Vol. 62, p. 784-807, jul./dez. 2023. DOI: 10.5380/dma.v62i0.84688 e-ISSN 2176-9109

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# Conservation of the Atlantic Forest in the Anthropocene: legal setbacks in Santa Catarina, Brazil

## *Conservação da Mata Atlântica no Antropoceno: retrocessos legais em Santa Catarina, Brasil*

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Article received on February 14, 2022, final version accepted on January 31, 2023, published on October 27, 2023.

**ABSTRACT**: The Atlantic Forest biome is the fifth most threatened in the world, and in Brazil, the Federal Constitution of 1988, when the New Forest Code of 1965 was in force, declared it a National Heritage Site. Then, the biome received specific regulatory protection, conditioning its use to fulfill criteria that ensure its conservation. The state of Santa Catarina has its territory fully inserted in the Atlantic Forest, where forest ecosystems are predominant, represented by Dense Ombrophylous Forest, Mixed Ombrophylous Forest, Seasonal Deciduous Forest, high-altitude grasslands, and Coastal Vegetation. Threats to the biome were intensified with the publication of the MMA Dispatch No. 4.410/2020, which forced all its agencies and entities to authorize economic activities in Permanent Preservation Areas (PPA), which were irregularly damaged until 2008, and not from 1990 onwards, as had been the case in the Atlantic Forest Law. Although it was later revoked, the environmental agency in Santa Catarina maintained the guidelines set out in the terms of the 2020 MMA dispatch. This article analyzes the effects and consequences of this institutional change on the state's conservation of the Atlantic Forest. Data were obtained through research on documentary sources and legislation collected between January and July 2021. The timeframe for analysis begins in 1965 with the publication of the New Forest Code and continues until June 2021. The collected data were analyzed based on four "clarity of corridors" a term used to address political actions taken based on scientific evidence. The disregard for the timeframe (1990 - 2008) for the restoration of PPAs in Santa Catarina is characterized as a setback, bearing in mind the importance of conserving coastal zones to prevent disasters and other effects of climate change, such as the viability of economies in the Anthropocene.

*Keywords*: permanent preservation area; timeframe; corridors of clarity; new forest code.

**RESUMO**: O bioma Mata Atlântica é o quinto mais ameaçado do mundo e, no Brasil, foi declarado Patrimônio Nacional pela Constituição Federal de 1988, momento em que vigorava o Novo Código Florestal de 1965. Em seguida, o bioma recebeu proteção normativa específica, condicionando seu uso ao cumprimento de critérios que assegurem sua conservação. Santa Catarina tem seu território integralmente inserido na Mata Atlântica onde predominam os ecossistemas florestais representados pela Floresta Ombrófila Densa, Floresta Ombrófila Mista, Floresta Estacional Decidual, Campos de Altitude e Vegetação Litorânea. As ameaças ao bioma se intensificaram com a publicação do Despacho MMA nº 4.410/2020, que obrigou todos os seus órgãos e entidades vinculadas a autorizar atividades econômicas em Área de Preservação Permanente (APP) irregularmente degradadas até 2008, e não a partir de 1990, conforme previsto na Lei da Mata Atlântica. Apesar de ter sido revogado posteriormente, em Santa Catarina o órgão ambiental manteve orientação balizada nos termos do despacho do Ministério do Meio Ambiente de 2020. Neste artigo são analisados os efeitos e as consequências desta mudança institucional para a conservação da Mata Atlântica no Estado. Os dados foram obtidos por meio de pesquisa em fontes documentais e legislação, coletados entre janeiro e julho de 2021. O marco temporal para análise inicia em 1965 com a publicação do Novo Código Florestal e segue até junho de 2021. Os dados levantados foram analisados a partir de quatro "corredores de claridade", termo utilizado para tratar da tomada de ação política baseada em evidências científicas. A desconsideração pelo marco temporal (1990 - 2008) para a restauração das APPs em Santa Catarina é caracterizado como um retrocesso, tendo em vista a relevância da conservação das zonas costeiras para prevenir desastres e demais efeitos das mudanças no clima, como a viabilidade das economias no Antropoceno.

*Palavras-chave*: área de preservação permanente; marco temporal; corredores de claridade; novo código florestal.

## *1. Introduction*

Considering the countless impacts of human activities, whose repercussions can be seen on the ground and in the atmosphere at all scales, Crutzen & Stoermer (2000) propose adopting the term "Anthropocene" to designate the current geological epoch. The term Anthropocene was coined by biologist Eugene Stoermer in the 1980s and became popular after the article's publication by Paul Crutzen in 2000.

This concept has sparked discussion in scientific circles, with defenses of the transition to the Anthropocene based on the finding that human influence has permanently impacted the Earth. The worsening signs of the global socio-ecological crisis have been highlighted in recent research that points to drastic changes in the macro-processes of self-regulation of the Earth System (Vieira & Gasparini, 2020). In this scenario, the concept of Anthromas (Ellis *et al*., 2010) has become widespread, which refers to classifications of the earth's surface according to the degree of human interaction with ecosystems. Vieira & Sampaio (2022) identify the Anthropocene as reaching a critical point of no return and realizing that there are planetary limits (Steffen *et al*., 2015) to material growth at any cost.

The advance in biodiversity loss (IPBES, 2019), the global climate emergency (IPCC, 2018), and the emergence of pandemics are evidence of the inadequacy of the global community's responses to reduce these threats. The uncertainty arising from the extrapolation of planetary boundaries limits visions of the future and projections, reinforcing

the need for open, equal, and fair consultations involving academia, especially when changes are proposed on environmental issues (Fazey *et al.*, 2020). The intensity of anthropogenic forces raises governance challenges of different kinds, to be pursued from the perspective of complex adaptive systems (Jørgensen, *et al*., 2019), contemplated by the socio-ecological systems approach (Norström *et al*., 2014). In this sense, effective institutions are crucial in regulating the complex and uncertain relationships between nature and society to avoid commons' tragedy (Dietz *et al*., 2003).

The formal rules that regulate the use of and access to natural resources must be formulated on a solid scientific basis based on the best existing knowledge. Groups that advocate different policies tend to question the scientific *mainstream* when the recommendations confront or undermine their expectations of economic growth, leading to political polarization (Dixit & Weibull, 2007). In Brazil, where the main formal rules relating to forest conservation fall under federal competence, this polarization has threatened the protection of the Atlantic Forest biome.

The New Forest Code (Law No. 4.771/1965 - Brazil, 1965) did not contain sufficient provisions for defending and protecting the Atlantic Forest, a seriously threatened biome. As a general national standard, the Law for the Protection of Native Vegetation (Law No. 12.651/2012 - Brasil, 2012), which succeeded the New Forest Code, established a minimum level of protection for all vegetation in the country without taking into account the particularities of the different biomes. After the Atlantic Forest biome was declared a National Heritage Site by the 1988 Federal Constitution, it received specific regulatory protection, making its use conditional on meeting criteria that ensure its preservation. This protection began with Federal Decree No. 99.547/1990 (Brazil, 1990), which was replaced by Federal Decree No. 750/1993 (Brasil, 1993). It culminated with the approval of Federal Law No. 11.428/2006 (Brasil, 2006), regulated by Federal Decree No. 6.660/2008 (Brasil, 2008).

When evaluating the protection rules that apply to the Atlantic Forest, the "generality vs. specialty" relationship emerges between the rules for the protection of native vegetation and those for the protection of the Atlantic Forest. The Law for the Protection of Native Vegetation (Brasil, 2012), which replaced the New Forest Code of 1965 (Brasil, 1965), deals with the genus "native vegetation", while the Atlantic Forest Law deals with the species "native vegetation of the Atlantic Forest", hence its special character. Despite its specialty, the Atlantic Forest Law does not dispense with or conflict with the application of the Native Vegetation Protection Law, i.e., the two rules are integrated into the legal system for protecting the biome.

This necessary integration of rules is expressly determined in Law No. 11.428/2006 (Brazil, 2006), Article 1 of which states that "the conservation, protection, regeneration, and use of the Atlantic Forest biome (…) shall comply with the provisions of this Law, as well as current environmental legislation, in particular Law No. 4.771, of September 15, 1965" - repealed and replaced by Law No. 12.651/2012 (Brasil, 2012). However, on April 6, 2020, MMA Order No. 4,410/2020 (MMA, 2020) was published, through which the Ministry of the Environment (MMA) revoked Order No. 64,773/2017-MMA (MMA, 2017) and obliged all its agencies and entities to follow the legal understanding contained

in Opinion No. 00115/2019/DECOR/CGU/AGU (AGU, 2019).

With several protests against the content of MMA Order No. 4.410/2020 (MMA, 2020) and representations to the Judiciary, the MMA revoked it and declared that the constitutional jurisdiction of the Federal Supreme Court would be provoked so that the Court could resolve the supposed conflict between the Native Vegetation Law and the Atlantic Forest Law.

Even though it was revoked, MMA Order No. 4,410/2020 (MMA, 2020) took effect, and in Santa Catarina, the environmental agency maintains guidance based on the terms of Opinion No. 00115/2019 (AGU, 2019). Considering that Santa Catarina is one of the states whose territory is entirely within the scope of Law 11.428/2006 (Brasil, 2006; Brasil, 2008), it is important to analyze the effects and consequences of this understanding on the conservation of the Atlantic Forest in the state.

In addition to the winners and losers, society could lose out depending on the choices made about the rules for protecting the Atlantic Forest. Our hypothesis is that, despite the rapid transformations required to stabilize the planet, the governance structures of the Atlantic Forest in Santa Catarina remain oblivious to the relevance of production in the Anthropocene. In this research, we sought to answer the question: What are science's recommendations for dealing with uncertainty in choosing policy options for the governance of the Atlantic Forest in the Anthropocene?

## *2. Material and methods*

### *2.1. Study area*

The Brazilian territory comprises an area of 8,510,295.914 km$^2$ (IBGE, 2020), while the original distribution area covered by the Atlantic Forest biome in the 17 states (Figure 1) is 1,310,299 km$^2$, which corresponds to 15.3% of the national territory, being the fifth most threatened area and rich in endemic species in the world (IBGE, 2021).


FIGURE 1 - Map showing the original area of the Atlantic Forest in Brazil

SOURCE: IBGE (2008).

The distribution of the Atlantic Forest in the different states is very different. At the same time, in three of them, the biome originally covered 100% of the surface; in the other three states, this proportion is much lower, not reaching 10% (SOS Mata Atlântica, 2021). This area is home to more than 145 million people (72% of the Brazilian population), three of the largest urban centers in South America, and seven of the country's nine largest river basins (SOS Mata Atlântica, 2018). The Atlantic Forest also extends beyond Brazil's borders, covering part of the territory of Argentina and Paraguay (IBGE, 2021).

Despite the critical situation in which the Atlantic Forest finds itself, pressures on the biome persist. The loss of forest areas identified in the territory of the 17 Atlantic Forest states from 2018 to 2019 was 14,502 hectares. Comparing the suppression of native forests in the same 17 states mapped from 2017 to 2018, there was a 27.2% increase in the rate of deforestation (SOS Mata Atlântica, 2020).

According to the Atlantic Forest Law (Law No. 11.428/2006) (Brasil, 2006), the following native forest formations and associated ecosystems are part of the biome: Dense Ombrophilous Forest; Mixed Ombrophilous Forest; Open Ombrophilous Forest; Semideciduous Seasonal Forest and; Deciduous Seasonal Forest, as well as mangroves, restinga vegetation, High altitude Grasslands, inland swamps and forest enclaves in the Northeast.

With a territorial extension of 9,534,618.10 ha (1.12% of the Brazilian territory), Santa Catarina's territory is entirely within the limits of the Area of Application of Law No. 11,428 of 2006, published by the Brazilian Institute of Geography and Statistics (IBGE, 2008).

In Santa Catarina (Figure 2), the forest ecosystems represented by the Dense Ombrophilous Forest (Rain Forest of the Atlantic slope), the Mixed

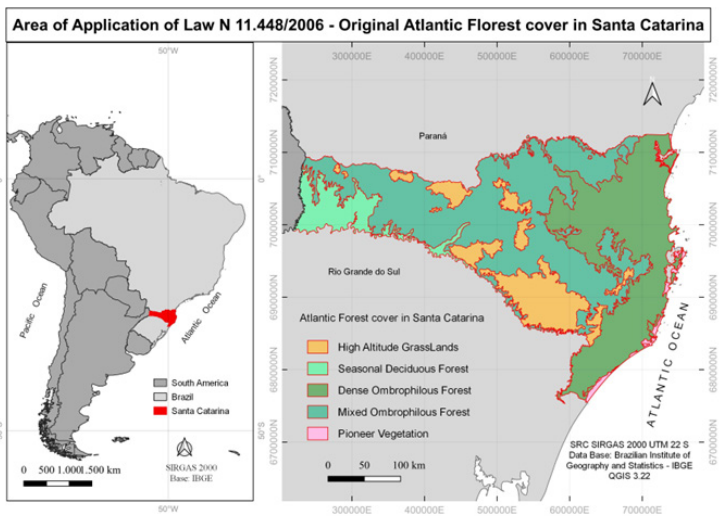


FIGURE 2 - Phytogeographic map of the original Atlantic Forest cover in Santa Catarina.
SOURCE: adapted from Klein (1978).

Ombrophilous Forest (Araucaria or Pine Forest) and the Seasonal Deciduous Forest (Subtropical Forest) predominate. There are also the associated ecosystems of the high altitude grasslands, and the pioneer formations with fluvial-marine influence (mangroves), and with marine influence (restinga), the latter two also characterized as Coastal Vegetation (Klein, 1978; Sevegnani *et al.,* 2013).

According to Klein (1978), forest formations covered 83.6% of the surface area of the state of Santa Catarina (Mixed Ombrophilous Forest - 44.9%; Dense Ombrophilous Forest - 30.7%; Seasonal Deciduous Forest - 8%), with the rest of the territory covered by the associated ecosystems of high-altitude grasslands, mangroves and restingas. According to SOS Mata Atlântica (2020), 28.8% of the remaining native vegetation remains in the state (2,753,410 ha), including the various stages of regeneration.

According to the Atlas of Atlantic Forest Remnants (SOS Mata Atlântica 2020), Santa Catarina is the state that proportionally has the most Atlantic Forest remnants to the original area. On the other hand, it was the deforestation champion from 2000 to 2005, with 45,530 ha deforested, and runner-up from 2005 to 2008, with 25,593 ha deforested.

The Permanent Preservation Areas (PPAs) in Santa Catarina, associated with consolidated rural areas, are mostly related to hydrography. By way of example, the state's sloping PPAs (greater than 45º) cover only 0.19% of its territory. Even including all areas with a slope greater than 25º, this amount makes up only 4.8%. Figure 3 and Table 1, based on the Digital Terrain Model (NASA, 2021), show the projection of the topography of Santa Catarina's territory, indicating the different slope ranges in the accompanying table. The map on the right shows that land with a slope of more than 45º represents a tiny fraction of the territory, practically restricted to the escarpments of the Serra Geral and Serra do Mar.

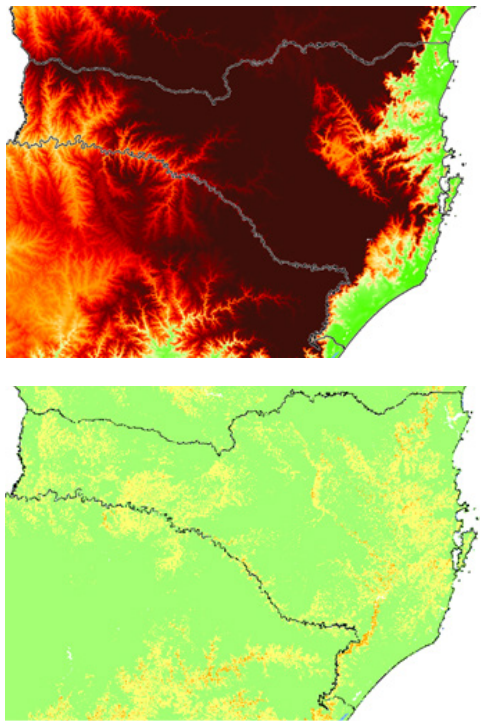

FIGURE 3 - Slope map of Santa Catarina.
SOURCE: MDT ASTER GDEM MET/NASA (2021).

TABLE 1- Slope data for the territory of Santa Catarina.

| Slope | Area (km2) | % |
|---|---|---|
| 0 to 12º | 67,150 | 70,4% |
| 12º to 25º | 23,634 | 24,8% |
| 25º to 45º | 4,396 | 4,6% |
| more than 45º | 183 | 0,19% |
| **TOTAL** | **95.362** | ~100% |

SOURCE: MDT ASTER GDEM MET/NASA (2021).

## *2.2. Data collection procedure*

The data from the survey of legislation protecting the Atlantic Forest Biome and administrative acts issued by the last government (2018-2021) was collected between January and June 2021, obtained through documentary research, a bibliographic survey, and federal and state legislation on the Atlantic Forest Biome and the protection of native vegetation (Table 2 and 3). The electronic portals consulted were: Planalto (www.planalto.gov.br), the National Environment Council (www.mma.gov.br/conama), and the Legislative Assembly of Santa Catarina (www.alesc.sc.gov.br/legislacao).

The timeframe for the analysis begins in 1965 when the New Forest Code (Law No. 4.771 of September 15, 1965) was published (Brasil, 1965) and continues until June 2021.

During this period, the legal frameworks that directly or indirectly affect the protection of Atlantic Forest vegetation and native vegetation were identified. These laws were compared with the events that occurred after the lawsuits that sought to maintain the prevalence of the Native Vegetation Protection Law over the Atlantic Forest Biome Protection Law in Santa Catarina. This procedure made it possible to relate the pressures that move the actors involved and evaluate the arguments brought to the debate, notably in Direct Unconstitutionality Action (ADI) No. 6.446, Public Civil Action No. 5011223-43.2020.4.04.7200/SC (AGU, 2020), with a sentence handed down in the 6th Federal Judicial Court of Santa Catarina (IMA, 2020), and in the Suspension of Injunction and Sentence No. 5024177-56.2021.4.04.0000/SC, granted by the TRF of the 4$^{th}$ region (TRF, 2021).

TABLE 2- Legislation consulted during the research period.

| Legal regulations | Theme |
|---|---|
| Law No. 4.771/1965 | Establishes the new Forest Code |
| Constitution of the Republic Federative Republic of Brazil/1988 | Art. 225 Everyone has the right to an ecologically balanced environment, which is a good for the common use of the people and essential to a healthy quality of life, imposing on the public authorities and the community the duty to defend and preserve it for present and future generations. |
| Decree No. 99.547/1990 | Provides for prohibiting the cutting and respective exploitation of native vegetation of the Atlantic Forest. |
| Decree No. 750/1993 | Provides for the cutting, exploiting, and suppressing of primary vegetation or vegetation in the advanced and medium stages of regeneration in the Atlantic Forest. |
| Law No. 11.428/2006 | Provides for the use and protection of the native vegetation of the Atlantic Forest Biome. |
| Decree No. 6.660/2008 | Regulates provisions of Law No. 11.428 of December 22, 2006, which provides for using and protecting native vegetation in the Atlantic Forest Biome. |
| Law No. 12.651/2012 | Provides for the protection of native vegetation. |
| Law No. 12.727/2012 | Amends Law No. 12.651 of May 25, 2012, which provides for the protection of native vegetation. |
| Law No. 13.887/2012 | Provides for the protection of native vegetation and other measures. |

SOURCE: prepared by the authors.

TABLE 3 - Documents consulted during the research period.

| Documents | Author |
|---|---|
| Order No. 64.773/2017 | Ministry of the Environment |
| Order No. 4.410/2020 | Ministry of the Environment revokes Order No. 64.773/2017-MMA |
| Opinion No. 00115/2019/DECOR/CGU/AGU | Federal Attorney General's Office |
| Direct Action for Unconstitutionality No. 6.446 | Supreme Court |
| Public Civil Action No. 5011223-43.2020.4.04.7200/SC | Brazilian Association of Environmental Prosecutors (ABRAMPA) |
| Request for admissibility, as Amicus Curiae, in ADI No. 6.446/DF before the STF. | Santa Catarina State Attorney General's Office |
| Sentence in Public Civil Action No. 5011223-43.2020.4.04.7200/SC | 6th Federal Court of Florianópolis |
| Suspension of the Injunction and Judgment of No. 2950/PR | Superior Court of Justice |
| Suspension of Injunction and Judgment No. 5024177-56.2021.4.04.0000/SC, | Federal Regional Court of the 4th Region |

SOURCE: prepared by the authors.

## *2.3. Data analysis*

After organizing the documents collected, the legislation protecting the Atlantic Forest Biome and administrative acts were analyzed to assess the possible impacts resulting from the options that might be taken considering the conflict of interpretation raised by the Federal Executive Branch's statement.

Polasky *et al*. (2020, p. 1140) argue for the need to create "corridors of clarity" to connect policy actions to outcomes in social-ecological systems, which can be defined as "the evidence-based scientific understanding of critical phenomena or causal pathways that are sufficient to justify taking policy action". Corridors of clarity set aside complexity and uncertainty that are "irrelevant to decision-making while retaining conceptual clarity and scientific rigor"*(ibid*, p. 1140). The corridors of light identified by the authors are:

(i) Follow the most robust and direct path between political decisions and results;

(ii) Present sufficient evidence for a policy proposal;

(iii) Prefer policies that do not compromise the future[1]; and

(iv) Identify the general scenario of the problem.

[1] Thank you for the translation suggested by the anonymous reviewer for the original "no-regrets.

## *3. Results and discussion*

### *3.1. The legal protection of the Atlantic Forest biome*

The main objective of the federal regulations is to ensure the rights and duties of citizens and public bodies concerning the exploitation of Atlantic Forest resources, considering sustainable criteria so as not to harm the ecosystems that make up the biome (SOS Mata Atlântica, 2021). The Atlantic Forest Law regulates the article of the Constitution that defines the biome as National Heritage, delimits its domain, prohibits the cutting and suppression of primary vegetation, defines criteria for identifying the successional stages of secondary vegetation, creates financial incentives for restoring ecosystems, encourages donations from the private sector for conservation projects and creates rules for economic exploitation.

The rules of use and conservation restricted to remnants of native vegetation in the primary stage and in the initial, medium, and advanced secondary stages of regeneration in the area covered by the Atlantic Forest biome were surveyed (Table 4). Law No. 12.651/2012 (Brasil, 2012), which provides for the protection of native vegetation, establishes general rules and concepts on the protection of vegetation, the delimitation and protection regime of PPAs; the delimitation and protection regime of the Legal Reserve, the protection regime of urban green areas and, in its transitional provisions, dealt with Environmental Regularization Programs (PRAs) for areas consolidated in PPAs and Legal Reserve areas.

TABLE 4 - Permitted uses according to the stages of vegetation regeneration in the area covered by the Atlantic Forest biome.

| Successional Stages of the Atlantic Forest Biome | Permitted use | Specifications |
|---|---|---|
| Primary vegetation and secondary vegetation in advanced stages of regeneration | a) Public utility<br>b) Preservationist practices<br>c) Scientific research | Activities essential to health protection or national security, infrastructure works for essential public services in sanitation, energy, and transportation (declared by the federal or state authorities). |
| Secondary vegetation in the medium-stage regeneration | a) Public utility<br>b) Preservationist practices<br>c) Scientific research<br>d) Social Interest<br>e) Authorization for small rural landowners and traditional populations. | Exceptionally, if it is necessary for survival, it respects all the provisions of the Forest Code, and the vegetation does not form an ecological corridor, is not of relevant landscape value, and does not harbor endangered species. Check that state or municipal legislation is not more restrictive. |
| Secondary vegetation in the initial stage of regeneration | The competent state agency will authorize cutting, suppressing, and exploiting vegetation: In states with less than 5% of the original vegetation that covered the state, initial secondary vegetation should be legally treated as being in a medium state of regeneration. | |

| | | |
|---|---|---|
| Secondary vegetation in advanced stages of regeneration | Urban perimeter established before December 22, 2006: At least 50% of the area must be maintained.<br><br>Urban perimeter after December 22, 2006: Suppression prohibited. | What has been suppressed must be compensated for, with at least the same area and the same environmental characteristics (in the same formation, basin, or micro-basin). |
| Secondary vegetation in medium stage | Urban perimeter until December 22, 2006: at least 30% of the area must be maintained. | What has been suppressed must be compensated for, with at least the same area and the same environmental characteristics (in the same formation, basin, or micro-basin). |
| | Urban perimeter after December 22, 2006: at least 50% of the area must be maintained. | What has been suppressed must be compensated for, with at least the same area and the same environmental characteristics (in the same formation, basin, or micro-basin). |

SOURCE: Law No. 11.428/2006 (Adapted from Brasil (2006).

### *3.2. Pressure on the use of permanent preservation areas occupied by agroforestry, ecotourism and tourism activities*

In April 2020, the MMA, provoked by the Ministry of Agriculture, Livestock and Supply (MAPA), issued MMA Order No. 4,410/2020, intending to change the already consolidated understanding that Federal Law No. 11,428/2006 (Atlantic Forest Law) (Brasil, 2006) enjoys specialty in the face of Federal Law No. 12,651/2012 (Law on the protection of native vegetation) (Brasil, 2012). Until then, the prevailing understanding was that set out in Order No. 64,773/2017 (MMA, 2017), through which the MMA sought to pacify the understanding of the partial inapplicability in the Atlantic Forest of articles 61-A and 61-B of Law No. 12,651/2012 (Brasil, 2012), given that the biome's special legal conservation regime was incompatible with the general provisions that authorize the continuation of economic activities in PPA irregularly degraded until 22/07/2008.

When it issued Order No. 4,410/2020 (MMA, 2020), the MMA reversed its understanding and began to argue that the general regime, which allows the consolidation of the occupation of PPAs and Legal Reserves illegally deforested between 1990 and 2008, should prevail over the special rule for the Atlantic Forest biome. However, the Atlantic Forest Law does not allow the consolidation of any clandestine and unauthorized suppression of native vegetation or the forgiveness of this illicit practice in the biome (MPF, 2021) since its Article 5 objectively establishes that primary or secondary vegetation at any stage of regeneration in the biome will not lose this classification in the event of a fire, deforestation, or any other type of unauthorized or unlicensed intervention. This means that an PPA occupied by agrosilvopastoral activities, ecotourism, or rural tourism after 1990 and an unauthorized or unlicensed area should be considered a remnant of the Atlantic Forest, not a consolidated rural area.

According to ABRAMPA (2020), the special rule did not retroact to harm or undo historical occupations before its advent. Specifically, it protects

the remnants of the Atlantic Forest that existed when these specific protective rules were first issued, established by Federal Decree No. 99,547/1990 (Brasil, 1990).

In this context, on May 6, SOS Mata Atlântica, the Brazilian Association of Members of the Environmental Public Prosecutor's Office (ABRAMPA) and the Federal Public Prosecutor's Office (MPF) filed a Public Civil Action with the 4th Federal Civil Court of the Superior Court of Justice of the Federal District (SJDF) intending to annul MMA Order No. 4,410/2020 (MMA, 2020), in defense of the integrity of the Atlantic Forest Law. In addition, the MPF formally recommended that the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) and several state environmental agencies stop following the conclusions contained in Opinion No. 00115/2019 (AGU, 2019).

On June 3, 2020, the MMA announced the revocation of Order No. 4,410/2020 (MMA, 2020). On the same date, the President of the Republic filed ADI No. 6,446 (AGU, 2020) with the STF, seeking, as a precautionary measure, the validity of MMA Order No. 4,410/2020 (MMA, 2020) and, on the merits, a declaration of nullity of the legal interpretation that superimposes the special protection regime for the Atlantic Forest on the general rules of the Native Vegetation Protection Law. Despite the express request for the validity of MMA Order No. 4,410/2020 (MMA, 2020), this administrative act was revoked the day after the initial petition was filed.

MMA Order No. 4.410/2020 (MMA, 2020) has prompted a series of legal actions, either trying to reverse the situation or to ensure that the order is upheld, as is the case with the initiative by the state of Santa Catarina, which has acted on both fronts. The Santa Catarina State Public Prosecutor's Office (MPE) and the Federal Public Prosecutor's Office (MPF/SC) have requested that IBAMA and the Santa Catarina State Environmental Institute (IMA) be ordered to refrain from canceling environmental infraction notices, embargo, and interdiction notices and seizure notices issued throughout the state of Santa Catarina, based on the finding of unauthorized suppression, cutting or use of remaining vegetation in the Atlantic Forest biome, based on the understanding established by MMA Order 4.410/2020 (Public Civil Action No. 5011223 43.2020.4.04.7200/SC forwarded to the 6th Federal Court of Florianópolis) (IMA, 2020). The federal court upheld the lawsuit on May 27, 2021. However, on June 10, 2021, the Attorney General's Office of the State of Santa Catarina requested admissibility as *Amicus Curiae* in ADI No. 6.446/DF (AGU, 2020) before the Supreme Court.

For its part, the IMA filed a lawsuit with the Federal Regional Court (TRF) of the 4th Region seeking a stay of the sentence handed down by the 6th Federal Court of Florianópolis. The IMA claimed that there was damage to public, legal and administrative order, given that the court decision which was the subject of the request for a stay: "unduly interferes with the duties legally carried out by the Santa Catarina Environment Institute - IMA, a state environmental authority, by preventing the entity from complying with federal environmental legislation - Law No. 12.651/2012 (Forest Code) (Brasil, 2012) - on state territory" (Public Civil Action No. 5011223-43.2020.4.04.7200/SC) (IMA, 2020, p. 10). He goes on to say:

> The state of Santa Catarina is the sixth largest food producer in the country. According to international re-

> search from agencies belonging to the United Nations, by 2050, the world population will reach approximately 9.8 billion inhabitants, a scenario in which Brazil will be the main global supplier of commodities, This is why the natural balance of factors is necessary, and not in an artificial way, using a court decision, so that imposing a sharp reduction in consolidated and already productive areas in the state of Santa Catarina, in addition to threatening public order and the economy, is to ignore the fact that economic development can be environmentally sustainable (Public Civil Action No. 5011223-43.2020.4.04.7200/SC) (IMA, 2020, p. 10).

It also claims that upholding the decision will require allocating human, technological, and financial resources to comply with it.

On June 18, 2021, the Superior Court of Justice suspended the injunction and sentence No. 2950/PR. Thus, the State of Santa Catarina obtained a suspension of the injunction, considering that there was a risk of serious damage to the public economy and administrative order. TRF 4 granted IMA/SC's request, suspending the sentence in Public Civil Action No. 5011223-43.2020.4.04.7200 filed by the MPF and MPE. In other words, even though the guidance of MMA Order No. 4,410/2020 (MMA, 2020) has been revoked, its content continues to guide the actions of environmental agencies in Santa Catarina.

Legal certainty is understood from the idea that all individuals have the right to rely on public acts and decisions that affect their rights based on current and valid legal rules, from which legal effects are expected and prescribed in the legal system (Canotilho, 2002). In this case, it is not a question of defending an absolute relaxation of legal certainty and property rights in favor of environmental protection since the demand falls solely and exclusively on PPAs that were irregularly suppressed between 1990 and 2008. In 1990, when the Atlantic Forest began to receive legal protection, it was already one of the most threatened environments on the planet (SOS Mata Atlântica, 2020).

Below, the arguments in favor of revoking MMA Order No. 4,410/2020 (MMA, 2020) will be presented based on four principles that aim to reduce the uncertainty of political choice in the Anthropocene.

### *3.3. Principle 1: Follow the most robust and direct path between political decisions and results*

This principle suggests that scientific information should not be focused on uncertainties irrelevant to policy (Polasky *et al*., 2020). Land use, for example, is directly associated with flooding and droughts, which affect people's lives and damage property. In this sense, this section will be dedicated to analyzing the arguments for making the Atlantic Forest Law more flexible used by the IMA in public civil action.

The IMA is the body of the National Environmental System (SISNAMA) responsible for implementing the National Environmental Policy (Law No. 6.938/1981) in Santa Catarina. Its main mission is to guarantee the preservation of the state's natural resources (IMA, 2021). Protecting the Atlantic Forest biome is a constitutional requirement, and its preservation and use of natural resources must comply with the dictates of the Atlantic Forest Law. The IMA's argument deals with the PPAs of all rural properties in the state. Furthermore, it does not demonstrate the existence of damage to the

administrative order or public economy since the extrapolation of data from a small sample (0.04% of the state's rural properties) is not sufficient to prove this:

> The State Secretariat for Agriculture, Fisheries, and Rural Development (SAR), together with the Agricultural Research and Rural Extension Company of Santa Catarina (Epagri), conducted a study comparing the impacts of the application of each of the laws (Forest Code versus Atlantic Forest Law) on rural properties in Santa Catarina. If they have to recover under the Atlantic Forest Law, 57.6% of properties with up to four fiscal modules will cease to exist due to reducing productive or consolidated areas for agroforestry activities. On these properties, according to the study, the recovery of APPs will consume more than 20% of the area that is currently used for production. In addition to this area, another 20% of all properties must be set aside as legal reserves. What is left over on small farms is insufficient to sustain a family in the countryside. The research was based on an analysis of 151 properties in various regions of Santa Catarina, most of which were characterized as smallholdings.

The IMA also argues that:

> In the establishments analyzed by the SAR/Epagri survey, the consolidated area is 69.9% of the total properties, while the area covered with native forest is 30.1%. This is a higher percentage than that required by the Forest Code, which determines a Legal Reserve of 10% or 20% of the area, considering the possibility of incorporating it into the APP on small properties. This production and preservation data indicates a sustainable production arrangement that includes economic development, social inclusion, and environmental balance.

The aforementioned consolidated area of 69.9% of all properties is an extrapolation that may be far from reality since the demand only applies to PPAs that were irregularly converted between 1990 and 2008 and not to all APPs currently occupied by agricultural activities.

According to 2016 data from the National Rural Registry System (SNCR - INCRA), Santa Catarina has 346,830 privately owned rural properties (95.4%) with a size of up to 4 rural modules, occupying 5,140,453.5 ha (57.3% of the state's total area), and 16,725 properties (4.6%) with an area greater than four fiscal modules, but which together occupy 3,832,383.1 ha (42.7%). This data shows a concentration of land by a few owners despite the prevalence of smallholdings. Therefore, it is impossible to generalize that the liabilities resulting from the occupation of PPAs from 1990 to 2008 are mostly found in the state's small rural properties, as the IMA tries to induce.

The IMA clarifies that the information declared in the Rural Environmental Registry (CAR) will serve as a database for control, monitoring, environmental and economic planning, and combating deforestation (IMA, 2021). The CAR consists of two stages: registration and analysis/approval. The registration stage was coordinated by the State Secretariat for Sustainable Development (SDS), while the analysis/approval stage is the responsibility of the IMA. After analysis and approval of the information registered in the CAR, it will be possible to assess the areas to be recovered and regularized through the Environmental Regularization Program (PRA), as well as the remaining surplus native vegetation for calculation and establishment of the Environmental Reserve Quotas (CRA).

As the analysis/homologation stage of the CAR is the responsibility of the IMA, the claim of damage to public, legal and administrative order is

meaningless, given that the court decision, which is the subject of the request for suspension, unduly interferes with the duties legally carried out by the IMA. On the contrary, the decision is closely aligned with the attribution given to the IMA and does not prevent the entity from complying with federal environmental legislation in the state; it merely reiterates that this compliance is not restricted to Law 12.651/2012 (Brasil, 2012).

In addition, Normative Instruction No. 2/MMA, of May 6, 2014 (MMA, 2014), states that the location and delimitation of Legal Reserve areas on georeferenced images must observe, among other criteria, that in cases where vegetation was suppressed before July 22, 2008, and the percentages of Legal Reserves provided for in the legislation in force at the time were maintained, the owners or possessors of rural properties must prove that the suppression of vegetation occurred by the provisions of the legislation in force at the time (Art. 2 of Normative Instruction No. 2/MMA, of May 6, 2014). 23). The same procedure must also be followed for PPA, and the state is responsible for assessing this information when validating the CAR. In this way, despite scientific evidence pointing to the need to protect the remaining vegetation, Santa Catarina preferred to make the Atlantic Forest Law more flexible by maneuvering the area calculations and diverting the powers of the environmental agency.

### *3.4. Principle 2: Present sufficient evidence for a policy proposal*

This principle suggests that scientific information should focus on what is sufficient for the policy proposal, avoiding complex links that are difficult to understand (Polasky *et al*., 2020). We argue that policies aimed at environmental control and recovery reduce the risks of disasters and the effects of climate change, especially on the most vulnerable population. Investments in these themes promote a regenerative economic model, generating income and jobs with activities in line with the demands of the Anthropocene.

As previously mentioned, Santa Catarina has 95.4% of privately-owned rural properties up to 4 rural modules and 4.6% of properties with an area greater than four fiscal modules, but which together occupy 3,832,383.1 ha (42.7%) (INCRA, 2016). In ACP No. 5011223-43.2020.4.04.7200/SC, there is a request for the IMA to verify the occupation of PPAs with agroforestry, ecotourism, and rural tourism activities, or the occupation of Legal Reserve areas with alternative land use, analyzing whether they were consolidated through deforestation or unauthorized intervention after September 26, 1990.

The IMA argues that there is a technical difficulty in complying with the legislation:

> The development of a new software program to analyze images back to 1990 - besides being technically unfeasible, as indicated by GELAR, since the images from that period are of poor quality - would undoubtedly require an even greater investment than that invested in SICAR.

In the *Amicus Curiae* request formulated by the Attorney General's Office of the State of Santa Catarina to the STF, it is further alleged:

> Finally, from an economic point of view, we must consider that not only in the state of Santa Catarina but also in other states, many of the areas in dispute are now occupied by schools, industries, shopping malls, supermarkets, hospitals, among others. Thus, any decision to be handed down by this Court must also consider the financial and budgetary impact it will have.

The interpretation disregards that the legal provision deals exclusively with the continuity of agroforestry, ecotourism, and rural tourism activities.

In addition to the confusion in the prosecutor's argument, there is a legal imbroglio for joining the PRA. Section II (Consolidated Areas in Permanent Preservation Areas) is an integral part of Chapter XIII (Transitional Provisions) of Law No. 12,651/2012 (Brasil, 2012), which provides for the possibility of authorizing the continuation of agroforestry, ecotourism, and rural tourism activities in PPAs in rural areas consolidated before July 22, 2008. However, this authorization is not automatic; it depends on adherence to the PRA.

It is important to highlight the distinction between the CAR and the PRA, both provided for in Law No. 12,651/2012 (Brasil, 2012). While the CAR is a nationwide electronic public registry, mandatory for all rural properties (Art. 29), the PRA is optional, and the interested party must apply for membership to the competent SISNAMA body (Art. 59, § 3º). The original wording of the law stipulated that the Federal Government, the states, and the Federal District should, within one (1) year from the date of publication of the law, which can be extended once for an equal period by an act of the Chief Executive, implement PRAs for rural properties and possessions (Art. 59). The Union did not issue an act extending the deadline, so it expired on May 25, 2013. As this legal deadline was not observed, in 2019, 6 years after the expiry of the legal deadline, the provision was amended, with a new wording for Art. 59 given by Law No. 13.887/2019 (Brasil, 2019), now eliminating any mention of deadlines, but adding that, if the states and the Federal District do not implement the PRA by December 31, 2020, the owner or possessor of rural property may join the PRA implemented by the Federal Government (Art. 59, § 7º). However, the Federal Government did not implement the PRA, and Decree No. 7,830/2012 (Brasil, 2012) revoked Decree No. 7,029/2009, which had established the Federal Program to Support the Environmental Regularization of Rural Properties, called the "Mais Ambiente Program". In other words, the Union is sending the administrator an alternative it did not make possible.

In Santa Catarina, the PRA was implemented through Decree No. 402 of October 21, 2015 (Santa Catarina, 2015), outside the legal deadline set by Law No. 12,651/2012 (Brasil, 2012). Even so, the decree also set a deadline of one year to join. Thus, in Santa Catarina, since 2016, there has been no legal provision for opting to join the PRA. This scenario of legal disputes and low priority for implementing environmental recovery policies illustrates the need for academia to influence society with scientific information that favors easy-to-understand language in line with the main challenges of the Anthropocene. What are the costs of the PRA not being implemented in terms of climate change

mitigation and water supply? Who are the most vulnerable to the changes generated by degraded areas?

### *3.5. Principle 3: Prefer policies that do not compromise the future*

In this principle, political action is justified by considering its clear benefits without entering into controversies or uncertain relationships (Polasky *et al*., 2020). Does anyone question the need for humanity to invest in energy efficiency to improve air quality and reduce carbon emissions? This section will focus on tragedies resulting from the effects of the suppression of vegetation cover. We argue that just the result of preventing disasters, such as landslides and flooding, would justify adopting PPA limits, including the precautionary principle.

In the Anthropocene, coastal communities are at the mercy of multiple interacting exposures, leading to the need to plan adaptive strategies (Bennett *et al*., 2016). Globally, disaster risk reduction perspectives have incorporated ecosystem-based approaches, for example, in the United Nations' post-2015 agenda (SFDRR, 2015) and the Paris Agreement on Climate Change (UNFCCC, 2015).

The need to maintain coastal ecosystems in order to reduce the risk of natural disasters did not stop the government from sanctioning Santa Catarina's environmental code (Law 14.675/2009) in April 2009 (Santa Catarina, 2009), reducing the PPA strips along watercourses to a mere 5 meters wide on rural properties of up to 50 hectares. In addition, the Santa Catarina Code already provided that all irregularities committed under the New Forest Code of 1965 would be forgiven. According to Girardi & Fanzeres (2010), the enactment of Santa Catarina's Environmental Code had negative effects, including raising expectations of a change in federal legislation and failing to promote the restoration of its areas. Also, according to these authors, no scientific study supported the Santa Catarina environmental code.

The situation is repeated in 2021, with the government of Santa Catarina taking a position against compliance with the Atlantic Forest Law based on inaccurate information with no ecological basis. In addition to adopting the concept of a consolidated rural area, one of the main planks of the rural caucus, several other factors of extreme importance for the socio-economic and environmental sustainability of the state were disregarded. It is worth noting that in 1986, the National Congress extended the national limits of PPAs along rivers due to the commotion caused by the great floods of 1983 and 1984 that devastated Santa Catarina. The rapporteur of the bill to revise the New Forest Code in the Senate (who was once governor of the state) stated emphatically that the text does not propose amnesty for anyone, "especially those who have committed environmental crimes, consciously or unconsciously, in order to obtain illicit advantages" (Senado, 2011).

Medeiros (2013) points out that in the application of a general national standard defining minimum marginal strips for the protection of a river or watercourse, the width of these strips needs to contemplate a set of functions, even if, in isolation, each of these functions is only partially contemplated. Here, it is worth highlighting the correct constitutional guideline that makes the states responsible for complementing the national rule, exercising their supplementary competence to meet specific needs that a general rule cannot

cover. Following this guideline, the marginal strips defined in Law No. 12,651/2012 (Brasil, 2012) are considered the minimum parameter, even though, in certain situations, this minimum width is not enough to meet all the environmental functions assigned to them adequately. In the case of the Atlantic Forest, there is a twofold commitment to relativizing the requirement for minimum standards of protection: the entire biome is seriously threatened, and the negative impacts resulting from the removal of these strips of protection along the rivers is a recurring cause of countless and repeated economic and social losses.

Referring to the process of revising the Forest Code, completed in May 2012, Medeiros (2014) points out that the source of the conflicts is non-compliance with the norm. The previous rule (Law No. 4.771/1965) (Brasil, 1965) created restrictions on property rights, establishing the PPAs and the Legal Reserve. According to the author, at the mercy of an exacerbated patrimonialism, the coercion created by Law No. 4.771/1965 (Brazil, 1965) was neglected and did not generate the desired responsibility. The demand to adapt to the terms of the law proved to be "unfeasible", legitimizing all the political pressure to revise the rule.

According to Bourscheit (2016), the text of Law No. 12,651/2012 (Brasil, 2012) has, in practice, greatly reduced restoration in the Atlantic Forest. The so-called "little ladder", which linked the area to be recomposed to the size of rural properties, simply released countless properties from the obligation to recover huge APPs and Legal Reserves, compromising ecosystem services.

In this context, disregarding the requirements of the Atlantic Forest protection rules from 1990 to 2008, allowing all irregular interventions in PPAs in the Atlantic Forest to be considered consolidated rural areas, further weakens the environmental framework and the democratic rule of law itself.

During the process of revising the New Forest Code, the working group formed by the Brazilian Society for the Advancement of Science (SBPC) and the Brazilian Academy of Sciences (ABC), after consulting more than three hundred scientific publications on the subject, warned that all PPAs along rivers should have their vegetation preserved. Those where this vegetation has been degraded should be fully restored. The document from this working group advocated removing the definition of consolidated rural area from the text of the law (Senado, 2011). The minimum size of riverbank protection has clear economic benefits for society and is recognized as a Nature-Based Solution (NBS) to disasters caused by flooding and erosion. There is no scientific controversy here, only political interests on the part of representatives of a backward, developmental sector linked to big business.

### *3.6. Principle 4: Identify the general problem scenario*

Called "Seeing the forest for the trees" by the authors, this principle emphasizes the need for scientific information to identify the general scenario of the problem through simple models without going into the specifics that represent smaller problems (Polasky *et al*., 2020). Complex issues such as climate change, when presented to society, are often dealt with in detail, making it difficult to clearly understand the causes of the phenomenon and ways to combat it. Here, we emphasize the risks of setbacks in environmental legislation based on

two simple observations about the Atlantic Forest of Santa Catarina: the loss of biodiversity and the containment of water oscillation (scarcity and flooding).

Santa Catarina's vegetation has been exploited solely for economic development for decades. Today's forests are remnants that have generally changed their original structure and currently have different phytosociological characteristics to those presented in past studies (Schorn *et al*., 2012; Reis *et al*., 2012). In addition to the reduction in forest cover in all regions of the state, there is also a reduction in the population of wild flora and fauna, reducing the genetic variability of the remaining populations (Reis *et al*., 2012).

Among the main threats to the Atlantic Forest in Santa Catarina are the advance of the real estate sector on the coast, the construction of major infrastructure projects such as hydroelectric dams and soybean plantations, and reforestation with exotic species such as pine or eucalyptus (Medeiros, 2006).

The hydrographic network of the state of Santa Catarina, in turn, is quite extensive and is represented by two independent drainage systems: the integrated inland slope system, with an area of approximately 60,185 km$^2$, led by the Paraná-Uruguai basin, and the Atlantic slope system, with an area of approximately 35,298 km$^2$, made up of a group of isolated basins (Santa Catarina, 1986).

The state's river basins have a relatively high drainage density. The regimes of Santa Catarina's rivers are mostly controlled by the rainfall regime, historically characterized by rainfall distributed throughout the year (Santa Catarina, 2018). With the effects of climate change, this regime has been altered, making periods of water scarcity more frequent and prolonged, as well as events of excessive rainfall in short periods. Restoring riparian vegetation, regardless of legal requirements, is an Ecosystem-Based Adaptation measure (Long *et al.*, 2015). The damage to the agricultural sector is evident, which invalidates the argument defended by the Attorney General's Office of the State of Santa Catarina in its request to join as *Amicus Curiae* in ADI No. 6.446/DF (AGU, 2020) since economic losses resulting from the excessive and unregulated use of natural resources are imposing a significantly higher social and economic cost.

In the 1980s, the IMA itself pointed out that water resources in Santa Catarina were in a worrying situation, with around 80% of the water in Santa Catarina compromised by heavy metals, pesticides, effluents, and urban and industrial waste (Santa Catarina, 1986). In the current scenario, this situation shows clear signs of worsening since, in recent decades, deforestation in the state has not been contained, consumption of natural resources has increased (notably water), and variations in the regional climate regime have accentuated extreme events with a major negative impact (SOS Mata Atlântica, 2020).

Habitat loss caused by changes in land use, climate change, and the accumulation of phosphorus or nitrogen pollution due to crop leaching are among the main threats to biodiversity on all continents and are equally decisive in Santa Catarina. The global scenario requires essential transitions towards sustainable pathways, and according to the Convention on Biological Diversity (CBD, 2021), each of the conditions necessary to achieve the 2050 Vision for Biodiversity requires a significant change in the current patterns of a wide range of human activities.

The indiscriminate and unsustainable exploitation of timber led to the depletion of stocks, generating an economic recession in the sector in

the state from the late 1980s onwards (Sevegnani *et al.*, 2013). The effect of this exploitation on biodiversity has been devastating: around 30% of the species sampled in the forests by the Floristic and Forest Inventory of Santa Catarina have fewer than ten individuals in Santa Catarina (Vibrans *et al.*, 2012). Currently, the agricultural and silvicultural matrix in the state is permeated predominantly by small isolated fragments of native vegetation, which has generated adverse consequences such as edge effects and reduced connectivity between these fragments, isolating many species and limiting gene flow (Sevegnani *et al.*, 2013). The connectivity generated by the restoration of PPAs is a strategy sought to reduce these impacts. This indicates that if the interpretation that all PPAs in Santa Catarina that had irregular vegetation suppression between 1990 and 2008 are regularized as consolidated rural areas prevail, there will be a compromise in efforts to conserve biodiversity and maintain the quality of water resources, as well as an increase in the harmful effects of climate change.

## *4. Conclusion*

In the Anthropocene, political action without a scientific basis or disregarding an understanding of critical factors tends to lead humanity down undesirable causal paths. The perspective of clarity corridors addressed here favors the interface between science and politics needed to respond to society's demands in a period of unprecedented global environmental change.

The data presented in this paper, which comes from a survey of legislation protecting the Atlantic Forest Biome and administrative acts issued by the previous government (2018-2021), shows that the movements sponsored by the federal and state governments threaten the national heritage status conferred on the Atlantic Forest biome. The intended submission of the Atlantic Forest Law to the terms of a general rule such as the Native Vegetation Protection Law, even about the latter's transitional provisions, was made explicit with the publication of MMA Order No. 4,410/2020. Even though it was repealed after reactions from society, the federal government continued to insist on this demand by filing ADI No. 6.446 with the STF, asking the Court to declare the legal interpretation that superimposes the special protection regime for the Atlantic Forest on the general rules of the Native Vegetation Protection Act null and void. The government of Santa Catarina is joining this lawsuit, requesting admissibility as *Amicus Curiae* in the case.

Following an injunction issued by the 6th Federal Court in Santa Catarina, IMA and IBAMA were ordered to refrain from canceling environmental infraction notices, embargo and interdiction notices, and seizure notices issued throughout the state of Santa Catarina based on the finding of unauthorized suppression, cutting or use of remaining vegetation in the Atlantic Forest biome, based on the understanding established by MMA Order 4.410/2020. The reaction of the state of Santa Catarina, through the IMA, was to ask for the injunction to be suspended, claiming that it threatened the economic and public order. The TRF of the 4$^{th}$ Region granted the request, and as a result, in practice, the interpretation of a revoked order (4.410/2020/MMA) was maintained.

The combination of these episodes with the fact that Santa Catarina has a large number of small rural properties, but 42.7% of its territory is linked to large rural properties, shows that the government

is subverting the constitutional logic, submitting the guarantee of the common right to an ecologically balanced environment to the economic interests of sectors of Santa Catarina society.

The state of Santa Catarina further aggravates this situation, and the federal government has failed to comply with federal legislation regarding the regular implementation of PRAs. As a result, the state is failing to implement a program that could significantly improve environmental conditions. This becomes more evident when you realize that most of the vegetation deficit in the PPAs is associated with areas of water resources (springs and the banks of watercourses).

By insisting on maintaining irregularly converted PPAs and not implementing the means to advance the restoration of these areas through the implementation of the PRA, the Santa Catarina government is compromising a constitutional right of the people, increasing the threats to an already seriously compromised biome, with potential damage to the conservation of biodiversity and strategic natural resources, thus taking a position that conflicts with the main current trends, which call for public policies that can mitigate or provide conditions for adapting to the challenges brought about by global climate change.

The assessment presented here also allows us to conclude that the political orientation of the federal and Santa Catarina state governments so far also increases the risks of a worsening economic crisis since productive activities depend on the availability of natural resources, ecosystem services, climate viability, and legal certainty.

In the middle of the Anthropocene, it is not plausible to defend policies that make it impossible to conserve biodiversity, maintain the quality of water resources, and amplify the harmful effects of climate change plaguing the state.

## *Acknowledgments*

We thank geographer Márcio Silva for his excellent work in producing the location figure and vegetation map of the Atlantic Forest. His efforts have certainly been of great help in understanding the geography and vegetation of this unique ecosystem.

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