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Conservation of Brazilian freshwater biodiversity: Thinking about the next 10 years and beyond

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Abstract

In 2021 the countries of the world will discuss a framework under the Convention on Biological Diversity (CBD) for a new environmental agenda for the next 10 years (the “post-2020”). Parties should consider Brazil to be a central nation in these discussions. The country holds a large freshwater biodiversity that needs to be protected, but current policies imperil species and ecosystems. Here we present topics to guide other CBD parties in discussing with Brazil a better agenda to conserve freshwater biodiversity in the “post-2020”. These initiatives include: (i) a national plan to reduce threats, (ii) restoration of freshwater ecosystems, (iii) protected areas, (iv) more investment in research, and (v) science communication. Brazil’s participation in these CBD negotiations is fundamental for a new agreement, but the country is under a presidential administration with little concern for the environment. While our suggestions are intended for participants in the CBD negotiations, they will also be relevant to other international actors in the coming years. Nations, international investors, private companies and NGOs around the world must therefore use their influence to press the current administration to protect the country’s environment, including its enormous freshwater biodiversity

Keywords: Freshwater protected areas; laws; mining; post-2020; restoration; biological invasions

Declarations

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Conflicts of interest

None

Since February 2020, the 196 Parties to the Convention on Biological Diversity (CBD) have been discussing the challenges of conserving biodiversity in a world that is undergoing climate change and increasing human population and consumption (CBD 2020). The parties will formulate a new global framework, scheduled to be agreed in 2021. These decisions will provide a global environmental agenda for the next 10 years (the “post-2020”).

49 The parties should consider Brazil to be central to the discussion of the post-2020 period
 50 due to its vast biodiversity, especially those in inland waters. The country contains a large
 51 percentage of the planet's freshwater species (Agostinho et al. 2005). For example, the country
 52 holds 3148 freshwater fish species (ICMBio 2018), a larger richness than North America,
 53 Central America, Europe, and Oceania combined (Dagosta and de Pinna 2019). Another example
 54 is freshwater Cladocera, with more than 140 species (Brito et al. 2020), a number that
 55 corresponds to ~ 23 % of the world's total for this group (Forró et al. 2008).

56 Brazil's high freshwater biodiversity is in constant peril (ICMBio 2018; Pelicice et al.
 57 2017). An assessment of the state of conservation of Brazilian freshwater species organized by
 58 the Chico Mendes Institute for Biodiversity Conservation (ICMBio) is being done through
 59 voluntary collaboration of national and international researchers. These evaluations have shown
 60 that many Brazilian fish species are extinct at the regional level (ICMBio 2018); this is alarming
 61 because the extinction of local or regional populations eliminates genetic variability. Brazilian
 62 diversity is being imperiled as dams, agricultural expansion, pollution, and other impacts take
 63 their toll on Brazil's aquatic ecosystems. Other threats include invasive species, a danger that is
 64 augmented by planned inter-basin water transfer projects and by unsustainable aquaculture and
 65 sport fishing (e.g., Daga et al. 2020; Garcia et al. 2018; Nobile et al. 2020; Ribeiro et al. 2017).

66 Although threats to Brazil's flora and fauna have been increasing for years (e.g., Ferreira
 67 et al. 2014; Azevedo-Santos et al. 2017; Fernandes et al. 2017), Brazil's current president (Jair
 68 Bolsonaro), who took office in January 2019, has greatly worsened the situation (e.g.,
 69 Supplementary Material A). For example, the president has submitted a proposed law to the
 70 National Congress (PL 191/2020) that would legalize mining and dam construction in
 71 indigenous areas (Congresso Nacional 2020). The collapse of the Brumadinho and Mariana
 72 mine-tailings dams (Cionek et al. 2019; Fernandes et al. 2016) made it very clear that Brazil is
 73 not able to monitor and ensure proper functioning of its mines (Ferreira et al. 2014; Nazareno
 74 and Vitule 2016). Impacts of mining in indigenous areas are likely to disrupt biodiversity in both
 75 terrestrial and freshwater ecosystems.

76 The Ministry of Environment was not abolished altogether, as had been promised by the
 77 president during his electoral campaign (Supplementary Material B). However, the person
 78 President Bolsonaro appointed to head the ministry (Ricardo Salles) has acted to set the
 79 environment back on many fronts. For example, Salles recently repealed important resolutions of
 80 the National Environment Council (CONAMA), including revoking resolution on licensing for
 81 irrigation projects (284/2001; see Supplementary Material C), thus imperiling many waterbodies
 82 and their biodiversity. This further reinforces the conclusion that Brazil must be placed at the
 83 center of the negotiations for a new agreement for the next decade and beyond. In view of this
 84 possibility, we present suggestions for the CBD signatory nations outlining the main actions that
 85 are necessary to conserve Brazilian freshwater biodiversity.

86

87 **Post-2020: Examples of needed actions**

88

89 *A national plan to reduce threats*

90 We believe that Brazil needs a national plan to reduce threats to biodiversity. Here we
 91 will provide examples of threats that should be considered in a discussion by the parties to the
 92 CBD.

93 Mining is an activity that has disrupted Brazilian aquatic ecosystems, especially gold, that
 94 releases a lot of mercury (Malm et al. 1998), and those associated with tailings dam associated
 95 (Fernandes et al. 2016). More inspections and restrictions on mining near waterbodies are needed
 96 (Pelicice et al. 2017); the same applies to tailings dams because they have a gigantic potential for
 97 biodiversity destruction (Cionek et al. 2019; Fernandes et al. 2016). Also needed is improved
 98 inspection to prevent illegal mining, including better control at the country's borders to avoid
 99 entry of mercury and other illegal inputs used in this activity.

100 Hydroelectric dams have fragmented major rivers for years (Agostinho et al. 2008;
101 Fearnside 2016a), and Brazil has ambitious plans for new Amazon dams. Brazil must consider
102 investing more in alternatives with less impact than Amazon dams, such as halting export of
103 electro-intensive commodities (especially aluminum), improved transmission and use efficiency,
104 and generation from the country's abundant wind and solar sources (Fearnside 2016a; Pelicice et
105 al. 2017).

106 Agriculture must respect the limits of ecosystems so that it is promoted with
107 sustainability. For example, numerous agricultural chemicals are currently allowed, hundreds of
108 them approved during the current presidential administration (Supplementary Material D). Many
109 of these poisons are banned in more-developed nations (Thomaz et al. 2020). The sale of these
110 chemicals for agriculture, and their irregular use, can cause disturbances in freshwater
111 ecosystems, since pesticides can reach waterbodies in the runoff of rainwater. When these
112 chemicals reach aquatic ecosystems, they can cause serious harm to the freshwater biota
113 (Miranda et al. 2008).

114 Many decisions, especially through new laws, have the capacity to expose Brazilian
115 freshwaters to introduced species from the most varied locations of the planet (Coelho and Henry
116 2017; Pelicice et al. 2014). The Aichi Targets have been ignored in this regard in various ways
117 (Lima Junior et al. 2018), with harmful consequences for ecosystems (Vitule et al. 2009).
118 Invasive species should be treated more seriously by authorities and by society in general.

119 Pollution of the country's ecosystems has been taking place for a long time. Hundreds of
120 cities in the country still throw domestic effluents into urban streams without any prior treatment.
121 In addition, many Brazilian ecosystems (and the species within them) have received
122 unprecedented amounts plastic waste (e.g., Andrade et al. 2019; Giarrizzo et al. 2019). The full
123 extent of the impacts of this on Brazilian freshwater biota is unknown. Brazil has failed to adopt
124 rigid measures to prevent the input of polymers and other types of waste in the country's
125 ecosystems.

126 *Restoration of freshwater ecosystems*

127 Restoration of freshwater ecosystems has barely been discussed in the country and is still
128 a topic largely restricted to the academic community. Brazilian authorities need to rethink
129 opportunities for depollution, following trends in a number of other countries.

130 *Protected areas*

131 Most Brazilian protected areas have limited value for protection of freshwater
132 biodiversity (e.g., Frederico et al. 2018). More-efficient protected areas therefore need to be
133 implemented to protect this diversity (Azevedo-Santos et al. 2019). However, this depends on
134 the good will of political agents.

135 *More investment in research*

136 Brazil is far from knowing the entirety of its freshwater biodiversity. For example, even
137 at this point in the 21st century, scientists described a large aquatic mammal (Hrbek et al. 2014).
138 In addition to the country's outstanding diversity of fish and other freshwater vertebrates, aquatic
139 invertebrate diversity is enormous over a wide range of taxonomic groups (Hamada et al. 2018,
140 2019). We are likely to lose species before we even know of their existence. Thus, basic studies
141 (e.g., surveys) on biodiversity should receive adequate investment in Brazil. In addition,
142 bureaucratic barriers that hinder this type of research need be removed (Bockmann et al. 2018);
143 in this regard, we recommend a revision of the biodiversity law (Law 13,123, May 20, 2015).

144 More investments are needed in biological collections, as these are essential for
145 taxonomic revisions and discoveries of new species. The September 2018 fire that destroyed
146 Brazil's National Museum in Rio de Janeiro (Supplementary Material E) suggests the extent to
147 which important collections have been neglected by the country's political authorities.

152 *Science communication*

153 Many of Brazil's public policies promote development without regard for impacts on
154 biodiversity (Fearnside 2016b; Pelicice et al. 2017). Environmental policies, including those
155 involving freshwater ecosystems, must be guided by scientific knowledge, which also requires
156 the participation of scientists in the policy-elaboration process (Azevedo-Santos et al. 2017).

157 Only a small fraction of the country's scientific knowledge of biodiversity is provided to
158 society at large. Although important examples of science outreach exist (see França et al. 2018),
159 these are still relatively few. Providing scientific knowledge to society at large (and government
160 investments for this purpose) is essential to conserving freshwater biodiversity.

161
162 **Final Remarks**

163 Parties to the CBD need to consider our suggestions for conserving Brazilian freshwater
164 biodiversity in discussions on the new treaty for the "post-2020" period. While our suggestions
165 are directed to the CBD parties, they also apply to other international actors, including
166 governments, businesses and non-governmental organizations (NGOs). Brazil's environmental
167 setbacks under the current presidential administration have reached a magnitude suggesting that
168 measures needed to protect the country's biodiversity will not be taken in the absence of
169 influence from international actors (Ferrante and Fearnside 2019). Countries importing Brazilian
170 soy, beef and timber must condition their purchases on adequate safeguards, among other
171 economic inducements to change the Brazilian government's behavior (Kehoe et al. 2019).
172 Private companies and NGOs, both national and international, among other actors such as
173 international investors, must also exert influence on environmental conservation in Brazil.

174 Parties to the CBD also need to consider creating an international fund for countries with
175 megadiversity, such as Brazil. Such a fund must not only focus on conservation of forests, but
176 also on freshwater biodiversity. Decisions for the next ten years are crucial for biodiversity and
177 future generations in Brazil.

178
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183
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