with access to general sewage system was 44.0% in 2008. [57] Considering that approximately 25% of the population lives and/or works in coastal zone, and that much of the sewage is released directly into water bodies or soil without treatment, as well as the waste is deposited in dumping grounds without any sanitary control, one would assume that the water quality for primary and secondary contact is the main environmental risk factor for human life in the Brazilian coastal zone. [58]

The possibility of accidental pollution, such as spills, leaks, fumes uncontrolled, among others, is critical in some sectors of the coastal zone, as well as environmental contamination by industrial gases releases, particulate matter, wastewater and solid waste. The activities carried out in the continent and the lack of basic services also entail the accumulation of solid waste that are carried through rivers, wind, and rain water into the oceans, as an important source of marine debris.

Due to the logistics and cheapest transport (shipping), availability of resources and energy, and people to work, coastal areas are target of industry implantation in punctual areas. Industrial and port complex along the Brazilian coast attract other complementary activities such as trade and services. When poorly planned, industrial activity causes severe impacts on the environment and coastal communities, including pollution. Shipping can also be a source of pollution and marine debris.

Besides the intensification of tourist exploitation and real estate in the coastal zone,

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[57] Brazil, IBGE, Ministry of Planning, Budget and Management, *Pesquisa Nacional de Saneamento Básico - 2008* (Brasilia, DF, 2010)

[58] Tânia M. Strohaecker, "Dinâmica Populacional", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

there is also the expansion of shrimp farming, especially in the states of Ceará (26% of total national production), Rio Grande do Norte (42%), Paraíba (4%), Pernambuco (6%), Sergipe (3%) and Bahia (10%). The main impacts of shrimp farming activity are water pollution, salinization of groundwater, destruction of mangroves, the risks of introducing alien species and spread of epidemics and the breakdown of traditional fishermen communities.[59] This activity is controversial with regard to the serious environmental impacts if not properly planned, but it is an alternative to the social development, expanding job opportunities for segments of the population with lower education level, which intensifies inter displacement. However, excessive dependence of this activity for indirect revenues of small municipalities shown to be harmful when there are bans on the production of the farms due to viral diseases, as has occurred in some states. [60] Both aquaculture and agriculture activities developed in coastal and marine areas can cause significant environmental impacts such as deforestation, degradation, loss of habitats and consequently loss of biodiversity, introduction of alien species, and coastal and marine pollution.

Increasing impacts on the oceans from coastal development are straining the health of marine ecosystems. Impacts to these environments include declining fish populations, degradation of coral reefs and other vital habitats, threats to rare or endangered species, and loss of artifacts and cultural heritage resources.

1.4. Human Activities And Impacts On Marine Ecosystems

Marine areas can be influenced by large scale stressors, such as over-fishing of oceanic species, destructive fishing practices, marine debris, ship-based marine pollution, alien invasive species, dumping, seabed mineral extraction, noise pollution, and also by long distance consequences of smaller scale perturbations. The effects of these threats added to the potential

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[59] K. R. Tancredo and others, "Impactos Ambientais da Carcinicultura Brasileira", *in 3rd International Workshop Advaces in Cleaner Production*, (São Paulo, SP, May 2011). Available from http://www.advancesincleanerproduction.net/third/files/sessoes/6A/6/Tancredo_KR%20-%20Paper%20-%206A6.pdf

[60] Tânia M. Strohaecker, "Dinâmica Populacional", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

impacts of climate change and ocean acidification have placed thousands of species at risk of extinction, and have damaged the structure, function, productivity and resilience of marine ecosystems[61].

Several authors consider fisheries as the greatest threat to the marine biodiversity. Besides fisheries have a large impact on target fish populations, they also had devastating effects on marine habitats, on the population biology of non-target (or by-catch) species, and hence, on marine food webs[62]. Towed gears, especially trawls and dredges, are non-selective gears that do substantial and long-lasting damage to the seafloor, flattening not only biogenic benthonic structures such as worm tubes, seagrasses, coral and oyster reefs but also geological structures like bolder fields, pinnacles, and seamounts[63]. This kind of equipment cause alterations in the chemical environment, including nutrient availability, effects on trophic interactions and altered predator-prey relationships as well. The combined impact of these stressors reduces the overall stability of marine ecosystems.

Estimates of the trawled area range from 50-75% of the global continental shelf[64]. If 50% of the continental shelf is trawled every year, as one estimate indicates, this is the equivalent of 150 times the rate of forest clearcutting on land[65]. According to FAO, 28.8% of fish stocks were estimated as fished at a biologically unsustainable level and, therefore, overfished. Of the stocks assessed in 2011, fully fished stocks accounted for 61.3% and under fished stocks 9.9%[66].

With reference to fishing production, the Brazil's situation is not unlike the rest of

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[61] See https://www.cbd.int/ebsa/about

[62] Larry B. Crowder and Eliot A. Norse, "The Greatest Threat: Fisheries", in *Marine Conservation Biology*, Eliot A. Norse and Larry B. Crowder, eds. (Washington, D.C., Island Press, 2005)

[63] Les Watling, "The Global Destruction of Bottom Habitats by Mobile Fishing Gear", in *Marine Conservation Biology*, Eliot A. Norse and Larry B. Crowder, eds. (Washington, D.C., Island Press, 2005)

[64] Michel J. Kaiser and others, "Modification of marine habitats by trawling activities: prognosis and solutions", Fish *and Fisheries,* Vol. 3, Issue 2, (June 2002), p. 114-136

[65] England, Royal Commission on Environmental Pollution, *Turning the Tide: Addressing the Impact of Fisheries on the Marine Environment- Twenty Fifth Report* (London, 2004). Available from http://webarchive.nationalarchives.gov.uk/20060820083451/http://rcep.org.uk/fishreport.htm

[66] FAO, *The State of World Fisheries and Aquaculture: Oportunities and Challenges* (Rome, 2014). Available from http://www.fao.org/3/a-i3720e/index.html

the world due to overfishing of some fish species, even considering the extension of its Exclusive Economic Zone and the small fish production. The biggest national effort in raising the status of marine fish stocks occurred between 1995 and 2005, with the Evaluation of the Sustainable Potential of Living Resources in the Exclusive Economic Zone (REVIZEE Program). According to the REVIZEE report, among the 153 stocks considered, 11% were not exploited, 4% are underexploited, 23% were fully exploited, 33% were overexploited and 29% were not evaluated conclusively, requiring additional studies[67]. In conclusion, the main resources exploited should not have increased production with increasing fishing effort, as most stocks were already fully exploited or overexploited.

Fisheries have a huge economic, social and cultural importance in Brazil. The country holds around 1 million professional fishermen and e 42,000 vessels, that generates more than 3.5 million direct and indirect jobs. The small scale fisheries is responsible for at least 50% of the fish production, and it is important for income, food security and the maintenance of livelihoods of thousands of fishing communities in the country.[68]

Nobody knows how much is the fish production in Brazil. The latest statistical bulletin published by the Ministry of Fisheries and Aquaculture was in 2011. Since then, there is no official consolidated data on the fishing activity in the country. Furthermore, 2008 was the last year that systematic effort data collection was made on a national scale. All reports published after 2008 are based on extrapolations of these older data, combined with regional data from some states like São Paulo, Santa Catarina and Rio de Janeiro, which have their own monitoring initiatives[69]. Information about which species has been fished, where, how and the quantities is fundamental for the management.

In 2011, the marine fisheries accounted for 68.9% of the total national production

[67] Brazil, Ministry of Environment, *Programa REVIZEE: Avaliação do Portencial Sustentável dos Recursos Vivos na Zone Econômica Exclusiva do Brasil – Relatório Executivo* (Brasilia, DF, 2006). Available from http://www.mma.gov.br/estruturas/revizee/_arquivos/rel_executivo_revizee.pdf

[68] Oceana Brasil and others, "Carta aberta à Presidenta Dilma Rouseff sobre o ordenamento da pesca", *statement to the President of Brazil,* Brasilia, 14 January 2015. Available from http://ciencia.estadao.com.br/blogs/herton-escobar/wp-content/uploads/sites/81/2015/01/Carta-Aberta-a-presidenta-Ordenamento-da-Pesca.pdf

[69] Interview with Mônica Brick Peres, President of Non-Governmental Organism Oceana, Interviewed by Herton Escobar to the Estadão Blog in 19 January 2015. Available from http://ciencia.estadao.com.br/blogs/herton-escobar/quanto-se-pesca-no-brasil-ninguem-sabe/

from the extractive fishing (553,670t), which represented an increase of 1% compared to 2010 (536,445t). The marine production of fish was 482,335t, representing an increase of 3.6% compared to 2010. The production of crustaceans was 57,345t and of clams was 13,989t, featuring a small increase of 1% and 0.3%, respectively, compared to 2010. Among the fishes, the most captured species was the real-sardine with 75,122t landings in 2011. The second most captured was the corvina (43,369t). For the crustaceans, shrimp sea bob and pink shrimp continued to be the species most captured in Brazil in 2011 with 15,417t and 10,331t respectively, representing together 45% of the total production of marine crustaceans. The lobster, one of the main species for export of fish from Brazil, represented 12% of the total caught (6,929t).[70]

Bycatch and discard of elasmobranches were identified as risk factors for rays and sharks due to the growth of the longline tuna fleet in the last decade. Brazil has become one of the six largest exporters of shark fins for the Asian market; the practice of disposal with the retention of fins contraries the Ordinance IBAMA 121/1998 which prohibits the landing of fins exceeding 5% of the total weight of carcasses[71]. Pelagic and fund longlines also imply incidental catches of seabirds attracted to baited hooks. The estimated annual catch is about 3,800 birds by bottom longline and 3,000 by pelagic longline in the EEZ area, between São Tomé Cape (RJ) and Chuí (RS)[72] (less than a half of Brazilian sea). The turtles are particularly susceptible to capture by surface longline. Surveys carried out in the South of the country, in water depths between 600 and 4,000 meters, showed the bycatch of 108 turtles in only 9 fishing throws[73]. Some studies show considerable damage to deep-water corals caused for fishing in the Southeast and South of the country, with reports of incidental catches of up to 4 tons of corals

[70] Brazil, Ministry of Fishries and Aquaculture, *Boletim Estatístico da Pesca e Aquicultura* (Brasilia, DF, 2011)

[71] Rosangela P. Lessa, "Recursos pesqueiros da região Nordeste", *in: Programa REVIZEE: avaliação do potencial sustentável de recursos vivos da Zona Econômica Exclusiva do Brasil – relatório executivo*, Ministry of Environment (Brasilia, DF, 2006)

[72] Carmen L.D.B. Rossi-Wongtschowski and others, "O Ambiente Marinho", *in: Programa REVIZEE: avaliação do potencial sustentável de recursos vivos da Zona Econômica Exclusiva do Brasil – relatório executivo*, Ministry of Environment (Brasilia, DF, 2006)

[73] P. C. R. Barata and others, "Captura Acidental da Tartaruga Marinha *Caretta caretta* (Lineaus, 1758) na Pesca de Espinhel de Superfície na ZEE Brasileira e em Águas Internacionais", *Semana Nacional de Oceanografia*, 11 (1998). Available from https://www.academia.edu/2590637/Captura_acidental_da_tartaruga_marinha_Caretta_caretta_Linnaeus_1758_na_pesca_de_espinhel_de_superf%C3%ADcie_na_ZEE_brasileira_e_em_%C3%A1guas_internacionais

in a single trawling. It is possible, therefore, that the environmental viability of the activity will require the establishment of fishing exclusion areas in the most sensitive regions[74].

Regarding mineral resources, Brazil established the Sector Plan for the Resources of the Sea (PSRM, in Portuguese is Plano Setorial para os Recursos do Mar). The VIII PSRM is in effect during the period from 2012-2015 and one of its priority surveys is to study "Mineral Potential Assessment of the Brazilian Continental Shelf (REMPLAC, in Portuguese is Avaliação da Potencialidade Mineral da Plataforma Continental Jurídica Brasileira)", with the proposal to identify geological and geomorphological aspects of the marine bottom and subsoil and to find areas of occurrence of new mineral resources.

In addition to oil and gas, the current records of mineral occurrences on the seabed include deposits of gravel, sand, carbonates, placers of heavy minerals, phosphorite, polymetallic nodules and cobalt crusts, evaporites and associated sulfur, coal, Gas hydrates and polymetallic sulphide. Polymetallic nodules and cobalt crusts were identified in oceanic sedimentary basins. Polymetallic sulphides and associated biotechnology are considered marine resources of greater economic and strategic interest, after oil and gas.[75] In the South Atlantic, it is possible the occurrence of polymetallic sulphides along the mid-ocean ridges and nearby Archipelago of São Pedro and São Paulo (VII PSRM).

The mentioned mineral resources are only potential, and it has not been performed environmental, economic and technological feasibility studies for exploitation. The PSRM recognizes that "mining can cause various environmental impacts on coastal and marine ecosystems, and may cause conflicts with other activities in the same space, which would require new planning and management policies by regulatory authorities, based on definition of technical criteria for the exploitation of these mineral resources. Whether mining and prospecting activities are appropriate will depend on the extent and frequency of the operation and its impacts on the seafloor and the species resident in the area.

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[74] Sílvio Jablonski, “A Zona Econômica Exclusiva – Óleo e Gás”, *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

[75] Sílvio Jablonski, “A Zona Econômica Exclusiva – Óleo e Gás”, *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

In addition to the mineral exploitation in shallow and deep water, the use of biotechnological potential derived from marine biodiversity and offshore power generation are also possible activities to be developed in maritime zones.

The offshore production of oil and natural gas is responsible for the most of the national total exploitation. On average, the offshore oil accounted for 93.5% of 2,466,000 barrels per day produced in July 2015[76]. In relation to natural gas, production of marine origin was 76% of the 95.3 million m³ per day in the same month[77].

The activities of the oil and natural gas industry involve a number of impacts on the coastal and marine environment in the whole production chain, from the offshore exploitation to the transportation, and along phases of implementation, from prospection to decommissioning. The main impacts in the exploration phase are changes in soil and bottom ecosystems and scaring the wildlife by seismic survey. In the installation and production phases, it may occur pollution caused by water disposal, operational discharges and drilling fluid leaks, with poisoning of the organisms and hydrocarbons and heavy metals bioaccumulation. The effects of pollutants depend on their concentration, toxicity and how quickly they disperse or break down in the marine environment. The exploitation affects the ecosystem, disturbing the habitat by noise and excessive lighting; interfering in feeding or breeding areas and migratory routes; developing new artificial habitats around the platform or structure. This is a risky activity due to the generation of chronic pollution and accident potential. The oil spill hazard occurs in all activities and it is more dangerous during the transportation.

With regard to seismic survey, permanent restricted areas were delimited in the northern coast of Piaui, north of Paraiba, south of Pernambuco and central north of Alagoas state, in order to protect breeding and feeding of the manatees on the Brazilian coast.

Estimates of oil entering the world's oceans is between 1 and 3 million tons per year.

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[76] Brazil, National Agency of Petroleum, Natural Gas and Biofuels, *Boletim da Produção de Petróleo e Gás Natural*, (Brasilia, DF, July 2015). Available from http://www.anp.gov.br/?pg=77431&m=produção&t1=&t2=produção&t3=&t4=&ar=0&ps=1&1441412343771

[77] Brazil, National Agency of Petroleum, Natural Gas and Biofuels, *Boletim da Produção de Petróleo e Gás Natural*, (Brasilia, DF, July 2015). Available from http://www.anp.gov.br/?pg=77431&m=produção&t1=&t2=produção&t3=&t4=&ar=0&ps=1&1441412343771

About 50% derives from land-based sources (for example discharges from industry and urban runoff); 24% comes from maritime transport (18% operational ship discharges and 6% accidental spills); 13% comes from atmospheric sources (oil handling facilities and vehicles exhaust); 10% comes from natural sources; and 3% comes from offshore extraction[78]. The strong presence of transporting oil by ships along the Brazilian coast, in several cases through sensitive environments, indicates the degree of risk involved.

The Brazilian territorial sea and EEZ are cut by different commercial navigation routes, with traffic strongly induced by oil production activity. The sea routes throughout the Brazilian EEZ interconnect the various parts of the Country. It is observed a consolidation of routes between Fortaleza, Suape, and Salvador ports, and in the southeast region, between Campos and Santos basin[79]. Environmental impacts caused by shipping activities include greenhouse gas emissions, sound pollution, wildlife collisions, transfer of alien invasive species, oil spills, pollution from sewage launch and solid waste.

One of the most significant impact to the Biodiversity is the introduction of invasive species. The risk of introducing exotic species, especially from vectors like ballast water and fouling on ship hulls and oil and gas platforms, is directly proportional to the volume of maritime traffic, to the reduction of the travel time and to the similarity environmental between ports of origin and destination. Due to the great damage potential for economy, environment and human health the international community has defined normative instruments to avoid or minimize the impacts caused by invasive species.

A survey conducted by the Brazilian Ministry of Environment recorded 66 exotic invasive species in Brazilian marine zone, including 1 pelagic bacteria, 3 phytoplankton, 10 zooplankton, 10 macroalgae, 38 zoobenthos and 4 fish species[80].

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[78] European Environment Agency, *Europe's Environment: The Fourth Assessment*, (Copenhagen, 2007). Available from http://www.eea.europa.eu/publications/state_of_environment_report_2007_1

[79] Sílvio Jablonski, "A Zona Econômica Exclusiva – Óleo e Gás", *in Macrodiagnóstico da Zona Costeira e Marinha do Brasil*, Ministry of Environment (Brasilia, DF, 2008)

[80] Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment, *Espécies Exóticas Invasoras: Situação Brasileira* (Brasilia, DF, 2006). Available from http://www.mma.gov.br/estruturas/174/_publicacao/174_publicacao17092009113400.pdf

CHAPTER 2 – CLASSIFICATION AND CURRENT STATUS OF PROTECTED AREAS IN BRAZIL, PRIORITY AREAS FOR CONSERVATION, LEGAL FRAMEWORK, AND GOVERNMENT PROGRAMS

2.1. The Importance Of Protected Areas, Identification Of Ecologically Or Biologically Significant Marine Areas (EBSMA) Process, And Brazilian Priority Areas For Conservation

The establishment of protected natural areas is based on the understanding that natural areas play key roles for the survival, well-being, quality of life and development of human societies. Protected areas are a relatively effective instrument of land use planning and environmental zoning.

> "In 1992, the largest-ever meeting of world leaders took place at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil. A historical set of agreements was signed at the "Earth Summit", including two binding agreements, the Convention on Climate Change (CCC), which targets industrial and other emissions of greenhouse gases such as carbon dioxide, and the Convention on Biological Diversity (CBD), the first global agreement on the conservation and sustainable use of biological diversity. The biodiversity treaty gained rapid and widespread acceptance."[81]

Over 150 nations signed the document at the Rio conference, and since then more than 193 countries have ratified the agreement.

The main goals of the CBD are: 1) to conserve biodiversity, 2) to ensure sustainable use of the components of biodiversity, and 3) to share the benefits arising from the commercial and other uses of genetic resources in a fair and equitable way.

The CBD is the most important international legal instrument addressing protected areas. The term *protected area* is defined by CBD as "a geographically defined area, which is

[81] Extracted from https://www.cbd.int/convention/guide/default.shtml?id=action

designated or regulated and managed to achieve specific conservation objectives"[82]. Quite similar, but more complete is the IUCN definition for a protected area as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values"[83].

The specially protected territorial areas are internationally recognized as fundamental tools for the on-site conservation of species, populations, and ecosystems. Protected areas are one of the major strategies for biodiversity conservation, since they conserve nature and the services it provides to humanity, including food, clean water supply, medicines, protection from the impacts of natural disasters, and mitigation to climate change. They can also contribute to people's livelihoods, particularly at the local economy level. The concept of protected areas has existed for thousands of years. Very old protected areas may still be found, including some where religious devotion has helped to conserve natural environments[84].

The IUCN classifies protected areas into six categories according to their management objectives: **I(a) Strict Nature Reserve:** Areas strictly protected for biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are controlled and limited to ensure protection of the conservation values. **I(b) Wilderness Area:** Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, protected and managed to preserve their natural condition. **II National Park:** Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems, which also have environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities. **III Natural Monument or Feature:** Areas set aside to protect a specific natural monument, which can be a land-form, sea mount, marine cavern, geological feature

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[82] Article 2 of the CBD, available from https://www.cbd.int/doc/legal/cbd-en.pdf

[83] See https://www.iucn.org/about/work/programmes/gpap_home/pas_gpap/

[84] Graeme L. Worboys, "Concept, Purpose and Challenges", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

such as a cave, or a living feature such as an ancient grove. **IV Habitat/Species Management Area:** Areas to protect particular species or habitats, where management reflects this priority. Many will need regular, active interventions to meet the needs of particular species or habitats, but this is not a requirement of the category. **V Protected Landscape or Seascape:** Areas where the interaction of people and nature over time has produced a distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values. **VI Protected Areas with Sustainable Use of Natural Resources:** Areas which conserve ecosystems, together with associated cultural values and traditional natural resource management systems. Generally large, mainly in a natural condition, with a proportion under sustainable natural resource management and where low-level non-industrial natural resource use compatible with nature conservation is seen as one of the main aims.[85] The IUCN categories are recognized by international organizations such as the United Nations and most countries as the global standard for defining and establishing protected areas and as such are increasingly being incorporated into government legislation. The CBD signatory countries have the mission to establish and maintain effectively and equitably managed system of PAs.

PAs provide several benefits shared across the society, even though people may not realize it. Some examples in Brazil include PA landscapes essential to the tourist economy, quantity and quality of water within the hydroelectric power reservoirs, and protection of important species used to produce medicines and cosmetics, such as andiroba, copaiba, and many species of marine algae. Regarding importance to tourism, a study by the Ministry of Environment (MMA in Portuguese) shows the 698 National and State PAs have the potential to attract up to 20 million people in 2016. This flow of visitors generates US$ 86 million to US$ 99 million a year in regions where these PAs are located, thereby ensuring the maintenance of these resources and boosting the local economy[86].

Marine Protected Areas (MPAs) are special designated areas of the oceans that

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[85] See http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/

[86] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, Ministry of Environment,2012)

protect habitats, wildlife, and cultural resources. Similar to terrestrial protected areas, MPAs are not necessarily closed to human uses such as fishing; it is dependent on the management category and its conservation objectives. MPA is a broad term that includes a wide range of purposes, legal authorities and levels of protection; however, all MPAs have a common focus on the long-term conservation of coastal and ocean resources[87]. MPAs are recognized as an increasingly important and promising management tool for mitigating or buffering impacts from coastal and offshore development, over-fishing, climate change, natural events, and other situations.

The world's oceans have been seriously under regulated through MPAs. By mid-2014 only approximately 3.4% of the global oceans were covered a MPAs by any IUCN management category, which includes 8.4% of the EEZs and 10.9% of territorial seas[88]. The MPAtlas website features an even worse current estimate of 2.12% of the oceans are under protection in a total of 11,333 MPAs, while only 0.94% are no-take areas[89].

In order to address the ocean conservation issues and to support effective policy action by countries and pertinent non-governmental organizations, the understanding of the most ecologically and biologically important ocean areas that bear healthy marine ecosystems is critical. The Conference of the Parties (COP) to the CBD in its ninth meeting in 2008 adopted scientific criteria for identifying "Ecologically or Biologically Significant Marine Areas" (EBSMAs) in need of protection[90]; this is a scientific guidance for selecting areas to establish a representative network of marine protected areas[91]. EBSMAs are defined using seven criteria: 1) uniqueness or rarity, 2) special importance of life-history stages, 3) importance for threatened, endangered or declining species and/or habitats, 4) vulnerability, fragility, sensitivity, or slow recovery; 5) biological productivity, 6) biological diversity, and 7) naturalness.

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[87] United States, NOAA's National Marine Protected Areas Center, *Marine Protected Areas* (2012) available from: http://marineprotectedareas.noaa.gov/pdf/mpa-center/mpa_center_brochure_october2012.pdf

[88] Bastian Bertzky, Monika Bertzky and Graeme L. Worboys, "Earth's Natural Heritage", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

[89] See http://www.mpatlas.org/explore/ accessed on 17 September 2015

[90] CBD, COP 9 Decision IX/20 Annex I, available from https://www.cbd.int/decision/cop/?id=11663

[91] CBD, COP 9 Decision IX/20 Annex II, available from https://www.cbd.int/decision/cop/?id=11663

EBSMA descriptions are developed through a regional, state-based process, and then reviewed and synthesized by the CBD Subsidiary Body for Scientific, Technical, and Technological Advice (SBSTTA) and finally disseminated by the COP[92]. The CBD Secretariat with regional partner organizations convened regional workshops (Western South Pacific, Wider Caribbean and Western Mid-Atlantic, Southern Indian Ocean, Eastern Tropical and Temperate Pacific, North Pacific, South Eastern Atlantic, Arctic, North-West Atlantic, and Mediterranean) in order to facilitate the description of areas meeting the EBSMA criteria. For the regional CBD EBSMA workshops, attendance has been by invitation only with intergovernmental experts nominated by the Parties, and recognized organizations invited through the CBD. In addition, for the Northeast Atlantic region they considered the results of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and the NorthEast Atlantic Fisheries Commission (NEAFC) workshops. Results from the Mediterranean Action Plan under the Barcelona Convention Regional Seas Programme were transmitted directly to SBSTTA for consideration. The map of EBSMA can be accessed here: https://www.cbd.int/ebsa/. The COP further noted that the application of the EBSMA criteria is an open and evolving process that should allow ongoing improvement and updating as improved scientific, and technical information becomes available in each region.

In Brazil, the Ministry of Environment conducted a great effort to determine the Priority Areas and Actions for Conservation, Sustainable Use of Biodiversity and Benefit Sharing in 2007[93]. Regarding coastal and marine environments, four technical workshops were each held in the North, Northeast, Southeast and South regions. There were 177 experts in biodiversity and sustainable use of natural resources with expertise in different coastal and marine ecosystems who attended the meetings collectively. These experts used the ecoregional scale assessments developed by The Nature Conservancy and the World Wildlife Fund[94], adapted

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[92] Daniel C. Dunn and others, "The Convention on Biological Diversity's Ecologically and Biologically Significant Areas: Origins, Development, and Current Status", *Marine Policy,* 49, (January 2014), p. 137-145

[93] Brazil, MMA Ordinance 09/2007. See http://www.mma.gov.br/estruturas/202/_arquivos/portariamma_n__9_2007_reas_prioritrias_202.pdf

[94] TNC and WWF, *Standards for Ecoregional Assessments and Biodiversity Visions* (Arlington, VA, 2006). Available from https://www.conservationgateway.org/Files/Pages/standards-ecoregional-ass.aspx#sthash.Xx9WrNTh.dpuf

from the systematic planning methodology for the Conservation[95] to define regional targets, threats, and conservation goals. The Priority Areas for Conservation were defined using the following criteria[96]:

- ✓ Conservation targets - biodiversity elements (e.g. species, environments, ecosystems, etc.) relevant to save, which occurrence areas were spatially known.
- ✓ Goals - quantitative value necessary to ensure the persistence of several targets in the long term.
- ✓ Representation - the selected areas set should contain a representative sample of the biodiversity of the region.
- ✓ Complementary - new areas should be incorporated in order to maximize the number of targets / conservation goals achieved.
- ✓ Irreplaceable - candidate areas are classified considering their potential contribution to achieving the conservation goals established and the effect of their unavailability in relation to other areas.
- ✓ Efficiency and flexibility - selected areas should provide the maximum biodiversity protection with the least spatial extent between the various possible options, determined by cost versus protection.
- ✓ Vulnerability - areas should be chosen giving the priority to endangered conservation targets.

The experts indicated 239 different conservation targets, including 85 coastal areas, 55 marine areas and 99 species[97]. Geo-referenced data were used for this assessment and the information has been gathered to produce a map of biological importance. In order to consolidate and update the Priority Areas and Actions for Conservation, Sustainable Use of Biodiversity and Benefit Sharing for Coastal and Marine Biomes, there were three additional

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[95] C. R. Margules and R. L. Pressey, "Systematic Conservation Planning", *Nature*, 405, (11 May 2000) p. 243–253. Available from http://www.nature.com/nature/journal/v405/n6783/full/405243a0.html

[96] C. R. Margules and R. L. Pressey, "Systematic Conservation Planning", *Nature*, 405, (11 May 2000) p. 243–253. Available from http://www.nature.com/nature/journal/v405/n6783/full/405243a0.html

[97] Brazil, Department of Biodiversity Conservation, Secretariat for Biodiversity and Forests, Ministry of Environment, *Áreas Prioritárias para Conservação, Uso Sustentável e Repartição de Benefícios da Biodiversidade Brasileira* (Brasilia, DF, 2007). Available from http://www.mma.gov.br/estruturas/chm/_arquivos/biodiversidade31.pdf

regional meetings. Aiming for participation of the broader society in the meetings, representatives from different entities (federal, state and municipal; private sector; civil society organizations; universities and centers of research) were invited.[98]

The map of Priority Areas for Conservation of Coastal and Marine Zones consists of 608 areas (3,344,658 km²), of which 506 are coastal and 102 are marine. In total, 25.8% has been already under legal protection (Indigenous Lands[99] (ILs) or Remnants of Quilombo Territories[100]). The final map can be accessed online[101].

The updated Priority Areas for Conservation were established by the Ministry of Environment Ordinance 09/2007[102]. This establishment of relevant areas can be useful in guiding public policy including environmental licensing, oil blocks bidding, biodiversity research, and definition of areas for the establishment of protected areas (federal and state levels).

2.2. Brazilian Federal Legal Framework And Governmental Plans And Actions

Due to rising concerns about the environment and the economic, environmental and social relevance of the coastal and marine areas under Brazilian jurisdiction, between the 1980s and 2000s the government established policies focused on coastal and marine management. The first of these standards was Law 6938/1981, or the National Environmental Policy (PNMA, in Portuguese is Política Nacional de Meio Ambiente), which aimed to preserve,

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[98] More information about the processes and features of each area: http://www.mma.gov.br/biodiversidade/biodiversidade-brasileira/%C3%A1reas-priorit%C3%A1rias .

[99] FUNAI (Brazilian governmental institution responsible for Indigenous issues) defines Indigenous Land as one part of the country, owned by Federation, inhabited by one or more indigenous peoples and/or used for their productive activities, environmental resources preservation for their well-being and necessary for their physical and cultural reproduction, according to their uses, customs and traditions. Available from: http://www.funai.gov.br/index.php/2014-02-07-13-24-32

[100] The remaining Quilombo communities are formed by the descendants of black slaves who in the slavery resistance process originated social groups occupying a common territory and sharing cultural characteristics. The Article 68 of the Temporary Constitutional Provisions Act, Federal Constitution/1988, established: "The definitive property rights of remnants of quilombos that have been occupying the same lands are hereby recognized, and the state shall grant them title to such lands."

[101] Brazilian Priority Areas for Conservation http://www.mma.gov.br/estruturas/chm/_arquivos/maparea.pdf or http://mapas.mma.gov.br/mapas/aplic/probio/areaspriori.htm?o4luusq1r3rsteg32dbvfngje1 for an interactive map

[102] See http://www.mma.gov.br/estruturas/202/_arquivos/portariamma_n__9_2007_reas_prioritrias_202.pdf

enhance and restore the environmental quality to ensure conditions for socioeconomic development, national security and the protection of the dignity of human life[103]. This law established the National Environmental System (SISNAMA, in Portuguese is Sistema Nacional de Meio Ambiente), composed of federal, state, and municipal organizations responsible for the protection and improvement of environmental quality. The tools of the National Environmental Policy are the establishment of 1) environmental quality standards; 2) environmental zoning; 3) environmental impact assessment; 4) licensing and review of pollution; 5) incentives for development, production and installation of technological equipment aimed at environmental quality improvement; 6) protected areas; 7) a national information system on the environment; 8) the Federal Technical Registry of Activities and Environmental Defense Instruments; 9) disciplinary or compensatory penalties for non-compliance of the environmental legislation; 10) an annual publication of the Quality of the Environment Report by IBAMA; 11) the supply of information regarding environment; 12) the Federal Technical Registry of potentially polluting activities and/or users of environmental resources; and 13) other economic instruments, such as forest concession, environmental servitude, environmental insurance. The PNMA determines the development of environmental impact assessment (EIA) by the enterprises for the installation and expansion of projects with potential environmental impact.

The Federal Constitution, enacted in 1988, conferred on the Coastal Zone the status of "National Heritage", thus, the use of coastal areas, including natural resources, must ensure the preservation of the environment[104]. The Constitution also defined the territorial waters and natural resources of the continental shelf and EEZ as "goods of the Union". The regulation of Article 225 of the Constitution has led to other standards containing provisions related to management and protection of living resources in the coastal and marine areas, such as the Law of Environmental Crimes[105], the SNUC Law[106] and the Forestry Code[107].

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[103] See http://www.planalto.gov.br/Ccivil_03/Leis/L6938.htm

[104] Brazil, Federal Constitution/1988, Article 225, paragraph 4. Available from http://www.planalto.gov.br/ccivil_03/Constituicao/Constituicao.htm

[105] Brazil, Law 9605/1998. See http://www.planalto.gov.br/ccivil_03/LEIS/L9605.htm

[106] Brazil, Law 9985/2000. See http://www.planalto.gov.br/ccivil_03/LEIS/L9985.htm

[107] Brazil, Law 12651/2012. See http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm

In the same year, the Brazilian government prepared the National Coastal Management Plan (PNGC, in Portuguese is Plano Nacional de Gerenciamento Costeiro) to guide resource use in the coastal zone in order to raise the quality of life of its population and protect the natural, historical, ethnic and cultural heritage[108]. The PNGC must also establish zoning uses and activities in the coastal area giving priority to the conservation and protection of the following goods: I - renewable and non-renewable natural resources; reefs, submerged rocks and algae; coastal and oceanic islands; river, estuary and lagoon systems, bays and inlets; beaches; rocky headlands, cliffs and sea caves; sandbanks and dunes; coastal forests, mangroves, swamps and underwater prairies; II - ecological sites of cultural relevance and other natural units of permanent preservation; III - monuments forming part of the natural, historical, paleontological, archaeological, speleological, ethnic, cultural and landscape heritages[109]. The PNGC is part of the National Policy for Marine Resources (PNRM, in Portuguese Política Nacional para os Recursos do Mar) and of the PNMA.

Brazil's accession to UN international conventions, such as the Ramsar Convention and the CBD, enabled the country to move forward in structuring policies aimed at the conservation and sustainable use of existing biological resources, including those contained in the coastal and marine areas. The fulfillment of the objectives outlined in the program of work on protecting areas of the CBD (Decision VII/28[110]) led to the adoption of the National Strategic Plan on Protected Areas (PNAP, in Portuguese is Plano Estratégico Nacional de Áreas Protegidas). Thus, the policies related to the management and protection of the environment in the coastal and marine areas were based on international agreements signed by Brazil in 1990s and subsequent commitments.

After UNCLOS came into force in 1994, the Federal Government established the National Policy for Marine Resources by Decree 5377 in 2005, but its guidelines were prepared in the 1980s. The PNRM intended to guide the development of activities aimed at the effective use, exploration and exploitation of living resources, mineral and energy of the territorial sea,

[108] Brazil, Law 7.661/1988. Available from http://www.planalto.gov.br/ccivil_03/Leis/L7661.htm

[109] Brazil, Article 3 of the Law 7.661/1988. Available from http://www.planalto.gov.br/ccivil_03/Leis/L7661.htm

[110] See https://www.cbd.int/decision/cop/?id=7765

the EEZ and the continental shelf, according to national interests, in a rational and sustainable manner for the socioeconomic development of the country, generating employment and income and contributing to the social inclusion[111]. The PNRM has the following goals: promote training for human resources; stimulate the development of marine research, science and technology; and encourage the exploitation and sustainable use of the resources of the sea water, seabed and its subsoil, and adjacent coastal areas. The implementation of the PNRM occurs through governmental plans, especially the PNGC, and for multi-annual programs called PSRM drawn up by the Inter-ministerial Commission for Marine Resources[112] (CIRM in Portuguese), unfolding in specific projects. One very relevant specific program was proposed by the PSRM III (1990-1993) and redesigned by PSRM IV (1994-1998), named Assessment Program for the Sustainable Potential of Living Resources in the EEZ (or Revizee Program). Currently, the PSRM VIII (2012-2015) in progress has as action the evaluation, monitoring, and conservation of marine biodiversity (REVIMAR), which has as a goal to keep the assessment of 6 reef ecosystems in MPAs monitored by the "reef check" methodology[113].

Approved by Decree 5758/2006, the National Strategic Plan on Protected Areas defines the principles, guidelines and actions to establish a comprehensive system of PAs ecologically representative, effectively managed, integrated with terrestrial and marine areas until 2015. The PNAP considers not only the SNUC categories of PAs (which will be the focus of the next topic), but also the Indigenous Lands and Remnants of Quilombo Territories, in addition to Legal Reserves and Permanent Preservation Areas, identified as integrating landscape elements. Its objectives and strategies are organized around four themes: 1) Planning, strengthening and management; 2) Governance, participation, equity and sharing of costs and benefits; 3) Institutional capacity; and 4) Evaluation and monitoring. To each theme were listed overall and specific objectives, as well as strategies to ensure their effectiveness. During the creation of PNAP, there was a specific group of experts to develop actions to the

[111] Brazil, Decree 5377/2005. Available from http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2005/Decreto/D5377.htm

[112] The CIRM was established by Decree 74557/1974 and it is composed by the following Ministries of: Navy; Foreign Affairs; Transport; Education; Sport; Development, Industry and Foreign Trade; Tourism; Mines and Energy; Science and Technology; Environment; and, Planning and Management.

[113] See http://www.reefcheck.org/

coastal and marine zones, including the establishment of PAs and the management of the fishing activity. They presented a set of principles, guidelines and strategies to protect the coastal and marine areas, including: MPAs should assist in the recovery of fish stocks; the system of MPAs should include all varieties of environments; the final percentage of each coastal and marine ecosystem to be protected should be defined considering studies of quality and effectiveness of the areas (representativeness), e.g. it is desirable that sites be prioritized on the basis that they are representative of one or more marine habitats or ecosystems and each protected area will contain a number of habitat and ecosystem types; and the design of PAs must take into account pressures, threats and existing conflicts between the coastal uses and the EEZ[114].

The ratification of the CBD by the Brazilian National Congress, in February 1994, started a series of federal government initiatives in order to comply with the commitments contained in CBD agreement. In particular, there was a development of strategies, plans and programs to promote the achievement of the CBD three primary objectives contained in Article 6, and more recently, the Aishi Targets. Currently there are a few projects regarding coastal and marine biodiversity conservation and MPAs management as well. The most relevant programs and projects include:

Marine Protected Areas Project (GEF-Mar) – This project was initiated in 2014 and has 5 years in duration. The overall goal is to support the enlargement and implementation of a globally significant, representative, and effective system of MPAs to reduce coastal and marine biodiversity loss, and identify mechanisms for their financial sustainability. One of the targets is to increase the MPAs to 5%. The project has an initial investment of USD 18.2 million from the Global Environmental Fund (GEF) via the World Bank, USD 20 million from Petrobras and more business counterparts in goods and services, reaching USD 70 million. The project is coordinated by MMA, ICMBio, and their financial counterparts.

Effective Conservation and Sustainable Use of Mangroves in Brazilian PAs (GEF-Mangue) – The project is funded by GEF and coordinated by MMA and ICMBio in partnership with IBAMA, state

[114] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

governments and non-governmental entities. The GEF-Mangue aims to develop and strengthen a network of PAs for mangrove ecosystems in Brazil, through political, financial and regulatory mechanisms; management of fisheries; coordination of territorial planning tools with management of PAs and dissemination of the values and functions of mangroves. This project intends to build the basis for improved conservation and sustainable use of the country's mangroves.

Integrated Management of Coastal and Marine Biodiversity Project (Terramar) – The program is a partnership between Brazilian and German governments with investment of EUR 11 million between 2015 and 2020 in actions focused on training and development of methodologies for monitoring and management of Brazilian coastal natural resources. The Terramar aims to ensure a consistent environmental planning and integrated management of marine and coastal zone in order to contribute to the protection and sustainable use of biodiversity.

Integrated Management of the Maritime Waterfront Project (Projeto Orla) – This project refers to a joint work between the Ministry of Environment and the Federal Department of Heritage. The project's actions are focused on the planning and management of coastal areas, especially areas under federal control, bridging the environmental, urban and heritage policies, with articulation among the three levels of Government and society.

Program for the Conservation of Brazilian Coral Reefs – The significant socioeconomic and environmental importance of coral reefs led MMA and partners to coordinate and encourage initiatives to establish a network of protection for this marine ecosystem. Some of these are: The publication of the book "Atlas of Coral Reef Protected Areas in Brazil"; Conscious Conduct Campaign in Reef Environments; Monitoring of Brazilian coral reefs using the "reef check" methodology[115]; and Coral Alive Project (environmental education and awareness).

Ecological Corridors Project – It aims to apply the concept of ecological corridors to the biodiversity conservation in two selected areas within two forest biomes of the country: The Central Corridor of the Amazon, in the State of Amazonas, and the Central Corridor of the Atlantic Forest, covering the coastal and marine zone between the South of Bahia State and

[115] See http://www.reefcheck.org/

Northern of Espirito Santo State. The project is in its second phase of implementation (2006 to 2015), which was funded primarily by the German financial cooperation (KFW), in addition to the Brazilian Government, Rain Forest Trust Fund (RFT) and the European Commission.

2.3. The National System Of Protected Areas

The implementation of a system of protected areas is Brazil's main strategy for *in situ* biodiversity conservation. Protected areas are spaces with relevant natural characteristics, which are meant to guarantee the representativeness of significant and ecologically viable samples of different populations, habitats and ecosystems of the national territory and territorial waters, preserving the existing biological heritage. These areas must ensure the sustainable use of natural resources and still provide the communities involved to develop sustainable economic activities in or around these areas.[116]

The existence of these areas generates benefits for society, through so-called environmental services, among which include: the continuous supply of good quality water, the microclimate improvement in regions with extreme temperatures and excessive pollution and the pollination which ensures high productivity for agricultural crops. There is also the role of PAs to ensure *in situ* genetic repositories, protection and conservation of soil, reduction of natural disaster severity, mitigation of the effects of climate change, and others.

The Brazilian Federal Constitution of 1988 ensures to all an ecologically balanced environment (Article 225) and imposes upon the Government the duty of defending it and preserving it. One of the instruments for fulfilling this duty is the definition of territorial spaces and their components to be especially protected, or rather, it indicates that Government must establish protected areas and guarantee an ecologically balanced environment.

There is no single concept for *Protected Area* in Brazilian law. The term is used in different contexts and with specific meanings, for example, riparian vegetation and

[116] Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment, *O Sistema Nacional de Unidades de Conservação da Natureza* (Brasilia , DF, 2012)

archaeological sites are considered PAs. For protected areas whose purpose is the protection of biodiversity, ecosystems and landscape, we use the term *conservation unit*, which can be understood as a subset of protected areas. Thus, the National System of Protected Areas (or National System of Conservation Units for a literal translation) defines a conservation unit as "territorial space and its environmental resources, including jurisdictional waters, with relevant natural features, legally established by the Government, with conservation objectives and defined limits under special administration, which apply appropriate protection safeguards[117]".

Thus, protected areas in Brazil include the conservation units defined by Law 9985/2000[118], the territories of traditional occupation, such as Indigenous Lands (ILs) or Remnants of Quilombo Territories, and the Legal Reserves and the Permanent Preservation Areas (APP, in Portuguese is Área de Preservação Permanente) instituted by Law 12651/2012[119].

The Brazilian Government created the National System of Protected Areas (SNUC, in Portuguese is Sistema Nacional de Unidades de Conservação da Natureza) by Law 9985/2000 on July 18, 2000, in order to establish a robust mechanism to ensure the establishment and management of protected areas (PAs) in Brazil. The importance of the System was the definition, standardization and consolidation of criteria for the establishment and management of protected areas. The SNUC provided advancements such as the participation of the society in the establishment, planning and management of the conservation units; the determination of buffer zones, mosaics and ecological corridors; and the introduction of economic variables in PA management.

The SNUC was designed to enhance the role of the protected areas. For this, the System is composed of conservation units from the three levels of government (federal, state and municipal).

The SNUC objectives are:

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[117] Law 9985/2000 (National System of Protected Areas). Available from http://www.planalto.gov.br/ccivil_03/LEIS/L9985.htm

[118] See http://www.planalto.gov.br/ccivil_03/LEIS/L9985.htm

[119] See http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm

I – to contribute to the maintenance of biological diversity and genetic resources in the country and in territorial waters;

II – to protect species threatened with extinction at the regional and national levels;

III – to preserve and restore the diversity of natural ecosystems;

IV – to promote sustainable development of natural resources;

V – to promote the use of the nature conservation principles and practices in the development process;

VI – to protect natural landscapes of scenic beauty;

VII – to protect areas with geological, geomorphological, speleological, archaeological, paleontological and cultural relevant features;

VIII – to protect and restore water and soil resources;

IX – to recover or restore degraded ecosystems;

X – to provide resources and incentives for scientific research, studies and environmental monitoring;

XI – to enhance the biological diversity economically and socially;

XII – to ensure conditions and to promote environmental education and interpretation, recreation in contact with nature and Eco-tourism;

XIII – to protect the natural resources necessary for the livelihood of traditional peoples, respecting and valuing their knowledge and their culture.

The Law 9985/2000 defined 12 conservation unit categories divided in 2 groups: Strict Protection Areas and Sustainable Use Areas (Table 1). Comparing with IUCN categories, Brazil has twice as many types. Due to the number, complexity and similarities among categories, some of them have never been used. With so many names and also because some nomenclatures do not have a clear meaning, it becomes confusing for people to understand the features of each PA. The literal translation for English can cause further losses in meaning as well. So, for this document most of the names of Brazilian conservation unit categories are the ones used by the Ministry of Environment's publication in English[120], but some of them were

[120] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, Ministry of Environment,2012)

chosen considering IUCN categories in order to facilitate the reading and understanding.

Table 1. Comparison between Brazilian PA management categories and IUCN categories

Brazilian categories (SNUC)		IUCN categories
Strict Protection	Ecological Station	I(a) - Strict Nature Reserve
	Biological Reserve	
	Wildlife Refuge	I(b) - Wilderness Area
	National Park	II - National Park
	Natural Monument	III - Natural Monument or Feature
Susteinable Use	Ecological Interest Management Area (ARIE)	IV - Habitat/Species Management Area
	Fauna Reserve	
	Private Natural Heritage Reserve (RPPN)	
	Protected Landscape/Seascape (APA)	V - Protected Landscape/Seascape
	National Forest	VI - Protected area with sustainable use of natural resources
	Extractive Reserve	
	Sustainable Development Reserve	

The basic purpose of the Strict Protection Areas is to preserve nature and only indirect use of natural resources is allowed, i.e., this type of conservation unit prohibit the consumption, collection, damage or destruction of living and non-living resources. There are five strict protection categories: Ecological Station, Biological Reserve, National (or State or Municipal) Park, Natural Monument and Wildlife Refuge.

The aim of Sustainable Use Areas is to harmonize nature conservation with the sustainable use of natural resources, wherein the meaning of sustainable use is exploitation of the environment in order to guarantee the sustainability of renewable resources and ecological processes, in a socially fair and economically viable way. The seven Sustainable Use management categories are: Protected Landscape/Seascape[121], Ecological Interest Management Area[122], National (or State or Municipal) Forest, Extractive Reserve, Fauna Reserve, Sustainable Development Reserve and Private Natural Heritage Reserve.

[121] The direct translation would be Environmental Protection Area, but in English it can be confused with Protected Areas in general. As this category is very similar with IUCN category V, it was considered more suitable. This nomenclature was first use to this SNUC Category by: Leandro M. Fontoura, "Tourism and territoriality in the establishment of protected areas on Ilha Grande - Rio de Janeiro, Brazil", *10th International Small Islands Conference*, (Fernando de Noronha, PE, 2014)

[122] For this category I propose a mix between the translation and IUCN category IV

Ecological Station: It aims at protecting nature and carrying out scientific research activities. Visitation is allowed only for environmental education. The ecosystem alterations permitted are: restoration of modified ecosystems; species management in order to preserve; and collection of organisms only for scientific research, up to 3% limit. The character of the property is public. **IUCN Category I(a)**

Biological Reserve: It aims at strictly preserving the biota and its natural attributes, avoiding direct human interference or environmental changes, except measures to recover altered ecosystems and management actions to preserve and restore the natural balance, biological diversity and natural ecological processes. Visitation is allowed only for environmental education. The character of the property is public. **IUCN Category I(a)**

National / State / Municipal Park: The main goal is safeguarding natural ecosystems of great scenic beauty and ecological importance. Scientific research; environmental education and interpretation; recreational activities; and ecological tourism are allowed. The character of the property is public. **IUCN Category II**

Natural Monument: It aims at preserving rare natural sites or great scenic beauty areas. It may consist of private areas when it is possible to reconcile the objectives with the property uses by owners. **IUCN Category III**

Wildlife Refuge: The objective is protecting the natural environments, ensuring the conditions for the survival and reproduction of species. It may consist of private areas when it is possible to harmonize the objectives with the property uses by owners. **IUCN Category I(b)**

Protected Landscape/Seascape (APA, in Portuguese is Área de Proteção Ambiental): Generally, it is a large area with a certain degree of human occupation, holding abiotic, biotic, aesthetic or cultural attributes especially important for the quality of life and well-being of human populations. The major goals are protecting biological diversity, regulating the development processes, and ensuring sustainable use of natural resources. This Sustainable Use management category area is composed of private and public properties. **IUCN Category V**

Ecological Interest Management Area (ARIE, in Portuguese is Área de Relevante Interesse Ecológico): It aims at keeping natural regional or local importance ecosystems and regulating the use of these areas. It is generally a small area, with little to no people living in. This type of Conservation Unit holds extraordinary natural features or hosts rare biological species. **IUCN Category IV**

National / State / Municipal Forest: It is a forest area with predominantly native species. The goal is the sustainable multiple use of forest resources and scientific research on methods for the sustainable exploitation of native forests. **IUCN Category VI**

Extractive Reserve: It aims at protecting the livelihoods and culture of traditional extractive populations. It is established in an area used by traditional communities, whose livelihood is based on the extraction of some natural resources. The exploitation of mineral resources and amateur or professional hunting is forbidden. **IUCN Category VI**

Fauna Reserve: It is a natural area with native animal populations, resident or migratory, suitable for studies on the sustainable economic management of wildlife resources. **IUCN Category IV**

Sustainable Development Reserve: It is a natural area housing traditional populations whose existence are based on sustainable exploitation of the natural resources which have been developed generation after generation and adapted to local ecological conditions. Its people and their livelihoods play a key role in protecting the nature and maintenance of biological diversity. **IUCN Category VI**

Private Natural Heritage Reserve (RPPN in Portuguese): These are designed within a private area by a voluntary act of the owner, it is established by the government in perpetuity. Activities allowed in this protected area are scientific research and visitation with tourist, recreational and educational goals. It aims at biodiversity conservation. **IUCN Category IV**

2.4. Current Status Of Coastal And Marine Protected Areas In Brazil

Protected Areas cover 15.4% of the global land area (excluding Antarctica) and 3.4% of the global ocean area[123]. This estimate from mid-2014 considered all nationally and internationally designated PAs of all IUCN management categories and governance types (including 'unknown') except for UNESCO biosphere reserves recorded in the World Database on Protected Areas[124] (WDPA).[125]

The total of Conservation Units in Brazil is 320 Federal, 634 State, 204 Municipal, and 782 Private Reserves. Table 2 shows the number and sizes of each Federal, State and Municipal conservation unit category. The contribution of municipal conservation units for the system is lower due to the small size of its PAs. It is important to observe that the strictest protection areas are federal conservation units, while most sustainable use areas are from states. The strict protection category most representative is Park (national, state and municipal level) both in number and in area. For sustainable use areas, Protected Landscapes/Seascapes occur more in state and municipal conservation units, while Federal Sustainable use PAs are more represented in National Forests.

In terms of area, Brazil holds 1.5 million km² protected areas in Conservation Units, with 528 thousand km² of strict protection areas and more than 1 million km² of sustainable use areas (Table 2). According to National Protected Areas Register approximately 17.2% of terrestrial biomes are under protection, which 5.8% are strict protection and 11% are sustainable use areas. Figure 2 shows the situation of the country in relation to Aishi target 11, for each biome and maritime zones (territorial sea and EEZ).

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[123] D. Juffe-Bignoli and others, Protected Planet Report 2014: Tracking Progress Towards Global Targets for Protected Areas (Cambridge, UK, UNEP-WCMC, 2014)

[124] See http://www.protectedplanet.net/

[125] Bastian Bertzky, Monika Bertzky and Graeme L. Worboys, "Earth's Natural Heritage", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

Table 2. Number and area of Conservation Units in Brazil[126]

SNUC Management Category	Federal		State		Municipal		TOTAL	
Strict Protection	**#**	**Area (km²)**	**#**	**Area (km²)**	**#**	**Area (km²)**	**#**	**Area (km²)**
Ecological Station	32	74,691	58	47,513	1	9	91	122,213
Biological Reserve	30	39,034	24	13,449	6	48	60	52,531
National, State or Municipal Park	71	252,978	195	94,889	95	221	361	348,088
Natural Monument	3	443	28	892	11	73	42	1,407
Wildlife Refuge	7	2,017	24	1,729	1	22	32	3,768
TOTAL Strict Protection	**143**	**369,164**	**329**	**158,472**	**114**	**372**	**586**	**528,007**
Sustainable Use	**#**	**Area (km²)**	**#**	**Area (km²)**	**#**	**Area (km²)**	**#**	**Area (km²)**
Protected Landscape / Seascape	32	100,101	185	334,898	77	25,922	294	460,922
Ecological Interest Management Area	16	447	24	443	8	32	48	921
National, State or Municipal Forest	65	163,913	39	136,053	0	0	104	299,966
Extractive Reserve	62	124,362	28	20,208	0	0	90	144,570
Fauna Reserve	0	0	0	0	0	0	0	0
Sustainable Development Reserve	2	1,026	29	110,090	5	176	36	111,293
Private Natural Heritage Reserve	634	4,832	147	686	1	0	782	5,517
TOTAL Sustainable Use	**811**	**394,681**	**452**	**602,377**	**91**	**26,131**	**1,354**	**1,023,189**
TOTAL Strict Protection + Sustainable Use without overlaps	**954**	**758,733**	**781**	**755,661**	**205**	**26,479**	**1,940**	**1,513,828**

[126] Source: Brazilian National Protected Areas Register (CNUC/MMA), available from http://www.mma.gov.br/images/arquivo/80112/CNUC_Categoria_Fevereiro_2015.pdf accessed in 27 October 2015

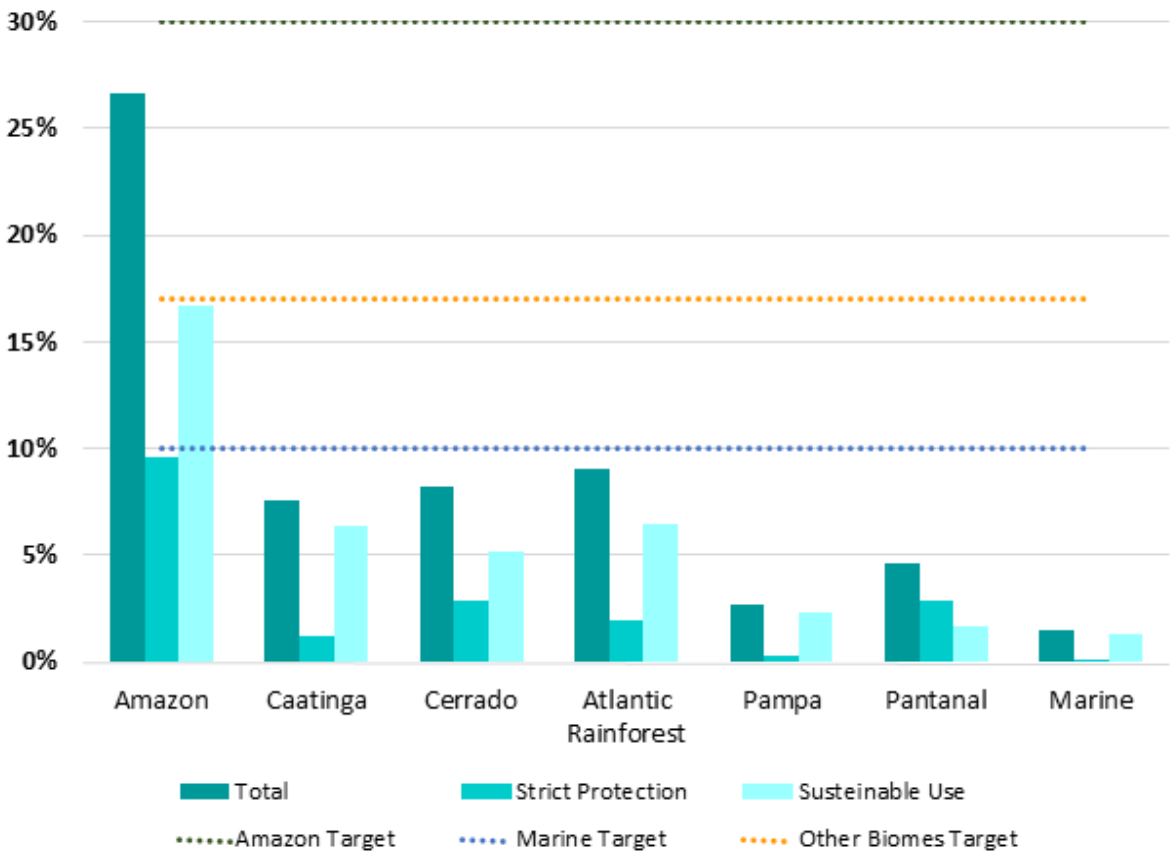

Figure 2. Percentage protected per biome and Aishi target 11 values [127]

The world's oceans are very under protected. The World Database on Protected Areas[128] shows only approximately 3.4% of the global ocean are MPAs of all IUCN management categories by mid-2014, but according to MPAtlas website, currently 2.12% of the oceans are under protection in a total of 11,333 MPAs, while only 0.94% are no-take areas[129]. Only 0.25% of marine areas beyond national jurisdiction are within protected areas[130].

In Brazil, the situation is not different from the rest of the world. While Brazil is

[127] Source: Brazilian National Protected Areas Register (CNUC/MMA), available from http://www.mma.gov.br/images/arquivo/80112/CNUC_Bioma_Fevereiro_2015.pdf accessed in 27 October 2015

[128] See http://www.protectedplanet.net/

[129] See http://www.mpatlas.org/explore/ accessed on 17 September 2015

[130] D. Juffe-Bignoli and others, *Protected Planet Report 2014: Tracking Progress Towards Global Targets for Protected Areas* (Cambridge, UK, UNEP-WCMC, 2014)

almost reaching Aishi target 11 in some terrestrial biomes (Figure 2), only 52,767 km² are protected in 157 conservation units, including 61 strict protection and 96 sustainable use areas. Besides marine area is almost half of the value of the Brazilian continental territory, 1.5% of the maritime areas, including the territorial sea and EEZ, are under environmental protection, while 17,2% of terrestrial areas are conservation units (Table 3).

Table 3. Continental and Marine Protected Areas [131]

SNUC Management Category	Continental PAs			Marine PAs		
Strict Protection	**#**	**Area (km²)**	**%**	**#**	**Area (km²)**	**%**
Ecological Station	91	122,075	1.4%	7	138	0.0%
Biological Reserve	57	51,975	0.6%	8	557	0.0%
National, State or Municipal Park	356	344,229	4.0%	39	3,859	0.1%
Natural Monument	42	1,407	0.0%	2	1	0.0%
Wildlife Refuge	31	3,585	0.0%	5	183	0.0%
TOTAL Strict Protection	**577**	**523,270**	**6.1%**	**61**	**4,738**	**0.1%**
Sustainable Use	**#**	**Area (km²)**	**%**	**#**	**Area (km²)**	**%**
Protected Landscape / Seascape	292	416,824	4.9%	65	44,097	1.2%
Ecological Interest Management Area	47	917	0.0%	4	4	0.0%
National, State or Municipal Forest	104	299,966	3.5%	0	0	0.0%
Extractive Reserve	90	139,086	1.6%	21	5,484	0.2%
Fauna Reserve	0	0	0.0%	0	0	0.0%
Sustainable Development Reserve	36	111,237	1.3%	5	55	0.0%
Private Natural Heritage Reserve	782	5,517	0.1%	1	0	0.0%
TOTAL Sustainable Use	**1,351**	**973,548**	**11.4%**	**96**	**49,641**	**1.4%**
TOTAL Strict Protection + Sustainable Use without overlaps	**1,928**	**1,461,061**	**17.2%**	**157**	**52,767**	**1.5%**

[131] Source: Brazilian National Protected Areas Register (CNUC/MMA), available from http://www.mma.gov.br/images/arquivo/80112/CNUC_Bioma_Fevereiro_2015.pdf accessed in 27 October 2015

In 2012, Prates and others made a big effort to evaluate the status of Brazilian Coastal and Marine Ecosystems Conservation. The study shows that considering only coastal areas about 40.1% were under any conservation unit category protection, leading to the achievement of national and international goals. Nevertheless, the combination between coastal and marine areas results in 3.14% under protection, far below the Aishi target 11.[132] Considering strict protection and fishing exclusion areas (no-take zones), the results are even more disappointing. However, it is not possible to obtain an accurate estimate about it, because neither there is a calculation of fishing exclusion areas yet, nor an assessment of the effectiveness of these areas.

The same study estimated the area of each type of coastal ecosystem (beaches, cliffs, dunes, restingas, swamps and wetlands, estuaries, lagoons, mangroves, and marshes) and analyzed the percentage of each one that is protected in conservation units (Table 4). Considering strict protection areas, only cliffs, dunes, mangroves and restingas have more than 10% of their area under protection. The areas of the other five coastal ecosystems (swamps and wetlands, estuaries, lagoons, marshes, and beaches) were far below 10% in strict protection areas. Thus, these ecosystems would demand greater attention from the government to establish new PAs. When the analysis includes sustainable use areas, most ecosystems exceed the 10% target. Only lagoons and marshes are very underrepresented in Protected Areas, constituting two priorities for the conservation of biodiversity in the country.[133] The calculation used just areas of each ecosystem located in Conservation Units, but did not consider other kinds of protected areas such as territories of traditional occupation and the Permanent Preservation Areas (for example, mangroves).

[132] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

[133] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil (Brasilia, DF, MMA, 2012)*

Table 4. Coastal ecosystems for strict protection and sustainable use areas in km²[134]

	Beaches	Cliffs	Dunes	Restingas	Swamps & Wetlands	Estuaries	Lagoons	Mangroves	Marshes
Ecosystem	827.78	1,444.75	3,183.12	4,691.83	48,496.71	66,967.87	15,184.26	12,254.44	121.49
Strict Protection	22.00	458.95	1,179.98	957.83	2,525.90	124.36	338.34	1,606.48	0.77
Sustainable Use	178.11	682.74	181.19	2,282.98	26,146.65	13,757.58	82.95	7,590.49	0.00
PA TOTAL	200.11	1,141.69	1,361.17	3,240.81	28,672.55	13,881.94	421.29	9,196.97	77.00
Percentage Protected	**24.2%**	**79.10%**	**42.80%**	**69.10%**	**59.10%**	**20.70%**	**2.70%**	**75.00%**	**0.60%**

In Brazil the official map of biomes is restricted to continental features. Thus, the lack of biogeographic boundaries for the marine biome, coupled with the lack of information on several marine ecosystems, make it difficult to calculate the representativeness of the environments protected. However, as explained previously, only 1.5% of the maritime areas are in Protected Areas, with 0.13% in strict protection categories.

Considering all this information, the implementation of coastal conservation units and establishment of new PAs in maritime areas, as well as increase the protection in the coastal ecosystems: lagoons and marshes must be priorities for the environmental agencies, especially ICMBio.

[134] Source: Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

CHAPTER 3 – CHALLENGES OF ESTABLISHING AND IMPLEMENTING COASTAL AND MARINE PROTECTED AREAS

3.1. Procedures To Establish Conservation Units In Brazil

An important factor in the establishment of protected areas is the process by which they are nominated and designated. There is not only one way for creating a protected site. The planning process varies according to the amount of government involvement (low to high), the financial resource available, the goal of protection, the resource in question, and the views of local communities, resource users, or other stakeholders.

In Brazil, conservation units are established by an act of the Federal, State or Municipal Government. The proposed creation of a new protected area is part of the duties of ICMBio (federal), state and municipal environmental agencies. Some protected areas require more than 10 years of planning and discussions before their establishment. Others are designated in less time. In each case, an arduous process of research, consultation and advocacy is required before the areas are officially assigned a protected status. This means that when an environmental agency proposes the creation of a new conservation unit, a great amount of effort has been employed to choose this space for protection.

The establishment of PAs is supported by several legal instruments related to public policies for biodiversity conservation in Brazil, such as: Article 225, Federal Constitution/1988; United Nations Conference on Environment and Development (Rio 92); CBD; Law 9985/2000 (SNUC) and its regulation (Decree 4340/2002); National Biodiversity Policy, Decree 4339/2002; Decree 5758/2006 (PNAP); National Policy for the Sustainable Development of Traditional Peoples and Communities, Decree 6040/2007; Priority Areas for Conservation, Sustainable Use of Biodiversity and Benefit Sharing, MMA Ordinance 09/2007.

The first step in the PA establishment process is to nominate or identify a specific site that has relevant areas for conservation or that is necessary for traditional communities. In

most cases, a scientific review process in which experts locate an area of interest based on certain ecological characteristics drives the initial part of this phase. Usually, governmental institutions, universities or NGOs conduct this research. The conservation unit establishment process starts through the presentation of a formal demand to the governmental environmental agency responsible for that region (can be federal, state or local depending of the size, location, and site situation) indicating the proposed area to establish a conservation unit, with or without technical studies. The demand for the establishment of a conservation unit can be performed by the environmental agencies, researchers, Congressmen or women, Senators, civil society, environmental NGOS, among others. In practice, much of the current demand for establishment of PAs is related to the interest and manifestation of civil society, the scientific community and/or government agencies, who are aware of the need for more robust mechanisms for the protection of Brazil's natural heritage.

Once a governmental environmental agency receives the demand of candidate sites from any sector of society, the appropriate agency conducts a technical evaluation to assess the potential for setting up a PA in the suggested area. The specific site shall be evaluated against selection criteria defined by the environmental agency to determine whether it meets the objectives for protection and is suitable for designation. The criteria provide standards for assessing the value of a potential PA and ensure consistency throughout the planning process. Each set of criteria is different, but usually includes ecological and social characteristics. The areas with potential to become conservation units are those that have one or more of the following characteristics: remaining natural areas in good state of preservation; the presence of endangered, rare, migratory and/or endemic species; areas included in the MMA map of Priority Areas and Actions for Conservation; scenic beauty; potential for ecotourism; rich in biodiversity; rare sites; presence of water resources; and availability of sustainable use of natural resources[135].

After that analysis, if the area is considered appropriate the agency proceeds to additional studies and surveys in order to designate the new conservation unit. Reports and

[135] Brazil, Department of Protected Areas, Secretariat for Biodiversity and Forests, Ministry of Environment, *Roteiro para Criação de Unidades de Conservação Municipais* (Brasilia, DF, 2010)

surveys are conducted focusing on the natural environment (physical and biotic); potential for visitation; and cultural and socioeconomic characterization considering the impacts of the establishment of a PA, including land surveys. The depth of analysis may differ depending on the particulars of each proposal. Before beginning the technical studies, the environmental agency usually carries out a survey of information already available on the region, in order to avoid duplication of studies, reduce costs and streamline the process. Some protected areas have been established on the basis of existing studies that were conducted by environmental and research institutions (e.g. technical reports, EIAs, monographs, theses etc.).

The technical studies are essential to the selection of the categories and limits appropriate to the proposal of conservation unit. For example, fisheries diagnostic studies are typically conducted for proposals that focus on marine areas. Technical studies can be done either by the staff of a government agency or by hired consultants.

Such studies are always complemented by surveys and inspections in the field to detail the information about communities that may reside and/or use the proposed area and to determine whether they are traditional populations (indigenous, quilombolas, caiçaras and others), what the occupations and human uses of the environment are in the region, and what the potential impacts of these uses might be. This information is essential to improve and to continue the proposal.

The phase of studies and surveys in the field is completed with the preparation of a preliminary description of the limits and category of the proposed protected area. This preliminary proposal is presented to and discussed with society. The choice of category will depend on the characteristics of the area and must follow the criteria established by the appropriate environmental agency, for example: 1) An area in pristine natural condition, rich in biological diversity, with endemic, rare or endangered species and the potential for research would probably be a Biological Reserve or Ecological Station; 2) An area in good natural condition or rich in biological diversity or with the occurrence of endangered species or particular areas without need of compulsory expropriation would probably be a Wildlife Refuge;

3) An area in good natural condition or rich in biodiversity, with beautiful scenery and some natural would attract public visitation might be a National, State or Municipal Park; 4) A small area in good or fair natural condition with at least a highly relevant and attractive scenic beauty could be a Natural Monument; 5) An area in good natural condition with presence of traditional communities and natural resources that will be managed in a sustainable manner by the communities could be recommended for an Extractive Reserve or Sustainable Development Reserve; 6) An area in good natural condition with timber of commercial value might be nominated for a National, State or Municipal Forest; 7) An extensive area in good condition and requiring organize human activities and land occupation could be designated as a Protected Landscape/Seascape. These are just a few examples; other criteria can be used in the definitions of these categories.

The next step in the establishment of a conservation unit process is called the consultation phase. It is characterized by meetings with various stakeholders, especially representatives of local government, NGOs and society, while giving the opportunity for participation to any citizen. Several government sectors shall be consulted to avoid overlapping conflicts with other interests. The manifestations (responses) of governmental institutions are analyzed by the lead environmental agency in order to adjust the proposed limits of the conservation unit. If any of these institutions were against the establishment of the PA, the staff of the lead agency evaluates the arguments and the possibility of a reformulation of the proposal (e.g., by changing the category and/or boundary or the establishment of more than one category or a mosaic).

The public consultation is a process driven generally by one or more public meetings and formal consultations with various public institutions. In the public consultation the lead environmental agency has a duty to present the PA proposal, providing adequate and understandable information to the local population and all stakeholders. Moreover, it has to mention the implications for the population living in and around the proposed conservation unit, in clear and accessible language. Despite its mandatory character[136], the public consultation does not include the power to take decisions about the establishment of a conservation unit;

[136] Brazil, Law 9985/2000, Article 22 Paragraphs 2° and 3°. See http://www.planalto.gov.br/ccivil_03/LEIS/L9985.htm

the process is simply informative and not deliberative. It aims to help the decision of the location, the size and the most appropriate boundaries for the future PA.

The consultation consists of public meetings or other forms of hearings with local people and stakeholders as defined by the environmental agency. A copy of the technical studies is made available at the responsible agency's headquarters (environmental agency or City Hall) or online. The availability of the technical studies also enables the participation of those who cannot attend the hearing. The public can request for information, or submit suggestions, or questions, etc. in advance of the meeting.

Public consultation meetings are open to the public and begin with extensive presentation about the proposal. The presentation must be clear and accessible and citizens, stakeholders and local institutions must be allowed to express their positions, to ask questions, and to hear their concerns and suggestions addressed. The goal is to ensure maximum participation of local stakeholders, as this process is intended to enable citizens to provide feedback, helping to improve the decision of the environmental agency about the future conservation unit.

To encourage high participation, the environmental agency must formally invite interested institutions and provide the notice of public consultation in the municipality at least 15 days in advance. People can be notified by local radio and TV stations, loudspeakers, electronic mail, fliers, advertising posters or other means to ensure the participation of the largest possible number of people.

The technical team of the environmental agency gathers and analyzes information and requests made before, during and after the consultations and from these contributions obtained, draws up a final proposal limit and category for the Conservation Unit. To define the boundaries of the PA, especially with large territorial extensions, the agency conducts inspection in the field using maps, aerial photos and satellite image. The development of the map and complete specifications (description of geographic coordinates of existing points on the map) are essential for the correct location, the shape and the size of the conservation unit.

At this stage it is necessary for the participation of a professional in GIS with experience in drawing maps and the specifications. This work should be done collaboratively with technical staff from the environmental agency, who have visited the site and may indicate which areas should be included and excluded in the PA proposal.

With all of this information, the proposed conservation unit goes to the executive branch (City Hall or State Government) for legal review. For Federal PAs the information goes to the Ministry of the Environment - MMA, where complementary technical and legal analyzes are held, as well as consultations with other federal institutions who may have interests in the proposed area.

After all these steps are completed, the proposal is then forwarded to the Chief Executive (Mayor, Governor or President of the Republic) accompanied by all the documents that are part of the process of establishing the PA. The conservation unit is only designated after the signature and publication in the Official Gazette of the respective Decree.

3.2. Challenges And Difficulties In Establishing New Conservation Units And Maintaining Current Polygons In Designated Protected Areas

The establishment of a protected area or a conservation unit in Brazil is a very complex and difficult task. Several studies are necessary which can involve a wide range of conflicts. According to data from the Social-Environmental Institute (ISA in Portuguese) and ICMBio, there has been a reduction in the rate of establishment of conservation units, even with the international commitments received by the country (Table 5). In fact, the current government ranks second in establishing fewest protected areas designated since 1985. From 2011 until now, the government established 10 conservation units and extended 6 existing ones. In addition, this government reduced the area of 6 protected areas in order to build dams, setting a historical reduction precedent of 164,000 hectares in protected areas. In total, the increase was 770,603 ha[137], an extremely low value when compared to previous governments (see Table 5).

[137] See http://uc.socioambiental.org/c%C3%B4mputos/brasil/per%C3%ADodo-presidencial

It is also worth noting a great effort of several Congressmen and women to change the law regarding other kinds of PA (Legal Reserves and the APPs instituted by Law 12651/2012, ILs and Remnants of Quilombo Territories). Additionally, they intend to increase the formalities in order to hamper the establishment of protected areas.

Table 5. Establishment of Federal Conservation Units in Brazil by presidential terms between 1959 and 2015[138]

Period	President	Strict Protection		Sustainable Use		TOTAL	
		#	Area (ha)	#	Area (ha)	#	Area (ha)
01/01/2011 to now	Dilma Vana Rousseff	6	792,787	4	96,577	**10**	**770,603**
01/01/2007 to 31/12/2010	Luis Inácio Lula da Silva	11	2,684,623	12	3,638,087	**23**	**6,322,710**
01/01/2003 to 31/12/2007	Luis Inácio Lula da Silva	19	8,836,103	35	11,568,579	**54**	**20,404,682**
01/01/1999 to 31/12/2003	Fernando Henrique Cardoso	22	7,935,913	38	4,887,403	**60**	**12,823,316**
01/01/1995 to 31/12/1998	Fernando Henrique Cardoso	5	704,123	16	8,035,400	**21**	**8,739,523**
02/10/1992 to 31/12/1994	Itamar Franco	0	0	1	14,640	**1**	**14,640**
15/03/1990 to 01/10/1992	Fernando Collor de Mello	3	975,258	11	400,469	**14**	**1,375,727**
15/03/1985 to 14/03/1990	José Sarney	21	2,008,540	30	7,486,879	**51**	**9,495,419**
31/12/1959 to 15/03/1985	Several mandates	57	13,100,692	27	1,912,400	**84**	**15,013,092**
TOTAL		**141**	**36,289,285**	**170**	**37,943,857**	**311**	**74,233,142**

There is a lack of information on the reason for the large decrease in the creation of PAs in Brazil. While the country has kept international commitments, clearly there is no political will in the expansion of PAs. In order to understand the reasons, challenges, and difficulties in establishing new conservation units, and in maintaining current polygons of protected areas, it is interesting to look back to the history of the establishment of protected areas in the country.

The establishment of the first protected areas in the world reflected a dispute of the urban-industrial society. The adopted environmental policies, which focused on lifestyles incompatible with the conservation of environmental resources, were based on the aesthetic

[138] Source: http://uc.socioambiental.org/c%C3%B4mputos/brasil/per%C3%ADodo-presidencial

and religious motivations. The first protected area in Brazil, named Itatiaia National Park, was established in 1937. The reason was to provide space for scientific research and leisure for the visitors. Before 1970s, the purpose of PAs in the country were scientific and/or preservation of scenic attributes. There was no clear strategy or planning process for PAs, which were established by specific and punctual chances.

Between the late 1960s and early 1970s the environmental movement began to gain momentum in Brazil, mainly due to the publication of some studies warning of the imminent exhaustion of its main sources of natural resources. Until the end of the 1980s, the general vision of the Brazilian environmental movement and public policies for environmental management was centered in the supremacy of nature over humans[139]. The establishment of natural protected areas was one of the main strategies of the environmental policy in the country, and it has been based on Theory of Island Biogeography. In that period most PAs were designated under the strict protection regime, which does not admit any kind of human permanence. The 1970s and 1980s were also marked by the construction of large infrastructure projects with high environmental impact such as the Trans-Amazon highway and the Itaipu hydroelectric plant.

From the spread of the concept of sustainable development, there was a change in the focus of PAs establishment policies. In the 1990s, some interactions between protected areas and society began to be admitted. Following the global trend, Brazil has adopted the model of sustainable use PAs as the main policy tool in biodiversity management.

After 8 years of proceedings in the National Congress and discussions, the SNUC (Law 9985) was approved in 2000. Public participation and technical studies became mandatory in the process of PA establishment. Nowadays, the designation of conservation units is justified by scientific criteria. Scenic beauty is still an element to be considered, however, it is no longer the key parameter, as it once had been. Contemporary scientific bases are also relied upon to resolve disputes regarding the social appropriation of nature at different levels (uses and

[139] Andreza Martins, “Conflitos Ambientais em Unidades de Conservação: Dilemas da Gestão Territorial no Brasil” *Biblio 3W: Revista Bibliográfica de Geografía y Ciencias Sociales*, Vol. XVII, Issue 989 (25 August 2012). Available from http://www.ub.edu/geocrit/b3w-989.htm

occupations). International, national, regional and local pressures raised by different interest groups are detected in the analysis of PAs establishment processes.

The designation of a new conservation unit demands a great effort to identify target areas and to conduct research, as mentioned before. Depending on the size of the area, the difficulties of access or the extent of human occupation, these studies may require a significant amount of time, labor and resources. But in general, with the current technology, such as satellite images and GIS tools, the maps can be performed without great difficulty by a well trained staff.

In fact, one of the biggest difficulties in establishing protected areas is politics. To ensure the conservation of significant expanses of natural environments, it is often necessary to limit or prohibit the exploitation of natural resources in the areas. The establishment of PAs is an especially hard task due to opposing resistance by individuals, groups or sectors (and their agents in politics) occupying, operating or planning to exploit natural resources, known or potential, in the proposed areas[140]. The interests of the stakeholders and users, such as farmers, loggers, miners, energy companies (oil and gas, hydroelectric), real estate, and others may be harmed by the establishment of a conservation unit.

"Allocating an area for special protection is removing it from the immediate economic circulation. This happens with the indication of areas for the establishment of integral protection conservation units, of course. For the sustainable use protected areas there is a partial withdrawal of economic circulation value of the property, given the limitations and permitted uses. From the legal point of view, allocating one area for environmental protection is to grant it special regime that should not be a free access to any activity or person. It is expected that reserved areas reflect a shortage of free land, with environmental value. In times of great appropriation of areas for agriculture, industry and urbanization, the question becomes dramatic."[141]

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[140] Maurício Mercadante, *Depoimento: Avanços e Retrocessos Pós-SNUC*, available from http://uc.socioambiental.org/o-snuc/depoimento-avan%C3%A7os-e-retrocessos-p%C3%B3s-snuc

[141] Paulo de B. Antunes, "Áreas protegidas e propriedade constitucional", *in São Paulo: Atlas* (São Paulo, SP, 2011)

Therefore, the establishment of protected areas often results in conflicts. People linked to candidate areas claim use rights and the social appropriation of environmental goods. This is the reason why history has shown that the delimitation of PAs involves conflicts of varying intensities, but constant over time[142].

One of the main causes of conflict is the problem of land tenure and titling regularization. The vast majority of strict protection conservation units in Brazil still do not have regularized land, because the property expropriation[143] process is very complex and also because it requires a large amount of financial resources. In the view of the new political-administrative rules and the lack of economic resources, people who have properties in PAs are living in precarious conditions without permission to perform any activity, not even renovate their own houses. However, in Brazil land tenure is a huge problem in some coastal areas, but it is not an issue in marine areas because maritime zones and others areas (for example oceanic islands and beaches) are owned by the Federal government.

The conflicts related to the private expropriation of land represents only a part of the complex tensions caused by the establishment of protected areas. Most disputes are due to the use of natural resources, such as mining (sand, limestone, oil and gas, etc.), fisheries and native species for the production of cosmetics and foods (plant and animal genetic resources), use of coastal areas for aquaculture, landscape appropriation by the tourism industry and the real estate market. These are only some examples of uses that allow us to understand the pressure and complexity of the conflicts.

One issue to consider in establishing PAs is that, in the past, the social and spatial interactions in the target area and the impacts of the conservation unit on local societies and the environment were not taken into account. Even today, most of the preliminary studies are conducted by environmentalists, who advocate the PA establishment and not by professionals

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[142] Leonardo B. dos Santos, "Trilhas da Política Ambiental: Conflitos, Agendas e Criação de Unidades de Conservação", *Ambiente & Sociedade*, Vol. 12, Issue 1 (Jan/June 2009). Available from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-753X2009000100010

[143] Expropriation is the procedure whereby the Government, based on public need, public utility or social interest, compulsorily turns out someone of some good (properties), acquiring it for the state in original character, with fair and previous indemnity.

unconnected to the environmental cause[144]. Martins (2012) has reviewed the literature on environmental conflicts in Brazil. She believes that academic research is too deficient, superficial and weak to monitor the social and spatial complexity that manifests the empirical context of rising tensions and social conflicts related to the territorial management and the use of natural resources in PAs[145].

The construction of large projects, such as hydroelectric plants, highways, railways, ports, etc., also generates conflicts. However, the society seems to better understand the advantages of building enterprises than the establishment of a PA. The benefits are more easily measured and immediately perceived. There are more financial resources to minimize the damage and compensate for any losses of local communities. The projects are defended by governments, employers, workers in search of employment, and income for the local people.

The benefits of PAs are more diffuse and harder to measure. There are fewer financial resources to offset harmed interests. Generally, the public only recognizes the importance of these natural areas when disaster befalls, for example, missing water situation (drought) or in the floods. In Brazil, protected areas are resisted by the local population, local businesses and state and municipal governments. The proposed creation of protected areas is advocated only by environmentalists and by a portion of the public, who are better informed and more sensitive to environmental issues. There is a wide asymmetry between forces for and against the establishment of a protected area. In fact, almost everyone, in lesser or greater degree, recognizes the importance of conserving nature. But people think that conservation should be done only on "the neighbor's land".[146]

Traditional approaches to designating PAs are dominated by a *top-down* model, where scientific information leads the process of identifying and designating specific areas. This

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[144] Andreza Martins, "Conflitos Ambientais em Unidades de Conservação: Dilemas da Gestão Territorial no Brasil" *Biblio 3W: Revista Bibliográfica de Geografía y Ciencias Sociales*, Vol. XVII, Issue 989 (25 August 2012). Available from http://www.ub.edu/geocrit/b3w-989.htm

[145] Andreza Martins, "Conflitos Ambientais em Unidades de Conservação: Dilemas da Gestão Territorial no Brasil" *Biblio 3W: Revista Bibliográfica de Geografía y Ciencias Sociales*, Vol. XVII, Issue 989 (25 August 2012). Available from http://www.ub.edu/geocrit/b3w-989.htm

[146] Maurício Mercadante, *Depoimento: Avanços e Retrocessos Pós-SNUC*, available from http://uc.socioambiental.org/o-snuc/depoimento-avan%C3%A7os-e-retrocessos-p%C3%B3s-snuc

model often imposes regulations or laws on resource users, sometimes with little regard for competing uses or human components of the ecological system. While this model is scientifically the most logical approach, in a democratic society the *top-down* model often leads to controversy or opposition because stakeholders are not formally brought into the establishment process and, as a result, they have little understanding of or little support for a site proposal. In contrast, a *bottom-up* approach focuses on directly involving of all stakeholders and interested parties during the planning and decision making stages of establishing a MPA. Involvement during the establishment process by those relying most of the resource being protected is often considered a desirable approach because it incorporates the interests of the community in the final designation and creates a sense of responsibility for protecting marine resources.[147] The formalization of *bottom-up* community involvement in environmental management projects has been driven by past failings of *top-down* approaches[148].

The engagement of local communities, stakeholders and users in PA establishment process was a progress. Despite the recognition that involving the public during the process is a very important step, public consultation has not been easy. The use of huge public meetings has brought on several problems. These hearings are publicized by the local media and by invitations to all associations, organizations and state and municipal agencies. Advance notice has enabled businessmen and politicians to mobilize the population against the proposed conservation unit, convincing them that the government will take their land and their jobs, and that the PA will hinder the local or regional development. Local politicians and businessmen encourage their employees and the community to attend the hearing in order to attack the proposal and the government. The hearing may become a political act. Often the presentation of the proposal needs to happen under police protection. Public hearings can take upwards of six, seven, or eight hours. In some cases, the aggressiveness and annoyance of the population

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[147] Samuel D. Brody, "An Evaluation of the Establishment Processes for Marine Protected Areas in the Gulf of Maine: Understanding the Role of Community Involvement and Public Participation", *in: Gulf of Maine Marine Protected Areas Project,* Report 3, (July 1998). Available from http://www.gulfofmaine.org/library/mpas/process_eval_0798.PDF

[148] Evan D. G. Fraser and others, "Bottom-up and Top-down: Analysis of Participatory Processes for Sustainability Indicator Identification as a Pathway to Community Empowerment and Sustainable Environmental Management", *Journal of Environmental Management*, 78 (2006) p.114–127

and the threat to the safety of the government team impeded the hearing, disrupting or delaying the PA establishment process. [149]

The PAs designation process is challenging and presents some obstacles. Nevertheless, several processes have already been completed, but have remained at a standstill for many years in the Ministry of Environment waiting for a more opportune time. Apparently, the biggest impediment to establish PAs is opposition within federal or state government. For example, the Ministry of Mines and Energy and parliamentary groups in the National Congress, which have interests in the commercial exploitation of areas, are against the establishment of PAs. The decision to designate or not a conservation unit is up to the chief of the executive (President, Governor or Major), who should consider both biological and social importance as economic implications. Besides being the president who established the fewest Conservation Units per term, Dilma Rousseff has implemented a new procedure of analysis of the PAs establishment processes, including one more step by which the Civil Office consults other ministries and state governments, again. This extra step almost makes it impossible to designate a new conservation unit.

There are 10 finalized federal PA establishment or enlargement processes in the MMA for the Amazon Biome and only one MPA (Alcatrazes Wildlife Refuge), with just 67,304 ha. In this particular case, the difficulty is to reconcile the interests of the Brazilian Navy, with the establishment of training area and shooting lane outside the bounds of the PA, without overriding the Tupinambás Ecological Station.[150] If Alcatrazes Wildlife Refuge is designated, this protected area will contribute very little to achieving the 10% target of the marine area under protection. Clearly, there is no prioritization of marine areas in the establishment of conservation units. Thus, a shift in the focus is required by the Establishment of Conservation Units sector of the environmental agencies (especially ICMBio, because marine areas are under federal jurisdiction), so that it will increase efforts to study and assess marine environments in order to establish new MPAs.

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[149] Maurício Mercadante, *Depoimento: Avanços e Retrocessos Pós-SNUC*, available from http://uc.socioambiental.org/o-snuc/depoimento-avan%C3%A7os-e-retrocessos-p%C3%B3s-snuc

[150] Lilian L. M. Hangae, ICMBio - General Coordinator of Establishment, Planning and Evaluation of Conservation Units, personal communication in 10/October/2015.

3.3. Procedures To Implement Coastal And Marine Protected Areas

The establishment of PAs *per se* does not guarantee the conservation of the area. After the designation of a protected area, the environmental agency starts a new challenge, the implementation of the conservation unit. An efficient implementation is vital to ensure the conservation goals of the conservation unit and, consequently, of the ecosystem. According the Aishi Biodiversity Target 11, by 2020 at least 10% of coastal and marine areas should be conserved through effectively and equitably managed PAs. This management is part of the implementation process, which covers all activities necessary to fulfill the objectives of the PA designated.

Some of the Brazilian coastal ecosystems continue to be underrepresented, but the situation of the marine ecosystems in Brazil remains critically unfavorable, and the environmental agencies' main concern must be to establish MPAs. However, in the case of coastal ecosystems, which are sufficiently represented in SNUC (40.1% of coastal areas under a conservation unit category protection), the priority becomes the effectiveness of management performed in these areas. It demands the implementation of management tools in the coastline and watersheds, to minimize negative impacts produced on the marine zone[151].

The implementation of Brazilian MPAs involves several actions and activities, including landholding regularization in conservation unit categories where it is necessary, protection (environmental emergencies, enforcement and surveillance), planning, management, environmental awareness and education, community integration and participatory environmental management, conflict management, public use and visitation, research and biodiversity monitoring, recovery of damaged areas, control of alien species, and others.

Establishment of PAs does not mean the transfer of all land to the government as public property. The land resources of PAs can be composed of federal properties, coastal areas, maritime areas, islands and floodplains, land under jurisdiction of the National Institute of

[151] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

Colonization and Agrarian Reform (INCRA), expropriated land transferred to the MMA/ICMBio domain, state public and/or private properties. Landholding regularization of conservation units includes the identification and transfer of the ownership of the properties that are within the perimeter of each decreed conservation unit of the environmental agency (ICMBio, state or municipal). In such cases, there may be the expropriation of rural properties, indemnity possessions, and the transfer of federal and state public properties to the environmental agency responsible for the PA. In ICMBio, consolidation of boundaries sector takes care of topographic demarcation and signaling the perimeter of federal conservation units in the field. Another important activity is the development, updating and dissemination of the PAs boundaries. These actions ensure information access to institutions, technicians and society, assisting in the protection of Brazil's natural heritage and promoting biodiversity conservation.[152]

Environmental protection refers to exercising the environmental policing power in preventing, combating, enforcing, monitoring and controlling practices that can cause environmental degradation. The main actions are attention to emergencies, enforcement and environmental monitoring. Activities related to emergencies include preventing and combating forest fires or accidents involving oil or other hazardous material (leak, spill, fire/explosion, chemicals or its abandoned packages). The enforcement/surveillance activity is part of environmental conservation strategy aiming to prevent environmental violations. The environmental policing authority takes administrative measures to punish offenders and recover the degradation. To ensure effectiveness, the federal, state, and municipal environmental police should be involved in the development of a joint protection plan. Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment. For protection purposes, monitoring is a set of observations and measurements of environmental parameters in a continuous or frequent manner that may be used to control management or trigger an alarm. In order to speed up the action in case of deforestation or forest fire in PAs, ICMBio and IBAMA use geoprocessing tools. For example, this sector of ICMBio estimates the area affected by fires in federal conservation units, draws up

[152] See http://www.icmbio.gov.br/portal/o-que-fazemos/consolidacao-territorial.html

deforestation alerts in PAs based on the PRODES[153] and DETER[154] systems and gives strong support to inspection teams and fighting fires to enter into operation with more efficiency. There is no remote environmental monitoring for marine areas, but a few conservation units are beginning some initiatives such as the use of vessel tracking system in fishing boats and the use of drones and cameras to monitor areas. The Brazilian Navy conducts patrols in the maritime zones of the country, and makes joint operation with environmental agencies.

Proper management of PAs must be grounded in knowledge of the physical, biotic and socioeconomic parameters of the place and the interactions among their elements. To draw up rules aimed at reconciling the use of land and natural resources with the objectives of PA designation is essential to research the ecosystems, natural processes and the positive or negative anthropogenic interference with the past, current or possible future impacts. Thus, the management of a PA implies understanding and preparing the set of actions necessary for the management and sustainable use of natural resources in any activity within and surrounding areas in order to reconcile the different types of uses with the goal of biodiversity conservation.

The planning of a conservation unit is important for a successful management. In Brazil, there are some planning and management tools, such as use plans or management agreements, sustainable forest management plans, protection plans, and management plans. The Use Plan regulates the use of natural resources by traditional communities living on Extractive Reserves and Sustainable Development Reserves that does not have management plan yet. This document consists of internal rules made, defined and agreed to by populations within PAs about their traditional activities, the management of natural resources, the use and occupation of the area and environmental conservation, with respect to the current legislation. A use plan will subsequently be incorporated into the management plan. The logging in National (or state or municipal) Forests requires a Sustainable Forest Management Plan. It is the set of planning and forest harvesting techniques, adapted to that specific forest conditions and social and economic goals of their uses. The objective of this plan is to guide the timber production, ensuring a better use of resources, increase the profitability of the activity, reduce the impact of

[153] See http://www.obt.inpe.br/prodes/index.php

[154] See http://www.obt.inpe.br/deter/

exploitation, reduce the risk of work accident and promote sustainability.

The most important management tool, the management plan, is a technical document that defines zoning and standards for the use of the conservation unit and natural resource management, including the implementation of the physical structures necessary for the management of the PA[155]. Until 5 years after designation, all conservation units of any SNUC category should have a management plan that addresses the general objectives of the PA[156]. The management plan is prepared under a multidisciplinary approach, considering particular features of each conservation unit. It should reflect a logical process of diagnosis and planning. Throughout the process, it should analyze biotic, abiotic, socioeconomic, historical, and cultural information and how they interrelate. The interpretation of the diagnostic study guides the definition of specific management objectives, zones for different types of uses and conservation, general standards and management programs. The process of developing management plans is a continuous cycle of consultation and decision-making based on the understanding of environmental, socioeconomic, historical and cultural issues characterizing the PA and its region. The process is participatory and it is usually complex depending upon the objectives of the conservation unit, the risks or threats to these objectives, the number of competing interests, the level of stakeholder involvement and the issues arising from outside the protected area. The management plan aims to: 1) Define the specific objectives to guide the management; 2) Promote the management of the protected area, based on knowledge available and generated; 3) Establish differentiation and intensity of use in zoning, aimed at protecting their natural and cultural resources; 4) Highlight the representativeness of the protected area in the ecosystem and Biome contexts, in front of the SNUC valuation attributes; 5) Establish specific rules regulating the occupation and use of the natural resources, buffer zone and ecological corridors; and 6) Recognize the appreciation and respect for social and cultural diversity of traditional communities and their organizational systems and social representation.

The actions that are proposed for social-environmental management are very

[155] Defined by Article 2° of the Law 9985/2000

[156] Provided by Article 27 of the Law 9985/2000

important for a successful and efficient PA implementation. The activities typically include environmental awareness and education, conflict management and community participatory environmental management. The social-environmental management aims to integrate the conservation unit with society at the national, state and regional level. The idea is to promote dialogue with communities and create a set of policies related to land management, conservation and environmental development, based on the principles of environmental education. Participation is an ongoing process. It takes time, resources, understanding and perseverance, but the final result should be a development process that involves people from the different stakeholder groups and their ideas, skills and knowledge. Law 9985/2000 requires the participation of the public in the establishment, planning and management of the conservation units, and stated that each conservation unit must have a consultative or deliberative council, depending on the management category[157]. These councils are composed of community and stakeholder representatives and should have equal representation between government agencies and civil society, advising the conservation unit's management and contributing to the transparency.

Increased human pressures on protected areas and biodiversity shows the need for knowledge to manage natural resources, in order to prevent a shortage or extinction of species and loss of biodiversity. Strategies to generate knowledge on natural resources support the most efficient choices under different approaches to management (environment, people, financial). Thus, research is an important activity to be developed in the protected areas, and actually most conservation units have some ongoing research projects. Because the studies are conducted by researchers and Universities for their own interests, several surveys are not exactly useful for PA management. Biodiversity monitoring is not common, and occurs in some cases when there are endangered species. To improve the quality of information, there shall be greater dissemination of research necessary for the management with universities and researchers. In addition, giving publicity to studies performed is important to show to the community the value and the threats for biodiversity conservation.

[157] Articles 15, 17, 18, 20 and 29 of the Law 9985/2000

3.4. Challenges And Difficulties In Implementing Coastal And Marine Protected Areas

A protected area must be implemented to achieve conservation goals successfully. Many areas officially declared as conservation units do not comply with the objectives for which they were established, because they were never fully implemented. The effective management of a PA depends primarily on the existence of adequate and regular amount of financial and human resources. The availability of these resources and its management will determine the degree to which implementation, maintenance and expansion of the National System of Protected Areas (SNUC) occurs and whether the country will be able to achieve national and international targets.

Another problem faced by protected areas is isolation and lack of connection with other PAs. Because of the critical situation of fragmentation, PAs can be considered ineffective for conservation. Law 9985/2000 provides for the establishment of *ecological corridors*, defined as portions of natural or semi-natural ecosystems, linking protected areas, enabling gene flow and the movement of biota, facilitating the dispersion of species and the recolonization of degraded areas, and also maintaining populations that require for their survival areas larger than those of the individual PAs[158].

The degree of implementation depends on some factors, such as the number and qualification of the employees, training of the staff and working conditions, financial resources, availability of vehicles and equipment, location and access to the area, category of protected area, and others. The effective implementation of the SNUC faces several problems, such as landholding regularization of declared PAs, most conservation units do not have management plan yet, lack of staff, equipment, and infrastructure. The main cause of these problems is the lack of investment in the environmental area. This situation may even worsen with the perspective of PAs expansion in coming years.

The operating budget for federal PAs was practically the same for all years between 2001 and 2011 while there was an expansion of 83.5% in federal conservation units. Thus, the

[158] Defined by Article 2° of the Law 9985/2000

financial resources allocated per protected hectare were reduced around 40% in this period.[159] The 2014 budget limits were not sufficient to meet all the needs of ICMBio. This federal environmental agency faced a serious situation, with spending restraint, due to the insufficient availability of funds which worsened with the budgetary cuts in federal government. Over the years, the budget of ICMBio has not sufficiently increased to meet the growing demands and contractual adjustments.[160] With the economic crisis in the country, the 2015 budget situation is not different. Financial and human resources needed to operate SNUC are scarce and require efficient policy and management strategies, as well as the integration between government and public efforts.

Traditional financing sources for PAs, especially public ones, are essential, but insufficient. The limited budget of PAs reduces the efficiency of management and protection, as well as hampers the integration of the conservation units with the economic dynamics of their surroundings. The lack of financial and human resources is a threat to the viability of these areas. The MMA's overall budget is currently behind seventeen other governmental areas, while cuts and contingencies are routine for the resources allocated to PAs system. The SNUC protects approximately 1.5 million km² of Brazilian territory and integrates federal, state and municipal PAs. The management of this immense territory (with area greater than the sum of the countries France, Spain and Italy) represents a major challenge for a great country with a wide variety of natural ecosystems and socioeconomic contexts.[161]

Compared to other countries, the Brazilian budget per hectare of PAs is 5 to 25 times lower than other nations, and even countries with lower GDP invest much more than Brazil on the maintenance of their PA networks. The investment per protected hectare is USD$ 2.36 per year in Brazil, while Argentina invests USD$ 11.42 and United States invests USD$ 83.48. At the same time, the ratio between the protected area and number of employees

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[159] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, MMA,2012)

[160] Brazil, ICMBio, Ministry of Environment, *Relatório de Gestão do Exercício de 2014* (Brasília, DF, 2015). Available from http://www.icmbio.gov.br/portal/images/stories/relatorio_de_gestao_icmbio_2014.pdf

[161] Brazil, Department of Protected Areas, Secretariat for Biodiversity and Forests, Ministry of Environment, "Pilares para a Sustentabilidade Financeira do Sistema Nacional de Unidades de Conservação", *Áreas Protegidas do Brasil, 7* (Brasilia, DF, 2009)

working in its management is among the lowest in the world. For example, while in South Africa this ratio is one employee for every 1,176 hectares in Brazil it is one employee for every 18,600 hectares.[162]

It is important to focus on the effective implementation of PAs in order to develop their full potential, providing products and services to the Brazilian society. To reach this target it would require an annual investment of BRL$531 million to the federal PAs network, and BRL$361 million for all state systems, with additional BRL$610 million in infrastructure and planning in the federal system, and BRL$1.2 billion in state conservation units. These estimates considered the minimum standards for effective management, using consolidated systems similar to the Brazilian in terms of magnitude, such as United States, Canada, Australia and Mexico for reference.[163]

Qualified staff is also fundamental for the effective management of conservation units, especially people working in the PAs located in remote areas. There is a great disparity between areas in terms of the number of staff. Some conservation units, located in municipalities without infrastructure, with low Human Development Index, and difficult access with high travel costs, usually have only one employee or none. Some sectors and conservation units have a little more employees, but most of them still do not have enough people working. For example, there are almost 1,800 employees working for ICMBio, but the Ministry of Environment estimates the actual necessity in 9,000[164]. How could efficient management be possible with this personnel deficit? The lack of financial and human resources causes delays in land regulation, development of management plans and other management instruments, insufficient protection actions and enforcement to combat environmental crimes, lack of infrastructure for tourism, difficulties in communication with local communities, and others.

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[162] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, MMA,2012)

[163] Brazil, Department of Protected Areas, Secretariat for Biodiversity and Forests, Ministry of Environment, “Pilares para a Sustentabilidade Financeira do Sistema Nacional de Unidades de Conservação”, *Áreas Protegidas do Brasil, 7* (Brasilia, DF, 2009)

[164] Brazil, Department of Protected Areas, Secretariat for Biodiversity and Forests, Ministry of Environment, “Pilares para a Sustentabilidade Financeira do Sistema Nacional de Unidades de Conservação”, *Áreas Protegidas do Brasil, 7* (Brasilia, DF, 2009)

Another great challenge for the implementation of PAs is its land regularization. The lack of land tenure regularization stems from the budget shortage to the indemnities and also from the slowness of public administration in getting basic information needed. For example, there is not an updated national land registry that allows joint activities between the state and federal landownership agencies, and knowledge of the rules and procedures to their effective implementation, as well as political will in solving the issue. Without a reliable land registry, there are portions of illegally appropriated land with original scriptures, which owner is the government. This would exempt the environmental agency of outstanding claims. There are also problems as overlapping properties, with two or more owners holding documentation to the same land. Moreover, differences in the value of indemnities paid in the actions of indirect expropriation and currency speculation of the land hinder the consolidation of conservation units.

The Management Plan is a product of a long and detailed process, which requires resources, skills and organizational systems to ensure success in management planning. According to ICMBio data, only 155 in a total of 320 conservation units have a management plan, i.e. less than half of the federal conservation units. The biggest challenge of the planning process is the necessity of certain flexibility to adapt to circumstances that are continuously changing. So, it is important to adopt an assessment tool to measure the implementation and effectiveness of the management plan, which requires more financial and human resources.

Some PAs are managed without engagement of the surrounding inhabitants, while others consider the interests and well-being of local communities in their management. Thus, the formulation of a management plan should be democratic and participatory, with the involvement of stakeholders, requiring several public meetings. Biotic, abiotic and social studies added to a participatory planning procedure make the development of a management plan a complex and lengthy process.

The surrounding communities and human activities exert pressures on protected areas. Most protected areas are exposed to various types of illegal activities, such as deforestation, logging, collection of plant products, hunting and trapping of wildlife, fishing, and

others. Enforcement is the main tool to inhibit environmental crimes and ensure the effectiveness of PAs. Due to the shortage of staff in environmental agencies, as well as lack of necessary vehicles and equipment, many PAs are not monitored frequently, but only in sporadic operations. The protection in PAs is weak and inefficient. The situation becomes even more complicated in MPAs considering the difficulty in traveling great distances, the high costs, the need for specialized personnel and the unavailability of affordable monitoring technology.

The establishment of a PA creates conflicts of uses and interests between environmental agencies and stakeholders. The lack of qualified personnel also impairs the communication with local communities and stakeholders. Without dialogue between government and the public, opposing parties may attempt to undermine the establishment process, or fail to adhere to the regulations of a designated site. As a result, establishment processes may produce *paper parks, areas that are officially designated but not actively managed to achieve MPA goals,* in which natural resources continue to be degraded because the rules are not followed and enforcement measures are ineffective[165].

[165] Samuel D. Brody, "An Evaluation of the Establishment Processes for Marine Protected Areas in the Gulf of Maine: Understanding the Role of Community Involvement and Public Participation", *in: Gulf of Maine Marine Protected Areas Project,* Report 3, (July 1998). Available from http://www.gulfofmaine.org/library/mpas/process_eval_0798.PDF

CHAPTER 4 – STRATEGIES TO ENHANCE ENVIRONMENTAL PROTECTION FOR COASTAL AND MARINE BIOMES IN BRAZIL: SOLUTIONS TO ESTABLISH NEW CONSERVATION UNITS AND IMPROVE IMPLEMENTATION IN PROTECTED AREAS

4.1. The Development Of A Coastal And Marine Spatial Planning As An Alternative Approach To Increasing The Establishment And Enlargement Of Marine Protected Areas

As explained in Chapter 2, some of the Brazilian coastal ecosystems (lagoons and marshes) are underrepresented in Protected Areas and only 1.5% of the maritime zones are under any conservation unit category. Environmental agencies need to focus on the establishment of MPAs. In Brazil, the territorial sea and EEZ are under federal jurisdiction; therefore, the establishment and management of protected areas in the marine ecosystems is responsibility of ICMBio. The priority actions of environmental agencies should be to ensure the implementation of the designated conservation units and the designation of new MPAs, as well as increase the protection in the lagoons and marshes coastal ecosystems.

Despite the need to prioritize marine ecosystems, it has not been a priority for the ICMBio establishment sector, where apparently the work remains focused on Amazon Biome. The Marine Protected Areas Project (GEF-Mar) was designed to support the establishment and implementation of a representative and effective system of MPAs to reduce coastal and marine biodiversity loss.

The Ministry of Environment, as well as NGOs, representatives of the marine sector, universities and research institutions, have advocated for the establishment of a National Policy for the Conservation of the Ocean[166]. Several scientists have argued that the establishment of marine reserves and no-take zones will promote the recovery of threatened or collapsed fish stocks, by serving as nurseries and a sending source for the export of mature individuals to

[166] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

adjacent areas. Therefore, most Brazilian marine scientists have also pointed out the necessity for changes in management paradigms, through the establishment of MPAs as an important fisheries management tool[167]. In this sense, the identification of priority marine areas for conservation and the assessment of their representativeness, with other projects developed, constitute a consistent basis for development of actions to ensure marine conservation in Brazil.

Knowledge and planning are essential for the establishment of protected areas. Considering the vast marine area of the country, there are many knowledge gaps concerning the Brazilian territorial sea, EEZ and continental shelf, including the seafloor and its subsoil. The marine area in Brazil is still not officially recognized as a *Biome* by IBGE, since the map of the Biomes is restricted to terrestrial features. Nor there is another official biogeographic delimitation to provide a basis for planning the conservation of marine biodiversity, to identify knowledge gaps, and to estimate the representativeness of ecosystems, habitats, and species in MPAs. In fact, scientific studies in the marine field have established their own boundaries, such as the Revizee Program, that segmented the Brazilian EEZ into four geographic regions (North, Northeast, Central and South) according to climatic, oceanographic, and biological features, and dominant substrates. This division was used by MMA as a reference for the process of updating the Priority Areas for Biodiversity Conservation[168]. In addition, the knowledge about Brazilian marine biology is concentrated in some areas, especially in the territorial sea. Comprehensive mapping exists only for certain ecosystems, such as shallow reefs, the only marine ecosystems that have been evaluated. The mapping of the other seabed typologies, like muds, seamounts, calcareous algae, rocky bottoms, phanerogams prairies, and deep reefs, do not have the appropriate precision to guide reliable representativeness estimates.[169] The identification of priority areas for conservation was performed with this limited data, so a new estimate of the representativeness for each marine environment should be carried out, as soon as possible,

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[167] Brazil, Secretariat for Biodiversity and Forests, Ministry of Environment, "Aquatic Protected Areas as Fisheries Management Tools", *Protected Areas of Brazil, series 4* (Brasilia, DF, 2007). Available from http://www.mma.gov.br/estruturas/sbf2008_dap/_publicacao/149_publicacao16122010110613.pdf

[168] Brazil, Department of Biodiversity Conservation, Secretariat for Biodiversity and Forests, Ministry of Environment, *Áreas Prioritárias para Conservação, Uso Sustentável e Repartição de Benefícios da Biodiversidade Brasileira* (Brasilia, DF, 2007). Available from http://www.mma.gov.br/estruturas/chm/_arquivos/biodiversidade31.pdf

[169] Ana Paula L. Prates and others, *Panorama da Conservação dos Ecossistemas Costeiros e Marinhos no Brasil* (Brasilia, DF, MMA, 2012)

utilizing higher resolution and more comprehensive mapping techniques. The government needs to increase its efforts and resources in order to find, gather and organize the information available, identify and fill the knowledge gaps, and assess the conservation status of the marine biodiversity. The development of joint actions for research, by the Ministry of Science, Technology and Innovation in partnership with the Ministry of Environment is fundamental in the advancement of knowledge and conservation of marine environments in Brazil and also to allow a preview planning to guide the establishment of MPAs.

Environmental policies are generally very complex because of the many options and commitments, conflicting values, diverse uses of the areas and natural resources, and competing priorities that often do not coincide at the national, state, and local levels. Thus, even if there is accurate scientific information available, a lack of consensus hinders action. The central issue is not the existence of the conflict, but the spaces and mechanisms to enable discussion, negotiations, and possibly collaboration. One important tool that can address the conflicts is Coastal and Marine Spatial Planning (MSP). Ehler and Douvere defined MSP as "a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process"[170]. Put simply, MSP is ideally a *bottom-up* process developed to improve collaboration and coordination among all coastal and ocean uses, and to better inform and guide decision-making that affects economic, environmental, security, and social and cultural interests.

The rationale development of an MSP implies both an overriding concern for the well-being of the natural marine environment and a desire for the efficient human use of marine resources, or at least a recognition of the inevitability of increasing demands being made upon the seas. These interests are regarded as closely interrelated, because human demands threaten the environmental integrity of the seas, potentially leading to the loss or compromising of the coveted marine resources themselves. This dilemma calls not for a

[170] Charles Ehler and Fanny Douvere, "Marine Spatial Planning: a step-by-step approach toward ecosystem-based management", *Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC,* Manual and Guides N° 53, ICAM Dossier N° 6, (Paris, UNESCO, 2009). Available from http://www.unesco-ioc-marinesp.be/msp_guides

complete withdrawal of human activity, but for a more rigorous understanding of the marine environment and careful supervision of human interaction with it, so that marine resources can be exploited in a sustainable manner.[171] MSP is a science-based instrument used to deal with specific ocean management challenges and advance their goals for economic sustainable development and marine conservation. This planning should be a process creating and determining a more rational use of marine space and the interactions among its uses, to balance demands for exploration with environmental conservation, and to deliver social and economic outcomes in an open and planned way.

An effective MSP is ecosystem-based, integrated across sectors, agencies, and levels of government, area-based, adaptive, strategic, and participatory. Emphasis is placed upon the need for stakeholder involvement. This is closely related to ecosystem-based management, in that stakeholder knowledge and perspectives are expected to contribute to understanding the complexity of ecosystems, including patterns of human interaction. The MSP is also used to coordinate activities among all coastal and ocean interests and provide the opportunity to share information. The process is designed to decrease user conflict, improve planning and regulatory efficiency, decrease associated costs and delays, engage affected communities and stakeholders, and preserve critical ecosystem functions and services[172]. Moreover, "planning saves money. Smart planning can reduce costs of creating reserves and increase their economic benefits, in some cases making them more valuable than before the reserve was created".[173]

Despite advances, in Brazil coastal and marine conservation planning has disregarded studies of representativeness that would ensure connectivity and protection of the coastal and marine diversity of landscapes, according the minimum percentage determined by both national targets and international commitments. Furthermore, there is a certain asymmetry in the management between different activities that affect biodiversity or involve

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[171] Stephen Jay, "Built at Sea: Marine Management and the Construction of Marine Spatial Planning", *Town Planning Review*, 81, Issue 2 (2010), p. 173-192

[172] United States, National Ocean Council, *Marine Planning Handbook* (July, 2013). Available from http://cmsp.noaa.gov/

[173] Jane Lubchenco and Kirsten Grorud-Colvert, "Making Waves: The Science and Politics of Ocean Protection", *Science* 23, Vol. 350, N° 6259 (October 2015), p. 382-383. Read more at http://phys.org/news/2015-10-ocean-gaining-momentum-lags.html#jCp

conflicts over the use of marine space. For example, while oil and gas production, because of its notoriety and implicit environmental risk, is required to comply with a strict and detailed ritual of licensing, fishing is subjected too much more lenient management standards. There is no duty for environmental licensing and studies related to the fishing activity, even for those fisheries with high environmental impacts, such as depth trawling.

The Brazilian federal government is starting to develop the capacity to do Marine Spatial Planning. It is a great challenge, considering the dimensions of the national territorial sea, EEZ and continental shelf, and number of maritime interests and uses. This planning process requires the engagement of the different sectors and stakeholders in coastal and marine areas. Aiming to broaden the understanding of the subject, as well as promoting the exchange of international experiences, the Brazilian Ministry of Environment, with support from UNESCO, promoted an International Workshop on Marine Spatial Planning in November 2014[174]. The event had an opening speech about the concepts of Marine Spatial Planning, presented by the Intergovernmental Oceanographic Commission (IOC). There were discussions about institutional challenges for the integrated development of planning, legal basis and the institutional arrangement, stakeholder engagement process, methodology and experience of different countries, scale of work adopted, criteria for defining planning areas, ecosystem-based approach, ecological principles, and challenges of implementation, considering the point of view of different sectors and the management of conflicts and interests, as well as the mechanisms for monitoring and evaluation.[175]

Community resistance to MPA proposals can be addressed through effective participatory processes that include consistent engagement over time, transparency, and the incorporation of benefits for communities[176]. Evaluate the planning processes is very important,

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[174] See http://hotsite.mma.gov.br/jornada-gerco/seminario-internacional-sobre-planejamento-integrado-do-espaco-marinho/

[175] See http://hotsite.mma.gov.br/jornada-gerco/documentos-do-evento-seminario-nacional-de-gerenciamento-costeiro/

[176] Carlos F. Gaymer and others, "Merging Top-down and Bottom-up Approaches in Marine Protected Areas Planning: Experiences from around the Globe", *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24, Supl. 2 (2014), p. 128-144. Available from http://onlinelibrary.wiley.com/doi/10.1002/aqc.2508/full

which will be discussed later. In the MSP development, it is fundamental to overlay maps of biodiversity conservation with key maps of current and potential uses, such as fishing, shipping, tourism, off-shore energy generation, mining, and oil and gas. These overlaps will allow a systemic overview that can guide decision-making regarding the use and the designation of strategic areas for exploitation or protection of biodiversity. After all the discussions between sectors, government agencies, stakeholders, and communities, and the definition of MSP, the establishment of protected areas will have fewer conflicts between society and ICMBio and between government sectors.

The process can increase popular knowledge about the necessity and benefits of MPAs, and also reach approval of a larger portion of the society. In addition, a participatory decision-making process can lead stakeholders and entrepreneurs to a better agreement that includes the designation of MPAs. This would ensure political support for the establishment of new MPAs, both because politicians need popular approval and because they have their political campaign financed by large companies. Political will is essential for the designation of PAs.

4.2. Achieving Public Support To Establish New Protected Areas

The rate at which PAs are being established is decreasing in Brazil and the requirements during the PAs designation process are increasing, mainly because it involves a wide range of conflict, which leads to less political will. Traditionally, public participation is legally required, but it has been one-way dialogue between the public and decision-makers in which agencies inform the public after determining a course of action. In the past, the social and spatial interactions in the target area and the impacts of the conservation unit on local societies and the environment were not taken into account, leading to serious conflicts. The government needs to find ways to address conflicts that hinder the establishment of MPAs.

The benefits of PAs are difficult to be measured and showed to the society, but it has to be done to minimize conflicts during the PA designation process. It is useful to

incorporate ecosystem services and social-ecological linkages from the beginning of stakeholders' engagement, much earlier than the designation of the conservation unit. The idea is to move from *people as impacts to people as beneficiaries* of coastal and ocean planning[177]. Resource users who take part in the establishment of MPAs will more readily understand the objectives of protection and potential its benefits. For example, a MPA can generate economic benefits for local people through visitor facilities, tourism, increased employment, and improved opportunities for fishers (increasing consumers for fishes due to the tourism). These benefits can positively affect both direct users and surrounding communities.

Direct involvement of affected community members and stakeholders in each stage of decision-making has several advantages when establishing a MPA. Public participation helps reduce user conflict, enhance governance, and improve resource management. Public engagement can increase the level of understanding and support for marine protection, thereby potentially reducing conflicts and the need for heavy enforcement. However, while stakeholder involvement can help designate a site that accommodates the users interests in the marine resources, it will not always lead to strict levels of protection, such as no-take zones, and/or successful resource management. [178] In general, many users do not support the establishment of no-take areas, because it affects their interests. The participatory process should be able to manage these issues, ensuring better compliance in the future.

Both *top-down* and *bottom-up* approaches have been criticized for failures to meet conservation objectives and sustain engagement of stakeholders over time[179]. Gaymer and others (2014) have analyzed five case studies from around the world and they found that how *bottom-up* and *top-down* approaches are used should consider the size of the MPA, the geographic scenario (e.g. coastal vs. remote), the level of anthropogenic influence, the

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[177] Elodie Le Cornu and others, "Current Practice and Future Prospects for Social Data in Coastal and Ocean Planning", *Conservation Biology*, Vol 28, n° 4 (2014). Available from http://onlinelibrary.wiley.com/doi/10.1002/aqc.2508/epdf

[178] Samuel D. Brody, "An Evaluation of the Establishment Processes for Marine Protected Areas in the Gulf of Maine: Understanding the Role of Community Involvement and Public Participation", *in: Gulf of Maine Marine Protected Areas Project,* Report 3, (July 1998). Available from http://www.gulfofmaine.org/library/mpas/process_eval_0798.PDF

[179] Wanfei Qiu and others, "Challenges in developing China's marine protected area system", *Marine Policy*, Vol. 33, Issue 4, (July 2009), p. 599-605

conservation objectives, the political and governance context, and specific cultural conditions, such as the presence of indigenous communities. Diverse variations or combinations of participation and governance exist. The authors also have pointed some challenges to achieving the right balance between *bottom-up* and *top-down* approaches: 1) Aligning local objectives and national/international conservation priorities. Generating appropriate incentives (e.g. economic, legal, participative) would help to increase local support where an MPA is being driven by national or international conservation objectives. 2) Building local trust, support, and empowerment. Transparency in the information provided and the purpose of the engagement process is critical for building trust with stakeholders and communities. Defining who, when, and how stakeholders are involved in the planning process is another important issue. In addition, participants need to understand how their contributions will be used and how they will inform the process. 3) Sustaining engagement over time. Irrespective of the MPA size, early and ongoing engagement of stakeholders seems a key to success. Advantages of incorporating stakeholder input at all stages of a planning process are related to improved acceptability, legitimacy, and support for future MPAs and to resolving anticipated potential conflicts. [180]

In Brazil, the law requires public consultation, but ultimate decision-making power remaining with the government. The engagement with communities can range from simply informing the public through notices and providing opportunities for comments, to active participation of communities and stakeholders in the planning and implementation. Currently, the level of participation depends on the manager, local conditions, and financial resources, that varies from place to place.

True participation requires empowerment of local communities, including education and capacity building for local people to get involved in the process of planning and implementing MPAs. Analyzing the literature on public participation in U.S. resource management, Dalton (2005) found four particular elements related to active involvement: opportunity for input, early involvement, motivated participants, and influence over the final

[180] Carlos F. Gaymer and others, "Merging Top-down and Bottom-up Approaches in Marine Protected Areas Planning: Experiences from around the Globe", *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24, Supl. 2 (2014), p. 128-144. Available from http://onlinelibrary.wiley.com/doi/10.1002/aqc.2508/full

decision. The author proposed a Framework for Involving the Public in Planning of U.S. Marine Protected Areas composed of factors that influence the success of participatory processes: active participant involvement, complete information exchange, fair decision making, efficient administration, and positive participant interactions. According her research, processes incorporating these factors will produce decisions that are more likely to be supported by stakeholders, meet management objectives, and fulfill conservation goals. The process has to be transparent, i.e. participants clearly see how the process works and how decision is reached, and representative, allowing participation of all segments of the broader community in the decision-making.[181]

Although a participatory process to establishing MPAs has its benefits, it is not an easy course to take. Extensive community and public involvement tends to be extremely time consuming and may delay much needed action to protect threatened resources. In general, a large amount of funding and staff, that are often unavailable at the site level, are required to involve all stakeholders in the planning process. A process containing a variety of interests will not always lead to a MPA that includes strict protection or results in sound resource management. In fact, community and stakeholders' participation can reduce the level of protection and the size of the site designation. Opposing viewpoints can dilute what begin as strict regulations and generate plans that involve few or no protection measures. [182]

Public meetings are an effective way to bring together community and all stakeholders in one forum to provide information and to give opportunities for comments, but smaller and most numerous group meetings could be more efficient, encouraging dialogue and building trust[183]. One strategy to Brazilian environmental agencies is using a variety of participatory techniques such as focus groups, citizen juries, thematic seminars, sectoral

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[181] Tracey M. Dalton, "Beyond Biogeography: A Framework for Involving the Public in Planning of U.S. Marine Protected Areas", *Conservation Biology*, Vol. 19, n° 5 (October, 2005), p. 1392-1401

[182] Samuel D. Brody, "An Evaluation of the Establishment Processes for Marine Protected Areas in the Gulf of Maine: Understanding the Role of Community Involvement and Public Participation", *in: Gulf of Maine Marine Protected Areas Project,* Report 3, (July 1998). Available from http://www.gulfofmaine.org/library/mpas/process_eval_0798.PDF

[183] Tracey M. Dalton, "Beyond Biogeography: A Framework for Involving the Public in Planning of U.S. Marine Protected Areas", *Conservation Biology*, Vol. 19, n° 5 (October, 2005), p. 1392-1401

workshops and others in order to increase the number of people participating and the heterogeneity of interests, and to avoid conflicts. This new approach should be developed by means of representative participatory engagement and transparency in decision-making. Learning about the ecological values and connections in the marine ecosystem, understanding marine protection terms, or building understanding between marine users can all lead to increased support for the establishment and management of MPAs.

Finally, an important strategy to improve the establishment of MPAs is getting media support. The media can communicate a particular topic to the larger public, i. e. people who have (or have not yet) participate in the planning process. This can result in new people participating in discussions, which might complicate the issue. In a cascading effect, as more interested parties get involved, the greater the possibility of more media coverage of an issue and vice versa. The exposure of local conflicts during the establishment of MPAs process gives new dimensions to public administration and social movements. The media is a tool able to enhance the pursuit of social demands by organized civil society and contribute to a new understanding of the conflict by public managers.

According to Hannigan (1995), the exhibition of environmental news on the media takes into account five factors: 1) Correlation with the widely accepted cultural concepts; 2) Coordination between the political and scientific agendas; 3) Dramatic character of the environmental problem; 4) Current issue (hot topic); and 5) Agenda with concrete actions. The media visibility is crucial to change environmental issues from conditions to focuses, and then to the policy development constraints. Without media coverage, environmental problems will have difficulty getting into the public discourse and becoming part of the democratic political process.[184]

The media agenda has proven to be an effective thermometer of social conflicts since it broadens the debate. However, news publications are not free from bias. However, the amplifying power of the media and its influence on social forces is undeniable. [185] The media can promote the establishment of a protected area, but also has the power to destroy the whole

[184] John A. Hannigan, "Sociologia ambiental:a formação de uma perspectiva social", *Coleção Perspectivas Ecológicas*, 31, Lisboa, Instituto Piaget (1995)

process. But on balance, the media has favored PAs. Most PAs created by the current government only occurred after the media pressured them during a re-election campaign.

4.3. Improving Implementation In Brazilian Coastal And Marine Protected Areas: Public Participation In The Planning And Management Processes

The implementation of a MPA is crucial to achieve local and global conservation goals. Financial and human resources needed to operate SNUC are scarce and require efficient policy and management strategies, as well as an integration between government and public efforts. While the lack of investments and staff needs to be faced in the long term, it is important immediately to think about and apply some strategies to avoid biodiversity loss.

Achieving public support for the management of a MPA is not the solution, but can contribute to overcome the difficulties due to the lack of financial resources and personnel. There are several forms of engagement and public participation, with respect to tools and methods. The capacities of the environmental agency in the MPA and its staff, financial resources, infrastructure, communication technologies available to the local community, and the regulatory and policy settings governing protected area management will influence which specific methods are most appropriate.

First, the direct benefits from MPAs should be disclosed to the entire public, especially the surrounding communities. Unfortunately, environmental agencies do not have satisfactory communication and marketing programs. As well as protect biodiversity and its associated products for future generations, environmental agencies could prioritize how MPAs can preserve water sources, support the restoration of fish stocks, mitigate the climate changes impacts, reduce erosion, provide recreational opportunities, keep cultural wealth, and offer sustainable economic development alternatives, but the public in general does not know. The society should understand and internalize the connection between conservation units and

[185] Leonardo B. dos Santos, "Trilhas da Política Ambiental: Conflitos, Agendas e Criação de Unidades de Conservação", *Ambiente & Sociedade*, Vol. 12, Issue 1 (Jan/June 2009). Available from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-753X2009000100010

economic activities.

An important consideration in choosing a way to disseminate information is the suitability of different media for communication between protected area managers and the public. The capacity of communities, organizations, and stakeholders is one determinant of the best means of communication. The agency may consider the internet/email access, the literacy levels of community groups, the use of visuals such as maps or fliers or interactive programs, and the availability of media. The rapid evolution of information and communications technology, including social media, along with more traditional forms of communication, has expanded the range of options. It is unlikely, however, that all stakeholders will have the same access to different communication mechanisms, so, care is required to ensure the disclosure of the MPA benefits and the engagement opportunities to every interested group. The acceptance and subsequent community involvement in implementing an MPA can be influenced by the perception of early benefits and economic incentives and by identifying the MPA as their own[186].

In addition, the access to protected areas is an important strategy for societal awareness, enhancing the importance of nature conservation. Those who know that the natural beauty protected in conservation units is a potential ally for environmental agencies to preserve this natural heritage that belongs to all mankind. In addition, tourism in conservation units generates direct and indirect jobs to local communities and stimulates the economy.

Second, the establishment of a MPA can be a source of job opportunities and alternative livelihoods. In addition to improving ecosystem health, which benefits the local community, MPAs can promote advance quality of life and empower coastal communities living in a high degree of poverty. For example, surrounding communities can be engaged to the MPAs as employees/workers or owners of tourism and service companies. There may be opportunities in many industries, trades and professions implementing new environmental

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[186] P. Francisco Cárcamo and others, “Using Stakeholders' Perspective of Ecosystem Services and Biodiversity Features to Plan a Marine Protected Area”. *Environmental Science and Policy,* 40, (2014), p. 116–131. Available from http://www.researchgate.net/publication/261436958_Carcamo_et_al_ESP_2014 and

Peter J. S. Jones and others, “Governing Marine Protected Areas - Getting the Balance Right”, *Technical Report,* United Nations Environment Programme, Nairobi, (2011). Available from http://www.unep.org/ecosystemmanagement/Portals/7/governing-mpas-final-technical-report-web-res.pdf

practices and engaging with other firms or public agencies. Employees of firms or agencies supplying services to a protected area or park agency (e.g., fencing contractors, tour operators, tour guides and monitors, cleaners at lodges, vehicle maintenance businesses, and so on) often have a close and sustained relationship with protected area agencies and their staff and will be required to comply with regulations and expectations; they can convey to others their views about the worth of protected areas or the quality of management. An increase in economic activity and trade is also expected around the MPA. With the growth of the tourism around the site, there is an increase in alternative livelihoods, especially activities related to the tourist trade. Surrounding people can work in hotels, restaurants, tour operations, souvenir sale, transport, leisure activities in nature or can open their own business. The conditions for fishers and farmers may improve as well with a better consumer market for their products.

Third, another action that can contribute to the implementation of MPAs is the work of volunteers in research, monitoring, management, environmental education, communication and marketing, and tour guidance. The participation of volunteers in conservation units increases the number of staff to activities necessary for the functioning of the MPA. The volunteer program is a method for bringing in professionals from several areas of expertise to provide specialized services to the conservation unit and, at the same time, it is an opportunity for students and professionals to develop new abilities and knowledge in the environmental and conservation field. Volunteers can assist in several areas and different themes, depending on their training and time available linked to the needs of the MPA. Local communities can also be engaged as providers of information of their own activities, act as subjects of researchers or as participants in research, and monitoring projects in resource and environmental management that will inform policy. Visitors and users of protected areas are often surveyed or otherwise monitored, or more actively engaged in gathering and even analyzing data. This covers monitoring environmental conditions (wildlife counts, alien species surveys) and the success of management interventions.

Fourth, the support of partners such as non-governmental organizations and private institutions is an option for conservation units with limited financial and human resources. According to the SNUC guidelines, agencies should seek the support and cooperation of NGOs,

private organizations and individuals to develop studies, scientific research, environmental education practices, leisure activities and eco-tourism, monitoring, maintenance, and other PA management activities[187]. The law also provides that protected areas can be managed by public interest civil society organizations that have similar goals as long as a management agreement is signed with the governmental agency responsible for the PA management[188]. In this co-management model a strong degree of local autonomy exists and the responsibilities are defined and shared between environmental agency and partners. These arrangements may be limited to management within a set management plan, or extend to broader goal-setting and governance of the protected area.

It is essential that managers enhance MPAs role in mobilizing the community representatives to participate in their management. The Brazilian environmental legislation ensures broad participation at several stages of implementation of the conservation units, such as in the development, implementation and adaptation of the management plan, and in the management through advisory councils. In general, managers perceive this mandatory participatory processes much more as a difficulty than as an opportunity. To build and maintain trust and engagement of the local stakeholders it is a crucial part of the participation process over time[189]. Early and ongoing involvement of stakeholders seems a key to success, from the planning process[190], to the evaluation[191], and the adaptive management of MPAs[192]. "Direct

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[187] Item IV, Article 5th of the Law 9985/2000

[188] Article 30 of the Law 9985/2000

[189] Carlos F. Gaymer and others, "Merging Top-down and Bottom-up Approaches in Marine Protected Areas Planning: Experiences from around the Globe", *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24, Supl. 2 (2014), p. 128-144. Available from http://onlinelibrary.wiley.com/doi/10.1002/aqc.2508/full

[190] Morgan Gopnik and others, "Coming to the table: early stakeholder engagement in marine spatial planning", *Marine Policy*, 36 (2012) p. 1139–1149. Available from http://www.researchgate.net/publication/228085389_Coming_to_the_table_Early_stakeholder_engagement_in_marine_spatial_planning

[191] Len Garces and others, "Evaluating the Management Effectiveness of Three Marine Protected Areas in the Calamianes Islands, Palawan Province, Philippines: Process, Selected Results and Their Implications for Planning and Management", *Ocean and Coastal Management*, 81, (2013), p.49–57. Available from http://isiarticles.com/bundles/Article/pre/pdf/16548.pdf

[192] Kelly Sayce and others, "Beyond traditional stakeholder engagement: public participation roles in California's statewide marine protected area planning process", *Ocean and Coastal Management*, 74 (2013), p. *57–66.* Available from https://www.researchgate.net/publication/257423598_Beyond_traditional_stakeholder_engagement_Public_participation_roles_in_California%27s_statewide_marine_protected_area_planning_process

involvement by stakeholders in the decision-making process can increase the level of understanding and support for marine protection."[193] Changing the goalposts for the planning process can seriously undermine previous work, lose social capital and eventually reduce or even prevent MPA success.

One of the main problems facing many MPAs is the lack of adequate investments, staff, and equipment for properly enforcing their management. Considering the logistic and economic challenges of monitoring MPAs, achieving public compliance with regulations is essential to an effective protection. However, conflicts between environmental agencies and stakeholders created with the MPA establishment disrupt public collaboration and reduce compliance with the regulations. In a heuristic model correlating social, cultural, political, economic, and other contextual factors in 127 marine reserves, Pollnac et al (2010) showed that high levels of compliance with MPAs rules were related to complex social interactions and not simply to the level of enforcement. Several key factors can motivate an individual to comply with resource use rules, including deterrence, social pressures, moral inclinations, and perceived legitimacy of rules and responsible authorities MPA managers, donors, and governments should consider investments in the processes and conditions that foster key factors that motivate compliance in existing and planned MPAs[194]. Compliance and other active MPA management interventions, such as formal monitoring, surveillance, collection of tourist access fees, and enforced punishments, positively affect ecological performance. At the same time, the level of community development and if this public was part of a political network positively influence compliance rates. The cited study suggested that MPA managers and staff should consider prioritizing their efforts toward the development of monitoring, surveillance, and user fee systems that enhance compliance with MPA rules and ecological performance.[195]

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[193] Samuel D. Brody, "An Evaluation of the Establishment Processes for Marine Protected Areas in the Gulf of Maine: Understanding the Role of Community Involvement and Public Participation", *in: Gulf of Maine Marine Protected Areas Project,* Report 3, (July 1998). Available from http://www.gulfofmaine.org/library/mpas/process_eval_0798.PDF

[194] Richard Pollnac and others, "Marine reserves as linked social-ecological systems", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 107, n° 43, (October 2010) p. 18262–18265

[195] Tracey Dalton, Richard Pollnac, and Graham Forrester, "Investigating Causal Pathways Linking Site-Level Characteristics, Compliance, and Ecological Performance in Caribbean MPAs", *Coastal Management*, 43, (May 2015) p. 329-341

If the community is able to understand the benefits of the PA and has a sense of belonging and ownership, people are more susceptible to comply with the rules and can even be able to participate in the management and monitoring activities. According to WWF, around the world local participation in monitoring and enforcement is often the best way to circumvent a constant lack of resources for patrolling rangers[196]. Public participation is beneficial to the management of MPAs because it creates support for protection through communication and education. The result may be marine protection based on partnerships between resource users and government officials. Stakeholders who clearly understand the reasons for siting a MPA and its potential outcomes will more likely support regulations over the long term. Ownership over the decision-making process can also help to increase compliance with the rules and avoid the need for costly enforcement measures. In some places, both terrestrial and marine Sustainable Use Protected Areas, fishery conservation management zones and buffer zones operate in a collaborative governance model, where local communities and/or resource users are party to formal management arrangements. Many PAs engage local community members as voluntary rangers, with at least semi-formal status within the agency and the management regime. [197]

Finally, to address the difficulties caused by lack of resources, agencies should pursue a partnership-based implementation plan and joint enforcement operations with other agencies, for example, the Brazilian Navy and Federal Police. A good example of a partnership occurred for the Review of the Management Plan of the Fernando de Noronha – Rocas – São Pedro e São Paulo Protected Landscape and Seascape, where ICMBio (the federal agency responsible for this MPA management) has support from the Island Administration and the State of Pernambuco which provided GIS staff for 2 years for the development of the management plan. This initiative ensures GIS professionals were at all meetings with the stakeholders, advisory council, and planning team, giving more transparency to the process. The partnership was advantageous for both the federal and state governments, as well as the community, because there was a great need to review the management plan, but ICMBio did

[196] See http://assets.panda.org/downloads/marineprotectedareas.pdf

[197] Stephen Dovers and others, "Engagement and Participation in Protected Area Management: Who, Why, How and When?", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

not have enough financial and human resources to properly carry out the process; and the community and state government wanted to change some mistakes in the zoning that were preventing important activities in the region and an update of the rules.

Therefore, in places with limited resources for implementing management activities, MPA managers and staff can look for opportunities to join other MPAs in political networks that facilitate sharing of technical expertise, information, and other resources[198]. In order to develop this approach, it is fundamental to identify an inter-agency, public, and science informed management and governance structure that provides for the best, most cost-effective, and fairest method. As discussed, partnership-based arrangements between government levels, government sectors and agencies, NGOs, private institutions and stakeholders are welcome in order to supply shortages and achieve the MPA conservation goals.

4.4. Improving Implementation In Brazilian Coastal And Marine Protected Areas: Achieving Increased Inputs, Political Support, And Enhanced Public Use

In Brazil, the limited budget reduces the efficiency of management and protection, as well as impairs the integration of the conservation units with the economic dynamics of their surroundings. “Inadequate funding at the planning and implementation stages seriously jeopardizes the probability of success, as this prevents the development or implementation of management plans, including strategies for surveillance and enforcement”[199].

In the previous item of this document, some options were pointed to immediately alleviate the lack of financial and human resources. All these ideas can help and the managers should be encouraged to use them strategically, but obviously they are not sufficient. Even whether participation is improved, conservation units still need an increase in their financial

[198] Diana Pietri and others, “Information Diffusion in Two Marine Protected Area Networks in the Central Visayas Region, Philippines”, *Coastal Management*, Special Issue: Tropical Marine Ecosystem-Based Management Feasibility, Vol. 37, Issue 3-4 (April, 2009) p. 331–348.

[199] Carlos F. Gaymer and others, “Merging Top-down and Bottom-up Approaches in Marine Protected Areas Planning: Experiences from around the Globe”, *Aquatic Conservation: Marine and Freshwater Ecosystems*, 24, Supl. 2 (2014), p. 128-144. Available from http://onlinelibrary.wiley.com/doi/10.1002/aqc.2508/full

resources. Collaborative approaches require significant levels of dedicated support from decision-makers and sufficient funding. Investments to build and/or renovate infrastructure, buy and maintain adequate equipment and vehicles, and improve working conditions are essential. Moreover, it is impossible to implement any strategy cited above without qualified staff.

The first step to improve public financial and human resources is earning popular support. Positive marketing would change the message about MPAs. "When properly managed, MPAs function as an effective insurance policy for both marine life and people"[200]. The society needs to understand the benefits of MPAs to support greater use of public resources for nature conservation. The public in general and decision-makers in particular should internalize the importance of the SNUC for the country's economic and social development, in the short and long term[s201]. The recognition by society of the benefits generated by PAs is essential to legitimate the pursuit and consolidation of different mechanisms for funding. Therefore, investing in these areas means immediate feedback in the form of social and economic benefits.

The financial management of the SNUC and its sources of funding is complex and insufficient to maintain the proper funding of protected areas. The Ministry of Environment should guide the formulation of policies for financial sustainability, combining environmental preservation and sustainable use of resources. It is also important to develop fund raising mechanisms to ensure predictability and consistency in the decentralization of resources. The insertion of conservation units and their managers in the socio-political, productive, and scientific scenarios is a challenge, in which popular participation and control are critical to the success and synergies of the proposed actions. The initial goal of the Ministry of Environment is to expand the sources of funding for PAs system, currently interrelated to the environmental agencies' budget and visitors' ticket payment for entry into certain protected areas. As additional elements, but limited to only a specific set of conservation units, it has been used other funding from international cooperation and from environmental compensation of

[200] See http://assets.panda.org/downloads/marineprotectedareas.pdf

[201] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, Ministry of Environment,2012)

enterprises users of natural resources or potentially polluting.[202]

According the SNUC law, the enterprise interested in build a project has an obligation to finance the implementation and maintenance of Strict Protection PAs, when the enterprise causes significant environmental impact, based on its Environmental Impact Assessment (EIA) [203]. This public policy instrument was called environmental compensation, and allows for the incorporation of social and environmental costs of degradation generated by certain enterprises. Although set a minimum of 0.5% of the cost of the overall project, after great pressure from businessmen and the productive sector the government has determined that the payment is between 0% and 0.5% of the venture. The drastic reduction of the proceeds from the environmental compensation was the greatest loss of SNUC[204]. The amount of compensation is proportional to the environmental damage caused by the project[205]. The government agency responsible for environmental licensing (federal, state or municipal) calculates the amount to be invested by the company and defines its destination, i.e. which protected areas will benefit and for which actions. The application of environmental resources should prioritize, in the following order: 1) Land tenure regularization and demarcation of land; 2) Development or review or implementation of the management plan; 3) Acquisition of goods and services necessary for the implementation of the PA; 4) Development of studies necessary for the establishment of new PAs; 5) Development of research needed for the management of PAs and their buffer zone[206]. Therefore, the environmental compensation is a source of funding and a strengthening mechanism very relevant to the SNUC. The execution and functioning mechanisms should be improved and simplified.

Among international cooperation arrangements, the most representative ongoing project for MPAs is the GEF-Mar. Started in October 2014, the GEF-Mar Project has one important target for the financial sustainability of MPAs, which is to identify and develop at

[202] See http://www.mma.gov.br/areas-protegidas/sistema-nacional-de-ucs-snuc/sustentabilidade-financeira

[203] Article 36 of the Law 9985/2000

[204] See http://uc.socioambiental.org/sustentabilidade-financeira/compensa%C3%A7%C3%A3o-ambiental

[205] For details of the calculation see http://www.mma.gov.br/areas-protegidas/camara-federal-de-compensacao-ambiental/metodologia-de-calculo-da-compensacao-ambiental

[206] Provided by Decree 4340/2002

least two financial methods to contribute to the sustainability of coastal and marine protected areas in the long term, getting ready to start this methods implementation.

Other indirect sources that can foment the expansion and consolidation of the SNUC, are the Tax over Circulation on Goods and Services (called Ecological ICMS, in Portuguese), similar to Value-Added Tax, and the Defense of Diffuse Rights Fund. Considered an intergovernmental tax incentive, the Ecological ICMS introduces environmental criteria in the calculation of the 25% share of transfers to municipalities, in which one factor considered is the percentage of PAs in their territories[207]. The idea is that government is compensated for the loss of revenues pursuant the designation of PAs[208]. Thus, the ecological ICMS tax can serve as a tool for stimulating the biodiversity conservation as it encourages the establishment of new conservation units, since the municipality is paid for having PAs. The additional revenue transferred increases the municipality's budget, causing secondary effects on local development important to the sustainability. Several countries are developing an Ecological VAT state law, beginning a virtuous circle in which the better the quality of municipal environment management, the better rates of participation in the amount of ICMS[209].

There are also mechanisms with potential resources for the conservation units, such as protected areas fund, forest concessions, payment for environmental services, utilization of genetic resources, extraction, and, as mentioned before, partnership-based PAs management. However, access these mechanisms requires establishing criteria and procedures for selecting projects. A MMA study evaluated the contribution of ecosystem services of the Brazilian PAs system, showing that the economic contributions of the services significantly exceed the amount that has been designed by the government to the maintenance of the SNUC. Some conclusions of this study was: 1) The production of timber in Amazon's National and State Forests, if managed through forest concession model, has the potential to generate from USD$

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[207] See http://www.icmsecologico.org.br/site/index.php?option=com_content&view=article&id=51&Itemid=81

[208] The Nature Conservancy, *A Genuine Brazilian Incentive to Conservation: Ecological ICMS*. Available from https://www.pdffiller.com/en/project/47504186.htm?form_id=29022974

[209] Wilson Loureiro, *ICMS Ecológico, a Oportunidade do Financiamento da Gestão Ambiental Municipal no Brasil*, (2009). Available from Wilson Loureiro, *ICMS Ecológico, a Oportunidade do Financiamento da Gestão Ambiental Municipal no Brasil*, (2009). Available from http://www.icmsecologico.org.br/site/images/artigos/a013.pdf

640 million to USD$ 1.18 billion per year; 2) Non-timber forest products, such as rubber and nuts has the potential to generate USD$ 30 million per year in only 17 extractive reserves analyzed, and can increase if the PAs receive investment to develop their productive capacities; 3) Tourism in the 67 National Parks can generate from USD$ 860 million to USD$ 960 million per year, and may reach USD$ 1.18 billion economic impact with visitation in all categories of protected areas if adequately exploited; 4) Establishment and maintenance of Brazilian PAs has prevented the emission of at least 2.8 billion tons of carbon, with an estimated value over USD$ 51.34 billion. The financial resources from reducing emissions from deforestation and forest degradation (REDD) mechanism ranges from USD$ 1.55 billion to USD$ 3.1 billion per year, exceeding the current investment necessary for further implementation of the areas; 5) The cost associated with treating water for human supply is lesser when the water comes from areas with forest cover. 9% of drinking water is direct collected in PAs and more 26% from sources downstream of PAs; and 6) In 2009, the revenue of Ecological ICMS to municipalities due to the existence of PAs in their territories was USD$ 215.35 million, considering the states with standards in ecological ICMS[210]. This study did nit consider the contribution of MPAs for the system, and it is recommended a specific research about economic benefits of MPAs.

Some PAs may adopt user costing, such as entry fees, and/or incorporate commercial operations, in which visitors and users pay for a desired experience. People from community can enjoy a state-supplied recreational opportunity. The payment can change the expectations of the visitor, and their relationship with protected area managers and workers. For example, user expectations of free facilities will likely be lower or more forgiving than the expectations of users who have paid for facility use. In addition, collection of tourist access fees has been found to positively affect ecological performance, at the same time, impacting the level of community development and, if this public was part of a political network, positively influencing compliance rates[211]. Thus, entry fees are a source of financial resources and, at the same time, can contribute to improve the performance of the PA and community's compliance

[210] Rodrigo Medeiros and others, *The Contribution of Brazilian Protected Areas to the National Economy: Executive Summary* (Brasilia, DF, Ministry of Environment,2012)

[211] Tracey Dalton, Richard Pollnac, and Graham Forrester, "Investigating Causal Pathways Linking Site-Level Characteristics, Compliance, and Ecological Performance in Caribbean MPAs", *Coastal Management*, 43, (May 2015) p. 329-341

with the rules. Services necessary for visitation may be granted through permits or authorizations or concessions to third parties, relieving the amount of staff needed and generating revenue for the conservation unit.

Conservation units need a minimum staff to guarantee its successful operation. The ideal amount of personnel varies with the size and local demands. Hiring more employees is crucial, the environmental sector needs to earn public and political support to approve the increase of staff, respecting at least studies of minimum personnel required, and to ensure the maintenance of employee's number. This estimate of the minimum staff number should consider each protected area and its specificities. The environmental agencies should develop internal policy ensuring the presence of staff in conservation units located in municipalities without infrastructure, with low Human Development Index, and difficult access with high travel costs. For this, employee associations along with their environmental authorities are negotiating with the government the establishment of human resource policies that encourage the permanence of servers in remote locations. Some strategies are: providing gratification or bonus to the employees according to the location; offering advantages to the staff living in difficult areas; guaranteeing the transfer for better areas after work a defined period in remote areas (in general, because there are few people in remote areas, it is very difficult a server gets transfer to a better location, discouraging voluntary transfer to these areas and causing server losses to other companies and sectors); and ensuring the safety of the staff working in hazardous areas.

Safety and health in the workplace are particularly important for PAs management. In field activities, employees are subject to extreme weather or environments; they may face dangerous circumstances such as wildfire, wild animals and armed poachers; they may use powerful chemicals; and they may be operational in aircraft, boats, four-wheel-drive vehicles and using equipment such as chainsaws. Their safety and well-being are paramount, and considerations for their training, necessary safety equipment, insurance cover and backup medical support (if needed) are critical.[212]

[212] Peter Jacobs, "Managing Operations and Assets", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

CONCLUSION

Brazil is an enormous country, with one of the greatest biological diversity and a large maritime area. The country owns 3,000 km of coral reefs and 12% of mangroves in the world. Coast and marine biomes are extremely important for the economy of the country. Around 18 % of Brazilian population lives on the coast and economic activities of this areas account for about 70% of the country's GDP, resulting in pressures on natural resources and negative impacts to the biodiversity. The major activities are tourism, fishery, industry, agriculture and aquaculture, and mineral exploration, but there is a big potential in the biotechnology and energy fields.

There is an asymmetry among regulations about licensing requirements for different activities, ranging from a simple request with supporting documents until the preparation of detailed environmental impact assessments. Despite industrial fishery is considered the greatest threat to the marine biodiversity, there is no duty for environmental licensing and studies related to the fishing activity in the country, even for those fisheries with high environmental impacts. Moreover, Brazil do not have fishing statistics since 2008. With reference to fishing production, the country's situation is not unlike of the rest of the world due to overfishing of some fish species. In fact, one of the major concerns of professionals and institutions that work with conservation of marine and coastal biodiversity is the collapse and the threat of extinction of fish stock. Several authors indicate the establishment of no-take zones as an effective instrument to recover overexploited or collapsed or threatened stocks because these areas can function as nurseries or as export sources of mature individuals for adjacent areas.

The main Brazilian strategy for biodiversity conservation *in situ* is the establishment and the maintenance of the National System of Protected Areas. Although the country has advanced significantly to achieve national biodiversity targets, especially in Amazon Biome, the marine environments are the smallest percentage of protected areas, about 1.5% is a recognized Conservation Uni. Several actions are required to ensure the biodiversity conservation on Brazilian coastal and marine environments and improve the National System of Protected Areas. Currently, the politics and social context in Brazil are unfavorable to the

establishment of new PAs and the implementation of the existing ones.

For the establishment of new MPAs is necessary increase efforts and resources in order to find, gather and organize the information available, identify knowledge gaps, and assess the conservation status of the marine biodiversity. It is also important to define an official biogeographic delimitation to provide a basis for planning the conservation of marine biodiversity and to estimate the representativeness of ecosystems, habitats, and species in MPAs. The development of a Coastal and Marine Spatial Planning can be a way to address conflicts among different uses. The process is designed to decrease user conflict, improve planning and regulatory efficiencies, decrease associated costs and delays, engage affected communities and stakeholders, and preserve critical ecosystem functions and services[213]. It is important to increase popular knowledge about the necessity and benefits of the MPA, and also reach support of the society, stakeholders and politicians. Finally, it is required a change in the focus of the establishment sector in ICMBio, prioritizing studies and processes related to MPAs.

Regarding coastal and marine biodiversity conservation, as important as MPAs establishment is to ensure their adequate implementation. The effective management of a MPA needs a certain amount of financial and human resources, which usually has been scarce and insufficient. Thus, it is required efficient policy and management strategies, besides joint efforts from both government and society. The MPA acceptance, and subsequent community involvement in the implementation, can be influenced by the perception of early benefits and economic incentives and by identifying the MPA as belonging to the community. If the society understands the benefits generated by MPAs, it is more likely people support greater use of public resources for nature conservation. The media also is an important tool to be considered, since it enhances the visibility of environmental issues and may contribute to improve policies and investments.

But it is crucial to know the Brazilian situation of biodiversity conservation and how the country is performing in this field. Are MPAs achieving the objectives for their establishment? What is the effectiveness level of the System of PAs (SNUC)? To answer these

[213] United States, National Ocean Council, *Marine Planning Handbook* (July, 2013). Available from http://cmsp.noaa.gov/

questions, as well as to ensure biological diversity and natural resources conservation it is necessary to develop methodologies and conduct biodiversity monitoring and periodic evaluation of the success of the conservation units and SNUC. Different levels of assessment are required: biodiversity monitoring (species, populations, ecosystems, or biome), evaluation of the management plan (allowing to adapt and re-plan actions), evaluation of the effectiveness of the conservation unit and assessment of the efficiency of the overall PAs' system. Therefore, monitoring of protected areas should be carried out on the scale of individual sites (conservation unit) and also on the scale of the system of protected areas (national or regional). Furthermore, monitoring can be on the efficiency of the management or on the biodiversity conservation success. Obviously, these approaches are confused because the main goal of the management is to ensure biodiversity conservation. Nevertheless, indicators for these approaches should be different as it is possible to have a management that meets its objectives, but does not ensure the maintenance of biodiversity.

Monitoring is the term used to refer to repeated observation or measurement to determine status and trend, assessed as change against a baseline measurement, often referred to as an indicator. The biodiversity monitoring is the long-term set of activities designed to measure the responses of populations or ecosystems to management and conservation practices and to the impact of external factors such as habitat loss, landscape changes, climate change, and others. Biodiversity monitoring is an important tool that generates information on the status of particular species or ecosystems to the government, as well as it provides data on threats/impacts from human interactions and environmental changes, guiding species or ecosystem management. As a conservation tool, biodiversity monitoring supports decision-making processes, public policy and management actions based on consistent information on populations and ecosystems and their trends. Monitoring of species and populations is also important to the use of natural resources. For example, the biological productivity of extractive fishing depends directly on natural replenishment capacity of exploited fish stocks. So it is essential to maintain an efficient and continuous system of gathering and analyzing technical and scientific data of stock assessments to support an adequate and sustainable fisheries management. Thereby, monitoring species being exploited is important for their conservation.

The ICMBio through partnerships with various sectors of society, has established guidelines for a National Monitoring Program in federal conservation units. Due to the immense biological diversity of the country, this program focuses on few target groups, representatives of fauna and flora with great importance for the ecosystems functioning. For coastal and marine areas, the program is structured by ecosystems, and shallow coral reefs, mangroves, and rocky shore are currently covered by the monitoring. As a strategy to ensure the sustainability and continuity of the monitoring activities, the program prioritizes rapid assessment protocols, to optimize time, financial and human resources, and involves the participation of local actors, community workers, ICMBio environmental analysts, technicians, and research centers' experts, and partnerships with education and research institutions and NGOs. The program has two strong components: training (both internal and external) and data/information management.[214]

The Brazilian National Coral Reef Monitoring Program started in 2002 using the Reef Check protocol adapted to cover coral reefs spread over more than 2000 km and the possibility of community participation, allowing the involvement of volunteers as well as local managers. The main objective was to provide useful information for the management of protected areas covering coral reefs. Voluntary participation of the adopted method allows the establishment of a large number of survey sites to help identify particularly relevant or representative environments that require more detailed search. The Reef Check method can be incorporated into a more comprehensive method of the Global Coral Reef Monitoring Network (GCRMN) later. From 2011, ICMBio initiated a process for continuity and internalization of the program in the federal protected areas by identifying and promoting training to servers, especially the ones who work in MPAs that include coral reef systems. The program is a partnership between the Ministry of Environment (MMA), Coastal Reef Institute (IRCOS), Federal University of Pernambuco (UFPE) and ICMBio. Currently, the program is implemented in five federal MPAs (Fernando de Noronha National Park, Atol das Rocas Biological Reserve, Coral Coast Protected Seascape, Abrolhos National Park and Corumbau Extractive Reserve). Regarding rocky shores, ICMBio initiated the establishment of guidelines for monitoring some areas of the ecosystem in 2013. Three MPAs, Arvoredo Marine Biological Reserve, Tupiniquins Ecological Station and

[214] See http://www.icmbio.gov.br/portal/o-que-fazemos/pesquisa-e-monitoramento/monitoramento.html

Tupinambás Ecological Station, were selected as pilot because they hold significant rocky shore areas and background in monitoring activities. Finally, there is a mangroves monitoring program coordinated by the ICMBio in technical cooperation with the United Nations Development Programme (UNDP). The Brazilian Mangrove Project involves a set of actions aimed at contributing to the conservation and sustainable use of mangrove ecosystems and well-being of coastal communities. Currently, 50 federal conservation units hold mangroves. About mangroves monitoring, the project aims to assess the ecosystem integrity and effectiveness of PAs for mangrove species conservation and to evaluate the sustainability of exploitation of some fish stocks. This information is especially important for Sustainable Use conservation units.[215]

The biodiversity monitoring is carried out within protected areas, so its parameters and results can be used with other indicators to assess the effectiveness of both conservation units' implementation and PAs system success. The evaluation of the effectiveness is fundamental to the improvement of the management, promoting the adaptive management. In the scale of conservation unit, the evaluation will consider its progress in achieving objectives and goals and the level of implementation in several areas, such as landholding regularization, protection, surveillance, enforcement, management, environmental education, participatory processes, conflict management, public use and visitation, research and biodiversity monitoring, recovery of damaged areas, control of alien species, and others. It is also important the evaluation of the management plan, to the conservation units that hold this instrument.

Besides the establishment goals of the conservation unit, the management plan defines specific and strategic objectives. The action programs (by theme, for example protection and management, environmental education, administration, research and monitoring) developed in the management plan are designed to achieve specific objectives, presenting targets, activities and indicators. The management planning process should be continuous and adaptive, involving a constant search for knowledge to update the management proposals, avoiding gaps between the actions and the local reality. Adaptive management is a cyclical

[215] See http://www.icmbio.gov.br/portal/o-que-fazemos/pesquisa-e-monitoramento/monitoramento/marinho-costeiro.html

process in which information about the past and present provide feedback and improve the way in which the management will be conducted in the future. Thereby, assess the level of implementation and the effectiveness of management activities adopted is a key step. Improving management plan comes since the assessment of the conservation unit's design and its connections with the environment outside their boundaries, up until the analysis of programs developed in the PA.

The Methodological Planning Guide[216] proposes 3 types of evaluation to be performed during the validity of the management plan: 1) Annual monitoring and evaluation of its implementation; 2) Monitoring and evaluation of the effectiveness of planning, to be held in the middle and the end of the validity of the management plan; and 3) Evaluation of the zoning effectiveness, to be carried out at the end of the management plan term, important to check if all the areas have been properly planned and if the situations which led to the establishment of temporary zones have been modified. Monitoring and evaluation is an instrument to ensure interaction between planning and execution, allowing for deviation correction and a permanent feedback of the whole process of planning, according to the experience of the management plan execution. Thus, the assessment is crucial to indicate the need for adjusting corrective actions or re-planning activities.[217] Therefore, the evaluation of the management plan should be implemented in order to promote adaptive management, improve planning and assess the effectiveness of the conservation unit. The assessment of efficiency, a growing demand of society, allows investigate how and if the objectives are being achieved and at what cost. Due to the lack of staff, few efforts have been devoted to evaluating the level of implementation and effectiveness of the management plan. Most of the conservation units that have management plan just monitoring it when the review of the management plan becomes urgent with the popular pressure. Possibly most of the management plans are not being implemented by conservation units.

The evaluation of the conservation unit management effectiveness is generally

[216] Maria Luiza V. Galante, Margarene M. L. Beserra, and Edilene O. Menezes, *Roteiro Metodológico de Planejamento: Parque Nacional, Reserva Biológica, Estação Ecológica*, (Brasilia, DF, IBAMA, 2002)

[217] Maria Luiza V. Galante, Margarene M. L. Beserra, and Edilene O. Menezes, *Roteiro Metodológico de Planejamento: Parque Nacional, Reserva Biológica, Estação Ecológica*, (Brasilia, DF, IBAMA, 2002)

achieved by the assessment of a series of criteria (represented by selected indicators) against agreed objectives or standards. This evaluation should be conducted to all conservation units, with or without management plan (where the status of the management plan is part of this evaluation).

There are several worldwide initiatives for monitoring PAs success. The Convention on Biological Diversity has required the development and implementation of management effectiveness evaluations by parties of at least 30 percent of each Party's PAs and of regional and national protected area systems[218]. In Brazil, monitoring the management of PAs has mainly conducted the WWF's RAPPAM methodology (Rapid Assessment and Prioritization of Protected Areas Management). The RAPPAM methodology is designed for broad level comparisons among many protected areas which together make a PAs network or system. This methodology provides protected area agencies with a country-wide overview of the effectiveness of protected area management, threats, vulnerabilities and degradation. RAPPAM is developed in order to: identify management strengths and weaknesses; analyze the scope, severity, prevalence, and distribution of a variety of threats and pressures; identify areas of high ecological and social importance and vulnerability; indicate the urgency and conservation priority for individual protected areas; help to develop and prioritize appropriate policy interventions and follow-up steps to improve protected area management effectiveness.[219]

ICMBio has performed RAPPAM methodology, but the frequency is low (every 5 years). The evaluations of federal conservation units management effectiveness was conducted between 2005-2006, considering 85% of existing PAs at the time, and in 2009-2010, when they were assessed 94% of existing federal conservation units. The next RAPPAM evaluation starts in 2015, that is why ICMBio is carrying out a great institutional effort to give permeability to the management monitoring and evaluation process, in different decision-making scales, using the least amount of financial resources possible. In addition, the Division of Monitoring and Management Assessment of ICMBio recently developed the Management Monitoring and

[218] CBD Program of Work on Protected Areas, COP 7 Decision VII/28 (2004). Available from https://www.cbd.int/decision/cop/default.shtml?id=7765

[219] J. Ervin, *WWF: Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Methodology*. (WWF, Gland, Switzerland, 2003). Available from assets.panda.org/downloads/rappam.pdf

Evaluation System (SAMGe, in Portuguese) to evaluate the effectiveness of PAs management and to monitor management tools. SAMGe is guided by correlations between objectives, nature conservation targets and their interrelation with society uses. It is expected the development of a management panel to display the management status quo of each conservation unit, prioritizing and justifying the actions. The application of SAMGe is annual while RAPPAM is applied every 5 years. According to ICMBio, the third application of RAPPAM and the first of SAMGe will be conducted until the end of 2015 for Amazon units and early 2016 for the other conservation units.[220]

It is worth mentioning that these initiatives do not directly assess the protection of biodiversity and the processes that maintain their integrity. Assess biodiversity conservation in the Brazilian federal protected areas requires research and monitoring of species and ecosystems, as explained earlier. There is also the full range of social, cultural and economic impacts caused by protected areas on local communities and that were not being monitored and evaluated. The addition of social parameters and indicators is important to evaluate the quality of public engagement and improve community participation in the management in the future. This analysis also supports the development of tools in order to implement more efficient participation methods.

Thus, it has been widely recognized that biodiversity monitoring and PAs efficiency assessment is a vital component of governance[221]. The evaluation of the effectiveness of both individual PAs, local network and overall system of PAs can be conducted for a range of different purposes and it has several important advantages. The assessment can improve the management, identifying the "best practices" in the various aspects of management and where they are applied. The definition of some key management factors might also be of interest to managers, and provides some basis for thought about the most critical issues to address at regional scales. As further management effectiveness studies are conducted, there will be more evidence about how the standard of protected area management can be improved. The

[220] See http://www.icmbio.gov.br/portal/o-que-fazemos/efetividade-da-gestao-de-ucs.html

[221] Fiona Leverington and others, *Management Effectiveness Evaluation in Protected Areas – A Global Study, 2nd Edition*, (Brisbane, Australia, University of Queensland, 2010)

evaluation also recognizes the reasons that led to better manage of the conservation unit, enabling and supporting an adaptive management, by providing essential information about the extent to which management interventions are being implemented and are being successful[222]. For this, it is important to institutionalize the evaluation process to ensure that the results are used to improve management.

Implementation of necessary changes often rests on the capacity of the evaluating organizations to influence funding and policy. Conducting assessments can guide the effective allocation of resources, identifying priorities of action, areas of highest financial resource needs, and livelihood of success, both in the individual conservation unit area and in the national system. The analysis of the results can facilitate sorting where resources are scarce. Information systems

must be built to make data available to managers in an easily accessible form linked to their decision-making process, and to keep it cost-effective, in balance with other aspects of management[223].

Additionally, the evaluation of management promotes responsibility and transparency, makes the management information more available, assisting in disseminate it to stakeholders, improves the quality of information and accountability, and show to the public what has been done, how resources are being used and decisions made, and the management progress. The application of the management effectiveness assessment can help engage the community, make allies and disseminate the PA, promoting its values and assisting in raising funds for the conservation unit and the entire system of PAs.

Thus, the process of assessing management effectiveness can provide a number of benefits, such as improving communication and cooperation between managers and other stakeholders, improving decision-making and ongoing management in a changing environment, reviewing MPA policies and programs, providing feedback on management to decision makers

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[222] Marc Hockings, Fiona Leverington and Carly Cook, "Protected Area Management Effectiveness", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

[223] Fiona Leverington and others, *Management Effectiveness Evaluation in Protected Areas – A Global Study, 2nd Edition*, (Brisbane, Australia, University of Queensland, 2010)

and interest groups, helping account for existing management expenditure, and justifying the need for additional resources. [224] Information generated from management effectiveness assessment certainly is essential for the management of the conservation unit in the future and will also give more subsidy for the definition of institutional policies aimed at improving the PAs management conditions and the biodiversity conservation.

[224] Marc Hockings, Fiona Leverington and Carly Cook, "Protected Area Management Effectiveness", *in Protected Area Governance and Management*, Graeme L. Worboys and others, eds. (Camberra, Anu Press, 2015)

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