Trends in
Ecology & Evolution

CellPress

Scientific Life

Including a diverse set of voices to address biological invasions

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Inclusivity is fundamental to progress in understanding and addressing the global phenomena of biological invasions because inclusivity fosters a breadth of perspectives, knowledge, and solutions. Here, we report on how the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) assessment on invasive alien species (IAS) prioritized inclusivity, the benefits of this approach, and the remaining challenges.

Inclusivity fosters better and more globally relevant science

Promoting inclusivity in science, the meaningful and equitable incorporation of diverse perspectives drawn from multiple cultures and nations, is increasingly recognized as critical to addressing global change [1]. Inclusive science invites and welcomes individuals and groups, especially those who are marginalized, have fewer resources, or are more likely to be excluded, to participate and to feel equal and respected. Inclusivity provides participants with access to resources and opportunities [2]. Inclusivity is particularly important when addressing the multiple and complex drivers of anthropogenic global change, such as biological invasions, which are perceived as negative or beneficial depending on the context [3,4]. Inclusivity is the driving force to build a more diverse science culture, which, in turn, can help create better and more globally relevant science.

Similar to many scientific disciplines, invasion science has frequently failed to be fully inclusive, resulting in large data and knowledge gaps across cultures, regions, ecosystems, and taxa, and in an incomplete understanding of the causes and impacts of biological invasions [5,6]. In other cases, biological invasions have been extensively studied for decades in some regions while seemingly ignored in others, creating spatial, temporal, and taxonomic data biases [6]. The local impacts of biological invasions can disproportionately affect marginalized groups [7], such as Indigenous Peoples and local communities (IPLC), ethnic minorities, rural populations, and poor urban communities. Biological invasions can also have gender- and age-differentiated impacts that generally decrease the health and well-being of people everywhere [8]. Therefore, inclusivity in invasion science is critical because resources [9] and ecological, economic, and societal impacts vary across regions [10], making full representation and engagement crucial for accurate global studies of biological invasions.

The IPBES Invasive Alien Species Assessment

The IPBES released the *Thematic Assessment of Invasive Alien Species and their Control* (hereafter IPBES IAS Assessment) in September 2023. Given the worldwide reach of IPBES and the global nature of biological invasions, the intergovernmental process offered an opportunity for a comprehensive and inclusive assessment. The IPBES IAS Assessment was undertaken by an international team with varying perspectives, expertise, and cultures, who reviewed diverse data and information sources in multiple languages (Figure 1). Here, we present the IPBES IAS Assessment process as a case study to highlight the options for, and challenges of, developing a truly inclusive global assessment of biological invasions.

Toward an inclusive author team: the IPBES process and its challenges

Nomination and selection processes

The IPBES Multidisciplinary Expert Panel (MEP) follows a specific process to select the assessment expert team. First, it issues a call for all governments and other relevant organizations to nominate experts (e.g., scientists with relevant expertise). Many IPBES member states have established national processes to select nominees inclusively. However, since English is the IPBES working language, this may preclude some non-anglophone experts from participating. When selecting nominees, the IPBES MEP seeks experts from a range of disciplines (e.g., ecology, social sciences, and economics), across career stages and knowledge systems, including Indigenous and Local Knowledge (ILK), to achieve geographical and gender balance for roles as fellows, lead authors, coordinating lead authors, review editors, and co-chairs. However, achieving balance in leadership roles (coordinating lead author and co-chair) can be challenging and, while not all IPBES member states were represented in leadership roles, a balance was reached regarding IPBES regions, and information on alien species was included from all countries. Having a geographically diverse group of experts contributed to a robust assessment of

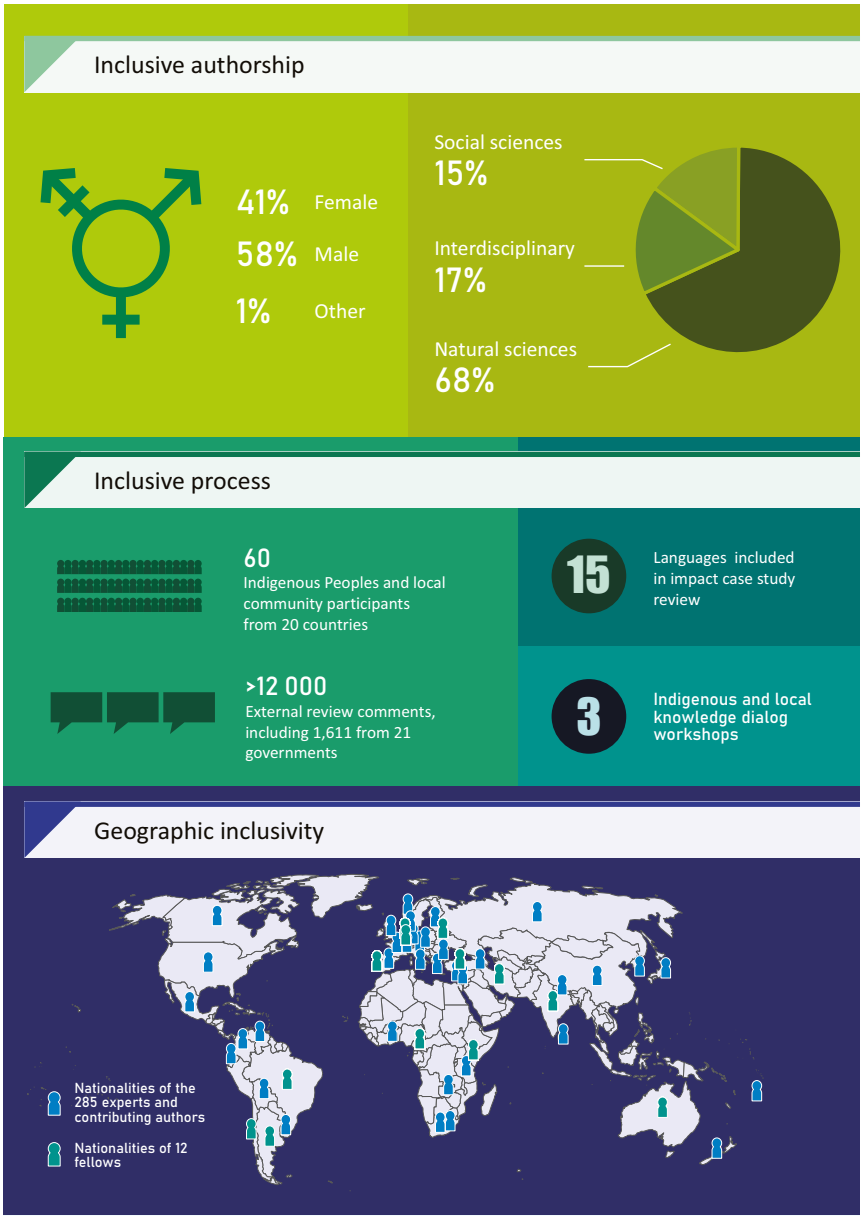

Figure 1. Extent of inclusivity in the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Invasive Alien Species (IAS) Assessment, arguably the most inclusive (although not fully inclusive) global report to date on IAS. Each chapter had small expert teams of 8–17 people. When wider expertise was needed, contributing authors with diverse backgrounds, numbering nearly 200, were invited from around the globe and were fundamental to the inclusion of data and knowledge that may have otherwise been overlooked or misunderstood. External reviews provided opportunities for any interested and qualified scientist, practitioner, or government to contribute to the assessment, increasing its legitimacy, policy relevance, and inclusion of diverse perspectives: 12 000 comments were received during the external reviews, including 1611 from 21 governments in the first and second external review. Despite all of these best efforts, some gaps remain unfilled. Note: some experts reported dual nationalities, which are included here.

available evidence and gave stakeholders confidence in the quality and local relevance of the findings [11].

Inclusive engagement with the author team

While the experts provided diverse insights and ideas and rich perspectives, inclusivity also created challenges, such as coordinating real-time meetings across time zones and English fluency impeding online meeting participation. Likewise, authors' ability to commit time and resources to the 4-year assessment process varied by country and institution. Some experts were able or empowered to allocate more time to IPBES tasks than were others. While authors from upper middle-income or lower-income countries were funded by IPBES to attend in-person meetings, authors from high-income countries were not, and some did not have the funds to fully engage, for example, by attending all in-person meetings. Nonetheless, an impressive degree of inclusivity was achieved (Figure 1).

A seat at the table: the role of IPLC

Participation by IPLC was critical to this assessment for many reasons not least because of their linked biological and cultural knowledge and innovative culturally informed strategies [12]. Globally, >2000 IAS colonize lands managed, used, and/or owned by Indigenous Peoples, threatening their quality of life and sometimes causing despair, sadness, and stress [8]. Nevertheless, ILK is often under-represented in invasion science [12,13]. To facilitate inclusion, the IPBES IAS Assessment engaged with ILK, holding three ILK dialog workshops with IPLC representatives and assessment experts. IPLC representatives were also invited as contributing authors and IPLCs participated in the external review process (Figure 1).

External reviews: the importance of a diverse team

Multiple external reviews by scientists, government representatives, IPLC, students,

nongovernmental organizations (NGOs), and individual citizens are critical to the IPBES assessment process. For the IPBES IAS Assessment, two external and open review rounds and an additional governments-only review period yielded >12 000 comments. Given that the expert team was inclusive, all concerns and comments could more effectively be addressed, particularly regarding the context-specific challenges of biological invasions.

Opportunities for young researchers and researchers from under-represented regions

A central part of the IPBES process is capacity building with inclusivity across regions and genders. The IPBES Fellowship Programme provides opportunities for outstanding early-career individuals from all backgrounds and disciplines to participate and be mentored by other experts. The IPBES IAS assessment included 12 fellows from all IPBES regions globally (Figure 1).

Global media attention raises awareness worldwide

Media attention following approval of the IPBES IAS Assessment was arguably the greatest ever obtained by any study on biological invasions. The launch garnered more than 4800 online news articles in 123 countries and across 50 languages, which reached billions of people. Conveying the urgency of this issue to governments, stakeholders, and IPLC is critical to achieving relevant management and policy outcomes. Having a globally inclusive and multilingual team ensured effective outreach across all nations. For example, the IPBES IAS Assessment team provided local examples to the media to communicate the relevance and urgency associated with biological invasions to all regions across the globe. The IPBES IAS Assessment authors have thus far participated in more than 100 science and policy events at the local, national, or international levels in multiple countries, languages, and in diverse in-person and online formats.

Opportunities for greater inclusivity

The goal of the IPBES IAS Assessment was to produce a comprehensive global synthesis on IAS. However, knowledge gaps highlighted in the report, particularly those related to taxonomic, geographical, and ecosystem representation, arose because less information and fewer data were available from some taxa, regions, and ecosystems (e.g., microbial taxa, Central Africa, and marine). Even though external review periods provided multiple opportunities for stakeholders to submit examples from their regions, language barriers and accessibility of materials likely hindered contributions of data and knowledge. Nonetheless, the diversity of the expert team boosted confidence that the analysis credibly reflected existing global knowledge.

Still, inclusivity was imperfect. For example, no active efforts were undertaken to include LGBTQ+, disabled, or neurodivergent people [14]. Greater effort to ensure the review process included a diverse range of stakeholders, including conservation practitioners and managers alongside academics, would increase inclusivity and enrich the understanding of both the issues and the solutions. While ILK was a focus of the literature search, including more ILK holders as authors would have further strengthened the assessment. Undoubtedly, there are many marginalized groups that did not have a voice in the IPBES IAS Assessment despite significant efforts. Identifying these groups and developing strategies to overcome barriers to inclusion must be prioritized.

Online platforms that facilitate real-time communication across the planet have increased inclusion. Rapidly emerging technologies, such as artificial intelligence, could increase access to non-English language information and help experts to overcome language barriers. Funding is always important for ensuring the greatest reach for global assessments. While the time of some experts was supported by their home institutions, additional funding would have increased equity, such as by enabling experts to recruit dedicated research assistants and postdoctoral fellows as contributing authors to support key roles in data collection and analyses or by supporting experts' salaries outside of the academic year.

The way forward: fostering more inclusivity in invasion science

Overall, having a diverse and inclusive team with experts from around the world is vital to understanding the multiple realities in which the threats of IAS are embedded. Throughout the process, the challenges of bringing diverse experiences and knowledge together to reach agreements by consensus were apparent, but overcoming them resulted in deeper discussions, more satisfactory agreements, and a richer experience for team members. We urge researchers to undertake the work of inclusivity beyond traditional working group models, which often fail to incentivize wide representation beyond the funding country or region. The IPBES IAS Assessment demonstrates that inclusion facilitates coordinated decision-making and buy-in for products and outcomes, a worthwhile path to success.

Acknowledgments

We are indebted to the entire expert team and to the many contributing authors, to the members of the IPBES Bureau and Multidisciplinary Expert Panel who were part of the assessment's management committee, and to the external reviewers who generously provided their expertise through the assessment. The assistance, guidance, and leadership from the IPBES secretariat and the technical support unit have been invaluable. We thank our host organizations for their ongoing encouragement and support.

Declaration of interests

M.A.N. is a member of the Editorial Board of *TREE*.

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https://doi.org/10.1016/j.tree.2024.02.009

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