

The Brazilian Atlantic Forest: occupation, death and protection of forest remnants and biodiversity

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Abstract

Metropolitan dynamics totally remodel natural systems. Is it an inevitable process of destruction of the latter, or are there possibilities of socio-cultural and political co-existence? The Atlantic forest biome, formed by diverse forest ecosystems, is a long coastal area extending from south to northeast of Brazil, presenting a variable depth, reduced to a narrow coastal strip in the North and Northeast from the state of Amapá (AP) to the city of Salvador (BA), but entirely covering the States of Espírito Santo and Rio de Janeiro, and wide stretches of the southernmost states. It is the most anthropized biome in the country.

These coastal regions were the first occupied by the Portuguese colonization and are the areas where much of the economic cycles of the Brazilian history were developed and where, for that reason, the destruction of the nature has been more profound. Geographical factors such as the location and availability of natural resources, such as abundant wood, were favorable to the installation of the political and economic power centres, and these coastal areas became the site of construction of two of the former Brazilian capitals, the cities of Salvador and Rio de Janeiro.

In the first half of the twentieth century this untouched ecosystem still covered the center-west of São Paulo State? and the north of Paraná State?. But historical, socio, cultural, and political factors contributed to its decay: the colonization and occupation of the coast and the progression of a pioneer front base on the development of agriculture, especially coffee plantations, caused the destruction of this dense vegetation. The logging activity, in particular, led to the conversion of the forest into an agricultural domain, where maize and wheat were first produced, and then soybeans. The use of timber? for construction, transported on railroads which later, served as a base for the industry of São Paulo, led to the near disappearance of this biome. It was also during this century that the installation of industry, concentrated in the areas near the city of Cubatão in São Paulo State, and the emission of polluting chemical substances in the air, constituted important factors for the destruction of the forest itself.

Currently, there are only remnants of this biome usually on riverbanks or in hard-to-reach areas, and it covers less than 7% of its initial extension. Since the late 1970s, the notion of environmental protection gained global relevance and began to guide public policies around the world. This notion has also made promising advances in the national context because it has gained voice through the pressure from nongovernmental organizations such as SOS Mata Atlântica, ISA, WWF, Greenpeace. As a result, these remnants were declared a Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization (Unesco). Its conservation can nowadays rely on specific environmental legislation and biodiversity conservation policies that contribute to the fulfillment of the country's international commitment towards multilateral institutions.

However, this coastal area simultaneously shelters, between the cities of São Paulo and Rio de Janeiro, a region of intense urban-metropolitan dynamism which provokes conflicts of use of the territory. Are these reserves, and the group of protected areas of this biome, able to resist to the situation or would these fail to do so, which would lead to the final demise of these natural systems? Or would public actions articulated with those of society, allow the beginning of a new cycle?

1. Introduction

Metropolitan dynamics totally remodel natural systems. Is it an inevitable process of destruction of the latter, or are there possibilities of socio-cultural and political co-existence with them? Before the industrialization period, the Atlantic forest biome, formed by diverse forest ecosystems, was a long coastal area extending from south to northeast of Brazil, presenting a variable width. Reduced to a narrow coastal strip in the North and Northeast from the state of Rio Grande do Norte (RN) to the city of Salvador (BA), it covered entirely the states of Espírito Santo and Rio de Janeiro, and wide stretches of the southernmost states. Having lost 93% of its original vegetation it is nowadays the most anthropized biome in the country, as shown in figures 1, 2 and 3.

These coastal regions were the first occupied by the Portuguese colonization and are the areas where much of the economic cycles of the Brazilian history were developed and where, therefore, the destruction of the nature has been more profound. Geographical factors such as the location and availability of natural resources, such as abundant wood, were favorable to the installation of the political and economic power centers, and this coastal area became the site of construction of two of the former Brazilian capitals, the cities of Salvador and Rio de Janeiro.

In the first half of the twentieth century, this ecosystem, little modified, still covered the center-west of São Paulo State and the north of Paraná State. However, historical, socio-cultural and political factors contributed to its decay: the coloniza-

tion and occupation of the coast and the progression of the agricultural pioneer front, especially coffee plantations, caused the destruction of this dense vegetation. The logging activity, in particular, led to the conversion of the forest into an agricultural domain, producing maize and wheat, and then soybeans. The use of timber for construction and as fuel for railway locomotives, which served as a base for the industrial development of São Paulo, led to the near disappearance of this biome. Later in this century the installation of industries, concentrated in the areas near the cities of Cubatão (SP) and São Paulo (in São Paulo State) and the emission of chemical substances in the air constituted important factors for the destruction of the forest itself.

Currently, there are only remnants of this biome, usually on riverbanks or in hard-to-reach areas, such as mountainous areas covering less than 7% of the initial total forest extension. Since the late 1970s, the notion of environmental protection has gained global relevance and began to guide public policies around the world. This notion has also made promising advances nationwide because it has gained voice through the pressure from nongovernmental organizations such as SOS Mata Atlântica, Instituto SocioAmbiental (ISA), World Wide Fund for Nature (WWF), Greenpeace. As a result, these remnants were declared a Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization (Unesco). Its conservation can nowadays count on specific environmental legislation and biodiversity conservation policies that contribute to the fulfillment of the country's international commitment towards multilateral institutions.

However, this coastal area also shelters many cities along this strip between São Paulo and Rio de Janeiro, a region of intense urban-metropolitan dynamism, thus provoking conflicts of use of the territory. Are these reserves, and the group of protected areas of this biome, able to endure given the situation, or will it reach the final demise of these natural systems? Would public actions, articulated with those of the society, be enough to allow the beginning of a new cycle?

There is a lack of consensus on the total surface originally covered by this biome. The figures vary depending on each institution dealing with the ecosystems of the Atlantic Forest, but all agree on the fact that currently only fragments remain. Following the legal definition of the Mata Atlântica (law 11.428. Brasil, 2006), this study adopted the value

of 1,309,736 km² of a Brazilian territory that shelters more than 72% of the Brazilian population.

In order to understand the dynamic transformations of present time it is irrelevant to look back as far as the arrival of the Portuguese, but the structuring of spaces resulting from the occupation process, and the mechanisms created to facilitate it, resulted in the reduction of the remnants that can be found today. Many of the Brazilian economic cycles occurred in the Atlantic Forest region, causing the exploitation of natural resources that prevail in the area. In this area are located the São Paulo and Rio de Janeiro metropolises, interconnected by the Paraíba do Sul Valley, as well as 13 out of the 27 Brazilian capital cities and about 75% of the Brazilian GDP is concentrated there. On the other hand, it is a biodiverse region of great importance for national conservation policies.

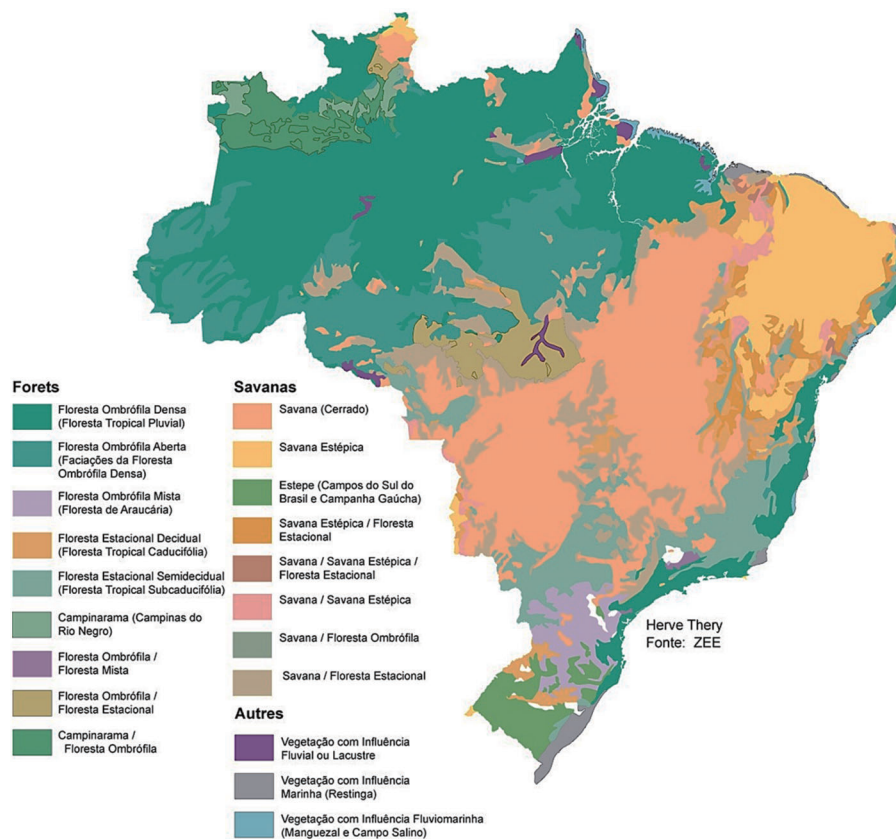
2. The historical process of occupation of the Atlantic Forest

It is worth to share some ideas and findings from Warren Dean's book "With Broadaxe and Firebrand" (1996) that became a classic in environmental history for anyone studying the Atlantic Rainforest as he analyzes the entire process of its destruction, although he was not the only one to highlight this fact. The destruction of this ecosystem had in land appropriation, one of its strongest inducers. From the nineteenth century the states controlled the land public patrimony and the land law (Lei de Terras), passed in 1850 was its mainstay guaranteeing the regularization of illegal occupied lands. Initially under the responsibility of the federal government, in 1891 they were transferred to the States and in 1895, the State of São Paulo placed the public lands for sale. Some criteria were established. For example, no buyer could claim more than 500 hectares of forests; and this measure extended up to 1.000 hectares of land forests when they were already occupied. However, land registration was not done, disputes marked political arenas and power groups within the state, *local people* failed to transform their rights as occupants into property titles and switch to commercial production. This process has brought about the acceleration of the destruction of the Atlantic Forests and this process has been now repeated in the Amazon pioneer frontiers (Mello-Théry, 2011).

The economic occupation of the forests in the country began in the 1790s, starting from the southeast (from Paraíba Valley to Campinas in the years

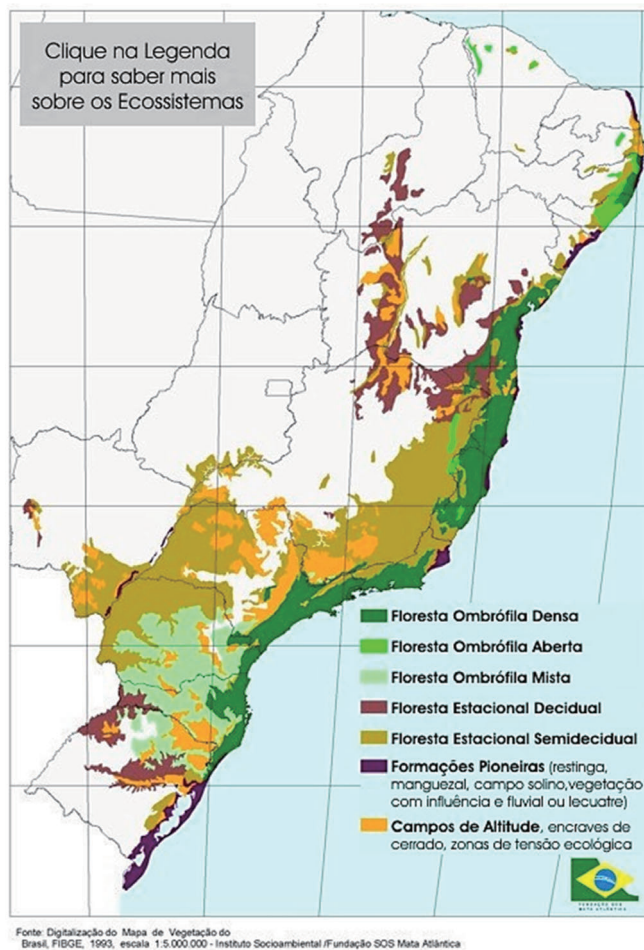
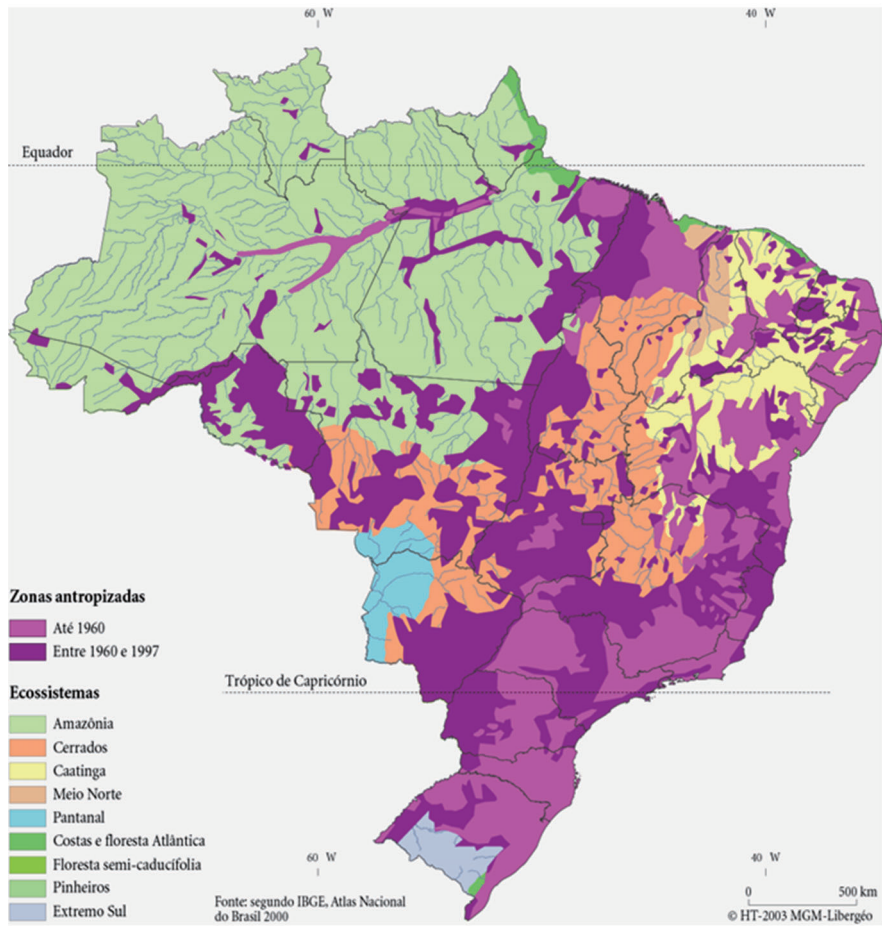


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1817) and spreading to the east (1870 in Espírito Santo). Ten thousand square kilometers of forests were depleted during the first century by this type of occupation, with the slopes being the first to be destroyed. The forests of the high, rugged and relatively barren regions were overthrown and cultivated by Germans and Italians. In 1890, the railway

companies consumed half a million cubic meters of firewood. The three maps below show the different types of vegetation in the Mata Atlântica domain and its process of anthropization.



Such economic dynamics caused the price of lands planted with coffee to increase making it a reason for speculation. Such lands' prices were higher than any other crop (in relation to rice it reached as much as 7 times), leading to the replacement of areas planted with sugar cane, cotton and subsistence by coffee plantations.

Well known in the country are the antagonisms of the Brazilian public actions, and in that historical period it was no different. Coexisting with the economic dynamics, with the risks of plantation agriculture and with eroded and arid slopes, gullies and exposed rock, abandonment of coffee plantations in rural areas, the first attempts of conservation took place: i) in 1862, governmental funding of reforestation in the springs; ii) in 1817: prohibited clearing of trees; iii) in 1856, the government acquires a few farms in Tijuca and in the Paineiras mountain to transform into conservation areas; iv) and from 1862 to 1892, with an order and authorization to replant the vegetation cover in Forest of Tijuca, but without restrictions to exotic and ornamental plants. During this period, 127,000 trees were planted.

At the end of that century, several governmental agencies were created, with specific responsibility for the management of natural resources, among which the Botanical Garden of Rio de Janeiro stands out. In 1896, the botanical section of the Geological and Geographical Commission (later the Brazilian Forest Service, 1899) highlighted the function of the Cantareira mountain: to protect river basins from the streams and to channel their water to the reservoirs of the city. In 1902, the botanist Albert Löfgren, created the "empty" frontier concept (i.e. exhausted and unproductive land) and proposed the establishment of the Arbor Day.

After this, the first conflict between landowners and public officials began. Landowners dominated the government and created barriers to the implementation of policies. This process continued to occur throughout the 20th century, with greater intensity. Degradation continued, while state capitals concentrated urban growth. In this century the Brazil's population grew from about 10 to almost 200 million people, new states (from 20 in 1872 to 26, with addition of the national capital, the Distrito Federal) and hundreds of new cities were created in this biome. The rural environment was transformed. Industries were installed in the Southeast region between São Paulo, Belo Horizonte and Rio de Janeiro. The concentration of industries in Cubatão resulted in acid rain and consequent de-

struction of many Atlantic Forest slopes. A natural system was striding towards its death.

Nevertheless, the twentieth century was a century when a raise of awareness of the environmental dimension and of great transformation of concepts, principles, and the creation of legal mechanisms to protect this biome. Society and governments developed public actions that could conserve what remains of the Atlantic Forest. Non-governmental organizations raised their voices and the Mata Atlântica was registered in the Federal Constitution as a national patrimony.

Governments reacted by creating conservation areas and implementing public actions and many of these areas were defined as conservation units, becoming areas of extreme importance for the conservation of biodiversity. At the end of the century, it was possible to say that the efforts that were and are being made contribute to protecting the remnants of this biome, although they are still considered as marginal activities, given the predominance of degrading activities.

The twentieth first century was also marked by actions from society, no longer in the form of large mobilizations on the international scale, but of daily actions¹ with a great deal of society involvement, with the clear perception that the protection of that natural system and its biodiversity depends on the local development. There has been a better understanding that people's actions can therefore contribute in an incisive way, so that the remnants can be the starting point for a new cycle.

3. The first half of the 20th century and the Mata Atlântica biome: height and decay

From 1900 to 1950, the Brazilian population grew three times and the population of São Paulo four times. The process of industrialization of São Paulo State required a lot of energy for industrial, residential and transportation uses, which was obtained through cutting the Atlantic forest.

From the economic point of view, the first half of the twentieth century is marked by the so-called coffee cycle, which was responsible for 75% of the budget of São Paulo State and the basis for the country's trade balance.

1. Experiences of local and urban gardens, reforestation with native vegetation of degraded areas by illegal occupations near cities, development of a green economy based on originating products of the biome such as de Cambuci's fruit among others. In the project "Experimental networks of sustainability (ENESUS)" the research developed in Biosphere reserves, of which 122 of these initiatives were identified in the area of the Biosphere Reserve of the Green Belt of São Paulo.

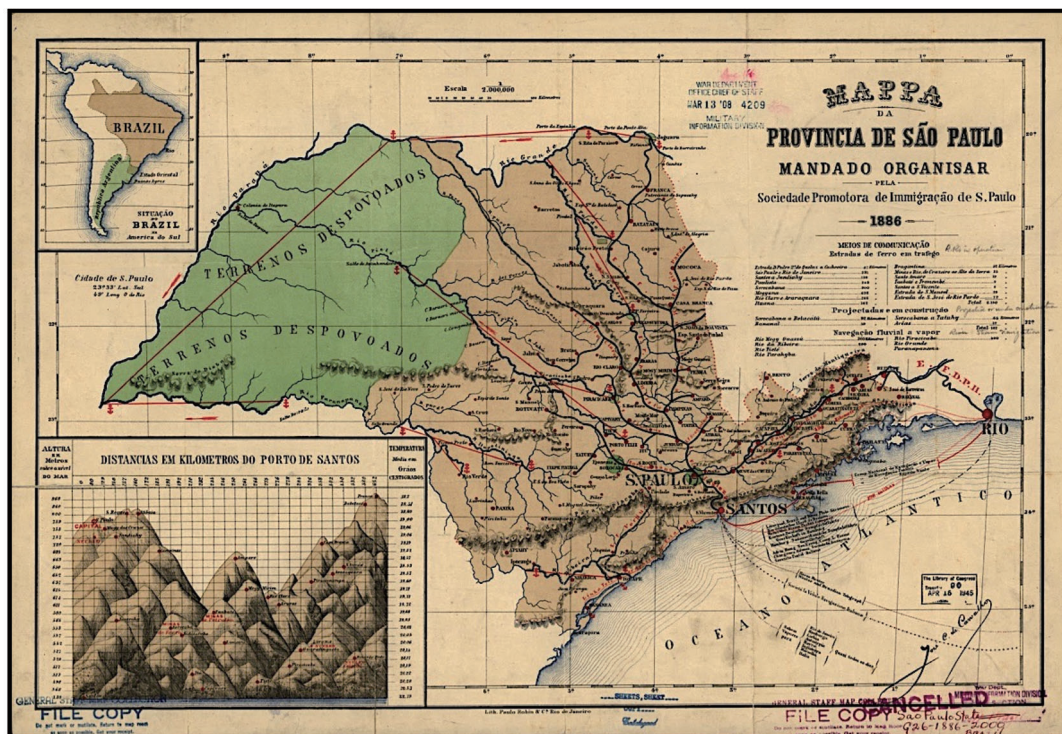
In a different political context from the previous ones, those new times stimulated the arrival of European immigrants, as slavery had been abolished in 1888. More than 1 million European immigrants (Italian, Spanish, Portuguese, Japanese and others) arrived in the country between 1888 and 1914. This labor force, which allowed the expansion of plantations, caused intense deforestation, gave rise to new cities, focusing on the development of the railways, which linked these new producing regions to the port of the city of Santos. The French geographer Monbeig chose it as an object of study, analyzing in his book “Pioneers and farmers in São Paulo” (1986) the three conditions for the advance of this pioneer front from the west of São Paulo to the north of Paraná. First, the availability and the quality of the land (i.e. the red earth originating from the decomposition of basalt, known as *terra roxa*, the purple earth). Secondly the State actions and finally the willingness of society to move forward.

The dominant mentality was to generate wealth for the country, valuing the strategies used to guarantee production cycles. Activities based on the use of wood, associated with building industry, railway transportation and the supply of firewood to the cities contributed to speed up the Atlantic Forest destruction. The evolution of the process was marked by speculation on land prices and successive cycles of occupation. Slashing and burning of large tracts

of primary forest increased soil fertility and the possibility of crop development, but for a limited time, because in the short run the land became sterile. The disappearance of animals caused the spreading of pests which attacked the production of coffee in the Paraíba valley. As coffee farms lost productivity in these now very poor soils, such farms were usually converted to pasture fields for cattle.

The construction of the railway system also created a strong demand for the use of natural resources, and in 1910 it consumed 80 km² of primary forest (i.e. 2.4 million m³ of wood) to put the 1.500 railpads of railways’ tracks per km, and additional 20 km² of forests only for the maintenance of the railway.

The Portuguese agronomist Edmundo Navarro de Andrade carried out a research on forest species. He set up 18 experimental garden stations in Jundiaí, Campinas and Rio Claro and planted 95 forest species before deciding on the eucalyptus as the best one. Andrade considered that “that ugly, low, unequal and unhealthy forest” should be replaced, valuing the advantages of the absorption of water and the production of aromatic oils with disinfectant and curative qualities of eucalyptus. Based on this research, the Sao Paulo railway company began to promote the advantages of eucalyptus by developing a project to create forest gardens along the railways, considering that the eucalyptus rapid



Source: *Mappa da Provincia de São Paulo mandada organizar pela Sociedade Promotora de Imigração de São Paulo*. Rio de Janeiro: Lith. Paulo Robin & Cia, 1886. 1 mapa color.; 38 x 58 cm. Arquivo Público do Estado de São Paulo.

growth would allow both reforestation and maintenance of the railways.

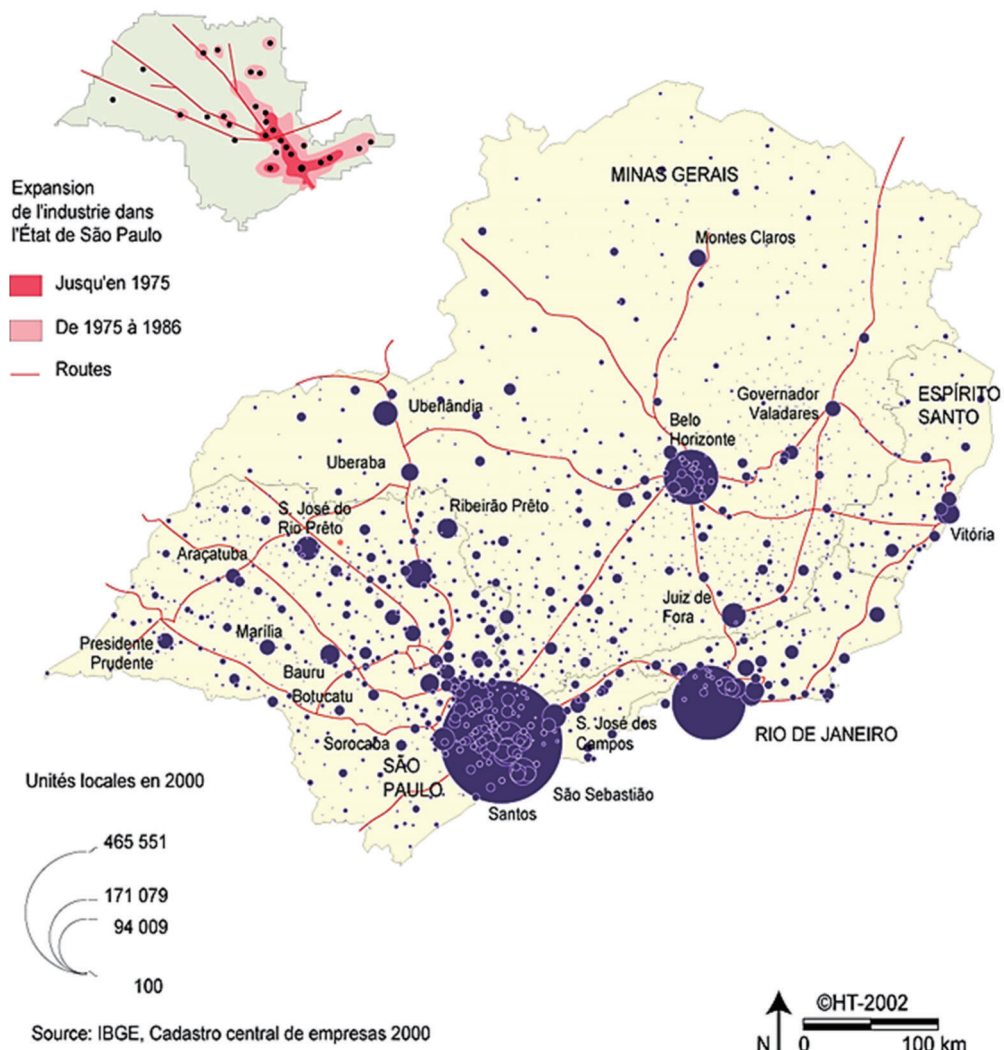
Together with this dominant process, there were also conservationist arguments synthesized in two streams of thought: one of these, on the impacts of forest clearing, was defended by Álvaro da Silveira, a botanist, while counter-arguments about the value of the Botanical Gardens were presented by João Barbosa Rodrigues. In 1913, Alberto Torres proposed the inclusion in the Brazilian Constitution of a clause in defense of the natural resources, since there was a need for protection of springs, reforestation and irrigation more than for roads and railways. He argued that repairing ruined areas, establishing populations in areas open to cultivation, educating men to use them should be part of government decisions and policies.

4. The disappearance of the Atlantic Forest: industries and metropolization

The mid-twentieth century is marked, therefore, with public actions involving conservation and

development. According to Gonzaga de Campos, from the Ministry of Agriculture, the states of São Paulo, Rio de Janeiro, Minas Gerais and Espírito Santo still contained about 500 thousand km² of secondary forest and *cerrados* (a kind of Brazilian savanna), being the remaining reserve stock of the Atlantic Forest of approximately 390 thousand km². However, the loss in the four States was probably of 50% between 1910 and 1947. At the same time, a decree law (number 25) was considered an instrument of forest assets protection.

The surveys carried out to diagnose the forest situation in São Paulo showed only 41,640 km² of primary forest in 1905, which were concentrated in the State public lands, showing that for the farmers the most important, of course, was not the conservation of the forest. Between the 1920s and 1950s, the area of private forested land was still diminishing and by the end of 1950 there were only about 27,700 km² left. The annual destruction was of more than 3 thousand km² per year, between 1920 and 1934 (Dean, 1996).



Government decision in the 1950s (during President Juscelino Kubitschek's government) stimulated the accelerated development of the Brazilian industrialization, whose nascent process had occurred in the period of World War II, with the strategy of so called Import Substitution. The core area for industrialization was the southeast region, between São Paulo-Rio de Janeiro-Belo Horizonte, spreading along the Paraíba do Sul River Valley and near the port of Santos. In the 1960s, there were 18 major industries (refinery, steel, fertilizers and chemical products) in the municipality of Cubatão, whose exports of these products gave to the municipality 2% of the country's exports. This caused not only the degradation of the Atlantic Forest but also deep health problems and birth of children with neurological deficiencies and anencephaly, causing the valley to be nicknamed "Death Valley".

Decentralization of the industry from the late 1970s to the interior of the São Paulo state led to the creation of new cities or to the growth of existing ones in both regions of Santos (because of the port) - Campinas and of the Paraíba do Sul Valley, expanding alongside the old railways.

At the beginning of the 2000's the industry had spread through São Paulo, Minas Gerais, Rio de Janeiro and Espírito Santo States. Such aspects are highlighted in the map below.

The Death Valley situation began to be modified only after the creation of the Pollution Control Law in the State of São Paulo (1976), when it became mandatory, due to pressures from the UN and from national and international environmentalists, to install filters or replace old machinery in the industries. Government, industrialists and population were able within a period of six years, with the implementation of the environmental recovery plan, to control the 320 polluting sources that existed at the time.

An important environmental recovery plan with reforestation was carried out in the Atlantic Forest: in addition to mobilizing public agencies responsible for environmental control, non-governmental initiatives were part of the actions, including as a main strategy the dispersal of seeds by airplanes, having this reached good results.

5. Protected remnants: the biosphere reserves in the atlantic forest and priority areas for biodiversity conservation

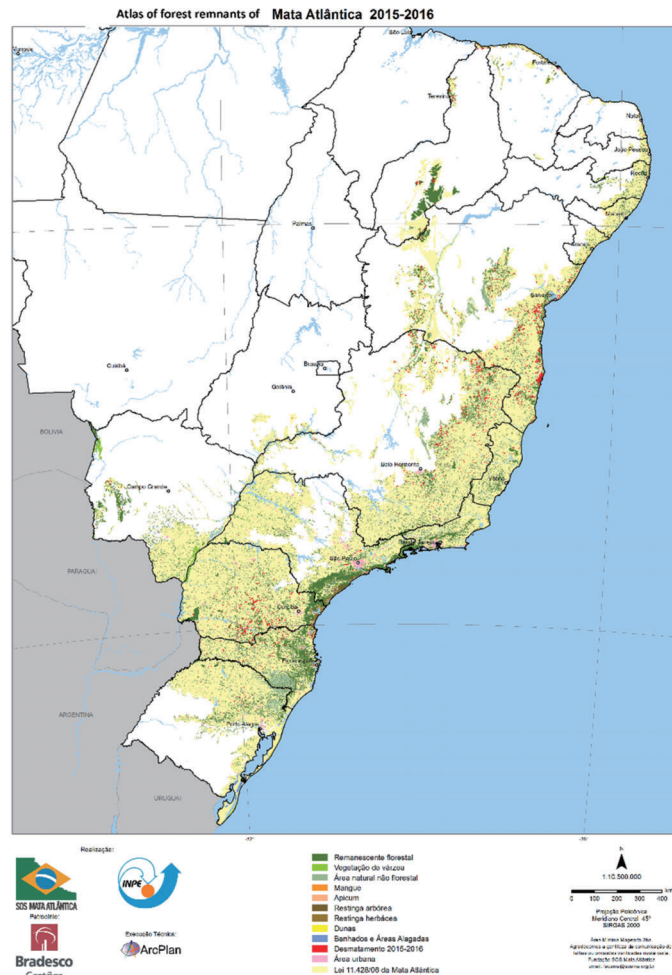
The Atlantic Forest is considered a "hotspot" of the world's biodiversity, having been reduced

to 3% of its original area in the northeast region, while 20% of the remnants are in the Ribeira de Iguape river valley, in the southeast region (border between São Paulo and Paraná). Even today, there is strong pressure on the remnants, but private foundations, states and federal governments take different actions to conserve them. We can take the case of the ecological corridors to illustrate this situation: supported by international (PPG-7) and national resources: its strategy was conservation in public and private areas, in a participatory management model. The central corridor of the Atlantic Forest (CCMA) focused on the protection of forest remnants, through the revegetation and sustainable production activities. In the Mata Atlântica biome there are 92 federal conservation units, which protect more than 38.400 square kilometers (ICMBio, 2017). Alternatives have been established since the 1930's for extending the lifetime of this forest system through the maintenance of remaining forest areas and the expansion of new forest areas. The map below shows the remnants of the Mata Atlântica in 2015-2016:

However, one other aspect, the lack of articulation among the different environmental laws, such as the Forestry Code and the national system of protected areas (SNUC) a mix of misleading terms and lack of technical basis leads to a confusion that can be disastrous to the conservation of the biome, which brings its effectiveness to be questioned, as did Scárdua and Leuzinger (2011). They analyze the legal instruments inserted in the Law of the Atlantic Forest and conclude that it is excessively permissive for local people and small farmers, when it comes to the use of forest resources. On the other hand, it is extremely strict when it comes to the use by other segments of society, with some flexibility for some sectors that are more representative, such as cocoa producers. This legislation also created new forms of environmental compensation, which end up generating cumulative obligations for the entrepreneur, since they do not exclude similar situations already regulated by other norms.

Brazil joined the MAB program² and created its National Committee (Cobramab) in 1974. In 1991 approved the creation of the first reserve, the Mata

2. Man and the Biosphere Programme (MAB) is an Intergovernmental Scientific Programme that combines the natural and social sciences, economics and education to improve human livelihoods and the equitable sharing of benefits, and to safeguard natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate, and environmentally sustainable. <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/>



Source: <http://www.sosma.org.br/en/wp-content/uploads/2015/06/atlas.jpg>

Atlântica Biosphere Reserve. At the same time, actions from non-governmental organizations have gained great repercussion. The SOS Mata Atlântica Foundation, with works aiming at knowledge generation and at mobilization for its conservation since 1990 is a good example of this

The Mata Atlântica Biosphere Reserve form an ecological corridor of 35 million hectares distributed in 17 Brazilian states, which is considered a cultural and natural heritage of the country. Among them we highlight the Discovery Coast (*Costa do Descobrimento*) and the Southeast Atlantic Forest (*Reservas da Mata Atlântica do Sudeste*) Reserves. Since the country adopted the concept of Biosphere Reserve and added it to the law of the National System of Conservation Units, the public actions follow the evolution of this notion, aiming for the future use at the scenic beauty preservation or at the development of natural processes related to the reproduction of microorganisms which form the base of the food chain and genetic information in the protected areas.

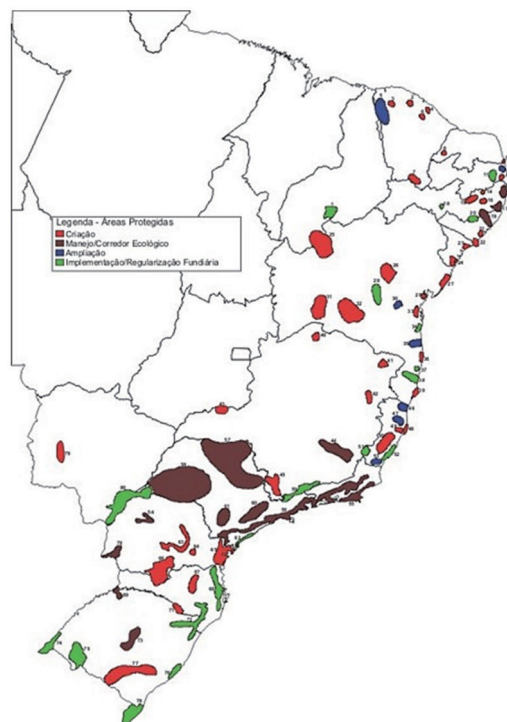
As usual, it is possible to perceive the emer-

gence of contradictory visions. Many scientists consider that after the Biodiversity Convention was signed there is a predominance of an “utilitarian mentality” since what is important is to explore the traditional knowledge of the locals about conservation and sustainable use of the biodiversity.

The map below shows the priority areas for actions in existing conservation units. The red color means creation and management of new areas or ecological corridors; brown means enlargement of the areas; blue means implementation of the protected areas and green is the land regularization of these areas.

In terms of regional planning, two ecological corridors formed by the association of two areas, one from southern São Paulo to Rio de Janeiro and another from Espírito Santo to southern Bahia were prioritized.

Public actions alone will not be able to stop the ecosystem degradation process. It is necessary to count on the increase of the awareness of the society on the conservation of the biodiversity. In this regard, these concerns are part of the joint actions



Fonte: <http://www.rbma.org.br/anuariomataatlantica/index.php>

Portraits of Brazilian society: knowledge of the population about the environment and environmental problems		
Climate change: caused by	Problems related to human actions	79%
	Natural process	16%
Environmental Preservation and Economic Growth	Environmental preservation should be a priority over economic growth	44%
	It is possible to reconcile the two	40%
Environmental preservation and awareness: the most important issues	Deforestation	53%
	Water pollution	44%
	Climate changes	30%
	Initiatives to preserve the environment have remained unchanged in recent years	40%
	Prevent water waste	71%
	Saving energy	58%
	Willing to pay more for correct environmental products	52%
	Prioritize “green” products or recyclable packaging	18%
	Do garbage separation	59%
	Brazilians consider recycling very important	67%
	Do not have access to selective garbage collection	48%

Source: CNI/Ibope, 2012.

to address the root causes of biodiversity loss, according to the decisions of Aichi (COP10, Japan, 2010) and the Strategic Biodiversity Plan. Thus, it is important to understand the levels of environmental awareness of the Brazilian society regarding such subjects identified in the CNI / Ibope survey:

6. Conclusions: end or start of a new cycle?

For sure, the day this biome will disappear is close. If overlooked the environmental value and the services this biome can provide, it will be hard to give priority actions in favor of nature. According to recent studies of regional specificities, the Atlantic Forest is currently drastically reduced of its original area, but we can still find larger frag-

ments, which allowed the adoption of the ecological corridor strategy.

Much work has been done, involving non-governmental organizations, states and private owners, which allowed for the creation of the Private Reserves of Natural Assets (RPPN), of which 360 were created from 1990 to 2017. These efforts have allowed the increase of protected areas and the evolution of its remnants. But even so, the Atlantic Forest is still one of the most endangered tropical forests in the world. The beginning of a new cycle will only be possible if authorities, managers and population are agile in the implementation of concrete actions of protection.

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