



POLICY FORUM

BIODIVERSITY CONSERVATION

When the cure kills—CBD limits biodiversity research

National laws fearing biopiracy squelch taxonomy studies

By **K. Divakaran Prathapan¹, Rohan Pethiyagoda², Kamaljit S. Bawa³, Peter H. Raven⁴, Priyadarsanan Dharma Rajan,⁵ and 172 co-signatories from 35 countries***

The Convention on Biological Diversity (CBD) commits its 196 nation parties to conserve biological diversity, use its components sustainably, and share fairly and equitably the benefits from the utilization of genetic resources. The last of these objectives was further codified in the Convention's Nagoya Protocol (NP), which came into effect in 2014. Although these aspirations are laudable, the NP and resulting national ambitions on Access and Benefit Sharing (ABS) of genetic resources have generated several national regulatory regimes fraught with unintended consequences (1). Anticipated benefits from the commercial use of genetic resources, especially those that might flow to local or indigenous communities because of regulated access to those resources, have largely been exaggerated and not yet realized. Instead, national regulations created in anticipation of commercial benefits, particularly in many countries that are rich in biodiversity, have curtailed biodiversity research by in-country scientists as well as international collaboration (1). This weakens the first and foremost

objective of the CBD—conservation of biological diversity. We suggest ways that the Conference of the Parties (CoP) of the CBD may proactively engage scientists to create a regulatory environment conducive to advancing biodiversity science.

The opportunity to ever know about many of the kinds of organisms with which we share this world is rapidly slipping through our fingers. Of the estimated 12 million species of eukaryotes on Earth, fewer than 2 million have been named. Current estimates are that 20% of the species on Earth are in danger of extinction, driven primarily by a range of human activities. Although biological resources had long been treated as a common heritage of humankind, the CBD reinforced the notion of sovereign rights of nation states over biological resources within their political boundaries and entrusted the nation parties to take measures to share benefits arising from the utilization of genetic resources. In most countries, particularly developing countries, the agendas of numerous pressure groups, many of them well-intended but not prioritizing science, get mixed up during the legislative process, while conservation biologists and taxonomists, a vanishingly small constituency, hold little leverage. Thus, the resulting national legislations vary greatly, from being extremely prohibitive of research, to a very few that are relatively enabling, such as Costa Rica and South Africa. The problem is particularly acute where there is a poor policy-science interface resulting from weak scientific institutions.

In many developing nations, conservation approaches may be largely reduced to mere protectionism—preventing deforestation and

Taxonomy of many species of *Rhododendron* from the Himalaya (four are seen flowering) is uncertain.

prohibiting the destruction of fauna and flora. Given the magnitude of the threats, effective conservation also demands the scientific understanding of species, the anthropogenic and other disturbances they face, and the development of scientific conservation interventions. None of this is possible unless scientists have access to the resources they seek to study, and ability to share resources and expertise with other countries. No one country will ever have the expertise to identify all the plants, animals, fungi, and protists that it contains.

COMMERCIAL VALUE: HYPE VERSUS REALITY

The CBD inspired many biodiversity-rich nations to entertain unrealistic expectations regarding the commercial value of their native species. It is true that important medicines have been derived from plants, and less commonly, animals. However, a widely publicized example (2) that captured the public imagination and the attention of governments, estimating that “11 of the top 25 best-selling pharmaceutical products are entities derived from natural products,” is misleading. These “natural products” are derived largely from ubiquitous organisms over which sovereign ownership or community interest could not be reasonably or practically asserted. Eight are derived from fungi common in soil or similar environments, and two are obtained from genetically engineered bacteria or ovarian cells (2).

Additionally, high-throughput screening, combinatorial chemistry, synthetic biology, and other advanced methodologies have largely replaced the role of natural products in the discovery of new molecules for developing new drugs, rendering physical access to biological material less important than it has been in the past. Modern technologies, including CRISPR gene editing, are redefining the modalities of access and utilization of biological resources in ways that were not foreseeable during NP negotiations.

Overall, examples of financially significant ABS agreements, a quarter-century after the CBD was signed, are scarce. Often-mentioned cases are marginal arrangements for the use of plant extracts for treatment of bone fractures as is traditional in the Cook Islands, the failed Merck-INBio initiative in Costa Rica, and the now discredited case of the “Indian ginseng.” A survey of mostly megadiverse countries having functional ABS legislation showed that very few commercial ABS agreements (2.05 per year per country) have been concluded (3), suggesting lack of demand for genetic resources by potential users, as well as restrictive procedures for access, as factors for the poor performance.

¹Kerala Agricultural University, Thiruvananthapuram 695522, Kerala, India. ²Ichthyology Section, Australian Museum, Sydney, New South Wales, Australia. ³University of Massachusetts, Boston, MA, USA. ⁴Missouri Botanical Garden, St. Louis, MO 63166, USA. ⁵Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore 560064, India. *A full list of co-signatories can be found in the supplementary materials. Email: prathapankd@gmail.com; priyan@atree.org

OBSTACLES TO RESEARCH

The principles underlying the CBD and NP are laudable, and underscore that international collaboration in research is crucial for conservation of biodiversity and that access to genetic resources should be facilitated. However, even as national governments, following the CBD, began to enact legislation to regulate access to their biological resources and benefit-sharing from the derived products, consequences of such actions on biodiversity research and food security were pointed out by the science community (4–6). About 100 countries have enacted, or are considering, laws that regulate access by scientists to biological material and benefit sharing. Since the CBD came into effect, and especially after the NP led nation states to step up legislative processes to tighten their control over genetic resources (1, 7), obtaining permits for access to specimens for noncommercial research has become increasingly difficult in many countries in South Asia, East Africa, and South America, including megadiverse countries and biodiversity hotspots (8). More than 1200 Brazilian researchers recently submitted an appeal to the Ministry of the Environment to differentiate taxonomic studies from commercial research under the New Biodiversity Law (9). In some cases, researchers have even been prosecuted.

Although the importance of biological inventories and taxonomy is widely appreciated, especially by the CBD itself, for most nations, including those with the largest numbers of species, the cataloging of species remains woefully incomplete, an already difficult challenge made more so by legislation ensuing from the CBD (1, 4). Taxonomy involves comparison of preserved specimens, including types scattered across the world's natural history museums. Although most countries have established institutions for regulating access and material transfer, cross-border exchange and loaning of such historical specimens, and taxonomic revisions and monographic studies on widely distributed groups of organisms, can now be extremely challenging, if not impossible owing to fears of biopiracy. Although the system works well among developed countries, museums may be wary of risks of loaning specimens to scientists in developing countries, fearing that their return may not be permitted. Biodiversity research has seemingly become suspect in the minds of many regulatory bodies, owing to fear that a taxonomic discovery today might conceivably translate into a commercial development tomorrow. Meanwhile, biodiversity is vanishing and scarce talent is walking away from research.

The recent decision to consider the use of digital sequence information (DSI) under the framework of the CBD and NP (10) may

go beyond physical access to genetic materials and run counter to the larger overall goals of the CBD. Scientific information in the form of DSI is increasingly being published through portals of the International Nucleotide Sequence Database Collaboration (INSDC) such as GenBank. Unlimited and open access of DSI encourages collaboration to gain insights into the evolution, maintenance, conservation, and sustainable use of biological diversity.

Although NP Article 8(a) appears to encourage regulations that do not impede bona fide scientific research, the NP's definition of the "utilization of genetic resources" as the "means to conduct research and development on the genetic and/or biochemical composition of genetic resources" (Article 2c) makes no exceptions for purely academic or conservation-related biodiversity research, such as taxonomic studies. The protocol cautions nations to take into account "the need to address a change of intent for such research," effectively warning regulators of the "risk" of pure research spawning commercial applications.

FINDING SOLUTIONS IN SEEDS

With the sovereignty of nations over their biological resources now well established, and the ABS regimes put in place by many countries, individual states are unlikely to discontinue restrictive practices on their own, despite the CBD itself acknowledging the importance of research and knowledge-sharing. Though well-intentioned, the regulations are inimical to the pursuit of basic biodiversity science. The CoP should recognize the problem and urge the parties to establish enabling legal mechanisms for conservation-relevant biodiversity research, including taxonomy. Without close cooperation between scientists and national policy-making bodies, the broader goals of the CBD will be difficult to achieve.

Not-for profit research, such as inventories and taxonomic studies intended for the public domain, should be differentiated from commercial research leading to proprietary rights (8). Access has to be open when the benefits are in the public domain and the providers of the resource are free to make use of the benefits like anybody else. However, if the benefits are confined to the private realm through intellectual property rights, the provider may secure a share bilaterally (11).

The International Treaty on Plant Genetic Resources for Food and Agriculture, popularly known as the "Seed Treaty," provides a promising model. This treaty ensures worldwide public accessibility of genetic resources of essential food and fodder crops. Whereas the CBD and NP necessitate access to genetic resources on a bilateral basis through case-

by-case negotiations, the Seed Treaty adopted a multilateral system for access and benefit sharing (MLS) through a Standard Material Transfer Agreement, averting the need for bilateral negotiations. The MLS established under the Seed Treaty has been viewed as a very successful model in terms of volume of material exchanged (8500 transfers every week) (12), in contrast to the very limited performance of the bilateral system of CBD and NP (3). Exchange of genetic material under the Seed Treaty is exempted from the NP, and the benefit-sharing requirement arises only when access for further research and breeding is restricted through intellectual property rights. One possible course of action for the CoP to the CBD might be to add an explicit treaty or annex to promote and facilitate biodiversity research, conservation, and international collaboration. Such a treaty will address legal uncertainties in the governance of global research commons such as microbial culture collections held by the World Federation of Culture Collections as well as DSI published through the portals of INSDC or taxonomic type materials held in various museums all over the world.

As scientists aspiring to describe Earth's biological diversity in the face of formidable odds, we ask that the parties to the CBD do more to raise the legal curtain that has fallen between biodiversity scientists and the biodiversity they strive to discover, document, and conserve. ■

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SUPPLEMENTARY MATERIALS

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K. Divakaran Prathapan*, Rohan Pethiyagoda, Kamaljit S. Bawa, Peter H. Raven,
Priyadarsanan Dharma Rajan*, and 172 co-signatories from 35 countries

*Corresponding author. Email: prathapankd@gmail.com (K.D.P.); priyan@atree.org (P.D.R.)

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List of co-signatories

List of co-signatories

Luis E. Acosta (luis.acosta@unc.edu.ar), Instituto de Diversidad y Ecología Animal (IDEA), CONICET-Universidad Nacional de Córdoba, Córdoba, Argentina

Byron Adams (byron_adams@byu.edu), Monte L. Bean Museum, Brigham Young University, Provo, Utah, USA

Sina Adl (sina.adl@usask.ca), University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Shane T. Ah Yong (shane.ahyong@austmus.gov.au), Australian Museum, Sydney, New South Wales, Australia

Robert Anderson (randerson@mus-nature.ca), Canadian Museum of Nature, Ottawa, Ontario, Canada

Claudia P. Arango (claudia.arango@qm.qld.gov.au), Queensland Museum, South Brisbane, Queensland, Australia

Miquel A. Arnedo (marnedo@gmail.com), Department of Evolutionary Biology, Ecology and Environmental Sciences & Biodiversity Research Institute, University of Barcelona, Barcelona, Spain

Jonathan W. Armbruster (armbrjw@auburn.edu), Auburn University, Auburn, Alabama, USA

Luciano Javier Avila (avilacnp@gmail.com), IPEEC-CONICET, Puerto Madryn, Chubut, Argentina

Celso O. Azevedo (bethylidae@gmail.com), Universidade Federal do Espírito Santo, Vitória, Espírito Santo, Brazil

Diego Baldo (diegobaldo@gmail.com), Universidad Nacional de Misiones, Posadas, Argentina

Maxwell V. L. Barclay (m.barclay@nhm.ac.uk), Natural History Museum, London, UK

Rosemarie Baron-Szabo (Rosemarie.Baron-Szabo@senckenberg.de), Smithsonian Institution, Washington, DC, USA; and Senckenberg Research Institute, Frankfurt/Main, Germany

Aaron M. Bauer (aaron.bauer@villanova.edu), Villanova University, Villanova, Pennsylvania, USA

Bastian Bentlage (bastian.bentlage@gmail.com), University of Guam Marine Laboratory, Mangilao, Guam, USA

Aleš Bezděk (bezdek@entu.cas.cz), Biology Centre CAS, Institute of Entomology, 370 05 České Budějovice, Czech Republic

Graham Bird (zeuxo@clear.net.nz), Waikanae, Kapiti, 5036, New Zealand

Vladimir Blagoderov (v.blagoderov@nms.ac.uk), National Museums Scotland, UK

Ladislav Bocak (ladislav.bocak@upol.cz), Department of Zoology, Faculty of Science, Palacky University, Olomouc, Czech Republic

Alexandre Bonaldo (bonaldo@museu-goeldi.br), Museu Paraense Emílio Goeldi, Belém, Pará, Brazil

Jason E. Bond (jbond@auburn.edu), Department of Biological Sciences, Auburn University, Auburn, Alabama, USA

Christopher J. Borkent (chris.borkent@gmail.com), California State Collection of Arthropods, California Department of Food and Agriculture, Sacramento, California, USA

Marc A. Branham (marcbran@ufl.edu), Department of Entomology and Nematology, University of Florida, Gainesville, Florida, USA

Salvador Carranza (salvador.carranza@ibe.upf-csic.es), Institut de Biologia Evolutiva, Barcelona, Spain

Ramon Carreno (racarren@owu.edu), Ohio Wesleyan University, Delaware, Ohio, USA.

M. R. de Carvalho, (gogolia99@gmail.com), American Museum of Natural History, Central Park West at 79th Street, New York, NY, 10024, U.S.A.

Santiago Castroviejo-Fisher (castroviejo.fisher@gmail.com), Lab. de Sistemática de Vertebrados, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Av. Ipiranga, 6681, Prédio 40, sala 110, 90619-900, Porto Alegre, Brazil

Hideyuki Chiba (chiba.zootaxa@gmail.com), Bernice Pauahi Bishop Museum, Honolulu, Hawai'i, USA

Fedor Čiampor (f.ciampor@savba.sk), Plant Science and Biodiversity Centre, Slovak Academy of Sciences, Bratislava, Slovakia

Dave J. Clarke (djclarke@memphis.edu), Department of Biological Sciences, The University of Memphis, Memphis, Tennessee, USA

Allen G. Collins (tesserazoa4zt@gmail.com), Smithsonian Institution, National Museum of Natural History, Washington, DC, USA

Reginaldo Constantino (termites.zootaxa@gmail.com), Departamento de Zoologia, Universidade de Brasília, Brasília, Distrito Federal, Brazil

Francisco A. Crespo (crespo.zootaxa@gmail.com), Centro Nacional de Diagnóstico e Investigación en Endemo-epidemias, Buenos Aires, Argentina

Marymegan Daly (daly.66@osu.edu) Ohio State University, Columbus, Ohio USA

Patrycja Dominiak (heliocopris@gmail.com), Department of Invertebrate Zoology and Parasitology, University of Gdańsk, 80-308 Gdańsk, Poland

Norm Dronen (n-dronen@tamu.edu), Laboratory of Parasitology, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas, USA

Alain Dubois (adubois@mnhn.fr), Muséum National d'Histoire Naturelle, Paris, France

Thomas F. Duda, Jr. (tfduda@umich.edu), University of Michigan Museum of Zoology & Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, Michigan, USA

Marc Eléaume (marc.eleaume@mnhn.fr), Muséum national d'Histoire naturelle, Département Origine et Évolution, CP 51, 57 rue Cuvier, 75231 Paris Cedex 05, France

Sven Erlacher (erlacher@naturkunde-chemnitz.de), Museum of Natural History, Chemnitz, Germany

Pedro Cordeiro Estrela (pedrocometa@gmail.com), Universidade Federal da Paraíba, João Pessoa, Paraíba, Brazil

Neal Evenhuis (neale@bishopmuseum.org), Bernice Pauahi Bishop Museum, Honolulu, Hawai'i, USA

Karin Hoch Fehlauer-Ale (fehlauer.ale@gmail.com), Lab. de Bentos, Centro de Estudos do Mar, Universidade Federal do Paraná, Pontal do Paraná, Paraná, Brazil

Hans Fery (hanfry@aol.com), Zoologische Staatssammlung München, München, Germany

Uwe Fritz (Uwe.Fritz@senckenberg.de), Senckenberg Natural History Collections, Dresden, Germany

Stephen D. Gaimari (stephen.gaimari@cdfa.ca.gov), Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California, USA

Rosser Garrison (rgarrison@cdfa.ca.gov), Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California, USA.

Philippe Gaubert (philippe.gaubert@umontpellier.fr), Institut de Recherche pour le Développement / Institut des Sciences de l'Évolution de Montpellier, Université de Montpellier, 34095 Montpellier, France

Daniel L. Geiger (geiger@vetigastropoda.com), Santa Barbara Museum of Natural History, Santa Barbara, California, USA

Anthony C. Gill (gill.anthony@gmail.com), Macleay Museum and School of Life and Environmental Sciences, A12 - Macleay Building, The University of Sydney, New South Wales 2006, Australia

Matthew L. Gimmel (mgimmel@sbnature2.org), Santa Barbara Museum of Natural History, Santa Barbara, California, USA

Tom Goldschmidt (tomgoldschmidt@web.de), Zoologische Staatssammlung München, München, Germany

Rajkamal Goswami (rajkamalgoswami@gmail.com), Center For Research in Ecology, Development and Research (CEDAR), House No. 201, Phase 1, Vasant Vihar, Dehradun-248006, Uttarakhand, India

Abel Pérez González (abelaracno@gmail.com), Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina

Victor H. Gonzalez (vhgonza@ku.edu), University of Kansas, Lawrence, Kansas, 66045, USA

Dennis Gordon (Dennis.Gordon@niwa.co.nz), National Institute of Water & Atmospheric Research, Private Bag, 14901, Kilbirnie, Wellington, New Zealand

David J. Gower (d.gower@nhm.ac.uk), Natural History Museum, London, UK

Penelope Greenslade (p.greenslade@federation.edu.au), Faculty of Science, Federation University, Ballarat, Victoria 3353, Australia

Vladimir I. Gusarov (vladimir.gusarov@nhm.uio.no), Natural History Museum, University of Oslo, Oslo, Norway

Eduardo Hajdu (eduardo.hajdu@gmail.com), Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

Danilo Harms (danilo.harms@uni-hamburg.de), Dept. of Arachnology, *Centrum für Naturkunde (CeNak) - Center of Natural History*, Universität Hamburg - Zoological Museum, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

Matthew P. Heinicke (heinicke@umich.edu), University of Michigan-Dearborn, Dearborn, Michigan, USA

Eric J. Hilton (ehilton@vims.edu), Department of Fisheries Science, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia, USA

C.J. Hodgson (HodgsonCJ@cardiff.ac.uk), The National Museum of Wales, Cardiff, CF10 3NP, UK

Gustavo Hormiga (hormiga@gwu.edu), George Washington University, Washington, D.C., USA

Lauren E. Hughes (l.hughes@nhm.ac.uk), Natural History Museum, London, UK

Pat Hutchings (pat.hutchings@austmus.gov.au), Australian Museum, Sydney, New South Wales, Australia

Peter Jäger (Peter.jaeger@senckenberg.de), Senckenberg Research Institute, Senckenberganlage 25, 60325 Frankfurt, Germany

John T. Jennings (J_JENNINGS@onaustralia.com.au), University of Adelaide, Adelaide, South Australia, Australia

Marcin Kadej (marcin.kadej@uwr.edu.pl), Department of Invertebrate Biology, Evolution and Conservation, University of Wrocław, Wrocław, Poland

Lauri Kaila (Lauri.Kaila@Helsinki.fi), Zoology Unit, Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland

Marcin Jan Kamiński (mkaminski@miiz.waw.pl), Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland

G.S. Karaman (karaman@t-com.me), Academy of Science and Arts of Montenegro, Podgorica, Montenegro

Tom Karanovic (tomislav.karanovic@gmail.com), University of Tasmania, Hobart, Tasmania, Australia

Jeyaraney Kathirithamby (jeyaraney.kathirithamby@zoo.ox.ac.uk), Department of Zoology, University of Oxford, Oxford, UK

Peter H. Kerr (peter.kerr@cdfa.ca.gov), Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California, USA

Lawrence R. Kirkendall (lawrence.kirkendall@uib.no), University of Bergen, Bergen, Norway

Marcelo Visentini Kitahara (mvkitahara@unifesp.br), Universidade Federal de São Paulo, Campus Baixada Santista, Santos, São Paulo, Brazil

Michelle Klautau (mklautau@gmail.com), Universidade Federal do Rio de Janeiro, Instituto de Biologia - Departamento de Zoologia, Laboratório de Biologia de Porifera
Av. Carlos Chagas Filho 373 - CCS - Bloco A - Sala A0-100, Ilha do Fundão - Rio de Janeiro – RJ, Brazil

Boris C. Kondratieff (Boris.Kondratieff@Colostate.edu), Colorado State University, Dept. of Bioagricultural Sciences & Pest Management, Fort Collins, Colorado, USA

Andreas Kroh (andreas.kroh@nhm-wien.ac.at), Naturhistorisches Museum Wien, Vienna, Austria

Facundo M. Labarque (facundo.labarque@gmail.com), Laboratório Especial Coleções Zoológicas, Instituto Butantan, São Paulo, Brazil

John M. Leavengood, Jr. (johnshorrorcorner@gmail.com), Florida State Collection of Arthropods, Florida Department of Agriculture and Consumer Services, Gainesville, Florida, USA

Agostino Letardi (agostino.letardi@enea.it), ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Rome, Italy

Ai-Ping Liang (liangap@ioz.ac.cn), Institute of Zoology, Chinese Academy of Sciences, Beijing, China

Flávio C.T. Lima (fctlima@gmail.com), Universidade Estadual de Campinas, Instituto de Biologia, Museu de História Natural Prof. Adão José Cardoso, Campinas, São Paulo, Brazil

Zhiwei Liu (zliu@eiu.edu), Eastern Illinois University, Charleston, Illinois, USA

Ivan Löbl (ivan.lobl@bluewin.ch), Muséum d'histoire naturelle, Geneva, Switzerland

Volker Lohrmann (v.lohrmann@uebersee-museum.de), Übersee-Museum Bremen, Bremen, Germany

Nikolaus Malchus (Bivalvia.Zootaxa@gmx.net), Institut Català de Paleontologia Miquel Crusafont, Catalunya, Spain

M. B. Malipatil (Mallik.Malipatil@ecodev.vic.gov.au), La Trobe University / Agriculture Victoria, AgriBio, Bundoora, Victoria, Australia

Antonio C. Marques (marques@ib.usp.br), Instituto de Biociências e Centro de Biologia Marinha, Universidade de São Paulo, São Paulo, Brazil

R. Matzke-Karasz (r.matzke@lrz.uni-muenchen.de), Ludwig-Maximilians-University, München, Germany

Georg Mayer (gmayer@onychophora.com), Department of Zoology, University of Kassel, 34132 Kassel, Germany

Jaime G. Mayoral (mayoralj@fiu.edu), Department of Biological Sciences. Florida International University, Miami, Florida, USA

S. J. McInnes (s.mcinnnes@bas.ac.uk), British Antarctic Survey, Cambridge, CB3 0ET, UK

Alessandro Minelli (alessandro.minelli@unipd.it), University of Padova, Padova, Italy

Melinda L. Moir (Melinda.Moir@dpird.wa.gov.au), Agriculture and Food, Department of Primary Industries and Regional Development, South Perth, Western Australia, 6151, Australia

Scott Monks (monks.scott@gmail.com), Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, México

Juan J. Morrone (juanmorrone2001@yahoo.com.mx), Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad de México, México

C. Muster (muster@rz.uni-leipzig.de), 18581 Putbus, Germany

Zoltán Tamás Nagy (zoltan-tamas.nagy@naturalsciences.be), Royal Belgian Institute of Natural Sciences, Brussels, Belgium

K. Seena Narayanan (seena.narayanan@atree.org), Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore – 560064, India

Eugenio H. Nearns (gino@nearns.com), Purdue University, West Lafayette, Indiana, USA

Jeff Nekola (jnekola@unm.edu), University of New Mexico, Albuquerque, New Mexico, USA

Silvio S. Nihei (silvionihei@gmail.com), Instituto de Biociências, Universidade de São Paulo, São Paulo, Brazil

Alexander Nützel (a.nuetzel@lrz.uni-muenchen.de), SNSB-Bayerische Staatssammlung für Paläontologie und Geologie, Department of Earth and Environmental Sciences, Palaeontology & Geobiology, GeoBio-Center LMU, Richard-Wagner-Str. 10, 80333 Munich, Germany.

Annemarie Ohler (annemarie.ohler@gmail.com), Muséum National d'Histoire Naturelle, Paris, France

Victor Goyannes Dill Orrico (zootaxa.hylids@gmail.com), Universidade Estadual de Santa Cruz, Ilhéus, Bahia, Brazil

Jose M. Padial (jpadial@amnh.org), American Museum of Natural History, New York, New York, USA

Lawrence M. Page (lpage1@ufl.edu), Florida Museum of Natural History, University of Florida, Gainesville, Florida, USA

Paulo Passos (ppassos@mn.ufrj.br), Departamento de Vertebrados, Museu Nacional, Rio de Janeiro, Brazil

Dennis Paulson (dpaulson@pugetsound.edu), Slater Museum of Natural History, Tacoma, Washington, USA

Philip D. Perkins (perkins@oeb.harvard.edu), Department of Entomology, Museum of Comparative Zoology, Harvard University, USA

Tobias Pfingstl (dr.tobias.pfingstl@gmail.com), Karl-Franzens-Universität Graz, Graz, Austria

Carlos Prieto (prieto.zootaxa@gmail.com), Universidad del Atlántico, Facultad de Ciencias Básicas, Departamento de Biología, Barranquilla, Colombia

Lívia Rodrigues Pinheiro (lrpinheiro@gmail.com), Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil

Ricardo Pinto-da-Rocha (ricrocha@usp.br), Instituto de Biociências, Universidade de São Paulo, São Paulo, Brazil

Lorenzo Prendini (lorenzo@amnh.org), Division of Invertebrate Zoology, American Museum of Natural History, New York, New York, USA

Benjamin Price (neuropterida@gmail.com), Natural History Museum, London, UK

Jurate De Prins (jurate.deprins@gmail.com), Royal Belgian Institute of Natural Sciences, Brussels, Belgium

Martin Ramirez (ramirez@macn.gov.ar), Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina

Claus Rasmussen (claus.rasmussen@bios.au.dk), Aarhus University, Aarhus, Denmark

P. Rasmussen (rasmus39@msu.edu), Michigan State University Museum, East Lansing, Michigan, USA

David Redei (david.redei@gmail.com), Nankai University, Tianjin, China

Ignacio Ribera (ignacio.ribera@ibe.upf-csic.es), Institut de Biologia Evolutiva, Barcelona, Spain

Antonio Ricarte (ricarte24@gmail.com), Centro Iberoamericano de la Biodiversidad (CIBIO), Universidad de Alicante, San Vicente del Raspeig, Alicante, Spain

Julio Rivera (julio.riverac@usil.pe), Universidad San Ignacio de Loyola, Lima, Peru

Michael G. Rix (michael.rix@qm.qld.gov.au), Biodiversity and Geosciences Program, Queensland Museum, Brisbane, Queensland, Australia

Bruno Rossaro (bruno.rossaro@unimi.it), Università degli Studi di Milano, Milano, Italy

Aniruddha Datta Roy (datta.roy82@gmail.com), Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

Gustavo R.S. Ruiz (gustavoruiz86@hotmail.com), Universidade Federal do Pará, Belém, Pará, Brazil

Frederico F. Salles (ffsalles@gmail.com), Laboratório de Sistemática e Ecologia de Insetos, Universidade Federal do Espírito Santo, São Mateus, Espírito Santo, Brazil

Allen F. Sanborn (asanborn@barry.edu), Barry University, Miami Shores, Florida, USA

Michel Sartori (michel.sartori@vd.ch), Musée cantonal de zoologie, Lausanne, Switzerland

Matthias Schöller (schoeller@tricho.b.shuttle.de), Biologische Beratung, Berlin, Germany

Rüdiger M. Schmelz (rmschmelz@gmail.com), University of A Coruña, A Coruña, Spain

Michael Schrödl (Michael.Schroedl@zsm.mwn.de), Zoologische Staatssammlung München, München, Germany

Gabriel Hoinsoude Segniagbeto (h_segniagbeto@yahoo.fr) University of Lome, Lome, Togo

J. Serrano (jserrano@um.es), Universidad de Murcia, Murcia, Spain

Satoshi Shimano (sim@hosei.ac.jp), Hosei University, Fujimi, Chiyoda, Tokyo, Japan

Mann Kyoon Shin (mkshin@ulsan.ac.kr), University of Ulsan, Ulsan, Korea (South)

Ekaterina Sidorchuk (e.a.sidorchuk@gmail.com), Arthropoda Laboratory, Paleontological Institute, Russian Academy of Sciences, Moscow, Russia.

Cameron D. Siler (camsiler@ou.edu), Sam Noble Oklahoma Museum of Natural History and Department of Biology, University of Oklahoma, Norman, Oklahoma, USA

Boris Sket (Boris.Sket@BF.uni-lj.si), Univerza v Ljubljani, Ljubljana, Slovenia

Aaron D. Smith (aaron.smith@nau.edu), Northern Arizona University, Flagstaff, Arizona, USA

Andrew B.T. Smith (asmith@unl.edu), Canadian Museum of Nature, Ottawa, Ontario, Canada

Robin Smith (smith@lbn.go.jp), Lake Biwa Museum, Kusatsu, Shiga, Japan

Allan H. Smith-Pardo (Allan.H.Smith-Pardo@aphis.usda.gov), 389 Oyster Point Blvd. Suite 2, South San Francisco, CA. 94080, USA

John Sparks (otophysic@gmail.com), Department of Ichthyology, American Museum of Natural History, New York, New York, USA

W. E. Sterrer (westerrer@gov.bm), Bermuda Natural History Museum, Flatts, Bermuda

Adam Stroński (adam@miiz.waw.pl), Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland

Jörundur Svavarsson (jorundur@hi.is), University of Iceland, Reykjavík, Iceland

Mario Toledo (toledo.pinguicula.mario3@gmail.com), Brescia, Italy

Evan Twomey (evan.twomey@gmail.com), Pontifical Universidade Católica do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil

Karthikeyan Vasudevan (karthik@ccmb.res.in), Centre for Cellular & Molecular Biology, Telangana, India

Miguel Vences (m.vences@tu-braunschweig.de), Technical University of Braunschweig, Braunschweig, Germany

Nicole de Voogd (nicole.devoogd@naturalis.nl), Naturalis Biodiversity Center, Leiden, The Netherlands

Qiao Wang (Q.Wang@massey.ac.nz), Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand

Gillian W. Watson (gillian.watson@cdfa.ca.gov), Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California, USA

Wanda M. Weiner (weiner@isez.pan.krakow.pl), Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Krakow, Poland

Marcelo Weksler (mweksler@mn.ufrj.br), Departamento de Vertebrados, Museu Nacional, Rio de Janeiro, Brazil

Thomas Wesener (t.wesener@leibniz-zfmk.de), Zoological Research Museum A. Koenig, Leibniz Institute for Terrestrial Biodiversity, Bonn, Germany

Daniel Whitmore (d.whitmore@nhm.ac.uk), Natural History Museum, London, UK

Helena Wiklund (h.wiklund@nhm.ac.uk), Natural History Museum, London, UK

Paul H. Williams (P.Williams@nhm.ac.uk), Natural History Museum, London, UK

Shaun L. Winterton (wintertonshaun@gmail.com), Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California, USA

Timothy S. Wood (tim.wood@wright.edu), Department of Biological Sciences, Wright State University, Dayton, Ohio, USA

Shen-Horn Yen (shenhornyen@gmail.com), National Sun Yat-Sen University, Kaohsiung, Taiwan

Hussam Zaher (hussam.zaher@gmail.com), Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil

Z.-Q. Zhang (zhangz@landcareresearch.co.nz), New Zealand Arthropod Collection, Landcare Research, Auckland 1072, New Zealand

Hong-zhang Zhou (zhouhz@ioz.ac.cn), Key Laboratory of Zoological Systematics and Evolution Institute of Zoology, Beijing, China