

Preparation of a list of Brazilian plant and fungal species: methods and results

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Abstract

The latest estimates on the richness of the Brazilian flora vary from 61,710 to 70,208 species of bryophytes, pteridophytes, gymnosperms and angiosperms. Over the last decades many new species have been described and there was no national effort to update the knowledge on the country's plant diversity. The only major work to treat it in a comprehensive way was *Flora Brasiliensis*, published by Carl von Martius over one century ago, covering 22,000 species. Besides the academic interest in the matter, the elaboration of a list of formally described species is the first target of the Global Strategy for Plants Conservation (GSPC), and Brazil as a signatory of the Convention on Biological Diversity (CBD), has assumed this commitment. The development of the 'Lista do Brasil' began with a meeting at the Jardim Botânico do Rio de Janeiro in September 2008. By the end of March 2010 the list included 40,989 accepted species and was being corrected and prepared for publication with the help of more than 400 Brazilian and international specialists. The actual number of species of our flora, with the amount of endemisms, and its distribution around the six biomes is presented here.

Keywords

Brazilian flora; GSPC targets; endemism

Introduction

Brazil is one of the most biodiverse countries in the world, encompassing some 15-20% of species known to science. The most recent publications estimate that the Brazilian flora includes 3,100 species of bryophytes, 1,200-1,400 species of ferns, 5-16 species of gymnosperms and 50-60,000 species of angiosperms (Shepherd, 2005; Giulletti *et al.*, 2005). Despite these estimates, the only major work to treat the Brazilian flora in a comprehensive manner was the *Flora Brasiliensis* by Carl von Martius (1846-1906), which covered c.19,958 species with confirmed occurrence in this territory (Martius 1833, Urban 1906). Since that major work, only regional treatments have been published, and many new species have been described, making it almost impossible to calculate precisely how many species are recorded for the country. The work of Sobral & Stehmann (2009) shows that in the last 16 years, 2,875 new species of angiosperms were described for Brazil, indicating a real need for a revision of all information available on our biodiversity.

Beyond the academic interest in the question, Brazil, as a signatory to the Convention on Biological Diversity assumed a number of commitments for the year 2010. Consequently,

on 21st December 2006, the National Biodiversity Committee (CONABIO), the collegiate body of deliberative and consultative groups that coordinates the implementation of commitments made by the country under the Convention, as well as the principles and guidelines of the National Biodiversity Policy, published the resolution specifically stating the Brazilian targets for 2010. This includes the preparation of a list of formally described species of plants, animals and micro-organisms.

To achieve this goal, in August 2008 the Rio de Janeiro Botanic Garden (JBRJ) was designated by the Ministry of Environment (MMA) to coordinate the preparation of the list of species of the Brazilian flora. This nomination was followed by a meeting in September at the JBRJ, where it was determined that the list would include fungi, algae, bryophytes and vascular plants.

Methodology

The development of the list began with a meeting on 18-19th September 2008, which gathered 17 taxonomists of several institutions around Brazil and coordinators of regional lists. The coordinators of families and/or major taxonomic groups and the minimum fields that the list should contain, according to Species 2000, adapted to the country's reality were established at this meeting.

The first step consisted in integrating the lists already published or made available by experts in different groups (e.g. Hennen *et al.*, 2003; Gradstein & Costa, 2003; Barbosa *et al.*, 2006; Maia *et al.*, 2006; Queiroz *et al.*, 2006; Procopiak *et al.*, 2006; Mendonça *et al.*, 2008; Stehmann *et al.*, 2009). Through a partnership between the JBRJ and the Royal Botanic Gardens - Kew, data on the Brazilian flora from the World Checklist of Selected Plant Families (2009) and The International Plant Names Index/IPNI (Authors of Plant Names, 2009) were also made available.

All the information was merged into a system developed by the Centro de Referência em Informação Ambiental (CRIA) to manage the data. After this step, experts (indicated by the coordinator of the family or group) received a password so that they could, on-line, add new data or correct those existing in the system. Once the taxon had all the information needed, the specialist would indicate that the record was "checked".

The list has an on-line version (<http://floradobrasil.jbrj.gov.br/2010>), which is dynamic and will be periodically updated to include new species and taxonomic changes over time. The other product is a book that will be released in September 2010 and presented at the 10th Conference of the Parties (COP 10) in Nagoya, Japan.

Results

During 2009, more than 400 taxonomists worked on a single database, revising about 90,000 names, from which 78,723 were marked as "checked" and are available on-line for public consultation.

As a result of this work, 40,989 species of plants and fungi were documented for Brazil, of which 18,932 (46,2%) are endemic. In the catalogue 3,608 species of fungi, 3,496 algae, 1,521 bryophytes, 1,176 ferns, 26 gymnosperms and 31,162 angiosperms (Forzza *et al.*, 2010) are presented.

Notably, the total number of species reaches only 55% to 65% of the recently published estimates that vary from 61,710 to 70,208 (Lewinsohn & Prado, 2005). If analyzed separately, the results show that the groups are also below the previous evaluations. Fungi represent 26-28%, and algae, 33-46% of the estimations suggested by Lewinsohn & Prado (2005). For bryophytes, for which the values varied from 1,660–3,200 species, it was only slightly below the accounts made by Costa (2009).

The estimates of 1,200-1,400 species of ferns were consistently cited by several studies and the numbers are not very far off (84–98% of the evaluations of Prado, 1998, Shepherd 2005, Lewinsohn & Prado 2005 and MMA, 1998). The richness of Gymnosperms increased, from the previous 14-16, to 26 species, of which three are subsynchronous (*Pinus* L.). The angiosperms are just above the lowest published prior estimate, but far below recent estimates that revolved around 40,000-45,000 species. This is the largest group among plants, holding 76% of the total diversity sampled.

The richest region is the Southeast (21,682), followed by the North (14,615), Northeast (14,054), South 11,350 and Midwest (9,950). The most diverse biome is the Atlantic Forest, with 19,355 species. Amazonia comes in second place, with 13,317 species, followed by Cerrado with 12,669, Caatinga with 5,218, Pampa with 1,964 and Pantanal with 1,240. The Atlantic Forest is also the one with highest endemism, 7,646 (39%), contributing significantly with the country's high values. This pattern is also found in each group separately, the only exception being gymnosperms which are more diverse in the Amazon.

These data show that regions with the highest concentration of active researchers match the domain that presents the greatest diversity of species, the Atlantic Forest. The pattern for fungi is slightly different because the main research groups are in Recife and Rio de Janeiro and Sao Paulo.

References

- Authors of Plant Names. 2009. The International Plant Names Index (IPNI). Published on the Internet <http://www.ipni.org> [accessed 15 March 2009].
- Barbosa, M.R.V.; Sothers, C.; Mayo, S.; Gamarra-Rojas, C. & Mesquita, A.C. (orgs.). 2006. *Checklist das plantas do nordeste brasileiro: Angiospermas e Gymnospermas*. Brasília: Ministério de Ciência e Tecnologia.
- Costa, D.P. 2009. Briófitas. In: Stehmann, J.R., Forzza, R.C., Salino, A., Sobral, M., Costa, D.P. & Kamino, L.H.Y. (Eds.). *Plantas da Floresta Atlântica*. Jardim Botânico do Rio de Janeiro. p. 13–17.
- Forzza, R.C., Baumgratz, J.F.A. Bicudo, C.E.M., Carvalho Jr., A.A., Costa, A., Costa, D.P., Hopkins, M., Leitman, P.M., Lohmann, L.G., Maia, L.C., Martinelli, G., Menezes, M., Morim, M.P., Coelho, M.A.N., Peixoto, A.L., Pirani, J.R., Prado, J., Queiroz, L.P., Souza, V.C., Stehmann, J.R., Sylvestre, L.S., Walter, B.M.T. & Zappi, D. 2010 (eds). *Catálogo de Plantas e Fungos do Brasil*. Jardim Botânico do Rio de Janeiro, Andrea Jakobsson Estúdio Editorial. 1700 p.
- Giulietti, A.M.G., Harley, R.M., Queiroz, L.P., Wanderley, M.G.L. & Van den Berg, C. 2005. Biodiversidade e conservação das plantas no Brasil. *Megadiversidade* 1: 52–61.

- Gradstein, S.R. & Costa, D.P. 2003. The Hepaticae and Anthocerotae of Brazil. *Memoirs of the New York Botanical Garden* 87: 1-318.
- Hennen, J.F., Figueiredo, M.B., Carvalho Jr., A. de A. & Hennen, P.G. 2005. *Catalogue of the species of plant rust fungi (Uredinales) of Brazil*. <http://www.jbrj.gov.br>
- International Plant Names Index (IPNI). 2009. <http://www.ipni.org/stats.html> [acessado 7 de julho de 2010].
- Lewinsohn, T.L. & Prado, P.I. 2005. Quantas espécies há no Brasil? *Megadiversidade* 1: 36–42.
- Martius, C.P.F. (Ed.). 1833. *Flora brasiliensis, pars prior*. Sumptibus J.G. Cottae, Stuttgartiae et Tubingen. p. 1-50.
- Mendonça, R.C., Felfili, J.M., Walter, B.M.T., Silva Júnior, M.C., Rezende, A.V., Filgueiras, T.S., Nogueira, P.E. & Fagg, C.W. 2008. Flora vascular do bioma Cerrado: checklist com 12.356 espécies. In: Sano, S.M., Almeida, S.P. & Ribeiro, J.F. *Cerrado: ecologia e flora*. Brasília, DF. Embrapa Cerrados/Embrapa Informação Tecnológica, v.2., pp.421–1279.
- MMA.1998. Primeiro relatório_nacional para a Convenção da Diversidade Biológica. Ministério do Meio Ambiente, Brasília.
- Prado, J. 1998. Pteridófitas do Estado de São Paulo. In: C.E.M. Bicudo & G.J. Shepherd (eds.). *Biodiversidade do Estado de São Paulo. 2. Fungos Macroscópicos & Plantas*. FAPESP, São Paulo. p. 47-61.
- Procopiak, L.K., Fernandes, L.F. & Moreira filho, H. 2006. Diatomáceas (Bacillariophyta) marinhas e estuarinas do Paraná, Sul do Brasil: lista de espécies com ênfase em espécies nocivas. *Biota Neotropica* 6(3). <http://www.biotaneotropica.org.br>
- Queiroz, L. P., Conceição, A. A. & Giulietti, A. M. 2006. Nordeste semi-árido: caracterização geral e lista das fanerógamas. In: Giulietti, A. M., Conceição, A. A., Queiroz, L. P., (eds.) *Instituto do Milênio do Semi-árido – Diversidade e caracterização das fanerógamas do semi-árido brasileiro*. Recife: Associação Plantas do Nordeste. Vol. 1. Pp. 15–359.
- Shepherd, G.J. 2005. Plantas Terrestres. In: Lewinsohn, T.M. (org.) Avaliação do estado do conhecimento da biodiversidade brasileira. *Série Biodiversidade* 15(2): 145–192.
- Stehmann, J.R., Forzza, R.C., Salino, A., Sobral, M., Costa, D.P. & Kamino, L.H.Y. (Eds.). 2009. *Plantas da Floresta Atlântica*. Jardim Botânico do Rio de Janeiro. 505 pp.
- World Checklist of Selected Plant Families*. 2009. The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; <http://apps.kew.org/wcsp/> accessed 12 March 2009.