GBIF

Science Review

Compiling the year's research uses of data accessed through the Global Biodiversity Information Facility

2014

Foreword

This years' *Science Review* demonstrates the continued growth in research that, to a greater or lesser extent, is underpinned by data made accessible by GBIF. An interesting feature of this year's selection of papers are studies that use GBIF-mediated data to determine the causes of past extinctions, in particular the role humans may (large mammals) or may not (Mallorcan mountain goat) have played. This illustrates how the scope of GBIF extends beyond extant biodiversity to include data that speak to organisms that are now extinct: GBIF's scope is expanding both in space and in time.

Browsing the research summarized in the *Review*, one thing which struck me is that visitors to GBIF.org currently don't have an easy way to discover the wealth of research that makes use of GBIF-mediated data. Imagine being able to visit the GBIF page for a particular dataset and see the research to which it contributed. Or being able to navigate through a map to see the geographic distribution of research that builds upon GBIF-mediated data. In a sense, as the body of research grows, we could envisage GBIF—or others in our wider community—developing tools to display these research outputs in much the same way that the data itself are displayed, becoming not just a means of navigating data, but a way to navigate knowledge.

ROD PAGE
Chair, GBIF Science Committee

About the *Science Review*

The GBIF *Science Review* draws from the Secretariat's literature tracking programme, an ongoing effort to identify research uses and citations of biodiversity data accessed through GBIF's global infrastructure. Each issue of the *Review* assembles a complete annual list of peer-reviewed scientific papers known to make substantive use of GBIF-mediated data.

Segments of this growing bibliographic archive—which grew by 350 papers in 2014—appears in relevant contexts across GBIF.org. Noteworthy uses also appear throughout the year in **GBits**, the Secretariat's newsletter; monthly slide updates from its communications team; and at http://gbif.org/newsroom/uses. The complete list of citations from 2008 to 2014 can be viewed at both http://gbif.org/mendeley or http://www.mendeley.com/groups/1068301/gbif-public-library.

Those interested in sharing research uses that have escaped our attention may relay citation information to comms@gbif.org.

The categories used in the *Review* are intended to help readers navigate the major subject areas of GBIF-assisted research, but some papers inevitably span multiple topics. For clarity's sake, they appear under only one category in the *Review*. The countries assigned to authors are based on the location of the institutions identified in the author information, while funding information included for the highlighted papers draws upon the papers' acknowledgements.

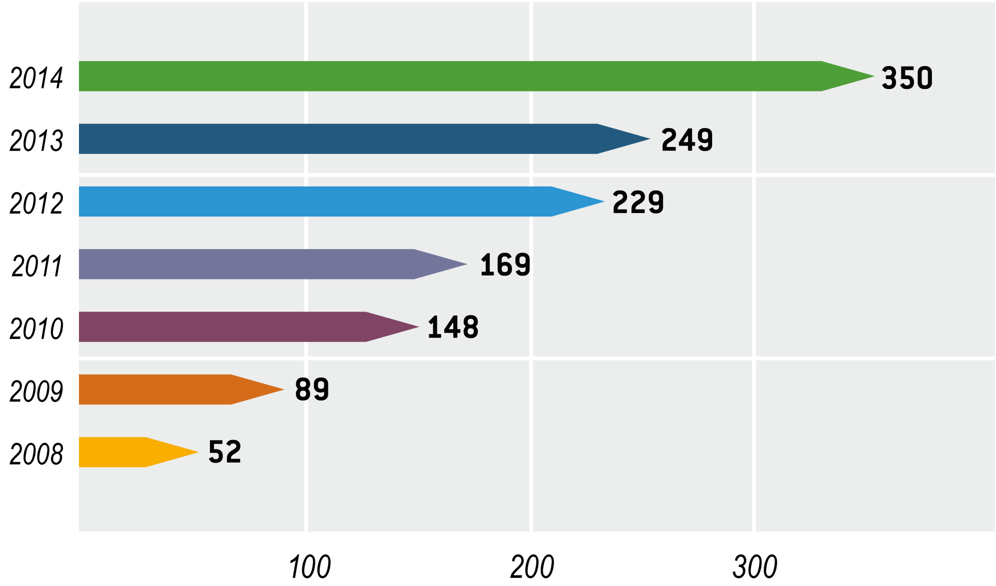
The examples summarized at the start of each section highlight a few key research investigations enhanced by the free and open access available through the GBIF network of Participants and publishers.

CONTENTS

Uses and trends

These visualizations of the use of GBIF-mediated data serve to show not just the growing number of peer-reviewed publications appearing each year, but also the increasing number of countries, islands and territories whose institutions host authors who apply the data in their research articles. Each trend highlights the GBIF network's widening sphere of influence and impact on scientific research related to the biological domain.

ANNUAL NUMBER OF PEER-REVIEWED ARTICLES USING GBIF-MEDIATED DATA

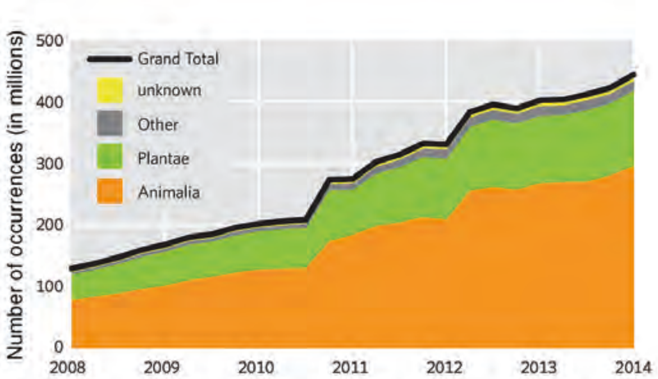


CBD: AMOUNT OF GBIF-MOBILIZED DATA INDICATES PROGRESS TOWARD AICHI TARGET 19

In the *4th Global Biodiversity Outlook (GBO-4)*, the Convention on Biological Diversity cited the amount of data mobilized through the GBIF network as a primary indicator for measuring progress toward Aichi Target 19 on the sharing of biodiversity knowledge.

While judging the advances made in building systems to share biodiversity information to be 'on track', GBO-4 highlighted the need for further investment in data mobilization and better, more coordinated models and technologies for decision-making.

Learn more at www.cbd.int/gbo4

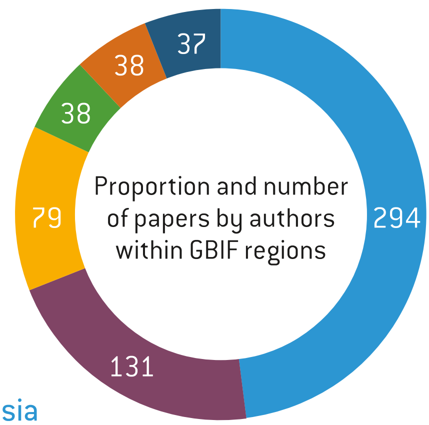


NUMBER OF ARTICLES WITH AUTHORS BY COUNTRY

114	United States
45	United Kingdom
41	Spain
37	Germany
32	Australia
21	Mexico
20	France • Italy
19	Brazil • Netherlands • South Africa
17	Canada
16	Argentina
14	Portugal • Switzerland
13	China
10	Poland
9	Colombia
8	India • Norway
7	Belgium • Sweden
6	Czech Republic • Kenya • New Zealand • Russia
5	Denmark • Ecuador • Finland • Greece
4	Austria
3	Chile • Hungary • Iran • Panama • Turkey
2	Costa Rica • Ethiopia • Iceland • Israel • Japan • Peru • Romania • Serbia • Slovakia
1	Belarus • Bolivia • Brunei Darussalam • Bulgaria • Cameroon • Croatia • Egypt • Estonia • Faroe Islands • French Polynesia • Indonesia • Kosovo • Luxembourg • Malawi • Malaysia • Malta • Morocco • Namibia • Nepal • New Caledonia • Nigeria • Papua New Guinea • Rwanda • Singapore • Sudan • Tunisia • Uganda • Uruguay • Yemen

countries with authors using GBIF-mediated data in peer-reviewed papers published in 2014

77



GBIF Regions *Asia* *Africa* *Europe* *Latin America* *North America* *Oceania*

Invasive alien species

examples

HYDRILLA VERTICILLATA, CC BY-NC 2002, JON SULLIVAN
HTTPS://FLIC.KR/P/EHS8IN

GAUGING THE IMPACT OF GEOGRAPHICALLY BIASED DATA ON DISTRIBUTION MODELS

Barnes MA, Jerde CL, Wittmann ME et al. (2014) Geographic selection bias of occurrence data influences transferability of invasive *Hydrilla verticillata* distribution models. *Ecology and Evolution*. doi:10.1002/ece3.1120.
Author countries: United States, China, Australia
Research funding: U.S. Army Corps of Engineers; National Oceanic and Atmospheric Administration; National Fish and Wildlife Foundation; U.S. Forest Service; The Nature Conservancy

This study looks at an aquatic plant, *Hydrilla verticillata*, to assess how geospatial biases in occurrence data influence species distribution models. Native to central Asia and Australia, this 'formidable global invader' now occurs across Central and South America, Africa, Europe, New Zealand, and most of temperate North America—a global reach that enhances its usefulness for such a study.

Starting with 4,336 records of *H. verticillata* drawn from GBIF.org and other sources (including more than 1,000 identified within its native range), the authors developed models that omitted native-range data from different countries and from randomized samples within the native range. While the results 'possessed strong predictive power' for native and North American ranges, they also highlighted the impact of spatial biases resulting from political gaps in data. To improve future model predictions and their use in environmental management, the authors encourage efforts to 'focus on areas of conspicuous data absences, especially when such absences coincide with political delineations.'

IMPROVING ECOLOGICAL FORECASTING

Bradley BA, Early R & Sorte CJB (2014) Space to invade? Comparative range infilling and potential range of invasive and native plants. *Global Ecology and Biogeography*. doi:10.1111/geb.12275
Author countries: United States, United Kingdom, Portugal, Spain
Research funding: U.S. Dept of Defense, Strategic Environmental Research and Development Program

To test the assumption that species distribution models predict disproportionately smaller potential ranges for non-natives than natives, researchers compared the distributions of 13,575 native, endemic, alien and invasive plants in the United States to determine how these groups' different range attributes might influence ecological forecasting. Describing GBIF as "the only source that could consistently provide distributional data for all of our target species at a global scale", the study concluded that invasives had not achieved the expected degree of range infilling, suggesting that "plants introduced to the US still have plenty of space to invade".

REDUCING INVASIVE SPECIES RISKS THROUGH RAPID WATCH LISTS

Faulkner KT, Robertson MP, Rouget M et al. (2014) A simple, rapid methodology for developing invasive species watch lists. *Biological Conservation* 179: 25-32. doi:10.1016/j.biocon.2014.08.014
Author country: South Africa
Research funding: South African National Department of Environment Affairs; DST-NRF Centre for Invasion Biology

Developing biosecurity schemes that prevent the introduction of potentially invasive alien species can be excessively complicated and expensive for many resource-poor nations. These South African researchers proposed a rapid, cost-effective method of creating species watch lists based on three consistent predictors of invasion success: past precedents, environmental suitability and introduction effort. Using GBIF-mediated data on 419 invasive species in addition to other sources, the authors demonstrate that this technique works quickly and transparently to produce an initial assessment of key threats across taxa that applies at different national and provincial scales without substantial financial or scientific input.

LEARNING THE TRAITS OF SUCCESSFUL INVADERS

Higgins SI & Richardson DM (2014) Invasive plants have broader physiological niches. *Proceedings of the National Academy of Sciences of the United States of America.* 111(29): 10610-10614. doi:10.1073/pnas.1406075111
Author countries: New Zealand, South Africa
Research funding: University of Otago; Dept of Science and Technology - National Research Foundation

Seeking to learn from past invasions, the authors investigating how physiological traits of a given plant may indicate its inherent invasive potential. Their hindcasting exercise draws from experience, taking a pragmatic look at acacia and eucalypts, two tree groups whose 749 closely related species now occur far beyond their native Australia.

By calibrating GBIF-mediated global data for both groups with physiological and environmental variables like growth rate, respiration, temperature and and soil nitrogen, the authors highlight a suite of traits that determine invasive success, highlighting species tolerant of a broader range of environmental contexts.

Notably, to test their model's fitness, they tested it by predicting an independent dataset comprised of all GBIF records for acacia and eucalypt outside Australia. The results correctly predicted 95% of eucalypt records and 83% of acacia records.

MODEL GLOBALLY, REFINE REGIONALLY

Kelly R, Leach K, Cameron A et al. (2014) Combining global climate and regional landscape models to improve prediction of invasion risk. *Diversity and Distributions* 20(8): 884-894. doi:10.1111/ddi.12194
Author country: United Kingdom
Research funding: Natural Heritage Research Partnership (Northern Ireland Environment Agency & Queen's University Belfast)

Global climate niche models are widely used to predict the risks posed by invasive species due to changing species distributions and habitat suitability. But such models may overlook the role that finer scale factors like land use, topography and soil and water chemistry play in invasion biology—in part because of the lack of reliable global data for such characteristics.

After producing global models based on GBIF-mediated data for 15 non-native aquatic plants (eight already established in Ireland and seven other high-risk species), the Belfast-based authors combine and refine them with regional data on a variety of human and physiochemical variables. This simple method significantly improves predictions for regional invasions and highlights the explicit importance of factors related to land use, nutrient concentration and natural landscape.

PROFILING PROBLEMATIC PLANTS

Kuester A, Conner JK, Culley T et al. (2014) How weeds emerge: a taxonomic and trait-based examination using United States data. *The New Phytologist* 202(3): 1055-68. doi:10.1111/nph.12698
Author country: United States
Research funding: National Science Foundation

One common comparative framework for the study of invasive plants seeks to place introduced species along a 'continuum' that ranges from naturalized to weedy to invasive. Useful as this framework is, however, it doesn't account for the emerging and costly problem of herbicide resistance. The authors draw on GBIF and other data sources to look for broad patterns in the United States across taxonomic, physical and biochemical traits of what they call 'problematic plants'—the weedy, the invasive and the herbicide-resistant.

In addition to exploring over- and under-represented families, they explore the potential of many characteristics of the 'ideal invader'. The investigation of one variable—the introduction time of invasive weeds and 'non-problematic' introduced non-weeks—relies exclusively on GBIF-mediated occurrence data for U.S. herbaria specimens. Their conclusions identify plant genera and traits that warrant vigilance, particularly among species introduced to agricultural fields that reproduce abundantly and often—prime candidates for herbicide resistance.

FAIRY MOSS (*AZOLLA FILICULOIDES*). CC BY-NC JOEL CARNAT HTTPS://FLIC.KR/P/GMI7BX

CONTROLLING A POTENTIAL PLAGUE OF 'LOCUSTS'

Li G, Xu G, Guo K et al. (2014) Mapping the Global Potential Geographical Distribution of Black Locust (*Robinia pseudoacacia* L.) Using Herbarium Data and a Maximum Entropy Model. *Forests* 5(11): 2773-2792. doi:10.3390/f5112773

Author country: China

Research funding: National Nature Science Foundation of China, Specialized Research Fund for the Doctoral Program of Higher Education, Institute of Soil and Water Conservation

A native of eastern North America, black locust (*Robinia pseudoacacia*) has been introduced widely throughout the world over the past 300 years. And while *R. pseudoacacia* has significant economic and ecological value, that value comes with significant risks given that the tree has become an uncontrollable invader in parts of Europe, Asia, and the South Pacific.

BLACK LOCUST (*ROBINIA PSEUDOACACIA*), CC BY-SA 2015 HARUM.KOH https://flic.kr/p/seQTyw

Relying primarily on 32,434 GBIF-mediated herbarium records, researchers modeled the area that black locust currently occupies and its potentially 'invadable distribution' area. The results can help guide natural resource decision makers in assessing whether and where the appropriate response to *R. pseudoacacia* is afforestation or invasive control.

SMALL-SCALE PREDICTORS OF GLOBAL INVASIVENESS AND RARITY

Pandit MK, White SM & Pocock MJO (2014) The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis. *The New Phytologist* 203(2): 697-703. doi:10.1111/nph.12799

Author countries: India, United Kingdom

Research funding: Natural Environment Research Council

Why do some plants become endangered while others become invasive? Researchers compared genomic and cytogenic traits—genome size, number of chromosomes, and chromosome sets (or ploidy level)—to test whether these variables could predict the relative rarity or invasiveness of a set of 890 flowering plants from 62 genera widely distributed from tropical to boreal regions.

GBIF-mediated data contributed to their conclusions that invasiveness is negatively related to genome size and positively related to chromosome number and ploidy level. The same data enabled a parallel investigation of the effect of latitude on such traits. While these results show a linear increase in genome size at higher latitudes, latitude appears unimportant in explaining differences in invasiveness or cytogenic traits.

ANTICIPATING CONFLICTS BETWEEN INVASIVE AND IMPERILLED SPECIES

Rose JP & Todd BD (2014) Projecting Invasion Risk of Non-Native Watersnakes (*Nerodia fasciata* and *Nerodia sipedon*) in the Western United States. *PLoS ONE* 9(6): e100277. doi:10.1371/journal.pone.0100277

Author country: United States

Two natives of the eastern United State—the common watersnake (*Nerodia fasciata*) and Southern watersnake (*Nerodia sipedon*)—have recently established reproductive populations in western North America. To calculate the risks these predators present for the region's many modified freshwater systems, the authors modeled both snakes' potential distribution across western North America with the explicit intention of evaluating prospective conflicts with imperiled native species.

Occurrence records from GBIF and other sources for the two *Nerodia* species fed into distribution models that highlighted the ranges they can be expected to invade. The authors then compared these results with the known ranges of native species—both potential prey as well as predators currently occupying similar ecological niches. Together the two invaders appear to pose significant threats to several aquatic natives of California, including federally and state listed snakes, salamanders and frogs. In hope of helping authorities responsible for protecting native species elsewhere to develop responses, the authors detail their effort to design a systematic, transferable model for evaluating similar invasions.

BIOTIC AND ABIOTIC EFFECTS ON SPECIES DISTRIBUTION

Silva DP, Gonzalez VH, Melo GAR et al. (2014) Seeking the flowers for the bees: Integrating biotic interactions into niche models to assess the distribution of the exotic bee species

Lithurgus huberi in South America. *Ecological Modelling* 273: 200-209. doi:10.1016/j.ecolmodel.2013.11.016
Author countries: Brazil, Argentina
Research funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Whitley Wildlife Conservation Trust

Lithurgus huberi is the sole representative of the Old World genus of solitary bees in the Americas, occurring mainly in Brazil and Argentina where it is considered a widespread but locally rare exotic. Having made new observations during recent fieldwork, the authors sought to assess what effect the distribution of host plant species might have on this specialist bee. In addition to identifying other worthwhile areas to survey, this approach could also gauge the impact of biotic variables (rather than abiotic ones, like climate) on the bee's distribution.

GBIF-mediated and other occurrence data fed models for the seven host plants known to provide *L. huberi* with pollen, which generated predictions for both the bee and its hosts that largely coincide. While these results may show how biotic and abiotic factors already intersect and regulate the bee's ecological niche, they also support the widely held theory that climate is the prime variable determining the broad-scale species distribution.

COMPARING AND CONTRASTING INVASION MODELS

Tingley R, Vallinoto M, Sequeira F & Kearney MR (2014) Realized niche shift during a global biological invasion. *Proceedings of the National Academy of Sciences of the United States of America* 111(28): 10233-8. doi:10.1073/pnas.1405766111
Author countries: Australia, Brazil, Portugal|
Research funding: Natural Sciences and Engineering Research Council of Canada; Endeavour International; University of Sydney; Australian Research Council; European Social Fund and Portuguese Ministério da Educação e Ciência; Conselho Nacional de Desenvolvimento Científico e Tecnológico; Ministério de Ciência e Tecnologia; Fundo Europeu de Desenvolvimento Regional

Seeking to improve the accuracy of invasive species forecasting, the authors use GBIF-mediated and other data to contrast two models for understanding worldwide invasions of the cane toad (*Rhinella marina*). The first physiological and mechanistic model examines whether the toad's traits adapted to its new environments (a fundamental niche shift). By contrast, the second model considers the combined influence of biotic and abiotic conditions (a realized niche shift), which highlighted the role of other species in limiting the toad's native population—constraints absent in Australia with disastrous effect. Improved knowledge of the dynamics at play in each type of niche shift may improve invasion management strategies.

CANE TOAD (*RHINELLA MARINUS*) CC BY 2011, BRIAN GRATWICKE https://flic.kr/p/ayvEys

bibliography

AUTHORS	TITLE	JOURNAL	DOI/URL	AUTHOR COUNTRIES
Barnes MA, Jerde CL, Wittmann ME et al.	Geographic selection bias of occurrence data influences transferability of invasive Hydrilla verticillata distribution models	Ecology and Evolution	doi: 10.1002/ece3.1120	United States, China, Australia
Beaumont LJ, Gallagher RV, Leishman MR et al.	How can knowledge of the climate niche inform the weed risk assessment process? A case study of Chrysanthemoides monilifera in Australia	Diversity and Distributions 20(6): 613-625	doi: 10.1111/ddi.12190	Australia
Borges LMS, Sivrikaya H & Cragg SM	First records of the warm water shipworm *Teredo bartschi* Clapp, 1923 (Bivalvia, Teredinidae) in Mersin, southern Turkey and in Olhão, Portugal	Bioinvasion Records 3(1): 25-28	doi: 10.3391/bir.2014.3.1.04	United Kingdom, Germany, Turkey
Bradley BA, Early R & Sorte CJB	Space to invade? Comparative range infilling and potential range of invasive and native plants	Global Ecology and Biogeography	doi: 10.1111/geb.12275	United States, United Kingdom, Portugal, Spain,

AUTHORS	TITLE	JOURNAL	DOI/URL	AUTHOR COUNTRIES
Carlos-Júnior LA, Barbosa NPU, Moulton TP et al.	Ecological Niche Model used to examine the distribution of an invasive, non-indigenous coral	Marine Environmental Research	doi: 10.1016/j.marenvres.2014.10.004	Brazil, United States
Cheek MD	First official record of a naturalised population of *Mimosa albida* Humb. & Bonpl. ex Willd. var. albida in Africa	BioInvasions Records 4	www.reabic.net/journals/bir/2015/Accepted/BIR_2015_Cheek_correctedproof.pdf	South Africa
Crafton R	Modeling invasion risk for coastal marine species utilizing environmental and transport vector data	Hydrobiologia	doi: 10.1007/s10750-014-2027-x	United States
Diaz R, Manrique V, Hibbard K et al.	Successful Biological Control of Tropical Soda Apple (Solanales: Solanaceae) in Florida: A Review of Key Program Components	Florida Entomologist 97(1): 179-190	www.bioone.org/doi/pdf/10.1896/054.097.0124	United States, Argentina
DiTommaso A, Darbyshire SJ, Marschner CA et al.	North-East, North-Central, Mid-Atlantic United States and Southern Canada: Japanese Hedgeparsley (Torilis japonica)—A New Invasive Species in the United States?	Invasive Plant Science and Management 7(4): 553-560	doi: 10.1614/IPSM-D-14-00028.1	Canada, United States
Donaldson JE, Hui C, Richardson DM et al.	Invasion trajectory of alien trees: the role of introduction pathway and planting history	Global Change Biology 20(5): 1527-37	doi: 10.1111/gcb.12486	South Africa, Australia
Faulkner KT, Robertson MP, Rouget M et al.	A simple, rapid methodology for developing invasive species watch lists	Biological Conservation 179: 25-32	doi: 10.1016/j.biocon.2014.08.014	South Africa
Fuller P, Knott D, Kingsley-Smith P et al.	Invasion of Asian tiger shrimp, Penaeus monodon Fabricius, 1798, in the western north Atlantic and Gulf of Mexico	Aquatic Invasions 9(1): 59-70	doi: 10.3391/ai.2014.9.1.05	United States
Gallardo B	Europe's top 10 invasive species: relative importance of climatic, habitat and socio-economic factors	Ethology Ecology & Evolution 26(2-3): 130-151	doi: 10.1080/03949370.2014.896417	United Kingdom
Gallardo B & Aldridge DC	Is Great Britain heading for a Ponto-Caspian invasional meltdown?	Journal of Applied Ecology	doi: 10.1111/1365-2664.12348	United Kingdom, Spain
García-Díaz P, Ross JV, Ayres C et al.	Understanding the biological invasion risk posed by the global wildlife trade: propagule pressure drives the introduction and establishment of Nearctic turtles	Global Change Biology	doi: 10.1111/gcb.12790	Australia, Spain
Goldsmit J, Howland K & Archambault P	Establishing a baseline for early detection of non-indigenous species in ports of the Canadian Arctic	Aquatic Invasions 9(3): 327-342	doi: 10.3391/ai.2014.9.3.08	Canada
González-Moreno P, Diez JM, Richardson DM et al.	Beyond climate: disturbance niche shifts in invasive species	Global Ecology and Biogeography	doi: 10.1111/geb.12271	Spain, United States, Switzerland, South Africa
Higgins SI & Richardson DM	Invasive plants have broader physiological niches	Proceedings of the National Academy of Sciences of the United States of America 111(29): 10610-10614	doi: 10.1073/pnas.1406075111	New Zealand, South Africa
Hill MP, Axford JK, & Hoffmann AA	Predicting the spread of *Aedes albopictus* in Australia under current and future climates: Multiple approaches and datasets to incorporate potential evolutionary divergence	Austral Ecology 39(4): 469-478	doi: 10.1111/aec.12105	Australia, South Africa
Horvitz N, Wang R, Zhu M et al.	A simple modeling approach to elucidate the main transport processes and predict invasive spread: River-mediated invasion of A geratina adenophora in China	Water Resources Research 50(12): 9738-9747	doi: 10.1002/2014WR015537	Israel, China

AUTHORS	TITLE	JOURNAL	DOI/URL	AUTHOR COUNTRIES
Hutchinson JMC, Reise H, & Robinson DG	A biography of an invasive terrestrial slug: the spread, distribution and habitat of Deroceras invadens	NeoBiota 23: 17-64	doi: 10.3897/neobiota.23.7745	Germany, United States
Jacobs LEO, Richardson DM & Wilson JRU	*Melaleuca parvistaminea* Byrnes (Myrtaceae) in South Africa: Invasion risk and feasibility of eradication	South African Journal of Botany 94: 24-32	doi: 10.1016/j.sajb.2014.05.002	South Africa
Kalwij JM, Steyn C & le Roux PC	Repeated monitoring as an effective early detection means: first records of naturalised *Solidago gigantea* Aiton (Asteraceae) in southern Africa	South African Journal of Botany 93: 204-206	doi: 10.1016/j.sajb.2014.04.013	South Africa, Czech Republic
Kelly R, Leach K, Cameron A et al.	Combining global climate and regional landscape models to improve prediction of invasion risk	Diversity and Distributions 20(8): 884-894	doi: 10.1111/ddi.12194	United Kingdom
Kuester A, Conner JK, Culley T et al.	How weeds emerge: a taxonomic and trait-based examination using United States data	The New Phytologist 202(3): 1055-68	doi: 10.1111/nph.12698	United States
Lamoureaux SL & Bourdôt GW	The potential distribution of yellow bristle grass (*Setaria pumila*) in New Zealand	New Zealand Plant Protection 67: 226-230	http://www.nzpps.org/journal/67/nzpp_672260.pdf	New Zealand
Lembrechts JJ, Milbau A & Nijs I	Alien Roadside Species More Easily Invade Alpine than Lowland Plant Communities in a Subarctic Mountain Ecosystem	PLoS ONE 9(2): e89664	doi: 10.1371/journal.pone.0089664	Belgium, Sweden
Li G, Xu G, Guo K et al.	Mapping the Global Potential Geographical Distribution of Black Locust (*Robinia pseudoacacia* L.) Using Herbarium Data and a Maximum Entropy Model	Forests 5(11): 2773-2792	doi: 10.3390/f5112773	China
Li YM, Dlugosch KM & Enquist BJ	Novel spatial analysis methods reveal scale-dependent spread and infer limiting factors of invasion by Sahara mustard	Ecography	doi: 10.1111/ecog.00722	United States
Liu X, Li X, Liu Z et al.	Congener diversity, topographic heterogeneity and human-assisted dispersal predict spread rates of alien herpetofauna at a global scale	Ecology Letters 17(7): 821-9	doi: 10.1111/ele.12286	China, Australia, United States
Lübcker N, Zengeya TA, Dabrowski J et al.	Predicting the potential distribution of invasive silver carp *Hypophthalmichthys molitrix* in South Africa	African Journal of Aquatic Science 39(2): 157-165	doi: 10.2989/16085914.2014.926856	South Africa
Novoa A, Le Roux JJ, Robertson MP	Introduced and invasive cactus species-a global review	AoB Plants	doi: 10.1093/aobpla/plu078	South Africa
Orlova-Bienkowskaja MJ & Volkovitsh MG	Range expansion of *Agrilus convexicollis* in European Russia expedited by the invasion of the emerald ash borer, *Agrilus planipennis* (Coleoptera: Buprestidae)	Biological Invasions	doi: 10.1007/s10530-014-0762-6	Russia
Padalia H, Srivastava V & Kushwaha SPS	Modeling potential invasion range of alien invasive species, *Hyptis suaveolens* (L.) Poit. in India: Comparison of MaxEnt and GARP	Ecological Informatics 22: 36-43	doi: 10.1016/j.ecoinf.2014.04.002	India
Pandit MK, White SM & Pocock MJO	The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis	The New Phytologist 203(2): 697-703	doi: 10.1111/nph.12799	India, United Kingdom
Parsa S, Hazzi NA, Chen Q et al.	Potential geographic distribution of two invasive cassava green mites	Experimental & applied acarology 65(2): 195-204	doi: 10.1007/s10493-014-9868-x	Colombia, China, United States
Pearson RG	Asian common toads in Madagascar: an urgent effort to inform surveys and eradication efforts	Global Change Biology	doi: 10.1111/gcb.12693	United Kingdom

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Quinn A, Gallardo B & Aldridge DC	Quantifying the ecological niche overlap between two interacting invasive species: the zebra mussel (*Dreissena polymorpha*) and the quagga mussel (*Dreissena rostriformis bugensis*).	Aquatic Conservation: Marine and Freshwater Ecosystems 24(3): 324-337	doi:10.1002/aqc.2414	United Kingdom
Qvenild M, Setten G & Skår M	Politicising plants: Dwelling and invasive alien species in domestic gardens in Norway	Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 68(1): 22–33	doi:10.1080/00291951.2013.870599	Norway
Ray JC, Johnson WP, Ray JD & Kazmaier RT	Notes on *Lythrum salicaria* L. in Texas and on its distribution on Palo Duro Creek, Randall County, Texas	Phytologia, 96(4), 225–234.	www.phytologia.org/uploads/2/3/4/2/23422706/964225-234johnson_et_al_lythrum_salicaria_6-18.pdf	United States
Raybaud V, Beaugrand G, Dewarumez J-M & Luczak C	Climate-induced range shifts of the American jackknife clam *Ensis directus* in Europe	Biological Invasions 17(2): 725-741	doi:10.1007/s10530-014-0764-4	France
Rose JP & Todd BD	Projecting Invasion Risk of Non-Native Watersnakes (*Nerodia fasciata* and *Nerodia sipedon*) in the Western United States	PLoS ONE 9(6): e100277	doi:10.1371/journal.pone.0100277	United States
Schmitz U, Köhler S & Hussner A	First records of American *Wolffia columbiana* in Europe – Clandestine replacement of native *Wolffia arrhiza*?	BioInvasions Records 3 (4): 213-216	http://www.reabic.net/journals/bir/2014/Issue4.aspx	Germany
Setyawan AD	A new record of naturalized *Selaginella uncinata* (Desv.) Spring (Selaginellaceae) from Java, Indonesia	Biodiversitas 15(2): 261-268	doi:10.13057/biodiv/d150221	Indonesia
Shabani F, Kumar L & Esmaeili A	Future distributions of *Fusarium oxysporum* f. spp. in European, Middle Eastern and North African agricultural regions under climate change	Agriculture, Ecosystems & Environment 197: 96-105	doi:10.1016/j.agee.2014.08.005	Australia, Iran
Silva DP, Gonzalez VH, Melo GAR et al.	Seeking the flowers for the bees: Integrating biotic interactions into niche models to assess the distribution of the exotic bee species *Lithurgus huberi in* South America	Ecological Modelling 273: 200-209	doi:10.1016/j.ecolmodel.2013.11.016	Brazil, Argentina
Speziale KL, Lambertucci SA & Ezcurra C	*Bromus tectorum* invasion in South America: Patagonia under threat?	Weed Research 54(1): 70-77	doi:10.1111/wre.12047	Argentina
Stiels D, Gaißer B, Schidelko K et al.	Niche shift in four non-native estrildid finches and implications for species distribution models	Ibis 157(1): 75-90	doi:10.1111/ibi.12194	Germany
Strubbe D, Beauchard O & Matthysen E	Niche conservatism among non-native vertebrates in Europe and North America	Ecography 38 (3): 321-329	doi:10.1111/ecog.00632	Belgium, Netherlands
Szyniszewska AM & Tatem AJ	Global Assessment of Seasonal Potential Distribution of Mediterranean Fruit Fly, *Ceratitis capitata* (Diptera: Tephritidae)	PLoS ONE 9(11): e111582	doi:10.1371/journal.pone.0111582	United States
Taylor S & Kumar L	Climate Change and Weed Impacts on Small Island Ecosystems: *Lantana camara* L. (Magnoliopsida: Verbenaceae) Distribution in Fiji	Pacific Science 68(1): 117-133	doi:10.2984/68.1.11	Australia
Taylor S & Kumar L	Impacts of climate change on invasive *Lantana camara* L. distribution in South Africa	African Journal of Environmental Science and Technology 8(6): 391-400	doi:10.5897/AJEST2014.1705	Australia
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Tingley R, Vallinoto M, Sequeira F & Kearney MR	Realized niche shift during a global biological invasion	Proceedings of the National Academy of Sciences of the United States of America 111(28): 10233-8.	doi:10.1073/pnas.1405766111	Australia, Brazil, Portugal
Van Hengstum T, Hooftman DAP, Oostermeijer JGB & van Tienderen PH	Impact of plant invasions on local arthropod communities: a meta-analysis	Journal of Ecology 102(1): 4-11	doi:10.1111/1365-2745.12176	Netherlands, United Kingdom
Villar JL, Juan A & Alonso MÁ	*Tamarix hohenackeri bunge*, a new record for the flora of Mexico	Acta Bontanica Mexicana 106: 117–128	http://www1.inecol.edu.mx/abm/verhtml/106/Acta106(117-128).html	Spain
Weyl P & Coetzee J	The invasion status of *Myriophyllum spicatum* L. in southern Africa	Management of Biological Invasions 5(1): 31-37	doi:10.3391/mbi.2014.5.1.03	South Africa
Wittmann ME, Jerde CL, Howeth JG et al.	Grass carp in the Great Lakes region: establishment potential, expert perceptions, and re-evaluation of experimental evidence of ecological impact	Canadian Journal of Fisheries and Aquatic Sciences 71(7): 992-999	doi:10.1139/cjfas-2013-0537	United States
Xu Z	Potential distribution of invasive alien species in the upper Ili river basin: determination and mechanism of bioclimatic variables under climate change	Environmental Earth Sciences 73(2): 779-786	doi:10.1007/s12665-014-3083-2	China

Impacts of climate change

examples

COMPARING CLIMATE MODELING METHODS

Elmendorf SC, Henry GHR, Hollister RD et al. (2014) Experiment, monitoring, and gradient methods used to infer climate change effects on plant communities yield consistent patterns. *Proceedings of the National Academy of Sciences of the United States of America* 112(2). doi:10.1073/pnas.1410088112
Author countries: United States, Canada, Faroe Islands, Norway, Iceland, Sweden, United Kingdom, Switzerland
Research funding: National Science Foundation; U.S. Fish and Wildlife Service; Icelandic Research Fund; Icelandic Centre for Research and Ministry of Agriculture; Research Council of Norway; Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning; International Polar Year Program of Canada; ArcticNet; Parks Canada; Northern Scientific Training Program; National Science and Engineering Research Council of Canada; U.S. Forest Service; International Institute of Tropical Forestry; University of Puerto Rico.

The three typical approaches for forecasting climate change impacts each have largely well-recognized constraints. But few previous studies have analysed the results produced by each of the three (experiments, monitoring observations, and so-called 'space-for-time' substitutions). Applying GBIF-mediated data to determine a baseline thermal niche for the species that comprise 85 arctic and alpine plant communities in North America and Europe, this international team systematically compared the results achieved through each method. The researchers' evaluation showed consistency in describing overall trends and directions of change, but a notable tendency of inferences based on present-day patterns of ecological systems to overestimate them—suggesting that experimental warming and long-term monitoring may provide the most accurate means of predicting impacts.

HIGH LATITUDES ≠ LOW RISK

Gerick AA, Munshaw RG, Palen WJ et al. (2014) Thermal physiology and species distribution models reveal climate vulnerability of temperate amphibians. *Journal of Biogeography* 41(4): 713-723. doi:10.1111/jbi.12261
Author countries: Canada, United States
Research funding: Natural Sciences and Engineering Research Council of Canada; Canada Research Chairs Program

One prevailing hypothesis has been that cold-blooded creatures inhabiting higher latitudes may be less vulnerable to climate change impacts than those in the tropics thanks to their greater thermal safety margin (TSM), or inherent tolerance of temperature changes. But by closely examining the effects of rising temperatures on both the physiology and distribution of three northern North American frogs—*Spea intermontana*, *Rana aurora* and *Pseudacris regilla*—the authors challenge both that notion and the analytical methods previously used to justify it.

PACIFIC CHORUS FROG (*PSEUDACRIS REGILLA*). © 2013 STEVEN JOHNSON

Their analysis underscores the issue that the use of longer-term average temperatures rather than extreme temperatures may underestimate the impact of future climates on temperature-dependent breeders such as amphibians. In addition, their projected distribution models, which draw upon GBIF-mediated and other data, suggest that rapid temperature changes will quickly erode these species' TSMs, meaning that even when exposure is not lethal in itself, it may translate into lower individual survival rates due to predation—all of which highlights cause for concern that all three of the study's focal species will be at greater risk by 2050.

NEAR-TERM FORECASTS FOR IBERIAN FLORA

Heap MJ, Culham A, Lenoir J et al. (2014) Can the Iberian Floristic Diversity Withstand Near-Future Climate Change? *Open Journal of Ecology* 04(17): 1089-1101. doi:10.4236/oje.2014.417089
Author countries: United Kingdom, France, Spain

End-of-century predictions about climate-related impacts on species remain subject to long-term uncertainties regarding both the data and emissions scenarios, but land managers and policymakers must make short-term decisions now. Recognizing the high proportion of Europe's plant diversity represented by the geographically isolated Iberian peninsula's geographic isolation, the authors relied on GBIF-mediated data for 3,267 peninsular plant species to identify vulnerable species and habitats and to assess whether the existing network of protected areas (PAs) will effectively protect floristic diversity up to 2020.

Their results comprise several important findings. First, they suggest that existing PAs appear capable of preserving all but about 100 species with distinctly northerly ranges, though only in the short term: 'the long-term outlook for Iberian plant diversity is bleak'. In addition, contrary to consensus, shifting species ranges are not uniformly poleward and upward, as local climate, topography and the extreme pressures on northern species contribute to clear westerly and easterly trends.

PROTECTING THE IRREPLACEABLE SPECIES OF THE TROPICAL ANDES

Ramirez-Villegas J, Cuesta F, Devenish C et al. (2014). Using species distributions models for designing conservation strategies of Tropical Andean biodiversity under climate change. *Journal for Nature Conservation* 22(5): 391–404. doi:10.1016/j.jnc.2014.03.007
Author country: Colombia, United Kingdom, Ecuador, Peru, Canada
Research funding: Spanish Agency for International Cooperation and Development; The Mountain Partnership and the Swiss Agency for Development and Cooperation; CGIAR

The Tropical Andes hosts a great diversity of species, many of which occur nowhere else on Earth. But resource overexploitation, expanding human populations and future climate change pose a particularly acute combination of threats for the region's many narrowly distributed endemic species.

Here researchers used GBIF-derived data originally applied in Warren et al. (2013) (http://dx.doi.org/10.1038/nclimate1887) to create ecological niche models for 1,555 birds and 9,457 vascular plants in hope of gaining a comprehensive estimate of potential climate change impacts. While the resulting patterns vary significantly based on different time scales and dispersal scenarios, the anticipated changes remain 'extremely severe', with extinction risks likely intensifying more among plants than birds. The authors highlight the expected influence of changing land uses—and their absence from this study—in proposing a regional conservation approach that focuses on landscape-scale conditions, networks and development strategies.

CLIMATE CHANGE OR HABITAT LOSS: WHAT'S WORSE?

Riordan EC & Rundel PW (2014) Land Use Compounds Habitat Losses under Projected Climate Change in a Threatened California Ecosystem. *PLoS ONE* 9(1): e86487. doi:10.1371/journal.pone.0086487

Author country: United States

Research funding: University of California Los Angeles Foundation

Climate change presents a second formidable threat to species diversity in regions already under intense development pressure from growing human communities. Here the authors examine projected impacts of both on 20 key constituent species of California sage scrub, a diverse plant association containing many endemic and imperiled species. Its native range spreads across of southwestern and central western California, where land-use changes around the dense population centres have already reduced these unique coastal scrublands to as little as 10% of their original extent.

Using GBIF-mediated and herbaria data to create models linked to scenario-based assessments of future climate change and land use, the results suggest that projected impacts from habitat loss could be as large if not larger on species richness patterns for coastal sage scrub than those from climate change. The potential for these distinct drivers of change to compound one another's negative effects underscores how important it is for conservation planners and resource managers to address both.

LARGE MAMMAL EXTINCTIONS: WHO (NOT WHAT) DONE IT

Sandom C, Faurby S, Sandel B & Svenning J (2014) Global late Quaternary megafauna extinctions linked to humans, not climate change. *Proceedings of the Royal Society/Biological Sciences* 281(1787). doi:10.1098/rspb.2013.3254

Author country: Denmark

Research funding: 15 Juni Fonden; European Research Council

Dozens of large mammals have vanished from each continent over the past 130,000 years, but the causes of these unprecedentedly rapid and widespread disappearances have remained enigmatic, with climate change and expanding human populations seen as the leading suspects. Drawing in part on GBIF-mediated occurrences for 177 extinct or continentally extirpated mammals, the authors weigh the evidence in what they call 'the first comprehensive, species-level, fine-grained global macroecological analysis' of these large-scale Quartenary extinctions.

PURPLE SAGE (*SALVIA LEUCOPHYLLA*) IS ONE OF 20 CONSTITUENTS COASTAL SAGE SCRUB SPECIES FACING LONG-TERM IMPACTS FROM BOTH CHANGING CLIMATES AND LAND USES. HTTPS://FLIC.KR/P/RHPN

By combining and comparing models of glacial and interglacial climate change and the palaeobiogeographical spread of modern and extinct humans and immediate ancestors, the study evaluates their relative impacts on species-level extinctions across each region. With uniformly high species losses occurring where Homo sapiens was the first hominin to appear, the results signal the strong hand that modern humans likely had in the loss of other large mammals.

LONG-TERM, ON-THE-GROUND TESTING OF CLIMATE-SHIFT PREDICTIONS

Savage J & Vellend M (2014) Elevational shifts, biotic homogenization and time lags in vegetation change during 40 years of climate warming. *Ecography*. doi:10.1111/ecog.01131
Author country: Canada
Research funding: Natural Sciences and Engineering Research Council of Canada

Are plant distribution shifts towards higher elevations climate-driven? To test the impacts on plant communities, the authors repeated an earlier survey of semi-permanent vegetation plots in a montane protected area in southern Québec and overlaid GBIF-mediated occurrence records in eastern North America. Major elements of the climatic predictions—elevational distribution shifts, biodiversity change, and biotic homogenization—appear consistent with observations over four decades, though the relatively slow rate of change suggests that species may respond more slowly than expected.

HINDCASTING A MALLORCAN EXTINCTION WITH FOSSILIZED GOAT SCAT

Welker F, Duijm E, van der Gaag KJ et al. (2014) Analysis of coprolites from the extinct mountain goat *Myotragus balearicus*. *Quaternary Research* 81(1): 106-116. doi:10.1016/j.yqres.2013.10.006
Author country: Netherlands, Spain
Research funding: Netherlands Research Council

Four to five millennia ago, ***Myotragus balearicus***, a dwarf mountain goat inhabiting the Mediterranean island of Mallorca, winked out of existence. Given that humans arrived on the island at roughly the same time, the prevailing hypotheses was that this small, slow-moving endemic suffered the same fate as larger mammals elsewhere, where extinction followed soon after the human colonization.

In this study, however, the authors arrive at a subtler, more complicated conclusion, analysing ancient DNA, pollen and macrofossils and reconstructed climate models that use GBIF- and Naturalis-mediated specimen data for *Buxus balearica*, a once-plentiful, now-rare box species. Fossilized droppings from *M. balearicus* suggest it depended at least seasonally on this plant, which previously dominated the island's 'old' vegetation until declining precipitation caused its retreat to small mountain populations. While contact and conflict with humans cannot be ruled out, the lack of archaeological evidence suggests that the rapid vegetation change may have contributed to if not caused the disappearance of the tiny Mallorcan goat.

FEMALE DIANA FRITTILARY (*SPEYERIA DIANA*), OUACHITA NATIONAL FOREST, OKLAHOMA, USA. HTTP://INATURALIST.ORG/OBSERVATIONS/1651875

CLIMATE DRIVES LIFE HISTORY CHANGES IN BUTTERFLY'S DECLINE

Wells CN & Tonkyn DW (2014) Range collapse in the Diana fritillary, *Speyeria diana* (Nymphalidae). *Insect Conservation and Diversity* 7(4): 365-380. doi:10.1111/icad.12059
Author country: United States
Research funding: Clemson University; Sarah Bradley Tyson Memorial Fellowship; Blue Ridge Parkway Foundation; American Museum of Natural History

The Diana fritillary (*Speyeria diana*) is a large, spectacular North American butterfly that has become increasingly rare across its historic range. In this first paper to study the shifting distribution of a butterfly from the southeastern United States, the authors find that the Diana fritillary has vanished from the Atlantic coastal plain—where Dutch explorer Pieter Cramer first described it in 1777—persisting only in two disjunct populations in the Southern Appalachians and the highlands of Arkansas and Oklahoma.

This analysis, which relies on an exhaustive compilation of records that includes GBIF-mediated data, indicates the species' ongoing shift to higher elevations and earlier female flight times—both results aligned with the predicted effects of climate change. Explanations for the Diana fritillary's collapse across its lowland ranges, however, are less clear, possibly including many factors such as the loss of southern forestlands, increased deer browsing of the understory or altered fire regimes.

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Cabrelli AL, Stow AJ & Hughes L	A framework for assessing the vulnerability of species to climate change: a case study of the Australian elapid snakes	Biodiversity and Conservation 23(12): 3019-3034	doi: 10.1007/s10531-014-0760-0	Australia
Casazza G, Giordani P, Benesperi R et al.	Climate change hastens the urgency of conservation for range-restricted plant species in the central-northern Mediterranean region	Biological Conservation 179: 129-138	doi: 10.1016/j.biocon.2014.09.015	Italy
Castellanos-Frías E, García de León D, Pujadas-Salva A et al.	Potential distribution of *Avena sterilis* L. in Europe under climate change	Annals of Applied Biology 165(1): 53-61	doi: 10.1111/aab.12117	Chile, Spain
Early R & Sax DF	Climatic niche shifts between species' native and naturalized ranges raise concern for ecological forecasts during invasions and climate change	Global Ecology and Biogeography	doi: 10.1111/geb.12208	United Kingdom, Portugal, Spain, USA
Elmendorf SC, Henry GHR, Hollister RD et al.	Experiment, monitoring, and gradient methods used to infer climate change effects on plant communities yield consistent patterns	Proceedings of the National Academy of Sciences of the United States of America 112(2): 448-452	doi: 10.1073/pnas.1410088112	United States, Canada, Faroe Islands, Norway, Iceland, Sweden, United Kingdom, Switzerland
Gerick AA, Munshaw RG, Palen WJ et al.	Thermal physiology and species distribution models reveal climate vulnerability of temperate amphibians	Journal of Biogeography 41(4): 713-723	doi: 10.1111/jbi.12261	Canada, United States,
Gil-Díaz T, Haroun R, Tuya F et al.	Effects of Ocean Acidification on the Brown Alga *Padina pavonica*: Decalcification Due to Acute and Chronic Events	PLoS ONE 9(9): e108630	doi: 10.1371/journal.pone.0108630	Spain
Harsch MA & HilleRisLambers J	Species distributions shift downward across western North America	Global Change Biology	doi: 10.1111/gcb.12697	United States
Hattab T, Albouy C, Lasram FBR et al.	Towards a better understanding of potential impacts of climate change on marine species distribution: a multiscale modelling approach	Global Ecology and Biogeography 23(12): 1417-1429	doi: 10.1111/geb.12217	France, Tunisia, Canada
Heap MJ, Culham A, Lenoir J et al.	Can the Iberian Floristic Diversity Withstand Near-Future Climate Change?	Open Journal of Ecology 04(17): 1089-1101	doi: 10.4236/oje.2014.417089	United Kingdom, France, Spain
Ikeda DH, Grady KC, Shuster SM et al.	Incorporating Climate Change and Exotic Species into Forecasts of Riparian Forest Distribution	PLoS ONE 9(9): e107037	doi: 10.1371/journal.pone.0107037	United States
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AUTHORS	TITLE	JOURNAL	DOI/URL	AUTHOR COUNTRIES
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Riordan EC & Rundel PW	Land Use Compounds Habitat Losses under Projected Climate Change in a Threatened California Ecosystem	PLoS ONE 9(1): e86487	doi:10.1371/journal.pone.0086487	United States
Sánchez-Guillén RA, Muñoz J, Hafernik J et al.	Hybridization rate and climate change: are endangered species at risk?	Journal of Insect Conservation 18(3): 295-305	doi:10.1007/s10841-014-9637-5	Mexico, Spain, Ecuador, United States
Sandom C, Faurby S, Sandel B & Svenning J	Global late Quaternary megafauna extinctions linked to humans, not climate change	Proceedings of the Royal Society/Biological Sciences 281(1787)	doi:10.1098/rspb.2013.3254	Denmark
Savage J & Vellend M	Elevational shifts, biotic homogenization and time lags in vegetation change during 40 years of climate warming	Ecography	doi:10.1111/ecog.01131	Canada
Schmitt T, Habel JC, Rödder D & Louy D	Effects of recent and past climatic shifts on the genetic structure of the high mountain yellow-spotted ringlet butterfly *Erebia manto* (Lepidoptera, Satyrinae): a conservation problem	Global Change Biology 20(7): 2045-61	doi:10.1111/gcb.12462	Germany
Shabani F, Kumar L & Taylor S	Projecting date palm distribution in Iran under climate change using topography, physicochemical soil properties, soil taxonomy, land use, and climate data	Theoretical and Applied Climatology 118(3): 553-567	doi:10.1007/s00704-013-1064-0	Australia
Steadman DW & Franklin J	Changes in a West Indian bird community since the late Pleistocene	Journal of Biogeography 42(3): 426-438	doi:10.1111/jbi.12418	United States
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Vilaça ST, Biosa D, Zachos F et al.	Mitochondrial phylogeography of the European wild boar: the effect of climate on genetic diversity and spatial lineage sorting across Europe	Journal of Biogeography 41(5): 987-998	doi:10.1111/jbi.12268	Italy, Austria, Germany, Portugal, United States, Slovakia, Spain, Greece, Poland, Belarus, Croatia, Luxembourg
Watling JI, Fletcher RJ, Speroterra C et al.	Assessing Effects of Variation in Global Climate Data Sets on Spatial Predictions from Climate Envelope Models	Journal of Fish and Wildlife Management 5(1): 14-25	doi:10.3996/072012-JFWM-056	United States
Welker F, Duijm E, van der Gaag KJ et al.	Analysis of coprolites from the extinct mountain goat *Myotragus balearicus*	Quaternary Research 81(1): 106-116	doi:10.1016/j.yqres.2013.10.006	Netherlands, Spain
Wells CN & Tonkyn DW	Range collapse in the Diana fritillary, *Speyeria diana* (Nymphalidae)	Insect Conservation and Diversity 7(4): 365-380	doi:10.1111/icad.12059	United States
Zeng C, Gomez-Mestre I & Wiens JJ	Evolution of rapid development in spadefoot toads is unrelated to arid environments	PLoS ONE 9(5): e96637	doi:10.1371/journal.pone.0096637	Germany, Spain, United States

Species conservation and protected areas

examples

VOLUNTEER DIVERS MONITOR RED SEA REEF LIFE

Branchini S, Pensa F, Neri P et al. (2014) Using a citizen science program to monitor coral reef biodiversity through space and time. *Biodiversity and Conservation* 24(2): 319-336. doi:10.1007/s10531-014-0810-7

Author country: Italy

Research funding: Italian Ministry of Education, University and Research; Ministry of Tourism of the Arab Republic of Egypt; Egyptian Tourist Authority; Association of Italian Tour Operators; Settemari; Scuba Nitrox Safety International; Scuba School International; *TuttoTurismo*; Neos; Underwater Life Project; Project Aware Foundation; Viaggio nel Blu and Holiday Service diving services; Italian Ministry of the Environment and Land and Sea Protection

Threats to the world's coral reefs put the wellsprings of marine diversity and important ecosystem services at risk. Emerging research projects like SCUBA Tourism for the Environment (STE) have increasingly relied upon the passion of volunteer divers to monitor reef life. Divers collected observations of 72 Red Sea animals over four years, tested a recreational survey protocol while STE relied on GBIF-mediated occurrences to assess relative rarity.

The resulting data showed no significant changes in the health or biodiversity status of reefs in the Northern Red Sea but revealed trends based on different protection strategies. In addition, analysis of the divers' sightings showed that casual non-specialists performed transects as accurately as conservation volunteers, suggesting that such monitoring programmes could make cost-effective and reliable contributions to the Egyptian Ministry of Tourism's environmental management policies.

TWO DIVERS PASSING AT HALAHI REEF, RED SEA, EGYPT. CC BY 2011 DEREK KEATS HTTPS://FLIC.KR/P/ALCBXD

SYSTEMATIC APPROACHES FOR ADDRESSING GAPS IN PERU'S PROTECTED AREA NETWORK

Fajardo J, Lessman J, Bonaccorso E et al. (2014) Combined use of systematic conservation planning, species distribution modelling, and connectivity analysis reveals severe conservation gaps in a megadiverse country (Peru). *PLoS ONE* 9(12): e114367. doi:10.1371/journal.pone.0114367

Author countries: Spain, Ecuador, United States, United Kingdom, Peru

Research funding: Santander Universidades; Ministry of Economy and Competitiveness of Spain; Universidad Tecnológica Indoamérica

Twentieth-century conservation relied on opportunity, aesthetics and politics to select protected areas (PAs), but advances in GIS and decision-support tools have changed today's equation for the better. The timing is opportune, with threats mounting in many of the world's most biologically diverse countries.

In this study researchers first examine how well Peru's PAs currently serve the country's megadiversity, finding it focused primarily on conserving sites in the Amazon. A systematic analysis then probes how best to extend and prioritize a complementary network that is more representative, efficient and connected. After applying site-selection algorithms to distribution models for 2,869 Peruvian animals and plants (which rely in part on GBIF-mediated data), the team sought to achieve maximum connectivity while addressing severe gaps in conserving key areas of the Peruvian Andes and Pacific coast.

TESTING THE ACCURACY OF RANGE MAPS FROM THE GLOBAL AMPHIBIAN ASSESSMENT

Ficetola GF, Rondinini C, Bonardi A et al. (2014) Habitat availability for amphibians and extinction threat: a global analysis. *Diversity and Distributions* 21: 302–311. doi:10.1111/ddi.12296
Author countries: Italy, France
Research funding: University of Milano-Bicocca

The range maps produced for IUCN's landmark 2004 Global Amphibian Assessment (GAA) are now themselves milestones, providing the only authoritative, global-scale source of distribution information on this unique class of vertebrates. Given their increasingly wide use not just in conservation but also in biogeographic, ecological and evolutionary studies, the authors sought to evaluate and quantify the maps' levels of error and accuracy, particularly at the presumptive edges of species ranges.

The research compares the GAA maps with those produced solely by GBIF-mediated records for 4,507 amphibian species as well as a closely curated collection of more recent observation (also supplied with data via GBIF). This paired analysis demonstrates the relative accuracy of the GAA ranges even as it highlights continental-scale sampling biases and the need for greater investment and data mobilization in both South America and tropical Asia.

CREATING CONSISTENT, TRANSPARENT BASELINE DATA FOR THE RED PANDA

Kandel K, Huettmann F, Suwal MK et al. (2014) Rapid multi-nation distribution assessment of a charismatic conservation species using open access ensemble model GIS predictions: Red panda (*Ailurus fulgens*) in the Hindu-Kush Himalaya region. *Biological Conservation* 181: 150-161. doi:10.1016/j.biocon.2014.10.007
Author countries: Nepal, United States, United Kingdom
Research funding: Nagao Natural Environment Foundation, Japan; Oregon Zoo Foundation; Rufford Small Grants Foundation; People's Trust for Endangered Species; Chester Zoo; Idea Wild

The red panda (*Ailurus fulgens*) is a rare tree-dwelling mammal native to remote portions of the Hindu Kush-Himalaya (HKH). Inhabiting mountainous, often inaccessible forests with dense bamboo understories has made this charismatic but elusive creature even more difficult to study. IUCN lists *A. fulgens* as 'vulnerable' due to expected declines in a population already estimated to be small, but data are relatively sparse—which adds to the value of the authors' collecting (and publishing through GBIF.org) a new dataset that contains 1,120 observations, primarily from feces deposited at feeding sites in Nepal.

RED PANDA (*AILURUS FULGENS*) NEAR DOBATE, NEPAL. CC BY-NC-ND 2014 MICHAEL BAMFORD HTTPS://FLIC.KR/P/Q62S5G

Their species distribution model seeks to predict areas most likely to host red panda, establishing baseline knowledge for science-based species and habitat management in the HKH. Open-access provisions for both the dataset and the model encourage their broader use in future research and assessment.

ASSESSING SPECIES RICHNESS TO CONSERVE BIODIVERSITY IN GUYANA

McPherson TY (2014) Landscape scale species distribution modeling across the Guiana Shield to inform conservation decision making in Guyana. *Biodiversity and Conservation* 23(8): 1931-1948. doi:10.1007/s10531-014-0696-4
Author country: United States

Guyana faces conservation challenges common to countries of the Southern tropics—inadequate and scattered biodiversity data, limited in-country expertise and funding, and growing interest in possible financial rewards of resource development and extraction. And yet, like the rest of the countries on the 2.6 billion-year-old Guyana Shield, even the sparse scientific information available highlights its biological richness.

Gathering specimen data from the world's natural history museums and herbaria (with GBIF as one source), the author first modeled species richness for seven taxon-based groups at a landscape scale. In hope of contributing to the development of a national protected areas network, the maps applied three conservation scenarios, two of which accommodate and account for the interests of Guyana's indigenous peoples, whose traditional knowledge of biodiversity represent a largely untapped source.

IMPROVED SOURCING OF SPECIES INFORMATION NEEDED IN SPAIN'S BIOSPHERE RESERVES

Pino-Del-Carpio A, Ariño AH & Miranda R (2014) Data exchange gaps in knowledge of biodiversity: implications for the management and conservation of Biosphere Reserves. *Biodiversity & Conservation* 23(9): 2239-2258. doi:10.1007/s10531-014-0718-2
Author country: Spain
Research funding: Association of Friends of the University of Navarra

UNESCO Biosphere Reserves (BRs) have a mandate to act as sites for learning about best practices and exchanges of information that improve links between biodiversity conservation and socioeconomic development. To test their efficacy in that project, the authors review three key sources of species information on threatened and non-threatened vertebrates in 34 of Spain's 45 BRs, which comprise the second largest national portfolio in the world.

The results of their analysis are surprisingly partial. Management documents, GBIF-mediated data, and national atlases and red books produced different species lists for each Reserve, with just 75.9% of the 566 species named across the combined sources appearing in all three. Most worryingly, threatened freshwater fishes and amphibians are the most poorly represented groups in the BRs' own management documents, suggesting that the use of multiple sources (including GBIF) may improve the scientific basis of species management within the Reserves.

CONSERVATION ASSESSMENT OF ANGOLA'S TIMBER TREES

Romeiras MM, Figueira R, Duarte MC et al. Documenting biogeographical patterns of African timber species using herbarium records: a conservation perspective based on native trees from Angola. *PLoS ONE* 9(7): e103403. doi:10.1371/journal.pone.0103403
Author countries: Portugal, United Kingdom
Research funding: Portuguese Foundation for Science & Technology

The increasing globalization of the timber trade has inevitably led to increased pressure on some tree species. But as in other tropical countries, the dearth of baseline scientific data about commercially valuable timber species in Angola could risks rapid overexploitation that no ban, restriction or sustainable harvesting scheme can fix.

Recent field surveys in the vast, largely government-owned forests of southern Africa's largest country have not closed the 40-year gap in botanical data corresponding to a war of independence and civil war. After identifying 18 key Angolan timber trees, these researchers drew upon 2,253 specimen records from 62 collections published through GBIF. In addition to revealing striking differences in the trees' biogeographic patterns, the results suggest that 11 species should be given higher priority for conservation, particularly those concentrated in the Cabinda's Maiombe forest.

A RETROSPECTIVE STUDY OF THE DISAPPEARANCE OF THE PASSENGER PIGEON

Stanton JC. Present-day risk assessment would have predicted the extinction of the passenger pigeon (*Ectopistes migratorius*). *Biological Conservation* 180: 11-20. doi:10.1016/j.biocon.2014.09.023
Author country: United States

The astonishment expressed by so experienced an observer as John James Audubon as he described a flock of passenger pigeons darkening the Kentucky sky for three days in 1813 finds its tragic counterbalance in the seemingly inexplicable extinction of *Ectopistes migratorius* 101 years later. How did the most abundant bird in North America disappear so quickly? And what—if anything—could we have done differently?

Here, the author marks the centenary of the last bird's demise with a comprehensive reconstruction of its rapid decline and loss as well as a retrospective IUCN Red List assessment. GBIF-mediated specimen records contribute to the breeding habitat portion of a highly detailed model, which also accounts for the

PASSENGER PIGEON (*ECTOPISTES MIGRATORIUS*, FORMERLY *COLUMBA MIGRATORIA*), PLATE 62, FROM JOHN JAMES AUDUBON'S *BIRDS OF AMERICA* (1827) passenger pigeon's erratic migrations, habitat loss and nesting collapses. The results not only resolve the central mystery, attributing primary responsibility to decades of commercial overharvesting, but also suggest that regular Red Listing would likely have unmasked the rising extinction risk—thereby signalling the present-day importance of species monitoring strategies in an era of rapid environmental change.

MEASURING PARKS' EFFECTIVENESS IN PROTECTING BIODIVERSITY IN KENYA

Tóth AB, Lyons SK, & Behrensmeyer AK (2014) A Century of Change in Kenya's Mammal Communities: Increased Richness and Decreased Uniqueness in Six Protected Areas. *PLoS ONE* 9(4): e93092. doi:10.1371/journal.pone.0093092
Author country: United States
Research funding: National Museum of Natural History

Scientific documentation of Kenya's mammal communities since the late 19th century is robust, between historical specimens from the colonial era of big-game hunting and modern observations from the national parks established after the Second World War. This case study leverages those data (many accessed through GBIF) to examine the long-term impact of protected areas on biodiversity protection.

While detailing some species turnover and a decline in the uniqueness of local mammalian communities across the six parks that comprise the study area, the analysis reveals that these protected areas have sustained species richness in spite of increasing environmental change and human encroachments.

ARE EUROPE'S MOST PROTECTED AMPHIBIANS FROM SAFE FROM PESTICIDES?

Wagner N, Rödder D, Brühl CA et al. (2014) Evaluating the risk of pesticide exposure for amphibian species listed in Annex II of the European Union Habitats Directive. *Biological Conservation* 176: 64-70. doi:10.1016/j.biocon.2014.05.014
Author country: Germany
Research funding: Deutsche Forschungsgemeinschaft

In 1992, the European Union's Habitats Directive established the Natura 2000 network of protected areas as a keystone element of EU nature conservation. The Directive's Annex II designates the use of special areas of conservation (SAC) for listed species, including 25 amphibians. But regular use of herbicides and fungicides in agricultural portions of SAC puts amphibians at risk during any life-stage, as their permeable skin quickly absorbs higher chemical concentrations than do other animal classes.

Calculating the proportion of SAC lands treated regularly with pesticides, this German research team relied on GBIF-mediated data and other sources to reveal that nearly all of most at-risk amphibians had sufficient protection. However, varying levels of exposure across site and national scales likely warrants ongoing amphibian monitoring in SAC management plans.

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Aguirre-Gutitierrez J, Serna-Chavez H, Villalobos- Arambula AR et al.	Similar but not equivalent: ecological niche comparison across closely–related Mexican white pines	Diversity and Distributions 21(3): 245-257	doi: 10.1111/ddi.12268	Netherlands, Mexico
Andréfouët S & Hamel MA	Tropical islands quick data gap analysis guided by coral reef geomorphological map	Marine Pollution Bulletin	doi: 10.1016/j.marpolbul.2014.01.055	New Caledonia
Bean WT, Prugh LR, Stafford LR et al.	Species distribution models of an endangered rodent offer conflicting measures of habitat quality at multiple scales	Journal of Applied Ecology 51(4): 1116-1125	doi: 10.1111/1365-2664.12281	United States
Bean WT, Stafford R., Butterfield HS et al.	A Multi-Scale Distribution Model for Non-Equilibrium Populations Suggests Resource Limitation in an Endangered Rodent	PLoS ONE 9(9)	doi: 10.1371/journal.pone.0106638	United States
Branchini S, Pensa F, Neri P et al.	Using a citizen science program to monitor coral reef biodiversity through space and time	Biodiversity and Conservation 24(2): 319-336	doi: 10.1007/s10531-014-0810-7	Italy

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Brito JC, Godinho R, Martínez-Freiría F et al.	Unravelling biodiversity, evolution and threats to conservation in the Sahara-Sahel	Biological Reviews of the Cambridge Philosophical Society 89(1): 215-231	doi: 10.1111/brv.12049	Portugal, Spain, United Kingdom, Finland, Morocco, France, Spain
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Romeiras MM, Figueira R, Duarte MC et al.	Documenting biogeographical patterns of African timber species using herbarium records: a conservation perspective based on native trees from Angola	PLoS ONE 9(7): e103403	doi:10.1371/journal.pone.0103403	Portugal, United Kingdom
Silva, VNP, Pressey RL, Machado RB et al.	Formulating conservation targets for a gap analysis of endemic lizards in a biodiversity hotspot	Biological Conservation 180: 1-10	doi:10.1016/j.biocon.2014.09.016	Brazil, Australia
Stanton JC	Present-day risk assessment would have predicted the extinction of the passenger pigeon (*Ectopistes migratorius*)	Biological Conservation 180: 11-20	doi:10.1016/j.biocon.2014.09.023	United States
Tóth AB, Lyons SK, & Behrensmeyer AK	A Century of Change in Kenya's Mammal Communities: Increased Richness and Decreased Uniqueness in Six Protected Areas	PLoS ONE 9(4): e93092	doi:10.1371/journal.pone.0093092	United States
Wagner N, Rödder D, Brühl CA et al.	Evaluating the risk of pesticide exposure for amphibian species listed in Annex II of the European Union Habitats Directive	Biological Conservation 176: 64-70	doi:10.1016/j.biocon.2014.05.014	Germany

Biodiversity and human health

examples

MAPPING THE NICHE OF EBOLA HOST ANIMALS

Pigott DM, Golding N, Mylne A et al. (2014) Mapping the zoonotic niche of Ebola virus disease in Africa. *eLife* 3: e04395. doi:10.7554/eLife.04395
Author countries: United Kingdom, United States, Canada, Sweden
Research funding: University Of Oxford; Bill and Melinda Gates Foundation; Medical Research Council; Biotechnology and Biological Sciences Research Council; German Academic Exchange Service; U.S. National Library of Medicine; European Union 7th Framework Programme for Research and Technological Development; Canadian Institutes of Health Research; Wellcome Trust; Science & Technology Directorate; Fogarty International Center; National Institute of Allergy and Infectious Diseases

In 2014, as the Ebola virus disease took hold in West Africa —an outbreak that is both the largest ever recorded and the region's first—an international team of researchers sought to identify regions and countries at greatest risk from the epidemic. While uncertainty remains about the virus's true reservoir, bats are suspected to play an important role as the life cycle of Ebola and other filoviruses. Relying on GBIF-mediated occurrence data, the researchers modelled the ranges of three species believed to be the most likely reservoirs for Ebola's transmission to humans: the hammer-headed bat (*Hypsignathus monstrosus*), little collared fruit bat (*Myonycteris torquata*) and Franquet's epauletted fruit bat (*Epomops franqueti*).

Combining these data with the location data on previous zoonotic transmissions, the study identified at-risk areas across 22 countries in Central and West Africa with a combined human population of 22 million. The authors argue that these findings will help to prioritize surveillance for Ebola outbreaks and improve the diagnostic capacity in at-risk regions.

HAMMER-HEADED FRUIT BAT (*HYPSIGNATHUS MONSTROSUS*) WITH YOUNG.

OVERLOOKING KNOWN SOURCES OF HEALING?

Amirkia V & Heinrich M (2014) Alkaloids as drug leads – A predictive structural and biodiversity-based analysis. *Phytochemistry Letters* 10: xlviii–liii. doi:10.1016/j.phytol.2014.06.015
Author country: United Kingdom

Are alkaloids underrepresented in modern medicine? The authors used GBIF-mediated occurrence records for known plant sources of alkaloids, in part, to examine potential reasons for a steep drop in the number of new alkaloid-based medicines despite their 4,000-year history of human healing.

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Samy AM, van de Sande WWJ, Fahal AH & Peterson AT	Mapping the potential risk of mycetoma infection in Sudan and South Sudan using ecological niche modeling.	PLOS Neglected Tropical Diseases 8(10): e3250	doi:10.1371/journal.pntd.0003250	United States, Egypt, Netherlands, Sudan
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Food, farming and biofuels

examples

PREDICTING CLIMATE IMPACTS ON THE PROFITABILITY OF UK FISHERIES

Jones MC, Dye SR, Pinnegar JK et al. (2014) Using scenarios to project the changing profitability of fisheries under climate change. *Fish and Fisheries* doi:10.1111/faf.12081
Author countries: Canada, United Kingdom
Research funding: UK Department for Environment, Food and Rural Affairs; Nippon Foundation; National Geographic Society; Natural Sciences and Engineering Research Council of Canada; European Union 7th Framework Programme for Research and Technological Development; Natural Environment Research Council

With climate change expected to lead to large-scale shifts in marine species distributions, researchers explored scenarios to investigate possible impacts on UK fisheries. GBIF and other global databases supplied the occurrence data for 31 fish and vertebrate species needed to build species distribution models, which are then linked in turn to cost-benefit analyses.

Despite predictions that a few species like European sea bass and sardines may increase, the results indicate future decreases in marine productivity, total catch value and weight and, thus, the fisheries' profitability. Whether these impacts derive directly from changes in species distribution or abundance or indirectly from altered operating costs, the authors recommend increased adaptive capacity and diversification as the most effective means of minimizing and offsetting the anticipated drop in revenues.

THE WEALTH THAT BUILT THE CORNISH TOWN OF MEVAGISSEY DERIVED FROM THE SUCCESS OF SMALL FISHING BOATS THAT CALLED ITS HARBOUR HOME. PHOTO CC BY-SA 2014 LOCO STEVE HTTPS://FLIC.KR/P/OG3E1S

STALKING THE WILD CHILI PEPPER

Kraft KH, Brown CH, Nabhan GP et al. (2014) Multiple lines of evidence for the origin of domesticated chili pepper, *Capsicum annuum*, in Mexico. *Proceedings of the National Academy of Sciences of the United States of America* 111(17):6165-70. doi:10.1073/pnas.1308933111
Author countries: United States, Kenya, Mexico, France
Research funding: The Fulbright Program; University of California Institute for Mexico and the United States; University of California, Davis, Dept of Plant Sciences

The task of locating the geographic origins and identity of crop species typically combines genetic and archaeological analysis of ancient botanical remains like starch and pollen grains. To find the wild source of today's domesticated chili pepper, researchers here extend these methods with the addition of linguistic and ecological models. The former reconstructs the crop-related vocabularies of protohistorical languages of northeastern and central-east Mexico, while the latter draws on GBIF-mediated data to produce distribution models for *Capiscum annuum* var. *glabriusculum* circa 6,000 years ago.

The independent evidence from each discipline points to slightly different locations, but by hypothesizing that human interest in the chili's wild relative first appeared further south than previously believed, the authors suggest that Mexican food crops arose across a Mesoamerican Fertile Crescent.

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Chomicki G & Renner SS	Watermelon origin solved with molecular phylogenetics including Linnaean material: another example of museomics	The New Phytologist	doi: 10.1111/nph.13163	Germany
d'Eeckenbrugge GC & Lacape J-M	Distribution and Differentiation of Wild, Feral, and Cultivated Populations of Perennial Upland Cotton (*Gossypium hirsutum* L.) in Mesoamerica and the Caribbean	PLoS ONE 9(9): e107458	doi: 10.1371/journal.pone.0107458	France
Galluzzi G & López Noriega I	Conservation and Use of Genetic Resources of Underutilized Crops in the Americas—A Continental Analysis	Sustainability 6(2): 980-1017	doi: 10.3390/su6020980	Colombia, Italy
Ghamkhar K, Nichols PGH, Erskine W et al.	Hotspots and gaps in the world collection of subterranean clover (*Trifolium subterraneum* L.)	The Journal of Agricultural Science	doi: 10.1017/S0021859614000793	Australia, New Zealand, Spain
Hager HA, Sinasac SE, Gedalof Z et al.	Predicting potential global distributions of two miscanthus grasses: implications for horticulture, biofuel production, and biological invasions	PLoS ONE 9(6): e100032	doi: 10.1371/journal.pone.0100032	Canada
Hussein JM, Mshandete AM & Kivaisi AK	Molecular phylogeny of saprophytic wild edible mushroom species from Tanzania based on ITS and nLSU rDNA sequences	Current Research in Environmental & Applied Mycology 4(2): 250-260	doi: 10.5943/cream/4/ 2 /1 2	Tanzania
Johnson AL, Govindarajulu R & Ashman T-L	Bioclimatic evaluation of geographical range in Fragaria (Rosaceae): consequences of variation in breeding system, ploidy and species age	Botanical Journal of the Linnean Society 176(1): 99-114	doi: 10.1111/boj.12190	United States
Jones MC, Dye SR, Pinnegar JK et al.	Using scenarios to project the changing profitability of fisheries under climate change	Fish and Fisheries	doi: 10.1111/faf.12081	Canada, United Kingdom
Kraft KH, Brown CH, Nabhan GP et al.	Multiple lines of evidence for the origin of domesticated chili pepper, *Capsicum annuum*, in Mexico	Proceedings of the National Academy of Sciences of the USA 111(17): 6165-6170	doi: 10.1073/pnas.1308933111	United States, Kenya, Mexico, France

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Shabani F, Kumar L & Taylor S	Distribution of Date Palms in the Middle East Based on Future Climate Scenarios	Experimental Agriculture 51(2): 244-263.	doi:10.1017/S001447971400026X	Australia
Shabani F & Kumar L	Sensitivity Analysis of CLIMEX Parameters in Modeling Potential Distribution of *Phoenix dactylifera* L.	PLoS ONE 9(4): e94867	doi:10.1371/journal.pone.0094867	Australia
Tendall DM, Hellweg S, Pfister S et al.	Impacts of river water consumption on aquatic biodiversity in life cycle assessment--a proposed method, and a case study for Europe	Environmental Science & Technology 48(6): 3236-44	doi:10.1021/es4048686	Switzerland, Netherlands
Vanderplank S, Ezcurra E, Delgadillo J et al.	Conservation challenges in a threatened hotspot: agriculture and plant biodiversity losses in Baja California, Mexico	Biodiversity and Conservation: 23(9): 2173-2182	doi:10.1007/s10531-014-0711-9	Mexico
Volk GM, Chao CT, Norelli J et al.	The vulnerability of US apple (Malus) genetic resources	Genetic Resources and Crop Evolution	doi:10.1007/s10722-014-0194-2	United States
Wang W, Tang X, Zhu Q et al.	Predicting the impacts of climate change on the potential distribution of major native non-food bioenergy plants in China	PLoS ONE 9(11): e111587	doi:10.1371/journal.pone.0111587	China

Ecosystem services

examples

CALCULATING THE ECONOMIC VALUE OF WILD FOODS IN EUROPE

Schulp CJE, Thuiller W & Verburg PH (2014) Wild food in Europe: A synthesis of knowledge and data of terrestrial wild food as an ecosystem service. *Ecological Economics* 105: 292–305. doi:10.1016/j.ecolecon.2014.06.018
Author countries: France, Netherlands
Research funding: ERA-Net; European Union 7th Framework Programme for Research and Technological Development

While collecting and consuming wild food is recognized as an important cultural ecosystem service, quantitative measures of these provisions have been harder to come by. The authors synthesized data for wild food species through GBIF and other sources, using the density of occurrences and social science data about collecting and foraging to quantify and map the value of the wild game and plants consumed throughout Europe.

WILD LINGONBERRIES FOR SALE AT TAXINGE SLOTT SOUTH OF STOCKHOLM. CC BY-NC 2010 VILSESKOGEN HTTPS://FLIC.KR/P/8ZVJYJ

BUSTLING MARKET IN BOHICON, BENIN. CC BY-NC-ND 2008 ADAM COHN HTTPS://FLIC.KR/P/5R6DTW

ASSESSING THE VULNERABILITY OF MEDICINAL PLANTS IN WEST AFRICA

van Andel TR, Croft S, van Loon EE et al. (2014) Prioritizing West African medicinal plants for conservation and sustainable extraction studies based on market surveys and species distribution models. *Biological Conservation* 181: 173-181. doi:10.1016/j.biocon.2014.11.015

Author country: Netherlands

Research funding: Netherlands Organization for Scientific Research

Wild-harvested medicinal plants are an important source of health and trade for people in sub-Saharan Africa. By combining quantitative surveys of herbal markets in Ghana and Benin with the first detailed distribution maps for 12 commercially extracted medicinal plants (which draw upon GBIF-mediated data), this study assess the potential vulnerability of species to overharvesting with the goal of safeguarding important provisioning services of West African ecosystems.

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Convertino M, Muñoz-Carpena R, Kiker GA et al.	Design of optimal ecosystem monitoring networks: hotspot detection and biodiversity patterns	Stochastic Environmental Research and Risk Assessment	doi: 10.1007/s00477-014-0999-8	United States
Nuutinen V, Butt KR, Jauhiainen L et al.	Dew-worms in white nights: High-latitude light constrains earthworm (*Lumbricus terrestris*) behaviour at the soil surface	Soil Biology and Biochemistry 72: 66-74	doi: 10.1016/j.soilbio.2014.01.023	United Kingdom, Finland, United States
Schulp CJE, Thuiller W & Verburg PH	Wild food in Europe: A synthesis of knowledge and data of terrestrial wild food as an ecosystem service	Ecological Economics 105: 292–305.	doi:10.1016/j.ecolecon.2014.06.018	France, Netherlands
Schulp CJE, Burkhard B, Maes J et al.	Uncertainties in ecosystem service maps: a comparison on the European scale	PLoS ONE 9(10): e109643	doi:10.1371/journal.pone.0109643	Netherlands, Germany, Italy
Schulp CJE, Lautenbach S & Verburg PH	Quantifying and mapping ecosystem services: Demand and supply of pollination in the European Union	Ecological Indicators 36: 131–141	doi:10.1016/j.ecolind.2013.07.014	Netherlands, Germany
van Andel TR, Croft S, van Loon EE et al.	Prioritizing West African medicinal plants for conservation and sustainable extraction studies based on market surveys and species distribution models	Biological Conservation 181: 173-181	doi:10.1016/j.biocon.2014.11.015	Netherlands

Advancing biodiversity science

examples

SUBSAMPLING DATA TO REMOVE SPECIES BIAS FROM DISTRIBUTION MODELS

Beck J, Böller M, Erhardt A et al. (2014) Spatial bias in the GBIF database and its effect on modeling species' geographic distributions. *Ecological Informatics* 19: 10-15. doi:10.1016/j.ecoinf.2013.11.002
Author country: Switzerland
Research funding: Swiss National Science Foundation

Spatial bias in species distribution data results from a dataset's density of records reflecting factors like uneven sampling or mobilization, rather than the true density of a species. Understanding, accounting for and removing such inaccuracies is an important step in improving the development and application of distribution models for research and decision-making.

Using as a case study the small tortoiseshell (*Algais uriticae*), a common Eurasian butterfly, the authors examined how the spatial clustering of GBIF-mediated data affects model quality. For widespread species with abundant data, they recommend and propose a subsampling routine that removes spatial bias without reducing the predictive strength of resulting models.

SARDINIAN BROOK SALAMANDER (*EUPROCTUS PLATYCEPHALUS*) HTTPS://FLIC.KR/P/NHKG0K

OPEN ACCESS DATA IMPROVES KNOWLEDGE ON CLIMATIC NEEDS OF PLANTATION TREES

Booth TH (2014) Using biodiversity databases to verify and improve descriptions of tree species climatic requirements. *Forest Ecology and Management* 315: 95-102. doi:10.1016/j.foreco.2013.12.028
Author country: Australia
Research funding: CSIRO

Though climate research tends to focus on impacts on native species, such changes threaten important commercial species, too. Australian eucalypts and acacia are planted in more than 90 countries, and this study examines how open-access data available through the Atlas of Living Australia and GBIF can improve existing commercial forestry information on their climatic requirements.

A detailed analysis of occurrence records for *Eucalyptus nitens* and *E. botryoides* (within and beyond their native ranges) suggests how forest managers could apply such data to assess vulnerability and plan adaptation strategies.

MAPPING EUROPE'S HERPS

Creemers R, Denoël M, Campos J et al. (2014) Updated distribution and biogeography of amphibians and reptiles of Europe. *Amphibia-Reptilia* 35(1): 1-31. doi:10.1163/15685381-00002935
Author countries: Portugal, Italy, Netherlands, France, Serbia, Belgium, Russia, Greece, Spain, Germany
Research funding: Societas Europaea Herpetologica; Fundação para a Ciência e Tecnologia (Portugal); Spanish Ministry of Environment; the Ministry of Education, Science and Technological Development of Republic of Serbia; Fonds de la Recherches Scientifique, Belgium; Generalitat de Catalunya, Spain; Alexander von Humboldt Foundation

The species distribution maps developed by Societas Europaea Herpetologica for *The Atlas of Amphibians and Reptiles in Europe* were highly useful and original upon their release. But the scientific landscape has shifted considerably since 1997 with the growth of GIS, computing power and accumulated occurrence data, all of which have helped fuel parallel improvements in taxonomic understanding.

Updated with data now availalbe from GBIF.org and other sources, this update to the *Atlas* refreshes maps for 218 taxa (73 amphibians and 145 reptiles) while working toward a distributed, interactive and dynamic online system for data on European herpetofauna. The accompanying analysis seeks to identify patterns of species richness and endemism as well as major spatial and taxonomic gaps in hope of targeting key areas for future inventory and research.

DEDUCING AVAILABLE HABITAT FOR AMPHIBIANS

Ficetola GF, Rondinin C, Bonnardi A et al. (2014) Habitat availability for amphibians and extinction threat: a global analysis. *Diversity and Distributions* 21: 302-311. doi:10.1111/ddi.12296
Author countries: Italy, France
Research funding: University of Milano-Bicocca

As a group, amphibians are among the world's most imperilled animals, and habitat loss and degradation represent the greatest threat they face by far. Despite this understanding, quantitative assessments of habitat availability exist for only a few species.

Here the authors produced the first global evaluation of available habitat for amphibians by repurposing data gathered through GBIF and other sources for analysis in Ficetola et al. (see p.20). Combining this recent high-precision dataset with land cover, elevation, and species range maps from the 2004 Global Amphibian Assessment, the results provide deductive suitable habitat models that more accurately predict the distribution of 5,363 amphibians species. The approach refines the expert-based polygons by defining suitable and unsuitable habitats and provides a 'coarse but robust' assessment, establishing large-scale priorities in data-poor areas and highlighting the need for more finer-scale studies of habitat requirements.

COMPARING METHODS FOR REMOVING SAMPLING BIASES IN SPECIES DISTRIBUTION MODELS

Fourcade Y, Engler JO, Rödder D et al. (2014) Mapping Species Distributions with MAXENT Using a Geographically Biased Sample of Presence Data: A Performance Assessment of Methods for Correcting Sampling Bias. *PLoS ONE* 9(5): e97122. doi:10.1371/journal.pone.0097122
Author countries: France, Germany
Research funding: Plan Loire Grandeur Nature; European Regional Development Fund; German Federal Environmental Foundation

Despite its wide use in conservation science and practice to estimate areas most likely to host a given species, species distribution modelling (SDM) remains prone to errors attributable to biases in source data. This study tests five proposed methods for correcting SDM sampling bias, using records for both 'virtual' and real species—the latter including GBIF-mediated data on the white-spotted slimy salamander (Plethodon cylindraceus)—comparing the accuracy of resulting models across a range of conditions.

In addition to highlighting the importance of bias type and intensity in selecting correction methods, the authors found that systematic sampling of records generated the best and most consistently performing models, offering the most efficient results as well as a key area for further research.

MULTI-SCALE ANALYSIS REVEALS KEY DRIVERS OF SPECIES COMPOSITION

Kent R, Bar-Massada A & Carmel Y (2014) Bird and mammal species composition in distinct geographic regions and their relationships with environmental factors across multiple spatial scales. *Ecology and evolution* 4(10): 1963-71l. doi:10.1002/ece3.1072
Author countries: United Kingdom, Israel
Research funding: Israel Science Foundation; Israeli Ministry of Science and Technology

Which environmental factors drive global patterns of species composition? This study sought answers through a comparative multi-scalar analysis of the distribution of mammals and breeding birds across Australia and the continental United States.

Using GBIF-mediated records for 1,376 bird species (572 from Australia / 804 from the U.S.) and 655 mammals (371 AU / 284 US), the authors examined the impact of environmental factors on the groups' distribution by systematically upscaling their continent-wide analyses across grid cells ranging in size from 10 to 10,000 km2. The results show that climate and land use / land cover explain most of the variance in species composition at all scales, although with consistently contrasting effects.

DETERMINING WHERE MISTLETOE CAN GO

Lira-Noriega A & Peterson AT (2014) Range-wide ecological niche comparisons of parasite, hosts and dispersers in a vector-borne plant parasite system. *Journal of Biogeography* doi:10.1111/jbi.12302
Author country: United States
Research funding: University of Kansas; Consejo Nacional de Ciencia y Tecnologıa, Mexico; GBIF Young Researchers Award

Climatic factors shaping the ecological dynamics between parasites, their hosts and their vectors are poorly understood. This study examined whether

DESERT MISTLETOE (*PHORADENDRON CALIFORNICUM*), COACHELLA VALLEY, CALIFORNIA CC BY-SA 2008 JOE DECRUYENAERE HTTPS://FLIC.KR/P/4MWQEV

the distribution of desert mistletoe (*Phoradendron californicum*) hinges on its own ecological niche in the Sonoran and Mojave deserts, those of the trees it infects or those of the birds that disperse its seeds.

By modeling and comparing the amounts of overlap between the parasite, eight common hosts (using GBIF-mediated records) and 10 common avian dispersers, the authors uncovered broad support for the finding that mistletoe only infects host species within areas suitable and accessible to it.

REVIEWING NATIONAL BALANCE SHEETS ON CAPITAL, CAPACITY AND NATURAL HERITAGE

Lira-Noriega A & Soberón J (2014) The relationship among biodiversity, governance, wealth, and scientific capacity at a country level: Disaggregation and prioritization. *Ambio*. doi:10.1007/s13280-014-0581-0
Author country: United States
Research funding: JRS Biodiversity Foundation

In this examination of the relationships between biodiversity richness, wealth and institutional capacity in more than 200 countries and territories, this study used the number of records mobilized through GBIF as part of an index of scientific capacity. The overall picture that emerges is not simple, with patterns of wealth and capacity displaying a complicated pattern that cuts against conventional wisdom. The authors conclude by encouraging collaborations to improve access to primary biodiversity data (digitized or not) not yet available for analysis, science and policy.

BACK TO THE FUTURE: INTEGRATING THE FOSSIL RECORD INTO SPECIES DISTRIBUTION MODELLING

Meseguer AS, Lobo JM, Ree R et al. (2014) Integrating Fossils, Phylogenies, and Niche Models into Biogeography to reveal ancient evolutionary history: the Case of *Hypericum* (Hypericaceae). *Systematic Biology* 64(2): 215-232. doi:10.1093/sysbio/syu088
Author countries: Spain, France, United States, United Kingdom
Research funding: Spanish Ministry of Science

Studies that explore ancestral species ranges rely on both fossils and present-day observations, but the assumptions behind such reconstructions carry uncertainties, due in part to highly variable historic rates of extinction that can eliminate significant and unobservable fractions of scientific evidence. Here, using a large, well-known plant genus and newly available global-scale paleo-climate models, the researchers offer an example for linking the fossil record to ecological and climatic information in a reconstructed history of *Hypericum*, St. John's wort. GBIF-mediated occurrences for extant species contribute to their identification of key dispersal corridors and barriers as well as a potentially high extinction rates in Eurasia during the recent long-term climatic oscillations.

POLLEN SHOWS LIMITS TO THE ANDES' INFLUENCE

Palazzesi, L, Barreda, VD, Cuitiño, JI et al. (2014) Fossil pollen records indicate that Patagonian desertification was not solely a consequence of Andean uplift. *Nature Communications* 5:3558. doi:10.1038/ncomms4558
Author countries: Argentina, United Kingdom, Brazil
Research funding: Agencia Nacional de Promoción Científica y Tecnológica; Consejo Nacional de Investigaciones Científicas y Técnicas

The harsh, arid grasslands of Patagonia seem like a clear product of the rain shadow created by the uplift of southern Andes between 14 and 12 million years ago. But this study of plant richness, based on fossil spores and pollen grains from shallow marine sediments in eastern Patagonia, hints at a more dynamic past. GBIF-mediated records for closest living, climate-sensitive plant relatives helped call attention to the earlier presence of rainforest ferns and gymnosperms. The disappearance of these tropical and humid-zone plants from the region within the past 6 million years supports an alternative scenario in which the rise of the Andes only started a desertification process that later climatic changes further promoted.

NEOTROPICAL ORCHID BEES—LUMP OR SPLIT?

Silva DP, Vilela B, De Marco P & Nemésio A (2014) Using Ecological Niche Models and Niche Analyses to Understand Speciation Patterns: The Case of Sister Neotropical Orchid Bees. *PLoS ONE* 9(11): e113246. doi:10.1371/journal.pone.0113246

Author country: Brazil
Research funding: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Coordenação de Aperfeiçoamento de Pe soal de Ensino Superior (CAPES)

The Amazon and Atlantic forests have seen alternating cycles of expansion and contraction during the past 23 million years. These processes have isolated several subpopulations of the orchid bee genera *Eulaema* and *Eufriesea*, sparking disagreements over whether they should now be considered separate populations of the same species or different species altogether. By developing ecological niche models built with data drawn from GBIF.org and other sources, this Brazilian research team measured the overlap in environments that the bees inhabit today. The comparative divergence supports a taxonomic split between the two populations while identifying key new areas for future surveys.

STUDYING EUROPEAN DIVERSITY UNDERFOOT

Simaiakis SM & Strona G (2014) Patterns and processes in the distribution of European centipedes (Chilopoda). *Journal of Biogeography* 42(6): 1018-1028. doi:10.1111/jbi.12463
Author country: Greece

Despite a worldwide history that stretches back hundreds of millions of years and an important ecosystem function, centipedes do not suffer from scientific overexposure. This study draws on GBIF-mediated and other data to characterize key patterns and processes among 585 European species in the class Chilopoda, revealing the presence of four distinct biogeographic segments in the region, including a potential soil-invertebrate hotspot in the Balkan Peninsula—a possible legacy of providing microrefuges from recent Pleistocene glaciers.

DO GENES OR ECOLOGY KEEP SERPENTS SEPARATE?

Tarroso P, Pereira RJ, Martínez-Freiría F et al. (2014) Hybridization at an ecotone: ecological and genetic barriers between three Iberian vipers. *Molecular Ecology* 23(5): 1108-23. doi:10.1111/mec.12671
Author country: Portugal
Research funding: Fundação para a Ciência e Tecnologia; European Regional Development Fund

Sited along a transition between the Mediterranean and Euro-Siberian bioregions, northern Spain's High Ebro area hosts three overlapping vipers: the 'sister' species *Vipera aspis* and *V. latastei* and the more genetically distinctive *V. seoanei*. In this 'triple contact zone' where hybrids are not uncommon, the authors found a unique setting investigating the processes that shape species boundaries.

Combining genetic analysis of field specimens with distribution models that use data from GBIF.org and other sources, the results highlight how the ecological barriers that sharply delineate suitable habitat for each species effectively maintain distinct species despite the presence of fertile hybrids.

APPLYING NICHE MODELS TO ESTIMATE RISKS OF VENOMOUS SNAKEBITES

Yañez-Arenas C, Peterson AT, Mokondoko P et al. (2014) The Use of Ecological Niche Modeling to Infer Potential Risk Areas of Snakebite in the Mexican State of Veracruz. *PLoS ONE* 9(6): e100957. doi:10.1371/journal.pone.0100957
Author countries: Mexico, United States
Research funding: CONACYT

Human death and disease from poisonous snakebites in the tropics is so frequent that the World Health Organization classifies the phenomena as a 'neglected tropical disease'. This study focuses its analysis on the Mexican state of Veracruz— home to 21 venomous snakes and the country's second highest snakebite rate—seeking to establish whether estimates of suitable viper habitat can reliably predict risks.

Building on ecological niche models that exploit data from GBIF.org and other sources on nine viper species, the authors then apply the distance from the model's center as a measure of environmental suitability, potential abundance and, thereby, incidence risk. While the predictive results vary across the focal species, the approach suggests the value of wider, more general application, possibly corroborated with density estimates for snake populations.

CENTIPEDE (CHILOPODA) ON THE WALL OF A CHAPEL, NORTH-EAST OF POLYGYROS CC BY 2015 LUC T. HTTPS://FLIC.KR/P/UJULPY

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Al-Ajami AAA	Study on the seriousness of the mistletoe plant acacia trees and how to combat it. Al-mahaweet - Republic of Yemen	International Journal of Research In Agriculture and Food Sciences 2:4	www.ijsk.org/uploads/3/1/1/7/3117743/2_mistletoe_plant.pdf	Yemen
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Antunes Carvalho F, Filer D & Renner S	Taxonomy in the electronic age and an e-monograph of the papaya family (Caricaceae) as an example	Cladistics 31(3): 321-329	doi: 10.1111/cla.12095	Germany, United Kingdom
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biodiversity science

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Beck J, Böller M, Erhardt A et al.	Spatial bias in the GBIF database and its effect on modeling species' geographic distributions	Ecological Informatics 19: 10-15	doi: 10.1016/j.ecoinf.2013.11.002	Switzerland
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Creemers R, Denoël M, Campos J et al.	Updated distribution and biogeography of amphibians and reptiles of Europe	Amphibia-Reptilia 35(1): 1-31	doi:10.1163/15685381-00002935	Portugal, Italy, Netherlands, France, Serbia, Belgium, Russia, Greece, Spain, Germany
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Esperón-Rodríguez M & Barradas VL	Ecophysiological vulnerability to climate change: water stress responses in four tree species from the central mountain region of Veracruz, Mexico	Regional Environmental Change	doi: 10.1007/ s10113-014-0624-x	Mexico
Feng X & Papeş M	Ecological niche modelling confirms potential north-east range expansion of the nine-banded armadillo (*Dasypus novemcinctus*) in the USA	Journal of Biogeography	doi: 10.1111/jbi.12427	United States
Ficetola GF, Rondinin C, Katariya V et al.	Habitat availability for amphibians and extinction threat: a global analysis	*Diversity and Distributions* 21: 302-311	doi: 10.1111/ ddi.12296	Italy, France
FitzJohn RG, Pennell MW, Zanne AE et al.	How much of the world is woody?	Journal of Ecology 102(5): 1266-1272	doi: 10.1111/1365-2745.12260	Canada, Australia, United States, Netherlands
Forasiepi AM, Soibelzon LH, Gomez CS et al.	Carnivorans at the Great American Biotic Interchange: new discoveries from the northern neotropics	Die Naturwissenschaften	doi: 10.1007/ s00114-014-1237-4	Argentina, Panama, Canada, Switzerland
Fourcade Y, Engler JO, Rödder D et al.	Mapping Species Distributions with MAXENT Using a Geographically Biased Sample of Presence Data: A Performance Assessment of Methods for Correcting Sampling Bias	PLoS ONE 9(5): e97122	doi: 10.1371/journal. pone.0097122	France, Germany
Fritsch PW, Manchester SR, Stone RD et al.	Northern Hemisphere origins of the amphi-Pacific tropical plant family Symplocaceae	Journal of Biogeography	doi: 10.1111/ jbi.12442	United States, South Africa
García Parisi PA, Lattanzi FA, Grimoldi A A et al.	Multi-symbiotic systems: functional implications of the coexistence of grass-endophyte and legume-rhizobia symbioses	Oikos	doi: 10.1111/ oik.01540	Argentina, Germany
García-Verdugo C	Character shift and habitat colonization in widespread island taxa	Botanical Journal of the Linnean Society 174(3): 399-411	doi: 10.1111/ boj.12126	United States, Spain
Glukhov AZ & Strelnikov II	Lamina shape variability in species of the genus Ficus L. in different ecological conditions	Contemporary Problems of Ecology 7(2): 210-220	doi: 10.1134/ S1995425514020048	Ukraine
Goatley CHR & Bellwood DR	Moving towards the equator: reverse range shifts in two subtropical reef fish species, Chromis nitida (Pomacentridae) and Pseudolabrus guentheri (Labridae)	Marine Biodiversity Records 7: e12	doi: 10.1017/ S1755267214000098	Australia
Gomez JJ & Cassini MH	Environmental predictors of habitat suitability and biogeographical range of Franciscana dolphins (Pontoporia blainvillei)	Global Ecology and Conservation 3: 90-99	doi: 10.1016/j. gecco.2014.11.007	Argentina
González-Maya JF, Castañeda F, González R et al.	Distribution, Range Extension, And Conservation Of The Endemic Black-Headed Bushmaster (Lachesis Melanocephala) In Costa Rica And Panama	Herpetological Conservation and Biology 9(2): 369-377	http://www. herpconbio.org/ Volume_9/Issue_2/ Gonz%C3%A1lez-Maya_etal_2014.pdf	Mexico, Costa Rica
Gross A, Holdenrieder O, Pautasso M et al.	Hymenoscyphus pseudoalbidus, the causal agent of European ash dieback	Molecular Plant Pathology 15(1): 5-21	doi: 10.1111/ mpp.12073	Switzerland
Grossenbacher DL, Veloz SD, & Sexton JP	Niche and range size patterns suggest that speciation begins in small, ecologically diverged populations in North American monkeyflowers (Mimulus spp.)	Evolution 68(5): 1270-80	doi: 10.1111/ evo.12355	United States

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Guevara L, Sánchez-Cordero V, León-Paniagua L et al.	A new species of small-eared shrew (Mammalia, Eulipotyphla, Cryptotis) from the Lacandona rain forest, Mexico	Journal of Mammalogy 95(4): 739-753	doi: 10.1644/14-MAMM-A-018	Mexico, United States
Habel JC, Mulwa RK, Gassert F et al.	Population signatures of large-scale, long-term disjunction and small-scale, short-term habitat fragmentation in an Afromontane forest bird	Heredity 113(3): 205-14	doi: 10.1038/hdy.2014.15	Kenya, Germany, Poland, United States, Belgium
Hafner MS, Hafner DJ, Gonzáles EE et al.	Rediscovery of the pocket gopher *Orthogeomys lanius* (Rodentia: Geomyidae) in Veracruz, Mexico	Journal of Mammalogy 95(4): 792-802	doi: 10.1644/13-MAMM-A-319	United States, Mexico
Halama M, Poliwoda A, Jasicka-Misiak I et al.	*Pholiotina cyanopus*, a rare fungus producing psychoactive tryptamines	Open Life Sciences 10(1)	doi: 10.1515/biol-2015-0005	Poland
Halvorsen R, Mazzoni S, Bryn A et al.	Opportunities for improved distribution modelling practice via a strict maximum likelihood interpretation of MaxEnt	Ecography	doi: 10.1111/ecog.00565	Norway
Haszprunar G	A nomenclator of extant and fossil taxa of the Valvatidae (Gastropoda, Ectobranchia)	ZooKeys 377: 1-172	doi: 10.3897/zookeys.377.6032	Germany
Hendricks JR, Saupe EE, Myers CE et al.	The Generification of the Fossil Record	Paleobiology 40(4): 511-528	doi: 10.1666/13076	United States
Hernández-Mejía BC, Warren AD & Llorente-Bousquets J	Distribution of Genus Codatractus Lindsey, 1921 (Hesperiidae: Eudaminae)	Southwestern Entomologist 39(4): 813-852	doi: 10.3958/059.039.0415	Mexico, United States
Hidalgo-Galiana A, Sánchez-Fernández D, Bilton DT et al.	Thermal niche evolution and geographical range expansion in a species complex of western Mediterranean diving beetles	BMC Evolutionary Biology 14(1): 187	doi: 10.1186/s12862-014-0187-y	Spain
Hipsley CA & Müller J	Relict Endemism of Extant Rhineuridae (Amphisbaenia): Testing for Phylogenetic Niche Conservatism in the Fossil Record	Anatomical Record	doi: 10.1002/ar.22853	Germany
Hosner PA, Sánchez-González LA, Peterson AT et al.	Climate-driven diversification and Pleistocene refugia in Philippine birds: evidence from phylogeographic structure and paleoenvironmental niche modeling	Evolution 68(9): 2658-2674	doi: 10.1111/evo.12459	United States, Mexico
Hustad VP, Kučera V, Rybáriková N et al.	Geoglossum simile of North America and Europe: distribution of a widespread earth tongue species and designation of an epitype	Mycological Progress	doi: 10.1007/s11557-014-0969-z	United States, Slovakia, Czech Republic
Ibrahimi H, Gashi A, Bilalli A et al.	Three new country records from the genus Limnephilus Leach, 1815 (Trichoptera: Limnephilidae) from the Republic of Kosovo	Biodiversity Data Journal 2: e4140	doi: 10.3897/BDJ.2.e4140	Kosovo
Iosif, R Papeş M, Samoilă C et al.	Climate-induced shifts in the niche similarity of two related spadefoot toads (genus Pelobates)	Organisms Diversity & Evolution	doi: 10.1007/s13127-014-0181-7	Romania, United States
Jansen S, Choat B, Scholz A et al.	How drought and deciduousness shape xylem plasticity in three Costa Rican woody plant species	IAWA Journal 35(4): 337-355	doi: 10.1163/22941932-00000070	Germany, Australia
Jordan GJ, Carpenter RJ, & Brodribb TJ	Using fossil leaves as evidence for open vegetation	Palaeogeography, Palaeoclimatology, Palaeoecology 395: 168-175	doi: 10.1016/j.palaeo.2013.12.035	Australia
Jordan GJ, Carpenter RJ, Koutoulis A et al.	Environmental adaptation in stomatal size independent of the effects of genome size	The New Phytologist	doi: 10.1111/nph.13076	Australia

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Kent R, Bar-Massada A & Carmel Y	Bird and mammal species composition in distinct geographic regions and their relationships with environmental factors across multiple spatial scales	Ecology and Evolution 4(10): 1963-71	doi: 10.1002/ ece3.1072	United Kingdom, Israel
Kindt R, Lillesø J-PB, van Breugel P et al.	Correspondence in forest species composition between the Vegetation Map of Africa and higher resolution maps for seven African countries	Applied Vegetation Science 17(1): 162-171	doi: 10.1111/ avsc.12055	Kenya, Denmark, Ethiopia, Malawi, Uganda, Tanzania, Rwanda
Kobelkowsky-Vidrio T, Ríos-Muñoz C, & Navarro-Sigüenza AG	Biodiversity and biogeography of the avifauna of the Sierra Madre Occidental, Mexico	Biodiversity and Conservation	doi: 10.1007/s10531-014-0706-6	Mexico
Kolesik P & Butterill PT	New gall midges (Diptera: Cecidomyiidae) from Papua New Guinea	Austral Entomology	doi: 10.1111/ aen.12095	Australia, Czech Republic, Papua New Guinea
Kostikova A, Litsios G, Burgy S et al.	Scale-dependent adaptive evolution and morphological convergence to climatic niche in Californian eriogonoids (Polygonaceae)	Journal of Biogeography 41(7): 1326-1337	doi: 10.1111/ jbi.12294	Switzerland, Spain
Kostikova, A, Salamin, N, & Pearman, PB	The role of climatic tolerances and seed traits in reduced extinction rates of temperate polygonaceae	Evolution 68(7): 1856-70	doi: 10.1111/ evo.12400	Switzerland
Kougioumoutzis K & Tiniakou A	Ecological factors driving plant species diversity in the South Aegean Volcanic Arc and other central Aegean islands	Plant Ecology & Diversity: 1-14	doi: 10.1080/ 17550874. 2013.866989	Greece
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Kristinsson H, Heiðmarsson S & Hansen E.S	Lichens From Iceland In The Collection Of Svanhildur Svane	Botanica Lithuanica 20(1): 14-18	doi: 10.2478/ botlit-2014-0002	Iceland, Denmark
Laptikhovsky VV	Does starfish predation determine spawning seasonality in the whelk Buccinum undatum in the Gulf of St Lawrence?	Journal of Molluscan Studies 80(2): 219-221	doi: 10.1093/ mollus/eyu010	United Kingdom
Lawson AM & Weir JT	Latitudinal gradients in climatic-niche evolution accelerate trait evolution at high latitudes	Ecology Letters	doi: 10.1111/ ele.12346	Canada
Le Roux JJ, Strasberg D, Rouget M et al.	Relatedness defies biogeography: the tale of two island endemics (*Acacia heterophylla* and *A. koa*)	The New Phytologist 204(1): 230-42	doi: 10.1111/ nph.12900	South Africa, France, South Africa, United States
Lehmann GUC, Frommolt K-H, Lehmann AW et al.	Baseline data for automated acoustic monitoring of Orthoptera in a Mediterranean landscape, the Hymettos, Greece	Journal of Insect Conservation 18(5): 909-925	doi: 10.1007/s10841-014-9700-2	Germany
Letardi A	Note on some antlions from Mozambique (Neuroptera: Myrmeleontidae)	Biodiversity Data Journal 2: e1050	doi: 10.3897/ BDJ.2.e1050	Italy
Licona-Vera Y & Ornelas JF	Genetic, Ecological and Morphological Divergence between Populations of the Endangered Mexican Sheartail Hummingbird (Doricha eliza)	PLoS ONE 9(7): e101870	doi: 10.1371/journal. pone.0101870	Mexico
Linse K, Jackson JA, Malyutina MV et al.	Shallow-Water Northern Hemisphere Jaera (Crustacea, Isopoda, Janiridae) Found on Whale Bones in the Southern Ocean Deep Sea: Ecology and Description of *Jaera tyleri* sp. nov.	PLoS ONE 9(3): e93018	doi: 10.1371/journal. pone.0093018	United Kingdom, Russia, Germany
Lira-Noriega A & Manthey JD	Relationship of genetic diversity and niche centrality: a survey and analysis	Evolution 68(4): 1082-93	doi: 10.1111/ evo.12343	United States

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Lira-Noriega A & Soberón J	The relationship among biodiversity, governance, wealth, and scientific capacity at a country level: Disaggregation and prioritization	Ambio	doi: 10.1007/s13280-014-0581-0	United States
Lira-Noriega A, Toro-Nunez O, Oaks JR et al.	The roles of history and ecology in chloroplast phylogeographic patterns of the bird-dispersed plant parasite *Phoradendron californicum* (Viscaceae) in the Sonoran Desert	American Journal of Botany	doi: 10.3732/ajb.1400277	United States
Liston A, Cronn R & Ashman T-L	Fragaria: A genus with deep historical roots and ripe for evolutionary and ecological insights	American Journal of Botany 101: 1-14	doi: 10.3732/ajb.1400140	United States
Liu H & Osborne CP	Water relations traits of C4 grasses depend on phylogenetic lineage, photosynthetic pathway, and habitat water availability	Journal of Experimental Botany	doi: 10.1093/jxb/eru430	United Kingdom, China
López-Uribe MM, Zamudio KR, Cardoso CF et al.	Climate, physiological tolerance and sex-biased dispersal shape genetic structure of Neotropical orchid bees	Molecular Ecology 23(7): 1874-90	doi: 10.1111/mec.12689	United States, Brazil
Louy D, Habel JC, Abadjiev S et al.	Molecules and models indicate diverging evolutionary effects from parallel altitudinal range shifts in two mountain Ringlet butterflies	Biological Journal of the Linnean Society 112(3): 569-583	doi: 10.1111/bij.12240	Germany, Bulgaria, Romania, Hungary
Malpica A & Ornelas JF	Post-glacial northward expansion and genetic differentiation between migratory and sedentary populations of the broad-tailed hummingbird (*Selasphorus platycercus*)	Molecular Ecology 23(2): 435-452	doi: 10.1111/mec.12614	Mexico
McDonnel A	Non-twining milkweed vines of Oklahoma: an overview of *Matelea biflora* and *Matelea cynanchoides*	Oklahoma Native Plant Record 14	www.academia.edu/10264741/Non-twining_milkweed_vines_of_Oklahoma_an_overview_of_Matelea_biflora_and_Matelea_cynanchoides	United States
McMichael CNH, Palace MW & Golightly M	Bamboo-dominated forests and pre-Columbian earthwork formations in south-western Amazonia	Journal of Biogeography	doi: 10.1111/jbi.12325	United States
Meseguer AS, Lobo JM, Ree R et al.	Integrating Fossils, Phylogenies, and Niche Models into Biogeography to reveal ancient evolutionary history: the Case of Hypericum (Hypericaceae)	Systematic Biology	doi: 10.1093/sysbio/syu088	Spain, France, United States, United Kingdom
Messias PA, Vidal Jr JD, Koch I et al.	Host specificity and experimental assessment of the early establishment of the mistletoe *Phoradendron crassifolium* (Pohl ex DC.) Eichler (Santalaceae) in a fragment of Atlantic Forest in southeast Brazil	Acta Botanica Brasilica 28(4): 577-582	doi: 10.1590/0102-33062014abb3523	Brazil
Mifsud S	A Study of the Genus Persicaria Miller (Polygonaceae) in the Maltese Islands	The Central Mediterranean Naturalist 5(3-4): 25-26	http://www.maltawildplants.com/publ/#P24	Malta
Mimura M, Mishima M, Lascoux M et al.	Range shift and introgression of the rear and leading populations in two ecologically distinct Rubus species	BMC Evolutionary Biology 14(1): 209	doi: 10.1186/s12862-014-0209-9	Japan, Sweden, China
Mogni VY, Oakley LJ & Prado DE	The distribution of woody legumes in neotropical dry forests: The Pleistocene arc theory 20 years on	Edinburgh Journal of Botany: 1-26	doi: 10.1017/S0960428614000298	Argentina

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Moreira X, Mooney KA, Rasmann S et al.	Trade-offs between constitutive and induced defences drive geographical and climatic clines in pine chemical defences	Ecology Letters 17(5): 537-546	doi: 10.1111/ele.12253	United States, Spain
Muscarella R, Galante PJ, Soley-Guardia M et al.	ENMeval: An R package for conducting spatially independent evaluations and estimating optimal model complexity for Maxent ecological niche models	Methods in Ecology and Evolution	doi: 10.1111/2041-210X.12261	United States
Negret PJ & Laverde-R O	The enigmatic Black Tinamou: Do distribution, climate, and vocalizations reveal more than one species?	The Auk 132(1): 132-139	doi: 10.1642/AUK-14-183.1	Colombia
Novillo A & Ojeda RA	Elevation patterns in rodent diversity in the dry Andes: disentangling the role of environmental factors	Journal of Mammalogy 95(1): 99-107	doi: 10.1644/13-MAMM-A-086.1	Argentina
Orlova-Bienkowskaja MJ & Bieńkowski A	*Paridea angulicollis* (Motschulsky, 1854) (Coleoptera: Chrysomelidae: Galerucinae) is a new genus and species for Russia *Paridea angulicollis* (Motschulsky, 1854) (Coleoptera: Chrysomelidae: Galerucinae)	Caucasian Entomological Bulletin 10(1): 85-87	http://ssc-ras.ru/files/files/10_Orlova-Bienkowskaja,%20Bie_kowski.pdf	Russia
Ortego J, Bonal R, Muñoz A et al.	Living on the edge: the role of geography and environment in structuring genetic variation in the southernmost populations of a tropical oak	Plant Biology	doi: 10.1111/plb.12272	Spain
Ortego J, Guglielmone AA & Sork VL	Climatically stable landscapes predict patterns of genetic structure and admixture in the Californian canyon live oak	Journal of Biogeography	doi: 10.1111/jbi.12419	Spain, United States
Palazzesi L, Barreda VD, Cuitiño JI et al.	Fossil pollen records indicate that Patagonian desertification was not solely a consequence of Andean uplift	Nature Communications 5: 3558	doi: 10.1038/ncomms4558	Argentina, United Kingdom, Brazil
Pappalardo P, Pringle JM, Wares JP et al.	The location, strength, and mechanisms behind marine biogeographic boundaries of the east coast of North America	Ecography 38	doi: 10.1111/ecog.01135	United States
Pelayo-Villamil P, Guisande C, Vari RP et al.	Global diversity patterns of freshwater fishes - potential victims of their own success	Diversity and Distributions 21(3): 345-356	doi: 10.1111/ddi.12271	Colombia,Spain, United States, Italy, France
Pérez-Barros P, Lovrich GA, Calcagno JA et al.	Is *Munida gregaria* (Crustacea: Decapoda: Munididae) a truly transpacific species?	Polar Biology 37(10): 1413-1420	doi: 10.1007/s00300-014-1531-9	Argentina
Pérez F, Hinojosa LF, Ossa CG et al.	Decoupled evolution of foliar freezing resistance, temperature niche and morphological leaf traits in Chilean Myrceugenia	Journal of Ecology 102(4): 972-980	doi: 10.1111/1365-2745.12261	Chile
Perktaş U, Gür H, Sağlam İK et al.	Climate-driven range shifts and demographic events over the history of Kruper's Nuthatch Sitta krueperi	Bird Study 62(1): 14-28	doi: 10.1080/00063657.2014.977220	United States, Turkey, Mexico
Phartyal SS, Kondo T, Fuji A et al.	A comprehensive view of epicotyl dormancy in Viburnum furcatum: combining field studies with laboratory studies using temperature sequences	Seed Science Research 24(04): 281-292	doi: 10.1017/S0960258514000257	Japan, India, United States
Pironon S, Villellas J, Morris WF, Doak DF, & García MB	Do geographic, climatic or historical ranges differentiate the performance of central versus peripheral populations?	Global Ecology and Biogeography 24(6): 611-620	doi:10.1111/geb.12263	Spain, Sweden, United States

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Polgar G, Zane L., Babbucci M et al.	Phylogeography and demographic history of two widespread Indo-Pacific mudskippers (Gobiidae: Periophthalmus)	Molecular Phylogenetics and Evolution 73: 161-176	doi:10.1016/j.ympev.2014.01.014	Brunei Darussalam, Italy, Switzerland
Quintero I, González-Caro S, Zalamea P-C & Cadena CD	Asynchrony of Seasons: Genetic Differentiation Associated with Geographic Variation in Climatic Seasonality and Reproductive Phenology.	The American Naturalist 184(3): 352-363	doi:10.1086/677261	Colombia, Panama
Richter D, Matuła J & Pietryka M	The Northernmost Populations of Tetraspora Gelatinosa (Chlorophyta) from Spitsbergen	Polish Polar Research 35(3): 521-538	doi:10.2478/popore-2014-0027	Poland
Rodríguez-Gómez F & Ornelas JF	Genetic divergence of the Mesoamerican azure-crowned hummingbird (*Amazilia cyanocephala*, Trochilidae) across the Motagua-Polochic-Jocotán fault system	Journal of Zoological Systematics and Evolutionary Research 52(2): 142-153	doi:10.1111/jzs.12047	Mexico
Romiguier J Gayral P, Ballenghien M et al.	Comparative population genomics in animals uncovers the determinants of genetic diversity	Nature 515: 261–263	doi:10.1038/nature13685	France, Switzerland, United States, United Kingdom
Rubel F, Brugger K, Monazahian M et al.	The first German map of georeferenced ixodid tick locations	Parasites & Vectors 7(1): 477	doi:10.1186/s13071-014-0477-7	Austria, Germany
Ruiz-Sanchez E & Ornelas JF	Phylogeography of *Liquidambar styraciflua* (Altingiaceae) in Mesoamerica: survivors of a Neogene widespread temperate forest (or cloud forest) in North America?	Ecology and Evolution 4(4): 311-28	doi:10.1002/ece3.938	Mexico
Sackett LC, Seglund A, Guralnick RP et al.	Evidence for two subspecies of Gunnison's prairie dogs (*Cynomys gunnisoni*), and the general importance of the subspecies concept	Biological Conservation 174: 1-11	doi:10.1016/j.biocon.2014.03.010	United States
Salas JA, Burneo SF, Viteri HF & Carvajal MR	First record of the pale-faced bat *Phylloderma stenops* Peters 1865 (Chiroptera: Phyllostomidae) in the province of Guayas, Southwest Ecuador	Check List 10(5): 1218-1222	doi: 10.15560/10.5.1218	Ecuador
Sandel M, Rhode FC & Harris PM	Interspecific relationships and the evolution of sexual dimorphism in pygmy sunfishes (Centrarchidae: Elassoma)	Molecular Phylogenetics and Evolution 77: 166-176	doi:10.1016/j.ympev.2014.04.018	United States
Scarponi D, Huntley JW, Capraro L & Raffi S	Stratigraphic paleoecology of the Valle di Manche section (Crotone Basin, Italy): A candidate GSSP of the Middle Pleistocene	Palaeogeography, Palaeoclimatology, Palaeoecology 402: 30-43	doi:10.1016/j.palaeo.2014.02.032	Italy, United States
Schwery O, Onstein RE, Bouchenak-Khelladi Y et al.	As old as the mountains: the radiations of the Ericaceae	The New Phytologist	doi:10.1111/nph.13234	Switzerland, New Zealand
Schwinn M, Türkay M & Sonnewald M	Decapod fauna of the Helgoland trench (Crustacea) a long-term study in a biodiversity hotspot	Marine Biodiversity 44(4): 491-517	doi:10.1007/s12526-014-0217-4	Germany
Sepúlveda D, Villalobos E & Espinosa H	New record of *Malthopsis gnoma* (Lophiiformes: Ogcocephalidae) in the southern Gulf of Mexico	Marine Biodiversity Records, 7, e19	doi:10.1017/S1755267214000104	Mexico
Sigel EM, Windham MD & Pryer KM	Evidence for reciprocal origins in *Polypodium hesperium* (Polypodiaceae): A fern model system for investigating how multiple origins shape allopolyploid genomes	American Journal of Botany 101(9): 1476-1485	doi:10.3732/ajb.1400190	United States
Silva DP, Vilela B, De Marco P & Nemésio A	Using Ecological Niche Models and Niche Analyses to Understand Speciation Patterns: The Case of Sister Neotropical Orchid Bees	PLoS ONE 9(11): e113246.	doi:10.1371/journal.pone.0113246	Brazil

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Simaiakis SM & Strona G	Patterns and processes in the distribution of European centipedes (Chilopoda)	Journal of Biogeography 42(6): 1018-1028	doi:10.1111/jbi.12463	Greece
Šmarda P, Bureš P, Horová L et al.	Ecological and evolutionary significance of genomic GC content diversity in monocots	Proceedings of the National Academy of Sciences of the United States of America 111(39): eE4096–102	doi:10.1073/pnas.1321152111	Czech Republic, United Kingdom, Australia, South Africa, Italy
Solhjouy-Fard S & Sarafrazi A	Potential impacts of climate change on distribution range of *Nabis pseudoferus* and *N. palifer* (Hemiptera: Nabidae) in Iran	Entomological Science 17(3): 283-292	doi:10.1111/ens.12064	Iran
Sosnovsky Y	Microscopical investigation of the leaf architecture in greenhouse-cultivated Ficus (Moraceae)	Plant Systematics and Evolution	doi:10.1007/s00606-014-1184-8	Ukraine
Srivastava G & Mehrotra RC	Phytogeographical implication of Bridelia Will. (Phyllanthaceae) fossil leaf from the late Oligocene of India	PLoS ONE 9(10): e111140	doi:10.1371/journal.pone.0111140	India
Steidinger BS, Turner BL, Corrales A & Dalling JW	Variability in potential to exploit different soil organic phosphorus compounds among tropical montane tree species	Functional Ecology 29(1): 121-130	doi:10.1111/1365-2435.12325	United States, Panama
Strona G, Fattorini S, Montano S et al.	ECo: A new measure evaluating the degree of consistency between environmental factors and spatial arrangement of species assemblages	Ecological Indicators 52: 66-74	doi:10.1016/j.ecolind.2014.11.033	Italy, Portugal
Sutkowska A, Pasierbiński A, Warzecha T, Mandal A & Mitka J	Refugial Pattern of Bromus Erectus in Central Europe Based on ISSR Fingerprinting	Acta Biologica Cracoviensia Series Botanica: 107-119	doi:10.2478/abcsb-2013-0026	Poland
Tarroso P, Pereira RJ, Martínez-Freiría F et al.	Hybridization at an ecotone: ecological and genetic barriers between three Iberian vipers	Molecular Ecology 23(5): 1108-23	doi:10.1111/mec.12671	Portugal
Teixeira M, Vechio FD, Neto AM & Rodrigues MT	A New Two-Pored Amphisbaena Linnaeus, 1758, from Western Amazonia, Brazil (Amphisbaenia: Reptilia)	South American Journal of Herpetology 9(1): 62-74	doi:10.2994/SAJH-D-14-00004.1	Brazil
Thode VA, Silva-Arias GA, Turchetto C et al.	Genetic diversity and ecological niche modelling of the restricted *Recordia reitzii* (Verbenaceae) from southern Brazilian Atlantic forest	Botanical Journal of the Linnean Society 176(3): 332-348	doi:10.1111/boj.12202	Brazil
Todou G, Onana JM, Akoa A et al.	The Ecological Niche Of *Dacryodes buettneri* (Burseraceae), A Timber Tree In Central Africa	Journal of Tropical Forest Science 26(3): 420-427	http://www.frim.gov.my/v1/JTFSOnline/jtfs/v26n3/420-427.pdf	Cameroon, France
Trainor AM & Schmitz OJ	Infusing considerations of trophic dependencies into species distribution modelling	Ecology Letters 17(12): 1507-1517	doi:10.1111/ele.12372	United States
Van Zonneveld MJ, Castañeda N, Scheldeman X et al.	Application of consensus theory to formalize expert evaluations of plant species distribution models	Applied Vegetation Science 17(3): 528-542	doi:10.1111/avsc.12081	Belgium, Costa Rica, Colombia, Kenya, Czech Republic
Velez-Liendo X, Strubbe D & Matthysen E	Effects of variable selection on modelling habitat and potential distribution of the Andean bear in Bolivia	Ursus 24(2): 127-138	doi:10.2192/URSUS-D-12-00027R4.1	Bolivia, Belgium
Velle LG, Nilsen LS, Norderhaug A & Vandvik V	Does prescribed burning result in biotic homogenization of coastal heathlands?	Global Change Biology 20(5): 1429-40	doi:10.1111/gcb.12448	Norway
Vieira RP & Cunha MR	In situ observation of chimaerid species in the Gorringe Bank: new distribution records for the north-east Atlantic Ocean	Journal of Fish Biology 85(3): 927-32	doi:10.1111/jfb.12444	Portugal, United Kingdom

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Visser V & Molofsky J	Ecological niche differentiation of polyploidization is not supported by environmental differences among species in a cosmopolitan grass genus	American Journal of Botany 102(1): 36-49	doi:10.3732/ajb.1400432	South Africa, United States
Voshell SM & Hilu KW	Canary grasses (Phalaris, Poaceae): biogeography, molecular dating and the role of floret structure in dispersal	Molecular Ecology 23(1): 212-24	doi:10.1111/mec.12575	United States
Vukov TD, Cvijanovi M, Wielstra B & Kalezi ML	The Roles of Phylogeny and Climate in Shaping Variation in Life-History Traits of the Newt Genus Triturus (Caudata, The roles of phylogeny and climate in shaping variation in life-history traits of the newt genus Triturus (Caudata, Salamandridae)	Annales Zoologici Fennici 51(5): 445-456	doi: 10.5735/086.051.0505	Serbia, Netherlands
Wasowicz P, Pasierbiński A, Przedpelska-Wasowicz EM & Kristinsson H	Distribution patterns in the native vascular flora of Iceland	PLoS ONE 9(7): e102916	doi:10.1371/journal.pone.0102916	Poland
Watson S.-A, Morley SA, Bates AE et al.	Low global sensitivity of metabolic rate to temperature in calcified marine invertebrates	Oecologia 174(1): 45-54	doi:10.1007/s00442-013-2767-8	United Kingdom, Australia, Singapore
Wetterer JK	Geographic distribution of Gnamptogenys hartmani (Hymenoptera, Formicidae), an agro-predator that attacks fungus-growing ants	Terrestrial Arthropod Reviews 7(2-4): 147-157	doi: 10.1163/18749836-07021078	United States
Wetterer JK	Geographic distribution of *Strumigenys louisianae* (Hymenoptera: Formicidae)	Terrestrial Arthropod Reviews 7(2-4): 159-170	doi: 10.1163/18749836-07021080	United States
Wielstra B, Sillero N, Vörös J & Arntzen JW	The distribution of the crested and marbled newt species (Amphibia: Salamandridae: Triturus) – an addition to the New Atlas of Amphibians and Reptiles of Europe	Amphibia-Reptilia 35(3): 376-381	doi: 10.1163/15685381-00002960	United Kingdom, Netherlands, Portugal, Hungary
Wilk M, Pawłowska J & Wrzosek M	Wentiomyces sp. from plant litter on poor fen in northeastern Poland	Acta Mycologica 49(2): 237-247	doi: 10.5586/am.2014.021	Poland
Willis CG, Davis CC, Xi Z & Franzone B.	Community assembly meets biogeography: Malpighiaceae and the origin of seasonally dry tropical forest of Mexico	Frontier in Genetics 5	doi:10.3389/fgene.2014.00433	United States
Willis CG, Hall J-C, Rubio de Casas R et al.	Diversification and the evolution of dispersal ability in the tribe Brassiceae (Brassicaceae)	Annals of Botany 114(8): 1675-1686	doi:10.1093/aob/mcu196	United States, Canada, Spain
Wilson GW, Rentz DC & Venter F	First record of the larvae of "Hippotion rosetta" (Swinhoe, 1892) (Lepidoptera: Sphingidae) feeding on the foliage of nepenthes (Nepenthaceae) in Cape York Peninsula, Queensland	Australian Entomologist 41(4): 203	http://search.informit.com.au/documentSummary;dn=880958064256642;res=IELHSS	Australia
Wright, A. N., Hijmans, R. J., Schwartz, M. W., & Shaffer, H. B. (2014).	Multiple sources of uncertainty affect metrics for ranking conservation risk under climate change	Diversity and Distributions 21(1): 111–122	doi:10.1111/ddi.12257	United States
Yañez-Arenas C, Peterson AT, Mokondoko P et al.	The Use of Ecological Niche Modeling to Infer Potential Risk Areas of Snakebite in the Mexican State of Veracruz	PLoS ONE 9(6): e100957	doi:10.1371/journal.pone.0100957	Mexico, United States

Data management

examples

TOOLS TO STREAMLINE DATA QUALITY & CURATION

Candela L, Castelli D, Coro G et al. (2014) An infrastructure-oriented approach for supporting biodiversity research. *Ecological Informatics* 26(2):162-172. doi:10.1016/j.ecoinf.2014.07.006
Author country: Italy
Research funding: European Union 7th Framework Programme for Research and Technological Development

The authors introduce a set of tools developed by the D4Science Data Infrastructure that support acquisition and preparation of species occurrence data from GBIF, OBIS and other sources. This suite seeks to reduce the time that researchers spend in assessing the quality of data as well as curating them.

CLEAN GLOBAL DATA MAY MATTER MORE THAN COMPLEX MODELS

García-Roselló E, Guisande C, Manjarrés-Hernández A et al. (2014) Can we derive macroecological patterns from primary Global Biodiversity Information Facility data? *Global Ecology and Biogeography* 24(3): 335-347. doi:10.1111/geb.12260
Author countries: Spain, Colombia, United States
Research funding: ENDESA

To understand the impact of data sampling biases and quality concerns in global-scale models, this team used all available GBIF-mediated data for fish species from marine-only orders to compare four common procedures. Their findings suggest that, as long as researchers clean the original data, correct for autocorrelation and account for obvious underestimations in species richness, the work of improving both data quantity and quality may matter more in accurately predicting distributions than the development of sophisticated mathematical models.

TEXT-MINING FOR PLACE NAMES

Singh G & de By RA (2015) Spatial Extent Models for Natural Language Phrases Involving Directional Containment. *Transactions in GIS* 19: 202–224. doi:10.1111/tgis.12105
Author country: Netherlands

The presence of millions of non-geocoded records mediated by GBIF sparked this exploration of assigning spatial extents to gazeteer-style names like 'central northern California'. Using the two-volume *Ornithological Gazetteer of Brazil* (Paynter and Traylor 1991), the authors compared and tested spatial interpretations of multiple natural language phrases in hope of deriving consistent, recommended approaches.

IMPROVING GEOREFERENCING OF SPECIMEN DATA WITH PREVIOUSLY DIGITIZED COLLECTIONS

Van Erp M, Hensel R, Ceolin D & van der Meij M (2014) Georeferencing Animal Specimen Datasets. *Transactions in GIS* 19(4): 563-581. doi:10.1111/tgis.12110
Author country: Netherlands
Research funding: European Union 7th Framework Programme for Research and Technological Development

The lack of geographic precision represents a major challenge in efforts to unlock historic natural history collections. Here the authors detail how the Netherlands' Naturalis adopted a consistent approach for resolving the challenges commonly presented by the structured but poorly articulated legacy data contained on collectors' specimen cards for fields like 'Town/City', 'Province/State' and 'Coordinates'. Central to the approach is the use of existing GBIF-mediated occurrences as a domain-specific knowledge base that improves the quality and accuracy of proposed georeferences while significantly decreasing the number of unlocatable records.

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Candela L, Castelli D, Coro G et al.	An infrastructure-oriented approach for supporting biodiversity research	Ecological Informatics 26(2): 162-172	doi:10.1016/j.ecoinf.2014.07.006	Italy
García-Roselló E, Guisande C, Manjarrés-Hernández A et al.	Can we derive macroecological patterns from primary Global Biodiversity Information Facility data?	Global Ecology and Biogeography 24(3): 335-347	doi:10.1111/geb.12260	Spain, Colombia, United States
Guralnick R, Conlin T, Deck J et al.	The Trouble with Triplets in Biodiversity Informatics: A Data-Driven Case against Current Identifier Practices	PLoS ONE 9(12): e114069	doi:10.1371/journal.pone.0114069	United States
Lin Y-P, Deng D, Lin W-C et al.	Uncertainty analysis of crowd-sourced and professionally collected field data used in species distribution models of Taiwanese moths	Biological Conservation 181: 102-110	doi:10.1016/j.biocon.2014.11.012	Taiwan, Netherlands, Australia, Germany, France
Lucarini D, Gigante D, Landucci F et al.	The anArchive taxonomic Checklist for Italian botanical data banking and vegetation analysis: Theoretical basis and advantages	Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology 1-8	doi:10.1080/11263504.2014.984010	Italy, Czech Republic
Mathew C, Güntsch A, Obst M et al.	A semi-automated workflow for biodiversity data retrieval, cleaning, and quality control	Biodiversity Data Journal 2(2): e4221	doi:10.3897/BDJ.2.e4221	Germany, Sweden, Italy, United Kingdom, Finland, Netherlands
Miller JT & Jolley-Rogers G	Correcting the disconnect between phylogenetics and biodiversity informatics	Zootaxa 3754(2): 195	doi:10.11646/zootaxa.3754.2.8	Australia
Ningthoujam SS, Choudhury MD, Potsangbam KS et al.	NoSQL Data Model for Semi-automatic Integration of Ethnomedicinal Plant Data from Multiple Sources	Phytochemical Analysis 25(6): 495-507	doi:10.1002/pca.2520	India, United Kingdom, Malaysia
Rao T & Rajinikanth TV	A Hybrid Random Forest based Support Vector Machine Classification supplemented by boosting	Global Journal of Computer Science and Technology: C Software and Data Engineering, 14(1): 43-53	https://globaljournals.org/GJCST_Volume14/2-A-hybrid-Random-Forest-based-Support-Vector.pdf	India
Rao T & Rajinikanth TV	Supervised Classification of Remote Sensed data Using Support Vector Machine	Global Journal of Computer Science and Technology: C Software and Data Engineering, 14(1).	https://globaljournals.org/GJCST_Volume14/5-Supervised-Classification-of-Remote-Sensed-data.pdf	India
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Thomas KA, Fornwall MD, Weltzin JF & Griffis RB	Organization of marine phenology data in support of planning and conservation in ocean and coastal ecosystems	Ecological Informatics 24: 169-176	doi:10.1016/j.ecoinf.2014.08.007	United States
Van Erp M, Hensel R, Ceolin D & van der Meij M	Georeferencing Animal Specimen Datasets.	Transactions in GIS 19(4): 563-581	doi:10.1111/tgis.12110	Netherlands
Walls RL, Guralnick R, Deck J et al.	Meeting report: advancing practical applications of biodiversity ontologies	Standards in Genomic Sciences 9(1): 17	doi:10.1186/1944-3277-9-17	United States, Germany, French Polynesia, United Kingdom

Data papers

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Cally S, Solbès P, Grosso B & Murienne J	An occurence records database of French Guiana harvestmen (Arachnida, Opiliones)	Biodiversity DataJournal 2(2): e4244	doi: 10.3897/ BDJ.2.e4244	France
Camacho A, Dorda B & Rey I	Iberian Peninsula and Balearic Island Bathynellacea (Crustacea, Syncarida) database	ZooKeys 386: 1-20	doi: 10.3897/ zookeys.386.6296	Spain
Decker P, Reip HS & Voigtländer K	Millipedes and centipedes in German greenhouses (Myriapoda: Diplopoda, Chilopoda)	Biodiversity Data Journal 2:e1066	doi:10.3897/ BDJ.2.e1066	Germany
Díaz A, Bover P & Alcover J	Fossil Vertebrate Database from Cova des Pas de Vallgornera (Llucmajor, Mallorca)	International Journal of Speleology: 43(2)	doi: 10.5038/1827-806X.43.2.10	Spain
Galicia D, Pulido-Flores G, Miranda R et al.	Hidalgo Fishes: Dataset on freshwater fishes of Hidalgo state (Mexico) in the MZNA fish collection of the University of Navarra (Spain)	ZooKeys 403: 67-109	doi: 10.3897/ zookeys.403.7149	Spain, Mexico
Griswold T, Gonzalez V & Ikerd H	AnthWest, occurrence records for wool carder bees of the genus Anthidium (Hymenoptera, Megachilidae, Anthidiini) in the Western Hemisphere	ZooKeys 408: 31-49	doi: 10.3897/ zookeys.408.5633	United States
Groom QJ	The distribution of the vascular plants on the North Frisian Island, Amrum	Biodiversity Data Journal (2) e1108	doi: 10.3897/ BDJ.2.e1108	Belgium
Monteiro M, Reino L, Beja P et al.	The collection and database of Birds of Angola hosted at IICT (Instituto de Investigação Científica Tropical), Lisboa, Portugal	ZooKeys 387: 89-99	doi: 10.3897/ zookeys.387.6412	Portugal, South Africa, Nigeria
Morales Rozo A, Valencia F, Acosta A & Parra J	Birds of Antioquia: Georeferenced database of specimens from the Colección de Ciencias Naturales del Museo Universitario de la Universidad de Antioquia (MUA)	ZooKeys 410: 95-103	doi: 10.3897/ zookeys.410.7109	Colombia
Pérez-Luque AJ, Bonet FJ, Pérez-Pérez R et al.	Sinfonevada: Dataset of Floristic diversity in Sierra Nevada forests (SE Spain)	PhytoKeys 35: 1-15	doi: 10.3897/ phytokeys.35.6363	Spain
Piazza P, Błażewicz-Paszkowycz M, Ghiglione C et al.	Distributional records of Ross Sea (Antarctica) Tanaidacea from museum samples stored in the collections of the Italian National Antarctic Museum (MNA) and the New Zealand National Institute of Water and Atmospheric Research (NIWA)	ZooKeys 451: 49-60	doi:10.3897 zookeys.451.8373	Italy, Poland, New Zealand
Rios P & Cristobo J	Antarctic Porifera database from the Spanish benthic expeditions	ZooKeys 401: 1–10	doi: 10.3897/ zookeys.401.5522	Spain
Schweiger O, Harpke A, Wiemers M & Settele J	CLIMBER: Climatic niche characteristics of the butterflies in Europe	ZooKeys 367: 65-84	doi: 10.3897/ zookeys.367.6185	Germany

GBIF as a research infrastructure

We conclude this year's *Science Review* with peer-reviewed papers that, rather than applying data accessed and delivered through GBIF, describe or compare elements of the network as a data and research infrastructure. Where previous years' accounts of these 'GBIF discussed' papers tended to focus on forward-looking plans for the emerging biodiversity facility, scientists and researchers both within and beyond biological domains now frequently mark the example that GBIF offers—be it in the development of standards, tools, data models or workflows—while seeking to address challenges and seek relevant precedents in the era of big data.

examples

TOWARD AN OPEN-ACCESS MODEL FOR ECOLOGICAL MODELS

Bonet FJ, Pérez-Pérez R, Benito BM et al. (2014) Documenting, storing, and executing models in Ecology: A conceptual framework and real implementation in a global change monitoring program. *Environmental Modelling & Software* 52: 192-199. doi:10.1016/j.envsoft.2013.10.027
Author country: Spain
Research funding: Andalusian Regional Government

Modelling and data processing are now an inherent part of ecological research, but guidance on best practices and analytical procedures around the documentation, storage or operation of such work is largely absent. The Spanish authors here describe ModeleR, a workflow-based tool used in an environmental monitoring programme in the Sierra Nevada region. By adopting an open access approach to data publication modelled on GBIF, they propose to extend the tool's collaborative utility through linked and federated repositories that can be shared and even executed by other researchers.

CULTIVATING LONG-TERM RESEARCH VALUE THROUGH OPEN ACCESS DATA

Costello MJ, Appeltans W, Bailly N et al. (2013) Strategies for the sustainability of online open-access biodiversity databases. *Biological Conservation* 173:155-165. doi:10.1016/j.biocon.2013.07.042
Author countries: New Zealand, Belgium, Germany, Netherlands, Philippines, United States, United Kingdom
Research funding: European Commission 7th Framework Programme

Calling attention to the fact that biodiversity data gathered on the strength of research funding 'often stagnate when project funding expired', the authors explore the critical roles that collaborative data infrastructures can play in preserving the value of research. With the unique scientific insights possible from massive global databases only now beginning to emerge, they suggest that scientific and academic communities and their supporers should fully acknowledge the academic and scientific value of contributing to open-access efforts.

DESCRIBING THE NATIONAL BENEFITS OF FEDERATED RUSSIAN BIODIVERSITY DATA

Ivanova NV & Shashkov MP (2014) Approaches to Development of Common Information Resource on Species Biodiversity. *Mathematical Biology and Bioinformatics* 9(2). http://www.matbio.org/article.php?journ_id=18&id=199&lang=eng
Author country: Russia

In introducing the GBIF network to Russian speakers, the authors call attention to how its community standards could support the development of a Russian Biodiversity Database that would aggregate and unify biodiversity data at a national level.

COMPARING VIRTUAL HERBARIA

Jones T, Baxter D, Hagedorn G et al. (2014) Trends in access of plant biodiversity data revealed by Google Analytics. *Biodiversity Data Journal* 2: e1558. doi:10.3897/BDJ.2.e1558
Author countries: United States, Germany, Australia

Using Google Analytics, the authors analyzed the digital presence of plant biodiversity data provided by 15 different online resources, including GBIF.org. The knowledge drawn from this analysis provides comparative statistics along with metrics about usability, design, and potential future development within biodiversity informatics.

A SCIENTIFIC ASSESSMENT OF GLOBAL KNOWLEDGE ON SPECIES AND BIODIVERSITY

Pimm SL, Jenkins CN, Abell R et al. (2014) The biodiversity of species and their rates of extinction, distribution, and protection. *Science* 344(6187): 1246752-1246752. doi:10.1126/science.1246752

Author countries: United States, Switzerland, Brazil, United Kingdom

Research funding: CAPES—Ciência Sem Fronteiras

This research team reviews knowledge of species (and recognized gaps in it), with a focus on extinction rates, distributions and protection in order to contribute to an upcoming assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). While citing significant progress in expanding biodiversity knowledge through new global data sources like the GBIF network, they highlight these databases' role in analysing and updating estimates on rates of species extinction, hypothesizing them to be 1,000 times higher than natural background rates—yet still likely to be underestimated for the future.

PUBLISHING AND SHARING BIODIVERSITY DATASETS VIA THE IPT

Robertson T, Döring M, Guralnick RP et al. (2014) The GBIF Integrated Publishing Toolkit: Facilitating the Efficient Publishing of Biodiversity Data on the Internet. *PLoS ONE* 9(8): e102623. doi:10.1371/journal.pone.0102623

Author countries: Denmark, United States, Belgium

Working with partners from VertNET in the United States and INBO in Belgium, developers at the GBIF Secretariat described the features and functions of the Integrated Publishing Toolkit software. The discussion outlines the impetus and creation of the IPT, its continuing evolution, and its impact on the biodiversity research community and data publishing.

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Baker E, Rycroft S, & Smith V	Linking multiple biodiversity informatics platforms with Darwin Core Archives	Biodiversity Data Journal 2:e1039	doi:10.3897/BDJ.2.e1039	United Kingdom
Banbury BL & O'Meara BC	Reol: R interface to the Encyclopedia of Life	Ecology and Evolution 4(12): 2577-2583	doi:10.1002/ece3.1109	United States
Bino G, Ramp D & Kingsford RT	Identifying minimal sets of survey techniques for multi-species monitoring across landscapes: an approach utilising species distribution models	International Journal of Geographical Information Science 28(8): 1674-1708	doi:10.1080/13658816.2013.871016	Australia
Bonet FJ, Pérez-Pérez R, Benito BM et al.	Documenting, storing, and executing models in Ecology: A conceptual framework and real implementation in a global change monitoring program	Environmental Modelling & Software 52: 192-199	doi:10.1016/j.envsoft.2013.10.027	Spain
Booth TH, Nix HA, Busby JR et al.	Bioclim: the first species distribution modelling package, its early applications and relevance to most current MaxEnt studies	Diversity and Distributions 20(1):1-9	doi:10.1111/ddi.12144	Australia
Cook JA, Edwards SV, Lacey EA et al.	Natural History Collections as Emerging Resources for Innovative Education	BioScience 64(8):725-734	doi:10.1093/biosci/biu096	United States
Costello MJ, Appeltans W, Bailly N et al.	Strategies for the sustainability of online open-access biodiversity databases	Biological Conservation 173:155-165	doi:10.1016/j.biocon.2013.07.042	New Zealand, Germany, Belgium, Netherlands, United Kingdom, Philippines, United States
Costello MJ & Wieczorek JR	Best practice for biodiversity data management and publication	Biological Conservation 173:68-73	doi:10.1016/j.biocon.2013.10.018	New Zealand, United States

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Duputié A, Zimmermann NE, & Chuine I	Where are the wild things? Why we need better data on species distribution	Global Ecology and Biogeography 23(4):457-467	doi:10.1111/geb.12118	France, Switzerland
Emilio G-R, Guisande C, Juergen H et al.	Using ModestR to download, import and clean species distribution records	Methods in Ecology and Evolution	doi:10.1111/2041-210X.12209	Spain, Colombia
Favret C	Cybertaxonomy to accomplish big things in aphid systematics	Insect Science 21(3):392-399	doi:10.1111/1744-7917.12088	Canada
Fuentes D & Fiore N	The LifeWatch approach to the exploration of distributed species information	ZooKeys 463:133-48	doi:10.3897/zookeys.463.8397	Italy
Graham M & Kennedy J	Vesper: Visualising species archives	Ecological Informatics 24:132-147	doi:10.1016/j.ecoinf.2014.08.004	United Kingdom
Herrando-Perez S, Brook BW & Bradshaw CJA	Ecology Needs a Convention of Nomenclature	BioScience 64(4):311-321	doi:10.1093/biosci/biu013	Spain, Australia
Hoffmann A, Penner J, Vohland K et al.	The need for an integrated biodiversity policy support process – Building the European contribution to a global Biodiversity Observation Network (EU BON)	Nature Conservation 6:49-65	doi:10.3897/natureconservation.6.6498	Germany, France, United Kingdom, Estonia, Spain, Bulgaria, Finland, Denmark
Hudson LN, Newbold T, Contu S et al.	The PREDICTS database: a global database of how local terrestrial biodiversity responds to human impacts	Ecology and Evolution 4(24): 4(24): 4701-4735	doi:10.1002/ece3.1303	United Kingdom, Tanzania, Denmark, Belgium, Germany, Ghana, Costa Rica, Argentina, Malaysia, Mexico, Colombia, Uruguay, Hungary, Brazil, Canada, Portugal, Sweden, Guyana, Ireland, Spain, Italy, Czech Republic, Japan, Australia, India, Greece, Papua New Guinea, United States, Jordan, Philippines, Kenya, China, Finland, Nigeria, Singapore, Netherlands, Russia
Isaac, N. J. B., van Strien, A. J., August, TA et al.	Statistics for citizen science: extracting signals of change from noisy ecological data	Methods in Ecology and Evolution 5(10): 1052-1060	doi:10.1111/2041-210X.12254	United Kingdom
Ivanova NV & Shashkov MP	Approaches to Development of Common Information Resource on Species Biodiversity	Mathematical Biology and Bioinformatics 9(2)	http://www.matbio.org/article.php?journ_id=18&id=199&lang=eng	Russia
Jones T, Baxter D, Hagedorn G et al.	Trends in access of plant biodiversity data revealed by Google Analytics	Biodiversity Data Journal 2:e1558	doi:10.3897/BDJ.2.e1558	United States, Germany, Australia
Kalwij JM, Robertson MP, Ronk A et al.	Spatially-Explicit Estimation of Geographical Representation in Large-Scale Species Distribution Datasets	PLoS ONE 9(1):e85306	doi:10.1371/journal.pone.0085306	South Africa
Laurenne N, Tuominen J, Saarenmaa H et al.	Making species checklists understandable to machines - a shift from relational databases to ontologies	Journal of Biomedical Semantics 5(1):40	http://www.jbiomedsem.com/content/5/1/40	Finland
Mathew C, Güntsch A, Obst M et al.	A semi-automated workflow for biodiversity data retrieval, cleaning, and quality control	Biodiversity Data Journal 2: e4221	doi: 10.3897/BDJ.2.e4221	Germany, Sweden, Italy, United Kingdom, Finland, Netherlands
Matutinovic SF	Open Access in Botany	Botanica Serbica 38(1): 191-195	http://botanicaserbica.bio.bg.ac.rs/arhiva/pdf/2014_38_1_610_full.pdf	Serbia

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Miyazaki Y, Murase A, Shiina M et al.	Biological monitoring by citizens using Web-based photographic databases of fishes	Biodiversity and Conservation 23(9):2383-2391	doi:10.1007/s10531-014-0724-4	Japan
Monteiro M, Reino L, Beja P et al.	The collection and database of Birds of Angola hosted at IICT (Instituto de Investigação Científica Tropical), Lisboa, Portugal	ZooKeys 387:89-99	doi:10.3897/zookeys.387.6412	Portugal, South Africa, Nigeria
Parr CS, Wilson N, Leary P et al.	The Encyclopedia of Life v2: Providing Global Access to Knowledge About Life on Earth	Biodiversity Data Journal 2:e1079	doi:10.3897/BDJ.2.e1079	United States
Pimm SL, Jenkins CN, Abell R et al.	The biodiversity of species and their rates of extinction, distribution, and protection	Science 344(6187):1246752–1246752	doi:10.1126/science.1246752	United States, Brazil, Switzerland, United Kingdom
Pylro VS, Roesch LFW, Ortega JM et al.	Brazilian Microbiome Project: revealing the unexplored microbial diversity--challenges and prospects	Microbial Ecology 67(2):237-41	doi:10.1007/s00248-013-0302-4	Brazil, United Kingdom
Robertson T, Döring M, Guralnick RP et al.	The GBIF Integrated Publishing Toolkit: Facilitating the Efficient Publishing of Biodiversity Data on the Internet	PLoS ONE 9(8):e102623	doi:10.1371/journal.pone.0102623	Denmark, United States, Belgium
Skevakis G, Makris K, Kalokyri V et al.	Metadata management, interoperability and Linked Data publishing support for Natural History Museums	International Journal on Digital Libraries 14(3-4):127-140	doi:10.1007/s00799-014-0114-2	Greece
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