










ESSAY

Strategies for advancing inclusive biodiversity research through equitable practices and collective responsibility

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Abstract

Biodiversity research is essential for addressing the global biodiversity crisis, necessitating diverse participation and perspectives of researchers from a wide range of backgrounds. However, conservation faces a significant inclusivity problem because local expertise from biodiversity-rich but economically disadvantaged regions is often underrepresented. This underrepresentation is driven by linguistic bias, undervalued contributions, parachute science practices, and capacity constraints. Although fragmented solutions exist, a unified multistakeholder approach is needed to address the interconnected and systemic conservation issues. We devised a holistic framework of collective responsibility across all research participants and tailored strategies that embrace diversity and dismantle systemic barriers to equitable collaboration. This framework delineates the diverse actors and practices required for promoting inclusivity in biodiversity research, assigning clear responsibilities to researchers, publishers, institutions, and funding bodies. Strategies for researchers include cultivating self-awareness, expanding literature searches, fostering partnerships with local experts, and promoting knowledge exchange. For institutions, we recommend establishing specialized liaison roles, implementing equitable policies, allocating resources for diversity initiatives, and enhancing support for international researchers. Publishers can facilitate multilingual dissemination, remove financial barriers, establish inclusivity standards, and ensure equitable representation in peer review. Funders must remove systemic barriers, strengthen research networks, and prioritize equitable resource allocation. Implementing these stakeholder-specific strategies can help dismantle deep-rooted biases and structural inequities in biodiversity research, catalyzing a shift toward a more inclusive and representative model that amplifies diverse perspectives and maximizes collective knowledge for effective global conservation.

KEYWORDS

collaboration, conservation, diversity, ecology, equitable participation, equity, global south, inclusivity, representation, tropical regions

Jose Valdez and Gabriella Damasceno contributed equally to this work.

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INTRODUCTION

The rapid decline of global biodiversity requires urgent and coordinated action (Díaz & Malhi, 2022). Fragmented efforts are insufficient to address the complexities of this crisis. Instead, researchers must embrace a collaborative and integrative approach, engaging diverse expertise across disciplines, regions, and institutions (Hofstra et al., 2020; Keune et al., 2022; Pizzutto et al., 2021; Romanelli et al., 2014). This collaborative approach can facilitate the extensive data synthesis and collective initiatives crucial for understanding and protecting global biodiversity (Ocampo-Ariza et al., 2023; Ochoa-Ochoa et al., 2023). Although biodiversity research thrives on collaboration, the field currently faces problems of inclusivity, representation, and equitable collaboration (Maas et al., 2021).

Biodiversity hotspots and conservation priority areas are often located in economically disadvantaged regions rich in Indigenous knowledge and scientific expertise (Fisher & Christopher, 2007; Redvers et al., 2023). However, researchers and institutions from regions like North America and Western Europe historically wield disproportionate influence in the global biodiversity research landscape (Gomez et al., 2022; Liu et al., 2011; Miller et al., 2023; Raja et al., 2022). The underrepresentation of data from biodiverse regions is evident in databases like the Global Biodiversity Information Facility (GBIF), that despite housing billions of records still has significant gaps in these areas (Chapman et al., 2024; Garcia-Rosello et al., 2023; Meyer et al., 2015; Yesson et al., 2007). Moreover, local scientists contribute critical fieldwork, data, and knowledge, yet they face challenges in recognition, leadership roles, funding, and publishing (Liu et al., 2023; Williams et al., 2023). This disparity overshadows local contributions and leads to conservation priorities and directives being set by individuals detached from source environments and cultures (Trimble & Plummer, 2019). Consequently, funding and leadership opportunities are often diverted away from local experts, hindering capacity building, effective conservation efforts, and perpetuating underrepresentation. To foster inclusive biodiversity research and address the global biodiversity crisis, the root causes of marginalization and underrepresentation must be acknowledged and addressed.

Although issues of inclusivity and underrepresentation are gaining visibility, proposed solutions are usually issue-specific, scattered throughout the literature, and lacking a cohesive approach (Böhm & Collen, 2015). These solutions are also often reactionary and oversimplify complex and systemic issues by assigning blame or sole accountability to one group. However, these imbalances stem not from isolated factors, but from biases subtly embedded in prevailing structures, practices, and behaviors over time. Simplistic Global South versus North dichotomies overlook complex intersectional realities and intraregional differences (Ardiantiono et al., 2024; Echeverri et al., 2022; Garelnabi et al., 2022; Valdez, Vergara, et al., 2024), neglecting both the substantial research contributions from Global South countries (Chowdhury et al., 2022; Khanna et al., 2022) and inequities in the Global North (Bailey et al.,

2020; Gibney, 2022; Woolston, 2021). Additionally, while colonial legacies have indeed contributed to current inequities and systemic disadvantages (Ochoa-Ochoa et al., 2023; Raja et al., 2022; Trisos et al., 2021), references to colonization can fuel unproductive narratives of victimhood and blame, hindering collective progress. Focusing solely on these labels also fails to address the intersection of gender, race, ethnicity, and socioeconomic status that influences access to research opportunities beyond simple geographical classifications (Echeverri et al., 2022). Tackling these deeply rooted problems requires collective action and shared responsibility to dismantle the multifaceted complex systemic structures limiting inclusion in biodiversity research.

To overcome the pervasive underrepresentation in biodiversity research, a transition must be made from fragmented and reactive approaches to a holistic framework of collective responsibility that amplifies and empowers underrepresented voices at all levels of research. Interconnected participants operate at different levels within this system, so all participants must recognize their roles in either cultivating inclusion or perpetuating barriers. Researchers at all career stages should be aware of their unconscious biases and daily behaviors that may marginalize others (Mendoza-Lera & Knäbel, 2023). Surface-level solutions and top-down approaches are insufficient to effectively address the deeply embedded implicit biases and structural inequities in prevailing cultural and institutional structures. Achieving meaningful progress requires coordinated efforts across the research landscape, with researchers, institutions, funders, and publishers collaborating to dismantle systemic barriers and promote inclusive and equitable practices. We sought to move beyond oversimplifications, reactionary blame, and unproductive narratives by proposing a unified framework that fosters collective responsibility and empowers underrepresented voices. This framework incorporates strategies from diverse sources and personal insights to offer a comprehensive set of approaches that, although not exhaustive, embraces diversity, removes barriers, and fosters collaboration.

FOUR MAIN CHALLENGES UNDERMINING INCLUSIVE RESEARCH

Of the numerous challenges hindering equitable participation and representation in biodiversity research, four main obstacles stand out.

Linguistic bias

Despite the rise of robust national research systems outside traditionally overrepresented regions, the global scientific landscape remains divided due to the prevalence of English as the lingua franca (Droz et al., 2023; Marginson, 2022; MoChridhe, 2019). The dominance of English in science creates a significant barrier for non-English-speaking researchers, limiting their ability to share findings and resulting in adverse

review outcomes, lower publication acceptance rates, and hampered professional advancement, international engagement, and acknowledgment within the scientific field (Amano et al., 2016; Amano, Berdejo-Espinola, et al., 2023; Amano, Ramírez-Castañeda, et al., 2023; Angulo et al., 2021; Chan, 1976; MoChridhe, 2019). Furthermore, a lack of linguistically inclusive policies by journals and publishers exacerbates these issues (Arenas-Castro et al., 2024). Researchers who are not native English speakers, especially early in their careers, invest additional effort in scientific activities such as reading, writing, and presenting in English (Amano, Ramírez-Castañeda, et al., 2023). This can hinder their professional development and further contribute to their underrepresentation and limited visibility (Amano, Ramírez-Castañeda, et al., 2023; MoChridhe, 2019). Moreover, misconceptions regarding the rigor of non-English research serve as implicit biases that further perpetuate systemic inequality and affect how such work is perceived and acknowledged globally.

Undervalued research contributions

The undervaluation of biodiversity research from underrepresented regions, often published in languages other than English, stems from the linguistic bias and systemic barriers that currently exist, including overreliance on traditional academic outlets, neglect of local and regional dissemination channels and databases, and misperceptions of non-English rigor. As a result, research originating outside traditional academic centers can lack visibility, even in peer-reviewed journals (Amano et al., 2021; Angulo et al., 2021; Chowdhury et al., 2022; Gomez et al., 2022; Skopec et al., 2020). This is reflected in the lower citation rates and global impact of non-English research publications (Bol et al., 2023; Busse et al., 2022; Khanna et al., 2022) relative to English publications, despite a significant growth in non-English publications comparable to research conducted by those who speak English as their native language (Chowdhury et al., 2022). These issues are compounded by several interrelated and culturally significant factors (Ito & Wiesel, 2006). For instance, many biodiversity studies in underrepresented regions are oriented toward local reports for stakeholders and policymakers (Valdez, Vergara, et al., 2024). If studies are published, they are often in local or regional journals and indices with limited visibility (Aguado-López et al., 2016; Bol et al. 2023). The underrepresentation of Open Journal Systems (OJS) journals exacerbates the situation because only a small fraction of these journals, which span 60 languages and 136 countries, are indexed in major databases (Khanna et al., 2022). Additionally, many countries lack a publish-or-perish culture and career incentive structure, which removes the need to publish (Valdez, Vergara, et al., 2024). Last, many researchers hesitate to share their data due to concerns about misuse, lack of acknowledgment, disregard for cultural context, and repetition of patterns of exploitation of Indigenous knowledge (Nature, 2023; Valdez, Pereira, et al., 2023; Valdez, Vergara, et al., 2024).

Parachute science and extractive practices

Parachute science, or helicopter science, is characterized by external researchers conducting research studies without meaningful and sustainable collaboration with local experts or communities (de Vos & Schwartz, 2022; Miller et al., 2023; Odeny & Bosurgi, 2022). Many published studies do not include any locally affiliated coauthors, posing a significant threat to the integrity and relevance of scientific research (Mabele et al., 2023; Odeny & Bosurgi, 2022; Raja et al., 2022; Stefanoudis et al., 2021). Parachute science often leads to incomplete understandings of local biodiversity because external researchers may overlook important socio-ethnic, geopolitical, and other contextual factors and fail to address the specific needs and challenges of local communities and their relevance to local biodiversity conservation strategies (Hanson et al., 2009; Rakotonarivo & Andriamihaja, 2023; Soares, Franco, et al., 2023). Moreover, the power imbalances between researchers from traditionally overrepresented countries and those in historically marginalized and underrepresented regions continue to reinforce the lack of representation for local researchers in decision-making processes and credit attribution, further marginalizing their contributions to scientific knowledge (de Vos & Schwartz, 2022; Haelewaters et al., 2021; Raja et al., 2022). Although there has been a growing awareness of this issue in recent years (Odeny & Bosurgi, 2022), it is clear that much work remains to be done to increase awareness and effectively address this issue (Armenteras, 2021; Asase et al., 2022).

Capacity constraints and accessibility

Researchers from underrepresented countries often encounter a multitude of capacity constraints that hinder their active participation in international collaborations. The limited availability of resources, financial constraints, lack of accessible research publications due to open-access limitations, and technological infrastructure pose significant obstacles, limiting the ability of these researchers to proactively engage in international collaborations and hindering their contribution to global scientific endeavors (Meo et al., 2013; Rodrigues et al., 2022; Silveira et al., 2023; Valdez, Pereira, et al., 2023; Williams et al., 2023). Moreover, the lack of cross-cultural and cross-disciplinary research partnerships can create a perception that researchers from developing regions may lack the necessary skills and knowledge to bridge cultural and disciplinary gaps. As a result, their valuable insights and expertise are often overlooked, perpetuating disparities in research visibility and recognition. These challenges also include difficulty accessing important biodiversity data, with restricted behind paywalls that are unaffordable for many institutions and researchers in these underrepresented regions (Valdez, Pereira, et al., 2023; Wild, 2015). These issues severely reduce overall access to information and crucial data, making it difficult to conduct comprehensive analyses and gain a deeper understanding of biodiversity insights.



FIGURE 1 Main challenges and strategies for researchers, institutions, publishers, and funders to foster inclusivity and dismantle barriers in biodiversity research.

Given the intricate nature of the challenges, achieving greater equity in biodiversity research requires concerted efforts from various actors across the research landscape. We devised targeted strategic actions that individual researchers, institutions, publishers, and funders can take to help dismantle barriers and foster a more inclusive research environment (Figure 1).

RESEARCHER STRATEGIES TO PROMOTE INCLUSIVE BIODIVERSITY RESEARCH AND OVERCOME CHALLENGES

Although large-scale transformations are complex, individual researchers can be key units of systemic change through individual and collective efforts (Dot & Grid, 2023; Milliken, 2021; Steinberger, 2022). The ideas for change often begin with individuals who, through small but compounding actions, trigger ripple effects that gradually gain collective momentum, ultimately culminating in societal change (Dot & Grid, 2023; Milliken, 2021). By leveraging their platforms, social

networks, and peers, motivated researchers can help shift cultural norms, policies, and practices. There are four primary ways through which researchers can contribute to promoting inclusivity.

Cultivate self-reflection and awareness

Individual researchers from traditionally overrepresented regions must reflect on their research practices, regardless of career level, and recognize and address biases shaping their methodologies, data collection, and interpretation (Mendoza-Lera & Knäbel, 2023; Odeny & Bosurgi, 2022; Trisos et al., 2021). Although diversity workshops and trainings offer a foundation, true self-reflection involves continuous learning and applied practice through active listening and open dialogue around privilege and marginalization, seeking marginalized perspectives (e.g., through books, articles, talks, and mentorship), and using tools such as journaling for critical self-reflection. It also requires proactive efforts to engage those resistant to self-reflection, such as leading by example, amplifying marginalized

voices, and directly confronting inequities, discriminatory language, biased framings, and harmful norms. Additionally, advocating for cultural and institutional changes, creating diversity initiatives, regular inclusivity and equity checks throughout the research cycle, and championing collaborative partnerships that prioritize equitable representation of communities are also essential (Haelewaters et al., 2021; Trisos et al., 2021). These actions can transform the research environment into a more inclusive space, inspiring others to adopt similar practices and thereby discouraging discrimination.

Expand the scope of information search

To overcome the linguistic bias and underrepresentation of non-English studies, individuals from traditionally overrepresented regions can enhance inclusivity in biodiversity research through several strategies. First, non-local researchers should actively collaborate with native speakers to access biodiversity literature across different languages and local contexts, seeking assistance from colleagues or local researchers in their network to find, review, and interpret relevant literature (Droz et al., 2023). Additionally, researchers can utilize social media platforms, such as LinkedIn, ResearchGate, and academic networks or platforms, that are specifically designed to connect with underrepresented researchers, such as Authoraid. Professional societies, such as the Society for Conservation Biology (SCB), can serve as a critical platform to connect with local chapters. Although engaging in collaborative discussions can foster mutual learning and knowledge exchange, it is important to avoid extractive science and acknowledge contributions through coauthorship (Haelewaters et al., 2021; Trisos et al., 2021).

Second, researchers must proactively seek out and cite research from underrepresented regions because they offer valuable insights that are often overlooked (Ardiantiono et al., 2024; Bol et al., 2023; Nakamura et al., 2023; Odeny & Bosurgi, 2022). Although accessing this research can be challenging because it is not always accessible through commonly used academic databases (Abimbola, 2023; Aguado-López et al., 2016; Haddaway & Bayliss, 2015; Khorozyan, 2022), it can be facilitated by actively exploring regional indices, such as SciELO, DOAJ (Directory of Open Access Journals), J-STAGE (Japan), CNKI (China), KISTI (South Korea), LILACS (Latin America and the Caribbean), African Journals Online (AJOL), and Redalyc (Latin America, Spain, and Portugal). These resources, along with platforms such as Typeset, ResearchRabbit, Perplexity.ai, and Elicit, can help provide access to a wider range of literature.

Finally, to overcome language barriers, researchers can utilize translation tools (Steigerwald et al., 2022), such as Google Translate or DeepL, and large language models (LLMs), such as ChatGPT (Kayaalp et al., 2024). These tools can help researchers translate search terms, specific sections, and even full texts of a paper or report into other chosen languages, allowing access to biodiversity research published in languages other than English and to a broader range of literature and insights.

Foster collaboration with local researchers

To avoid parachute science and extractive practices, researchers should make sure they take several key steps. The first step is to actively seek out ongoing research projects conducted by local scientists and institutions prior to conducting their own research in underrepresented regions (Haelewaters et al., 2021; Mahdjoub et al., 2023; Marginson, 2022). Forming partnerships with local researchers and organizations improves understanding of the local context, research priorities, and conservation challenges (Haelewaters et al., 2021; Ryan-Davis & Scalice, 2022; Trisos et al., 2021). Such partnerships can help maximize efficiency by building on existing local expertise and networks, rather than requiring extensive preliminary studies in unfamiliar locations. Community-based monitoring and information systems is one framework that involves local communities and emphasizes context-specific knowledge and integration of social factors into biodiversity monitoring efforts (Chapman et al., 2024).

Second, when applying for research grants or funding for research that is based in these underrepresented regions, external researchers should proactively prioritize the inclusion of relevant local experts from these regions as co-applicants or collaborators (Armenteras, 2021; Ocampo-Ariza et al., 2023; Odeny & Bosurgi, 2022; Raja et al., 2022). This inclusion helps ensure that local expertise and perspectives are integral to the research project from its inception, fostering inclusivity and equitable distribution of resources (Ramírez-Castañeda et al., 2022).

Finally, researchers should codesign research with local partners to ensure that research questions are relevant, culturally sensitive, and are aligned with community needs (Armenteras, 2021; Ocampo-Ariza et al., 2023; Ramírez-Castañeda et al., 2022). Researchers can find partners through local networks, conferences, and expert directories or engage with community organizations and Indigenous knowledge holders. Platforms like the International Network for Next-Generation Ecologists, Partnerships for Enhanced Engagement in Research, and Global Community Innovation Platforms and professional societies with regional chapters can facilitate these connections. Initiatives, such as the Colombian-German Network for Research and Innovation (BioGeCo) and the Amazon Cooperation Treaty Organization (OCTA), can also serve as models for successful bilateral and multilateral collaborations.

Promote knowledge exchange and bilateral capacity building

Addressing the capacity constraints in biodiversity research requires a multifaceted approach. It first involves knowledge exchange and acknowledging local perspectives. Local communities possess invaluable insights into their ecosystems, and researchers should actively seek to incorporate local written and oral knowledge into research designs (Armenteras, 2021; Ocampo-Ariza et al., 2023). Citizen science can help address

knowledge gaps, particularly in underrepresented regions (Chowdhury, Fuller, Ahmed, et al., 2023; Chowdhury, Fuller, Rokonzaman, et al., 2023). Involving local stakeholders across research phases, from data collection to dissemination, can contribute to open science and integrating Indigenous expertise into databases like GBIF (Bedessem et al., 2023; Serbe-Kamp et al., 2023; Turnhout & Ganzevoort, 2023) while empowering participants and embracing diverse perspectives.

A more equitable research culture also involves integrating local experts and organizations throughout the conceptualization, design, implementation, and management of projects to ensure culturally sensitive work that leverages local knowledge (Armenteras, 2021; Ocampo-Ariza et al., 2023; Sze et al., 2024; Trisos et al., 2021). Embracing inclusive authorship and citation practices further recognizes local contributions and ensures equitable representation in scientific publications (Haelewaters et al., 2021; Mahdjoub et al., 2023; Ramírez-Castañeda et al., 2022; Soares, Cockle, et al., 2023).

Another action is through the facilitation of training workshops and bilateral skill sharing. Researchers can empower local researchers by organizing skill-enhancement workshops that equip them with the skills needed for independent biodiversity research based on local needs and resources (Asase et al., 2022; Bravo et al., 2016; Busse et al., 2022; Odeny & Bosurgi, 2022; Valdez, Vergara, et al., 2024). Furthermore, researchers from traditionally well-represented regions can gain valuable insights by learning about local perspectives and knowledge systems. For example, networks, such as AuthorAid, and initiatives, such as those of the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES) Secretariat, provide opportunities for knowledge exchange through collaborative workshops and training programs.

Lastly, researchers from well-established institutions can significantly advance equity in biodiversity research by mentoring and supporting underrepresented students and early-career scientists (Higino et al., 2023; Nordseth et al., 2023; Odeny & Bosurgi, 2022; Smith et al., 2017). This mentorship empowers these researchers to lead projects, fostering leadership, collaboration, and professional development. Examples of mentorship programs include the SCB Social Science Working Group mentoring program, IPBES Fellowship Programme, Women in Nature Conservation Leadership Program, Ecological Society of America SEEDS Program, Conservation Leadership Program Mentorship Scheme, African Climate and Development Society Mentorship Program, YETI (Young Ecologists Talk and Interact) in India, Latin American Leadership Academy Mentorship Program, and The Nature Conservancy's Indigenous Conservation Internship Program.

Strategies across career stages

It is important to recognize that the individual strategies mentioned may not universally apply, and cultivating inclusion requires recognizing the unique challenges faced by researchers at different stages in academic hierarchies. However, individuals at all levels can promote equity through approaches tailored

to their position and sphere of influence. A coordinated effort spanning career stages can create a more equitable and diverse research culture. Table 1 outlines three tailored strategies for each career level. Although not exhaustive, these examples provide actionable steps for researchers to contribute to a more inclusive research culture.

INSTITUTIONAL STRATEGIES TO PROMOTE INCLUSIVE BIODIVERSITY RESEARCH AND OVERCOME CHALLENGES

Research and academic institutions, particularly in privileged and resource-rich regions, wield considerable influence by providing essential support, resources, and funding that enable researchers to conduct impactful studies and initiatives. Their role is essential in advancing scientific knowledge and fostering a more inclusive and diverse research landscape. To promote inclusivity and drive positive change, these entities can implement four key strategies.

Establish specialized liaison roles

To establish specialized liaison roles, many institutions have advanced a diverse student and researcher population, including first-generation and international individuals with linguistic proficiency and a deep sociocultural understanding of focal regions of interest. By establishing formal liaison roles that leverage their talent pool, institutions can optimize inclusive collaboration without additional resources. Liaisons can serve as bridges between local communities and researchers, facilitate communication and identifying collaborators with localized knowledge, clarify issues from both perspectives, and develop mutually beneficial research initiatives. Liaisons can also champion diversity and inclusion by advocating for policies that promote these values throughout research stages, from funding acquisition to data sharing and publication. To maximize impact, institutions can establish a liaison council, a central hub for researchers planning international studies to connect with the appropriate regional liaison. These roles can help spur new global collaborations while better utilizing their diverse talents and expertise.

Implement equitable policies and practices

To foster equitable policies and practices, institutions must implement policies promoting equity, diversity, and inclusion at all levels of practice (Armenteras, 2021; Tarrago, 2021; Tricco et al., 2017). This includes supporting underrepresented researchers through transparency in hiring, promotion, and funding processes that redistribute resources for an inclusive culture, moving institutions beyond superficial gestures to systemic transformation. Additionally, to ensure fair resource allocation, evaluations of researchers and grant proposals should prioritize collaborative projects that involve local experts from marginalized regions.

TABLE 1 Specific actions to promote inclusivity across individual research career stages.

Career stage	Action
Graduate students	<p>Seek training opportunities and collaborations</p> <p>Aspiring researchers can actively seek opportunities to collaborate with scientists and institutions from underrepresented regions. These collaborations foster mutual learning and enable a more comprehensive understanding of local biodiversity challenges (Ramírez-Castañeda et al., 2022). Creating or joining networks for researchers and students further enhances the achievement of this goal. In addition to previously mentioned suggestions like AuthorAid, BioGeCo, and other platforms, another noteworthy initiative is the Youth ES Specialists (YESS) network (https://www.es-partnership.org/services/networking/young-es-specialists-yess/), which aims to foster collaboration and provides opportunities for young scientists to connect and collaborate in the field of ecosystem services.</p> <p>Support capacity-building initiatives</p> <p>Students can actively contribute to capacity-building initiatives in underrepresented regions by participating in training workshops and knowledge exchange programs, even in online formats (Smith et al., 2017). This engagement supports and empowers local researchers and scientists (Haelewaters et al., 2021; Mendoza-Lera & Knäbel, 2023). Additionally, platforms such as ONet (https://onet.ipbes.net/) and the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services Secretariat (https://www.ipbes.net/building-capacity) play a crucial role in connecting science with policy, with a particular emphasis on capacity building for biodiversity research.</p> <p>Acknowledge local knowledge</p> <p>When conducting research or literature reviews, students should recognize and value local knowledge and expertise (Nakamura et al., 2023). This includes diverse or heterogeneous forms of knowledge in ways previously described. Incorporating local and diverse perspectives improves the relevance and impact of biodiversity research.</p>
Early career researchers	<p>Mentor and support underrepresented colleagues</p> <p>Early career researchers can mentor and provide support to colleagues from underrepresented regions, fostering their growth and development within the scientific community (Smith et al., 2017; Asase et al., 2022; Nordseth et al., 2023). Joining mentorship programs as described in the previous section not only fosters career growth for underrepresented researchers, but also contributes to creating a more diverse and vibrant research landscape. Joining networks is also helpful to both promote work from underrepresented peers and create collaboration opportunities. Platforms such as AuthorAid (www.authoraid.info) connect over 14,000 researchers worldwide and offer peer mentoring, specifically for those in low- and middle-income countries. Gotara (www.gotara.com) also focuses on leadership training to close gender gaps. These and other similar platforms facilitate relationship building, skills development, and online mentorship, complementing in-person efforts for global capacity building.</p> <p>Advocate for diversity in research projects</p> <p>Early career researchers can actively promote diversity and inclusivity by advocating for inclusive hiring practices and encouraging the inclusion of local perspectives and expertise in research projects (Higino et al., 2023; Soares, Cockle, et al., 2023). Emphasizing the value of diverse research teams can lead to more comprehensive and effective outcomes. Joining groups of collective representation will also help empower early career researchers in pursuing inclusivity.</p> <p>Support inclusive research practices</p> <p>Researchers can use their platforms to advocate for inclusive research practices and foster collaboration with underrepresented regions. Designing studies collaboratively with local partners not only facilitates mutual learning and understanding of local priorities, but also advances the cause of biodiversity research (Armenteras, 2021; Odeny & Bosurgi, 2022; Silveira et al., 2024; Sze et al., 2024; Trisos et al., 2021). Encouraging colleagues to engage in diverse partnerships can further enhance the diversity and inclusivity of research efforts.</p>
Principal investigators	<p>Advocate for equitable inclusion policies and funding schemes</p> <p>As senior academics and research team leaders, principal investigators have the power to advocate for equitable inclusion policies and funding schemes within their institutions. This ensures resources are distributed more fairly and supports diverse research projects (Haelewaters et al., 2021; Soares, Cockle, et al., 2023).</p> <p>Encourage diversity in research teams</p> <p>Principal investigators should prioritize diversity and inclusivity when assembling research teams, including researchers from underrepresented regions (Trisos et al., 2021; Higino et al., 2023). They can further promote a culture of diversity by establishing a code of conduct that emphasizes respect and discourages intolerance within their groups.</p> <p>Allocate funding for collaboration</p> <p>Principal investigators can allocate funds specifically for collaborative research with underrepresented regions with less access to funds for research (Maestre & Eisenhauer, 2019; Silveira et al., 2024). This financial support encourages joint research projects and helps bridge resource gaps.</p>
Heads of departments or institutes	<p>Foster a culture of inclusive collaborations</p> <p>Leaders can actively promote and support inclusive partnerships that span different regions within their institutions, encouraging collaborations that transcend geographic boundaries and foster inclusivity (Haelewaters et al., 2021; Silveira et al., 2024). By facilitating knowledge exchange and cooperation between researchers from diverse backgrounds, these partnerships can lead to more comprehensive and impactful research outcomes.</p> <p>Champion inclusivity in academic policies</p> <p>Heads of departments or institutes play a vital role in advancing inclusivity by working toward implementing academic policies that prioritize diversity and promote international collaboration in biodiversity research (Higino et al., 2023; Silveira et al., 2024). Creating a supportive and inclusive academic environment paves the way for meaningful collaborations that incorporate diverse perspectives and expertise.</p>

(Continues)

TABLE 1 (Continued)

Career stage	Action
	Establish long-term partnerships with underrepresented regions Institutional leaders can actively seek and establish long-term research partnerships with institutions from underrepresented regions (Maestre & Eisenhauer, 2019; Marginson, 2022; Ramírez-Castañeda et al., 2022). These formal partnerships would promote resource and technology exchange for mutually beneficial endeavors. These alliances can also harness the specific funding opportunities set aside by international funding agencies and donors for collaborative research. This collaborative approach promotes shared goals and mutual benefits, fostering knowledge exchange and cooperation between researchers from diverse backgrounds and regions.

Allocate resources for diversity initiatives

Institutions can demonstrate their commitment to a diverse and equitable research community by allocating resources to diversity initiatives, such as workshops on cultural competence and inclusion training (Nordseth et al., 2023). Institutions can also allot some of their fellowships and scholarship programs toward supporting young researchers from diverse backgrounds and underrepresented regions. Additionally, allocating resources to capacity-building programs tailored to the specific needs of local communities can help avoid parachute science by empowering local researchers and ensuring that efforts contribute to long-term positive outcomes (Bravo et al., 2016; Ocampo-Ariza et al., 2023; Odeny & Bosurgi, 2022; Soares, Cockle, et al., 2023; Valdez, Pereira, et al., 2023).

Enhance support for international researchers

Institutions can strengthen their commitment to a more welcoming research culture by addressing the specific needs of international researchers. Targeted support should include assistance with visa applications and navigating bureaucratic processes to ease logistical burdens (Garelnabi et al., 2022). The provision of language resources and cultural orientation programs can facilitate smoother sociocultural transitions for researchers from diverse regions with differing norms (Haelewaters et al., 2021). Recognizing the unique challenges of cultural adaptation, supportive measures can help international researchers feel a sense of belonging as valued members of new academic environments.

PUBLISHER STRATEGIES TO PROMOTE INCLUSIVE BIODIVERSITY RESEARCH AND OVERCOME CHALLENGES

Publishers are pivotal in promoting inclusive biodiversity research and facilitating the dissemination of knowledge on a global scale. Their contributions to fostering inclusivity can be achieved in four main ways.

Multilingual dissemination with emerging technologies

Science is inherently multilingual, yet publishers have traditionally relied on an English-based publication model. Transitioning

to multilingual dissemination can facilitate broader global knowledge exchange and representation (Arenas-Castro et al., 2024; Bol et al., 2023; Droz et al., 2023; Higinio et al., 2023). However, it is important to recognize that the costs of supporting many languages can be prohibitive for many publishers. Artificial intelligence (AI) and LLMs present opportunities to help address this challenge.

One key way AI and LLMs can assist is by translating already existing and future research findings into multiple languages. Translating the extensive body of scientific literature into diverse languages increases accessibility for non-English readers, allowing valuable insights to reach broader audiences (Arenas-Castro et al., 2024). Until recently, manually translating the extensive body of existing scientific literature was prohibitively costly and time-intensive for publishers. However, AI-powered machine translations and LLMs provide an effective solution to automate and expedite the translation of scientific literature into diverse languages at scale.

Publishers can also use AI and LLMs to revolutionize the submission process for all researchers regardless of their linguistic background. By leveraging the potential of AI-powered translation, publishers can enable researchers to upload and submit their work in any language (Arenas-Castro et al., 2024; Golan et al., 2023). User-friendly, multilingual interfaces employing LLMs can help assist non-English speakers throughout the publishing process, and advanced translation technologies could automatically translate peer review comments, making the process more inclusive and reducing language barriers. Allowing researchers the option to publish directly in their native languages empowers local experts to disseminate discoveries in their own linguistic and cultural frameworks. This allows local scientists to share their work authentically through local languages and perspectives, leading to a more holistic understanding of topics deeply embedded in local communities, such as Indigenous knowledge of ecosystems, conservation challenges, and sustainable practices.

Remove financial barriers

Although many journals offer limited waivers and discounts for authors from lower-income countries, these efforts often fall short due to ineffective waivers, inadequate reductions in article processing charges (APCs), and stringent eligibility criteria, leading to the exclusion of researchers from low- to middle-income countries whose charges exceed their monthly income (Kwon, 2022; Peterson et al., 2019; Smith et al., 2021). Addressing these

issues requires reforms in waiver systems and more inclusive eligibility criteria (Arenas-Castro et al., 2024; Nakamura et al., 2023).

One possible strategy is for journals to provide incentives, such as offering publication credits to peer reviewers that can be used for future submissions. This can attract a wider diversity of expert reviewers and help overcome the challenge of recruiting sufficient qualified reviewers. Emerging technologies such as automated translations can also bridge linguistic barriers between authors and reviewers from different regions.

Another important strategy is to prioritize open and accessible publishing. Open-access journals play a pivotal role in advancing free and open science. However, even when publishers waive APCs, research may still remain behind paywalls, limiting its accessibility, especially in lower-income regions. Journals can address this by creating multilanguage abstracts and disseminate findings to the local press (Higino et al., 2023). Alternatively, publishers could allow authors to post open-access translations of preprints on multilingual regional preprint platforms, such as SciELO, to help make research more accessible and in local languages (Haelewaters et al., 2021). The preprint translations could include a link to the peer-reviewed published article to provide access to readers interested in the final version. This dual-track approach balances commercial interests with open knowledge.

Clear policy standards and guidelines

To promote equitable research practices, publishers should establish clear policies that prevent extractive research and prioritize community participation (Arenas-Castro et al., 2024; Haelewaters et al., 2021; Soares, Cockle, et al., 2023). Transparency in reporting research permissions, data access, funding, and accession numbers is crucial for maintaining research integrity. Coauthorship guidelines should also explicitly recognize diverse forms of knowledge and contributions beyond academic credentials, such as local expertise. By codifying inclusionary criteria, journals can foster responsible collaboration, prevent exclusionary practices, and acknowledge the value of diverse contributions.

Equitable representation in the peer review process

Journals and editorial board members remain heavily populated with people from overrepresented countries (Smith et al., 2023). To address geographic bias, publishers and societies must commit to equitable geographic representation among editors and reviewers (Bol et al., 2023; Liu et al., 2023; Nakamura et al., 2023). Inclusivity in editorial boards and peer review processes ensures that research from underrepresented regions receives fair evaluation and recognition. Implementing diversity criteria in the publication process will enhance the representation of global perspectives and reduce potential bias against editors from underrepresented institutions (Liu et al., 2023; Nakamura et al., 2023).

FUNDER STRATEGIES TO PROMOTE INCLUSIVE BIODIVERSITY RESEARCH AND OVERCOME CHALLENGES

Funding bodies, including local, national, and multilateral entities like the Global Environmental Facility, the Green Climate Fund, and philanthropic organizations such as MacArthur, Packard, and Moore, wield substantial influence in shaping biodiversity research and environmental policies. Their decisions and policies can significantly impact the allocation of resources, research priorities, and conservation efforts. Funders can drive positive change in biodiversity research through three key avenues.

Remove systemic barriers

Funding bodies play a crucial role in promoting inclusivity by removing systemic barriers to cross-border collaboration in biodiversity research (Pratt & Vries, 2023; Soares, Cockle, et al., 2023). By encouraging international research partnerships and developing more equitable access to funding and resources, funders can improve data accessibility for researchers worldwide (Higino et al., 2023; Soares, Cockle, et al., 2023).

Strengthen research networks

To promote equitable collaboration and knowledge exchange, funding bodies must prioritize and support research networks. Empowering researchers from underrepresented regions to assume leadership roles in biodiversity research requires strategic investments in capacity-building programs tailored to address specific needs (Busse et al., 2022; Haelewaters et al., 2021; Soares, Cockle, et al., 2023). Additionally, supporting collaborative research projects that actively engage local stakeholders and communities leads to more relevant and impactful conservation efforts.

Equitable resource allocation

Funders hold influence at every level of the research ecosystem, from universities and research institutions to government-funded organizations. This influence can be used to ensure adequate resource allocation for collaborative research, capacity building, and knowledge exchange among researchers and institutions from various regions, promoting multilateral research and capacity-building efforts (Ocampo-Ariza et al., 2023; Silveira et al., 2023; Trisos et al., 2021).

CONCLUSIONS

Promoting inclusive biodiversity research demands a proactive and concerted effort across all levels of the research ecosystem—individual researchers, publishers, institutions, and funding organizations. Researchers must embrace diversity,

actively advocate for reforms, and build reciprocal partnerships to remove biases and cultivate an inclusive research culture. Institutions can create specialized liaison roles, implement equity, and enhance support for international researchers. Publishers can play a pivotal role by promoting multilingual dissemination and embracing emerging technologies to facilitate broader knowledge exchange. Funding organizations hold the responsibility of dismantling systemic barriers and investing in research networks that prioritize inclusivity and relevance. Nevertheless, the solutions presented here do not represent an exhaustive list but rather aim to open up dialogue encouraging a continuous exploration of new ideas and innovative approaches for achieving inclusivity. Collectively, researchers, institutions, funders, and publishers have the power to drive a transformative shift in biodiversity and conservation research, ensuring equitable representation and maximizing the potential of our diverse and collective knowledge.

POSITIONALITY STATEMENT

We acknowledge and embrace our unique positionality at the intersection of these diverse global perspectives. Although our current affiliations lie mainly with institutions in traditionally overrepresented regions, our strong and deeply rooted connections on personal and professional levels to marginalized peoples and underrepresented regions offer us direct insights into the limitations explored in the article concerning inclusive biodiversity research. We come from diverse backgrounds and countries such as Latin America and Asian countries, including Colombia, Brazil, Bolivia, India, Singapore, and part of the Dominican Republic diaspora, or belong to marginalized groups. Despite our current institutional affiliations, we maintain strong cultural ties and remain actively involved in biodiversity research in these regions. Our dual perspective empowers us to better understand the complexities of the issues at hand and advocate for more inclusive approaches to biodiversity research. We carry with us the knowledge, experiences, and insights gained from working in these diverse ecosystems and collaborating with and belonging to these local communities. Our understanding of the cultural, social, and ecological contexts of these regions enriches our research and allows us to approach the topic of inclusive biodiversity science with depth and sensitivity. We believe our position as advocates for change, coupled with our gained ability to navigate both worlds, positions us as catalysts for positive transformation in the pursuit of inclusive biodiversity research that empowers and uplifts voices from all around the globe.

AUTHOR CONTRIBUTIONS

Jose Valdez: Conceptualization; synthesizing conceptual frameworks; writing; manuscript formatting; project supervision; visualization. **Gabriella Damasceno:** Conceptualization; synthesizing conceptual framework; literature review; manuscript formatting; review; editing. **Rachel R. Y. Oh:** Conceptualization; synthesizing conceptual framework; literature review; manuscript formatting; review; editing. **Laura Catalina**

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