Rio de Janeiro Botanic Garden Research Institute - JBRJ
Brazilian National Center for Flora Conservation - CNCFlora

Project: **"Conservation assessment of Brazilian tree species towards the Global Tree Assessment"**

(REPORT 1/2020)

Based upon the project "Conservation Assessment of Brazilian tree species towards the Global Tree Assessment" here we present our main deliverable: "107 reassessments of Brazilian tree species".

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Summary

1. Introduction

Global biodiversity is eroding fast in the context of the sixth mass extinction event. As the current global rate of species extinction reaches figures of tens to hundreds of times higher than it has averaged over the past 10 million years (Ceballos et al., 2015; Humphreys et al., 2019), in order to mitigate this trend of geological magnitude, solid actions are needed to be taken if humanity expects to guarantee species' persistence in the years to come (Abu Dhabi Call, Species Survival Commission, 2019).

Scientists' understanding of biological diversity´s extinction risk and consequently the best practices to secure them a perennial fate are robustly disclosed through the extinction risk assessment protocol proposed by The IUCN Red List of Threatened Species (hereafter the IUCN Red List). The IUCN Red List is often regarded as the most effective tool to identify which species are facing high extinction risk and which are the main drivers of species' population declines. The tool bridges the necessary integration between the scientific community and decision-makers by informing which at-risk species are closer to the brink and what actions are needed to mitigate stress vectors affecting their survival, enhancing their chances to be brought back from the verge.

The Global Trees Campaign (GTC) a joint initiative between Fauna & Flora International (FFI) and Botanic Gardens Conservation International (BGCI) was launched in 1999 to take effective conservation actions for the world's most threatened tree species, following the publication of The World List of Threatened Trees (Oldfield et al., 1998). The Global Tree Assessment (GTA), led by BGCI and the IUCN Species Survival Commission (SSC), Global Tree Specialist Group (GTSG), continues to develop an extensive global collaborative partnership to safeguard the world's threatened tree species from extinction.

Trees were specifically selected because this life form represents a crucial biodiversity element, acting as architectural components of most terrestrial ecosystems. Additionally, trees play a central role in several biogeochemical cycles, and its vast array of uses and applications directly contributes with relevant sectors of the global economy - what is also among the

plausible explanations of acute population reductions experienced over the last centuries by several species.

Brazil is the biggest tropical country in the world and is frequently placed among the most biodiverse. Considering its tree diversity, the country stands at the top of global diversity ranks, with almost 9,000 native tree species documented so far (Beech et al., 2017; Flora do Brasil 2020 under construction, 2020). Brazil also leads the ranking for endemic tree species, with estimates accounting between 3,949 to 4,333 trees assigned to occur exclusively within the country's border (Flora do Brasil 2020 under construction, 2020; Beech et al., 2017).

In contrast to the escalating threats to tree species in the country, we still lack up-to-date conservation status assessments for most of these species, as just 48% (2,092 species) of Brazilian endemic trees had their conservation status assessed to date (23,3% of the country's total tree diversity), and less than 500 had their conservation status reassessed so far. Considering this discrepancy, BGCI and CNCFlora/JBRJ (BP-RLA) are moving forward a joint initiative aiming to detect the conservation status of all Brazilian tree species as soon as possible, while simultaneously re- assess the extinction risk of tree species already evaluated in 2013.

Repeated assessments of extinction risk conducted over time are crucial to detect trends in species' conservation status. Moreover, reassessments provide the baseline which will allow the development of a Red List Index for the country in the years to come, making possible to better understand the consequences of changes in species' risk category and the reasons behind the change - directly contributing towards the implementation of tailored conservation actions.

Following the project scope, the present report discloses the findings obtained after the extinction risk reassessment of 107 Brazilian trees, which adds up to the final remarks of the ongoing project and represent another step in the full accomplishment to detect and monitor the conservation status of Brazilian trees.

The reassessments of these 107 selected species followed the national legislation (where species assessed must be reassessed after five years since its publication) and the IUCN recommendations (IUCN, 2019; Martinelli e Moraes, 2013; MMA, 2014). This procedure is necessary to take into account variables such as cost-benefits for these assessments, giving priority to Threatened, Near Threatened (NT) or Data Deficient (DD) species that can suffer changes in their categories, as up-to-date information on species' distribution, population size, trends, incident threats and ongoing conservation actions are being brought to light. In the

context of the species considered in the present effort, all were considered Threatened (16 assessed as CR; 50 EN and 41 as VU).

2. Material and Methods

CNCFlora/JBRJ extinction risk assessment workflow follows the methodology established by the IUCN Red List system of criteria and categories of extinction risk. A pre-assessments analyses and data gathering are carried out and precedes risk analyzes and assessments, which are carried out entirely within the CNCFlora system (http://cncflora.jbrj.gov.br).

The following steps describe CNCFlora extinction risk assessment workflow:

1. Definition of the species list to be reassessed in accordance with the Brazilian Environmental Ministry (MMA) Ordinance nº 43 (MMA, 2014) that put in place the Programa Pró-Especies (National Program for Species Conservation), published in 2014, where it is defined that species should be reassessed every five years (§ 2º do art. 7°).
2. Taxonomic verification based on Flora do Brasil 2020 and expert's opinion.
3. Georeferencing of species occurrence records gathered from the following databases: GBIF, Reflora, Jabot and CRIA SpeciesLink.
4. Occurrence data cleaning (elimination of duplicates and incomplete/non-informative or unreliable records).
5. Pre-assessment data analysis data gathering (sourcing for data on potential uses, in situ and ex situ protection, inclusion in the CITES appendices).
6. Inclusion of all collated data in CNCFlora' system; for each species that was included in the present initiative, we assembled and inserted all available data in the CNCFlora system as a data sheet for each particular species.
7. Validation of occurrence records by specialists within CNCFlora system GIS environment.
8. Spatial indexes (EOO and AOO) generation within CNCFloras's system (using Minimum Convex Polygon (MCP) and UTM projection).

9. Reassessment of extinction risk.
10. Review of assessments by CNCFlora/JBRJ evaluators.
11. Documentation of assessments and storage in a database (*Elasticsearch* and *CouchDB*) and in csv format.
12. Publication of the evaluations.
13. Submission of assessments for the IUCN SIS Connect and Mappin and for CNCFlora Portal.

2.1 Detailed species list generation

We selected native endemic and non-endemic species assessed by BP-RLA - CNCFlora/JBRJ in 2013 (Red Book - Martinelli e Moraes, 2013) for reassessments. We have included 107 species and updated the names of the selected species using only the name that is considered valid and accepted by the Flora of Brasil 2020 (from API service available at: http://servicos.jbrj.gov.br/flora/taxon).

All the species in this list have the life form "tree". However, there are many species in the list that are both "tree" as well as another life form. We investigated whether the names of the species are included in the Global Tree Search (GTS) database. Some of the selected species were published in the IUCN Red List of Threatened Species prior to 2010 and need to be reassessed. We excluded all of the species that we reviewed for the Royal Botanical Gardens, Kew' red list unit, such as the *Myrcia* group.

The 107 species list was compiled through a script developed by our team and available at: https://github.com/pablopains/CNCFlora) in R version 3.6.1 (R Core Team, 2019) to download Brazilian Flora 2020 dataset that provide an improved checklist of plants that occur in Brazil (from the Darwin Core Archive (DwC-A) here: http://ipt.jbrj.gov.br/jbrj/resource?r=lista_especies_flora_brasil). We queried the Brazilian Flora 2020 dataset to return information of taxonomic status, vernacular names, endemism level, biomes, federal units of occurrence, life forms, vegetation type and habitat for each candidate tree species. The Brazilian Flora 2020 dataset was formatted with R package *flora* (Carvalho, 2017) and *dplyr* (Wickham et al., 2019). Additionally, we performed a second checking for Brazilian endemism using GlobalTreeSearch database (available at:

https://tools.bgci.org/global_tree_search.php) dataset and we performed search in the IUCN Red List (from API service here: http://apiv3.iucnredlist.org/api/v3/species) in R.

2.2 Data validation (Specialist participation - Appendix 2)

This step is carried out by specialists on each botanic family or infra levels. A total of 30 specialists responsible for monographs on Flora do Brasil 2020 were invited to testify the identity of all specimens associated with each taxa. During this step, the confirmation of the species names is also performed in order to avoid evaluation efforts over unresolved or confused taxonomic hypotheses. The records validation procedures are performed within the CNCFlora system through their own login and passwords.

2.3 Threats

We adopt the IUCN Threat Classification Scheme - V. 3.2.(IUCN, 2012) to determine the main drivers of decline upon *foci* species' population/habitats, also including information regarding the timing of the event, its scope and its severity , which will together assist in the threat impact score estimation.

Multiple data sources for threats were gathered from specific literature when available and from vegetation dynamic monitoring platforms, such as PRODES (http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes), SOS Mata Atlântica (SOS Mata Atlântica e INPE, 2018; https://aquitemmata.org.br), and LAPIG (https://www.lapig.iesa.ufg.br/lapig/index.php/produtos/dados-geograficos), where national data of land cover change and its uses is widely available.

2.4 Files for Mapping and IUCN SIS Connect

The file in format *.csv* maps was produced according to the IUCN Red List of Threatened Species - Mapping Attributes standards MS Excel file, containing of the attribute fields and their associated data standards for both point, WGS84 datum and for area calculations we have used the Universal Transverse Mercator (UTM) projection system. (Version 1.16, 2018). The information to compose the document was requested by programming from the

CNCFlora database. In the file assessments.csv, in the column Maps, we have listed endemic species as "Done" and non-endemic species as "Incomplete". Species with less than 3 occurrence records or where the specimen label information was inconsistent to accurately georeferenced it, the fields AOO and EOO might be empty in the allfields.csv sheet. The tab setting in the file is comma and ISO-UTF8 (**Appendix 3**).

The *.csv* files have comma as field separator, except for References, which is separated only by (|). The display mode is UTF-8. The *.csv* files are: allfields.csv; assessments.csv; commonnames.csv; conservationneeded.csv; countries.csv; credits.csv; habitats.csv; plantspecific.csv; references.csv; synonyms.csv; taxonomy.csv; threats.csv; usetrade.csv

We have generated 13 files through database queries (*Elasticsearch* and *CouchDB*), mapped to a code layer developed in the PHP programming language (Zend 3) and exported using the scheme described in the SIS Fields for data import _v6 scheme and several improvements advice by BGCI' staff. These files will be submitted to SIS Connect by BGCI (**Appendix 4**).

3. Results

Attached to the present document, four appendices containing the findings and supplementary material of the present reassessment effort are also submitted, as follows:

(i) Appendix 1 - List of 107 reassessed species.
(ii) Appendix 2 - List of taxonomic specialists by family of the 107 species reassessed.
(iii) Appendix 3 - Species maps (report in csv).
(iv) Appendix 4 - List of files in SIS Connect' format CNCFlora BP-RLA (zip).

3.1 Species' conservation status per botanical family

For the 107 species reassessed (**Appendix 1**), 81 are considered Brazil's endemic, therefore, their assessments represent their global conservation status, while the remaining species (26) are treated as non-endemic of the country (therefore, their regional conservation assessment is presented).

The largest taxonomic group is represented by the myrtle family (Myrtaceae), which stands out with 13% of the species (14 spp.), followed by Fabaceae/Leguminosae (12%, 13 spp.) and Lauraceae (9%, 10 spp.). In **Figure 01** the listing of all families and the number of species reassessed and their respective categories after the reassessment are provided.

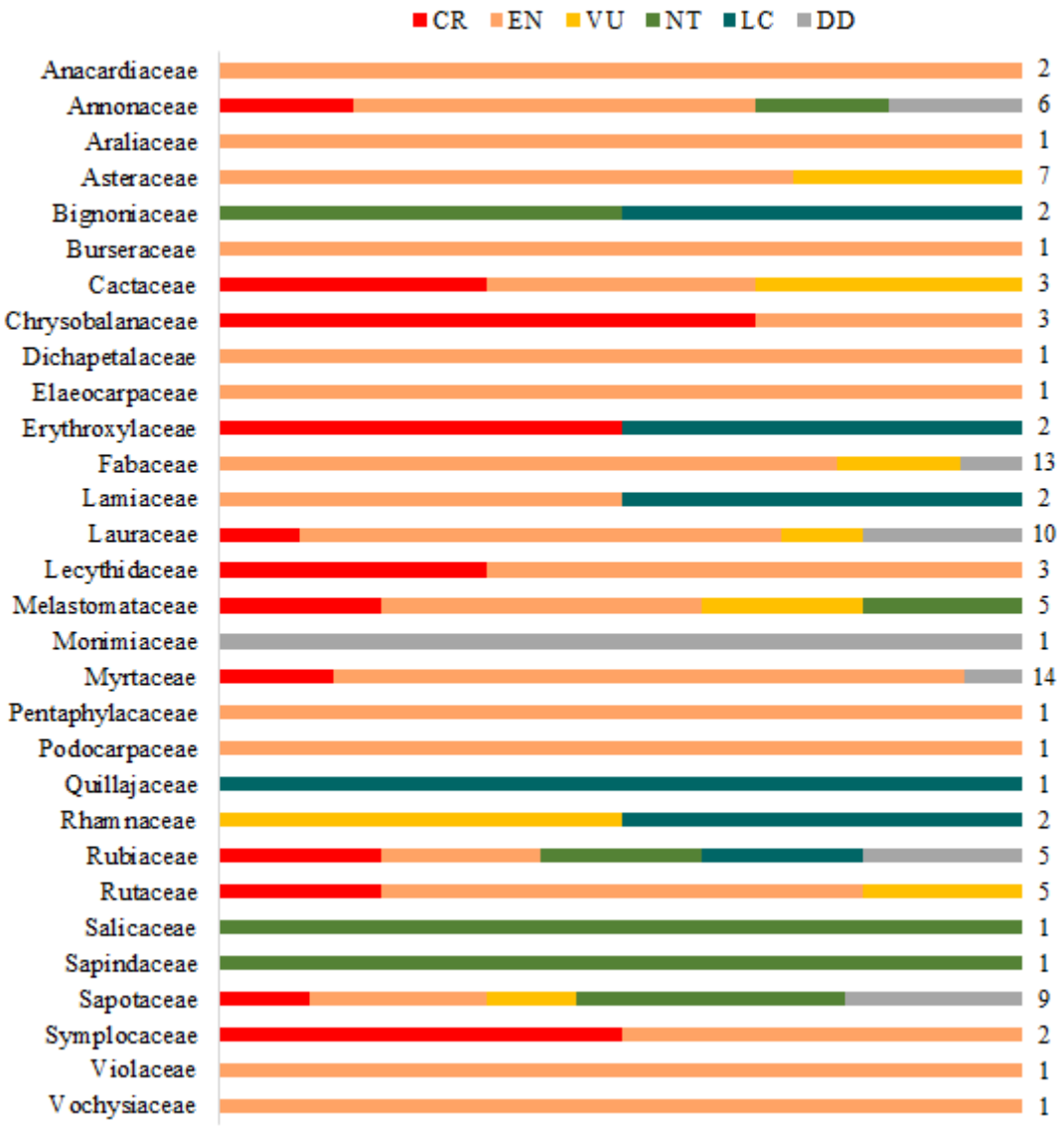

Figure 01 - Species' conservation status per botanical family reassessed in the present work.

3.2 Changes in species categories of risk

The 107 reassessments have already been published in the National Red Book (Martinelli e Moraes, 2013), but most of these assessments are not included on the global Red List of the IUCN. However, 43 species included here are already assessed at the IUCN Red List prior to 2010, representing their reassessments as well. Here we show the contrasts of the outcomes of these assessments undertaken back in 2013 (Martinelli e Moraes, 2013) with the reassessments conducted in 2020.

Our reassessment effort resulted in category changes for 59 species. The reassessments revealed that out of 107 tree species, 83 are considered now under a Threatened category (where 14 are now considered CR, 59 are now considered EN and 10 are currently categorized as VU); 24 are now not considered non-threatened categories, where 9 are considered NT and 6 as LC. Finally, 9 species are now regarded as DD (**Table 01**).

Table 01 - Main outcomes from the extinction risk reassessment of 107 Brazilian trees:

Main outcomes	Spp.
Reassessed species (all Threatened)	107
Threatened species (CR, EN, VU) after reassessments	83
Non-threatened species after reassessments (LC, NT, DD)	24
Number of species with category change	59
Number of uplisted species	24
Number of downlisted species	26
Changed for DD	9
Number of species with no category change	48

➢ From the 16 species considered as CR in their first assessment, 8 remained treated as CR, 5 were downlisted to EN, 1 to VU category, 1 to LC and 1 is now considered DD.

➢ From the 50 species considered as EN in their first assessment, 33 remained treated as EN, while 5 were uplisted as CR species; 2 species were downlisted to VU, 1 species was downlisted as NT, 3 species downlisted as LC and 6 are now considered DD.

➢ From the 41 species considered VU in their first assessment, only 7 remained treated as VU, one was uplisted as CR, 21 species were uplisted as EN, out of which 8 species are now regarded as NT, 2 are now considered LC and 2 are placed under DD.

The Alluvial graph below (**Figure 02**) illustrates changes in categories after reassessments of all 107 predominantly-tree species herein reassessed.

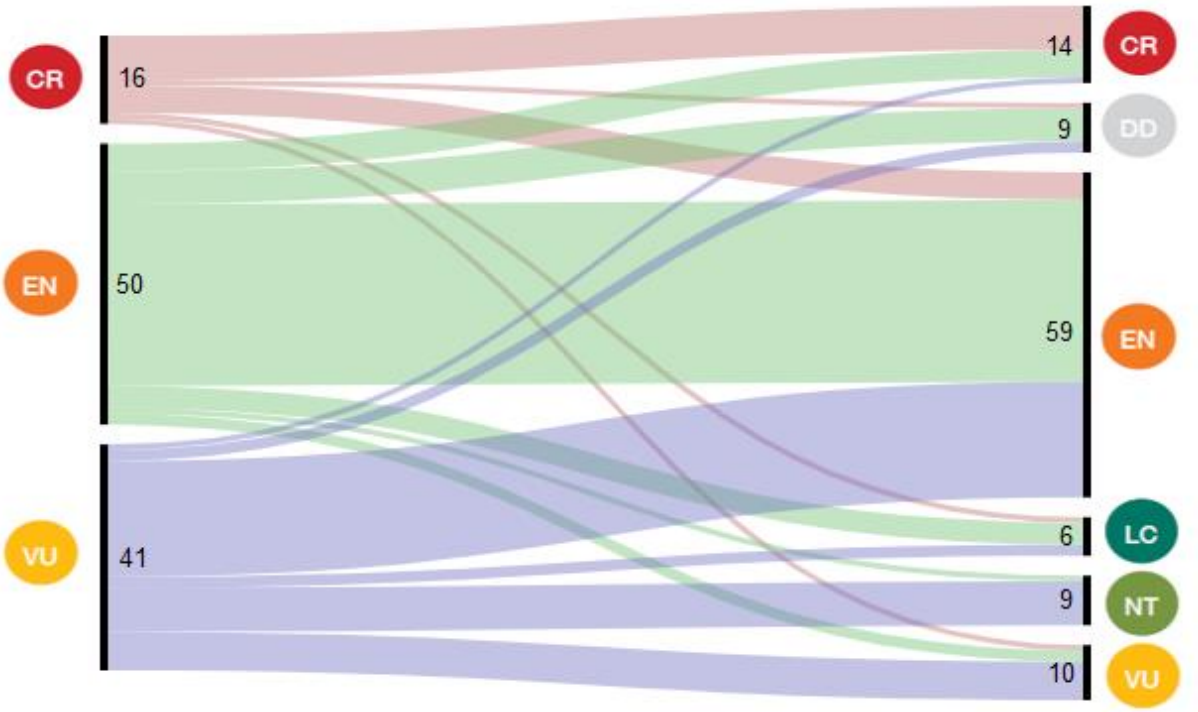

Figure 02 - Alluvial graph of transition of category changes.

A few intriguing examples of change in species conservation status deserves to be highlighted, such is the case of *Guettarda paludosa* Müll.Arg. (Rubiaceae), which was previously considered CR, possibly extinct, but after careful revision, it was declared DD now, as no new information came to light in more than 180 years since the last record. The only available specimen was collected by Blanchet in the 1840's, in a region where sampling efforts are still insufficient and specific searches for the species whereabouts was never conducted.

The following five species - *Duguetia scottmorii* Maas (Annonaceae), *Acritopappus pintoi* Bautista & D.J.N.Hind (Asteraceae), *Stephanopodium magnifolium* Prance (Dichapetalaceae), *Inga pedunculata* (Vinha) T.D.Penn. (Fabaceae) and *Euxylophora paraensis* Huber (Rutaceae) - were considered CR, but new data and new occurrence records resulted in changes on their spatial index (AOO and EOO) and therefore their categories of risk were updated to EN.

Initially 21 species declared VU were uplisted to EN mostly because new data was made available and a revision of the application of the IUCN system was conducted in the present reassessment. Many important timber sources such as *Amburana acreana* (Ducke) ACSm., *Zollernia magnifica* A.M.Carvalho & Barneby, *Urbanodendron bahiense* (Meisn.) Rohwer and *Pouteria macrocarpa* (Mart.) D.Dietr. are now considered EN because they are only found in predominantly forested ecosystems and are subject to direct threats that affects their viability.

3.3 Reassessed species per biome

Among the 107 tree species assessed, 53 spp. occur exclusively within the Atlantic Rainforest limits, 25 exclusively within the Amazon and another 11 and 5 species occurring exclusively in the Cerrado (Central Brazilian Savanna) and Caatinga, respectively; 13 species were documented in more than one biome, as highlighted by **Figure 03.**

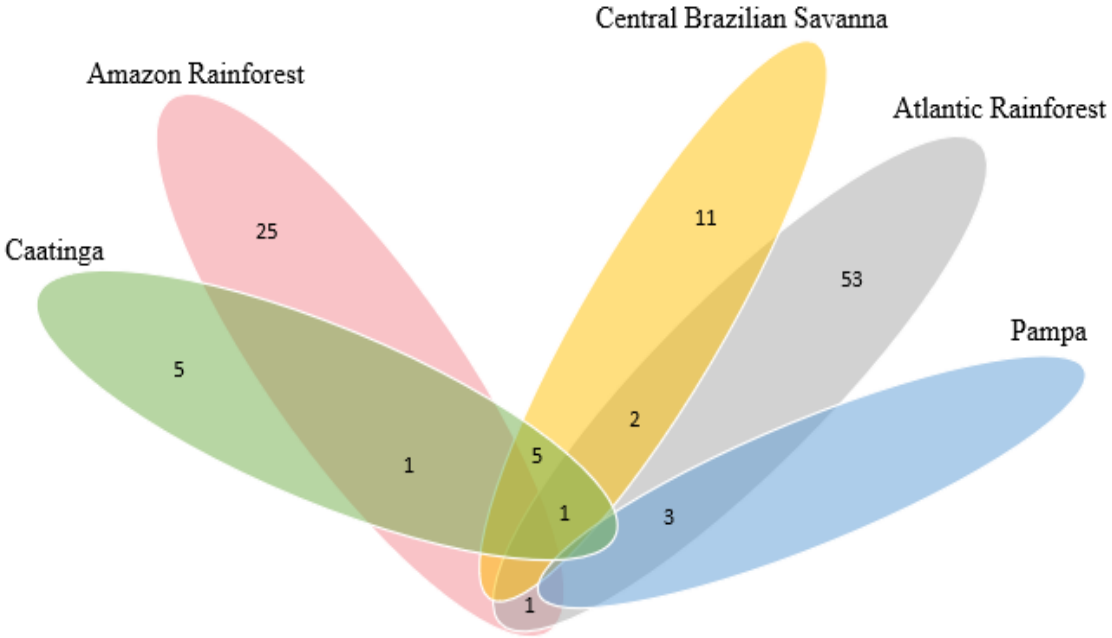

Figure 03 - Reassessed tree species distribution among and within Brazilian biomes.

3.4 Main uses attributed to 107 species trees

Among the 107 species reassessed, 27 species have some type of use, according to bibliographic information or expert indication. Some species have more than one type of use simultaneously. According to **Figure 04**, it is possible to observe the uses attributed to the species (53 indications).

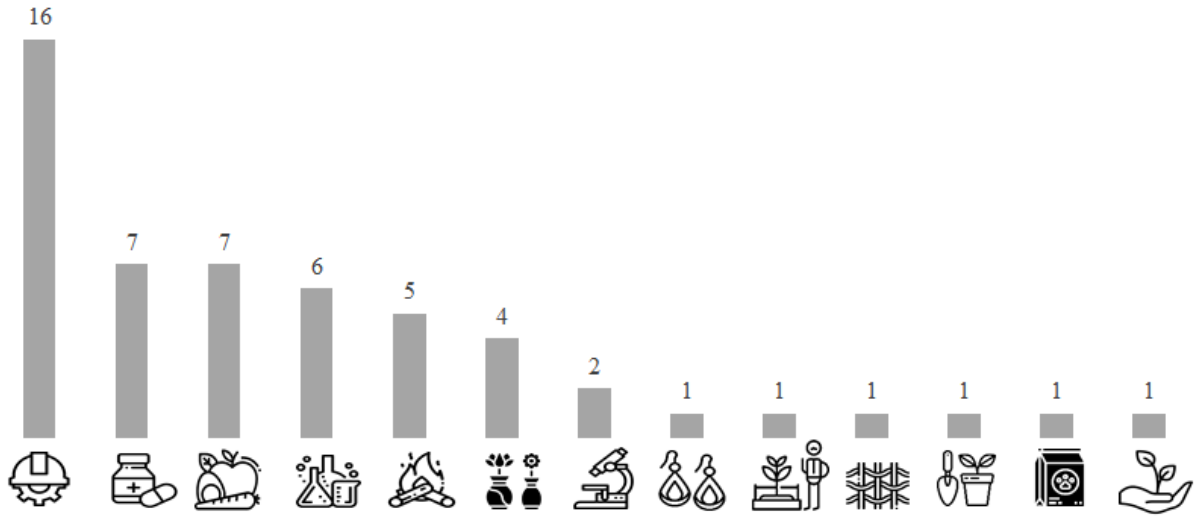

Figure 04 - Number of uses attributed to the species evaluated. Icons are in order from left to right: *Construction/structural materials; Medicine - human and veterinary; Food - human; Manufacturing chemicals; Fuel; Handicrafts, jewellery, decorations, curios, etc.; Research; Wearing apparel, accessories; Sport hunting/specimen collecting; Fibre; Pets/display animals, horticulture; Food - animal* and *Other*.

3.5 Threats to species trees

Altogether, 399 threat events were inserted and associated with 107 species (**Figure 05)**, only one threat event record is not represented in the image below, as it did not fit into any of the threats categories proposed by the IUCN (12.1 Other threat).

Figure 05 - Major threats documented for 107 species following the IUCN Threats Classification Scheme (Version 3.2, 2012).

3.6 Conservation Actions

For the conservation actions compiled during the present work, 85 species were recorded at least once in some type of protected areas. However, even within protected areas many species are under threat.

Still for ongoing conservation actions, 21 species occur in areas covered by National Action Plans and 40 species occur in areas covered by Territorials National Action Plans GEF Pró-Especies under development.

For the existing National Plans, two species occur in territories of the National Action Plan for the Conservation of Endangered Flora of the Grão Mogol-Francisco Sá Region (Pougy et al., 2015a), 7 species in territories of the National Action Plan for the Conservation of Southern Espinhaço Endangered Flora (Pougy et al., 2015b), 6 species in the National Action Plan for the Conservation of Endangered Endemic Flora of the State of Rio de Janeiro (Pougy et al., 2018) and 4 species in the National Action Plan for the Conservation of Lacustrine and Lagoon Systems in Southern Brazil (ICMBio, 2018).

4. Final remarks

Out of 107 extinction risk reassessments, 81 consists of endemic trees, representing their global conservation assessment. The remaining 26 species are not endemic to Brazil and therefore we present here their regional conservation assessment.

Our results indicate that, once nearly 55% of the total reassessed species changed its initial categories, and that out of 107 species initially declared as threatened (CR, EN, VU), 83 species (77%) still being considered under a threat category. Further on, we showed that, out of the 107 species initially considered Threatened, 24 taxa are currently being regarded as Not Threatened.

In the face of many data being brought to light in recent years, species that were published in Red List in 2013 presented new distribution data, being no longer regarded as endemics to Brazil or presenting up to date information on taxonomic uncertainties, which lead to distinct categorization of risk under the IUCN categories and criteria framework.

Digitization of biological collection data is critical for understanding and documenting plant diversity. Over the past decade, botanists experienced the impact of one of the most comprehensive scientific collections and herbaria's digitization efforts. By making biological collection data available online, studies on biodiversity are facilitated, as highlighted by consistent progress verified in recent years with the development of the monographs of Flora do Brasil 2020 (BFG, 2018; Canteiro et al., 2019). This initiative also improved and facilitated the conservation assessment of plant species, not only because it provided an accurate and

validated taxonomic baseline, but also because it made available critical information regarding species' documentation from both a geographic and temporal perspectives, which has proved very important for species' reassessment of conservation status.

Moreover, most plant species conservation assessments rely on geographic data derived from specimens data, and as a consequence, the vast majority of the assessments were conducted using **B criterion** (IUCN, 2019). Population trends data still seldom available for most species, as highlighted by the vast utilization of criteria which are not dependent of this kind of data.

We expect that once reassessments move forward, we will be able to detect patterns of species's category changes over the time frame considered, and correlate it with efforts to bring up to light new data and undertaken conservation actions implemented to safeguard Brazilian plant biodiversity's fate.

In this context, efforts to reassess species extinction risk are worthwhile, especially considering the recent advances experienced in botanic academia data access and sharing improvements. We concluded that conducting reassessments after the time frames defined both nationally (five years since first assessment) and internationally (10 years period since first global assessment) is vital, and the time scale is well defined since it promotes a consistent and much needed accumulation of data to make plausible changes in species extinction risk categories. Next steps of the present project consists in evaluating the extinction risk of further 900 Brazilian trees for the first time, adding up conservation assessments towards the achievement of the Global Tree Campaign main goal.

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