EDITORIAL

Frontiers of Biogeography
the scientific journal of
the International Biogeography Society

Community science biogeography

Keywords: biodiversity shortfalls, biogeography, citizen science, community science, e-science, iEcology

The field of Biogeography, "the study, at all scales of analysis, of the distribution of life across space and how it has changed through time" (Whittaker and Ladle 2011, p4) is a data hungry science (Amano et al. 2016, La Sorte and Somveille 2021). Knowledge of species distributions, founded on the Linnean system of classification and the allied approach of voucher specimens collected and maintained in natural history museums and herbaria, has been built up over hundreds of years, involving many thousands of collectors, many of whom have not been salaried professional scientists. The idea of involving non-professionals in gathering data on species distributions and abundance is thus arguably not of itself an innovation in biogeography. However, historically, those involved in collecting were mostly highly skilled individuals who had acquired specialist knowledge in methods of collection, identification, specimen curation, labelling, etc. Contemporary citizen science programmes, by contrast, are frequently less demanding in specialist skills and thus can involve a broader public than in the past. Citizen science, or as some now prefer to call it, community science, is 'a method of integrating public outreach and scientific data collection locally, regionally, and across large geographical scales' (Cooper et al. 2007).

The emphasis on public outreach and of a reciprocal connection between scientists and interested members of the public is a deliberate and important element of many contemporary citizen/community science initiatives (Cooper et al. 2007, Devictor et al. 2010). Another important and distinctive feature is the scale of involvement in terms of the number of people potentially or actually involved in data collection and their reach in terms of geographical extent of sampling. This is well exemplified by Cornell Lab of Ornithology's eBird initiative, which by enlisting the skills of amateur birdwatchers has contributed significantly to filling biogeographical knowledge shortfalls, including across remote areas of the world (Amano et al. 2016, La Sorte and Somveille 2021).

Although the contribution of citizen or community science to filling biogeographical shortfalls in taxa other than birds is decidedly patchy, it is encouraging to note that the latest generation of mobile naturalist apps such as eBird and iNaturalist are generating enormous quantities of high quality, contextualized biogeographical data at regional and global scales (e.g., La Sorte & Somveille 2021). The data from these powerful digital platforms are carefully curated and typically freely available on global databases such as the Global Biodiversity Information Facility (GBIF) (Bonney 2021). Biogeographers are also discovering a wealth of incidental data that, with appropriate tools and methods, can be generated from the images and text that members of the public contribute to websites, social media, and file-sharing platforms. Such analysis has even given rise to two new sub-disciplines; i) conservation culturomics, concerned with the study of human–nature interactions based on the quantitative analysis of digital corpora (Ladle et al. 2016), and; ii) iEcology, which seeks to quantify patterns and processes in the natural world using data accumulated in digital sources collected for other purposes (Jaric et al. 2020).

The active (through mobile naturalist apps) and passive (through conservation culturomics and iEcology) crowd-sourcing of biogeographic data by the wider public, alongside other targeted citizen science programmes, has the potential to fill biodiversity shortfalls, accelerate the search for rare and lost species, promote public engagement with science and conservation, and provide exciting opportunities for biogeographers to test new ideas and engage in interdisciplinary research. However, many of these relatively new forms of data bring their own challenges, biases and limitations, requiring critical attention (Correia et al. 2021). For these reasons, we are keen to encourage contributions to *Frontiers of Biogeography* that make use of citizen/community science data, and/or which pay critical attention to the properties of the resulting data sets as tools for biogeographical science, and/or which focus on the potential of citizen science programmes to engage the interest of wider publics in the production, understanding and dissemination of biogeographical research, whether for pure or applied purposes.

A little over a year ago, we put out a call for submissions on the theme of citizen or community-based science in biogeography. In part because we see this as an ongoing topic of interest, we have decided not to compile the resulting papers into a single special issue of the journal, but to publish them simply as regular Research Papers. Nonetheless, issue 1 of volume 15 contains several papers illustrating the varied ways in which such data may be deployed in biogeographical studies and others will follow. Each of these papers has been submitted, reviewed, and

e-ISSN: 1948-6596 https://escholarship.org/uc/fb doi:10.21425/F5FBG60136

edited according to precisely the same protocols and approaches as any other Research Article submitted to *Frontiers of Biogeography* and the editors involved are listed, as is standard in the journal, at the end of each article.

DeCecco et al. (2023) illustrate the use of essentially opportunistic data for caterpillar occurrence from iNaturalist alongside (and in comparison with) data from structured surveys for eastern North America. Their detailed spatial and temporal analyses, demonstrate the value of this particular form of citizen science data for filling data shortfalls for lepidoptera, not just spatially, but also for analysis of caterpillar phenology. In another paper in this issue, Ducarme (2023) demonstrates how citizen science can contribute to filling the Wallacean (distributional data) shortfall (cf. La Sorte and Somveille 2020), in this case, as part of a mixed-methods approach applied to the study of a single marine invertebrate species, the horned sea star. Notably, in this instance, the analysis points to the species having a less extensive geographical distribution than previously claimed in the literature. Also illustrating the potential of citizen science data gathering for invertebrates, Peeters et al. (2023) show how volunteers can be encouraged to contribute data for isolated water bodies otherwise inaccessible to science, in the shape of private urban ponds in the Netherlands. Sadar and Marske (2023) exemplify the use of a different form of data, photographed occurrences of four species of widow spiders (*Latrodectus*), sourced by invitation from social media communities and then combined with data from GBIF, and including data from online community science repositories. These data allowed the ranges of the species to be refined and bioclimate niche models to be generated. Finally, Graba-Landry et al. (2023) provide an example of the use of citizen science data for two marine fish in Tasmania, specifically with a focus on refining knowledge of the range margins of the species concerned. As the authors point out, in an era of anticipated rapid climate change, the capacity to monitor and rapidly update the distributions of species of interest will be a contribution of real value that citizen science can make at scale.

We hope that readers of the journal will find these papers of interest and we look forward to future submissions exploring the potential of citizen or community science data and initiatives in biogeography.

Robert J. Whittaker[1,2*], Janet Franklin[3], Richard J. Ladle[4], Frank A. La Sorte[5] and Lauren M. Schiebelhut[6]

[1] School of Geography and the Environment, University of Oxford, South Parks Road, Oxford OX1 3QY, UK.

[2] Center for Macroecology, Evolution and Climate, GLOBE Institute, University of Copenhagen, Universitetsparken 15, 2100 Copenhagen, Denmark.

[3] Department of Geography, San Diego State University, San Diego, CA 92182 USA.

[4] CIBIO-InBIO, Research Centre in Biodiversity and Genetic Resources, University of Porto, Campus de Vairão, 4485-661 Vairão, Portugal.

[5] Cornell Lab of Ornithology, Cornell University, Ithaca, NY 14850, USA.

[6] Life and Environmental Sciences, University of California, Merced, 5200 N. Lake Road, Merced, California 95343, USA.

* Correspondence: Robert J. Whittaker, eic.frontiers@biogeography.org

References

Amano, T., Lamming, J.D.L. & Sutherland, W.J. (2016) Spatial gaps in global biodiversity information and the role of citizen science. Bioscience, 66, 393–400. https://doi.org/10.1093/biosci/biw022

Bonney, R. (2021) Expanding the impact of citizen science. BioScience, 71, 448–451. https://doi.org/10.1093/biosci/biab041

Cooper, C.B., Dickinson, J., Phillips, T. & Bonney, R. (2007) Citizen science as a tool for conservation in residential ecosystems. Ecology and Society, 12, 11. Available at: http://www.ecologyandsociety.org/vol12/iss2/art11/

Correia, R. A., Ladle, R., Jarić, I., et al. (2021) Digital data sources and methods for conservation culturomics. Conservation Biology, 35, 398-411. https://doi.org/10.1111/cobi.13706

Devictor, V., Whittaker, R.J. & Beltrame, C. (2010) Beyond scarcity: citizen science programmes as useful tools for conservation biogeography. Diversity and Distributions, 16, 354–362. https://doi.org/10.1111/j.1472-4642.2009.00615.x.

Di Cecco, G.J., Belitz, M. W., Cooper, R.J., Larsen, E.A., Lewis, W.B., Ries, L., Guralnick, R.P. & Hurlbert, A.H. (2023) Phenology in adult and larval Lepidoptera from structured and unstructured surveys across eastern North America. Frontiers of Biogeography, 15, e56346. https://doi.org/10.21425/F5FBG56346.

Graby-Landry, A., Champion, C., Twiname, S., Wolfe, B., Haddy, J., Mossop, D., Pecl, G. & Tracey, S.R.

(2023) Citizen science aids the quantification of the distribution and prediction of present and future temporal variation in habitat suitability at species' range edges. Frontiers of Biogeography, 15, e58207. https://doi.org/10.21425/F5FBG58207

Jarić, I., Correia, R.A., Brook, B.W., et al. (2020) iEcology: harnessing large online resources to generate ecological insights. Trends in Ecology and Evolution, 35, 630-639. https://doi.org/10.1016/j.tree.2020.03.003

Ladle, R.J., Correia, R.A., Do, Y., Joo, G-J., Malhado, A.C.M., Proulx, R., Roberge, J-M. & Jepson, P. (2016) Conservation culturomics. Frontiers in Ecology and the Environment 14, 269-275. https://doi.org/10.1002/fee.1260

La Sorte, F.A. & Somveille, M. (2020) Survey completeness of a global citizen-science database of bird occurrence. Ecography, 43, 34–43. https://doi.org/10.1111/ecog.04632

La Sorte, F.A., and Somveille, M. (2021) The island biogeography of the eBird citizen-science programme. Journal of Biogeography 48, 628–638. https://doi.org/10.1111/jbi.14026

Peeters, T.H.M., Wilhelm, W., Gerritsen, A.A.M. & Seelen, L.M.S. (2023) Ecological characterisation of urban ponds in the Netherlands: a study based on data collected by volunteers. Frontiers of Biogeography, 15, e57816. https://doi.org/10.21425/F5FBG57816

Sadir, M. & Marske, K.A. (2023) Climatic niche overlap models reveal niche partitioning among black widow spiders and potential ecological impacts of invasive brown widows in North America. Frontiers of Biogeography, 15, e35943. https://doi.org/10.21425/F5FBG35943

Whittaker, R.J. & Ladle, R.J. (2011) Chapter 1: the roots of conservation biogeography. In: Conservation Biogeography (ed. by R.J. Ladle and R.J. Whittaker), pp 3–12. Wiley-Blackwell, Oxford.

