

## OPINIÃO

### Contribution of southern Brazil to the climate and biodiversity conservation agenda

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**Implications:** We highlight the importance of the South Brazilian grasslands and the Araucaria Forest formations located in the Pampa and Atlantic Forest Biomes and their associated coastal and estuarine environments for the conservation of biodiversity, carbon storage and maintenance of significant ecosystem services. We reinforce the need to strengthen research institutions on the environment and the broad participation of different segments of society in the southern region of Brazil to change the course of environmental policies, highlighting the potential of the states of Rio Grande do Sul, Santa Catarina and Paraná on national and international agendas on biodiversity and climate.

**Palavras-chave:** Araucaria Forest, Coastal and estuarine environments, importance of research institutions, Pampa, public policies, South Brazilian grasslands

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**Implicações:** Destacamos aqui a importância dos ecossistemas Campos Sulinos e Floresta com Araucárias, formações localizadas nos Biomas Pampa e Mata Atlântica, e de ambientes costeiros e estuarinos associados para a conservação da biodiversidade, armazenamento de carbono e manutenção de serviços ecossistêmicos significativos. Reforçamos a necessidade de fortalecer as instituições de pesquisa em meio ambiente e a ampla participação de diversos segmentos da sociedade da região Sul do Brasil para a mudança dos rumos das políticas ambientais, destacando as potencialidades dos estados do Rio Grande do Sul, Santa Catarina e Paraná nas agendas nacionais e internacionais sobre biodiversidade e clima.

**Palavras-chave:** Ambientes costeiros e estuarinos, Campos Sulinos, Florestas com Araucária, importância das instituições de pesquisa, políticas públicas, Pampa

## Presentation

On the occasion of the discussion of a climate cooperation agreement between the USA and Brazil and facing the opportunities of conservation and restoration derived from the outcomes of the recent Glasgow Climate Change Conference (<https://unfccc.int/conference/glasgow-climate-change-conference-october-november-2021>), we joined the manifestations of various sectors of both the Brazilian society and the international community<sup>1,2,3</sup> that warn of the risks of an agreement developed without broad participation of the different segments of Brazilian society, as well as not considering regional demands represented by markedly distinct ecosystems found among Brazilian states. We emphasize that the society's demands to the environment, science, human rights and democracy are demands of national interests and need to be considered in all debates about the environmental agenda.

With this paper we present an overview of how institutions and society in the southern part of Brazil can contribute to a change in direction in environmental policies. This recognizes the high relevance of the region for biodiversity conservation and carbon storage. We focus on the two major ecosystems found in the states of Rio Grande do Sul, Santa Catarina and Paraná, namely the South Brazilian grasslands and the Araucaria Forest, both of which give the region a common cultural and ecological identity. We add the associated coastal and estuarine environments. We raise our voice due to the fact that the southern part of Brazil has been overlooked in national and international policies for biodiversity and climate.

Never before has so much biodiversity been lost in historical times in the world as it has been in recent decades. This is also true for southern Brazil, a region with very high biodiversity that has been historically neglected in conservation<sup>4</sup>. The predatory way of production in some sectors of the Brazilian economy, especially in agriculture, makes Brazil one of the countries with the highest rate of biodiversity loss in the world. In consequence, the international community demands that the country changes its path and establishes long-term commitments to effectively reduce

environmental degradation, to implement sustainable practices in its land use systems and to combat global warming.

## The South Brazilian grasslands

The South Brazilian grasslands (*Campos Sulinos* in Portuguese) are part of the largest continuous grassland region of the Neotropics. They include, in the South, the grasslands of the Pampa and, in the North, the grasslands in the highlands of the Atlantic Forest region. These ecosystems are among the most biodiverse grasslands in the world, with high diversity both at the local level (for instance, a record of 56 plant species of plants in a single square meter in the municipality of Quaraí<sup>5</sup>), as well as at the regional level, with clear floristic and ecological differences between and within major regions<sup>6</sup>.

The southern part of the South Brazilian grasslands, the "Pampa Biome", covers 178,000 km<sup>2</sup> and is restricted to the state of Rio Grande do Sul. While it corresponds to only 2.07% of Brazil's territory, it shows high biodiversity. For instance, the Pampa holds more than 3,500 plant species<sup>7</sup>. In the last decades, more than two million hectares of native grasslands of the Pampa have been converted into crops, planted pastures, and forestry (data from MapBiomas). Per year, 125 thousand hectares of natural ecosystems are lost. This process results from the recent increases in the value of agricultural commodities which stimulated the cultivation of soybean in a region historically dedicated to extensive livestock farming on natural grassland: areas planted with soybean have increased by 188.5% between 2000 and 2015. It also is the result of policies that encourage the monoculture of exotic trees, attracting international companies. In contrast, grazing on natural grassland is a type of land use that has been shown to allow conciliation of conservation of regional biodiversity and economic interests<sup>8,9</sup>.

The highland grasslands, situated within the Atlantic Forest region, a biodiversity hotspot, occupy about 13,000 km<sup>2</sup>. They occur naturally in mosaics with Araucaria Forest (see below), forming a unique landscape of high scenic beauty and with high socioecological and cultural values. The highland grassland stands out for its high species richness and expressive endemism: 273 plant species are endemic and thus globally restricted to this region<sup>10</sup>. This corresponds to approximately 25% of the grassland plants in the highland grasslands<sup>11</sup>. These grasslands are also an important habitat for many animal species. At least 21 species of vertebrates can be considered endemic to South Brazilian grasslands. Some endemic species, such as several species of annual fish of the genus *Austrolebias*, found in the region's rivers and creeks, and some amphibians of the genus *Melanophryniscus*, have very small areas of occupation, with a few tens of square kilometers or less, and are critically endangered. The region is extremely important for migratory bird species, including some from North America (genera *Pluvialis*, *Bartramia*, *Calidris*, *Hirundo*, among others).

Many species threatened with extinction depend directly or indirectly on the maintenance of these natural ecosystems in southern Brazil<sup>12</sup>.

The South Brazilian grasslands provide important ecosystem services, such as nutrient storage and cycling, drainage and storage of rainwater and thus contributions to water balance and availability, soil respiration, provisioning of food for livestock, maintenance of pollinators and of predators of plant pests. The grasslands also contribute, under good practices of cattle rearing, to sequestration and storage of carbon in the soil, which helps to mitigate global climatic changes, among other roles<sup>13, 14</sup>. Records in the region show that the grasslands present the second highest average organic Carbon content in the soil in Latin America<sup>15</sup>.

Distinctly from the situation in northern Brazil, in the South Brazilian grasslands livestock raising occurs in natural grassland whose plant species co-evolved with large foraging herbivores, extinct 12,000 years ago<sup>16</sup>. The South Brazilian grasslands thus have a natural vocation for sustainable grazing practices, and extensive cattle rearing can contribute to biodiversity conservation<sup>17</sup>. It is reasonable to state that livestock farming in natural grasslands is among the most harmonic types of coexistence between humans and the environment in Brazil. However, the accelerated change in land use in the grasslands of the region has led to intensification of livestock farming systems, reducing the native grassland area. Without promoting appropriate policies, the scenario is replacement of natural ecosystems by crops, introduction of exotic forage grasses and degradation of grasslands due to over overgrazing<sup>18</sup>, ultimately leading to the disappearance of grasslands, their biodiversity and the ecosystem services they provide.

In response to the rapid land use change in the region, it is necessary to promote policies that support the restoration of degraded areas of the South Brazilian grasslands and the maintenance of sustainable land practices, including extensive cattle rearing. A basis for this are investments in research, rural extension, improving human resources, strengthening of the productive chain in the restoration sector and of social organizations. The current unavailability of native plant seeds for restoration actions is an example for the need for development of ecological restoration capacity in South Brazilian grasslands. At current, large-scale restoration of these grasslands is severely hampered. We need to include Brazilian non-forest environments in the priority agenda of conservation and restoration, especially as a way to attend the goals set by the United Nations (UN) which defined the current decade, 2020-2030, as the UN Decade on Ecosystem Restoration. Also, we need to support research and development activities to actually restore the grassland environment.

In addition, although the South Brazilian grasslands have a high potential for conservation through sustainable use, the creation of conservation units in the region is pressing. In the Pampa

biome, for example, only 3.3% of the territory is protected in conservation units, representing approximately 0.4% of the protected areas in the National System of Nature Conservation Units.

## The Araucaria Forest

The Mixed Ombrophilous Forest or Araucaria Forest is one of the three main forest formations of southern Brazil<sup>19,20,21</sup>. Until the beginning of the twentieth century, the Araucaria Forest was very representative in the landscapes of southern Brazil, covering much of the southern plateau. Its extent was about 200 thousand square kilometers in the states of Rio Grande do Sul, Santa Catarina, and Paraná<sup>22,23</sup>. *Araucaria angustifolia* is a key species of this forest: the main element in its physiognomy and the only species of the Araucariaceae family found in Brazil<sup>24</sup>. It plays an essential role in ecological succession and provides habitat for many other species. More than 50 species are associated with the occurrence of the Araucaria tree, and many of them have biological requirements which directly depend on this plant species. Moreover, this forest may be socially relevant in many rural areas<sup>25,26,27</sup>. The devastation of Araucaria Forest began with the colonization process in southern Brazil. In the last two centuries, with the advancement of urban areas, population growth, expansion of economic activities, and energy and road projects, the Araucaria Forest has been reduced to approximately 3% of its original area, and less than 1% of these forests can be considered primary. To make it worse, the remnants of this forest formation are small and are very fragmented, which contributes to their isolation and insulation.

Studies show the importance of the Araucaria Forest in maintaining the planet's climate. It is widely evidenced that the more advanced succession or regeneration stages of the forest accumulate a greater amount of biomass and carbon, due to the fact that there are individuals of greater diameter and height and, possibly, greater specific mass due to the age of the trees and the floristic composition richer species, reinforcing the importance of maintaining Araucaria Forest remnants in good condition<sup>28</sup>. Predictive models indicate that the increase in the temperature of the Earth can drastically reduce the habitats of occurrence of *Araucaria angustifolia* by 2070<sup>29,30</sup>.

Effective conservation measures include the expansion and implementation of protected areas in the Araucaria Forest formations, establishment of conservation programs integrated with agricultural approaches, including forest management strategies and restoration of degraded areas originally covered by Araucaria Forest.

## The aquatic environments

Rivers and lakes associated with Campos Sulinos and Araucaria Forest have high species richness of aquatic organisms, comparable to those found in the headwaters of the tributaries of the Amazon River<sup>31</sup>. Despite dense sampling of these areas, it is estimated that about 10% of the fish species of Rio Grande do Sul and Parana states remain to be described<sup>32,33</sup>.

Coastal and marine ecosystems, especially environments such as seagrass mats and submerged aquatic vegetation, have a well-recognized importance in capturing suspended matter and the associated organic carbon (blue carbon). Despite this fundamental role in the sequestration of carbon dioxide (CO<sub>2</sub>) and other ecosystem services, these ecosystems are being lost at critical rates and urgent action is needed to stop such losses<sup>34</sup>.

The coast of the state of Rio Grande do Sul extends over more than 600 km and includes about 170 km<sup>2</sup> of shallow estuarine areas - 70% of these formed by the Laguna dos Patos, the most extensive choked lagoon in the world<sup>35</sup>. These coastal environments, essential for the maintenance of aquatic biodiversity, have been undergoing drastic reduction and extreme fragmentation, resulting in changes in the structure of biotic communities. These changes are related to anomalous climatic events, but also to growing impacts associated with human activities, such as human occupation of the coastal zone, eutrophication, dredging, agriculture, pollution and predatory fishing practices. Bottom trawling, in particular, is responsible for displacing large amounts of sediment, destroying habitats, increasing water turbidity and releasing pollutants and carbon deposited under the ocean floor.

Through the document "Open letter to world leaders: Put marine ecosystems at the center of climate policy"<sup>36</sup>, experts emphasize that blue carbon is a golden opportunity: marine systems globally contain around 49 times the amount of carbon as is in the atmosphere. However, it is a major risk if left unprotected. They also warn that the current annual loss of seagrass is estimated to release around 299 million tonnes of carbon every year and that restoring and protecting our marine habitats as a central tenet of climate policy could play a key role in our salvation.

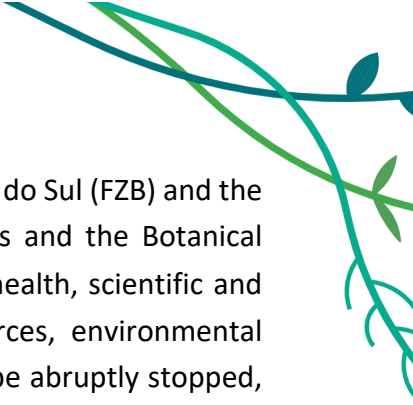
To plan and implement the conservation and restoration effort of these ecosystems with a view to reversing these impacts and reducing their effect on climate change, research is needed on coastal ecosystems with potential for carbon sequestration and changes in land use practices and other activities, including adequate fisheries management. To this end, on a regional scale, it is necessary that the states of Rio Grande do Sul, Santa Catarina and Paraná make effective commitments to policies that guarantee the sustainable management of the territory and the legal protection of these environments, in addition to structuring and strengthening bodies that can research, propose, monitor and inspect the necessary actions.

## The fundamental importance of strengthening research institutions and environmental policies, and of respecting non-governmental organizations

The elaboration of environmental agendas and the establishment of international agreements have not been sufficient for some signatory countries to be effective in planning and implementing actions to achieve the goals of sustainability, conservation of biodiversity and reduction in greenhouse gas emissions. It is undeniable that research institutions and the knowledge generated by them are crucial for development and monitoring of efficient conservation strategies and public policies, and thus for achievement of these goals. Equally important is the role of organizations of the civil society with profile and technical experience in the application of scientific knowledge in field actions for endangered species and environments, and also considering traditional communities and peoples. In practice, initiatives that join researchers, socio-environmentalists and technicians from public agencies are the ones that offer the best results, as seen, for example, in the National Action Plans for the conservation of threatened species.

Unfortunately, however, in many countries we see the opposite: a disruption of institutions and the weakening of professionals (actors) who generate knowledge and promote environmental actions. This includes increasing cuts in the financing of institutions<sup>37</sup>. With the current political-economic crisis, Brazil, until recently one of the most innovative countries in terms of science and conservation of biodiversity, has suffered a drastic reduction in related funding and has seen a dismantling of its public research institutions. Likewise, the disruption of cooperation with organizations of the civil society and the interruption of international donation contracts directed, in part, to the implementation of environmental projects in the Amazon, as well as the persecution of environmentalists and accusations without evidence that NGOs were committing crimes<sup>38</sup>, have immensely reduced the ability to deal effectively with global warming and the risks of an upcoming mass extinction. In addition, the current Brazilian Government has systematically weakened environmental legislation, including using the Covid-19 pandemic – that also led to the impossibility of manifestations in the streets – as an opportunity to advance laws and regulations that are setbacks to the legal framework of environmental protection<sup>39</sup>. This demonstrates the inability of the Brazilian government to recognize both the opportunities associated with the fact that the country is one of the nations with the greatest biodiversity in the world and the environmental benefits and social well-being this biodiversity generates as well as the important complementary role of government and society in facing environmental challenges.

Like the weakening of national institutions for research, monitoring, conservation and management of the environment (IBAMA, ICMBio, INPE, among others), promoted by the Federal Government, the governments of some states of the Federation have promoted the dismantling of public bodies that act in the environmental area. This also occurs in southern Brazil. Proof of this is,



for example, the recent extinction of the Fundação Zoobotânica do Rio Grande do Sul (FZB) and the dismantling, still in progress, of its organs: the Museum of Natural Sciences and the Botanical Garden of Porto Alegre, which operate in the areas of research, education, health, scientific and cultural dissemination, conservation and sustainable use of natural resources, environmental management and public environmental policies. These services are about to be abruptly stopped, as the state government maintains its intention to dismiss all researchers and technicians from these agencies. This is done under weak arguments for spending cuts and despite innumerable appeals from research institutions in Brazil and across the globe. The planned extinction of the Museum of Natural Sciences (SEMA-RS) represents the dismantling, by the state, of a consolidated research institution, trained personnel and conservation of scientific collections, essential in biodiversity studies. The collections of the Museum of Natural Sciences, with 604,000 lots / specimens (including 2,883 type specimens), distributed in 58 collections, represent the largest collection available on the diversity of the South Brazilian grasslands and the Araucaria Forest. This collection is irreplaceable, as it brings historical records (since the end of the 19th century), including areas modified by human activity, whose original fauna and flora are extirpated. The political discourse of research and rational exploration of Biodiversity is at least contradictory with these governmental decisions underway in Brazil. Where will State governors apply resources destined to Biodiversity conservation and restoration research if the dismantling of state institutions responsible for this process is promoted at the same time?

## Conclusions

Whereas it is increasingly recognized that biodiversity conservation and climate change mitigation are inextricably linked<sup>40</sup> it is also recognized that broad social participation in decision-making is crucial. We consider it essential that spaces of dialogue are opened to the interests of Brazilian society - NGOs, research institutions, indigenous leaders and traditional communities – in order to advance in the development of national and subnational environmental guidelines. A positive agenda and commitments capable of guaranteeing effectiveness that results in the application of resources destined to the confrontation of the Climate Crisis in Brazil can only be achieved with inclusion of Brazilian society, also on the regional (state) level. The biodiversity-rich and threatened ecosystems of southern Brazil can contribute immensely to addressing climate change, but for this it is necessary that the debate on prioritization of conservation targets be widened beyond tropical ecosystems.

We need to go far beyond the vague statements made at international conferences and in the media, as recently at the COP 26 meeting in Glasgow. Political authorities at all levels need to demonstrate coherence between discourse and practice, through the adoption of concrete



measures and actions and promoting social participation. Otherwise, the discourse is nothing more than an attempt of greenwashing that does nothing to combat climate change and environmental sustainability.

### Author's note

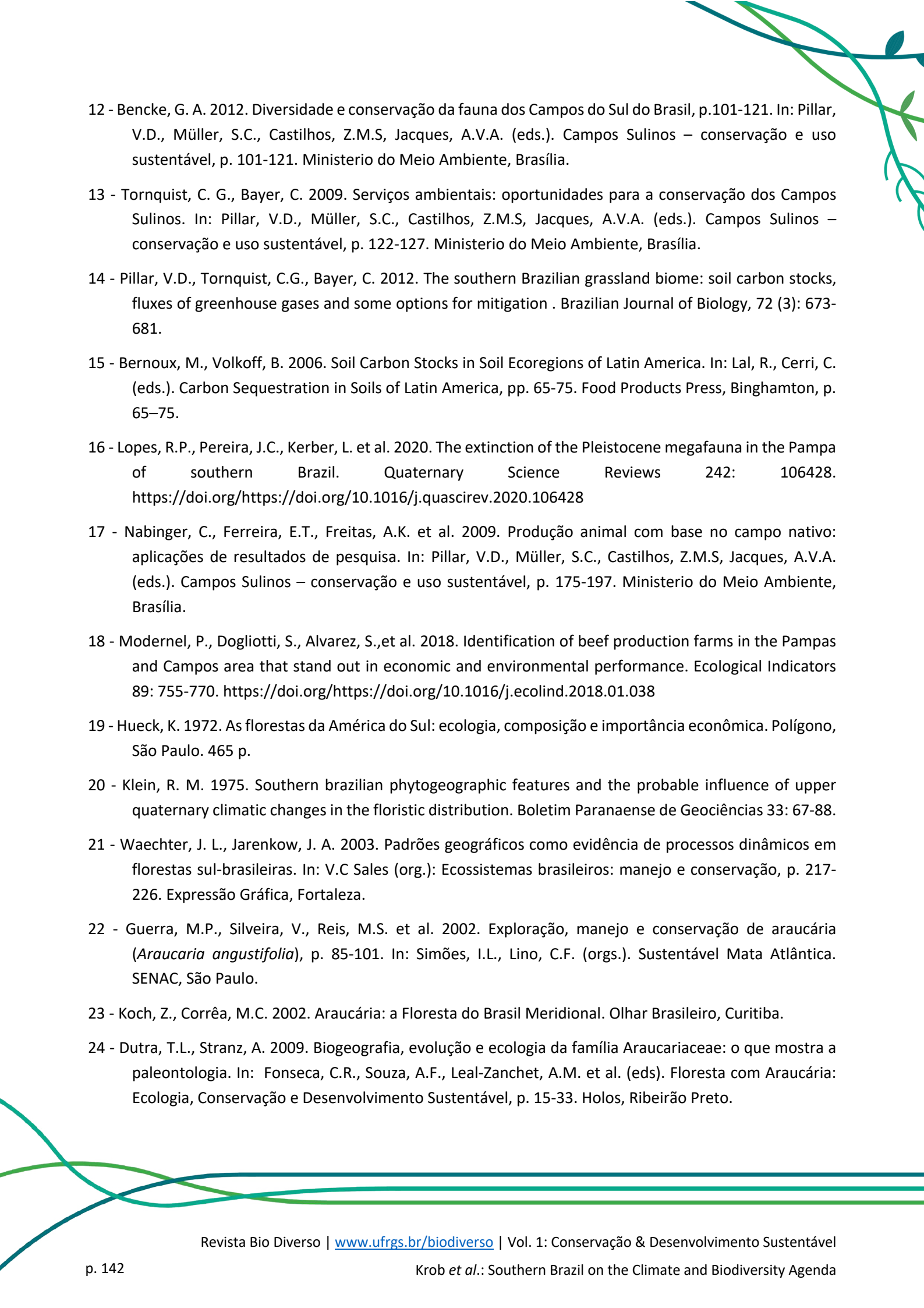
This publication is an adaptation of a letter sent to the Government of the United States of America and the Summit of Heads of State for the Climate prior to the meeting held on April 22 in Washington. Updates made in the text are the responsibility of the authors.

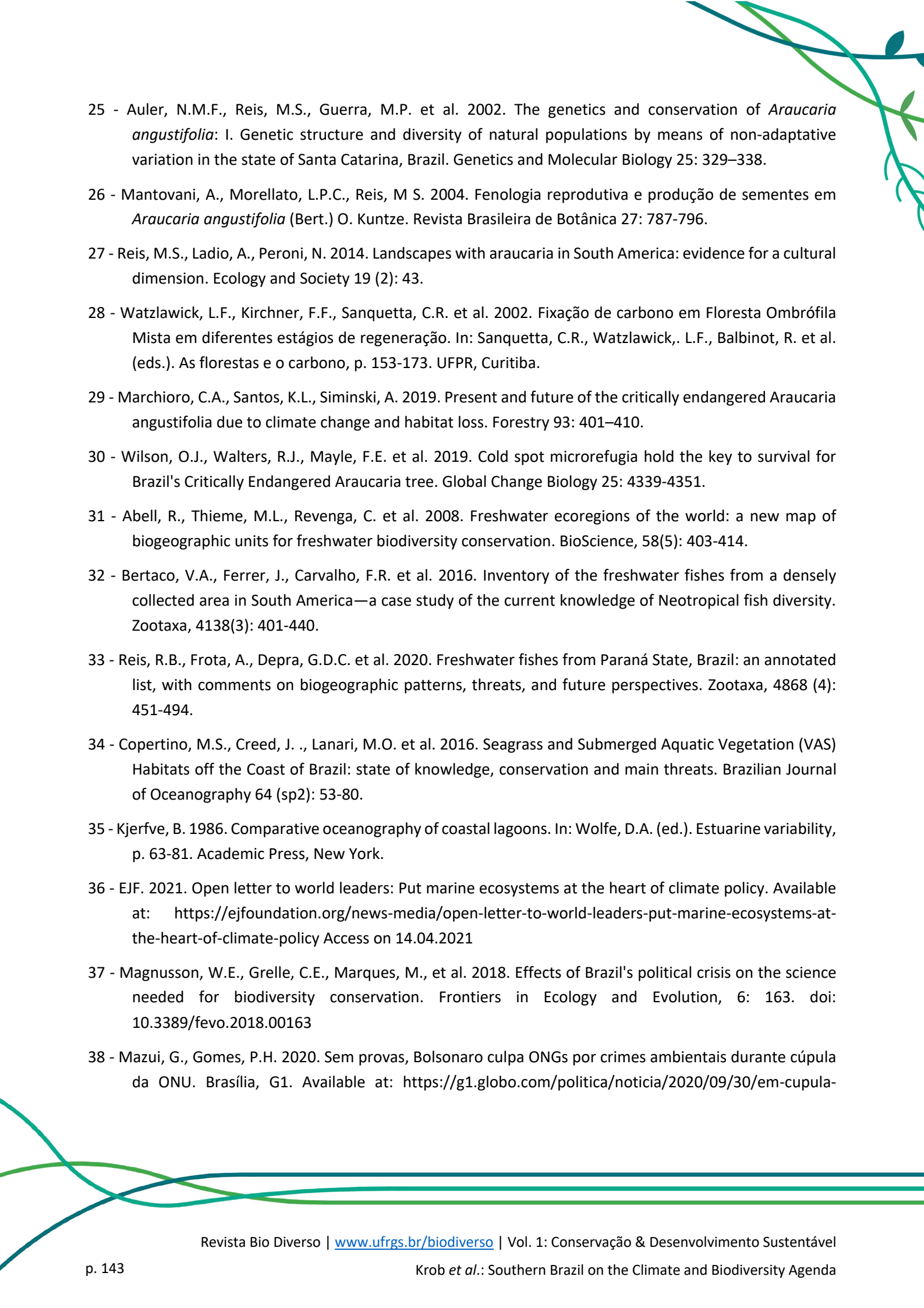
The original letter was signed by the following institutions:

Associação dos Funcionários da Fundação Zoobotânica do Rio Grande do Sul - AFFZB, Associação Nascente Maquiné – Anama, Associação dos Servidores da Fepam – ASFEPAM, Associação dos Servidores do Instituto do Meio Ambiente de Santa Catarina – ASSIMA, Associação dos Servidores da Secretaria Estadual de Meio Ambiente do Rio Grande do Sul - ASSEMA, Associação Viane de Cooperação e Intercâmbio no Trabalho, Educação Cultura e saúde – AVICITECS, Curso de Ciências Biológicas da Unipampa, Sociedade Brasileira de Etologia – SBET, Grupo Universitário de Pesquisas Espeleológicas da Universidade Estadual de Ponta Grossa - Gupe-UEPG, Sociedade Brasileira de Carcinologia, Sociedade Brasileira para o Estudo de Quirópteros, Sociedade Brasileira de Herpetologia, Sociedade Brasileira de Ictiologia, Sociedade Brasileira de Malacologia, Sociedade Brasileira de Mastozoologia, Sociedade Brasileira de Ornitologia, Sociedade Brasileira de Zoologia, Círculo de Referência em Agroecologia, Sociobiodiversidade, Soberania e segurança Alimentar e Nutricional da Universidade Federal do Rio Grande do Sul – AsSsAN, Instituto Biociências da Universidade Federal do Rio Grande do Sul – IB-UFRGS, Instituto Curicaca, Instituto Hórus de Desenvolvimento e Conservação Ambiental, Mater Natura – Instituto de Estudos Ambientais, Observatório de Conservação Costeira do Paraná – OC2, Programa de Pós-Graduação em Biologia Animal da Universidade Federal do Rio Grande do Sul, Programa de Pós-Graduação em Biologia de Ambientes Aquáticos Continentais da Universidade Federal do Rio Grande, Pró-Reitoria de Pesquisa e Pós-Graduação da FURG, Sociedade Brasileira para o Estudo dos Elasmobrânquios – SBEEL, Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental – SPVS.

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