



EDITORIAL NOTE

Brazilian legislation on genetic heritage harms Biodiversity Convention goals and threatens basic biology research and education

RUY JOSÉ V. ALVES¹, MARCELO WEKSLER², JOÃO A. OLIVEIRA³, PAULO A. BUCKUP², JOSÉ P. POMBAL JR.², HÉLCIO R.G. SANTANA³, ADRIANO LÚCIO PERACCHI⁴, ALEXANDER W.A. KELLNER⁵, ALEXANDRE ALEIXO⁶, ALFREDO RICARDO L. BONINO⁷, ALZIRA MARIA P. DE ALMEIDA⁸, ANA LUISA ALBERNAZ⁶, CAMILA C. RIBAS⁹, CARLA ZILBERBERG¹⁰, CARLOS EDUARDO V. GRELLE¹⁰, CARLOS FREDERICO D. DA ROCHA¹¹, CARLOS JOSÉ E. LAMAS¹², CÉLIO FERNANDO B. HADDAD¹³, CIBELE R. BONVICINO¹⁴, CYNTHIA P.A. PRADO¹⁵, DANIELA O. DE LIMA¹⁶, DENISE C. ROSSA-FERES¹⁷, FABRÍCIO R. DOS SANTOS¹⁸, FÁTIMA REGINA G. SALIMENA¹⁹, FERNANDO A. PERINI¹⁸, FLÁVIO A. BOCKMANN²⁰, FRANCISCO LUÍS FRANCO²¹, GISELE M.L. DEL GIUDICE²², GUARINO R. COLLI²³, IMA CÉLIA G. VIEIRA⁶, JADER MARINHO-FILHO²³, JANE M.C.F. WERNECK³, JORGE A.D. DOS SANTOS²², JORGE LUIZ DO NASCIMENTO²⁴, JORGE LUIZ NESSIMIAN¹⁰, JOSÉ LUIS P. CORDEIRO²⁵, KLEBER DEL CLARO²⁶, LEANDRO O. SALLES², LILIAN CASATTI¹⁷, LUCIA HELENA R. PY-DANIE¹⁹, LUÍS FÁBIO SILVEIRA¹², LUÍS FELIPE TOLEDO²⁷, LUIZ F. DE OLIVEIRA², LUIZ ROBERTO MALABARBA²⁸, MARCELO D. DA SILVA¹², MÁRCIA S. COURI²⁹, MÁRCIO R.C. MARTINS³⁰, MARCOS D.S. TAVARES¹², MARCOS EDUARDO G. SOBRAL³¹, MARCUS VINÍCIUS VIEIRA¹⁰, MARIA DE LOURDES A. OLIVEIRA³, MÁRIO CÉSAR C. DE PINNA³², MICHAEL J.G. HOPKINS⁹, MIRCO SOLÉ³³, NAÉRCIO A. MENEZES¹², PAULO PASSOS², PAULO SERGIO D'ANDREA³, PEDRO C.E.A. PINTO⁷, PEDRO L. VIANA⁶, PETER M. TOLEDO³⁴, ROBERTO E. DOS REIS³⁵, ROBERTO VILELA³, ROGÉRIO P. BASTOS³⁶, ROSANE G. COLLEVATTI³⁶, RUI C. SILVA¹⁰, SANTIAGO C. FISHER³⁵ and ULISSES CARAMASCHI²

Beginning in November 2018, Brazilian legislation regulating access to genetic heritage and associated traditional knowledge will cause a bureaucratic collapse of Biodiversity research in Brazil. Law number 13.123/2015 and Decree 8772/2016 impose severe barriers to basic and applied research, and to international cooperation by introducing mandatory registry of research access to native organisms in Brazil. This legal framework was meant to improve governmental control over systems of biotechnology research using genetic material and associated chemical compounds, which are central points of the Nagoya Protocol (CBD 2011) and the Convention on Biological Diversity (CBD 1992, 2012). However, the requirements imposed by the mandatory registry of research in the new National System for Governance of Genetic Heritage and Associated Traditional Knowledge (SisGen), the system of Material Transfer Agreements (MTAs), and the need to record access to organismal data prior to publication of scientific results or exportation of specimens for scientific research are technically impracticable and not part of the Nagoya Protocol or CBD. These systems have already begun to compromise biodiversity studies and training of human resources in biological sciences, which depend on international partnerships. Biological collections and laboratories based in Brazil will cease to function due to the high operational costs and legal impediments affecting

Correspondence to: Ruy José Valka Alves
E-mail: ruyvalka@mn.ufrj.br

access to national biodiversity by foreigners. On the global scenario, Brazilian science will certainly lose competitiveness.

In violation to the Nagoya Protocol (CBD 2011), law number 13.123/2015 does not recognize basic scientific research as a special area that should be fostered and stimulated through streamlined processes. The Nagoya Protocol recommends that parties should “[c]reate conditions to promote and encourage research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries, including through simplified measures on access for non-commercial research purposes, taking into account the need to address a change of intent for such research” (CBD 2011, Article 8A). Likewise, article 8C stresses the importance of genetic resources for food and agriculture, and their special importance to food safety. While this last recommendation is followed by Decree 8772/2016 (chapter IV), the recommendation for facilitating non-commercial research is ignored. On the contrary, Kafkian bureaucratic restrictions were created.

Between 2006 and 2015, CGen (the Brazilian Genetic Resources Council) Resolution 21/2006 exempted basic research in evolution, identification of organisms, epidemiology, and organization of scientific collections from the requirements of prior licensing and data registration for accessing the so-called genetic heritage. The resolution did not exempt researchers from several other licensing and mandatory data registration systems, such as the scientific specimens collecting system (SisBio), export licenses, CITES registration of endangered species, ethical requirements, sanitary vigilance approvals, and permits for scientific expeditions, but was a much-needed respite from the bureaucratic burden imposed by the Government. Most significant among these systems are the permit procedures for collecting of specimens, which already requires complex reporting in the SisBio database. Despite the redundancy of these multiple control systems, the new law revoked CGen Resolution 21/2006 in 2015.

The imposed bureaucracy is also retroactive and demands all biology-related research since November 2015 to be regularized by November 2018, and that noncompliant institutions will be liable to substantial fines. The requirement to register hundreds of thousands, and possibly millions, of accesses to organisms will paralyze the functioning of hundreds of laboratories based in Brazilian universities and research institutes. It is worth noting that most basic science researchers in Brazil lack the technical assistance necessary to comply with the new data recording requirements. Long hours, possibly days or months, which are now dedicated to research, curation of collections, and teaching will be deviated to the filling of electronic forms.

To illustrate the burden imposed by the new requirements, based on an estimate of the amount of time necessary to register the DNA sequences of Brazilian organisms with data deposited in GenBank since November 2015 (query: Brasil|Brazil NOT Homo sapiens; release date >11/2015; 683.353 sequences) in the current system, Brazilian scientists would spend a total of 7,116 days filling online forms (using a conservative estimate of 5 minutes per entry, working 8 hours a day in front of a computer). This example deals with a single molecular database. Metagenomic studies imply thousands of accessions per sampling. Systematic and inventory research often involve hundreds to thousands of sampled individuals housed in various collections in Brazil and abroad. Compulsory inclusion of all this data into any database prior to publication is a massive waste of time and resources, considering the very fact that the data will be published.

In addition to increased bureaucratic burden, the law imposes many restrictive rules to international collaboration in non-commercial research. In its very first paragraph, law number 13.123/2015 prohibits foreign researchers from accessing the Brazilian genetic heritage and associated traditional knowledge without fulfilling significant legal and bureaucratic commitments. This means that curators may no longer show specimens deposited in scientific collections to foreign visiting scientists without prior registration of legal contracts among research institutions. Such binding documents include the need to formally record the access to Brazilian biodiversity components prior to publication of results.

The restrictive legislation in Brazil conflicts with global initiatives to foster Biodiversity Sciences. Governments, through the Convention on Biological Diversity, have acknowledged the existence of a “taxonomic impediment” to the sound management of biodiversity (Global Taxonomy Initiative, GTI 2018). The purpose of the GTI is to remove or reduce this taxonomic impediment - in other words, the knowledge gaps in our taxonomic system (including those associated with genetic systems), the shortage of trained taxonomists and curators, and the impact these deficiencies have on our ability to conserve, use and share the benefits of our biological diversity (Global Taxonomy Initiative 2018).

Brazil is a signatory country of the United Nations Convention on Biodiversity (CBD 1992). Article 12 of the CBD emphasizes the need for scientific and technical research, education and training in measures for identification, conservation, and sustainable use of biological diversity. This is a massive task involving thousands of researchers and students. Article 15 of the CBD recognizes the sovereign rights of states over their natural resources and the need to create renditions to facilitate access to genetic resources for environmentally sound uses by other Contracting Parties and *not* to impose restrictions that run counter to the objectives of the CBD.

Recommendations of the eighth meeting of the United Nations Conference of the Parties to the Convention on Biological Diversity COP8 Biodiversity and Systematics workshop and the associated meeting (CBD 2006) included the duplication of support to taxonomy and its infrastructure at the local, national and global levels. The Guiding principles for the drafting of a policy for collections management, research and dissemination of Brazilian Biodiversity Information (CBD 2006) also included the need for international collaboration, a significant expansion of inventory effort, independent and autonomous production of knowledge within the areas of expertise of the researchers and their institutions, and autonomous control by institutions over their collections and associated specimen-based information, over database development for collections-management purposes and over their specimen and information exchange policies.

After becoming a Party to the CBD in 1992, Brazil has invested substantial resources to study its biodiversity, improving the vastly underfunded conditions of institutions with biological reference collections, and elaborating a policy for keeping such collections (Peixoto et al. 2006). In 2006, the national research funding agency CNPq, in partnership with Ministry of Science, Technology and Innovation (MCT) and the Coordination for the Improvement of the Higher Education Personnel (CAPES), created the Taxonomy Training Program (PROTAX), in recognition to the imperious need to know the species composition of Brazil and their phylogenetic relationships to preserve national biodiversity (CNPq 2018). CNPq invested US\$ 1,735,988,196.00 into scholarships and research projects involving the biological sciences (CNPq 2018). At the state level, the BIOTA-FAPESP Program, launched in 1999 (<http://www.fapesp.br/biota/>), became a benchmark of organized effort to know, map and analyze the biodiversity of the State of São

Paulo, including its fauna, flora and microorganisms, as well as to evaluate the possibilities of sustainable exploitation and to subsidize the formulation of conservation policies.

Consistent with the concern about the need to train new highly-skilled professionals in Biodiversity research, CAPES, in 2011, brought together all graduate courses in botany, ecology, oceanography, zoology, and related fields into a new Biodiversity area (<http://capes.gov.br/component/content/article/44-avaliacao/4653-biodiversidade>). This effort has resulted in the largest global organization targeting higher education on Biodiversity, currently covering 141 graduate programs.

Should the currently used interpretations of the law remain unaltered, the most productive research fields will be the most penalized. The performance of Brazilian Zoology in the global scenario has been substantial, with two universities, USP and UFRJ, leading the rank of the number of published papers worldwide (<http://cwur.org/2017/subjects.php#Zoology>). Overall, the performance of biodiversity-based research will become unsustainable, undermining all investment made by government agencies.

We are currently describing less than half the number of species that become extinct every year. In 2009, the formally described species of the world amounted to about 1.9 million species, with 297,897 plants, 98,998 fungi, 64,788 chordates and 1,359,365 invertebrates and 66,307 microorganisms (Chapman 2009). Arthropods may comprise 80-90% of all species of terrestrial macroorganisms (Stork 2010) and 85-95% of arthropods, invertebrates and microorganisms have yet to be named and described (Hollingsworth 2017). By 2016, the World flora had approximately 374,000 described and accepted plant species, and about 2,000 new species were described annually, with Australia, Brazil, China and New Guinea being the largest contributors (Christenhusz and Byng 2016). These authors noted that the numbers of new plant species being described were declining due to reduction in financial and scientific support for fundamental natural history studies. In Brazil this decline is yet to come and this productive phase is at the brink of collapse due to adverse biodiversity legislation.

If we need to know our planet's species to protect them, we are certainly not doing enough and governmental bureaucracy in Brazil is certainly not helping. The current legal framework has already begun to compromise biodiversity studies, activities of natural history collections, and international cooperation. Minimally, in compliance with Article 8 of the Nagoya Protocol, Brazilian authorities should exempt non-commercial biodiversity research from unnecessary bureaucratic burden through legal mechanisms equivalent to the former CGen Resolution 21/2006.

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AUTHORS' AFFILIATIONS

- ¹Departamento de Botânica, Museu Nacional/ UFRJ, Quinta da Boa Vista, s/n, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil
- ²Departamento de Vertebrados, Museu Nacional/UFRJ, Quinta da Boa Vista, s/n, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil
- ³Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Avenida Brasil, 4365, Manguinhos, 21040-360 Rio de Janeiro, RJ, Brazil
- ⁴Universidade Federal Rural do Rio de Janeiro, Instituto de Biologia, Departamento de Biologia Animal, C.P. 74503, 23851-970 Seropédica, RJ, Brazil
- ⁵Laboratório de Sistemática e Tafonomia de Vertebrados Fósseis, Departamento de Geologia e Paleontologia, Museu Nacional/ UFRJ, Quinta da Boa Vista, s/n, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil
- ⁶Museu Paraense Emílio Goeldi, Coordenação de Zoologia, Av. Magalhães Barata, 376, São Braz, 66040-170 Belém, PA, Brazil
- ⁷Universidade Federal da Paraíba, Centro de Ciências Exatas e da Natureza, Campus I, Departamento de Sistemática e Ecologia, CCEN, UFPB, Cidade Universitária, 58059-900 João Pessoa, PB, Brazil
- ⁸Fundação Oswaldo Cruz, Centro de Pesquisas Aggeu Magalhães, Centro de Pesquisa Aggeu Magalhães, Av. Prof. Moraes Rego, s/n, Cidade Universitária, 50670-420 Recife, PE, Brazil
- ⁹Instituto Nacional de Pesquisas da Amazônia, Programa de Coleções e Acervos Científicos, Av. André Araújo, 2936, Aleixo, 69060-001 Manaus, AM, Brazil
- ¹⁰Universidade Federal do Rio de Janeiro, Departamento de Zoologia, UFRJ, Departamento de Zoologia, CCS, Bloco A, Ilha do Fundão, 21941-590 Rio de Janeiro, RJ, Brazil
- ¹¹Departamento de Ecologia, Instituto de Biologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier, 524, Maracanã, 20550-019 Rio de Janeiro, RJ, Brazil
- ¹²Universidade de São Paulo, Museu de Zoologia da USP, Av. Nazaré, 481, Laboratório de Diptera, Sala 404, Ipiranga, 04263-000 São Paulo, SP, Brazil
- ¹³Departamento de Zoologia e Centro de Aquicultura, Universidade Estadual Paulista, Av. 24 A, 1515, 13506-900 Rio Claro, SP, Brazil
- ¹⁴Instituto Nacional de Câncer, Coordenação de Pesquisa, Rua André Cavalcanti, 37, 4º andar, 20231-050, Rio de Janeiro, RJ, Brazil
- ¹⁵Universidade Estadual Paulista, Laboratório de Ecologia e Comportamento de Anuros, Departamento de Morfologia e Fisiologia Animal, Faculdade de Ciências Agrárias e Veterinárias, Via de Acesso Prof. Paulo Donato Castellane Km 05, 14884-900 Jaboticabal, SP, Brazil
- ¹⁶Universidade Federal da Fronteira Sul, Rua Jacob Reinaldo Haupenthal, 1580, Centro, 97900-000 Cerro Largo, RS, Brazil
- ¹⁷Universidade Estadual Paulista, Departamento de Zoologia e Botânica, Instituto de Biociências, Letras e Ciências Exatas, 15054-000 São José do Rio Preto, SP, Brazil
- ¹⁸Universidade Federal de Minas Gerais, Instituto de Ciências Biológicas, Departamento de Biologia Geral, Av. Antonio Carlos, 6627, C.P. 486, Sala L3-244, ICB, Pampulha, 31270-010 Belo Horizonte, MG, Brazil
- ¹⁹Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas, ICB, Departamento de Botânica, Campus Universitário, Martelos, 36036-900 Juiz de Fora, MG, Brazil
- ²⁰Universidade de São Paulo, FFCLRP, Departamento de Biologia, Av. Bandeirantes, 3900, Monte Alegre, 14040-901 Ribeirão Preto SP, Brazil
- ²¹Laboratório Especial de Coleções Zoológicas, Instituto Butantan, Av. Dr. Vital Brasil, 1500, 05503-900 São Paulo, SP, Brazil
- ²²Universidade Federal de Viçosa, Centro de Ciências Biológicas e da Saúde, Campus Universitário, s/n, Centro, 36570-000 Viçosa, MG, Brazil

- ²³ Universidade de Brasília, Departamento de Zoologia, Instituto de Ciências Biológicas, 70910-900 Brasília, DF, Brazil
- ²⁴ Instituto Chico Mendes de Conservação da Biodiversidade/ICMBio, Reserva Biológica Guaribas, PB 071, Km 01 (Estrada para Jacaraú), Pau D'Arco, Zona Rural, 58280-000 Mamanguape, PB, Brazil
- ²⁵ Fundação Oswaldo Cruz, Estrada Rodrigues Caldas, 3400, Taquara, 22713-375 Rio de Janeiro, RJ, Brazil
- ²⁶ Diretor de Pesquisa, Universidade Federal de Uberlândia, Rua Ceará, s/n, Umuarama, 38400-902 Uberlândia, MG, Brazil
- ²⁷ Universidade Estadual de Campinas, Multiusuário de Bioacústica, Laboratório de História Natural de Anfíbios Brasileiros, Departamento de Biologia Animal, Instituto de Biologia, 13083-970 Campinas, SP, Brazil
- ²⁸ Presidente da Sociedade Brasileira de Ictiologia, Universidade Federal do Rio Grande do Sul, Instituto de Biociências, Departamento de Zoologia, Av. Bento Gonçalves, 9500, Agronomia, 91501-970 Porto Alegre, RS, Brazil
- ²⁹ Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, s/n 20940-040 Rio de Janeiro, RJ, Brazil
- ³⁰ Presidente da Sociedade Brasileira Herpetologia, Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, Rua do Matão, Trav. 14, 05508-090 São Paulo, Brazil
- ³¹ Universidade Federal de São João Del-Rei, Departamento de Ciências Naturais, Praça Dom Helvécio, 74, Dom Bosco, 36301-160 São João Del Rei, MG, Brazil
- ³² Diretor, Universidade de São Paulo, Museu de Zoologia da USP, Departamento de Vertebrados, Av. Nazaré, 481, Caixa Postal 42494, Ipiranga, 05422-970 São Paulo, SP, Brazil
- ³³ Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, Rod. Jorge Amado, Km 16, 45662-900 Salobrinho, Ilhéus, BA, Brazil
- ³⁴ Instituto Nacional de Pesquisas Espaciais, Coordenação Ciência do Sistema Terrestre, Avenida dos Astronautas, 1758, Jardim da Granja, 12227-010 São Jose dos Campos, SP, Brazil
- ³⁵ Escola de Ciências, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga 6681, Prédio 40, sala 110, 90619-900 Porto Alegre, RS, Brazil
- ³⁶ Universidade Federal de Goiás, Laboratório de Ecologia e Comportamento Animal, Departamento de Ecologia, Instituto de Ciências Biológicas, 74000-970 Goiânia, GO, Brazil