






PERSPECTIVE

Replacing “parachute science” with “global science” in ecology and conservation biology

Alex Asase¹  | Tiwonge I. Mzumara-Gawa²  | Jesse O. Owino³  |
Andrew T. Peterson⁴  | Erin Saupe⁵ 

¹Department of Plant and Environmental Biology, University of Ghana, Accra, Ghana

²Department of Biological Sciences, Malawi University of Science and Technology, Limbe, Malawi

³Rift Valley Eco-Region Research Program, Kenya Forestry Research Institute, Londiani, Kenya

⁴Biodiversity Institute, University of Kansas, Lawrence, Kansas, USA

⁵Department of Earth Sciences, University of Oxford, Oxford, UK

Correspondence

Alex Asase, Department of Plant and Environmental Biology, University of Ghana, P.O. Box LG55 Legon, Accra, Ghana.

Email: aasase@ug.edu.gh

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Abstract

Biodiversity remains relatively unknown and understudied in many parts of the developing world with significant information gaps, in stark contrast to many areas in the developed world, where knowledge about biodiversity can approach encyclopedic. Access to resources, such as funding, data, information, expertise, and biological collections (often collected by colonial-era scientists from across the developing world), is often quite limited for developing-world scientists. The life of a biodiversity scientist in the developing world is therefore one of manifold dilemmas and challenges, as well as numerous opportunities. Although collaborations exist between developing-world scientists and developed-world scientists, too many of those collaborations are not deep or permanent, and developing-world scientists are too often relegated to a subordinate role. The focus in this contribution is on providing suggestions for how to open and build access to resources for developing-world scientists. Everyone benefits if developing-world and developed-world scientists work together collaboratively to pose interesting and novel questions, generate new data, update existing data, carry out analyses, and arrive at interesting insights and interpretations. In this way, the biodiversity science community can replace “parachute” science with “global science.”

KEYWORDS

biodiversity, developing world, expertise, funding, partnerships, resources

1 | BACKGROUND

During much of the 19th century, a significant portion of the world was divided into colonial possessions of a relatively few, dominant, largely European countries (e.g., England, Spain, France, Netherlands). This “colonial era” coincided with a period of massive growth of biological exploration of the world and therefore

generated much of the present base of knowledge about biological diversity, at least within the so-called “Western” scientific tradition (Laely, Meyer, & Schwere, 2018). It also, however, generated a situation in which biodiversity knowledge was quickly exported to the colonial power, and specimens deposited in museums there, for the most part little accessible to the colony (Mears & Modest, 2013; Wintle, 2016).

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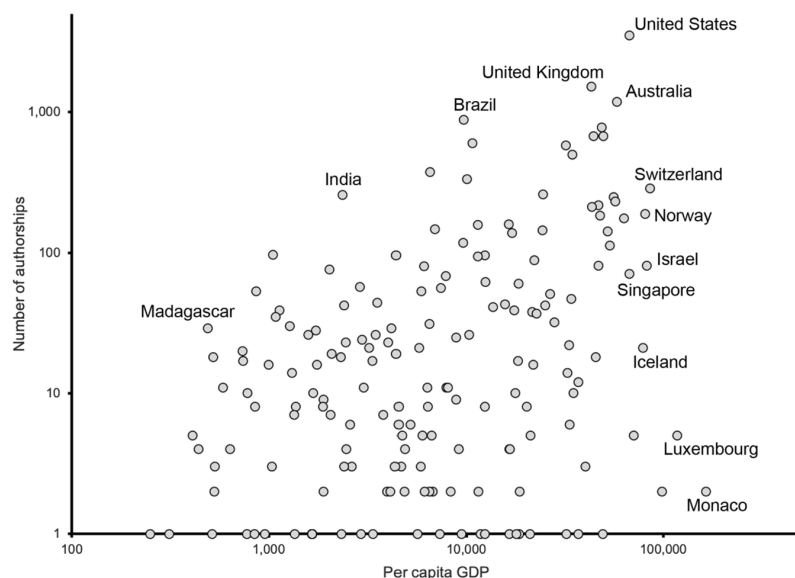


FIGURE 1 Summary of the relationship between the number of authorships (i.e., representation as author or coauthor) on 9935 papers on “ecology” or “conservation” in *Web of Science*, for 2015–2020 versus per-capita gross domestic product (GDP). We note that the number of authorships is not solely indicative of scientific success but does provide a measure of productivity and impact globally. Note also that countries with zero productivity in this time period are not shown, in light of the logarithmic scale. See Data S1, Supporting Information for the full information on all countries considered

After colonies gained independence (generally in the 19th century in the Americas, and in the 20th century in Africa), these imbalances in resources, access to information, and access to specimens did not disappear. In large part, and not without exception, former colonies continued to be economically resource-poor, and with less access to information and materials, which translated into levels of activity and scientific stature that did not, for the most part, match those of the former colonial powers. Many of these imbalances continue up to the present, likely owing, at least in part, to inertial differences created by the colonial heritage (i.e., the rich get richer, the poor stay poor). These resource contrasts among countries globally have been termed variously as first world versus third world, western versus nonwestern countries, global north versus global south, temperate versus tropical, and so on; none of these contrasts represents an ideal terminology. In the biodiversity science world, these imbalances manifest as, for example, a clear, positive relationship between scientific productivity and per capita economic activity (Figure 1) and as a discord between areas where research is needed and areas where research is conducted (Wilson et al., 2016). This relationship between prosperity and productivity can be noted to varying degrees on many scales (e.g., globally among countries, rich versus poor institutions within Europe or the United States, or wealthy Sao Paulo versus resource-poor Tocantins within Brazil).

Distillation down to simple resource access is certainly an oversimplification. Other factors that have limited access to resources by former colonies include conflict, dominant language, lack of awareness of collections, and location, as well as corruption (Nye, 2020). Still, we posit that abundant access to resources, both

with respect to funding and information, can make for rapid scientific advancement and progress for any nation. Thus, we focus this commentary on questions of access to resources, which for scientists include funding, data, information, and expertise. For convenience, we divide the world into “Developed” and “Developing” components, bearing in mind that many countries will not fit comfortably into one or the other of these two terms. We are a group of colleagues located in developed (UK, United States) and developing (Ghana, Malawi, Kenya) countries, and we present this set of reflections on “doing science” in these different contexts, with an eye to creating a global science environment that is equitable and inclusive for everyone involved.

2 | BIODIVERSITY SCIENTISTS IN THE DEVELOPING WORLD

The life of a biodiversity scientist in the developing world is one of manifold dilemmas and challenges, as well as opportunities. Funding remains the single most important challenge for biodiversity scientists in the developing world (Parker, Cranford, Oakes, & Leggett, 2012). The biodiversity scientist in the developing world is often burdened by inadequate scientific infrastructure and resources, including field and laboratory equipment, and access to the scientific literature (Agosti, 2006).

Although sources of funding have improved in recent years (Miller, Agrawal, & Roberts, 2013), the level of funding in biology remains meager compared to that in other areas, such as health sciences, agriculture, and education. Developing-world biodiversity scientists often struggle to secure travel grants to visit other laboratories,

or to attend conferences for the purpose of networking and exchanging ideas with colleagues (not to mention funding for purchase of expensive laboratory equipment), as many of their institutions have no budgetary allocations for these purposes. Funds with which to publish in open-access journals, increasingly a crucial element in academic life (Solomon & Björk, 2012), remain virtually nonexistent.

Salary levels are generally low for scientists in the developing world, including for internationally recognized biodiversity experts (Harris, 2004). Many biodiversity scientists therefore need to diversify income sources by engaging in consultancies, administrative posts, government positions, or extra teaching loads at universities. As a consequence, many developing-world biodiversity scientists have less time than they would wish (and less time than their developed-world colleagues) to spend on their research that might address important biodiversity issues.

In the natural world, the unprecedented rate of biodiversity loss in many parts of the world, especially in developing countries, underscores the need for developing-world biodiversity scientists to engage in conservation-related activities (Rodríguez et al., 2007). This work often perforce must include advocacy to protect biodiversity and support its sustainable management. As a result, many developing-world biodiversity scientists are deeply involved in community conservation education and advocacy, perhaps often to a greater degree than are their developed-world counterparts (Adenle, Stevens, & Bridgewater, 2015; Gossa, Fisher, & Milner-Gulland, 2015). Although important, this advocacy requires time, which again may take them away from research endeavors.

Biodiversity remains relatively unknown and understudied in many parts of the developing world. This information gap stands in stark contrast to many areas in the developed world, where knowledge about biodiversity can approach encyclopedic. These information gaps, in tandem with too-frequent lack of funding for more in-depth analyses (e.g., genomic analyses), mean that a substantial amount of research effort for the biodiversity scientist in the developing world is spent in more basic tasks, such as describing species, gathering baseline biodiversity data, estimating species abundances and frequencies, and creating basic species inventories. Clearly, some advanced work is ongoing in the developing world in conservation biology and ecology, but we simply assert that many basic information needs must be addressed.

These knowledge gaps mean that unique biological insights are often more easily accessible to developing-world scientists, with exciting discoveries in some cases happening within city limits (Mahood et al., 2013) or on

the university campus (Gbogbo et al., 2017). However, this type of research, although important towards making progress in science, is often less attractive to the international scientific community of publishers and funders, such that manuscripts from developing-world scientists are often rejected for publication in high-impact journals. Too often, when these basic-science contributions are rejected, the authors are recommended to submit to a “regional journal.” Because many institutions hire, promote, and evaluate research by journals with a heavy bias to those of commercial firms (Abbott et al., 2010), and based on the largely discredited “impact” factors (Simmons, 2008; Starbuck, 2005), this situation might require changes in internal policies of such institutions in developing-world countries.

Biodiversity scientists in the developing world too often end up as lone rangers without strong research teams or lasting partnerships. Although collaborations exist between developing-world scientists and developed-world scientists, these collaborations may not be deep or permanent for reasons such as economic inequalities and cultural differences (Seidler et al., 2021). When collaborating with developed-world scientists, developing-world scientists are too often relegated to a subordinate role (North, Hastie, & Hoyer, 2020). That is, the research is designed and developed by the developed-world scientist and implemented with the developing-world scientists as collaborators brought on to make the work feasible (Cimini, Zaccaria, & Gabrielli, 2016; Mègnigbèto, 2013). Collaborations with in-country partners and with colleagues elsewhere in the developing world are also too often scanty, unreliable, and transient (Harris, 2004). Developing-world biodiversity scientists are engaged in generation of new knowledge, but may be reluctant to share that information overmuch owing to lack of trust and to funder policies.

Finally, access to biological collections that were collected by colonial-era scientists from across the developing world is often quite limited for developing-world scientists. Biological collections are permanent records documenting the existence of a species at a particular time in space, with many applications in ecology and conservation biology (James et al., 2018; Nualart, Ibáñez, Soriano, & López-Pujol, 2017). The great bulk of developing-world specimens is stored in natural history museums in the developed world; access to these specimens and associated data continues to be a source of stress and shortfall in analyses (Bakker et al., 2020; Paknia, Sh, & Koch, 2015; Schilthuizen, Vairappan, Slade, Mann, & Miller, 2015). Developing-world scientists are frequently eager to access the entirety of the specimen record from their nations or regions, yet too often those resources are locked up in colonial collections far

away in Europe or North America, and often without digital representation (e.g., images, data records) available to a researcher in the developing world. Certainly, the situation has seen improvements, thanks to initiatives such as the ALUKA-African Plants Initiative (Dabyshire, Saltmarsh, & Malcom, 2007), Global Biodiversity Information Facility (GBIF: <https://www.gbif.org>), speciesLink (<http://splink.cria.org.br>), and others, but much of the specimen record remains unavailable.

3 | WAYS FORWARD: DEVELOPING-WORLD SCIENTISTS

Sweeping changes (resources, training, etc.) are needed for developing-world biodiversity scientists to deliver the high-impact science that they wish to create, which will inform conservation, policy, and (ultimately) sustainable development (Barber et al., 2014). A key ingredient for change for developing-world scientists is improved funding of biodiversity research. In the first place, governments of developing-world countries should include biodiversity and natural systems in their budgets at levels equivalent to areas such as health sciences, agriculture, and education, in view of the importance of natural systems and ecosystem services to many areas of human well-being (Wu, 2013). Biodiversity scientists in developing-world countries should work to develop their skills in grantwriting, to access more competitive grants from donor agencies; this objective can also be achieved via collaborations, of course. Governments of developing-world countries may be able to supplement their own funds for biodiversity research via accessing multilateral donor funds, such as those of the Global Environment Facility. Finally, governments and institutions in developing-world countries should work to improve salaries and incentives for their scientists, to avoid “brain drain,” which may siphon off the best and most capable individuals from their scientific communities (Requena, 2016).

A further key ingredient for creating change for developing-world biodiversity scientists is that of building science capacity, in terms of both expertise and infrastructure. That is, an important task is creating a broad pool of local and national researchers with expertise and training at the highest levels (Barber et al., 2014), both in basic science and at the science-policy interface (Gustafsson, Díaz-Reviriego, & Turnhout, 2020). Such expertise is needed to generate high-quality, large-scale, primary biodiversity data resources and to analyze and interpret data to produce biodiversity information products (CONABIO, 2012). Although many training and capacity-building initiatives have been created (e.g., Peterson & Ingenloff, 2015), our belief is that training at the highest levels (i.e., Masters and Ph.D.) is crucial to full participation by the developing world in the scientific

enterprise (Gill, Mankelov, & Mills, 2019; Lubchenco, Barner, Cerny-Chipman, & Reimer, 2015; Omisore, 2018). Developing-world countries that have invested in funding doctoral-level training for their citizens have enjoyed massive increases in scientific stature (e.g., in terms of producing numerous papers in scientific journals; note the high position of Brazil in Figure 1). Developing countries should also consider building stronger biodiversity institutions such as the South African National Biodiversity Institute in South Africa and the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad in Mexico, which have become hubs for excellence in biodiversity science, as well as important advisory entities within their respective national governments.

As the career of a scientist progresses, a crucial, long-term challenge is that of building lasting, productive scientific associations. These collaborations may be with other national scientists, with other scientists from the developing world, or with scientists from the developed world; all of these relationships can be significant enabling factors in growing a scientist's career in the developing and developed world. Ideally, these collaborations will last for longer than single projects and instead will be long-lasting, deep relationships that serve to elevate the scientific profiles of each individual involved. Concerted and continued collaboration can also allow sufficient data to be collected such that developing-world scientists no longer need to focus their efforts solely on collecting baseline biodiversity data, but can extend their studies to other ecological and evolutionary phenomena.

Sharing data, expertise, knowledge, and information is key to creating change for developing-world scientists (Gaikwad & Chavan, 2006). Recent initiatives offer opportunities to make biodiversity information (and biological collections) accessible to everyone globally (Costello, Michener, Gahegan, Zhang, & Bourne, 2013). Data sharing not only broadcasts the data that one has to the world but also brings the world's data together for use by oneself, and this two-way information flow benefits scientists in both the developed and developing worlds (Sousa-Baena, Garcia, & Peterson, 2013).

Participating in open-access literature initiatives is also key, as open access reduces resource gaps between the developed and developing worlds (Ahmed, 2007; Bolick, Emmett, Greenberg, Rosenblum, & Peterson, 2017; Bonaccorso et al., 2014; Peterson, Emmett, & Greenberg, 2013). However, a crucial point is that this shift not just be to use open-access publishing platforms, because some of such platforms involve serious expenses in the form of “article processing charges” (APCs). Rather, science should shift to platforms that (a) allow authors to retain sufficient rights that they can post them on institutional repositories or on shared sites such as ResearchGate

(“green” open access); (b) provide significant and meaningful APC waivers for developing-world scientists; or (c) are entirely free (or at least low-cost) for both reading and publishing papers (termed “platinum” open access; Peterson, Emmett, Bolick, Greenberg, & Rosenblum, 2016; Bolick et al., 2017). For developing-world scientists fortunate enough to rise in the academic ranks in their countries, a crucial transition is that of changing the metrics by which academics are evaluated for promotion and tenure—too often, these metrics currently are based on publication only in developed-world forums (e.g., “indexed journals”). (Developed-world scientists also have important roles in this process of fixing the system of scientific communication, as is discussed below.)

Finally, an important factor for creating change for developing-world biodiversity scientists is fluency in the English language (Ramírez-Castañeda, 2020), as English has become the preferred language for science communication (itself a reflection of historical dominance of colonial powers). English looks to continue as the language of choice for high-impact scientific journals in the foreseeable future and consequently acts as a gatekeeper for recognition of scientific contributions (North et al., 2020). Proficiency in English, both written and spoken, is therefore necessary if the research of a developing-world scientist is to be accessible globally and to gain recognition. English language training is thus an important ingredient in the science training curriculum, and skills in scientific writing should be taught across the developing world.

4 | WAYS FORWARD: DEVELOPED-WORLD SCIENTISTS

Certainly, the easiest way forward for developed-world scientists is to continue with the *status quo*, that is, doing things the way things have “always” been done. In this sense, developed-world scientists often perform their research “by parachute”: a developed world scientist swoops in to a research site, works out the necessary permits, performs the research, and gets out (Barber et al., 2014; Stefanoudis et al., 2021). If contact is made with developing-world scientists, it is frequently incidental and even uncomfortable. Too often, such contacts are initiated only to obtain the necessary permits, or to benefit from the help of a local “fixer.” The developing world is viewed as a fabulous storehouse of biodiversity that should be open to the entire developed world that might wish to study that diversity, with as little impediment as is possible. At most, the developed-world scientist might give a seminar, or take along a few students as field assistants, but no deep communication or lasting relationship is built. Such *status quo* researchers rarely take on

developing-world students in their labs, and rarely have ongoing relationships other than possibly obtaining the research permits for the next field season.

The preceding paragraph is, of course, a caricature, but it is not far from the reality experienced by many developed-world scientists. That is, too often, developed-world scientists do not invest in the scientists based in the places where they work. Although it is true that some developed-world scientists do go farther, too many do not. Indeed, this investment may require time and effort, but it can also provide a new and deeper understanding of biodiversity dynamics from developing-world scientists who have intimate knowledge of their home regions and who are present there year-round.

Importantly, the rewards of working in the developing world must not be reaped without sharing such rewards globally through equitable partnerships with developing-world scientists. Such collaborations can often be facilitated by funding to work on shared research projects, as has been emphasized in funding programs such as the JRS Biodiversity Foundation (<https://jrsbiodiversity.org/>). Collaborating with young scientists is particularly beneficial for training a new generation of biodiversity experts in the developing world. In this regard, a premium should be on opening opportunities for graduate study, considered as the highest level of training and capacitation.

In addition to engaging in lasting collaborations with developing-world scientists, developed-world scientists should consider participating in initiatives that seek actively to decolonize biodiversity data and scientific collections. Decolonizing biodiversity collections is the process of making broadly and openly available the biodiversity resources housed in the developed world that derive from the developing world. Existing initiatives include the Brazilian Virtual Herbarium (Pignal, Romaniuc-Neto, De Souza, Chagnoux, & Canhos, 2012), many activities of the *Comisión Nacional para el Uso y Conocimiento de la Biodiversidad* in Mexico (CONABIO, 2012), and the West African Plants project (Asase, Sainge, Radji, Ugbogu, & Peterson, 2020), among others. On a more proximate level, when working in the developing world, developed-world scientists should share the data that result from their work openly and efficiently with scientists in the host countries as the data are collected, and in the form of primary, research-grade data.

As with the situation for developing-world scientists, when developed-world scientists publish their work, they will ideally publish in journals that can be read by everyone (open access journals), and not just those based in wealthy institutions and countries that can afford an expensive subscription. However, these scientists should go beyond “just” open access publishing, and they should send their papers to journals that are either green

or platinum open access, and that therefore allow everyone (developed and developing worlds) to participate fully. That is, scientists can and should “vote with their papers,” and support and develop a broader diversity of scholarly journals that can provide more opportunities for all scientists, regardless of where they are based. Finally, developed-world biodiversity scientists should consider the important contributions made by developing-world scientists: one easy path is by citing their work when such is appropriate.

5 | CONCLUSIONS

In this perspective piece, we have focused on providing suggestions for how to open and build access to resources for developing-world scientists. The pathways forward explored in this commentary are not exhaustive and not exclusive to the categories defined; that is, most recommendations for the developing-world scientist can also be applied to the developed-world scientist and vice versa. We believe that everyone benefits if developing-world and developed-world scientists work together collaboratively to pose interesting and novel questions, generate new data, update existing data, carry out analyses, and arrive at interesting interpretations. At the center of this advance are long-term relationships that are full partnerships (maybe even friendships) that recognize the unique, varied, and valuable contributions each individual brings to the collaboration. In this way, the scientific community will replace “parachute” science with “global science” to gain a deeper understanding of biodiversity dynamics.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

The data used to create Figure 1 is openly accessible to the public via <https://worldpopulationreview.com/countries/countries-by-gdp>.

ORCID

Alex Asase  <https://orcid.org/0000-0003-0116-3445>

Tiwonge I. Mzumara-Gawa  <https://orcid.org/0000-0002-5364-9853>

Jesse O. Owino  <https://orcid.org/0000-0003-0872-1200>

Andrew T. Peterson  <https://orcid.org/0000-0003-0243-2379>

Erin Saupe  <https://orcid.org/0000-0002-0370-9897>

REFERENCES

- Abbott, A., Cyranoski, D., Jones, N., Maher, B., Schiermeier, Q., & Van Noorden, R. (2010). Metrics: Do metrics matter?. *Nature News*, 465, 860–862.
- Adenle, A. A., Stevens, C., & Bridgewater, P. (2015). Global conservation and management of biodiversity in developing countries: An opportunity for a new approach. *Environmental Science & Policy*, 45, 104–108.
- Agosti, D. (2006). Biodiversity data are out of local taxonomists' reach. *Nature*, 439, 392.
- Ahmed, A. (2007). Open access towards bridging the digital divide—Policies and strategies for developing countries. *Information Technology for Development*, 13, 337–361.
- Asase, A., Sainge, M. N., Radji, R. A., Ugbogu, O. A., & Peterson, A. T. (2020). A new model for efficient, need-driven progress in generating primary biodiversity information resources. *Applications in Plant Sciences*, 8, e11318.
- Bakker, F. T., Antonelli, A., Clarke, J. A., Cook, J. A., Edwards, S. V., Ericson, P. G. P., ... Gillespie, R. G. (2020). The global museum: Natural history collections and the future of evolutionary science and public education. *PeerJ*, 8, e8225.
- Barber, P. H., Ablan-Lagman, M. C. A., Berlinck, R. G. S., Cahyani, D., Crandall, E. D., Ravago-Gotanco, R., ... Starger, C. J. (2014). Advancing biodiversity research in developing countries: The need for changing paradigms. *Bulletin of Marine Science*, 90, 187–210.
- Bolick, J., Emmett, A., Greenberg, M. L., Rosenblum, B., & Peterson, A. T. (2017). How open access is crucial to the future of science. *Journal of Wildlife Management*, 81, 564–566.
- Bonaccorso, E., Bozhankova, R., Cadena, C. D., Čapská, V., Czerniewicz, L., Emmett, A., ... Rosenblum, B. (2014). Bottlenecks in the open-access system: Voices from around the globe. *Journal of Librarianship and Scholarly Communication*, 2, pE1126.
- Cimini, G., Zaccaria, A., & Gabrielli, A. (2016). Investigating the interplay between fundamentals of national research systems: Performance, investments and international collaborations. *Journal of Informetrics*, 10, 200–211.
- CONABIO. (2012). *CONABIO: Dos Décadas de Historia, 1992–2012*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México, D. F.: Author.
- Costello, M. J., Michener, W. K., Gahegan, M., Zhang, Z.-Q., & Bourne, P. E. (2013). Biodiversity data should be published, cited, and peer reviewed. *Trends in Ecology and Evolution*, 28, 454–461.
- Dabyshire, I., Saltmarsh, A., & Malcom, P. (2007). Application of the ALUKA African plants resource to African flora projects. In X. M. van der Burgt, L. J. G. van der Maesen, & J. M. Onana (Eds.), *Systematics and conservation of African plants: Proceedings of the 18th AETFAT congress, Yaoundé, Cameroun* (pp. 771–779). London, England: Royal Botanic Gardens, Kew.
- Gaikwad, J., & Chavan, V. (2006). Open access and biodiversity conservation: Challenges and potentials for the developing world. *Data Science Journal*, 5, 1–17.
- Gbogbo, F., Tabiri, K., & Musah, Y. (2017). Diversity and abundance of small mammals along a disturbance gradient on a university campus in Ghana. *International Journal of Ecology and Development*, 32(1), 54–65.
- Gill, J. C., Mankelov, J., & Mills, K. (2019). The role of earth and environmental science in addressing sustainable development priorities in eastern Africa. *Environmental Development*, 30, 3–20.

- Gossa, C., Fisher, M., & Milner-Gulland, E. J. (2015). The research-implementation gap: How practitioners and researchers from developing countries perceive the role of peer-reviewed literature in conservation science. *Oryx*, 49, 80–87.
- Gustafsson, K. M., Díaz-Reviriego, I., & Turnhout, E. (2020). Building capacity for the science-policy interface on biodiversity and ecosystem services: Activities, fellows, outcomes, and neglected capacity building needs. *Earth System Governance*, 4, 100050.
- Harris, E. (2004). Building scientific capacity in developing countries. *EMBO Reports*, 5, 7–11.
- James, S. A., Soltis, P. S., Belbin, L., Chapman, A. D., Nelson, G., Paul, D. L., & Collins, M. (2018). Herbarium data: Global biodiversity and societal botanical needs for novel research. *Applications in Plant Sciences*, 6, e1024.
- Laely, T., Meyer, M., & Schwere, R. (2018). *Museum cooperation between Africa and Europe: A new field for museum studies*. Bielefeld, Germany: transcript Verlag.
- Lubchenco, J., Barner, A. K., Cerny-Chipman, E. B., & Reimer, J. N. (2015). Sustainability rooted in science. *Nature Geoscience*, 8, 741–745.
- Mahood, S. P., John, A. J. I., Eames, J. C., Oliveros, C. H., Moyle, R. G., Hong, C., ... Sheldon, F. H. (2013). A new species of lowland tailorbird (Passeriformes: Cisticolidae: *Orthotomus*) from the Mekong floodplain of Cambodia. *Forktail*, 29, 1–14.
- Mears, H., & Modest, W. (2013). Museums, African collections and social justice. In R. Sandell & E. Nightingale (Eds.), *Museums, equality and social justice* (pp. 294–309). Oxfordshire, England: Routledge.
- Mégnigbêto, E. (2013). International collaboration in scientific publishing: The case of West Africa (2001–2010). *Scientometrics*, 96, 761–783.
- Miller, D. C., Agrawal, A., & Roberts, J. T. (2013). Biodiversity, governance, and the allocation of international aid for conservation. *Conservation Letters*, 6, 12–20.
- North, M. A., Hastie, W. W., & Hoyer, L. (2020). Out of Africa: The underrepresentation of African authors in high-impact geoscience literature. *Earth-Science Reviews*, 2020, 103262.
- Nualart, N., Ibáñez, N., Soriano, I., & López-Pujol, J. (2017). Assessing the relevance of herbarium collections as tools for conservation biology. *Botanical Review*, 83, 303–325.
- Nye, J. (2020). Libraries, archives, and museums interwoven in the digital south: From a paucity of resources to data richness for understanding the South Asian subcontinent. In H. Kremers (Ed.), *Digital cultural heritage* (pp. 295–301). Berlin/Heidelberg, Germany: Springer.
- Omisore, A. G. (2018). Attaining sustainable development goals in sub-Saharan Africa; the need to address environmental challenges. *Environmental Development*, 25, 138–145.
- Paknia, O., Sh, H. R., & Koch, A. (2015). Lack of well-maintained natural history collections and taxonomists in megadiverse developing countries hampers global biodiversity exploration. *Organisms Diversity & Evolution*, 15, 619–629.
- Parker, C., Cranford, M., Oakes, N., & Leggett, M. (2012). *The little biodiversity finance book*. Oxford: Global Canopy Programme.
- Peterson, A. T., Emmett, A., Bolick, J., Greenberg, M. L., & Rosenblum, B. (2016). Subsidizing truly open access. *Science*, 352, 1405.
- Peterson, A. T., Emmett, A., & Greenberg, M. L. (2013). Open access and the author-pays problem: Assuring access for readers and authors in a global community of scholars. *Journal of Librarianship and Scholarly Communication*, 1, eP1064.
- Peterson, A. T., & Ingenloff, K. (2015). Biodiversity informatics training curriculum, version 1.2. *Biodiversity Informatics*, 10, 65–74.
- Pignatelli, M., Romaniuc-Neto, S., De Souza, S., Chagnoux, S., & Canhos, D. A. L. (2012). Saint-Hilaire virtual herbarium, a new upgradeable tool to study Brazilian botany. *Adansonia*, 35, 7–18.
- Ramírez-Castañeda, V. (2020). Disadvantages in preparing and publishing scientific papers caused by the dominance of the English language in science: The case of Colombian researchers in biological sciences. *PLoS One*, 15, e0238372.
- Requena, J. (2016). Venezuela's brain drain is accelerating. *Nature*, 536, 396–396.
- Rodríguez, J. P., Taber, A. B., Daszak, P., Sukumar, R., Valladares-Padua, C., Padua, S., ... Aguirre, A. A. (2007). Globalization of conservation: A view from the south. *Science*, 317, 755–756.
- Schilthuizen, M., Vairappan, C. S., Slade, E. M., Mann, D. J., & Miller, J. A. (2015). Specimens as primary data: Museums and “open science”. *Trends in Ecology and Evolution*, 30, 237–238.
- Simons, K. (2008). The misused impact factor. *Science*, 322, 165–165.
- Solomon, D. J., & Björk, B.-C. (2012). A study of open access journals using article processing charges. *Journal of the American Society of Information Sciences*, 63, 1485–1495.
- Sousa-Baena, M. S., Garcia, L. C., & Peterson, A. T. (2013). Completeness of digital accessible knowledge of the plants of Brazil and priorities for survey and inventory. *Diversity and Distributions*, 20, 369–381.
- Starbuck, W. H. (2005). How much better are the most-prestigious journals? The statistics of academic publication. *Organization Science*, 16, 180–200.
- Stefanoudis, P. V., Licuanan, W. Y., Morrison, T. H., Talma, S., Veitayaki, J., & Woodall, L.C. (2021). Turning the tide of parachute science. *Current Biology*, 31, R184–R185. <https://doi.org/10.1016/j.cub.2021.01.029>
- Seidler, R., Primack, R. B., Goswami, V. R., Khaling, S. M., Devy, S., Corlett, R. T., ... Wrangham, R. (2021). Confronting ethical challenges in long-term research programs in the tropics. *Biological Conservation*, 255, 108933.
- Wilson, K. A., Auerbach, N. A., Sam, K., Magini, A. G., Moss, A. S. L., Langhans, S. D., ... Meijaard, E. (2016). Conservation research is not happening where it is most needed. *PLoS Biology*, 14, e1002413.
- Wintle, C. (2016). Decolonizing the Smithsonian: Museums as microcosms of political encounter. *American Historical Review*, 121, 1492–1520.
- Wu, J. (2013). Landscape sustainability science: Ecosystem services and human well-being in changing landscapes. *Landscape Ecology*, 28, 999–1023.

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