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Essays and Perspectives

Biodiversity conservation gaps in Brazil: A role for systematic conservation planning

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ABSTRACT

A recent study aimed to estimate the biodiversity conservation gaps of the Brazilian protected area network by analysing more than 880 thousand records of species presence from online databases. Although we agree with its general message that Protected Areas are poorly known, unevenly distributed, and not sufficient to safeguard the Brazilian biodiversity, we question its methodological approach and feel that its conclusions must not be received uncritically. A major concern is that their analyses are based on an arbitrary set of widespread, abundant, and non-threatened species and on a subset of the species widely recognized as conservation priorities, such as the red-listed species. Furthermore, they question the efficiency of the Brazilian protected area network based only on species data, missing other facets of biodiversity, such as habitat/community diversity, ecosystem processes, and services. We point out that the adequate way to estimate the Brazilian conservation gaps and to properly indicate where they are in space is through systematic conservation planning. Official data indicate that spatial conservation gaps correspond to 16.5% of the Brazilian territory, being conservation Priority Areas not under Protected Areas. This spatial gap, however, is much smaller in Amazon in comparison to all other biomes. For the Caatinga drylands, we estimated three facets of the conservation gap (i.e., qualitative gap, target gap, and spatial gap). We highlight that the Brazilian protected area network has been very successful to safeguard many facets of the Brazilian biodiversity and that future expansions, based on systematic conservation planning, can efficiently protect elected biodiversity traits.

Introduction

Conservation decisions are made under serious constraints and trade-offs (Brooks et al., 2006). In the day-by-day conservation struggle, resources are limited, thus cheaper solutions are preferred over more expensive ones (Di Minin et al., 2017). In this sense, conservation goals, biodiversity traits, and quantitative targets should be clearly selected, otherwise resources can be spread too thinly to be effective anywhere. Therefore, decisions frequently need to be made on what, how much, and where to conserve. Recently, systematic conservation planning (SCP) emerged as a modern and objective tool to help the unpleasant and tough task of conservation prioritization (Margules and Pressey, 2000; Sarkar and Illoldi-Rangel, 2010).

Systematic conservation planning is performed to design cost-effective strategies to preserve a subset of the regional biodiversity, including threatened and highly endemic species, unique habitats, special landscape features, ecosystem processes, and services (Margules and Pressey, 2000). Any systematic conservation planning exercise need to determine its general conservation goals, carefully select biodiversity traits (i.e., threatened species, rare habitats), and define quantitative conservation targets. Then, objective methods determine a set of spatial sites, called Priority Areas (PI), where such quantitative conservation targets can be reached. The Priority Area map can be then used for decision actions, such as the creation of Protected Areas (PA) and habitat restoration. Under this framework, the effectiveness of a protected area network should be judged with respect to such previously defined goals and targets but not to other biodiversity trait.

Recently, Oliveira et al. (2017) aimed to estimate the biodiversity conservation gap of the Brazilian protected area network using a large set of species found in online databases (e.g., GBIF, Species Link, Birdlife International, Herpnet, Nature Serve, Orthoptera

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Species File) belonging to three groups of vertebrates (anurans, mammals, and birds), seven groups of arthropods (bees, spiders, millipedes, Orthoptera, dragonflies, moths, and Diptera), and eight families of angiosperms (Asteraceae, Bromeliaceae, Fabaceae, Melastomataceae, Myrtaceae, Orchidaceae, Poaceae, and Rubiaceae). To describe the sampling effort inside and outside Protected Areas they used the whole dataset but to test the efficiency of Protected Areas in representing species distributions they focused on 4344 species, those with more than 15 accurately geo-referenced occurrence points. Although we agree with its general message that Brazilian Protected Areas are poorly known, are unevenly distributed over the territory, and at this point are not sufficient to safeguard the Brazilian biodiversity, we feel that its analyses suffer from fundamental flaws and its conclusions must not be received uncritically.

In this short paper, we would like to share our concerns in relation to Oliveira et al. (2017) approach to estimate the efficiency of Brazilian protected area network. Furthermore, we would like to point out that the participatory systematic conservation planning exercise, organized by the Brazilian Ministry of Environment (MMA), can properly quantify and locate in space the Brazilian biodiversity conservation gap. In particular, SCP is used to estimate three complementary aspects of the Brazilian conservation gap: (i) Spatial gaps – regions that are considered conservation Priority Areas, because they contain relevant biodiversity traits, but are not part of the existing conservation area network, (ii) Qualitative gaps – number of selected biodiversity traits that are not represented inside the existing conservation area network, and (iii) Target gaps – proportion of pre-defined quantitative targets not achieved by the existing conservation area network.

The species selection concern

One major concern about Oliveira et al. (2017) analyses is the set of species chosen to test the efficiency of the Brazilian protected area network. First, their analyses miss hundreds of species that are of particular conservation concern (e.g., red-listed species). Second, in their data-set we can find thousands of species of no immediate interest for conservation, such as widespread species that have relatively larger geographic ranges, highly abundant species that are not threatened, and species that thrive in disturbed habitats. Therefore, by inflating the data-set with widespread species and by lacking species widely recognized as conservation priorities, their results can be seriously biased.

Oliveira et al. (2017) analyzed 11818 Angiosperm species while just 2118 are considered threatened by the Red Book of the Brazilian Flora (Martinelli and Moraes, 2013). Although they focused their analyses on plant species from eight highly-threatened families, they did not include existing information from additional 134 plant families included in the Red Book, missing a great deal of the phylogenetic diversity (Martinelli and Moraes, 2013). This, of course, jeopardize the results of their phylogenetic analyses. For vertebrates, they analyzed 757 amphibians, 1832 birds, and 697 mammals, many of them non-threatened widespread species, but missed 353 fish and 80 reptile species which are officially red-listed (MMA, 2014a,b). For the arthropods, 10611 species were analyzed but very few are nowadays considered a conservation priority. Furthermore, for their niche modelling analyses, due to methodological constraints, only species with more than 15 records were considered, given more weight to common than to scarce species.

We also believe that much care should be taken to interpret Oliveira et al. (2017) statement that “almost 55% of the Brazilian species and about 40% of the evolutionary lineages are not found in PAs [Protected Areas] while most species have less than 30% of their geographic distribution within PAs”. Although this can be superficially viewed as an indication of the inefficiency of the Brazilian conservation area network, the opposite is true. Since Oliveira et al. (2017) estimated that Protected Areas cover 25% of the Brazilian territory, they are protecting a disproportionally higher amount of biodiversity (45% of the species and 60% of the evolutionary lineages considered in their data-set). This is reinforced by the fact that indigenous lands, which they included in their analysis, despite its great importance for biodiversity conservation, especially in the Amazon, were not designed to maximize biodiversity protection, but culture, and their spatial locations respect the historical use of local communities.

Another important point is that, in Brazil, common non-threatened species, which are very important for ecosystem functioning and services, do not have necessarily to occur inside Protected Areas. Their long-term conservation is assisted by another important legal mechanism, the Brazilian Forest Code which requires rural private properties to set aside considerable natural vegetation areas of Legal Reserves and Areas of Permanent Preservation (New Forest Code, Law 12651, 25 May 2012, Brazil). Below, we point out that a good starting point to estimate the efficiency of the Brazilian protected area network is the set of species officially selected by the participatory systematic conservation planning exercises organized by Brazilian Ministry of Environment.

Brazil's systematic conservation planning

The Brazilian government established at the beginning of the 2000s one of the largest governmental participatory systematic conservation planning of the world, embracing all Brazilian biomes: Amazon (tropical rainforest), Atlantic Forest (coastal rainforest), Caatinga (semiarid dryland), Cerrado (savanna), Pampa (grassland), Pantanal (wetland), and the coastal area (MMA, 2004, 2007, 2016). This exercise was recently updated for the second time for three biomes: Caatinga, Cerrado, and Pantanal (Ministry of Environment, Law 223 of 21 June 2016). Nowadays, the Brazilian government recognizes 1530 Priority Areas (PI) for conservation, sustainable use, and shared benefits of the Brazilian biodiversity that covers 2,887,368 km^2 or 33.9% of the national territory (Fig. 1). By law, this exercise is updated every five years through a series of participatory workshops that typically receives representatives from federal and state environmental agencies, NGOs, and scientists, including taxonomists, ecologists, and conservation biologists. In those workshops, biodiversity traits are selected, goals and targets are established, distribution maps are compiled or generated, and a cost surface is created. Then, an optimization software (MARXAN; Ball and Possingham, 2000) is used to produce an objective spatially explicit solution which, after public scrutiny, is translated into a map of Priority Areas. Finally, for each area, specific conservation actions are suggested, including the creation of Protected Areas, sustainable forestry, restoration projects, management strategies, and biological surveys. Irreplaceability, urgency, richness of selected biodiversity traits, landscape metrics, and cost surface are some of the objective criteria used for selecting Priority Areas for the creation of Protected Areas. At the end of the process, Priority Areas are officially recognized (e.g., Ministry of Environment, Law 223 of 21 June 2016) and can be used for decision making.

The Brazilian spatial conservation gap

Based on the Brazilian Systematic Conservation Planning (MMA, 2007, 2016) and the National Register of Conservation Units (CNUC, 2017) it is possible to estimate the size of the Brazilian spatial conservation gap and where it is located (Fig. 1). In fact, 16.5% of the

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