Perspectives in Ecology and Conservation 21 (2023) 1–5

ABECO
ASSOCIAÇÃO BRASILEIRA DE CIÊNCIA ECOLÓGICA E CONSERVAÇÃO

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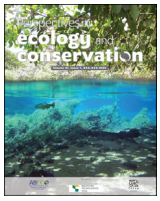

Policy Forums

Governance lessons from the Atlantic Forest to the conservation of the Amazon

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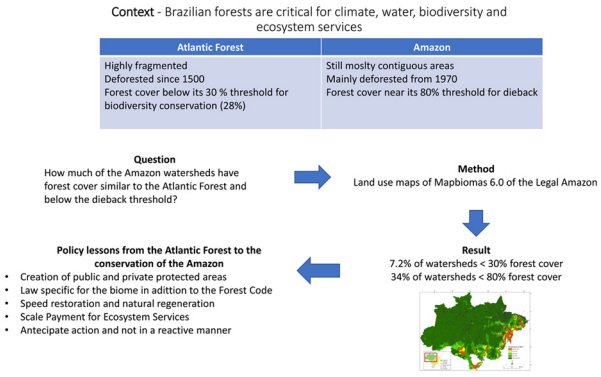
HIGHLIGHTS

- More than 12% of the watersheds of the Brazilian Amazon already have or are approaching natural forest cover below 30% and more than a third have below 80%.
- Regions of the Amazon already forest cover below the average of the Atlantic Forest.
- We propose learning policy lessons from the Atlantic Forest to avoid the same trajectory as the Amazon.
- They need to be implemented urgently to stop the route towards its tipping point, address the climate emergency and assure the provision of ecosystem services.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 13 May 2022
Accepted 28 October 2022
Available online 30 November 2022

Keywords:
Biodiversity
Climate
Deforestation
Ecosystem services
Policy
Restoration

ABSTRACT

Brazilian forests critical are for climate, water, biodiversity, and ecosystem services. The Atlantic Forest and the Amazon are among the most important tropical forests of the world but have different conservation status. The first is below its minimum threshold for biodiversity conservation while the Amazon is approaching its dieback threshold. Aiming to examine policy lessons from the Atlantic Forest which could be applied to the conservation of the Amazon, we first analysed the forest cover of basins of the Amazon compared to the reality of the Atlantic Forest. We found that regions of the Amazon already have forest cover similar to the Atlantic Forest and that 34% of them are below the dieback threshold. We propose policy lessons to avoid that the Amazon follow the same route of the Atlantic Forest and concluded that they need to be implemented urgently in a precautionary approach.

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https://doi.org/10.1016/j.pecon.2022.10.004

Introduction

Brazil has the largest area of tropical forests in the world (Turubanova et al., 2018). Its protection is fundamental to mitigating climate change and conserving biodiversity and freshwater on the planet (Jung et al., 2018), putting the country in a position of global environmental leadership (Ferreira et al., 2014). Despite this, Brazil has the largest loss of tropical forest area and the highest emission of forest carbon in the world (Zomer et al., 2016; Harris et al., 2021).

The Atlantic Forest is the most deforested biome in the country, where 29% of its original forest cover remains (Mapbiomas, 2021). Its threatening state is a result of the occupation of Brazil since the arrival of the Europeans in 1500 and the economic cycles since them. For States like São Paulo, Minas Gerais and Espírito Santo forest cover was below 10% of its original area by 1980 due to past history and high deforestation rates after the 1950 decade (Fonseca, 1985). Despite existing large areas with continuous fragments concentrated in a few regions, most of them are unevenly distributed, smaller than 50 ha, and occuring in private lands (80%) — Ribeiro et al. (2009). Any further deforestation puts at great risk the already highly endangered biota of this biome, which is considered a biodiversity hotspot (Myers et al., 2000). Restoring it is a priority to mitigate and adapt to climate change and assure the provision of ecosystem services to 70% of the Brazilian population, such as water for various purposes, including hydroelectricity production (Guedes Pinto and Voivodic, 2021).

Contrary to the Atlantic Forest, large-scale deforestation in the Amazon started only in the past few decades, mainly from 1970s. Due to this relatively recent trajectory of land use, around 80% of the region is still covered by its original vegetation in contiguous forests (PRODES, 2021). Across 2021, over one million hectares have been deforested, consisting in the highest deforestation rate in the last decade (PRODES, 2021). The combination of widespread deforestation and forest degradation has been associated with loss of resilience, risking dieback with profound implications for biodiversity, carbon storage, and climate change on a global scale (Boulton et al., 2022).

Here we examine policies developed aiming to contribute to the conservation of the Atlantic Forest and draw lessons to improve and design policies to the conservation of the Amazon, thus helping to conserve Brazil's forests. Such lessons also bring insights to review and strength policies to a new cycle of conservation of the Atlantic Forest. To support it we analysed the forest cover of basins of the Amazon compared to the reality of the Atlantic Forest. Despite the climate urgency to maintain the Amazon Forest cover above its dying back threshold, we investigate if parts of the biome have already reached the critical level of the Atlantic Forest.

We used Mapbiomas (Souza et al., 2020) collection 6.0 and estimated the forest cover of each basin of the Amazon, following level 5 of the classification of otto watersheds of the Brazilian Water Agency (ANA). We have grouped them into four forest cover classes, giving particular attention to areas of a minimum of 30% and 80% of forest cover. These thresholds were chosen for comparative purposes, being the lowest the threshold for forest habitat for the Atlantic Forest (Banks-Leite et al., 2014) and the highest, the most conservative risk limit for reaching the tipping point for the Amazon basin (Nobre et al., 2016).

We found that 7.2% of the watersheds (514), corresponding to 4.1% of the biome area already have less than 30% of the original native vegetation cover, and other 5% (357) or 3.7% of the area are approaching this threshold. These areas with critical low forest cover are in West Maranhão, South Pará, North Mato Grosso, and Rondônia, also known as the Arc of Deforestation (Fig. 1). Strikingly, these figures are similar to many regions of the Atlantic Forest that have been under intense anthropogenic use for hundreds of years (Marques and Grelle, 2021). Besides, 34% of the watersheds (2398) have less than 80% of their original forest cover and are moving towards the overall threshold of the biome. In addition to global impacts, it may end in local impacts connected to ecosystem services already faced in the regions of the Atlantic Forest with low forest cover, such as shortages in water supply and risk of energy blackout (Getirana et al., 2021). It may also result in a high level of endangered species as observed in the Atlantic Forest due to deforestation and loss of habitat (Marques and Grelle, 2021). Besides, regions of the Arc of deforestation, such as southeastern region of Pará, are already experiencing changes in the patterns of the dry and rainy seasons and has compromised services related to carbon sequestration. (Gatti et al., 2021; Leite-Filho et al., 2019).

Governance lessons

The Amazon has had one of the most successful initiatives to control forest loss in the tropics which resulted in a reduction of 80% in deforestation rates from 2004 to 2012. It was mostly a result of an integrated federal public policy plan — PPCDAm (Action Plan for the Prevention and Control of Deforestation in the Legal Amazon) and market tools to control the expansion of commodities (Soares-Filho and Rajão, 2018). Such a plan was abandoned by previous federal administrations and the current one has also weakened environmental policies which have resulted in the growth of deforestation rates for both biomes (Mapbiomas, 2021). But besides reactivating the principles of PPCDAm, lessons from successful and limited governance policies of the Atlantic Forest may be learned to build a path for the long-term conservation of the Amazon.

First, it is important to reinforce the need to create large contiguous protected areas in regions which still have high forest cover in public lands. The largest portion of conserved Atlantic Forest is a successful result of such strategy. The region called *Reserva da Mata Atlântica* in the States of São Paulo and Paraná protects around 2 million hectares in a mosaic of public protected areas and concentrates the largest portion of continuous forest of the biome (Pinto and Hirota, 2022). A similar successful strategy was implemented in the Amazon to protect large portions of forest threatened by the construction of roads, dams, and other infrastructure in the early 2000s and was fundamental do reduce deforestation in the 2004–2013 period (Ferreira et al., 2014). Despite such progress the Amazon still has large areas of undesignated public lands, which are one of the main frontiers of land grabbing and deforestation (Azevedo-ramos et al., 2020). A new cycle of creation of large pieces of protected areas in those lands should be a top priority to control deforestation. However, as there is very little amount of undesignated public lands in the Atlantic Forest (Sparovek et al., 2019), such strategy does not have potential to the conservation of this biome anymore.

Second, the creation of protected areas in the hotspots of deforestation, particularly in critical areas with little remaining forest cover identified by our study should be complementary to the large contiguous ones. In regions where most of the land is private, conservation should be complemented by private reserves. This was successfully applied in the Atlantic Forest, where hundreds of Private Reserves of Natural Heritage (RPPNs) were created and have had an important role to locally protecting endangered species (Rambaldi et al., 2005). Such strategy could still be expanded to the Atlantic Forest and has potential to be replicated to the regions of the amazon we identified with low forest cover and which have the dominance of private lands.

Third, other policy tools are needed in addition to the Native Vegetation Protection Law to reduce deforestation, as it allows legal forest conversion. The Atlantic Forest Law, published in 2006, a unique law to protect a biome in Brazil, has had a critical role

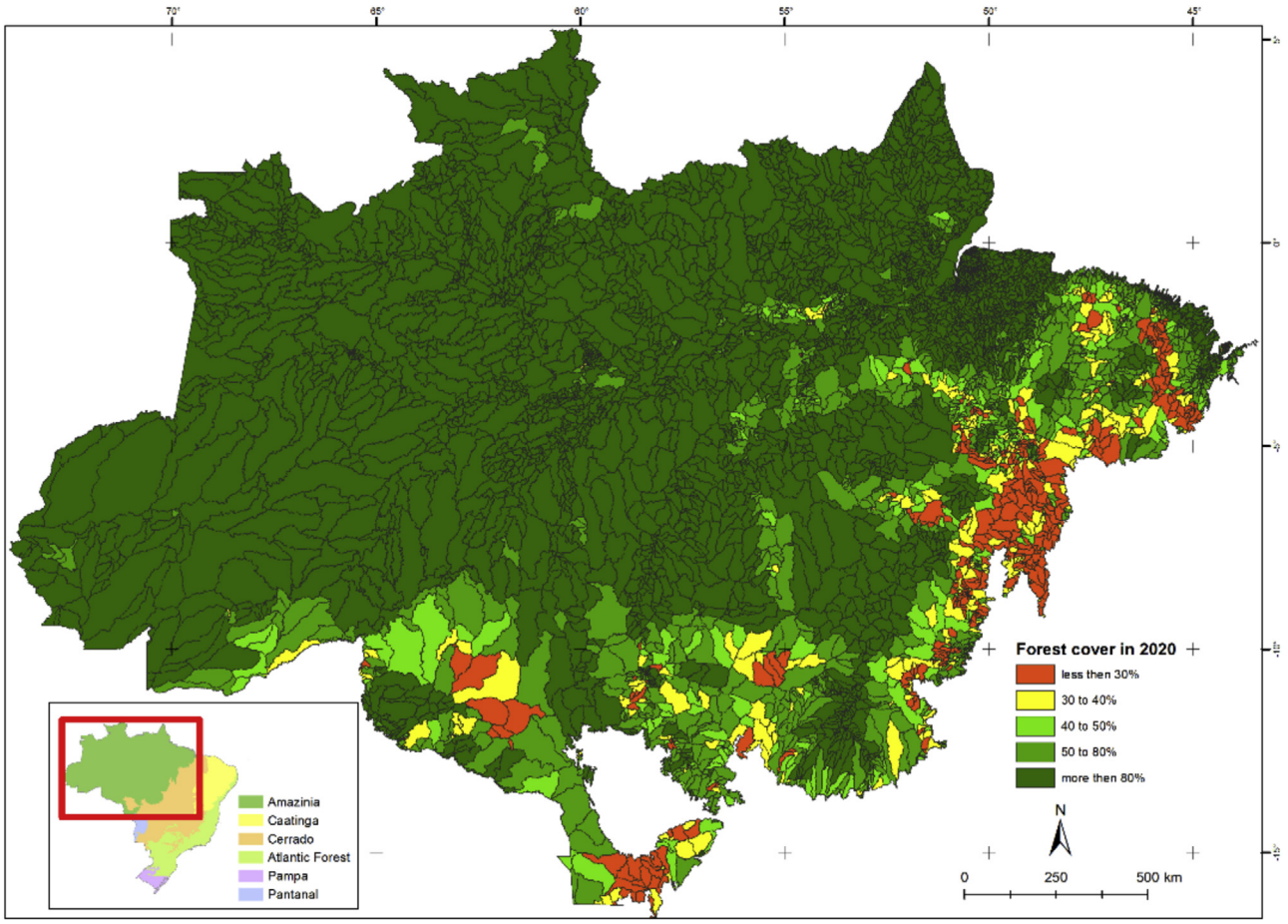

Fig. 1. Basins of the Legal Amazon and their proportion of original native vegetation cover.

to reduce deforestation beyond the threshold determined by the Native Vegetation Protection Law (Catherine et al., 2021). According to this legislation, deforestation of advanced successional stages only is authorized in case of public interest or social purpose and must be compensated. However, it is not a zero deforestation law, as it also allows cutting of forests in initial successional stages, what partially explains why one third of forest regeneration is lost and end of deforestation is not achieved in the biome (Piffer et al., 2022). The very critical situation of the biome, the current climate emergency and the zero deforestation commitments signed by Brazil require a review of the Atlantic Forest Law to become a Zero deforestation one. As the same context of climate emergency and international commitments applies to the Amazon, the lessons of successes and limitations of the Atlantic Forest Law should subsidize a similar law to the Amazon, designed considering the current knowledge, the political context, and the ecological and socioeconomic reality of the biome. It could be central to interrupting its deforestation trajectory and achieving zero deforestation.

While avoiding forest loss should be the absolute priority, restoration needs to be scaled and speeded by the Forest Code. There are 6.8 million ha of lack of native vegetation in the Atlantic Forest and 4.7 million ha in the Amazon regarding compliance with Forest Code. At least 4.1 million ha of riparian forests need to be restored in the Atlantic Forest and 1.1 million ha in the Amazon to comply with the requirement of Permanent Preservation Areas (Guidotti et al., 2016). But restoration must consider the need of planting trees as opposed to natural regeneration for each region. Given the burdens of the Atlantic Forest in doing effective and upscaled restoration, an important lesson is to implement it before a high level of degradation and fragmentation is achieved. This strategy is key to gaining the benefits of natural regeneration and avoiding investing in high-cost tree planting, necessary in highly degraded and fragmented lands, as in the case of many areas of the Atlantic forest (Niemeyer et al., 2020).

Thus, the advantage of the regeneration potential of the Amazon needs to be used urgently. But although natural regeneration is widespread in the Amazon region (Smith et al., 2021), some areas that are already very degraded are diminishing such capacity (Reis et al., 2022), going in the same route of the Atlantic Forest. As evidence, Farneda et al. (2018) found that approximately 30 years of matrix regeneration were insufficient for functional diversity to recover to the same levels as in continuous forest in the Amazon. Legislation for protecting regeneration areas is also very important, as one launched in Pará state in 2015 (SEMAS, 2015) that could be expanded for the other Amazonian states and be replicated to improve the Atlantic Forest Law, as areas regenerated with less than 10 years have limited protection of this Law and have also been cut (Piffer et al., 2022). Restoration following the Forest Code is also crucial to connect remaining fragments and biodiversity in the Atlantic Forest (Grelle et al., 2021) and may play the same role for the highly degraded regions of the Amazon we identified.

Complementary mechanisms, such as Payment for Environmental Services may also speed restoration. The main experiences of the Atlantic Forest are related to water supply, which have been locally effective but so far not enough to achieve conservation goals on a large scale (Ruggiero et al., 2019). Thus, more effective market incentives are needed to be effective in the Amazon and would need to consider and value other assets than water, like biodiversity.

Additional private governance mechanisms like certification and standards for commodities also play different roles in each region, having a higher scale of adoption and driving a positive agenda in the Atlantic Forest while in the Amazon it is less implemented and mostly acting in a no harm approach (Hajjar et al., 2019).

Despite the limitations of the effectiveness of policies to protect and restore the Atlantic Forest and its limitations to contribute to policies to the Amazon, relevant achievements also must be highlighted. The pioneer monitoring of the biome jointly conducted by SOS Mata Atlântica and INPE, the approval of the Atlantic Forest Law, and other efforts resulted in a sharp decrease in deforestation rates in the past decades, from an average loss of 100,000 ha per year in 1990s to reach bellow 12,000 ha in 2018 (SOS Mata Atlântica, 2021). At the same period regeneration rates increased substantially (Rosa et al., 2021) and a collective initiative was organized to restore the biome — *Pacto pela Restauração da Mata Atlântica* (Crouzeilles et al., 2019) becoming also a reference to the restoration of the Amazon and being an alternative for job creation and income generation (Brancalion et al., 2022). The same occurs for the Amazon where a positive agenda which considers territorial planning, bioeconomy, traditional knowledge among other issues has been intensively studied and proposed for the biome (Concertacao pela Amazonia, 2022).

Finally, the status of the Atlantic Forest may mislead to the simple nexus between deforestation, economic growth, and development. However, the same pattern of boom-bust of human development found in the Amazon deforestation frontier (Rodrigues et al., 2009) was described for the cycles of historical occupation of the Atlantic Forest from the 16th until the 20th century (Dean, 1995). The development of this region was a result not only of land use change but also of industrialization and a dynamic sector of services from the 1950s. An example is the Paraiba Valley of the State of São Paulo, where a strong industrialization process took place after the boom-bust of the coffee cycle (Silva et al., 2017). Such example confirms the Environmental Kuznet Curve (EKC) and the economic development hypothesis of forest transition for middle income countries like Brazil (García et al., 2021).

But despite the relevance of all the previous learnings, the main lesson from the Atlantic Forest to the Amazon is about timing and the gap between knowledge advance, policy formulation and implementation. Governance and protection have increased over time in the Atlantic Forest but always in a reactive manner and behind the pressure, being possible only to minimize impacts after they occurred. Most of the policy examples we mentioned and lessons we raised have worked partially or in a limited way to protect the Atlantic Forest because they have been implemented too late, have not been fully enforced or also because they were formulated in a different time and context. Many were developed before the climate crisis and the current understanding of exhaustion of ecosystem services and our dependence on them. With a new context, knowledge progress and lessons of what has worked and has not worked for the Atlantic Forest, the protection of the Amazon must not repeat the same path as the climate emergency does not allow the same route. Governance proposals, such as the ones outlined here, need to be formulated and implemented immediately, anticipating all the foreseen problems. As we have shown here, for some Amazonian regions it is already late, and degradation does not need only to be stopped but reversed.

Declaration of interests

The Chief Editor of the Journal also is a Board member of SOS Mata Atlântica, which is the organization of first author of the manuscript.

Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgments

We thank Lera Miles, from WCMC-UNEP, for participating in the design of the research and reviewing preliminary versions of the manuscript. We thank the contributions of two Editors and three Reviewers to improve our manuscript.

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