

The PREDICTS database: a global database of how local terrestrial biodiversity responds to human impacts

Lawrence N. Hudson^{1*}, Tim Newbold^{2,3*}, Sara Contu¹, Samantha L. L. Hill^{1,2}, Igor Lysenko⁴, Adriana De Palma^{1,4}, Helen R. P. Phillips^{1,4}, Rebecca A. Senior², Dominic J. Bennett⁴, Hollie Booth^{2,5}, Argyrios Choimes^{1,4}, David L. P. Correia¹, Julie Day⁴, Susy Echeverría-Londoño^{1,4}, Morgan Garon⁴, Michelle L. K. Harrison⁴, Daniel J. Ingram⁶, Martin Jung⁷, Victoria Kemp⁴, Lucinda Kirkpatrick⁸, Callum D. Martin⁴, Yuan Pan⁹, Hannah J. White¹⁰, Job Aben¹¹, Stefan Abrahamczyk¹², Gilbert B. Adum^{13,14}, Virginia Aguilar-Barquero¹⁵, Marcelo A. Aizen¹⁶, Marc Ancrenaz¹⁷, Enrique Arbeláez-Cortés^{18,19}, Inge Armbrrecht²⁰, Badrul Azhar^{21,22}, Adrián B. Azpiroz²³, Lander Baeten^{24,25}, Andrés Báldi²⁶, John E. Banks²⁷, Jos Barlow^{28,29}, Péter Batáry³⁰, Adam J. Bates³¹, Erin M. Bayne³², Pedro Beja³³, Åke Berg³⁴, Nicholas J. Berry³⁵, Jake E. Bicknell^{36,37}, Jochen H. Bihn³⁸, Katrin Böhning-Gaese^{39,40}, Teun Boekhout⁴¹, Céline Boutin⁴², Jérémy Bouyer^{43,44}, Francis Q. Brearley⁴⁵, Isabel Brito⁴⁶, Jörg Brunet⁴⁷, Grzegorz Buczkowski⁴⁸, Erika Buscardo^{49,50,51}, Jimmy Cabra-García⁵², María Calviño-Cancela⁵³, Sydney A. Cameron⁵⁴, Eliana M. Canello⁵⁵, Tiago F. Carrijo⁵⁵, Anelena L. Carvalho⁵⁶, Helena Castro⁵⁷, Alejandro A. Castro-Luna⁵⁸, Rolando Cerda⁵⁹, Alexis Cerezo⁶⁰, Matthieu Chauvat⁶¹, Frank M. Clarke⁶², Daniel F. R. Cleary⁶³, Stuart P. Connop⁶⁴, Biagio D'Aniello⁶⁵, Pedro Giovâni da Silva⁶⁶, Ben Darvill⁶⁷, Jens Dauber⁶⁸, Alain Dejean^{69,70}, Tim Diekötter^{71,72,73}, Yamileth Dominguez-Haydar⁷⁴, Carsten F. Dormann⁷⁵, Bertrand Dumont⁷⁶, Simon G. Dures^{4,77}, Mats Dynesius⁷⁸, Lars Edenius⁷⁹, Zoltán Elek⁸⁰, Martin H. Entling⁸¹, Nina Farwig⁸², Tom M. Fayle^{4,83,84}, Antonio Felicioli⁸⁵, Annika M. Felton⁸⁶, Gentile F. Ficetola⁸⁷, Bruno K. C. Filgueiras⁸⁸, Steven J. Fonte⁸⁹, Lauchlan H. Fraser⁹⁰, Daisuke Fukuda⁹¹, Dario Furlani⁹², Jörg U. Ganzhorn⁹³, Jenni G. Garden^{94,95}, Carla Gheler-Costa⁹⁶, Paolo Giordani⁹⁷, Simonetta Giordano⁹⁸, Marco S. Gottschalk⁹⁹, Dave Goulson⁶, Aaron D. Gove^{100,101}, James Grogan¹⁰², Mick E. Hanley¹⁰³, Thor Hanson¹⁰⁴, Nor R. Hashim¹⁰⁵, Joseph E. Hawes^{106,107}, Christian Hébert¹⁰⁸, Alvin J. Helden¹⁰⁹, John-André Henden¹¹⁰, Lionel Hernández¹¹¹, Felix Herzog¹¹², Diego Higuera-Díaz¹¹³, Branko Hilje^{114,115}, Finbarr G. Horgan¹¹⁶, Roland Horváth¹¹⁷, Kristoffer Hylander¹¹⁸, Paola Isaacs-Cubides¹¹⁹, Masahiro Ishitani¹²⁰, Carmen T. Jacobs¹²¹, Víctor J. Jaramillo¹²², Birgit Jauker¹²³, Mats Jonsell¹²⁴, Thomas S. Jung¹²⁵, Vena Kapoor¹²⁶, Vassiliki Kati¹²⁷, Eric Katovai^{128,129}, Michael Kessler¹³⁰, Eva Knop¹³¹, Annette Kolb¹³², Ádám Körösi^{133,134}, Thibault Lachat¹³⁵, Victoria Lantschner¹³⁶, Violette Le Féon¹³⁷, Gretchen LeBuhn¹³⁸, Jean-Philippe Lègaré¹³⁹, Susan G. Letcher¹⁴⁰, Nick A. Littlewood¹⁴¹, Carlos A. López-Quintero¹⁴², Mounir Louhaichi¹⁴³, Gabor L. Lövei¹⁴⁴, Manuel Esteban Lucas-Borja¹⁴⁵, Victor H. Luja¹⁴⁶, Kaoru Maeto¹⁴⁷, Tibor Magura¹⁴⁸, Neil Aldrin Mallari^{149,150}, Erika Marin-Spiotta¹⁵¹, E. J. P. Marshall¹⁵², Eliana Martínez¹⁵³, Margaret M. Mayfield¹⁵⁴, Grzegorz Mikusinski¹⁵⁵, Jeffrey C. Milder¹⁵⁶, James R. Miller¹⁵⁷, Carolina L. Morales¹⁶, Mary N. Muchane¹⁵⁸, Muchai Muchane¹⁵⁹, Robin Naidoo¹⁶⁰, Akihiro Nakamura¹⁶¹, Shoji Naoe¹⁶², Guiomar Nates-Parra¹⁶³, Dario A. Navarrete Gutierrez¹⁶⁴, Eike L. Neuschulz³⁹, Norbertas Noreika¹⁶⁵, Olivia Norfolk¹⁶⁶, Jorge Ari Noriega¹⁶⁷, Nicole M. Nöske¹⁶⁸, Niall O'Dea¹⁶⁹, William Oduro^{13,14}, Caleb Ofori-Boateng^{170,171}, Chris O. Oke¹⁷², Lynne M. Osgathorpe¹⁷³, Juan Paritsis¹⁷⁴, Alejandro Parra-H^{175,176}, Nicolás Pelegrin¹⁷⁷, Carlos A. Peres¹⁷⁸, Anna S. Persson¹⁷⁹, Theodora Petanidou¹⁸⁰, Ben Phalan¹⁸¹, T. Keith Philips¹⁸², Katja Poveda¹⁸³, Eileen F. Power¹⁸⁴, Steven J. Presley¹⁸⁵, Vânia Proença¹⁸⁶, Marino Quaranta¹⁸⁷, Carolina Quintero¹⁷⁴, Nicola A. Redpath-Downing¹⁸⁸, J. Leighton Reid¹⁸⁹, Yana T. Reis¹⁹⁰, Danilo B. Ribeiro¹⁹¹, Barbara A. Richardson^{192,193}, Michael J. Richardson^{192,193}, Carolina A. Robles¹⁹⁴, Jörg Römbke^{39,195}, Luz Piedad Romero-Duque¹⁹⁶, Loreta Rosselli¹⁹⁶, Stephen J. Rossiter¹⁹⁷, T'ai H. Roulston^{198,199}, Laurent Rousseau²⁰⁰, Jonathan P. Sadler²⁰¹, Szabolcs Sáfian²⁰², Romeo A. Saldaña-Vázquez²⁰³, Ulrika Samnegård²⁰⁴, Christof Schüepp¹³¹, Oliver Schweiger²⁰⁵, Jodi L. Sedlock²⁰⁶, Ghazala Shahabuddin²⁰⁷, Douglas Sheil^{208,209}, Fernando A. B. Silva²¹⁰, Eleanor M. Slade²¹¹, Allan H. Smith-Pardo^{212,213}, Navjot S. Sodhi²¹⁴, Eduardo J. Somarriba⁵⁹, Ramón A. Sosa²¹⁵, Jane C. Stout²¹⁶, Matthew J. Struebig³⁶, Yik-Hei Sung²¹⁷, Caragh G. Threlfall²¹⁸, Rebecca Tonietto^{219,220}, Béla Tóthmérész²²¹, Teja Tschamtko³⁰, Edgar C. Turner²²², Jason M. Tylianakis^{4,223}, Adam J. Vanbergen²²⁴, Kiril Vassilev²²⁵, Hans A. F. Verboven²²⁶, Carlos H. Vergara²²⁷, Pablo M. Vergara²²⁸, Jort Verhulst²²⁹, Tony R. Walker^{166,230}, Yanping Wang²³¹, James I. Watling²³²,

Konstans Wells^{233,234}, Christopher D. Williams²³⁵, Michael R. Willig^{236,237}, John C. Z. Woinarski²³⁸, Jan H. D. Wolf²³⁹, Ben A. Woodcock²⁴⁰, Douglas W. Yu^{241,242}, Andrey S. Zaitsev^{243,244}, Ben Collen²⁴⁵, Rob M. Ewers⁴, Georgina M. Mace²⁴⁵, Drew W. Purves³, Jörn P. W. Scharlemann^{2,6} & Andy Purvis^{1,4}

¹Department of Life Sciences, Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

²United Nations Environment Programme World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge, CB3 0DL, U.K.

³Computational Ecology and Environmental Science, Microsoft Research, 21 Station Road, Cambridge, CB1 2FB, U.K.

⁴Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, SL5 7PY, U.K.

⁵Frankfurt Zoological Society, Africa Regional Office, PO Box 14935, Arusha, Tanzania

⁶School of Life Sciences, University of Sussex, Brighton, BN1 9QG, U.K.

⁷Center for Macroecology, Climate and Evolution, the Natural History Museum of Denmark, Universitetsparken 15, 2100 Copenhagen, Denmark

⁸School of Biological and Ecological Sciences, University of Stirling, Bridge of Allan, Stirling, FK9 4LA, U.K.

⁹Department of Animal and Plant Sciences, University of Sheffield, Alfred Denny Building, Western Bank, Sheffield, S10 2TN, U.K.

¹⁰School of Biological Sciences, Queen's University Belfast, 97 Lisburn Road, Belfast BT9 7BL, U.K.

¹¹Evolutionary Ecology Group, University of Antwerp, Groenenborgerlaan 171, 2020 Antwerp, Belgium

¹²Nees Institute for Plant Biodiversity, University of Bonn, Meckenheimer Allee 170, 53113 Bonn, Germany

¹³Department of Wildlife and Range Management, FRNR, CANR, KNUST, Kumasi, Ghana

¹⁴SAVE THE FROGS! Ghana, Box KS 15924, Adum-Kumasi, Ghana

¹⁵Escuela de Biología, Universidad de Costa Rica, 2060 San José, Costa Rica

¹⁶CONICET, Lab. INIBIOMA (Universidad Nacional del Comahue-CONICET), Pasaje Gutierrez 1125, 8400 Bariloche, Rio Negro, Argentina

¹⁷HUTAN – Kinabatangan Orang-utan Conservation Programme, PO Box 17793, 88874 Kota Kinabalu, Sabah, Malaysia

¹⁸Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, México D.F., Mexico

¹⁹Colección de Tejidos, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Km 17 Cali-Palmira, Valle del Cauca, Colombia

²⁰Department of Biology, Universidad del Valle, Calle 13 #100-00, Cali, Colombia

²¹Biodiversity Unit, Institute of Bioscience, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

²²Faculty of Forestry, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

²³Laboratorio de Genética de la Conservación, Instituto de Investigaciones Biológicas Clemente Estable, Montevideo, Uruguay

²⁴Department of Forest and Water Management, Forest & Nature Lab, Ghent University, Geraardsbergsesteenweg 267, 9090 Gontrode, Belgium

²⁵Terrestrial Ecology Unit, Department of Biology, Ghent University, K. L. Ledeganckstraat 35, 9000 Gent, Belgium

²⁶MTA Centre for Ecological Research, Alkotmány u. 2-4, 2163 Vácrátót, Hungary

²⁷University of Washington, 1900 Commerce Street, Tacoma, Washington 98402

²⁸Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4YQ, U.K.

²⁹MCT/Museu Paraense Emílio Goeldi, Belém, Pará, Brazil

³⁰Agroecology, Georg-August University, Grisebachstrasse 6, 37077 Göttingen, Germany

³¹University of Birmingham, Edgbaston, Birmingham, B15 2TT, U.K.

³²Department of Biological Sciences, University of Alberta, CW 405 – Biological Sciences Centre, Edmonton, AB T6G 2E9, Canada

³³EDP Biodiversity Chair, CIBIO/InBio, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, 4485-601 Vairão, Portugal

³⁴The Swedish University of Agricultural Sciences, The Swedish Biodiversity Centre, SE 750 07 Uppsala, Sweden

³⁵University of Edinburgh, School of GeoSciences, Crew Building, King's Buildings, West Mains Road, Edinburgh EH9 3JN, U.K.

³⁶Durrell Institute of Conservation and Ecology (DICE), School of Anthropology and Conservation, University of Kent, Canterbury CT2 7NR, U.K.

³⁷Iwokrama International Centre for Rainforest Conservation and Development, 77 High Street, Georgetown, Guyana

³⁸Department of Animal Ecology, Philipps-University Marburg, Karl-von-Frisch Strasse 8, 35032 Marburg, Germany

³⁹Biodiversity and Climate Research Centre (BiK-F), Senckenberg Gesellschaft für Naturforschung, Senckenberganlage 25, 60325 Frankfurt am Main, Germany

⁴⁰Institute for Ecology, Evolution & Diversity, Biologikum, Goethe University Frankfurt, Max von Laue St. 13, D 60439 Frankfurt am Main, Germany

⁴¹CBS-KNAW Fungal Biodiversity Centre, Utrecht, The Netherlands

⁴²Environment Canada, Science & Technology Branch, Carleton University, 1125 Colonel By Drive, Raven Road, Ottawa, ON K1A 0H3, Canada

⁴³Unité Mixte de Recherche Contrôle des Maladies Animales Exotiques et Emergentes, Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), 34398 Montpellier, France

⁴⁴Unité Mixte de Recherche 1309 Contrôle des Maladies Animales Exotiques et Emergentes, Institut national de la recherche agronomique (INRA), 34398 Montpellier, France

⁴⁵School of Science and the Environment, Manchester Metropolitan University, Chester Street, Manchester, M1 5GD, U.K.

⁴⁶University of Évora – ICAAMA, Apartado 94, 7002-554 Évora, Portugal

⁴⁷Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences, Box 49, 230 53 Alnarp, Sweden

⁴⁸Department of Entomology, Purdue University, 901 W. State Street, West Lafayette, 47907 Indiana

⁴⁹Centro de Ecologia Funcional, Departamento de Ciências da Vida, Universidade de Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal

⁵⁰Escritório Central do LBA, Instituto Nacional de Pesquisa da Amazônia, Av. André Araújo, 2936, Campus II, Aleixo, CEP 69060-001, Manaus, AM, Brazil

⁵¹Department of Botany, School of Natural Sciences, Trinity College Dublin, College Green, Dublin 2, Ireland

⁵²Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, São Paulo, SP 05508-090, Brazil

⁵³Department of Ecology and Animal Biology, Faculty of Sciences, University of Vigo, 36310 Vigo, Spain

- ⁵⁴Department of Entomology, University of Illinois, Urbana, Illinois 61801
- ⁵⁵Museu de Zoologia da Universidade de São Paulo, Av. Nazaré 481, 04263-000, São Paulo, SP, Brazil
- ⁵⁶Instituto Nacional de Pesquisas da Amazônia, Av. André Araújo, 2.936, Petrópolis, CEP 69067-375, Manaus, AM, Brazil
- ⁵⁷Centre for Functional Ecology, Department of Life Sciences, University of Coimbra, Calçada Martim de Freitas, 3000-456 Coimbra, Portugal
- ⁵⁸Instituto de Biotecnología y Ecología Aplicada (INBIOTECA), Universidad Veracruzana, Av. de las Culturas Veracruzanas, 101, Col. Emiliano Zapata, CP 91090 Xalapa, Veracruz, Mexico
- ⁵⁹Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Tropical Agricultural Research and Higher Education Center, 7170 Cartago, Turrialba, 30501 Costa Rica
- ⁶⁰Department of Quantitative Methods and Information Systems, Faculty of Agronomy, University of Buenos Aires, Av. San Martín 4453, Ciudad Autónoma de Buenos Aires, Argentina C.P. 1417, Argentina
- ⁶¹Normandie Univ., EA 1293 ECODIV-Rouen, SFR SCALE, UFR Sciences et Techniques, 76821 Mont Saint Aignan Cedex, France
- ⁶²University of Aberdeen, Aberdeen, AB24 2TZ, U.K.
- ⁶³Department of Biology, CESAM, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
- ⁶⁴Sustainability Research Institute, University of East London, 4-6 University Way, London E16 2RD, U.K.
- ⁶⁵Department of Biology, University of Naples "Federico II", Naples, Italy
- ⁶⁶Programa de Pós-graduação em Ecologia, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, CEP 88040-900, Brazil
- ⁶⁷British Trust for Ornithology, University of Stirling, Stirling FK9 4LA, U.K.
- ⁶⁸Thünen Institute of Biodiversity, Bundesallee 50, 38116 Braunschweig, Germany
- ⁶⁹CNRS, Écologie des Forêts de Guyane (UMR-CNRS 8172), BP 316, 97379 Kourou cedex, France
- ⁷⁰Université de Toulouse, UPS, INP, Laboratoire Écologie Fonctionnelle et Environnement (Ecolab), 118 route de Narbonne, 31062 Toulouse, France
- ⁷¹Department of Landscape Ecology, Institute for Nature and Resource Conservation, Kiel University, Olshausenstrasse 75, 24098 Kiel, Germany
- ⁷²Department of Biology, Nature Conservation, University Marburg, Marburg, Germany
- ⁷³Institute of Integrative Biology, ETH Zurich, Switzerland
- ⁷⁴Programa de Biología, Universidad del Atlántico Km 7 vía Puerto Colombia, Atlántico, Colombia
- ⁷⁵Biometry and Environmental System Analysis, University of Freiburg, Tennenbacher Strasse 4, 79106 Freiburg, Germany
- ⁷⁶INRA, UMR1213 Herbivores, 63122 Saint-Genès-Champagnelle, France
- ⁷⁷Institute of Zoology, Zoological Society of London, Nuffield Building, Regents Park, London, NW1 4RY, U.K.
- ⁷⁸Department of Ecology and Environmental Science, Umeå University, 901 87 Umeå, Sweden
- ⁷⁹Wildlife, Fish and Environmental Studies, Swedish University of Agricultural Sciences, 901 83 Umeå, Sweden
- ⁸⁰MTA-ELTE-MTM Ecology Research Group, Hungarian Academy of Sciences, c/o Biological Institute, Eötvös Lóránd University, Pázmány Péter sétány 1/C., 1117 Budapest, Hungary and Hungarian Natural History Museum, Baross u. 13., 1088 Budapest, Hungary
- ⁸¹University of Koblenz-Landau, Institute for Environmental Sciences, Fortstr. 7, 76829 Landau, Germany
- ⁸²Department of Ecology – Conservation Ecology, Faculty of Biology, Philipps-Universität Marburg, Karl-von-Frisch-Street 8, 35032 Marburg, Germany
- ⁸³Faculty of Science, University of South Bohemia and Institute of Entomology, Biology Centre of Academy of Sciences Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic
- ⁸⁴Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, 88999 Kota Kinabalu, Sabah, Malaysia
- ⁸⁵Dipartimento di Scienze Veterinarie, Università di Pisa, Viale delle Piagge, n°2, 56124 Pisa, Italy
- ⁸⁶The Southern Swedish Forest Research Centre, The Swedish University of Agricultural Sciences, PO Box 49, 23453 Alnarp, Sweden
- ⁸⁷Laboratoire d'Ecologie Alpine (LECA), Université Grenoble Alpes, F-38000 Grenoble, France
- ⁸⁸Programa de Pós-Graduação em Biologia Animal, Universidade Federal de Pernambuco, Recife PE 50670-901, Brazil
- ⁸⁹Department of Plant Sciences, University of California, Davis, California 95616
- ⁹⁰Department of Natural Resource Sciences, Thompson Rivers University, 900 McGill Road, Kamloops, BC V2C 0C8, Canada
- ⁹¹IDEA Consultants Inc, Okinawa Branch Office, Aja 2-6-19, Naha, Okinawa 900-0003, Japan
- ⁹²Carl Zeiss Microscopy GmbH, Königsallee 9 – 21, 37081 Göttingen, Germany
- ⁹³University of Hamburg, Biocentre Grindel, Martin-Luther-King Platz 3, 20146 Hamburg, Germany
- ⁹⁴Seed Consulting Services, 106 Gilles Street, Adelaide 5000 SA, Australia
- ⁹⁵School of Geography, Planning and Environmental Management, The University of Queensland, St Lucia 4072, Qld, Australia
- ⁹⁶Ecologia Aplicada/Applied Ecology, Universidade Sagrado Coração (USC), Rua Irmã Arminda, 10-50, Jardim Brasil, Bauru, São Paulo, Brazil
- ⁹⁷DISTAV, University of Genova, Corso Dogali 1M, 16136 Genova, Italy
- ⁹⁸Dipartimento di Biologia, Università di Napoli Federico II, Campus Monte S. Angelo, Via Cinthia 4, 80126 Napoli, Italy
- ⁹⁹Universidade Federal de Pelotas (UFPEL), PO Box 354, CEP 96010-900, Pelotas RS, Brazil
- ¹⁰⁰Astron Environmental Services, 129 Royal Street, East Perth WA 6004, Australia
- ¹⁰¹Department of Environment and Agriculture, Curtin University, Kent Street, Bentley, WA 6102, Australia
- ¹⁰²Mount Holyoke College, Department of Biological Sciences, South Hadley, Massachusetts 01075
- ¹⁰³School of Biological Science, University of Plymouth, Drake's Circus, Plymouth, PL4 8AA, U.K.
- ¹⁰⁴351 False Bay Drive, Friday Harbor, Washington 98250
- ¹⁰⁵International University of Malaya-Wales, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
- ¹⁰⁶Coordenação de Botânica, Museu Paraense Emílio Goeldi, Caixa Postal 399, CEP 66040-170, Belém, Pará, Brazil
- ¹⁰⁷School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ, U.K.
- ¹⁰⁸Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, 1055 du P.E.P.S., PO Box 10380, Québec, QC G1V 4C7, Canada
- ¹⁰⁹Animal & Environmental Research Group, Department of Life Sciences, Anglia Ruskin University, East Road, Cambridge, CB1 1PT, U.K.

- ¹¹⁰University of Tromsø, Department of Arctic and Marine Biology, 9037 Tromsø, Norway
- ¹¹¹Universidad Nacional Experimental de Guayana, Apdo. Postal 8050, Puerto Ordaz 8015, Estado Bolívar, Venezuela
- ¹¹²Agroscope, Reckenholzstr. 191, 8046 Zurich, Switzerland
- ¹¹³Corporación Sentido Natural, Carrera 70H No. 122 – 98, Apartamento 101, Bogotá, Colombia
- ¹¹⁴Escuela de Ingeniería Forestal, Tecnológico de Costa Rica, Apartado 159-7050, Cartago, Costa Rica
- ¹¹⁵Asociación para la Conservación y el Estudio de la Biodiversidad (ACEBIO), Casa 15, Barrio Los Abogados, Zapote, San José, Costa Rica
- ¹¹⁶International Rice Research Institute, DAPO Box 7777, Metro Manila, The Philippines
- ¹¹⁷University of Debrecen, Department of Ecology, PO Box 71, 4010 Debrecen, Hungary
- ¹¹⁸Department of Ecology, Environment and Plant Sciences, Stockholm University, 106 91 Stockholm, Sweden
- ¹¹⁹Instituto de Investigaciones y Recursos Biológicos Alexander von Humboldt, Bogotá, Colombia
- ¹²⁰Hiroshima University, Graduate School of Education, 1-1-1, Kagamiyama, Higashi-Hiroshima 739-8524, Japan
- ¹²¹Scarab Research Group, University of Pretoria, Pretoria, South Africa
- ¹²²Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México, A.P. 27-3 Santa María de Guido, Morelia, Michoacán, México C.P. 58090, Mexico
- ¹²³Department of Animal Ecology, Justus-Liebig University, Heinrich-Buff-Ring 26-32, 35392 Giessen, Germany
- ¹²⁴Swedish University of Agricultural Sciences, Department of Ecology, Box 7044, 750 07 Uppsala, Sweden
- ¹²⁵Yukon Department of Environment, P.O. Box 2703, Whitehorse, YT Y1A 2C6, Canada
- ¹²⁶Nature Conservation Foundation, Mysore, India
- ¹²⁷Department of Environmental & Natural Resources Management, University of Patras, Seferi 2, 30100 Agrinio, Greece
- ¹²⁸Centre for Tropical Environmental and Sustainability Science (TESS) and School of Marine and Tropical Biology, James Cook University, Cairns, Qld, Australia
- ¹²⁹School of Science and Technology, Pacific Adventist University, Port Moresby, Papua New Guinea
- ¹³⁰Institute of Systematic Botany, University of Zurich, Zollikerstrasse 107, 8008 Zurich, Switzerland
- ¹³¹Institute of Ecology and Evolution, University of Bern, Baltzerstrasse 6, 3012 Bern, Switzerland
- ¹³²Institute of Ecology, University of Bremen, FB2, Leobener Str., 28359 Bremen, Germany
- ¹³³MTA-ELTE-MTM Ecology Research Group, Pázmány Péter s. 1/c, Budapest 1117, Hungary
- ¹³⁴Field Station Fabrikshleichach, Biocenter, University of Würzburg, Glasshüttenstr. 5, 96181 Rauhenebrach, Germany
- ¹³⁵Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Zürcherstrasse 11, 8903 Birmensdorf, Switzerland
- ¹³⁶Instituto Nacional de Tecnología Agropecuaria, EEA Bariloche, 8400 Bariloche, Argentina
- ¹³⁷INRA, UR 406 Abeilles et Environnement, F-84914 Avignon, France
- ¹³⁸Department of Biology, San Francisco State University, 1600 Holloway Ave, San Francisco, California 94132
- ¹³⁹Laboratoire de diagnostic en phytoprotection, Ministère de l'agriculture, des pêcheries et de l'alimentation du Québec, 2700 rue Einstein, QC G1P 3W8, Canada
- ¹⁴⁰Purchase College (State University of New York), 735 Anderson Hill Road, Purchase, New York 10577
- ¹⁴¹The James Hutton Institute, Craigiebuckler, Aberdeen, AB15 8QH, U.K.
- ¹⁴²Universidad de Antioquia, Calle 67 No. 53 – 108, Medellín, Colombia
- ¹⁴³International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. Box 950764, Amman, 11195 Jordan
- ¹⁴⁴Aarhus University, Department of Agroecology, Flakkebjerg Research Centre, Forsøgsvej 1, 4200 Slagelse, Denmark
- ¹⁴⁵Castilla La Mancha University, School of Advanced Agricultural Engineering, Department of Agroforestry Technology and Science and Genetics, Campus Universitario s/n, C.P. 02071, Albacete, Spain
- ¹⁴⁶Universidad Autónoma de Nayarit, Unidad Académica de Turismo, Coordinación de Investigación y Posgrado, Ciudad de la Cultura Amado Nervo s/n, C.P. 63155 Tepic, Nayarit, Mexico
- ¹⁴⁷Graduate School of Agricultural Science, Kobe University, Kobe, 657-8501, Japan
- ¹⁴⁸Hortobágy National Park Directorate, 4002 Debrecen, P.O.Box 216, Hungary
- ¹⁴⁹Fauna & Flora International Philippines, #8 Foggy Heights Subdivision San Jose, Tagaytay City 4120, Philippines
- ¹⁵⁰De La Salle University-Dasmariñas, West Ave, Dasmariñas 4115, Philippines
- ¹⁵¹Department of Geography, University of Wisconsin-Madison, 550 North Park Street, Madison, Wisconsin 53706
- ¹⁵²Marshall Agroecology Ltd, 2 Nut Tree Cottages, Barton, Winscombe, BS25 1DU, U.K.
- ¹⁵³Escuela de Posgrados, Facultad de Agronomía, Doctorado en Agroecología, Universidad Nacional de Colombia, Cra 30 No. 45-03, Ciudad Universitaria, Bogotá, Colombia
- ¹⁵⁴The University of Queensland, School of Biological Sciences, Brisbane, Qld 4120, Australia
- ¹⁵⁵Swedish University of Agricultural Sciences, Department of Ecology, Grimsö Wildlife Research Station, 730 91 Riddarhyttan, Sweden
- ¹⁵⁶Rainforest Alliance, 233 Broadway, 28th Floor, New York City, New York 10279
- ¹⁵⁷Department of Natural Resources and Environmental Sciences, N-407 Turner Hall, MC-047, 1102 South Goodwin Ave., Urbana, Illinois 61801
- ¹⁵⁸National Museums of Kenya, Botany Department, P.O. Box 40658, 00100 Nairobi, Kenya
- ¹⁵⁹Department of Zoology, National Museums of Kenya, P.O. Box 40658, 00100 Nairobi, Kenya
- ¹⁶⁰WWF, 1250 24th Street NW, Washington, District of Columbia 20037
- ¹⁶¹Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, CAS, Menglun, Mengla, Yunnan, 666303 China
- ¹⁶²Forestry and Forest Products Research Institute, Matsunosato 1, Tsukuba Ibaraki 305-8687, Japan
- ¹⁶³Laboratorio de Investigaciones en Abejas, Departamento de Biología, Facultad de Ciencias, Universidad Nacional de Colombia, Sede Bogotá, Colombia Carrera 30 No. 45-03, Edificio 421, Oficina 128, Bogotá, Colombia
- ¹⁶⁴El Colegio de la Frontera Sur, Carretera Panamericana y Periférico Sur S/N. 29290, Chiapas, Mexico

- ¹⁶⁵Department of Biosciences and Department of Environmental Sciences, Urban Ecology Research Group, University of Helsinki, Viikinkaari 2a, P.O. Box 65, FI-00014 Helsinki, Finland
- ¹⁶⁶School of Biology, The University of Nottingham, University Park, Nottingham, NG7 2RD, U.K.
- ¹⁶⁷Laboratorio de Zoología y Ecología Acuática – LAZOE, Universidad de Los Andes, Bogotá, Colombia
- ¹⁶⁸BIO-Diverse, Ließener Str. 32 a, 53179 Bonn, Germany
- ¹⁶⁹Oxford University Centre for the Environment, University of Oxford, South Parks Road, Oxford, OX1 3QY, U.K.
- ¹⁷⁰Department of Wildlife and Range Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
- ¹⁷¹Forestry Research Institute of Ghana, Kumasi, Ghana
- ¹⁷²Department of Animal & Environmental Biology, University of Benin, Benin City, Nigeria
- ¹⁷³The Royal Society for the Protection of Birds (RSPB), The Lodge, Sandy, Bedfordshire, SG19 2DL, U.K.
- ¹⁷⁴Laboratorio Ecotono, CONICET-INIBIOMA, Universidad Nacional del Comahue, Quintral 1250, Bariloche 8400, Argentina
- ¹⁷⁵Departamento de Biología, Faculdade de Filosofia Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Avenida. Bandeirantes, 3900 – CEP 14040-901 – Bairro Monte Alegre, Ribeirão Preto, SP, Brazil
- ¹⁷⁶Laboratorio de Investigaciones en Abejas-LABUN, Departamento de Biología, Facultad de Ciencias, Universidad Nacional de Colombia, Carrera 45 N° 26-85, Edificio Uriel Gutiérrez, Bogotá DC, Colombia
- ¹⁷⁷Instituto de Diversidad y Ecología Animal (CONICET-UNC) and Centro de Zoología Aplicada (UNC), Rondeau 798 X5000AVP Córdoba, Argentina
- ¹⁷⁸School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ, U.K.
- ¹⁷⁹Lund University, Department of Biology/Biodiversity, Ecology Building, 223 62 Lund, Sweden
- ¹⁸⁰Laboratory of Biogeography & Ecology, Department of Geography, University of the Aegean, 81100 Mytilene, Greece
- ¹⁸¹Department of Zoology, University of Cambridge, Cambridge, CB2 3EJ, U.K.
- ¹⁸²Department of Biology, Western Kentucky University, 1906 College Heights Blvd., Bowling Green, Kentucky 42101
- ¹⁸³Entomology, Cornell University, 4126 Comstock Hall, Ithaca, New York 14850
- ¹⁸⁴School of Natural Sciences, Trinity College Dublin, College Green, Dublin 2, Ireland
- ¹⁸⁵Center for Environmental Sciences and Engineering & Department of Ecology and Evolutionary Biology, University of Connecticut, 3107 Horsebarn Hill Road, Storrs, Connecticut 06269-4210
- ¹⁸⁶IN+, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal
- ¹⁸⁷CRA-ABP, Consiglio per la Ricerca e la sperimentazione in Agricoltura, Centro di ricerca per l'agrobiologia e la pedologia, Via Lanciola 12/A, 50125 – Cascine del Riccio, Firenze, Italy
- ¹⁸⁸The Royal Society for the Protection of Birds (RSPB), 2 Lochside View, Edinburgh Park, Edinburgh, EH12 9DH, U.K.
- ¹⁸⁹Department of Forest Ecosystems and Society, Oregon State University, Corvallis, Oregon 97331
- ¹⁹⁰Universidade Federal de Sergipe, Cidade Universitária Prof. José Aloísio de Campos, Jardim Rosa Elze, São Cristóvão, Brazil
- ¹⁹¹Centro de Ciências Biológicas e da Saúde, Universidade Federal de Mato Grosso do Sul, P.O Box 549, 79070-900 Campo Grande, Brazil
- ¹⁹²165 Braid Road, Edinburgh, EH10 6JE, U.K.
- ¹⁹³Associate Scientist, Luquillo LTER, Institute for Tropical Ecosystem Studies, College of Natural Sciences, University of Puerto Rico at Rio Piedras, P.O. Box 70377, San Juan, Puerto Rico 00936-8377
- ¹⁹⁴PROPLAME-PRHIDEB-CONICET, Departamento de Biodiversidad y Biología Experimental, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Ciudad Universitaria, PB II, 4to piso, (CP1428EHA) Ciudad Autónoma de Buenos Aires, Argentina
- ¹⁹⁵ECT Oekotoxikologie GmbH, Böttgerstr. 2-14, 65439 Flörsheim, Germany
- ¹⁹⁶Universidad de Ciencias Aplicadas y Ambientales U.D.C.A., CI 222 No. 55-37 Bogotá, Colombia
- ¹⁹⁷School of Biological and Chemical Sciences, Queen Mary University of London, Mile End Road, London, E3 5GN, U.K.
- ¹⁹⁸Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia 22904-4123
- ¹⁹⁹Blandy Experimental Farm, 400 Blandy Farm Lane, Boyce, Virginia 22620
- ²⁰⁰Département des sciences biologiques, Université du Québec à Montréal (UQAM), Case postale 8888, Succursale Centre-ville, Montréal, QC H3C 3P8, Canada
- ²⁰¹School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, B15 2TT, U.K.
- ²⁰²Institute of Silviculture and Forest Protection, University of West Hungary, Bajcsy-Zsilinszky u. 4., 9400 Sopron, Hungary
- ²⁰³Red de Ecología Funcional, Instituto de Ecología A.C. Carretera Antigua a Coatepec, N° 351 El Haya, CP 91070 Xalapa, Veracruz, Mexico
- ²⁰⁴Stockholm University, Department of Ecology, Environment and Plant Sciences, SE106 91 Stockholm, Sweden
- ²⁰⁵Helmholtz Centre for Environmental Research – UFZ, Theodor-Lieser-Strasse 4, 06120 Halle, Germany
- ²⁰⁶Lawrence University, 711 E. Boldt Way, Appleton, Wisconsin 54911
- ²⁰⁷School of Human Ecology, Dr. B.R. Ambedkar University, Lothian Road, Delhi 110006, India
- ²⁰⁸Department of Ecology and Natural Resource Management (INA), Norwegian University of Life Sciences (NMBU), Box 5003, 1432 Ås, Norway
- ²⁰⁹Center for International Forestry Research, Bogor, 16000 Indonesia
- ²¹⁰Universidade Federal do Pará, Instituto de Ciências Biológicas, Rua Augusto Correa, 01, Belém, 66075-110 Pará, Brazil
- ²¹¹Department of Zoology, University of Oxford, South Parks Road, Oxford, OX1 3PS, U.K.
- ²¹²USDA – APHIS – PPQ, 389 Oyster Point Blvd. Suite 2, South San Francisco, California 94080
- ²¹³Universidad Nacional de Colombia, Cra. 64 X Cl. 65. Bloque 11, Oficina 207, Medellín, Colombia
- ²¹⁴Department of Biological Sciences, National University of Singapore, 14 Science Drive 4, Singapore City 117543, Republic of Singapore
- ²¹⁵EComAS (Grupo de Investigación en Ecología de Comunidades Áridas y Semiáridas), Dpto. de Recursos Naturales, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, Santa Rosa, Argentina
- ²¹⁶School of Natural Sciences and Trinity Centre for Biodiversity Research, Trinity College Dublin, College Green, Dublin 2, Ireland
- ²¹⁷Kadoorie Conservation China, Kadoorie Farm and Botanic Garden, Lam Kam Road, Tai Po, New Territories, Hong Kong SAR, China
- ²¹⁸Department of Resource Management and Geography, The University of Melbourne, 500 Yarra Boulevard, Richmond, VIC 3121, Australia

- ²¹⁹Northwestern University Program in Plant Biology and Conservation, 2205 Tech Drive, O.T. Hogan Hall, Room 2-144, Evanston, Illinois 60208
- ²²⁰Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, Illinois 60022
- ²²¹MTA-DE Biodiversity and Ecosystem Services Research Group, Egyetem ter 1, Debrecen 4032, Hungary
- ²²²University Museum of Zoology, Downing Street, Cambridge, CB2 3EJ, U.K.
- ²²³University of Canterbury, Private bag 4800, Christchurch 8140, New Zealand
- ²²⁴NERC Centre for Ecology & Hydrology, Bush Estate, Penicuik, Edinburgh, EH26 0QB, U.K.
- ²²⁵Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Science, 23 Akademik Georgi Bonchev str., Block 23, 1113 Sofia, Bulgaria
- ²²⁶Department of Earth and Environmental Science, Division Forest, Nature and Landscape, KU Leuven, Celestijnenlaan 200E, 3001 Leuven, Belgium
- ²²⁷Departamento de Ciencias Químico-Biológicas, Universidad de las Américas Puebla, 72810 Cholula, Puebla, Mexico
- ²²⁸Universidad de Santiago de Chile, Avenida Alameda Libertador Bernardo O'Higgins 3363, Estación Central, Santiago, Chile
- ²²⁹Spotvogellaan 68, 2566 PN, The Hague, The Netherlands
- ²³⁰Dillon Consulting Limited, 137 Chain Lake Drive, Halifax, NS B3S 1B3, Canada
- ²³¹The Key Laboratory of Conservation Biology for Endangered Wildlife of the Ministry of Education, College of Life Sciences, Zhejiang University, Hangzhou 310058, China
- ²³²University of Florida, 3205 College Avenue, Fort Lauderdale, Florida 33314
- ²³³The Environment Institute and School of Earth and Environmental Sciences, The University of Adelaide, SA 5005, Australia
- ²³⁴Institute of Experimental Ecology, University of Ulm, Albert-Einstein-Allee 11, 89069 Ulm, Germany
- ²³⁵Behavioural Ecology and Biocontrol, Department of Biology, National University of Ireland, Maynooth, Co. Kildare, Ireland
- ²³⁶Center for Environmental Sciences & Engineering, University of Connecticut, 3107 Horsebarn Hill Road, Storrs, Connecticut 06269-4210
- ²³⁷Department of Ecology & Evolutionary Biology, University of Connecticut, 3107 Horsebarn Hill Road, Storrs, Connecticut 06269-4210
- ²³⁸Charles Darwin University, 7 Ellengowan Dr, Brinkin NT 0810, Australia
- ²³⁹University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics (IBED), P.O. Box 94248, 1090 GE Amsterdam, The Netherlands
- ²⁴⁰NERC Centre for Ecology & Hydrology, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB, U.K.
- ²⁴¹University of East Anglia, Norwich Research Park, Norwich, Norfolk, NR4 7TJ, U.K.
- ²⁴²Kunming Institute of Zoology, Kunming, Yunnan, 650023, China
- ²⁴³Institute of Animal Ecology, Justus-Liebig-University, Heinrich-Buff-Ring 26, 35392 Giessen, Germany
- ²⁴⁴A. N. Severtsov Institute of Ecology and Evolution, Leninsky Prospekt 33, 119071 Moscow, Russia
- ²⁴⁵Centre for Biodiversity and Environment Research, Department of Genetics, Evolution and Environment, University College London, Gower Street, London, WC1E 6BT, U.K.

Keywords

Data sharing, global change, habitat destruction, land use.

Correspondence

Lawrence Hudson, Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.
Tel: +44 (0)20 7942 5819; Fax: +44 (0)20 7942 5175;

E-mail: l.hudson@nhm.ac.uk
and

Tim Newbold, UNEP World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge, CB3 0DL, U.K.
Tel: +44 (0)1223 277 314; Fax: +44 (0)1223 277 136;
E-mail: tim.newbold@unep-wcmc.org

Funding Information

The PREDICTS project was supported by the U.K. Natural Environment Research Council (Grant Number NE/J011193/1) and is a contribution from the Imperial College Grand Challenges in Ecosystems and the Environment initiative. Adriana De Palma was supported by the U.K. Biotechnology and

Abstract

Biodiversity continues to decline in the face of increasing anthropogenic pressures such as habitat destruction, exploitation, pollution and introduction of alien species. Existing global databases of species' threat status or population time series are dominated by charismatic species. The collation of datasets with broad taxonomic and biogeographic extents, and that support computation of a range of biodiversity indicators, is necessary to enable better understanding of historical declines and to project – and avert – future declines. We describe and assess a new database of more than 1.6 million samples from 78 countries representing over 28,000 species, collated from existing spatial comparisons of local-scale biodiversity exposed to different intensities and types of anthropogenic pressures, from terrestrial sites around the world. The database contains measurements taken in 208 (of 814) ecoregions, 13 (of 14) biomes, 25 (of 35) biodiversity hotspots and 16 (of 17) megadiverse countries. The database contains more than 1% of the total number of all species described, and more than 1% of the described species within many taxonomic groups – including flowering plants, gymnosperms, birds, mammals, reptiles, amphibians, beetles, lepidopterans and hymenopterans. The dataset, which is still being added to, is therefore already considerably larger and more representative than those used by previous quantitative models of biodiversity trends and responses. The database is being assembled as part of the PREDICTS project (Projecting Responses of Ecological Diversity In Changing Terrestrial Systems – <https://www.nhm.ac.uk/our-science/our-work/biodiversity/predicts.html>). We make site-level sum-

Biological Sciences Research Council (Grant Number BB/F017324/1). Helen Philips was supported by a Hans Rausing PhD Scholarship.

Received: 11 August 2014; Revised and Accepted: 30 September 2014

***Ecology and Evolution* 2014; 4 (24): 4701–4735**

doi: 10.1002/ece3.1303

*These authors contributed equally to this paper.

[Correction added on 20 July 2023, after first online publication: URL for the PREDICTS project has been updated in the Abstract, Introduction and Discussion sections.]

Introduction

Despite the commitment made by the Parties to the Convention on Biological Diversity (CBD) to reduce the rate of biodiversity loss by 2010, global biodiversity indicators show continued decline at steady or accelerating rates, while the pressures behind the decline are steady or intensifying (Butchart *et al.* 2010; Mace *et al.* 2010). Evaluations of progress toward the CBD's 2010 target highlighted the need for datasets with broader taxonomic and geographic coverage than existing ones (Walpole *et al.* 2009; Jones *et al.* 2011). Taxonomic breadth is needed because species' ability to tolerate human impacts – destruction, degradation and fragmentation of habitats, the reduction of individual survival and fecundity through exploitation, pollution and introduction of alien species – varies among major taxonomic groups (Vié *et al.* 2009). For instance, the proportion of species listed as threatened in the IUCN Red List is much higher in amphibians than in birds (International Union for Conservation of Nature 2013). Geographic breadth is needed because human impacts show strong spatial variation: most of Western Europe has long been dominated by human land use, for example, whereas much of the Amazon basin is still close to a natural state (Ellis *et al.* 2010). Thus, in the absence of broad coverage, any pattern seen in a dataset is prone to reflect the choice of taxa and region as much as true global patterns and trends.

The most direct way to capture the effects of human activities on biodiversity is by analysis of time-series data from ecological communities, assemblages or populations, relating changes in biodiversity to changes in human activity (Vačkář 2012). However, long-term data suitable for such modeling have limited geographic and taxonomic coverage, and often record only the presence or absence of species (e.g., Dornelas *et al.* 2013). Time-series data are also seldom linked to site-level information on drivers of

primary data available alongside this article. The full database will be publicly available in 2015.

change, making it hard to use such data to model biodiversity responses or to project responses into the future. Ecologists have therefore more often analyzed spatial comparisons among sites that differ in the human impacts they face. Although the underlying assumption that biotic differences among sites are caused by human impacts has been criticized (e.g., Johnson and Miyanishi 2008; Pfeifer *et al.* 2014), it is more likely to be reasonable when the sites being compared are surveyed in the same way, when they are well matched in terms of other potentially important variables (e.g., Blois *et al.* 2013; Pfeifer *et al.* 2014), when analyses focus on community-level summaries rather than individual species (e.g., Algar *et al.* 2009), and when the spatial and temporal variations being considered are similar in magnitude (Blois *et al.* 2013). Collations of well-matched site surveys therefore offer the possibility of analyzing how biodiversity is responding to human impacts without losing taxonomic and geographic breadth.

Openness of data is a further important consideration. The reproducibility and transparency that open data can confer offer benefits to all areas of scientific research, and are particularly important to research that is potentially relevant to policy (Reichman *et al.* 2011). Transparency has already been highlighted as crucial to the credibility of biodiversity indicators and models (e.g., UNEP-WCMC 2009; Feld *et al.* 2010; Heink and Kowarik 2010) but the datasets underpinning previous policy-relevant analyses have not always been made publicly available.

We present a new database that collates published, in-press and other quality-assured spatial comparisons of community composition and site-level biodiversity from terrestrial sites around the world. The underlying data are made up of abundance, presence/absence and species-richness measures of a wide range of taxa that face many different anthropogenic pressures. As of March 2014, the dataset contains more than 1.6 million samples from 78 countries representing over 28,000 species. The dataset,

which is still being added to, is being assembled as part of the PREDICTS project (Projecting Responses of Ecological Diversity In Changing Terrestrial Systems – <https://www.nhm.ac.uk/our-science/our-work/biodiversity/predicts.html>), the primary purpose of which is to model and project how biodiversity in terrestrial communities responds to human activity. The dataset is already considerably larger and more representative than those used in existing quantitative models of biodiversity trends such as the Living Planet Index (WWF International 2012) and GLOBIO3 (Alkemade *et al.* 2009).

In this paper we introduce the database, describe in detail how it was collated, validated and curated, and assess its taxonomic, geographic and temporal coverage. We make available a summary dataset that contains, for each sampling location, the predominant land use, land-use intensity, type of habitat fragmentation, geographic coordinates, sampling dates, country, biogeographic realm, ecoregion, biome, biodiversity hotspot, taxonomic group studied and the number of measurements taken. The full dataset constitutes a large evidence base for the analysis of:

- The responses of biodiversity to human impacts for different countries, biomes and major taxonomic groups;
- The differing responses within and outside protected areas;
- How traits such as body size, range size and ecological specialism mediate responses and
- How human impacts alter community composition.

The summary dataset permits analysis of geographic and taxonomic variation in study size and design. The complete database, which will be made freely available at the end of the current phase of the project in 2015, will be of use to all researchers interested in producing models of how biodiversity responds to human pressures.

Methods

Criteria for inclusion

We considered only data that met all of the following criteria:

- Data are published, in press or were collected using a published methodology;
- The paper or report presents data about the effect of one or more human activities on one or more named taxa, and where the degree of human activity differed among sampling locations and/or times;
- Some measure of overall biodiversity, or of the abundance or occurrence of the named taxa, was made at two or more sampling locations and/or times;

- Measurements within each data source were taken using the same sampling procedure, possibly with variation in sampling effort, at each site and time;
- The paper reported, or authors subsequently provided, geographical coordinates for the sites sampled.

One of the modeling approaches used by PREDICTS is to relate diversity measurements to remotely sensed data, specifically those gathered by NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) instruments (Justice *et al.* 1998). MODIS data are available from early 2000 onwards so, after a short initial data collation stage, we additionally required that diversity sampling had been completed after the beginning of 2000.

Where possible, we also obtained the following (see Site characteristics, below, for more details):

- The identities of the taxa sampled, ideally resolved to species level;
- The date(s) on which each measurement was taken;
- The area of the habitat patch that encompassed each site;
- The maximum linear extent sampled at the site;
- An indication of the land use at each site, e.g. primary, secondary, cropland, pasture;
- Indications of how intensively each site was used by people;
- Descriptions of any transects used in sampling (start point, end point, direction, etc.);
- Other information about each site that might be relevant to modeling responses of biodiversity to human activity, such as any pressures known to be acting on the site, descriptions of agriculture taking place and, for spatially blocked designs, which block each site was in.

Searches

We collated data by running sub-projects that investigated different regions, taxonomic groups or overlapping anthropogenic pressures: some focused on particular taxa (e.g., bees), threatening processes (e.g., habitat fragmentation, urbanization), land-cover classes (e.g., comparing primary, secondary and plantation tropical forests), or regions (e.g., Colombia). We introduced the project and requested data at conferences and in journals (Newbold *et al.* 2012; Hudson *et al.* 2013). After the first six months of broad searching, we increasingly targeted efforts toward under-represented taxa, habitat types, biomes and regions. In addition to articles written in English, we also considered those written in Mandarin, Spanish and Portuguese – languages in which one or more of our data compilers were proficient.

Data collection

To maximize consistency in how incoming data were treated, we developed customized metadata and data capture tools – a PDF form and a structured Excel file – together with detailed definitions and instructions on their usage. The PDF form was used to capture bibliographic information, corresponding author contact details and meta-data such as the country or countries in which data were collected, the number of taxa sampled, the number of sampling locations and the approximate geographical center(s) of the study area(s). The Excel file was used to capture details of each sampling site and the diversity measurements themselves. The PDF form and Excel file are available in Supplementary Information. We wrote software that comprehensively validates pairs of PDF and Excel files for consistency; details are in the “Database” section.

Most papers that we considered did not publish all the information that we required; in particular, site coordinates and species names were frequently not published. We contacted authors for these data and to request permission to include their contributed data in the PREDICTS database. We used the insightly customer relationship management application (<https://www.insightly.com/>) to manage contact with authors.

Structure of data

We structured data into Data Sources, Studies, and Sites. The highest level of organization is the Data Source. A Data Source typically represents data from a single published paper, although in some cases the data were taken from more than one paper, from a non-governmental organization report or from a PhD or MSc thesis. A Data Source contains one or more Studies. A Study contains two or more Sites, a list of taxa that were sampled and a site-by-species matrix of observations (e.g., presence/absence or abundance). All diversity measurements within a Study must have been collected using the same sampling method. For example, a paper might present, for the same set of Sites, data from pitfall traps and from Malaise traps. We would structure these data into a single Data Source containing two Studies – one for each trapping technique. It is therefore reasonable to directly compare observations within a Study but not, because of methodological differences, among Studies. Sometimes, the data presented in a paper were aggregates of data from multiple sampling methods. In these cases, provided that the same set of sampling methods was applied at each Site, we placed the data in a single Study.

We classified the diversity observations as abundance, occurrence or species richness. Some of the site-by-species

matrices that we received contained empty cells, which we interpreted as follows: (1) where the filled-in values in the matrix were all non-zero, we interpreted blanks as zeros or (2) where some of the values in the matrix were zero, we took empty cells as an indication that the taxa concerned were not looked for at those Sites, and interpreted empty cells as missing values.

Where possible, we recorded the sampling effort expended at each Site and allowed the units of sampling effort to vary among Studies. For example, if transects had been used, the (Study-level) sampling effort units might be meters or kilometers and the (Site-level) sampling efforts might be the length of the transects. If pitfall traps had been used, the (Study-level) sampling effort units might be “number of trap nights” and the (Site-level) sampling efforts might be the number of traps used multiplied by the number of nights that sampling took place. Where possible, we also recorded an estimate of the maximum linear extent encompassed by the sampling at each Site – the distance covered by a transect, the distance between two pitfall traps or the greatest linear extent of a more complex sampling design (see Figure S1 in Supplementary Information for details).

Site characteristics

We recorded each Site’s coordinates as latitude and longitude (WGS84 datum), converting where necessary from local grid-based coordinate systems. Where precise coordinates for Sites were not available, we georeferenced them from maps or schemes available from the published sources or provided by authors. We converted each map to a semi-transparent image that was georeferenced using either ArcGIS (Environmental Systems Research Institute (ESRI) 2011) or Google Earth (http://www.google.co.uk/intl/en_uk/earth/), by positioning and resizing the image on the top of ArcGIS Online World Imagery or Google Maps until we achieved the best possible match of mapped geographical features with the base map. We then obtained geographic coordinates using geographic information systems (GIS) for each Site center or point location. We also recorded authors’ descriptions of the habitat at each Site and of any transects walked.

For each Site we recorded the dates during which sampling took place. Not all authors presented precise sampling dates – some gave them to the nearest month or year. We therefore recorded the earliest possible start date, the latest possible end date and the resolution of the dates that were given to us. Where dates were given to the nearest month or year, we recorded the start and end dates as the earliest and latest possible day, respectively. For example, if the authors reported that sampling took place between June and August of 2007, we recorded the

date resolution as “month,” the start of sampling as June 1, 2007 and end of sampling as August 31, 2007. This scheme meant that we could store sampling dates using regular database structures (which require that the year, month, and day are all present), while retaining information about the precision of sampling dates that were given to us.

We assigned classifications of predominant land use and land-use intensity to each Site. Because of PREDICTS’ aim of making projections about the future of biodiversity under alternative scenarios, our land-use classification was based on five classes defined in the Representative Concentration Pathways harmonized land-use estimates (Hurt et al. 2011) – primary vegetation, secondary vegetation, cropland, pasture and urban – with the addition of plantation forest to account for the likely differences in the biodiversity of natural forest and plantation forest (e.g., Gibson et al. 2011) and a “Cannot decide” category for when insufficient information was available. Previous work has suggested that both the biodiversity and community composition differ strongly between sites in secondary vegetation of different maturity (Barlow et al. 2007); therefore, we subdivided secondary vegetation by stage – young, intermediate, mature and (when information was lacking) indeterminate – by considering vegetation structure (not diversity). We used authors’ descriptions of Sites, when provided, to classify land-use intensity as minimal, light or intense, depending on the land use in question, again with “Cannot decide” as an option for when information was lacking. A detailed description of how classifications are assigned is in the Supplementary section “Notes on assigning predominant land use and use intensity” and Tables S1 and S2.

Given the likely importance of these classifications as explanatory variables in modeling responses of biodiversity to human impacts, we conducted a blind repeatability study in which one person (the last author, who had not originally scored any Sites) rescored both predominant land use and use intensity for 100 Sites chosen at random. Exact matches of predominant land use were achieved for 71 Sites; 15 of the remaining 29 were “near misses” specified in advance (i.e., primary vegetation versus mature secondary; adjacent stages of secondary vegetation; indeterminate secondary versus any other secondary stage; and cannot decide versus any other class). Cohen’s kappa provides a measure of inter-rate agreement, ranging from 0 (agreement no better than random) to 1 (perfect agreement). For predominant land use, Cohen’s kappa = 0.662 (if only exact agreement gets credit) or 0.721 (if near misses are scored as 0.5); values in the range 0.6–0.8 indicate “substantial agreement” (Landis and Koch 1977), indicating that our categories,

criteria and training are sufficiently clear for users to score Sites reliably. Moving to use intensity, we found exact agreement for 57 of 100 Sites, with 39 of the remaining 43 being “near misses” (adjacent intensity classes, or cannot decide versus any other class), giving Cohen’s kappa values of 0.363 (exact agreement only) or 0.385 (near misses scored as 0.5), representing “fair agreement” (Landis and Koch 1977); agreement is slightly higher among the 71 Sites for which predominant land use was matched (exact agreement in 44 of 71 Sites, kappa = 0.428, indicating “moderate agreement”: Landis and Koch 1977).

Where known, we recorded the number of years since conversion to the present predominant land use. If the Site’s previous land use was primary habitat, we recorded the number of years since it was converted to the current land use. If the habitat was converted to secondary forest (clear-felled forest or abandoned agricultural land), we recorded the number of years since it was converted/clear-felled/abandoned. Where ranges were reported, we used mid-range values; if papers reported times as “greater than N years” or “at least N years,” we recorded a value of $N \times 1.25$. Based on previous work (Wilcove et al. 1986; Dickman 1987), we assigned one of five habitat fragmentation classes: (1) well within unfragmented habitat, (2) within unfragmented habitat but at or near its edge, (3) within a remnant patch (perhaps at its edge) that is surrounded by other habitats, (4) representative part of a fragmented landscape and (5) part of the matrix surrounding remnant patches. These are described and illustrated in Table S3 and Figure S2. We also recorded the area of the patch of predominant habitat within which the Site was located, where this information was available. We recorded a value of -1 if the patch area was unknown but large, extending far beyond the sampled Site.

Database

Completed PDF and Excel files were uploaded to a PostgreSQL 9.1 database (PostgreSQL Global Development Group, <http://www.postgresql.org/>) with the PostGIS 2.0.1 spatial extension (Refractions Research Inc, <http://www.postgis.net/>). The database schema is shown in Figure S3.

We wrote software in the Python programming language (<http://www.python.org/>) to perform comprehensive data validation; files were fully validated before their data were added to the database. Examples of lower level invalid data included missing values for mandatory fields, a negative time since conversion, a latitude given as $1^\circ 61'$, a date given as 32nd January, duplicated Site names and duplicated taxon names. Commonly encountered

higher level problems included mistakes in coordinates, such as latitude and longitude swapped, decimal latitude and longitude incorrectly assembled from DD/MM/SS components, and direction (north/south, east/west) swapped round. These mistakes typically resulted in coordinates that plotted in countries not matching those given in the metadata and/or out to sea. The former was detected automatically by validation software, which required that the GIS-matched country for each Site (see “Biogeographical coverage” below) matched the country name entered in the PDF file for the Study; where a Study spanned several countries, we set the country name to “Multiple countries.” We visually inspected all Site locations on a map and compared them to maps presented in the source article or given to us by the authors, catching coordinates that were mistakenly out to sea and providing a check of accuracy.

Our database linked each Data Source to the relevant record in our Insightly contact management database. This allows us to trace each datum back to the email that granted permission for us to include it in our database.

Biogeographical coverage

In order to assess the data’s geographical and biogeographical coverage, we matched each Site’s coordinates to GIS datasets that were loaded into our database:

- Terrestrial Ecoregions of the World (The Nature Conservancy 2009), giving the ecoregion, biome and biogeographic realm;
- World Borders 0.3 (Thematic Mapping 2008), giving the country, United Nations (UN) region and UN sub-region;
- Biodiversity Hotspots (Conservation International Foundation 2011).

Global GIS layers appear coarse at local scales and we anticipated that Sites on coasts or on islands could fall slightly outside the relevant polygons. Our software therefore matched Sites to the nearest ecoregion and nearest country polygons, and recorded the distance in meters to that polygon, with a value of zero for Sites that fell within a polygon; we reviewed Sites with non-zero distances. The software precisely matched Sites to hotspot polygons. The relative coarseness of GIS polygons might result in small errors in our assessments of coverage (i.e., at borders between biomes, ecoregions and countries, and at the edges of hotspots) – we expect that these errors should be small in number and unbiased.

We also estimated the yearly value of total net primary production (TNPP) for biomes and five-degree latitudinal belts, using 2010 spatial (0.1-degree resolution) monthly datasets “NPP – Net Primary Productivity 1 month-

Terra/MODIS” compiled and distributed by NASA Earth Observations (http://neo.sci.gsfc.nasa.gov/view.php?datasetId=MOD17A2_M_PSN&year=2010). We used the NPP values (average for each month assimilation measured in grams of carbon per square meter per day) to estimate monthly and annual NPP. We then derived TNPP values by multiplying NPP values by the total terrestrial area for that ecoregion/latitudinal belt. We assessed the representativeness of land use and land-use intensity combinations by comparing the proportion of Sites in each combination to a corresponding estimate of the proportion of total terrestrial area for 2005, computed using land-use data from the HYDE historical reconstruction (Hurt et al. 2011) and intensity data from the Global Land Systems dataset (van Asselen and Verburg 2012).

Taxonomic names and classification

We wanted to identify taxa in our database as precisely as possible and to place them in higher level groups, which required relating the taxonomic names presented in our datasets to a stable and authoritative resource for nomenclature. We used the Catalogue of Life (<http://www.catalogueoflife.org/>) for three main reasons. First, it provides broad taxonomic coverage. Second, Catalogue of Life publishes Annual Checklists. Third, Catalogue of Life provides a single accepted taxonomic classification for each species that is represented. Not all databases provide this guarantee; for example, Encyclopedia of Life (<http://www.eol.org/>) provides zero, one or more taxonomic classifications for each represented species. We therefore matched taxonomic names to the Catalogue of Life 2013 Annual Checklist (Roskov et al. 2013, henceforth COL).

There was large variation in the form of the taxonomic names presented in the source datasets, for example:

- A Latin binomial, with and without authority, year and other information;
- A generic name, possibly with a number to distinguish morphospecies from congeners in the same Study (e.g., “*Bracon* sp. 1”);
- The name of a higher taxonomic rank such as family, order, class;
- A common name (usually for birds), sometimes not in English;
- A textual description, code, letter or number with no further information except an indication of some aspect of higher taxonomy.

Most names were Latin binomials, generic names or morphospecies names. Few binomials were associated with an authority – even when they were, time constraints mean that it would not have been practical to make use

of this information. Many names contained typographical errors.

We represented each taxon by three different names: “Name entered,” “Parsed name,” and “COL query name.” “Name entered” was the name assigned to the taxon in the dataset provided to us by the investigators who collected the data. We used the Global Names Architecture’s biodiversity package (<https://github.com/GlobalNamesArchitecture/biodiversity>) to parse “Name entered” and extract a putative Latin binomial, which we assigned to both “Parsed name” and “COL query name.” For example, the result of parsing the name “*Ancistrocerus trifasciatus* Müll.” was “*Ancistrocerus trifasciatus*.” The parser treated all names as if they were scientific taxonomic names, so the result of parsing common names was not sensible: e.g. “Black and White Casqued Hornbill” was parsed as “Black and.” We expected that common names would be rare – where they did arise, they were detected and corrected as part of our curation process, which is described below. Other examples of the parser’s behavior are shown in Table S4.

We queried COL with each “COL query name” and stored the matching COL ID, taxonomic name, rank and classification (kingdom, phylum, class, order, family, genus, species and infraspecies). We assumed that the original authors gave the most authoritative identification of species. Therefore, when a COL search returned more than one result, and the results were made up of one accepted name together with one or more synonyms and/or ambiguous synonyms and/or common names and/or misapplied names, our software recorded the accepted name. For example, COL returns three results for the salticid spider *Euophrys frontalis* – one accepted name and two synonyms.

When a COL search returned more than one result, and the results included zero or two or more accepted

names, we used the lowest level of classification common to all results. For example, COL lists *Notiophilus* as an accepted genus in two beetle families – Carabidae and Eirrhinidae. This is a violation of the rules of nomenclature, but taxonomic databases are imperfect and such violations are to be expected. In this case, the lowest rank common to both families is the order Coleoptera.

Curating names

We reviewed:

- Taxa that had no matching COL record;
- Taxa that had a result at a rank higher than species and a “Name entered” that was either a Latin binomial or a common name;
- Cases where the same “Parsed name” in different Studies linked to different COL records;
- Studies for which the lowest common taxonomic rank did not seem appropriate; for example, a Study of birds should have a lowest common taxonomic rank of class Aves or lower rank within Aves.

Where a change was required, we altered “COL query name”, recording the reason why the change was made, and reran the COL query. Sometimes, this curation step had to be repeated multiple times. In all cases, we retained the names given to us by the authors, in the “Name entered” and “Parsed name” columns.

Typographical errors were the most common cause for failed COL searches; for example, the hymenopteran *Diphaglossa gayi* was given as *Diphaglosa gayi*. Such errors were detected by visual inspection and by performing manual searches on services that perform fuzzy matching and suggest alternatives, such as Google and Encyclopedia of Life. In cases where “Parsed name” was

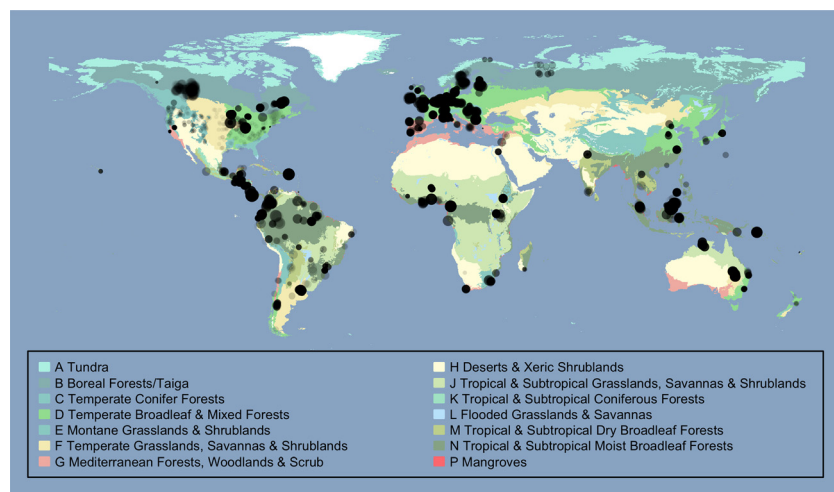


Figure 1. Site locations. Colors indicate biomes, taken from The Nature Conservancy’s (2009) terrestrial ecoregions of the world dataset, shown in a geographic (WGS84) projection. Circle radii are proportional to \log_{10} of the number of samples at that Site. All circles have the same degree of partial transparency.

Table 1. Coverage of hotspots.

Hotspot	Studies (%)	Sites (%)	Samples (%)	Terrestrial area (%)
None	50.72	63.63	52.33	84.01
Nearctic				
California Floristic Province	0.96	1.30	0.12	0.20
Madrean Pine–Oak Woodlands	0.24	0.01	<0.01	0.31
Neotropic				
Atlantic Forest	3.11	1.16	0.28	0.83
Caribbean Islands	0.48	0.67	2.59	0.15
Cerrado	1.91	0.66	0.11	1.37
Chilean Winter Rainfall and Valdivian Forests	2.39	1.69	0.32	0.27
Mesoamerica	8.13	7.83	8.94	0.76
Tropical Andes	6.46	3.02	4.11	1.04
Tumbes-Chocoma Magdalena	0.48	0.37	0.10	0.18
Palaearctic				
Caucasus	0.00	0.00	0.00	0.36
Irano-Anatolian	0.00	0.00	0.00	0.61
Japan	1.67	0.60	0.17	0.25
Mediterranean Basin	5.98	5.52	2.63	1.41
Mountains of Central Asia	0.00	0.00	0.00	0.58
Mountains of Southwest China	0.00	0.00	0.00	0.18
Afrotropic				
Cape Floristic Region	0.24	0.29	0.20	0.05
Coastal Forests of Eastern Africa	0.00	0.00	0.00	0.20
Eastern Afrotropic	1.20	1.27	0.83	0.07
Guinean Forests of West Africa	2.15	1.04	0.54	0.42
Horn of Africa	0.00	0.00	0.00	1.12
Madagascar and the Indian Ocean Islands	0.48	0.18	0.01	0.40
Maputaland–Pondoland–Albany	0.72	0.52	0.50	0.18
Succulent Karoo	0.00	0.00	0.00	0.07
Indo-Malay				
Himalaya	0.00	0.00	0.00	0.50
Indo-Burma	0.72	0.23	0.10	1.60
Philippines	1.20	0.77	0.44	0.20
Sundaland	6.46	6.12	23.55	1.01
Western Ghats and Sri Lanka	0.48	0.13	0.09	0.13
Australasia				
East Melanesian Islands	0.24	0.36	1.13	0.68
Forests of East Australia	0.72	1.45	0.31	0.17
New Caledonia	0.00	0.00	0.00	0.01
New Zealand	0.72	0.10	0.01	0.18
Southwest Australia	0.00	0.00	0.00	0.24
Wallacea	1.67	0.69	0.58	0.23
Oceania				
Polynesia–Micronesia	0.48	0.38	0.01	0.03

Hotspots are shown grouped by realm.

a binomial without typographical errors but that was not recognized by COL, we searched web sites such as Encyclopedia of Life and The Plant List (<http://www.theplantlist.org/>) for synonyms and alternative spellings and queried COL with the results. Where there were no synonyms or where COL did not recognize the synonyms, we searched COL for just the genus. If the genus was not recognized by COL, we used the same web services to obtain higher level ranks, until we found a rank that COL recognized.

Some names matched COL records in two different kingdoms. For example, *Bellardia*, *Dracaena* and *Ficus* are all genera of plants and of animals. In such cases, we instructed our software to consider only COL records from the expected kingdom. We also constrained results when a name matched COL records in two different branches within the same kingdom; for example, considering the *Notiophilus* example given above – if the Study was of carabid beetles, we would instruct software to consider only results within family Carabidae.

COL allows searches for common names. Where “Name entered” was a common name that was not recognized by COL, we searched web sites as described above and set “COL query name” to the appropriate Latin binomial.

Some studies of birds presented additional complications. Some authors presented taxon names as four-letter codes that are contractions of common names (e.g., AMKE was used by Chapman and Reich (2007) to indicate *Falco sparverius*, American kestrel) or of Latin binomials (e.g., ACBA was used by Shahabuddin and Kumar (2007) to indicate *Accipiter badius*). Some of these codes are valid taxonomic names in their own right. For example, Shahabuddin and Kumar (2007) used the code TEPA to indicate the passerine *Terpsiphone paradisi*. However, *Tepa* is also a genus of Hemiptera. Left uncurated, COL recognized TEPA as the hemipteran genus and the Study consequently had a lowest common taxonomic rank of kingdom Animalia, not of class Aves or a lower rank within Aves, as we would expect. Some codes did not appear on published lists (e.g., <http://www.birdpop.org/alphacodes.htm>, <http://www.pwrc.usgs.gov/bbl/manual/speclist.cfm>, <http://www.carolinabirdclub.org/bandcodes.html> and <http://infohost.nmt.edu/~shipman/z/nom/bbs.html>) or in the files provided by the authors, either because of typographical errors, omissions or incomplete coverage. Fortunately, codes are constructed by following a simple set of rules – the first two letters of the genus and species of binomials, and a slightly more complex method for common names of North American birds (<http://infohost.nmt.edu/~shipman/z/nom/bbl/rules.html>). We cautiously reverse-engineered unrecognized codes by following the appropriate rules and then searched lists of birds of the country concerned for possible matches.

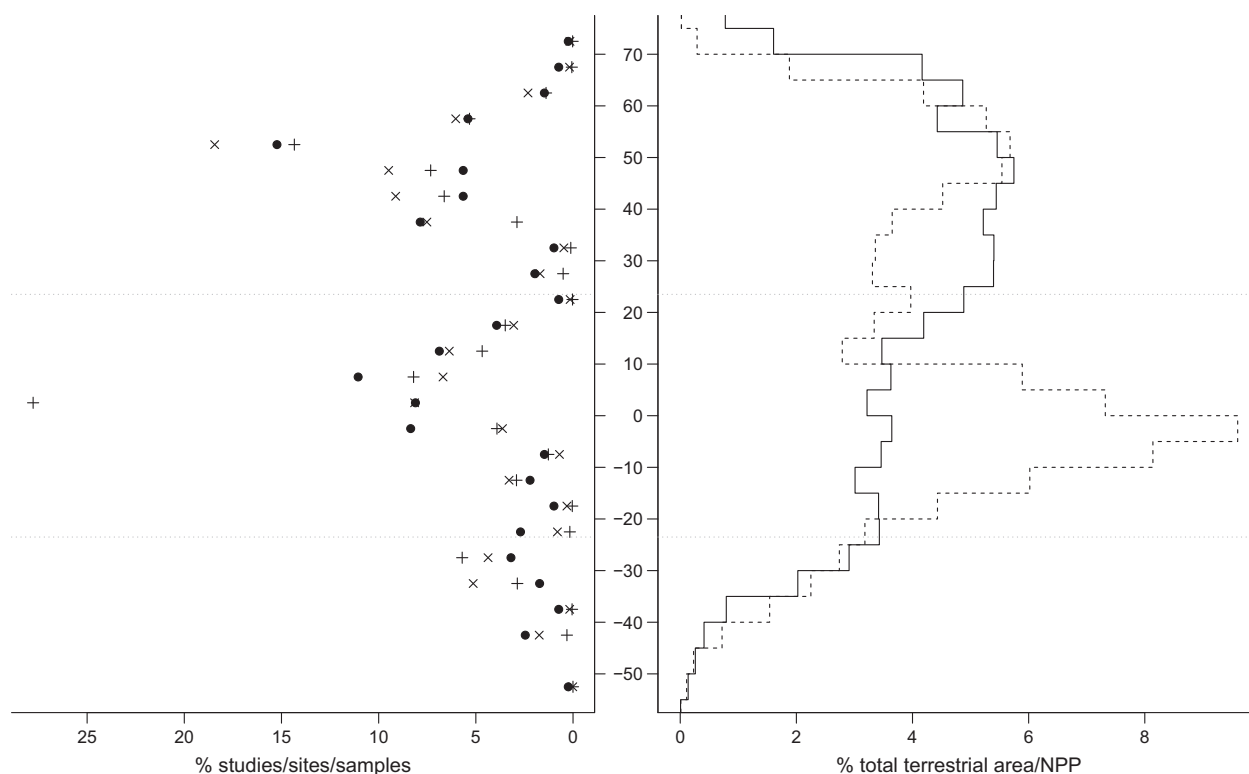


Figure 2. Latitudinal coverage. The percentage of Studies (circles), Sites (crosses) and samples (pluses) in five-degree bands of latitude. We computed each Study's latitude as the median of its Sites' latitudes. The solid and dashed lines show the percentage of total terrestrial area and percentage of total terrestrial NPP, respectively, in each five-degree band (see "Biogeographical coverage" in Methods). The dotted horizontal lines indicate the extent of the tropics.

For example, we deduced from the Wikipedia list of birds of India (http://en.wikipedia.org/wiki/List_of_birds_of_India) that KEZE – used in a study of birds in Rajasthan, north-western India (Shahabuddin and Kumar 2007) – most likely indicates *Ketupa zeylonensis*. Another problem is that collisions occur – the same code can apply to more than one taxon. For example, PEPT is the accepted code for *Atalotriccus pilaris* (pale-eyed pygmy tyrant – <http://www.birdpop.org/alphacodes.htm>), a species that occurs in the Neotropics. The same code was used by the Indian study of Shahabuddin and Kumar (2007) to indicate *Pernis ptilorhynchus* (crested honey buzzard). We therefore reverse-engineered bird codes on a case-by-case basis. Where a code could represent more than one species, we set "COL query name" as the lowest taxonomic rank common to all matching species.

Counting the number of species

It was not possible to precisely count the number of species represented in our database because of ambiguity inherent in the taxon names provided with the data. We

estimated the number of species as follows. Names with a COL result at either species or infraspecies level were counted once per name. Names with a COL result resolved to higher taxonomic ranks were counted once per Study. To illustrate this scheme, consider the bat genus *Eonycteris*, which contains three species. Suppose that Study A sampled all three species and that the investigators could distinguish individuals as belonging to three separate species but could not assign them to named species, reporting them as *Eonycteris* sp. 1, *Eonycteris* sp. 2 and *Eonycteris* sp. 3. Study B also sampled all three species of *Eonycteris* and again reported *Eonycteris* sp. 1, *Eonycteris* sp. 2 and *Eonycteris* sp. 3. We would erroneously consider these taxa to be six different species. We did not attempt to determine how often, if at all, such inflation occurred.

In order to assess the taxonomic coverage of our data, we computed a higher taxonomic grouping for each taxon as: (1) order where class was Insecta or Entognatha; (2) class where phylum was Arthropoda (excluding Insecta), Chordata or Tracheophyta; otherwise 3) phylum. So the higher taxonomic group of a

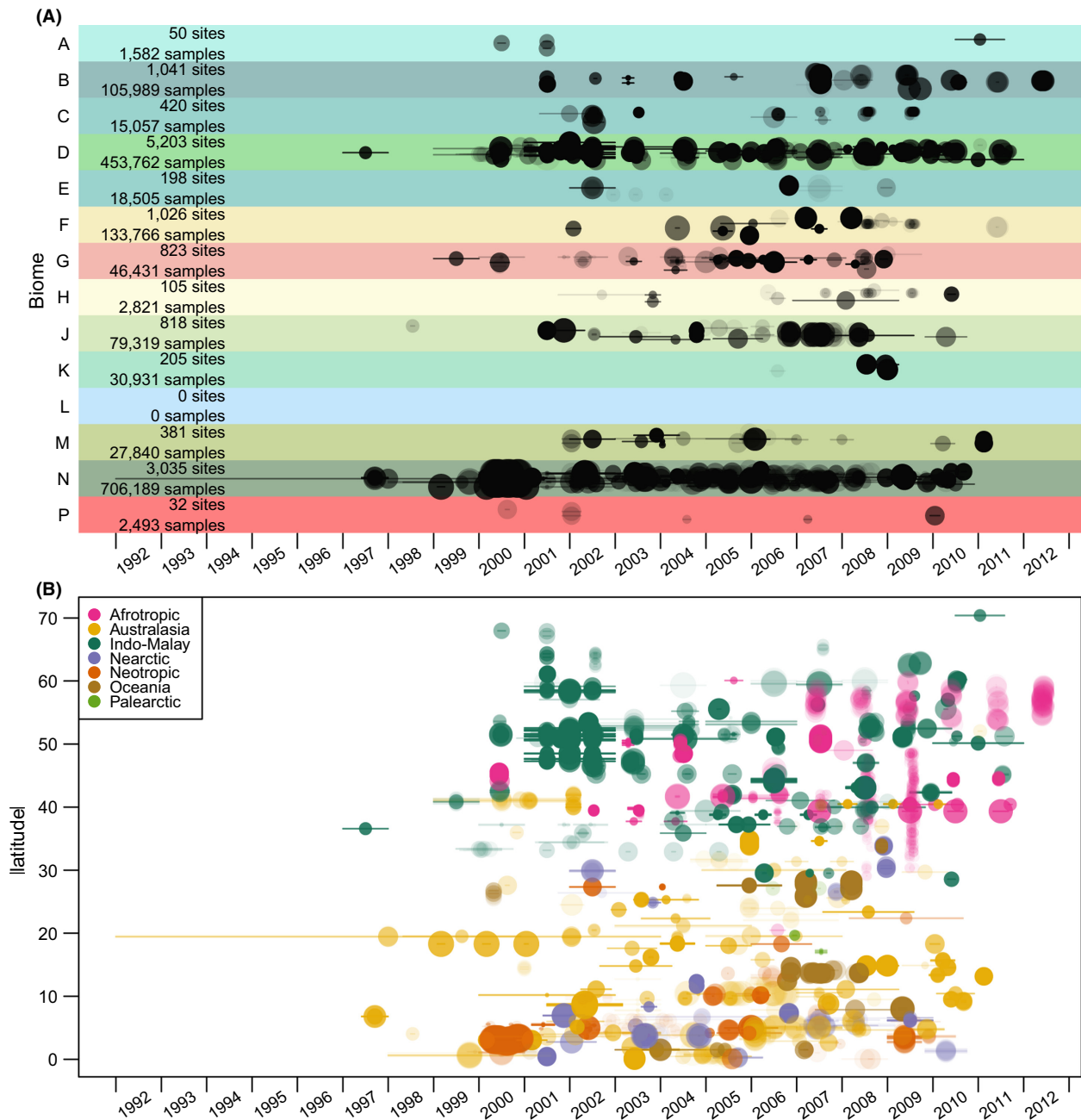


Figure 3. Spatiotemporal sampling coverage. Site sampling dates by biome (A) and absolute latitude (B). Each Site is represented by a circle and line. Circle radii are proportional to \log_{10} of the number of samples at that Site. Circle centers are at the midpoints of Site sampling dates; lines indicate the start and end dates of sampling. Y-values in (A) have been jittered at the study level. Circles and lines have the same degree of partial transparency. Biome colors and letters in (A) are as in Fig. 1. Colors in (B) indicate biogeographic realm.

bee is order Hymenoptera (following rule 1), the higher taxonomic group of a wolf is class Mammalia (rule 2), and the higher taxonomic group of a snail is phylum Gastropoda (rule 3). For each higher taxonomic group, we compared the numbers of species in our database to the estimated number of described species presented by

Chapman (2009). Some of the higher taxonomic groups that we computed did not directly relate to the groups presented by Chapman (2009) so, in order to compare counts, we computed Magnoliophyta as the sum of Magnoliopsida and Liliopsida; Gymnosperms as the sum of Pinopsida and Gnetopsida; Ferns and allies as

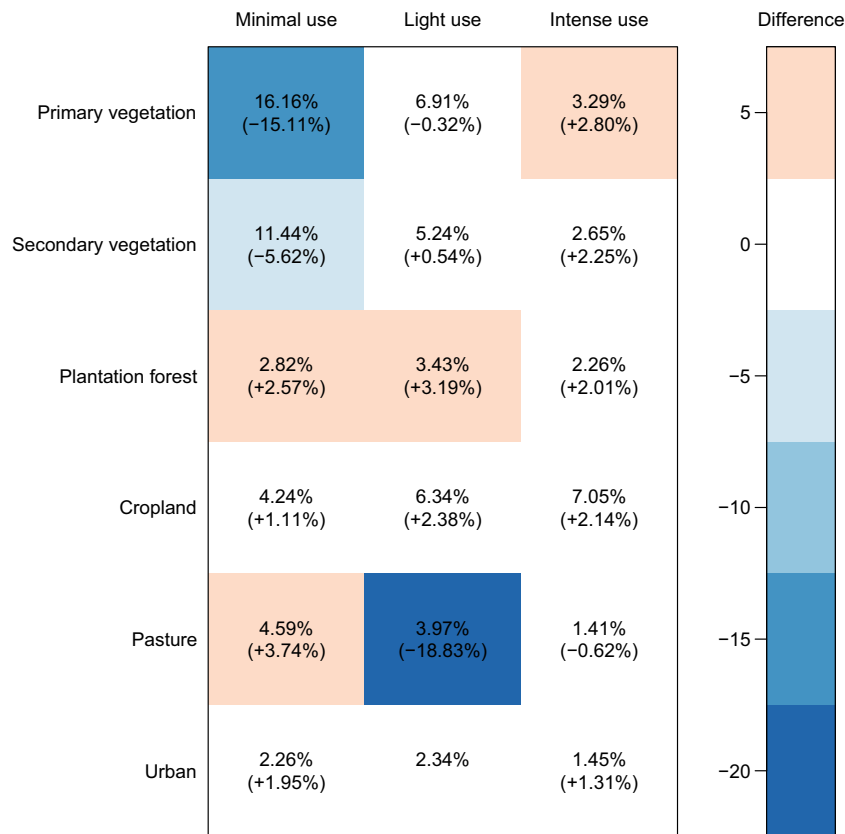


Figure 5. Representativeness of predominant land use and land-use intensity classes. Numbers are the percentage of Sites assigned to each combination of land use and intensity. Numbers in brackets and colors are the differences between these and the proportional estimated total terrestrial area of each combination of land use and land-use intensity for 2005, computed from the HYDE (Hurt et al. 2011) and Global Land Systems datasets (van Asselen and Verburg 2012); no difference is shown for “Urban”/“Light use” because these datasets did not allow us to compute an estimate for this combination. The 12.15% of Sites that could not be assigned a classification for predominant land use and/or land-use intensity are not shown.

Results

Between March 2012 and March 2014, we collated data from 284 Data Sources, 407 Studies and 13,337 Sites in 78 countries and 208 (of 814) ecoregions (Fig. 1). The best-represented UN-defined subregions are North America (17.51% of Sites), Western Europe (14.14%) and South America (13.37%). As of March 31, 2014, the database contained 1,624,685 biodiversity samples – 1,307,947 of abundance, 316,580 of occurrence and 158 of species richness. The subregions with the most samples are Southeast Asia (24.66%), Western Europe (11.36%) and North America (10.88%).

Of the world’s 35 biodiversity hotspots, 25 are represented (Table 1). Hotspots together account for just 16% of the world’s terrestrial surface, yet 47.67% of our measurements were taken in hotspots. The vast majority of measurements in hotspots were taken in the Sundaland hotspot (Southeast Asia) and the latitudinal band with

the most samples is 0° to 5° N (Fig. 2); many of these data come from two studies of higher plants from Indonesia that between them contribute just 284 sites but over 320,000 samples (Sheil et al. 2002).

The best-represented biomes are “Temperate Broadleaf and Mixed Forests” and “Tropical and Subtropical Moist Broadleaf Forests” (Figs 3, 4). “Flooded Grasslands and Savannas” is the only biome that is unrepresented in our database (Figs 3, 4); although this biome is responsible for only 0.7% of global terrestrial net primary productivity, it is nevertheless ecologically important and will be a priority for future collation efforts. Two biomes – “Tundra” and “Deserts and Xeric Shrublands” – are underrepresented relative to their areas. Of the world’s 17 megadiverse countries identified by Mittermeier et al. (1997), only Democratic Republic of Congo is not represented (Figure S4). The vast majority of sampling took place after the year 2000 (Fig. 3), reflecting our desire to collate diversity data that can be related to MODIS data,

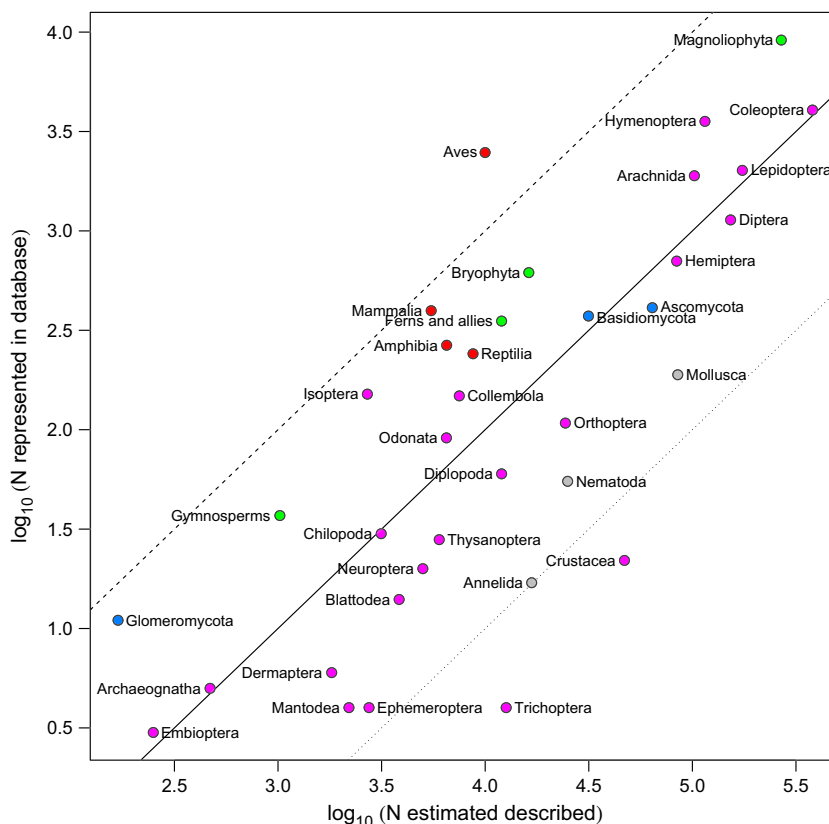


Figure 6. Taxonomic coverage. The number of species in our database against the number of described species as estimated by Chapman (2009). Vertebrates are shown in red, arthropods in pink, other animals in gray, plants in green and fungi in blue. The dashed, solid and dotted lines indicate 10, 1 and 0.1% representation, respectively. Groups with just a single species in the database – Diplura, Mycetozoa, Onychophora, Paupoda, Phasmida, Siphonaptera, Symphyla and Zoraptera – are not shown.

Table 2. Names represented in species attribute databases.

Attribute database	Trait	Group	Best guess binomials	Attribute database names	Species matches	Genus matches	Total matches
GBIF	Range size	All taxa	17,801		14,514		14,514
IUCN	Red list status	All taxa	17,801		3,521		3,521
CITES	CITES appendix	All taxa	17,801	20,094	467		467
PanTHERIA	Body mass	Mammalia	376	3,542	310	62	372
TRY	Seed mass	Plantae	6,924	26,107	2,017	2,820	4,837
TRY	Vegetative height	Plantae	6,924	2,822	772	768	1,540
TRY	Generative height	Plantae	6,924	9,911	1,633	2,546	4,179

GBIF (Global Biodiversity Information Facility, <http://www.gbif.org/>, queried 2014-03-31), IUCN (International Union for Conservation of Nature, <http://www.iucn.org/>, queried 2014-03-31), CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, <http://www.cites.org/>, downloaded 2014-01-27), PanTHERIA (Jones et al. 2009), TRY (Kattge et al. 2011). Best guess binomials: the number of unique “Best guess binomials” in the PREDICTS database within that taxonomic group. Attribute database names: the number of unique binomials and trinomials for that attribute in attribute database. Species matches: the number of “Best guess binomials” that exactly match a record in the attribute database. Genus matches: the number of generic names in the PREDICTS database with a matching record in the attribute database (only for binomials for which there was not a species match). Total matches: sum of species matches and genus matches. We did not match generic names for GBIF range size, IUCN category or CITES appendix because we did not expect these traits to be highly conserved within genera.

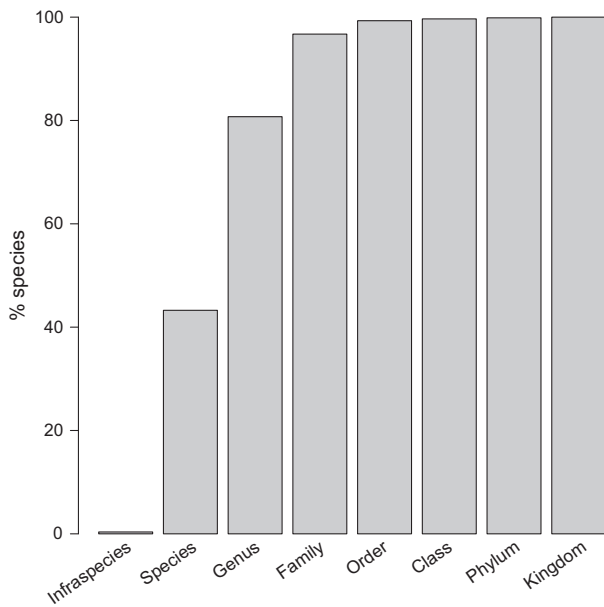


Figure 7. Cumulative percentage of species in the database, by the taxonomic rank at which the name was matched to COL.

which are available from early 2000 onwards. The database's coverage of realms, biomes, countries, regions and subregions is shown in Supplementary Tables S5–S11.

The distribution of Site-level predominant land use and use intensity is different from the distribution of the estimated total terrestrial area in each land use/land-use intensity combination for 2005 ($\chi^2 = 28,243.21$, $df = 16$, $P < 2.2 \times 10^{-16}$; we excluded “Urban”/“Light use” from this test because the HYDE and Global Land Systems datasets did not allow us to compute an estimate for this combination). The main discrepancies are that the database has far fewer than expected Sites that are classified as “Primary habitat”/“Minimal use”, “Secondary vegetation”/“Light use” and “Pasture”/“Light use” (Fig. 5). We were unable to assign a classification of predominant land use to 3.34% of Sites and of use intensity to 12.09% of Sites. The most common fragmentation layout was “Representative part of a fragmented landscape” (27.95% of Sites; Table S12) – a classification that indicates either that a Site is large enough to encompass multiple habitat types or that the Site is of a particular habitat type that is inherently fragmented and dominates the landscape e.g., the site is in an agricultural field and the landscape is comprised of many fields. We were unable to assign a fragmentation layout to 15.47% of Sites. We were able to determine the maximum linear extent of sampling for 60.09% of Sites – values range from 0.2 m to 39.15 km; median 120 m (Figure S5). The precise sampling days are known

for 45.44% of Sites; 42.19% are known to the nearest month and 12.37% to the nearest year. The median sampling duration was 91 days; sampling lasted for 1 day or less at 9.90% of Sites (Figure S6). The area of habitat containing the site is known for 25.49% of Sites – values are approximately log-normally distributed (median 40,000 square meters; Figure S7). We reviewed all cases of Sites falling outside the GIS polygons for countries (0.82% of Sites; Figure S8) and ecoregions (0.52% of Sites; Figure S9). These Sites were either on coasts and/or on islands too small to be included in the GIS dataset in question.

The database contains measurements of approximately 28,735 species (see “Counting the number of species” in Methods) – 17,733 animals, 10,201 plants, 800 fungi and 1 protozoan. We were unable to place 97 taxa in a higher taxonomic group because they were not sufficiently well resolved. The database contains more than 1% as many species as have been described within 20 higher taxonomic groups (Fig. 6). Birds are particularly well represented, reflecting the sampling bias in favor of this charismatic group. Our database contains measurements of 2,479 species of birds – 24.81% of those described (Chapman 2009) – and 2,368 of these are resolved to either species or infraspecies levels. A total of 228,644 samples – more than 14% of the entire database – are of birds. In contrast, just 397 species of mammals are represented, but even this constitutes 7.24% of described species. Chiroptera (bats) are the best-represented mammalian order with 188 species. Of the 115,000 estimated described species of Hymenoptera, 3,556 (3.09%) are represented in the database, the best representation of an invertebrate group. The hymenopteran family with the most species in the database is Formicidae with 2,060 species. The database contains data for 4,056 species of Coleoptera – 1.07% of described beetles. Carabidae is the best-represented beetle family with 2,060 species. Some higher taxonomic groups have well below 1% representation and, as might be expected, the database has poor coverage of groups for which the majority of species are marine – nematodes, crustaceans and molluscs.

Of the 28,735 species, 43.26% are matched to a COL record with a rank of species or infraspecies, 37.47% to a COL record with a rank of genus and 19.27% to a COL record with a higher taxonomic rank (Fig. 7). The species with the largest number of measurements – 1,305 – is *Bombus pascuorum* (the common carder bee), and bees constitute 35 of the top 100 most frequently sampled species: this results from a PREDICTS subproject that is examining pollinators. Birds make up most of the remaining top 100, with 36 species. Of the 407 Studies, 126 sampled within a single order (Fig. 8); just 12 Studies

examined a single species. The six most commonly examined higher taxonomic groups are Tracheophyta (12.04% of Studies), Aves (11.06%), Hymenoptera (7.86%),

Arthropoda (4.67%), Formicidae (4.67%) and Insecta (4.42%). The database contains 17,802 unique values of “Best guess binomial”. The overlap with species attribute

Figure 8. Number of Studies by lowest common taxonomic group. Bars show the number of Studies within each lowest common taxon (so, one Study examined the species *Swietenia macrophylla*, three Studies examined the species *Bombus pascuorum*, ten Studies examined multiple species within the genus *Bombus*, and so on). Colors are as in Figure 6. Numbers on the right are the primary references from which data were taken: 1 López-Quintero *et al.* 2012; 2 Buscardo *et al.* 2008; 3 Domínguez *et al.* 2012; 4 Nöske *et al.* 2008; 5 Center for International Forestry Research (CIFOR) 2013a; 6 Center for International Forestry Research (CIFOR) 2013b; 7 Sheil *et al.* 2002; 8 Dumont *et al.* 2009; 9 Proenca *et al.* 2010; 10 Baeten *et al.* 2010b; 11 Richardson *et al.* 2005; 12 Schon *et al.* 2011; 13 Muchane *et al.* 2012; 14 Vázquez and Simberloff 2002; 15 Bouyer *et al.* 2007; 16 O'Connor 2005; 17 Higuera and Wolf 2010; 18 Kati *et al.* 2012; 19 Lucas-Borja *et al.* 2011; 20 Louhaichi *et al.* 2009; 21 Power *et al.* 2012; 22 Brearley 2011; 23 Baeten *et al.* 2010a; 24 Williams *et al.* 2009; 25 Mayfield *et al.* 2006; 26 Kolb and Diekmann 2004; 27 Phalan *et al.* 2011; 28 Vassilev *et al.* 2011; 29 Paritsis and Aizen 2008; 30 Boutin *et al.* 2008; 31 Baur *et al.* 2006; 32 Fensham *et al.* 2012; 33 Brunet *et al.* 2011; 34 Kessler *et al.* 2009; 35 Hylander and Nemomissa 2009; 36 Barlow *et al.* 2007; 37 Kumar and Shahabuddin 2005; 38 Kessler *et al.* 2005; 39 Hietz 2005; 40 Krauss *et al.* 2004; 41 Hernández *et al.* 2012; 42 Calviño-Cancela *et al.* 2012; 43 Golodets *et al.* 2010; 44 Castro *et al.* 2010; 45 Milder *et al.* 2010; 46 Helden and Leather 2004; 47 McNamara *et al.* 2012; 48 Katovai *et al.* 2012; 49 Berry *et al.* 2010; 50 Letcher and Chazdon 2009; 51 Romero-Duque *et al.* 2007; 52 Marin-Spiotta *et al.* 2007; 53 Power and Stout 2011; 54 Norfolk *et al.* 2012; 55 Poveda *et al.* 2012; 56 Cabra-García *et al.* 2012; 57 Turner and Foster 2009; 58 Woodcock *et al.* 2007; 59 Lachat *et al.* 2006; 60 Rousseau *et al.* 2013; 61 Nakamura *et al.* 2003; 62 Basset *et al.* 2008; 63 Hanley 2011; 64 Billeter *et al.* 2008; Diekötter *et al.* 2008; Le Féon *et al.* 2010; 65 Sung *et al.* 2012; 66 St-Laurent *et al.* 2007; 67 Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) 2010; 68 Endo *et al.* 2010; 69 Alcalá *et al.* 2004; 70 Bicknell and Peres 2010; 71 Woinarski *et al.* 2009; 72 Garden *et al.* 2010; 73 Hylander and Weibull 2012; 74 Giordano *et al.* 2004; 75 Ström *et al.* 2009; 76 Römbke *et al.* 2009; 77 Giordani 2012; 78 Hu and Cao 2008; 79 Edenius *et al.* 2011; 80 O’Dea and Whittaker 2007; 81 Ims and Henden 2012; 82 Rosselli 2011; 83 Arbeláez-Cortés *et al.* 2011; 84 Santana *et al.* 2012; 85 Sheldon *et al.* 2010; 86 Wang *et al.* 2010; 87 Sodhi *et al.* 2010; 88 Naoe *et al.* 2012; 89 Cerezo *et al.* 2011; 90 Lantschner *et al.* 2008; 91 Chapman and Reich 2007; 92 Báldi *et al.* 2005; 93 Farwig *et al.* 2008; 94 Shahabuddin and Kumar 2007; 95 Borges 2007; 96 Wunderle *et al.* 2006; 97 Politi *et al.* 2012; 98 Moreno-Mateos *et al.* 2011; 99 Mallari *et al.* 2011; 100 Latta *et al.* 2011; 101 Sosa *et al.* 2010; 102 Miranda *et al.* 2010; 103 Flaspohler *et al.* 2010; 104 Bócon 2010; 105 Azpiroz and Blake 2009; 106 Aben *et al.* 2008; 107 Cockle *et al.* 2005; 108 Vergara and Simonetti 2004; 109 Azhar *et al.* 2013; 110 Reid *et al.* 2012; 111 Neuschulz *et al.* 2011; 112 Dawson *et al.* 2011; 113 Naidoo 2004; 114 Dures and Cumming 2010; 115 Meyer *et al.* 2009; 116 Summerville 2011; 117 Cleary *et al.* 2004; 118 Mudri-Stojnic *et al.* 2012; 119 Schüepp *et al.* 2011; 120 Bates *et al.* 2011; 121 Quintero *et al.* 2010; 122 Vergara and Badano 2009; 123 Kohler *et al.* 2008; 124 Meyer *et al.* 2007; 125 Hoffmann and Zeller 2005; 126 Caceres *et al.* 2010; 127 Lantschner *et al.* 2012; 128 Wells *et al.* 2007; 129 Bernard *et al.* 2009; 130 Martin *et al.* 2012; 131 Gheler-Costa *et al.* 2012; 132 Sridhar *et al.* 2008; 133 Scott *et al.* 2006; 134 Oke 2013; 135 Oke and Chokor 2009; 136 Kappes *et al.* 2012; 137 Walker *et al.* 2006; 138 Lo-Man-Hung *et al.* 2008; 139 Zaitsev *et al.* 2002; 140 Robles *et al.* 2011; 141 Brito *et al.* 2012; 142 Luja *et al.* 2008; 143 Smith-Pardo and Gonzalez 2007; 144 Schüepp *et al.* 2012; 145 Tylianakis *et al.* 2005; 146 Verboven *et al.* 2012; 147 Osgathorpe *et al.* 2012; 148 Tonietto *et al.* 2011; 149 Samnegård *et al.* 2011; 150 Cameron *et al.* 2011; 151 Malone *et al.* 2010; 152 Marshall *et al.* 2006; 153 Shuler *et al.* 2005; 154 Quaranta *et al.* 2004; 155 Légaré *et al.* 2011; 156 Noreika 2009; 157 Otavo *et al.* 2013; 158 Numa *et al.* 2012; 159 Jonsell 2012; 160 Mico *et al.* 2013; 161 Rodrigues *et al.* 2013; 162 Sugiura *et al.* 2009; 163 Verdú *et al.* 2007; 164 Banks *et al.* 2007; 165 Elek and Lovei 2007; 166 Fukuda *et al.* 2009; 167 Castro-Luna *et al.* 2007; 168 Shafie *et al.* 2011; 169 Struebig *et al.* 2008; 170 Threlfall *et al.* 2012; 171 Presley *et al.* 2008; 172 Willig *et al.* 2007; 173 MacSwiney *et al.* 2007; 174 Clarke *et al.* 2005; 175 Sedlock *et al.* 2008; 176 Verdasca *et al.* 2012; 177 D’Aniello *et al.* 2011; 178 Berg *et al.* 2011; 179 Summerville *et al.* 2006; 180 Hawes *et al.* 2009; 181 Cleary and Mooers 2006; 182 Krauss *et al.* 2003; 183 Ishitani *et al.* 2003; 184 Safian *et al.* 2011; 185 Furlani *et al.* 2009; 186 Isaacs-Cubides and Urbina-Cardona 2011; 187 Gutierrez-Lamus 2004; 188 Adum *et al.* 2013; 189 Watling *et al.* 2009; 190 Pillsbury and Miller 2008; 191 Pineda and Halffter 2004; 192 Ofori-Boateng *et al.* 2013; 193 de Souza *et al.* 2008; 194 Faruk *et al.* 2013; 195 Hilje and Aide 2012; 196 Alberta Biodiversity Monitoring Institute (ABMI) 2013; 197 Zaitsev *et al.* 2006; 198 Arroyo *et al.* 2005; 199 Paradis and Work 2011; 200 Buddle and Shorthouse 2008; 201 Kapoor 2008; 202 Alcayaga *et al.* 2013; 203 Magura *et al.* 2010; 204 Littlewood *et al.* 2012; 205 Körösi *et al.* 2012; 206 Oliveira *et al.* 2013; 207 Carrijo *et al.* 2009; 208 Reis and Canello 2007; 209 Chauvat *et al.* 2007; 210 Otto and Roloff 2012; 211 Zimmerman *et al.* 2011; 212 Pelegrin and Bucher 2012; 213 Savage *et al.* 2011; 214 Bragagnolo *et al.* 2007; 215 Jung and Powell 2011; 216 Bartolommei *et al.* 2013; 217 Dominguez-Haydar and Armbrecht 2010; 218 Armbrecht *et al.* 2006; 219 Hashim *et al.* 2010; 220 Schmidt *et al.* 2012; 221 Maeto and Sato 2004; 222 Bihn *et al.* 2008; 223 Delabie *et al.* 2009; 224 Fayle *et al.* 2010; 225 Gove *et al.* 2005; 226 Buczkowski and Richmond 2012; 227 Buczkowski 2010; 228 Noriega *et al.* 2012; 229 Navarro *et al.* 2011; 230 Noriega *et al.* 2007; 231 Horgan 2009; 232 Gardner *et al.* 2008; 233 da Silva 2011; 234 Silva *et al.* 2010; 235 Jacobs *et al.* 2010; 236 Slade *et al.* 2011; 237 Filgueiras *et al.* 2011; 238 Navarrete and Halffter 2008; 239 Davis and Philips 2005; 240 Parra-H and Nates-Parra 2007; 241 Fierro *et al.* 2012; 242 Nielsen *et al.* 2011; 243 Julier and Roulston 2009; 244 Winfree *et al.* 2007; 245 Hanley 2005; 246 Liu *et al.* 2012; 247 Gu *et al.* 2004; 248 Noreika and Kotze 2012; 249 Rey-Velasco and Miranda-Esquivel 2012; 250 Vanbergen *et al.* 2005; 251 Koivula *et al.* 2004; 252 Weller and Ganzhorn 2004; 253 Carvalho *et al.* 2010; 254 Aguilar-Barquero and Jiménez-Hernández 2009; 255 Fermon *et al.* 2005; 256 Ribeiro and Freitas 2012; 257 Gottschalk *et al.* 2007; 258 Cagle 2008; 259 Johnson *et al.* 2008; 260 Su *et al.* 2011; 261 Saldana-Vazquez *et al.* 2010; 262 Nicolas *et al.* 2009; 263 Sakchoowong *et al.* 2008; 264 Yoshikura *et al.* 2011; 265 Hanley *et al.* 2011; 266 Connop *et al.* 2011; 267 Redpath *et al.* 2010; 268 Goulson *et al.* 2010; 269 Goulson *et al.* 2008; 270 Hatfield and LeBuhn 2007; 271 McFrederick and LeBuhn 2006; 272 Diekötter *et al.* 2006; 273 Darvill *et al.* 2004; 274 Matsumoto *et al.* 2009; 275 Knight *et al.* 2009; 276 Herrmann *et al.* 2007; 277 Ancrenaz *et al.* 2004; 278 Felton *et al.* 2003; 279 Knop *et al.* 2004; 280 Davis *et al.* 2010; 281 Hanson *et al.* 2008; 282 Ferreira and Alves 2005; 283 Luskin 2010; 284 Grogan *et al.* 2008.

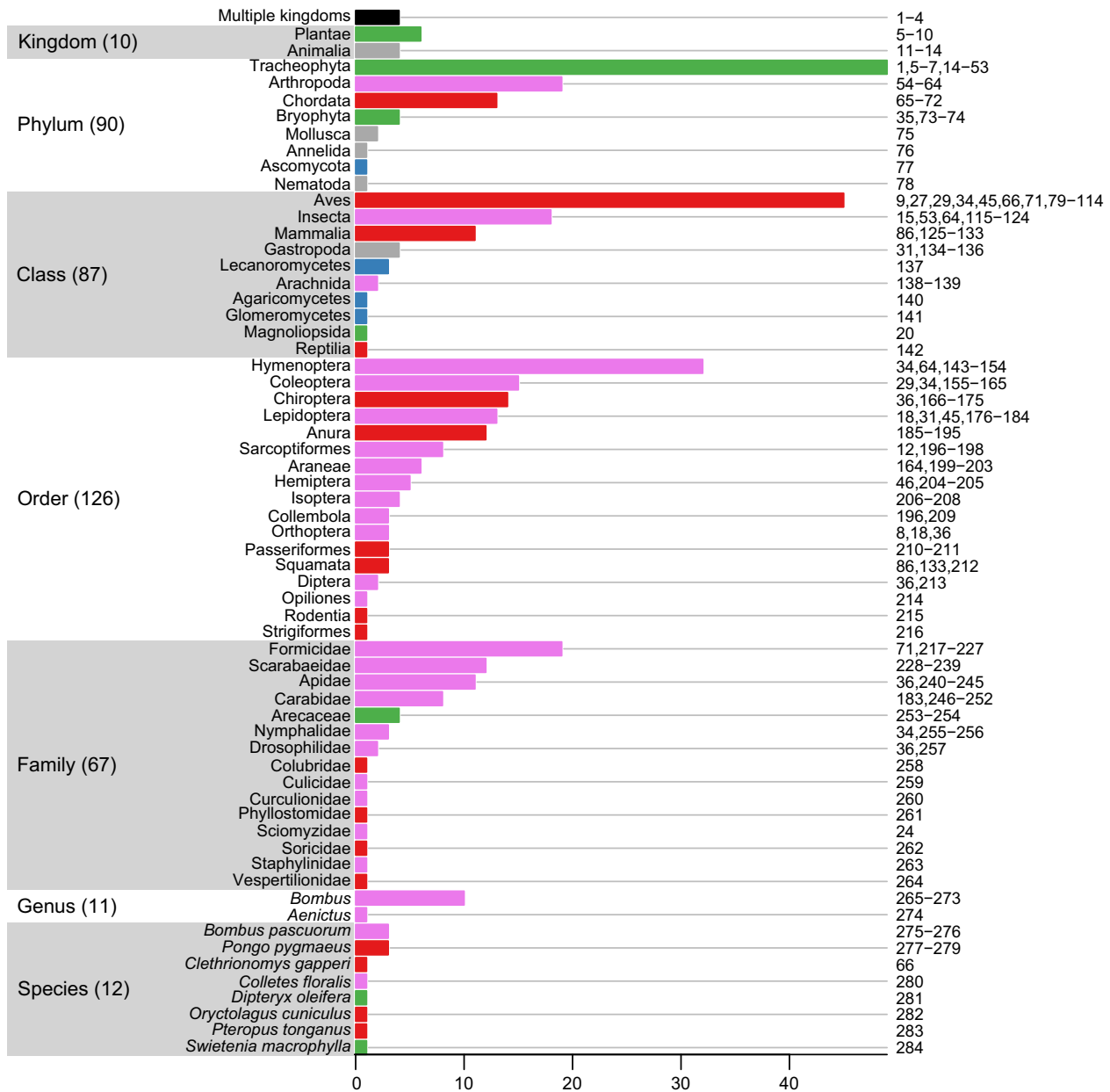
databases is often much higher than would be expected by chance (Table 2), greatly facilitating analyses that integrate PREDICTS data with species attributes (Newbold et al. 2013, 2014a,b).

Of the 284 Data Sources, 271 were taken from articles published in scientific peer-reviewed journals; the rest came from unpublished data (5), internet databases (3), PhD theses (2), agency reports (1) and other sources (2). The vast majority – 273 (96.13%) – of Data Sources are taken from English articles; the remainder are in Mandarin (0.35%), Portuguese (1.06%) or Spanish (2.46%). 29.15% of Data Sources come from just four journals (Fig. 9): Biological Conservation (11.07%), Biodiversity

and Conservation (8.86%), Forest Ecology & Management (5.17%) and Journal of Applied Ecology (4.06%). The Journal of Applied Ecology contributed many more Studies, Sites and samples than expected from the number of Data Sources (Fig. 9) because of a single Data Source that contributed 21 pan-European Studies and over 140,000 samples (data taken from Billeter et al. 2008; Diekötter et al. 2008 and Le Féon et al. 2010).

Discussion

The coverage of the PREDICTS dataset illustrates the large number of published articles that are based on



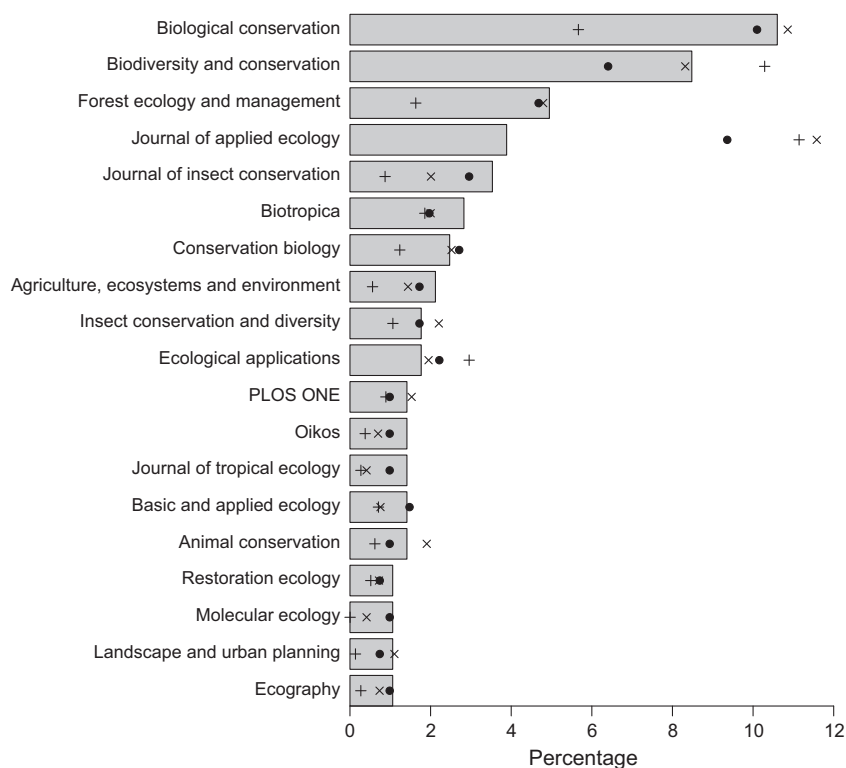


Figure 9. Data contributions by journal. The percentage of Data Sources (bars), Studies (circles), Sites (crosses) and samples (pluses) taken from each journal. Only journals from which more than one Data Source was taken are shown.

local-scale empirical data of the responses of diversity either to a difference in land-use type or along a gradient of land-use intensity or other human pressure. Such data can be used to model spatial responses of local communities to anthropogenic pressures and thus changes over time. This is essential for understanding the impact of biodiversity loss on ecosystem function and ecosystem services, which operate at the local level (Fontaine *et al.* 2006; Isbell *et al.* 2011; Cardinale *et al.* 2012; Hooper *et al.* 2012). Regardless of scale, no single Study is or could ever be representative, but the sheer number and diversity of Studies means that a collation of these data can provide relatively representative coverage of biodiversity. The majority of Data Sources (271 of 284) come from peer-reviewed publications and all data have used peer-reviewed sampling procedures. There are doubtless very many more published data than we have so far acquired and been given permission to use. For the majority of Data Sources (225), it was necessary to contact the author(s) in order to get more information such as the Site coordinates or the names of the taxa studied: even now that supplementary data are commonplace and often extensive, we usually had to request more detail than had been published.

The database currently lacks Sites in ten biodiversity hotspots and one megadiverse country (Democratic Republic of the Congo). It also has no data from many large tropical or partially tropical countries such as

Angola, Tanzania and Zambia. Many countries are under-represented given their area and/or the distinctiveness of their biota *e.g.*, Australia, China, Madagascar, New Zealand, Russia and South Africa. We have few data from islands and just 57 Sites from the biogeographic realm of Oceania (Fig. 3 and Table S8): we have not yet directly targeted Oceania or island biota more generally. The database contains no studies of microbial diversity and few of parasites – major shortcomings that also apply to other large biodiversity databases such as the Living Planet Index (WWF International 2012), the IUCN Red List (International Union for Conservation of Nature 2013) and BIOFRAG (Pfeifer *et al.* 2014). Fewer than 50% of the taxa in our database are matched to a Catalogue of Life record with a rank of species or infraspecies (Fig. 6). The quality and coverage of taxonomic databases continues to improve and we hope to improve our database's coverage by making use of new Catalogue of Life checklists as they become available. Improved software would permit the use of fuzzy searches to reduce the current manual work required to curate taxonomic names.

Intersecting our data with datasets of species attributes (Table 2) indicates much greater overlap among large-scale data resources than might be expected simply based on overall numbers of species. This suggests that the same species are being studied for different purposes, because of either ubiquity, abundance, interest or location. In one

sense this is useful, allowing a thorough treatment of certain groups of species, for example by incorporating trait data in analyses. On the other hand, it highlights the fact that many species are poorly studied in terms of distribution, traits and responses to environmental change. Indeed, many taxonomic groups that matter greatly for ecosystem functions (e.g., earthworms, fungi) are routinely underrepresented in data compilations (Cardoso *et al.* 2011; Norris 2012), including – despite our efforts toward representativeness – ours.

The PREDICTS database is a work in progress, but already represents the most comprehensive database of its kind of which we are aware. Associated with this article is a site-level extract of the data: columns are described in Table S13. The complete database will be made publicly available in 2015, before which we will attempt to improve all aspects of its coverage by targeting underrepresented hotspots, realms, biomes, countries and taxonomic groups. In addition to taking data from published articles, we will integrate measurements from existing large published datasets, where possible. We welcome and greatly value all contributions of suitable data; please contact us at <https://www.nhm.ac.uk/our-science/our-work/biodiversity/predicts.html>.

Acknowledgments

We thank the following who either contributed or collated data: The Nature Conservation Foundation, E.L. Alcalá, Paola Bartolommei, Yves Basset, Bruno Baur, Felicity Bedford, Roberto Bóçon, Sergio Borges, Cibeles Bragagnolo, Christopher Buddle, Rob Bugter, Nilton Cáceres, Nicolette Cagle, Zhi Ping Cao, Kim Chapman, Kristina Cockle, Giorgio Colombo, Adrian Davis, Emily Davis, Jeff Dawson, Moisés Barbosa de Souza, Olivier Deheuvels, Jiménez Hernández Fabiola, Aisyah Faruk, Roderick Fensham, Heleen Fermon, Catarina Ferreira, Toby Gardner, Carly Golodets, Wei Bin Gu, Doris Gutierrez-Lamus, Mike Harfoot, Farina Herrmann, Peter Hietz, Anke Hoffmann, Tamera Husseini, Juan Carlos Iturrondobeitia, Debbie Jewitt, M.F. Johnson, Heike Kappes, Daniel L. Kelly, Mairi Knight, Matti Koivula, Jochen Krauss, Patrick Lavelle, Yunhui Liu, Nancy Lo-Man-Hung, Matthew S. Luskin, Cristina MacSwiney, Takashi Matsumoto, Quinn S. McFrederick, Sean McNamara, Estefania Mico, Daniel Rafael Miranda-Esquivel, Elder F. Morato, David Moreno-Mateos, Luis Navarro, Violaine Nicolas, Catherine Numa, Samuel Eduardo Otaño, Clint Otto, Simon Paradis, Finn Pillsbury, Eduardo Pineda, Jaime Pizarro-Araya, Martha P. Ramirez-Pinilla, Juan Carlos Rey-Velasco, Alex Robinson, Marino Rodrigues, Jean-Claude Ruel, Watana Sakchoowong, Jade Savage, Nicole Schon, Dawn Scott, Nur Juliani Shafie, Frederick Sheldon, Hari Sridhar, Martin-Hugues St-Laurent, Ingolf

Steffan-Dewenter, Zhimin Su, Shinji Sugiura, Keith Summerville, Henry Tiandun, Diego Vázquez, José Verdú, Rachael Winfree, Volkmar Wolters, Joseph Wunderle, Sakato Yoshikura and Gregory Zimmerman.

Conflict of Interest

None declared.

References

- Aben, J., M. Dorenbosch, S. K. Herzog, A. J. P. Smolders, and G. Van Der Velde. 2008. Human disturbance affects a deciduous forest bird community in the Andean foothills of Central Bolivia. *Bird Conserv. Int.*, 18:363–380.
- Adum, G. B., M. P. Eichhorn, W. Oduro, C. Ofori-Boateng, and M. O. Rodel. 2013. Two-stage recovery of amphibian assemblages following selective logging of tropical forests. *Conserv. Biol.* 27:354–363.
- Aguilar-Barquero, V., and F. Jiménez-Hernández. 2009. Diversidad y distribución de palmas (Arecaceae) en tres fragmentos de bosque muy húmedo en Costa Rica. *Rev. Biol. Trop.* 57(Supplement 1):83–92.
- Alberta Biodiversity Monitoring Institute (ABMI). 2013. The raw soil arthropods dataset and the raw trees & snags dataset from Prototype Phase (2003–2006) and Rotation 1 (2007–2012) [<http://www.abmi.ca>].
- Alcalá, E. L., A. C. Alcalá, and C. N. Dolino. 2004. Amphibians and reptiles in tropical rainforest fragments on Negros Island, the Philippines. *Environ. Conserv.*, 31:254–261.
- Alcayaga, O. E., J. Pizarro-Araya, F. M. Alfaro, and J. Cepeda-Pizarro. 2013. Spiders (Arachnida, Araneae) associated to agroecosystems in the Elqui Valley (Coquimbo Region, Chile). *Rev. Colomb. Entomol.*, 39:150–154.
- Algar, A. C., H. M. Kharouba, E. R. Young, and J. T. Kerr. 2009. Predicting the future of species diversity: macroecological theory, climate change, and direct tests of alternative forecasting methods. *Ecography* 32:22–33.
- Alkemade, R., M. van Oorschot, L. Miles, C. Nellemann, M. Bakkenes, and B. ten Brink. 2009. GLOBIO3: a framework to investigate options for reducing global terrestrial biodiversity loss. *Ecosystems* 12:374–390.
- Ancrenaz, M., B. Goossens, O. Gimenez, A. Sawang, and I. Lackman-Ancrenaz. 2004. Determination of ape distribution and population size using ground and aerial surveys: a case study with orang-utans in lower Kinabatangan, Sabah, Malaysia. *Anim. Conserv.* 7:375–385.
- Arbeláez-Cortés, E., H. A. Rodríguez-Correa, and M. Restrepo-Chica. 2011. Mixed bird flocks: patterns of activity and species composition in a region of the Central Andes of Colombia. *Rev. Mex. Biodivers.* 82:639–651.
- Armbrecht, I., I. Perfecto, and E. Silverman. 2006. Limitation of nesting resources for ants in Colombian forests and coffee plantations. *Ecol. Entomol.* 31:403–410.

- Arroyo, J., J. C. Iturrondobeitia, C. Rad, and S. Gonzalez-Carcedo. 2005. Oribatid mite (Acari) community structure in steppic habitats of Burgos Province, central northern Spain. *J. Nat. Hist.* 39:3453–3470.
- van Asselen, S., and P. H. Verburg. 2012. A Land System representation for global assessments and land-use modelling. *Glob. Change Biol.* 18:3125–3148.
- Azhar, B., D. B. Lindenmayer, J. Wood, J. Fischer, A. Manning, C. McElhinny, et al. 2013. The influence of agricultural system, stand structural complexity and landscape context on foraging birds in oil palm landscapes. *Ibis* 155:297–312.
- Azpiroz, A. B., and J. G. Blake. 2009. Avian assemblages in altered and natural grasslands in the northern Campos of Uruguay. *Condor* 111:21–35.
- Baeten, L., M. Hermy, S. Van Daele, and K. Verheyen. 2010a. Unexpected understorey community development after 30 years in ancient and post-agricultural forests. *J. Ecol.* 98:1447–1453.
- Baeten, L., D. Velghe, M. Vanhellemont, P. De Frenne, M. Hermy, and K. Verheyen. 2010b. Early trajectories of spontaneous vegetation recovery after intensive agricultural land use. *Restor. Ecol.* 18:379–386.
- Báldi, A., P. Batáry, and S. Erdős. 2005. Effects of grazing intensity on bird assemblages and populations of Hungarian grasslands. *Agric. Ecosyst. Environ.* 108:251–263.
- Banks, J. E., P. Sandvik, and L. Keesecker. 2007. Beetle (Coleoptera) and spider (Araneae) diversity in a mosaic of farmland, edge, and tropical forest habitats in western Costa Rica. *Pan-Pac. Entomol.* 83:152–160.
- Barlow, J., T. A. Gardner, I. S. Araujo, T. C. Avila-Pires, A. B. Bonaldo, J. E. Costa, et al. 2007. Quantifying the biodiversity value of tropical primary, secondary, and plantation forests. *Proc. Natl Acad. Sci. USA*, 104:18555–18560.
- Bartolommei, P., A. Mortelliti, F. Pezzo, and L. Puglisi. 2013. Distribution of nocturnal birds (Strigiformes and Caprimulgidae) in relation to land-use types, extent and configuration in agricultural landscapes of Central Italy. *Rend. Lincei. Sci. Fis. Nat.* 24:13–21.
- Basset, Y., O. Missa, A. Alonso, S. E. Miller, G. Curletti, M. De Meyer, et al. 2008. Changes in arthropod assemblages along a wide gradient of disturbance in Gabon. *Conserv. Biol.* 22:1552–1563.
- Bates, A. J., J. P. Sadler, A. J. Fairbrass, S. J. Falk, J. D. Hale, and T. J. Matthews. 2011. Changing bee and hoverfly pollinator assemblages along an urban-rural gradient. *PLoS ONE* 6:e23459.
- Baur, B., C. Cremene, G. Groza, L. Rakosy, A. A. Schileyko, A. Baur, et al. 2006. Effects of abandonment of subalpine hay meadows on plant and invertebrate diversity in Transylvania, Romania. *Biol. Conserv.* 132:261–273.
- Berg, A., K. Ahrne, E. Ockinger, R. Svensson, and B. Soderstrom. 2011. Butterfly distribution and abundance is affected by variation in the Swedish forest-farmland landscape. *Biol. Conserv.* 144:2819–2831.
- Bernard, H., J. Fjeldsa, and M. Mohamed. 2009. A case study on the effects of disturbance and conversion of tropical lowland rain forest on the non-volant small mammals in north Borneo: management implications. *Mammal Study* 34:85–96.
- Berry, N. J., O. L. Phillips, S. L. Lewis, J. K. Hill, D. P. Edwards, N. B. Tawatao, et al. 2010. The high value of logged tropical forests: lessons from northern Borneo. *Biodivers. Conserv.* 19:985–997.
- Bicknell, J., and C. A. Peres. 2010. Vertebrate population responses to reduced-impact logging in a neotropical forest. *For. Ecol. Manage.* 259:2267–2275.
- Bihn, J. H., M. Verhaagh, M. Braendle, and R. Brandl. 2008. Do secondary forests act as refuges for old growth forest animals? Recovery of ant diversity in the Atlantic forest of Brazil. *Biol. Conserv.* 141:733–743.
- Billeter, R., J. Liira, D. Bailey, R. Bugter, P. Arens, I. Augenstein, et al. 2008. Indicators for biodiversity in agricultural landscapes: a pan-European study. *J. Appl. Ecol.* 45:141–150.
- Blois, J. L., J. W. Williams, M. C. Fitzpatrick, S. T. Jackson, and S. Ferrier. 2013. Space can substitute for time in predicting climate-change effects on biodiversity. *Proc. Natl Acad. Sci. USA* 110:9374–9379.
- Bóçon, R. 2010. Riqueza e abundância de aves em três estágios sucessionais da floresta ombrófila densa submontana, Antonina, Paraná. PhD thesis. Universidade Federal do Paraná, Brazil.
- Borges, S. H. 2007. Bird assemblages in secondary forests developing after slash-and-burn agriculture in the Brazilian Amazon. *J. Trop. Ecol.* 23:469–477.
- Boutin, C., A. Baril, and P. A. Martin. 2008. Plant diversity in crop fields and woody hedgerows of organic and conventional farms in contrasting landscapes. *Agric. Ecosyst. Environ.* 123:185–193.
- Bouyer, J., Y. Sana, Y. Samandougou, J. Cesar, L. Guerrini, C. Kabore-Zoungrana, et al. 2007. Identification of ecological indicators for monitoring ecosystem health in the trans-boundary W Regional park: a pilot study. *Biol. Conserv.* 138:73–88.
- Bragagnolo, C., A. A. Nogueira, R. Pinto-da-Rocha, and R. Pardini. 2007. Harvestmen in an Atlantic forest fragmented landscape: evaluating assemblage response to habitat quality and quantity. *Biol. Conserv.* 139:389–400.
- Brearley, F. Q. 2011. Below-ground secondary succession in tropical forests of Borneo. *J. Trop. Ecol.* 27:413–420.
- Brito, I., M. J. Goss, M. de Carvalho, O. Chatagnier, and D. van Tuinen. 2012. Impact of tillage system on arbuscular mycorrhiza fungal communities in the soil under Mediterranean conditions. *Soil Tillage Res.* 121:63–67.
- Brunet, J., K. Valtinat, M. L. Mayr, A. Felton, M. Lindbladh, and H. H. Bruun. 2011. Understorey succession in post-agricultural oak forests: habitat fragmentation affects forest specialists and generalists differently. *For. Ecol. Manage.* 262:1863–1871.

- Buczowski, G. 2010. Extreme life history plasticity and the evolution of invasive characteristics in a native ant. *Biol. Invasions* 12:3343–3349.
- Buczowski, G., and D. S. Richmond. 2012. The effect of urbanization on ant abundance and diversity: a temporal examination of factors affecting biodiversity. *PLoS ONE* 7: e41729.
- Buddle, C. M., and D. P. Shorthouse. 2008. Effects of experimental harvesting on spider (Araneae) assemblages in boreal deciduous forests. *Can. Entomol.* 140:437–452.
- Buscardo, E., G. F. Smith, D. L. Kelly, H. Freitas, S. Iremonger, F. J. G. Mitchell, et al. 2008. The early effects of afforestation on biodiversity of grasslands in Ireland. *Biodivers. Conserv.* 17:1057–1072.
- Butchart, S. H. M., M. Walpole, B. Collen, A. van Strien, J. P. W. Scharlemann, R. E. A. Almond, et al. 2010. Global biodiversity: indicators of recent declines. *Science* 328:1164–1168.
- Cabra-García, J., C. Bermúdez-Rivas, A. M. Osorio, and P. Chacón. 2012. Cross-taxon congruence of alpha and beta diversity among five leaf litter arthropod groups in Colombia. *Biodivers. Conserv.* 21:1493–1508.
- Caceres, N. C., R. P. Napoli, J. Casella, and W. Hannibal. 2010. Mammals in a fragmented savannah landscape in south-western Brazil. *J. Nat. Hist.* 44:491–512.
- Cagle, N. L. 2008. Snake species distributions and temperate grasslands: a case study from the American tallgrass prairie. *Biol. Conserv.* 141:744–755.
- Calviño-Cancela, M., M. Rubido-Bará, and E. J. B. van Etten. 2012. Do eucalypt plantations provide habitat for native forest biodiversity? *For. Ecol. Manage.* 270:153–162.
- Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, et al. 2011. Patterns of widespread decline in North American bumble bees. *Proc. Natl Acad. Sci. USA* 108:662–667.
- Cardinale, B. J., J. E. Duffy, A. Gonzalez, D. U. Hooper, C. Perrings, P. Venail, et al. 2012. Biodiversity loss and its impact on humanity. *Nature* 486:59–67.
- Cardoso, P., T. L. Erwin, P. A. V. Borges, and T. R. New. 2011. The seven impediments in invertebrate conservation and how to overcome them. *Biol. Conserv.* 144:2647–2655.
- Carrizo, T. F., D. Brandao, D. E. de Oliveira, D. A. Costa, and T. Santos. 2009. Effects of pasture implantation on the termite (Isoptera) fauna in the Central Brazilian Savanna (Cerrado). *J. Insect Conserv.* 13:575–581.
- Carvalho, A. L.d., E. J. L. Ferreira, J. M. T. Lima, and A. L. de Carvalho. 2010. Floristic and structural comparisons among palm communities in primary and secondary forest fragments of the Raimundo Irineu Serra Environmental Protection Area – Rio Branco, Acre, Brazil. *Acta Amazon.* 40:657–666.
- Castro, H., V. Lehsten, S. Lavorel, and H. Freitas. 2010. Functional response traits in relation to land use change in the Montado. *Agric. Ecosyst. Environ.* 137:183–191.
- Castro-Luna, A. A., V. J. Sosa, and G. Castillo-Campos. 2007. Bat diversity and abundance associated with the degree of secondary succession in a tropical forest mosaic in south-eastern Mexico. *Anim. Conserv.* 10:219–228.
- Center for International Forestry Research (CIFOR). 2013a. Multidisciplinary Landscape Assessment – Cameroon [<http://www.cifor.org/mla>].
- Center for International Forestry Research (CIFOR). 2013b. Multidisciplinary Landscape Assessment – Philippines [<http://www.cifor.org/mla>].
- Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) 2010. Unpublished data of reptilian and amphibian diversity in six countries in Central America [<http://catie.ac.cr/>].
- Cerezo, A., M. Conde, and S. Poggio. 2011. Pasture area and landscape heterogeneity are key determinants of bird diversity in intensively managed farmland. *Biodivers. Conserv.*, 20:2649–2667.
- Chapman, A. D. 2009. Numbers of living species in Australia and the world. Pp. 78. Australian Biological Resources Study, Canberra, Australia.
- Chapman, K., and P. Reich. 2007. Land use and habitat gradients determine bird community diversity and abundance in suburban, rural and reserve landscapes of Minnesota, USA. *Biol. Conserv.* 135:527–541.
- Chauvat, M., V. Wolters, and J. Dauber. 2007. Response of collembolan communities to land-use change and grassland succession. *Ecography* 30:183–192.
- Clarke, F. M., L. V. Rostant, and P. A. Racey. 2005. Life after logging: post-logging recovery of a neotropical bat community. *J. Appl. Ecol.* 42:409–420.
- Cleary, D. F. R., and A. O. Mooers. 2006. Burning and logging differentially affect endemic vs. widely distributed butterfly species in Borneo. *Divers. Distrib.* 12:409–416.
- Cleary, D. F. R., A. O. Mooers, K. A. O. Eichhorn, J. van Tol, R. de Jong, and S. B. J. Menken. 2004. Diversity and community composition of butterflies and odonates in an ENSO-induced fire affected habitat mosaic: a case study from East Kalimantan, Indonesia. *Oikos* 105: 426–446.
- Cockle, K. L., M. L. Leonard, and A. A. Bodrati. 2005. Presence and abundance of birds in an Atlantic forest reserve and adjacent plantation of shade-grown yerba mate, in Paraguay. *Biodivers. Conserv.* 14:3265–3288.
- Connop, S., T. Hill, J. Steer, and P. Shaw. 2011. Microsatellite analysis reveals the spatial dynamics of *Bombus humilis* and *Bombus sylvarum*. *Insect Conserv. Divers.* 4:212–221.
- Conservation International Foundation. 2011. The biodiversity hotspots [http://www.conservation.org/where/priority_areas/hotspots/Pages/hotspots_main.aspx].
- D’Aniello, B., I. Stanislao, S. Bonelli, and E. Balletto. 2011. Haying and grazing effects on the butterfly communities of two Mediterranean-area grasslands. *Biodivers. Conserv.* 20:1731–1744.

- Darvill, B., M. E. Knight, and D. Goulson. 2004. Use of genetic markers to quantify bumblebee foraging range and nest density. *Oikos* 107:471–478.
- Davis, A. L. V., and T. K. Philips. 2005. Effect of deforestation on a southwest Ghana dung beetle assemblage (Coleoptera: Scarabaeidae) at the periphery of Ankasa conservation area. *Environ. Entomol.* 34:1081–1088.
- Davis, E. S., T. E. Murray, U. Fitzpatrick, M. J. F. Brown, and R. J. Paxton. 2010. Landscape effects on extremely fragmented populations of a rare solitary bee, *Colletes floralis*. *Mol. Ecol.* 19:4922–4935.
- Dawson, J., C. Turner, O. Pileng, A. Farmer, C. McGary, C. Walsh, et al. 2011. Bird communities of the lower Waria Valley, Morobe Province, Papua New Guinea: a comparison between habitat types. *Trop. Conserv. Sci.* 4:317–348.
- Delabie, J. H. C., R. Cereghino, S. Groc, A. Dejean, M. Gibernau, B. Corbara, et al. 2009. Ants as biological indicators of Wayana Amerindian land use in French Guiana. *C.R. Biol.* 332:673–684.
- Dickman, C. R. 1987. Habitat fragmentation and vertebrate species richness in an urban environment. *J. Appl. Ecol.* 24:337–351.
- Diekötter, T., K. Walther-Hellwig, M. Conradi, M. Suter, and R. Frankl. 2006. Effects of landscape elements on the distribution of the rare bumblebee species *Bombus muscorum* in an agricultural landscape. *Biodivers. Conserv.* 15:57–68.
- Diekötter, T., R. Billeter, and T. O. Crist. 2008. Effects of landscape connectivity on the spatial distribution of insect diversity in agricultural mosaic landscapes. *Basic Appl. Ecol.* 9:298–307.
- Domínguez, E., N. Bahamonde, and C. Muñoz-Escobar. 2012. Efectos de la extracción de turba sobre la composición y estructura de una turbera de *Sphagnum* explotada y abandonada hace 20 años, Chile. *Anales Instituto Patagonia (Chile)* 40:37–45.
- Dominguez-Haydar, Y., and I. Armbrrecht. 2010. Response of ants and their seed removal in rehabilitation areas and forests at El Cerrejon coal mine in Colombia. *Restor. Ecol.* 19:178–184.
- Dornelas, M., A. E. Magurran, S. T. Buckland, A. Chao, R. L. Chazdon, R. K. Colwell, et al. 2013. Quantifying temporal change in biodiversity: challenges and opportunities. *Proc. Biol. Sci.* 280:10.
- Dumont, B., A. Farruggia, J. P. Garel, P. Bachelard, E. Boitier, and M. Frain. 2009. How does grazing intensity influence the diversity of plants and insects in a species-rich upland grassland on basalt soils? *Grass Forage Sci.* 64:92–105.
- Dures, S. G., and G. S. Cumming. 2010. The confounding influence of homogenising invasive species in a globally endangered and largely urban biome: does habitat quality dominate avian biodiversity? *Biol. Conserv.* 143:768–777.
- Edenius, L., G. Mikusinski, and J. Bergh. 2011. Can repeated fertilizer applications to young Norway spruce enhance avian diversity in intensively managed forests? *Ambio* 40:521–527.
- Elek, Z., and G. L. Lovei. 2007. Patterns in ground beetle (Coleoptera: Carabidae) assemblages along an urbanisation gradient in Denmark. *Acta Oecol. International Journal of Ecology* 32:104–111.
- Ellis, E. C., K. K. Goldewijk, S. Siebert, D. Lightman, and N. Ramankutty. 2010. Anthropogenic transformation of the biomes, 1700 to 2000. *Glob. Ecol. Biogeogr.* 19:589–606.
- Endo, W., C. Peres, E. Salas, S. Mori, J. Sanchez-Vega, G. Shepard, et al. 2010. Game vertebrate densities in hunted and nonhunted forest sites in Manu National Park, Peru. *Biotropica* 42:251–261.
- Environmental Systems Research Institute (ESRI). 2011. ArcGIS Desktop: Release 10. Environmental Systems Research Institute, Redlands, CA.
- Faruk, A., D. Belabut, N. Ahmad, R. J. Knell, and T. W. J. Garner. 2013. Effects of oil-palm plantations on diversity of tropical anurans. *Conserv. Biol.* 27:615–624.
- Farwig, N., N. Sajita, and K. Boehning-Gaese. 2008. Conservation value of forest plantations for bird communities in western Kenya. *For. Ecol. Manage.* 255:3885–3892.
- Fayle, T. M., E. C. Turner, J. L. Snaddon, V. K. Chey, A. Y. C. Chung, P. Eggleton, et al. 2010. Oil palm expansion into rain forest greatly reduces ant biodiversity in canopy, epiphytes and leaf-litter. *Basic Appl. Ecol.* 11:337–345.
- Feld, C. K., J. P. Sousa, P. M. da Silva, and T. P. Dawson. 2010. Indicators for biodiversity and ecosystem services: towards an improved framework for ecosystems assessment. *Biodivers. Conserv.* 19:2895–2919.
- Felton, A. M., L. M. Engstrom, A. Felton, and C. D. Knott. 2003. Orangutan population density, forest structure and fruit availability in hand-logged and unlogged peat swamp forests in West Kalimantan, Indonesia. *Biol. Conserv.* 114:91–101.
- Fensham, R., J. Dwyer, T. Eyre, R. Fairfax, and J. Wang. 2012. The effect of clearing on plant composition in mulga (*Acacia aneura*) dry forest, Australia. *Austral Ecol.* 37:183–192.
- Fermon, H., M. Waltert, R. I. Vane-Wright, and M. Muhlenberg. 2005. Forest use and vertical stratification in fruit-feeding butterflies of Sulawesi, Indonesia: impacts for conservation. *Biodivers. Conserv.* 14:333–350.
- Ferreira, C., and P. C. Alves. 2005. Impacto da implementação de medidas de gestão do habitat nas populações de coelho-bravo (*Oryctolagus cuniculus algericus*) no Parque Natural do Sudoeste Alentejano e Costa Vicentina. Pp. 95. Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO), Vairão, Portugal.
- Fierro, M. M., L. Cruz-Lopez, D. Sanchez, R. Villanueva-Gutierrez, and R. Vandame. 2012. Effect of biotic factors on the spatial distribution of stingless bees (Hymenoptera: Apidae, Meliponini) in fragmented neotropical habitats. *Neotrop. Entomol.* 41:95–104.

- Filgueiras, B., L. Iannuzzi, and I. Leal. 2011. Habitat fragmentation alters the structure of dung beetle communities in the Atlantic Forest. *Biol. Conserv.* 144:362–369.
- Flaspohler, D. J., C. P. Giardina, G. P. Asner, P. Hart, J. Price, C. K. Lyons, et al. 2010. Long-term effects of fragmentation and fragment properties on bird species richness in Hawaiian forests. *Biol. Conserv.* 143:280–288.
- Fontaine, C., I. Dajoz, J. Meriguet, and M. Loreau. 2006. Functional diversity of plant-pollinator interaction webs enhances the persistence of plant communities. *PLoS Biol.* 4:129–135.
- Fukuda, D., O. B. Tisen, K. Momose, and S. Sakai. 2009. Bat diversity in the vegetation mosaic around a lowland dipterocarp forest of Borneo. *Raffles Bull. Zool.* 57:213–221.
- Furlani, D., G. F. Ficotola, G. Colombo, M. Ugurlucan, and F. De Bernardi. 2009. Deforestation and the structure of frog communities in the Humedale Terraba-Sierpe, Costa Rica. *Zoolog. Sci.* 26:197–202.
- Garden, J. G., C. A. McAlpine, and H. P. Possingham. 2010. Multi-scaled habitat considerations for conserving urban biodiversity: native reptiles and small mammals in Brisbane, Australia. *Landscape Ecol.* 25:1013–1028.
- Gardner, T. A., M. I. M. Hernandez, J. Barlow, and C. A. Peres. 2008. Understanding the biodiversity consequences of habitat change: the value of secondary and plantation forests for neotropical dung beetles. *J. Appl. Ecol.* 45:883–893.
- Gheler-Costa, C., C. A. Vettorazzi, R. Pardini, and L. M. Verdade. 2012. The distribution and abundance of small mammals in agroecosystems of southeastern Brazil. *Mammalia* 76:185–191.
- Gibson, L., T. M. Lee, L. P. Koh, B. W. Brook, T. A. Gardner, J. Barlow, et al. 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. *Nature* 478:378–383.
- Giordani, P. 2012. Assessing the effects of forest management on epiphytic lichens in coppiced forests using different indicators. *Plant Biosyst.* 146:628–637.
- Giordano, S., S. Sorbo, P. Adamo, A. Basile, V. Spagnuolo, and R. C. Cobianchi. 2004. Biodiversity and trace element content of epiphytic bryophytes in urban and extrarurban sites of southern Italy. *Plant Ecol.* 170:1–14.
- Golodets, C., J. Kigel, and M. Sternberg. 2010. Recovery of plant species composition and ecosystem function after cessation of grazing in a Mediterranean grassland. *Plant Soil* 329:365–378.
- Gottschalk, M. S., D. C. De Toni, V. L. S. Valente, and P. R. P. Hofmann. 2007. Changes in Brazilian Drosophilidae (Diptera) assemblages across an urbanisation gradient. *Neotrop. Entomol.* 36:848–862.
- Goulson, D., G. C. Lye, and B. Darvill. 2008. Diet breadth, coexistence and rarity in bumblebees. *Biodivers. Conserv.* 17:3269–3288.
- Goulson, D., O. Lepais, S. O'Connor, J. L. Osborne, R. A. Sanderson, J. Cussans, et al. 2010. Effects of land use at a landscape scale on bumblebee nest density and survival. *J. Appl. Ecol.* 47:1207–1215.
- Gove, A. D., J. D. Majer, and V. Rico-Gray. 2005. Methods for conservation outside of formal reserve systems: the case of ants in the seasonally dry tropics of Veracruz, Mexico. *Biol. Conserv.* 126:328–338.
- Grogan, J., S. B. Jennings, R. M. Landis, M. Schulze, A. M. V. Baima, J. D. C. A. Lopes, et al. 2008. What loggers leave behind: impacts on big-leaf mahogany (*Swietenia macrophylla*) commercial populations and potential for post-logging recovery in the Brazilian Amazon. *For. Ecol. Manage.*, 255:269–281.
- Gu, W.-B., Y. Zhen-Rong, and H. Dun-Xiao. 2004. Carabid community and its fluctuation in farmland of salinity transforming area in the North China Plain: a case study in Quzhou County, Hebei Province. *Biodivers. Sci.* 12:262–268.
- Gutierrez-Lamus, D. L. 2004. Composition and abundance of Anura in two forest types (natural and planted) in the eastern Cordillera of Colombia. *Caldasia* 26:245–264.
- Hanley, M. E. 2005. Unpublished data of bee diversity in UK croplands.
- Hanley, M. E. 2011. Unpublished data of bee diversity in UK croplands and urban habitats.
- Hanley, M. E., M. Franco, C. E. Dean, E. L. Franklin, H. R. Harris, A. G. Haynes, et al. 2011. Increased bumblebee abundance along the margins of a mass flowering crop: evidence for pollinator spill-over. *Oikos* 120:1618–1624.
- Hanson, T. R., S. J. Brunsfeld, B. Finegan, and L. P. Waits. 2008. Pollen dispersal and genetic structure of the tropical tree *Dipteryx panamensis* in a fragmented Costa Rican landscape. *Mol. Ecol.* 17:2060–2073.
- Hashim, N., W. Akmal, W. Jusoh, and M. Nasir. 2010. Ant diversity in a Peninsular Malaysian mangrove forest and oil palm plantation. *Asian Myrmecol.* 3:5–8.
- Hatfield, R. G., and G. LeBuhn. 2007. Patch and landscape factors shape community assemblage of bumble bees, *Bombus* spp. (Hymenoptera: Apidae), in montane meadows. *Biol. Conserv.* 139:150–158.
- Hawes, J., C. da Silva Motta, W. L. Overall, J. Barlow, T. A. Gardner, and C. A. Peres. 2009. Diversity and composition of Amazonian moths in primary, secondary and plantation forests. *J. Trop. Ecol.*, 25:281–300.
- Heink, U., and I. Kowarik. 2010. What criteria should be used to select biodiversity indicators? *Biodivers. Conserv.* 19:3769–3797.
- Helden, A. J., and S. R. Leather. 2004. Biodiversity on urban roundabouts – Hemiptera, management and the species-area relationship. *Basic Appl. Ecol.* 5:367–377.
- Hernández, L., L. Delgado, W. Meier, and C. Duran. 2012. Empobrecimiento de bosques fragmentados en el norte de la Gran Sabana, Venezuela. *Interiencia* 37:891–898.
- Herrmann, F., C. Westphal, R. F. A. Moritz, and I. Steffan-Dewenter. 2007. Genetic diversity and mass resources promote colony size and forager densities of a

- social bee (*Bombus pascuorum*) in agricultural landscapes. *Mol. Ecol.* 16:1167–1178.
- Hietz, P. 2005. Conservation of vascular epiphyte diversity in Mexican coffee plantations. *Conserv. Biol.* 19:391–399.
- Higuera, D., and J. H. D. Wolf. 2010. Vascular epiphytes in dry oak forests show resilience to anthropogenic disturbance, Cordillera Oriental, Colombia. *Caldasia* 32:161–174.
- Hilje, B., and T. M. Aide. 2012. Recovery of amphibian species richness and composition in a chronosequence of secondary forests, northeastern Costa Rica. *Biol. Conserv.* 146:170–176.
- Hoffmann, A., and U. Zeller. 2005. Influence of variations in land use intensity on species diversity and abundance of small mammals in the Nama Karoo, Namibia. *Belg. J. Zool.* 135:91–96.
- Hooper, D. U., E. C. Adair, B. J. Cardinale, J. E. K. Byrnes, B. A. Hungate, K. L. Matulich, et al. 2012. A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature* 486:105–108.
- Horgan, F. G. 2009. Invasion and retreat: shifting assemblages of dung beetles amidst changing agricultural landscapes in central Peru. *Biodivers. Conserv.* 18:3519–3541.
- Hu, C., and Z. P. Cao. 2008. Nematode community structure under compost and chemical fertilizer management practice, in the north China plain. *Exp. Agric.* 44:485–496.
- Hudson, L. N., T. Newbold, D. W. Purves, J. P. W. Scharlemann, G. Mace, and A. Purvis. 2013. Projecting responses of ecological diversity In *Changing Terrestrial Systems (PREDICTS): can you help?* *BES Bull.* 44:36–37.
- Hurt, G. C., L. P. Chini, S. Frolking, R. A. Betts, J. Feddema, G. Fischer, et al. 2011. Harmonization of land-use scenarios for the period 1500–2100: 600 years of global gridded annual land-use transitions, wood harvest, and resulting secondary lands. *Clim. Change* 109:117–161.
- Hylander, K., and S. Nemomissa. 2009. Complementary roles of home gardens and exotic tree plantations as alternative habitats for plants of the Ethiopian montane rainforest. *Conserv. Biol.* 23:400–409.
- Hylander, K., and H. Weibull. 2012. Do time-lagged extinctions and colonizations change the interpretation of buffer strip effectiveness? – a study of riparian bryophytes in the first decade after logging. *J. Appl. Ecol.* 49:1316–1324.
- Ims, R. A., and J. A. Henden. 2012. Collapse of an arctic bird community resulting from ungulate-induced loss of erect shrubs. *Biol. Conserv.* 149:2–5.
- International Union for Conservation of Nature. 2013. The IUCN red list of threatened species [http://www.iucnredlist.org/].
- Isaacs-Cubides, P. J., and J. N. Urbina-Cardona. 2011. Anthropogenic disturbance and edge effects on anuran assemblages inhabiting cloud forest fragments in Colombia. *Natureza Conservacao* 9:39–46.
- Isbell, F., V. Calcagno, A. Hector, J. Connolly, W. S. Harpole, P. B. Reich, et al. 2011. High plant diversity is needed to maintain ecosystem services. *Nature* 477:199–203.
- Ishitani, M., D. J. Kotze, and J. Niemela. 2003. Changes in carabid beetle assemblages across an urban-rural gradient in Japan. *Ecography* 26:481–489.
- Jacobs, C. T., C. H. Scholtz, F. Escobar, and A. L. V. Davis. 2010. How might intensification of farming influence dung beetle diversity (Coleoptera: Scarabaeidae) in Maputo Special Reserve (Mozambique)? *J. Insect Conserv.* 14:389–399.
- Johnson, E. A., and K. Miyanishi. 2008. Testing the assumptions of chronosequences in succession. *Ecol. Lett.* 11:419–431.
- Johnson, M. F., A. Gómez, and M. Pinedo-Vasquez. 2008. Land use and mosquito diversity in the Peruvian Amazon. *J. Med. Entomol.* 45:1023–1030.
- Jones, K. E., J. Bielby, M. Cardillo, S. A. Fritz, J. O'Dell, D. L. Orme, et al. 2009. PanTHERIA: a species-level database of life history, ecology, and geography of extant and recently extinct mammals. *Ecology* 90:2648.
- Jones, J. P. G., B. Collen, G. Atkinson, P. W. J. Baxter, P. Bubb, J. B. Illian, et al. 2011. The why, what, and how of global biodiversity indicators beyond the 2010 target. *Conserv. Biol.* 25:450–457.
- Jonsell, M. 2012. Old park trees as habitat for saproxylic beetle species. *Biodivers. Conserv.* 21:619–642.
- Julier, H. E., and T. H. Roulston. 2009. Wild bee abundance and pollination service in cultivated pumpkins: farm management, nesting behavior and landscape effects. *J. Econ. Entomol.* 102:563–573.
- Jung, T. S., and T. Powell. 2011. Spatial distribution of meadow jumping mice (*Zapus hudsonius*) in logged boreal forest of northwestern Canada. *Mammalian Biology* 76:678–682.
- Justice, C. O., E. Vermote, J. R. G. Townshend, R. Defries, D. P. Roy, D. K. Hall, et al. 1998. The moderate resolution imaging spectroradiometer (MODIS): Land remote sensing for global change research. *IEEE Trans. Geosci. Remote Sens.* 36:1228–1249.
- Kapoor, V. 2008. Effects of rainforest fragmentation and shade-coffee plantations on spider communities in the Western Ghats, India. *J. Insect Conserv.* 12:53–68.
- Kappes, H., L. Katzschner, and C. Nowak. 2012. Urban summer heat load: meteorological data as a proxy for metropolitan biodiversity. *Meteorol. Z.* 21:525–528.
- Kati, V., K. Zografou, E. Tzirkalli, T. Chitos, and L. Willemse. 2012. Butterfly and grasshopper diversity patterns in humid Mediterranean grasslands: the roles of disturbance and environmental factors. *J. Insect Conserv.* 16:807–818.
- Katovai, E., A. L. Burley, and M. M. Mayfield. 2012. Understorey plant species and functional diversity in the degraded wet tropical forests of Kolombangara Island, Solomon Islands. *Biol. Conserv.* 145:214–224.
- Kattge, J., S. Diaz, S. Lavorel, C. Prentice, P. Leadley, G. Bonisch, et al. 2011. TRY – a global database of plant traits. *Glob. Change Biol.* 17:2905–2935.
- Kessler, M., P. J. A. Kessler, S. R. Gradstein, K. Bach, M. Schnull, and R. Pitopang. 2005. Tree diversity in primary

- forest and different land use systems in Central Sulawesi, Indonesia. *Biodivers. Conserv.* 14:547–560.
- Kessler, M., S. Abrahamczyk, M. Bos, D. Buchori, D. D. Putra, S. R. Gradstein, et al. 2009. Alpha and beta diversity of plants and animals along a tropical land-use gradient. *Ecol. Appl.* 19:2142–2156.
- Knight, M. E., J. L. Osborne, R. A. Sanderson, R. J. Hale, A. P. Martin, and D. Goulson. 2009. Bumblebee nest density and the scale of available forage in arable landscapes. *Insect Conserv. Divers.* 2:116–124.
- Knop, E., P. I. Ward, and S. A. Wich. 2004. A comparison of orang-utan density in a logged and unlogged forest on Sumatra. *Biol. Conserv.* 120:183–188.
- Kohler, F., J. Verhulst, R. van Klink, and D. Kleijn. 2008. At what spatial scale do high-quality habitats enhance the diversity of forbs and pollinators in intensively farmed landscapes? *J. Appl. Ecol.* 45:753–762.
- Koivula, M., V. Hyrylainen, and E. Soininen. 2004. Carabid beetles (Coleoptera: Carabidae) at forest-farmland edges in southern Finland. *J. Insect Conserv.* 8:297–309.
- Kolb, A., and M. Diekmann. 2004. Effects of environment, habitat configuration and forest continuity on the distribution of forest plant species. *J. Veg. Sci.* 15:199–208.
- Kőrösi, Á., P. Batáry, A. Orosz, D. Rédei, and A. Báldi. 2012. Effects of grazing, vegetation structure and landscape complexity on grassland leafhoppers (Hemiptera: Auchenorrhyncha) and true bugs (Hemiptera: Heteroptera) in Hungary. *Insect Conserv. Divers.* 5:57–66.
- Krauss, J., I. Steffan-Dewenter, and T. Tschardtke. 2003. How does landscape context contribute to effects of habitat fragmentation on diversity and population density of butterflies? *J. Biogeogr.* 30:889–900.
- Krauss, J., A. M. Klein, I. Steffan-Dewenter, and T. Tschardtke. 2004. Effects of habitat area, isolation, and landscape diversity on plant species richness of calcareous grasslands. *Biodivers. Conserv.* 13:1427–1439.
- Kumar, R., and G. Shahabuddin. 2005. Effects of biomass extraction on vegetation structure, diversity and composition of forests in Sariska Tiger Reserve, India. *Environ. Conserv.* 32:248–259.
- Lachat, T., S. Attignon, J. Djego, G. Goergen, P. Nagel, B. Sinsin, et al. 2006. Arthropod diversity in Lama forest reserve (South Benin), a mosaic of natural, degraded and plantation forests. *Biodivers. Conserv.* 15:3–23.
- Landis, J. R., and G. G. Koch. 1977. The measurement of observer agreement for categorical data. *Biometrics* 33:159–174.
- Lantschner, M. V., V. Rusch, and C. Peyrou. 2008. Bird assemblages in pine plantations replacing native ecosystems in NW Patagonia. *Biodivers. Conserv.* 17:969–989.
- Lantschner, M. V., V. Rusch, and J. P. Hayes. 2012. Habitat use by carnivores at different spatial scales in a plantation forest landscape in Patagonia, Argentina. *For. Ecol. Manage.* 269:271–278.
- Latta, S. C., B. A. Tinoco, P. X. Astudillo, and C. H. Graham. 2011. Patterns and magnitude of temporal change in avian communities in the Ecuadorian Andes. *Condor* 113:24–40.
- Le Féon, V., A. Schermann-Legionnet, Y. Delettre, S. Aviron, R. Billeter, R. Bugter, et al. 2010. Intensification of agriculture, landscape composition and wild bee communities: a large scale study in four European countries. *Agric. Ecosyst. Environ.* 137:143–150.
- Légaré, J.-P., C. Hébert, and J. Ruel. 2011. Alternative silvicultural practices in irregular boreal forests: response of beetle assemblages. *Silva Fennica.* 45:937–956.
- Letcher, S. G., and R. L. Chazdon. 2009. Rapid recovery of biomass, species richness, and species composition in a forest chronosequence in northeastern Costa Rica. *Biotropica* 41:608–617.
- Littlewood, N. A., R. J. Pakeman, and G. Pozsgai. 2012. Grazing impacts on Auchenorrhyncha diversity and abundance on a Scottish upland estate. *Insect Conserv. Divers.* 5:67–74.
- Liu, Y. H., J. C. Axmacher, C. L. Wang, L. T. Li, and Z. R. Yu. 2012. Ground beetle (Coleoptera: Carabidae) assemblages of restored semi-natural habitats and intensively cultivated fields in northern China. *Restor. Ecol.* 20:234–239.
- Lo-Man-Hung, N. F., T. A. Gardner, M. A. Ribeiro-Júnior, J. Barlow, and A. B. Bonaldo. 2008. The value of primary, secondary, and plantation forests for Neotropical epigeic arachnids. *J. Arachnol.* 36:394–401.
- López-Quintero, C. A., G. Straatsma, A. E. Franco-Molano, and T. Boekhout. 2012. Macrofungal diversity in Colombian Amazon forests varies with regions and regimes of disturbance. *Biodivers. Conserv.* 21:2221–2243.
- Louhaichi, M., A. K. Salkini, and S. L. Petersen. 2009. Effect of small ruminant grazing on the plant community characteristics of semiarid Mediterranean ecosystems. *Int. J. Agric. Biol.* 11:681–689.
- Lucas-Borja, M. E., F. Bastida, J. L. Moreno, C. Nicolas, M. Andres, F. R. Lopez, et al. 2011. The effects of human trampling on the microbiological properties of soil and vegetation in Mediterranean mountain areas. *Land Degrad. Dev.* 22:383–394.
- Luja, V., S. Herrando-Perez, D. Gonzalez-Solis, and L. Luiselli. 2008. Secondary rain forests are not havens for reptile species in tropical Mexico. *Biotropica* 40:747–757.
- Luskin, M. S. 2010. Flying foxes prefer to forage in farmland in a tropical dry forest landscape mosaic in Fiji. *Biotropica* 42:246–250.
- Mace, G. M., W. Cramer, S. Diaz, D. P. Faith, A. Larigauderie, P. Le Prestre, et al. 2010. Biodiversity targets after 2010. *Curr. Opin. Environ. Sustain.* 2:3–8.
- MacSwiney, M. C. G., P. L. Vilchis, F. M. Clarke, and P. A. Racey. 2007. The importance of cenotes in conserving bat assemblages in the Yucatan, Mexico. *Biol. Conserv.* 136:499–509.
- Maeto, K., and S. Sato. 2004. Impacts of forestry on ant species richness and composition in warm-temperate forests of Japan. *For. Ecol. Manage.* 187:213–223.

- Magura, T., R. Horvath, and B. Tothmeresz. 2010. Effects of urbanization on ground-dwelling spiders in forest patches, in Hungary. *Landscape Ecol.* 25:621–629.
- Mallari, N. A. D., N. J. Collar, D. C. Lee, P. J. K. McGowan, R. Wilkinson, and S. J. Marsden. 2011. Population densities of understory birds across a habitat gradient in Palawan, Philippines: implications for conservation. *Oryx* 45:234–242.
- Malone, L., J. Aulsford, B. Howlett, C. Scott-Dupree, N. Bardol, and B. Donovan. 2010. Observations on bee species visiting white clover in New Zealand pastures. *J. Apic. Res.* 49:284–286.
- Marin-Spiotta, E., R. Ostertag, and W. L. Silver. 2007. Long-term patterns in tropical reforestation: plant community composition and aboveground biomass accumulation. *Ecol. Appl.* 17:828–839.
- Marshall, E. J. P., T. M. West, and D. Kleijn. 2006. Impacts of an agri-environment field margin prescription on the flora and fauna of arable farmland in different landscapes. *Agric. Ecosyst. Environ.* 113:36–44.
- Martin, P. S., C. Gheler-Costa, P. C. Lopes, L. M. Rosalino, and L. M. Verdade. 2012. Terrestrial non-volant small mammals in agro-silvicultural landscapes of Southeastern Brazil. *For. Ecol. Manage.* 282:185–195.
- Matsumoto, T., T. Itioka, S. Yamane, and K. Momose. 2009. Traditional land use associated with swidden agriculture changes encounter rates of the top predator, the army ant, in Southeast Asian tropical rain forests. *Biodivers. Conserv.* 18:3139–3151.
- Mayfield, M. M., D. Ackerly, and G. C. Daily. 2006. The diversity and conservation of plant reproductive and dispersal functional traits in human-dominated tropical landscapes. *J. Ecol.* 94:522–536.
- McFrederick, Q. S., and G. LeBuhn. 2006. Are urban parks refuges for bumble bees *Bombus* spp. (Hymenoptera: Apidae)? *Biol. Conserv.* 129:372–382.
- McNamara, S., P. D. Erskine, D. Lamb, L. Chantalangsy, and S. Boyle. 2012. Primary tree species diversity in secondary fallow forests of Laos. *For. Ecol. Manage.* 281:93–99.
- Meyer, B., V. Gaebele, and I. D. Steffan-Dewenter. 2007. Patch size and landscape effects on pollinators and seed set of the horseshoe vetch, *Hippocrepis comosa*, in an agricultural landscape of central Europe. *Entomologia Generalis* 30:173–185.
- Meyer, B., F. Jauker, and I. Steffan-Dewenter. 2009. Contrasting resource-dependent responses of hoverfly richness and density to landscape structure. *Basic Appl. Ecol.* 10:178–186.
- Mico, E., A. Garcia-Lopez, H. Brustel, A. Padilla, and E. Galante. 2013. Explaining the saproxylic beetle diversity of a protected Mediterranean area. *Biodivers. Conserv.* 22:889–904.
- Milder, J. C., F. A. J. DeClerck, A. Sanfiorenzo, D. M. Sanchez, D. E. Tobar, and B. Zuckerberg. 2010. Effects of farm and landscape management on bird and butterfly conservation in western Honduras. *Ecosphere*, 1:art2.
- Miranda, M. V., N. Politi, and L. O. Rivera. 2010. Unexpected changes in the bird assemblage in areas under selective logging in piedmont forest in northwestern Argentina. *Ornitol. Neotrop.*, 21:323–337.
- Mittermeier, R. A., P. R. Gil, and C. G. Mittermeier. 1997. Megadiversity: earth's biologically wealthiest nations. Pp. 501. CEMEX/Agrupación Sierra Madre, Mexico City, Mexico.
- Moreno-Mateos, D., J. M. Rey Benayas, L. Perez-Camacho, E. de la Montana, S. Rebollo, and L. Cayuela. 2011. Effects of land use on nocturnal birds in a Mediterranean agricultural landscape. *Acta Ornithologica.* 46:173–182.
- Muchane, M. N., D. Karanja, G. M. Wambugu, J. M. Mutahi, C. W. Masiga, C. Mugoya, et al. 2012. Land use practices and their implications on soil macro-fauna in Maasai Mara ecosystem. *Int. J. Biodivers. Conserv.* 4:500–514.
- Mudri-Stojnic, S., A. Andric, Z. Jozan, and A. Vujic. 2012. Pollinator diversity (Hymenoptera and Diptera) in semi-natural habitats in Serbia during summer. *Arch. Biol. Sci.* 64:777–786.
- Naidoo, R. 2004. Species richness and community composition of songbirds in a tropical forest-agricultural landscape. *Anim. Conserv.* 7:93–105.
- Nakamura, A., H. Proctor, and C. P. Catterall. 2003. Using soil and litter arthropods to assess the state of rainforest restoration. *Ecol. Manag. Restor.* 4(Supplement):S20–S28.
- Naoy, S., S. Sakai, and T. Masaki. 2012. Effect of forest shape on habitat selection of birds in a plantation-dominant landscape across seasons: comparison between continuous and strip forests. *J. For. Res.* 17:219–223.
- Navarrete, D., and G. Halffter. 2008. Dung beetle (Coleoptera: Scarabaeidae: Scarabaeinae) diversity in continuous forest, forest fragments and cattle pastures in a landscape of Chiapas, Mexico: the effects of anthropogenic changes. *Biodivers. Conserv.* 17:2869–2898.
- Navarro, I. L., A. K. Roman, F. H. Gomez, and H. A. Perez. 2011. Seasonal variation in dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae) from Serrania de Coraza, Sucre (Colombia). *Revista Colombiana de Ciencia Animal* 3:102–110.
- Neuschulz, E. L., A. Botzat, and N. Farwig. 2011. Effects of forest modification on bird community composition and seed removal in a heterogeneous landscape in South Africa. *Oikos* 120:1371–1379.
- Newbold, T., L. N. Hudson, D. W. Purves, J. P. W. Scharlemann, G. Mace, and A. Purvis. 2012. PREDICTS: projecting Responses of Ecological Diversity in Changing Terrestrial Systems. *Front. Biogeogr.* 4:155–156.
- Newbold, T., J. P. W. Scharlemann, S. H. M. Butchart, C. H. Sekercioglu, R. Alkemade, H. Booth, et al. 2013. Ecological traits affect the response of tropical forest bird species to land-use intensity. *Proc. Biol. Sci.* 280:8.
- Newbold, T., J. P. W. Scharlemann, S. H. M. Butchart, Ç. H. Şekercioglu, L. Joppa, R. Alkemade, et al. 2014a. Functional

- traits, land-use change and the structure of present and future bird communities in tropical forests. *Glob. Ecol. Biogeogr.* 23:1073–1084.
- Newbold, T., L. N. Hudson, H. R. P. Phillips, S. L. L. Hill, S. Contu, I. Lysenko, *et al.* 2014b. A global model of the response of tropical and sub-tropical forest biodiversity to anthropogenic pressures. *Proc. Biol. Sci.* 281:10.
- Nicolas, V., P. Barriere, A. Tapiero, and M. Colyn. 2009. Shrew species diversity and abundance in Zيام Biosphere Reserve, Guinea: comparison among primary forest, degraded forest and restoration plots. *Biodivers. Conserv.* 18:2043–2061.
- Nielsen, A., I. Steffan-Dewenter, C. Westphal, O. Messinger, S. G. Potts, S. P. M. Roberts, *et al.* 2011. Assessing bee species richness in two Mediterranean communities: importance of habitat type and sampling techniques. *Ecol. Res.* 26: 969–983.
- Noreika, N. 2009. New records of rare species of Coleoptera found in Ukmergė district in 2004–2005. *New and Rare for Lithuania Insect Species* 21:68–71.
- Noreika, N., and D. J. Kotze. 2012. Forest edge contrasts have a predictable effect on the spatial distribution of carabid beetles in urban forests. *J. Insect Conserv.* 16:867–881.
- Norfolk, O., M. Abdel-Dayem, and F. Gilbert. 2012. Rainwater harvesting and arthropod biodiversity within an arid agro-ecosystem. *Agric. Ecosyst. Environ.* 162:8–14.
- Noriega, J. A., E. Realpe, and G. Fagua. 2007. Diversidad de escarabajos coprofagos (Coleoptera: Scarabaeidae) en un bosque de galeria con tres estadios de alteracion. *Univ. Sci.* 12:51–63.
- Noriega, J. A., J. M. Palacio, J. D. Monroy-G, and E. Valencia. 2012. Estructura de un ensamblaje de escarabajos coprofagos (Coleoptera: Scarabaeinae) en tres sitios con diferente uso del suelo en Antioquia, Colombia. *Actualidades Biológicas* 34:43–54.
- Norris, K. 2012. Biodiversity in the context of ecosystem services: the applied need for systems approaches. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* 367:191–199.
- Nöske, N. M., N. Hilt, F. A. Werner, G. Brehm, K. Fiedler, H. J. M. Sipman, *et al.* 2008. Disturbance effects on diversity of epiphytes and moths in a montane forest in Ecuador. *Basic Appl. Ecol.* 9:4–12.
- Numa, C., J. R. Verdu, C. Rueda, and E. Galante. 2012. Comparing dung beetle species assemblages between protected areas and adjacent pasturelands in a Mediterranean savanna landscape. *Rangeland Ecol. Manage.* 65:137–143.
- O'Connor, T. G. 2005. Influence of land use on plant community composition and diversity in Highland Sourveld grassland in the southern Drakensberg, South Africa. *J. Appl. Ecol.* 42:975–988.
- O'Dea, N., and R. J. Whittaker. 2007. How resilient are Andean montane forest bird communities to habitat degradation? *Biodivers. Conserv.* 16:1131–1159.
- Ofori-Boateng, C., W. Oduro, A. Hillers, K. Norris, S. K. Oppong, G. B. Adum, *et al.* 2013. Differences in the effects of selective logging on amphibian assemblages in three west African forest types. *Biotropica* 45:94–101.
- Oke, C. 2013. Land snail diversity in post extraction secondary forest reserves in Edo State, Nigeria. *Afr. J. Ecol.* 51:244–254.
- Oke, O. C., and J. U. Chokor. 2009. The effect of land use on snail species richness and diversity in the tropical rainforest of south-western Nigeria. *African Sci.* 10:95–108.
- Oliveira, D. E., T. F. Carrijo, and D. Brandão. 2013. Species composition of termites (Isoptera) in different Cerrado vegetation physiognomies. *Sociobiology* 60:190–197.
- Osgathorpe, L. M., K. Park, and D. Goulson. 2012. The use of off-farm habitats by foraging bumblebees in agricultural landscapes: implications for conservation management. *Apidologie* 43:113–127.
- Octavo, S. E., A. Parrado-Rosselli, and J. A. Noriega. 2013. Scarabaeoidea superfamily (Insecta: Coleoptera) as a bioindicator element of anthropogenic disturbance in an amazon national park. *Rev. Biol. Trop.* 61:735–752.
- Otto, C. R. V., and G. J. Roloff. 2012. Songbird response to green-tree retention prescriptions in clearcut forests. *For. Ecol. Manage.* 284:241–250.
- Paradis, S., and T. T. Work. 2011. Partial cutting does not maintain spider assemblages within the observed range of natural variability in eastern Canadian black spruce forests. *For. Ecol. Manage.* 262:2079–2093.
- Paritsis, J., and M. A. Aizen. 2008. Effects of exotic conifer plantations on the biodiversity of understory plants, epigeal beetles and birds in *Nothofagus dombeyi* forests. *For. Ecol. Manage.* 255:1575–1583.
- Parra-H, A., and G. Nates-Parra. 2007. Variation of the orchid bees community (Hymenoptera: Apidae) in three altered habitats of the Colombian “llano” piedmont. *Rev. Biol. Trop.* 55:931–941.
- Pelegrin, N., and E. H. Bucher. 2012. Effects of habitat degradation on the lizard assemblage in the Arid Chaco, central Argentina. *J. Arid Environ.* 79:13–19.
- Pfeifer, M., V. Lefebvre, T. A. Gardner, V. Arroyo-Rodriguez, L. Baeten, C. Banks-Leite, *et al.* 2014. BIOFRAG – a new database for analyzing Biodiversity responses to forest FRAGMENTATION. *Ecol. Evol.*, 4:1524–1537.
- Phalan, B., M. Onial, A. Balmford, and R. Green. 2011. Reconciling food production and biodiversity conservation: land sharing and land sparing compared. *Science* 333:1289–1291.
- Pillsbury, F. C., and J. R. Miller. 2008. Habitat and landscape characteristics underlying anuran community structure along an urban-rural gradient. *Ecol. Appl.* 18:1107–1118.
- Pineda, E., and G. Halffter. 2004. Species diversity and habitat fragmentation: frogs in a tropical montane landscape in Mexico. *Biol. Conserv.* 117:499–508.
- Politi, N., M. Jr Hunter, and L. Rivera. 2012. Assessing the effects of selective logging on birds in Neotropical piedmont

- and cloud montane forests. *Biodivers. Conserv.* 21:3131–3155.
- Poveda, K., E. Martinez, M. Kersch-Becker, M. Bonilla, and T. Tschardtke. 2012. Landscape simplification and altitude affect biodiversity, herbivory and Andean potato yield. *J. Appl. Ecol.* 49:513–522.
- Power, E. F., and J. C. Stout. 2011. Organic dairy farming: impacts on insect-flower interaction networks and pollination. *J. Appl. Ecol.* 48:561–569.
- Power, E. F., D. L. Kelly, and J. C. Stout. 2012. Organic farming and landscape structure: effects on insect-pollinated plant diversity in intensively managed grasslands. *PLoS ONE* 7:e38073.
- Presley, S. J., M. R. Willig, J. M. Jr Wunderle, and L. N. Saldanha. 2008. Effects of reduced-impact logging and forest physiognomy on bat populations of lowland Amazonian forest. *J. Appl. Ecol.* 45:14–25.
- Proenca, V. M., H. M. Pereira, J. Guilherme, and L. Vicente. 2010. Plant and bird diversity in natural forests and in native and exotic plantations in NW Portugal. *Acta Oecol. International Journal of Ecology* 36:219–226.
- Quaranta, M., S. Ambroselli, P. Barro, S. Bella, A. Carini, G. Celli, et al. 2004. Wild bees in agroecosystems and semi-natural landscapes. 1997–2000 collection period in Italy. *Bull. Insectology*, 57:11–62.
- Quintero, C., C. L. Morales, and M. A. Aizen. 2010. Effects of anthropogenic habitat disturbance on local pollinator diversity and species turnover across a precipitation gradient. *Biodivers. Conserv.* 19:257–274.
- Redpath, N., L. M. Osgathorpe, K. Park, and D. Goulson. 2010. Crofting and bumblebee conservation: the impact of land management practices on bumblebee populations in northwest Scotland. *Biol. Conserv.* 143:492–500.
- Reichman, O. J., M. B. Jones, and M. P. Schildhauer. 2011. Challenges and opportunities of open data in ecology. *Science* 331:703–705.
- Reid, J. L., J. B. C. Harris, and R. A. Zahawi. 2012. Avian habitat preference in tropical forest restoration in southern Costa Rica. *Biotropica* 44:350–359.
- Reis, Y. T., and E. M. Canello. 2007. Termite (Insecta, Isoptera) richness in primary and secondary Atlantic Forest in southeastern Bahia. *Iheringia Ser. Zool.* 97:229–234.
- Rey-Velasco, J. C., and D. R. Miranda-Esquivel. 2012. Unpublished data of the response of ground beetles (Coleoptera: Carabidae) in the northeastern Colombian Andes to habitat modification.
- Ribeiro, D. B., and A. V. L. Freitas. 2012. The effect of reduced-impact logging on fruit-feeding butterflies in Central Amazon, Brazil. *J. Insect Conserv.* 16:733–744.
- Richardson, B. A., M. J. Richardson, and F. N. Soto-Adames. 2005. Separating the effects of forest type and elevation on the diversity of litter invertebrate communities in a humid tropical forest in Puerto Rico. *J. Anim. Ecol.* 74:926–936.
- Robles, C. A., C. C. Carmaran, and S. E. Lopez. 2011. Screening of xylophagous fungi associated with *Platanus acerifolia* in urban landscapes: biodiversity and potential biodeterioration. *Landsc. Urban Plan.* 100:129–135.
- Rodrigues, M. M., M. A. Uchoa, and S. Ide. 2013. Dung beetles (Coleoptera: Scarabaeoidea) in three landscapes in Mato Grosso do Sul, Brazil. *Braz. J. Biol.* 73:211–220.
- Römbke, J., P. Schmidt, and H. Höfer. 2009. The earthworm fauna of regenerating forests and anthropogenic habitats in the coastal region of Paraná. *Pesqui. Agropecu. Bras.* 44:1040–1049.
- Romero-Duque, L. P., V. J. Jaramillo, and A. Perez-Jimenez. 2007. Structure and diversity of secondary tropical dry forests in Mexico, differing in their prior land-use history. *For. Ecol. Manage.* 253:38–47.
- Roskov, Y., T. Kunz, L. Paglinawan, T. Orrell, D. Nicolson, A. Culham, et al. 2013. Species 2000 & ITIS Catalogue of Life, 2013 Annual Checklist [<http://catalogueoflife.org/annual-checklist/2013/>].
- Rosselli, L. 2011. Factores ambientales relacionados con la presencia y abundancia de las aves de los humedales de la Sabana de Bogotá. PhD thesis. Universidad Nacional de Colombia, Colombia.
- Rousseau, L., S. J. Fonte, O. Tellez, R. van der Hoek, and P. Lavelle. 2013. Soil macrofauna as indicators of soil quality and land use impacts in smallholder agroecosystems of western Nicaragua. *Ecol. Ind.* 27:71–82.
- Safian, S., G. Csontos, and D. Winkler. 2011. Butterfly community recovery in degraded rainforest habitats in the Upper Guinean forest zone (Kakum forest, Ghana). *J. Insect Conserv.* 15:351–359.
- Sakchoowong, W., S. Nomura, K. Ogata, and J. Chanpaisaeng. 2008. Diversity of pselaphine beetles (Coleoptera: Staphylinidae: Pselaphinae) in eastern Thailand. *Entomol. Sci.* 11:301–313.
- Saldana-Vazquez, R. A., V. J. Sosa, J. R. Hernandez-Montero, and F. Lopez-Barrera. 2010. Abundance responses of frugivorous bats (Stenodermatinae) to coffee cultivation and selective logging practices in mountainous central Veracruz, Mexico. *Biodivers. Conserv.* 19:2111–2124.
- Samnegård, U., A. S. Persson, and H. G. Smith. 2011. Gardens benefit bees and enhance pollination in intensively managed farmland. *Biol. Conserv.* 144:2602–2606.
- Santana, J., M. Porto, L. Gordinho, L. Reino, and P. Beja. 2012. Long-term responses of Mediterranean birds to forest fuel management. *J. Appl. Ecol.* 49:632–643.
- Savage, J., T. A. Wheeler, A. M. A. Moores, and A. G. Taillefer. 2011. Effects of habitat size, vegetation cover, and surrounding land use on diptera diversity in temperate nearctic bogs. *Wetlands* 31:125–134.
- Schmidt, A. C., L. H. Fraser, C. N. Carlyle, and E. R. L. Bassett. 2012. Does cattle grazing affect ant abundance and diversity in temperate grasslands? *Rangeland Ecol. Manage.* 65:292–298.

- Schon, N. L., A. D. Mackay, and M. A. Minor. 2011. Soil fauna in sheep-grazed hill pastures under organic and conventional livestock management and in an adjacent ungrazed pasture. *Pedobiologia* 54:161–168.
- Schüepf, C., J. D. Herrmann, F. Herzog, and M. H. Schmidt-Entling. 2011. Differential effects of habitat isolation and landscape composition on wasps, bees, and their enemies. *Oecologia* 165:713–721.
- Schüepf, C., S. Rittiner, and M. H. Entling. 2012. High bee and wasp diversity in a heterogeneous tropical farming system compared to protected forest. *PLoS ONE* 7:e52109.
- Scott, D. M., D. Brown, S. Mahood, B. Denton, A. Silburn, and F. Rakotondraparany. 2006. The impacts of forest clearance on lizard, small mammal and bird communities in the arid spiny forest, southern Madagascar. *Biol. Conserv.* 127:72–87.
- Sedlock, J. L., S. E. Weyandt, L. Cororan, M. Damerow, S. Hwa, and B. Pauli. 2008. Bat diversity in tropical forest and agro-pastoral habitats within a protected area in the Philippines. *Acta Chiropt.* 10:349–358.
- Shafie, N. J., S. A. M. Sah, N. S. A. Latip, N. M. Azman, and N. L. Khairuddin. 2011. Diversity pattern of bats at two contrasting habitat types along Kerian River, Perak, Malaysia. *Trop. Life Sci. Res.* 22:13–22.
- Shahabuddin, G., and R. Kumar. 2007. Effects of extractive disturbance on bird assemblages, vegetation structure and floristics in tropical scrub forest, Sariska Tiger Reserve, India. *For. Ecol. Manage.* 246:175–185.
- Sheil, D., R. K. Puri, I. Basuki, M. van Heist, M. Wan, N. Liswanti, et al. 2002. Exploring biological diversity, environment and local people's perspectives in forest landscapes: methods for a multidisciplinary landscape assessment. Research, Center for International Forestry Research (CIFOR), Jakarta [<http://www.cifor.org/mla>].
- Sheldon, F., A. Styring, and P. Hosner. 2010. Bird species richness in a Bornean exotic tree plantation: a long-term perspective. *Biol. Conserv.* 143:399–407.
- Shuler, R. E., T. H. Roulston, and G. E. Farris. 2005. Farming practices influence wild pollinator populations on squash and pumpkin. *J. Econ. Entomol.* 98:790–795.
- da Silva, P. G. 2011. Espécies de Scarabaeinae (Coleoptera: Scarabaeidae) de fragmentos florestais com diferentes níveis de alteração em Santa Maria, Rio Grande do Sul. MSc thesis. Universidade Federal de Santa Maria, Brazil.
- Silva, F. A. B., C. M. Q. Costa, R. C. Moura, and A. I. Farias. 2010. Study of the dung beetle (Coleoptera: Scarabaeidae) community at two sites: atlantic forest and clear-cut, Pernambuco, Brazil. *Environ. Entomol.* 39:359–367.
- Slade, E. M., D. J. Mann, and O. T. Lewis. 2011. Biodiversity and ecosystem function of tropical forest dung beetles under contrasting logging regimes. *Biol. Conserv.* 144:166–174.
- Smith-Pardo, A., and V. H. Gonzalez. 2007. Bee diversity (Hymenoptera: Apoidea) in a tropical rainforest succession. *Acta Biol. Colomb.* 12:43–55.
- Sodhi, N. S., D. S. Wilcove, T. M. Lee, C. H. Sekercioglu, R. Subaraj, H. Bernard, et al. 2010. Deforestation and avian extinction on tropical landbridge islands. *Conserv. Biol.* 24:1290–1298.
- Sosa, R. A., V. A. Benz, J. M. Galea, and I. V. Poggio Herrero. 2010. Efecto del grado de disturbio sobre el ensamble de aves en la reserva provincial Parque Luro, La Pampa, Argentina. *Revista de la Asociación Argentina de Ecología de Paisajes*, 1:101–110.
- de Souza, V. M., B. de Souza, and E. F. Morato. 2008. Effect of the forest succession on the anurans (Amphibia: Anura) of the Reserve Catuaba and its periphery, Acre, southwestern Amazonia. *Rev. Bras. Zool.* 25:49–57.
- Sridhar, H., T. R. S. Raman, and D. Mudappa. 2008. Mammal persistence and abundance in tropical rainforest remnants in the southern Western Ghats, India. *Curr. Sci.* 94:748–757.
- St-Laurent, M. H., J. Ferron, C. Hins, and R. Gagnon. 2007. Effects of stand structure and landscape characteristics on habitat use by birds and small mammals in managed boreal forest of eastern Canada. *Canadian Journal of Forest Research-Revue Canadienne de Recherche Forestiere* 37:1298–1309.
- Ström, L., K. Hylander, and M. Dynesius. 2009. Different long-term and short-term responses of land snails to clear-cutting of boreal stream-side forests. *Biol. Conserv.* 142:1580–1587.
- Struebig, M. J., T. Kingston, A. Zubaid, A. Mohd-Adnan, and S. J. Rossiter. 2008. Conservation value of forest fragments to Palaeotropical bats. *Biol. Conserv.* 141:2112–2126.
- Su, Z. M., R. Z. Zhang, and J. X. Qiu. 2011. Decline in the diversity of willow trunk-dwelling weevils (Coleoptera: Curculionidae) as a result of urban expansion in Beijing, China. *J. Insect Conserv.* 15:367–377.
- Sugiura, S., T. Tsuru, Y. Yamaura, and H. Makihara. 2009. Small off-shore islands can serve as important refuges for endemic beetle conservation. *J. Insect Conserv.* 13:377–385.
- Summerville, K. S. 2011. Managing the forest for more than the trees: effects of experimental timber harvest on forest Lepidoptera. *Ecol. Appl.* 21:806–816.
- Summerville, K. S., C. J. Conoan, and R. M. Steichen. 2006. Species traits as predictors of lepidopteran composition in restored and remnant tallgrass prairies. *Ecol. Appl.* 16:891–900.
- Sung, Y. H., N. E. Karraker, and B. C. H. Hau. 2012. Terrestrial herpetofaunal assemblages in secondary forests and exotic *Lophostemon confertus* plantations in South China. *For. Ecol. Manage.* 270:71–77.
- The Nature Conservancy. 2009. Terrestrial ecoregions of the world [http://maps.tnc.org/gis_data.html].
- Thematic Mapping. 2008. World borders [http://thematicmapping.org/downloads/world_borders.php].
- Threlfall, C. G., B. Law, and P. B. Banks. 2012. Sensitivity of insectivorous bats to urbanization: implications for suburban conservation planning. *Biol. Conserv.* 146:41–52.

- Tonietto, R., J. Fant, J. Ascher, K. Ellis, and D. Larkin. 2011. A comparison of bee communities of Chicago green roofs, parks and prairies. *Landsc. Urban Plan.* 103:102–108.
- Turner, E. C., and W. A. Foster. 2009. The impact of forest conversion to oil palm on arthropod abundance and biomass in Sabah, Malaysia. *J. Trop. Ecol.* 25:23–30.
- Tylianakis, J. M., A. M. Klein, and T. Tschirntke. 2005. Spatiotemporal variation in the diversity of hymenoptera across a tropical habitat gradient. *Ecology* 86:3296–3302.
- UNEP-WCMC. 2009. International expert workshop on the 2010 biodiversity indicators and post-2010 indicator development. Pp. 65. UNEP-WCMC, Cambridge, U.K.
- Váčkář, D. 2012. Ecological footprint, environmental performance and biodiversity: a cross-national comparison. *Ecol. Ind.* 16:40–46.
- Vanbergen, A. J., B. A. Woodcock, A. D. Watt, and J. Niemela. 2005. Effect of land-use heterogeneity on carabid communities at the landscape scale. *Ecography* 28:3–16.
- Vassilev, K., H. Pedashenko, S. C. Nikolov, I. Apostolova, and J. Dengler. 2011. Effect of land abandonment on the vegetation of upland semi-natural grasslands in the Western Balkan Mts., Bulgaria. *Plant Biosyst.* 145:654–665.
- Vázquez, D. P., and D. Simberloff. 2002. Ecological specialization and susceptibility to disturbance: conjectures and refutations. *Am. Nat.* 159:606–623.
- Verboven, H. A. F., R. Brys, and M. Hermy. 2012. Sex in the city: reproductive success of *Digitalis purpurea* in a gradient from urban to rural sites. *Landsc. Urban Plan.* 106: 158–164.
- Verdasca, M. J., A. S. Leitao, J. Santana, M. Porto, S. Dias, and P. Beja. 2012. Forest fuel management as a conservation tool for early successional species under agricultural abandonment: the case of Mediterranean butterflies. *Biol. Conserv.* 146:14–23.
- Verdú, J. R., C. E. Moreno, G. Sánchez-Rojas, C. Numa, E. Galante, and G. Halffter. 2007. Grazing promotes dung beetle diversity in the xeric landscape of a Mexican Biosphere Reserve. *Biol. Conserv.* 140:308–317.
- Vergara, C. H., and E. I. Badano. 2009. Pollinator diversity increases fruit production in Mexican coffee plantations: the importance of rustic management systems. *Agric. Ecosyst. Environ.* 129:117–123.
- Vergara, P. M., and J. A. Simonetti. 2004. Avian responses to fragmentation of the Maulino Forest in central Chile. *Oryx* 38:383–388.
- Vié, J., C. Hilton-Taylor, and S. N. Stuart. 2009. Wildlife in a Changing World: an analysis of the 2008 IUCN Red List of Threatened Species. Pp. 180. International Union for Conservation of Nature, Gland, Switzerland.
- Walker, T. R., P. D. Crittenden, S. D. Young, and T. Prystina. 2006. An assessment of pollution impacts due to the oil and gas industries in the Pechora basin, north-eastern European Russia. *Ecol. Ind.* 6:369–387.
- Walpole, M., R. E. A. Almond, C. Besancon, S. H. M. Butchart, D. Campbell-Lendrum, G. M. Carr, et al. 2009. Tracking Progress Toward the 2010 Biodiversity Target and Beyond. *Science* 325:1503–1504.
- Wang, Y., Y. Bao, M. Yu, G. Xu, and P. Ding. 2010. Nestedness for different reasons: the distributions of birds, lizards and small mammals on islands of an inundated lake. *Divers. Distrib.* 16:862–873.
- Watling, J. I., K. Gerow, and M. A. Donnelly. 2009. Nested species subsets of amphibians and reptiles on Neotropical forest islands. *Anim. Conserv.* 12:467–476.
- Weller, B., and J. U. Ganzhorn. 2004. Carabid beetle community composition, body size, and fluctuating asymmetry along an urban-rural gradient. *Basic Appl. Ecol.* 5:193–201.
- Wells, K., E. K. V. Kalko, M. B. Lakim, and M. Pfeiffer. 2007. Effects of rain forest logging on species richness and assemblage composition of small mammals in Southeast Asia. *J. Biogeogr.* 34:1087–1099.
- Wilcove, D. S., C. H. McLellan, and A. P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. 237–256. *in* M. E. Soule, ed. *Conservation biology. The science of scarcity and diversity*, Sinauer Associates, Inc., Sunderland, MA.
- Williams, C. D., J. Sheahan, and M. J. Gormally. 2009. Hydrology and management of turloughs (temporary lakes) affect marsh fly (Sciomyzidae: Diptera) communities. *Insect Conserv. Divers.* 2:270–283.
- Willig, M. R., S. J. Presley, C. P. Bloch, C. L. Hice, S. P. Yanoviak, M. M. Diaz, et al. 2007. Phyllostomid bats of lowland Amazonia: effects of habitat alteration on abundance. *Biotropica* 39:737–746.
- Winfree, R., T. Griswold, and C. Kremen. 2007. Effect of human disturbance on bee communities in a forested ecosystem. *Conserv. Biol.* 21:213–223.
- Woinarski, J. C. Z., B. Rankmore, B. Hill, A. D. Griffiths, A. Stewart, and B. Grace. 2009. Fauna assemblages in regrowth vegetation in tropical open forests of the Northern Territory, Australia. *Wildlife Res.* 36:675–690.
- Woodcock, B. A., S. G. Potts, E. Pilgrim, A. J. Ramsay, T. Tscheulin, A. Parkinson, et al. 2007. The potential of grass field margin management for enhancing beetle diversity in intensive livestock farms. *J. Appl. Ecol.* 44:60–69.
- Wunderle, J. M., L. M. P. Henriques, and M. R. Willig. 2006. Short-term responses of birds to forest gaps and understory: an assessment of reduced-impact logging in a lowland Amazon forest. *Biotropica* 38:235–255.
- WWF International. 2012. *Living Planet Report 2012*. Pp. 160. WWF International, Gland, Switzerland.
- Yoshikura, S., S. Yasui, and T. Kamijo. 2011. Comparative study of forest-dwelling bats' abundances and species richness between old-growth forests and conifer plantations in Nikko National Park, central Japan. *Mammal Study* 36:189–198.

- Zaitsev, A. S., M. Chauvat, A. Pflug, and V. Wolters. 2002. Oribatid mite diversity and community dynamics in a spruce chronosequence. *Soil Biol. Biochem.* 34:1919–1927.
- Zaitsev, A. S., V. Wolters, R. Waldhardt, and J. Dauber. 2006. Long-term succession of oribatid mites after conversion of croplands to grasslands. *Appl. Soil Ecol.* 34:230–239.
- Zimmerman, G., F. W. Bell, J. Woodcock, A. Palmer, and J. Paloniemi. 2011. Response of breeding songbirds to vegetation management in conifer plantations established in boreal mixedwoods. *Forestry Chron.* 87:217–224.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

- Figure S1.** Maximum linear extents of sampling.
- Figure S2.** Graphical representations of fragmentation layouts.
- Figure S3.** Database schema.
- Figure S4.** Countries represented by area.
- Figure S5.** Histogram of Site maximum linear-extents of sampling.
- Figure S6.** Histogram of Site sampling durations.
- Figure S7.** Histogram of the area of habitat surrounding each Site.
- Figure S8.** Histogram of the distance from each Site to

the nearest country GIS polygon.

Figure S9. Histogram of the distance from each Site to the nearest ecoregion GIS polygon.

Table S1. Classification of land-use intensity for primary and secondary vegetation based on combinations of impact level and spatial extent of impact.

Table S2. Combinations of predominant land use and use intensity.

Table S3. Habitat fragmentation classifications.

Table S4. Examples of parsing different styles of taxonomic name with the Global Names Architecture's biodiversity package (<https://github.com/GlobalNamesArchitecture/biodiversity>).

Table S5. Coverage of countries.

Table S6. Coverage of regions.

Table S7. Coverage of subregions.

Table S8. Coverage of realms.

Table S9. Coverage of biomes.

Table S10. Distribution of samples by biome and kingdom.

Table S11. Distribution of samples by subregion and kingdom.

Table S12. Coverage of fragmentation layouts.

Table S13. Data extract columns.

Data S1. Data extract.