Author Accepted Manuscript of the paper:

Lynch, A., Fernández-Llamazares, Á., Palomo, I., Jaureguiberry, P., Amano, T., Basher, Z., Lim, M., Mwampamba, T.H., Samakov, A., Selomane, O. (2021) Culturally diverse expert teams have yet to bring comprehensive linguistic diversity to intergovernmental ecosystem assessments. One Earth, 4(2): 269–378. doi: 10.1016/j.oneear.2021.01.002

Culturally diverse expert teams have yet to bring comprehensive linguistic diversity to intergovernmental ecosystem assessments

Abigail J. Lynch[1*], Álvaro Fernández-Llamazares[2,3], Ignacio Palomo[4,5], Pedro Jaureguiberry[6], Tatsuya Amano[7,8], Zeenatul Basher[9, 10], Michelle Lim[11], Tuyeni Heita Mwampamba[12], Aibek Samakov[13], Odirilwe Selomane[14]

[1] U.S. Geological Survey, National Climate Adaptation Science Center, 12201 Sunrise Valley Drive, Reston, VA 20192, USA; ajlynch@usgs.gov
[2] Helsinki Institute of Sustainability Science (HELSUS), Faculty of Biological and Environmental Sciences, University of Helsinki, FI-00014, Helsinki, Finland
[3] Global Change and Conservation, Organismal and Evolutionary Research Program, Faculty of Biological and Environmental Sciences, University of Helsinki, FI-00014, Helsinki, Finland
[4] Laboratoire d'Ecologie Alpine, UMR 5553, CNRS-Université Grenoble Alpes-Université Savoie Mont-Blanc, CS 40700 38058 Grenoble cédex 9,France
[5] Basque Centre for Climate Change, Edificio Sede, Campus UPV/EHU, Barrio Sarriena, s/n, 48940 Leioa, Vizcaya, Spain
[6] Instituto Multidisciplinario de Biología Vegetal (IMBIV), CONICET and FCEFyN, Universidad Nacional de Córdoba, Casilla de Correo 495, 5000 Córdoba, Argentina
[7] School of Biological Sciences, The University of Queensland, Brisbane, 4072 Queensland, Australia
[8] Centre for Biodiversity and Conservation Science, The University of Queensland, Brisbane, 4072 Queensland, Australia
[9] Center for Systems Integration and Sustainability, Michigan State University, East Lansing, MI 48823, USA
[10] Gulf of Mexico Fishery Management Council, 4107 W Spruce Street, Tampa, FL 33607, USA
[11] Macquarie Law School, 6 First Walk, Macquarie University, Sydney 2109, New South Wales, Australia
[12] Institute for Ecosystems and Sustainability Research, National Autonomous University of Mexico, Morelia Campus, Antingua Carretera a Pátzcuaro 8701, C.P. 58190, Morelia, Michoacan, Mexico
[13] Aigine Cultural Research Center, 93 Toktogul Str, 720000, Bishkek, Kyrgyzstan
[14] Centre for Complex Systems in Transitions, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

***** Corresponding and lead author contact: ajlynch@usgs.gov

Summary

Multicultural representation is a stated goal of many global scientific assessment processes. These processes aim to mobilize a broader, more diverse knowledge base and increase legitimacy and inclusiveness of these assessment processes. Often, enhancing cultural diversity is encouraged through involvement of diverse expert teams and sources of knowledge in different languages. In this article, we examined linguistic diversity, as one representation of cultural diversity, in the eight published assessments of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Our results show that the IPBES assessment outputs are disproportionately filtered through English-language literature and authors from Anglophone countries. To incorporate more linguistic diversity into global ecosystem assessment processes, we present actionable steps for global science teams to recognize and incorporate non-English-language literature and contributions from non-Anglophones. Our findings highlight the need for broad-scale actions that enhance inclusivity in knowledge-synthesis processes through balanced representation of different knowledge holders and sources.

Keywords
Cultural diversity; Non-English languages; Non-Anglophones; intergovernmental process; IPBES; knowledge; language; language barriers; scientific literature; representation

Introduction

English is the *lingua franca* of science[1], especially in the areas of natural sciences[2]. Most journals indexed in Academic Rankings (i.e., with an impact factor) are written in English. Thus, publishing in English is often key to career development (e.g., citation rates[3], job performance[4], mobility[5]). There are advantages in having a common language in science and knowledge production. A common language facilitates communication across countries and cultures, which is essential in contemporary science and knowledge building processes[6]. In the absence of a common language, researchers from different regions would have difficulty working together.

Ignoring linguistic diversity in science, however, can perpetuate hegemonic patterns of knowledge production by discounting the evidence base found in non-English-language publications or inhibiting it from being broadly shared[e.g., 7–11]. Civil rights leader W.E.B. Du Bois's concept of 'double consciousness'[12] illuminates how non-Anglophone scholars often need to adopt the rules and structures of the systems that oppress their ways of knowing and the very foundations of their cultures to thrive in academia[13]. These systemic issues continue historic and ongoing colonization of thought[14].

Levels of linguistic representation differ across scientific disciplines[15,16]. For example, over a third of biodiversity conservation publications are in languages other than English[17]. The number of non-English publications is arguably higher for research on Indigenous and Local Knowledge (ILK), which is often published only in local languages relevant to Indigenous Peoples and Local Communities[18]. Importantly, knowledge of Indigenous groups whose languages are endangered are also the least represented in the published literature [e.g., 19].

Ignoring non-English-language knowledge sources can contribute to incomplete scientific understanding[20,21]. For instance, meta-analyses that omit a large proportion of literature because it is not in English could bias ecological evidence syntheses due to systematic differences in study characteristics (e.g., study species, ecosystem types) and statistical results (e.g., effect size)[22]. As one example, several studies have shown that there is extensive scientific literature on wildlife-wind farm interactions in languages such as Spanish[23] and German[24] which are not broadly cited in English-language literature. Including such non-English literature would greatly amplify the sample size that conclusions are based on and may either confirm or repute conclusions based on English-language only studies. The bias also extends to global databases which tend to be in English but require information generated worldwide to be complete. Consequently, it is not surprising that country-level data for such global databases (e.g., Global Biodiversity Information Facility, gbif.org) are more complete in countries with a higher proportion of Anglophones than those where English is rarely spoken[25].

Importantly non-Anglophone policymakers and the broader public might miss relevant scientific discoveries which are only communicated in English. Several studies have shown that access to scientific information can be limited for certain groups if national languages are not used[3,17,26,27]. As a result, the transfer of scientific knowledge into local policies may be hindered[28]. Furthermore, scientific discovery and its application can be slowed for non-Anglophones due to the linguistic burden of publishing in English[29–31]. People in countries where English is not widely spoken are less likely to read and publish ecological research in English-language journals[32,33], which in turn can deepen global-level inequities around the access to science and implementation of sustainability actions.

Language can be used as a proxy for broader ways of knowing[34,35]. The insistence on English as the language of science can exacerbate existing unequal power relationships[36,37] and dominant epistemic cultures[38] by reinforcing cultural imperialism [39]. Such concerns have led to calls for scientists to develop mechanisms to overcome language barriers and be more inclusive of non-English-language literature, regardless of discipline[17,40,41]. Reaching beyond 'tokenism,' institutions are seeking ways to establish more inclusive processes to incorporate diverse sources of evidence into knowledge production or synthesis[18,42,43].

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is a global science-policy body that aims to provide policymakers with the best available knowledge on the relationships between biodiversity and human well-being[44]. It is the largest and most important institution of its kind. Here, we use IPBES as a case study to examine the extent of inclusion of non-English-language literature, in terms of participating experts and the knowledge consulted, in environmental assessment processes.

IPBES explicitly operates on the principle of inclusion of diverse knowledge sources, facilitates dialogue between those with different values[45], and 'recognize[s] and respect[s] the contribution of ILK to the conservation and sustainable use of biodiversity and ecosystems'[46]. Thus, IPBES actively encourages use of non-English-language sources and even supports a task force specifically dedicated to facilitating the inclusion of ILK[47]. Several studies have already examined regional representation among the experts who participate in IPBES's different bodies

and expert groups[48–50], which, to our best knowledge, is the closest proxy we have to understand broader patterns of cultural diversity within IPBES.

Our study widens the lens with which representation is examined in IPBES to include other aspects of cultural diversity such as language (**Note S1**). Through five metrics, we analyzed linguistic diversity across eight IPBES assessments. Our results show that, despite having diverse expert teams, the IPBES assessment outputs are disproportionately filtered through English-language literature and authors from Anglophone countries.

Results

We examined linguistic diversity across four thematic assessments (Pollination, Scenarios and Modeling, Land Degradation and Restoration, Global) and four regional assessments (Africa, the Americas, Asia and the Pacific, Europe and Central Asia). We coded assessment experts, references (language and first author), comments, and final reports by language, nationality, and country of affiliation, as appropriate (**Table 1**; **Figures S1-7**). We considered language, nationality, and country of affiliation here to be a proxy of cultural representativity. We identified Anglophone affiliations by the 18 countries recognized by the United Kingdom (UK) government as being 'majority native English speaking' (listed in **Note S2**). These results can inform the inclusion of linguistic diversity in the second work programme of IPBES and other global initiatives.

Linguistic Diversity of Assessment Experts

Across the eight assessments, experts collectively represented 106 nationalities (54.9% of 193 United Nations member states). The majority of IPBES experts represented non-Anglophone countries with only ten Anglophone countries represented (9.4% of IPBES assessment expert nationalities compared to 9.3% of countries being Anglophone; **Figure 1C**). The Americas assessment had the fewest nationalities overall (25) and highest proportion of Anglophone countries (7). The Global assessment had the highest number of nationalities (54). The Europe and Central Asia assessment had the smallest number of Anglophone affiliations (3). Some countries, such as the United States (US) and UK, were disproportionately represented across all assessments compared to many countries in Africa and Asia.

Linguistic Diversity of Assessment References

References across all assessments were overwhelmingly in English (96.6%; **Table S1**; **Figure 1A**), followed by some regionally important languages, such as Spanish for the Americas regional assessment (5.5%), Russian for the Europe and Central Asia regional assessment (4.5%), and French for the Africa regional assessment (2.3%). Linguistic diversity was particularly low among references cited in the Global assessment (99.6% of references were in English) and the Asia and the Pacific regional assessment (only 5 out of 3,368 references were in a language other than English; 0.15% of total) despite the existence of significant collections of non-English scientific publications in the region (e.g., Chinese and Japanese literature).

Similar to reference language, first author affiliation for references revealed an overrepresentation of Anglophone countries when compared to Scimago Country Rank (scimagojr.com/countryrank.php) which tracks the number of scientific documents by country (**Figure 1B**). In the subset of references analyzed, 51% were first-authored by individuals in

Anglophone countries, even though, worldwide, only 9.3% of countries are Anglophone. The proportion of Anglophone affiliations for first authors ranged from 27% (Europe and Central Asia regional assessment) to 62% (Scenarios assessment). The four regional IPBES assessments show some additional patterns which, for the most part, align with their given regional foci (**Table S2**). The Americas assessment, for example, shows dominance of the US, UK, and Canada, with 36.7%, 10.6% and 9.3% of references, respectively (this is the most unbalanced dominance of Anglophone countries of all eight assessments).

Linguistic Diversity of Assessment Comments

A key component of the IPBES knowledge synthesis process includes the opportunity for scholars and stakeholders to review and comment on multiple drafts of the assessment text. Reviewer comments were variable across the assessments (*note that the Global assessment comments were not publicly available at the time of this analysis*). Across the seven assessments for which we examined comments, Anglophone countries had the highest number of assessment comments based on reviewer affiliation (32.9% of all comments compared to 9.3% of countries being Anglophone; **Figure 1C**). Two thematic assessments, Scenarios and Pollination, had even higher representation of Anglophone countries with 54.5% and 42.8% of comments, respectively. The regional assessments, as with the references, showed more diversity. The Americas assessment had the highest proportion of Anglophone country comments with 31.4% (the US provided 17% of all comments for that assessment) and the Africa assessment had the lowest with 15.7%.

Linguistic Diversity of Assessment Final Reports

The plain text versions of the assessment reports' Summaries for Policymakers (SPMs) are available for download in all six United Nations (UN) languages (i.e., Arabic, Chinese, English, French, Russian and Spanish) for all eight assessments. In addition to English, the laid out SPM is available in Chinese and French for the Pollination assessment, Chinese for the Scenarios assessment, and Czech and Japanese for the Global assessment. However, the complete approved assessment reports (i.e., the detailed documents sustaining the findings reported in the SPMs) were only available in English.

Discussion

Despite IPBES's explicit mandate for experts to use different sources of knowledge published in different languages[51], our analysis shows that there is limited linguistic diversity across all eight assessments; notably, there is a predominance of Anglophones' assessment comments and English-language literature (**Figure 1**). An extensive survey of the scientific literature produced globally on biodiversity and conservation reported that 35.6% of scientific documents were not in English[17]. This number contrasts with the very low percentage of non-English references in our analysis (3% across all assessments; **Table S1**). Although explaining the root causes of the patterns observed in our analysis is not possible based on our data, it raises important questions about challenges of increasing language diversity in environmental assessments. Our study opens the door for an important and timely discussion on how the incorporation of scientific outputs and knowledge products in different languages in the assessment process can contribute to establishing more inclusive knowledge-building processes, and address some of the power imbalances that exist in the scientific domain, particularly at the outset of defining assessment structures[52].

The English-Language Literature & Anglophone Imbalance

The prevalence of English-language literature is explained in part because most studies frequently cited in assessment processes are written in English[53]. While there are some important non-English-language resources[17,22], our results suggest that experts tend to cite English-language peer-reviewed literature preferentially. Even though IPBES experts are encouraged to value plurality of knowledge generation and synthesis arenas, pressure to produce high-quality assessments likely includes an implicit bias towards knowledge published in top-of-the-range scientific forums which tend to be internationally recognized indexed journals with high impact factors - most of which are in English. Moreover, non-English-language literature tends not to rank well by the common standards[4,54]. With the exception of some Chinese academic journals, publications in languages other than English are broadly deemed lower tier — including those published in languages with many speakers, such as Spanish, Portuguese, and French[55].

The observed trends in references cited in the assessments mirror the distribution of articles submitted to or published in several prominent ecological journals. These articles disproportionately represent authors from Western Europe, North America, and Oceania[32,56]. Some analyses even suggest that the proportion of English speakers in a country has a stronger effect on readership, submission, and acceptance rates of scientific articles than the percent of the gross domestic product invested in research and development[32].

Even after considering differences between countries in their proportion of citable scientific documents produced, as tracked by Scimago Country Rank, there is still an overrepresentation of Anglophones in the four thematic IPBES assessments (i.e., higher proportion than expected for references with Anglophone affiliations for first author). The average percentage of references with a US first affiliation in the four thematic IPBES assessments was high (27.4%) compared with the proportion of documents produced by US-affiliated researchers in pertinent areas of the Scimago Country Rank (21.4%, all / 19.1%, agriculture and biological sciences / 19.9%, environmental sciences; **Table S2**) which may be due to experts citing preferably high impact factor journals. Several other countries, such as the UK, the Netherlands, and Canada, were also highly represented with regards to assessment references. Conversely, countries like China (11.6%, all / 8.43%, agriculture and biological sciences / 11.6%, environmental sciences) and Japan (5.27%, all / 3.93%, agriculture and biological sciences / 3.16%, environmental sciences) were both underrepresented in IPBES assessments with only 1.1% and 1.2% of references across all assessments produced by those affiliated with each of the countries, respectively.

IPBES regional assessments have, on the other hand, been more successful at diversifying literature representation. For example, the Americas assessment used more references with Brazilians and Argentinians as first authors than would have been expected from these countries' Scimago ranks (6.2% and 3.7% of references, respectively; also see **Table S2**). This may be partially due to the smaller geographic scale and scope of regional assessments, which need only draw from knowledge generated in the region (versus globally). Regional experts are likely to be familiar with localized studies that have been published in national and/or local languages.

Meeting the Challenge of Linguistic Inclusion

Realizing that diversity in evidence from multiple languages produces better science[57,58], IPBES has taken the first step in recognizing and incorporating diverse knowledge systems into its assessments and deliverables through assembling culturally diverse expert teams. Bringing in diverse knowledge systems can also help to accommodate intellectual perspectives outside of the prevailing conversations and lead to more innovative research and decision making[11,59–63]. Yet, despite attempts to encourage cultural diversity (e.g., diversity in invited experts, review processes which can recommend sources in any language, ILK task force), English and Anglophone countries still clearly dominate across IPBES assessments.

The challenge of including knowledge in diverse languages is systemic and pervasive in science. Some elements are grounded in practicality (e.g., extra time is required to incorporate non-English-language literature), but others are much more ingrained within the power structures of scientific processes (e.g., historical context of 'ivory tower' bastions of science). It has proved 'easier' to address some of these challenges by further promoting English as the *lingua franca* of science, with few options for non-Anglophone scientists to publish in high-impact journals in their own languages (following 'World English theory'[64]). The result is that, even among non-Anglophone scientists, English journals are more valued and perpetuate the role Anglophones hold as 'gatekeepers' of science[65].

Our study shows that real and long-term shifts in inclusion of diverse evidence sources will need to go beyond bringing more voices to the table (after all, 106 nationalities have participated in IPBES assessments so far). Systemic shifts will require undoing deeply held ideologies of what is considered 'valuable knowledge,' reassessing the metrics of 'impact science,' and amplifying the language options for sharing and accessing scientific knowledge. Movements and initiatives to 'decolonize science'[66] and 'dismantle academic and methodological imperialism'[14] aimed at equalizing the playing field and correcting long-held historical prejudices on inclusion in science are beginning to gain traction[e.g., 67,68]. Likewise, efforts to transform education through anti-colonial praxis can shift scholarly discourses[69,70]. Some of these solutions are currently tractable but require putting policies in place to ensure widespread implementation, such as funding agency requirements to include multiple sources of evidence or sources in multiple languages[65]; others will require more directed efforts, in line with broader discussions of decoloniality and plurality[71], to ensure that inherent systemic inequities prominent in today's scientific culture are eliminated[72].

Promoting Diversity in Global Assessments

In an attempt to expand the evidence base and to include knowledge in multiple languages, IPBES has incorporated a number of innovative approaches[46]. These consist of: representative selection processes for chapter teams (e.g., geography, discipline, gender); inclusion of grey literature in addition to scholarly literature published in academic journals; inclusion of Indigenous scholars as assessment experts; organization of ILK dialogues with Indigenous Peoples and Local Communities to include verbally communicated knowledge; development of step-by-step guidelines for how to include grey literature and ILK in assessment chapters; using contributing authors to fill in expertise gaps and broaden the diversity of knowledge sources consulted; and synchronous interpretation during plenaries and ILK dialogues. These efforts have transformed how other knowledge systems are integrated into IPBES assessments[59,73]. As a consequence, across all assessments, the representation of Anglophones expert affiliations was

consistent with global proportions (i.e., 9.4% of IPBES expert nationalities compared to 9.3% of all countries being Anglophone).

Assembling representative expert teams is only the first step, however. Knowing, now, that even culturally diverse teams underutilize linguistically diverse literature underlines the need for additional processes to change the status quo. Anglophones have a responsibility to: demonstrate genuine interest and respect for what non-English-literature contains; show empathy and humility for what they 'don't know' and appreciate the struggle that non-native speakers have when required to use English to communicate (both written and verbally); and be willing to invest the time and effort needed to incorporate non-English-language literature. IPBES and other similar global assessment processes (e.g., Intergovernmental Panel on Climate Change, Global Environment Outlook, International Resource Panel, Global Biodiversity Outlook), and even multilateral environmental agreement processes such as the upcoming post-2020 Global Biodiversity Framework can continue to actively facilitate participation of non-Anglophone experts within these processes and require consultation of non-English-language knowledge (**Table 1**).

We acknowledge that many of these recommendations have constraints (e.g., funding) but opportunities are available even under current circumstances. See, for instance, the plain language summaries of the Scenarios assessment (relationalthinkingblog.com/2020/09/18/plain-language-summary-creating-desirable-futures-for-nature-the-nature-futures-framework). Existing resources that explicitly seek to assemble and share non-English-language sources can also help address these gaps. For example, the Conservation Evidence database systematically catalogues English-language journal articles, Non-English-language journal articles, and grey literature to identify conservation actions and the effects of these actions on biodiversity and ecosystem services[74].

Assessment processes can solicit and search for relevant non-English-language studies and, where relevant, include them, as IPBES has recently done to solicit ILK materials in national and local languages[75]. They can also facilitate searches for non-English-language literature in collaboration with native speakers of different languages[76] or with the aid of emerging technologies (e.g., litsearchr package in R [elizagrames.github.io/litsearchr] translates search strings into multiple languages). Additionally, the use of non-scientific databases that provide access to large volumes of non-English-language scientific literature (e.g., SciELO in Brazil [scielo.br], Dialnet in Spain [dialnet.unirioja.es], HAL in France [hal.archives-ouvertes.fr], J-STAGE in Japan [jstage.jst.go.jp]) could be also actively encouraged. All of these actions can serve to increase the legitimacy of assessment processes, making them more inclusive, representative, and accurate[22,77–80]. Beyond scholarly literature, additional processes are needed to make clear how what is often referred to as grey literature can be evaluated appropriately[81]. In IPBES, for example, the current criteria for evidence assessment speaks primarily (albeit not exclusively) to scientific literature[82].

Linguistic diversity in the broader inclusion context

Still, there is a need to go beyond encouraging experts to consult more diverse literature[83]. As has been done with ILK[43], future initiatives should also consider providing specific guidelines on how to collate the knowledge contained in scientific literature from other languages, and how to

combine that information in transparent and defensible ways so that it can contribute to informed and inclusive decision-making from local to global scales. For IPBES, this may come in the form of establishing a linguistic diversity task force, similar or related to the ILK task force. Ultimately, these efforts will assist in providing more comprehensive scientific information to improve the interface between knowledge and policy on sustainability issues across scales.

It is also important to address the underlying structural inequities which lead to privileging Anglophones in publishing[e.g., 84] and multicultural working styles[37]. There is the need to actively identify means of providing a level-playing field for non-Anglophones to contribute in collaborative endeavors such as intergovernmental assessments. Examples include best practice guidelines developed by those for whom English is not a first language, facilitation training for active participation among multicultural teams[e.g., 85], systematic review protocols that include search terms in multiple languages, actively encourage non-native speakers of English to provide feedback, even in their own languages, and guidance on inclusion of other forms of knowledge and evidence. IPBES and other global assessment processes have taken steps to introduce at least some of these recommendations, but they will require substantial additional effort to fully operationalize.

More broadly, our results highlight the need to embrace linguistic diversity in ecosystem assessments, re-evaluate the role of non-English-language literature in science, and make a concerted effort to incorporate such knowledge in assessments and other academic processes. This will require innovative approaches for more equitable representation from the outset before the power dynamics become a fixed feature. One key component for this important endeavor to succeed, is ensuring that high quality research is valued, regardless of the language of publication. Assessment processes can facilitate expert-evaluation of these resources. Scholars[e.g., 39] and efforts, such as the Helsinki Initiative in Multilingualism in Scholarly Communication (helsinki-initiative.org) and translatE (translatesciences.com), have also issued a series of recommendations to ensure that linguistic diversity is actively promoted in research assessment, evaluation, and funding systems. Even online translation tools can help facilitate these processes. And journals, especially high-ranked journals, can contribute to legitimizing linguistic diversity in science by enacting policies to publish extended abstracts, or even full articles in several languages[39], and promoting multicultural, multilingual editorial boards as well as reviewers[86]. These opportunities for structural reform have the potential to create significant inroads towards addressing systemic barriers to inclusion and unequal power relationships within ecosystem assessments and also, more broadly, within scientific culture.

Conclusion

Over the past decades, increasingly diverse sources of knowledge have been included in environmental decision making[43]. Conserving global biodiversity not only calls for innovative ways to live in harmony with nature. It also necessitates the collation and synthesis of the multiple ways of knowing that humanity has accumulated over millennia and centuries of conservation-related research [87]. Much of this knowledge has been generated locally and is expressed daily in local languages, traditions, and cultures[42,46]. This rich knowledge base often exists in transcribed form, but mostly in the languages that local experts speak in their different regions (i.e., not English)[46].

Yet, our analysis shows that having diverse expert teams does not fully address the issue of low linguistic diversity. Further efforts and mechanisms are needed to effectively incorporate linguistically diverse literature and knowledge into ecosystem assessment processes (**Table 1**). To reframe power balances in science, it is time to move beyond the bare minimum of encouraging culturally and linguistically diverse experts and knowledge holders to bring to the table literature and expertise available in their own languages in addition to English and actively apply non-English knowledge and better integrate non-Anglophone expertise into team dynamics. Linguistic diversity is a joint effort uniting non-Anglophones and Anglophones to ensure inclusion of diverse literature and knowledge in global ecosystem assessments, as well as to broader scientific processes.

Experimental Procedures

Resource Availability

Lead Contact

For queries related to this article, please contact Abigail J. Lynch, ajlynch@usgs.gov.

Materials Availability

Not applicable to this study.

Data availability

The dataset generated through this study is available through the U.S. Geological Survey's data repository, ScienceBase, at https://doi.org/10.21429/pdn4-bk48.

Linguistic diversity

We examined linguistic diversity in the IPBES process across all of its published assessments: four thematic assessments (Pollination, Scenarios and Modeling, Land Degradation and Restoration, Global) and four regional assessments (Africa, the Americas, Asia and the Pacific, and Europe and Central Asia) (all available at: ipbes.net/assessing-knowledge). We used five metrics which examined linguistic diversity as represented by assessment experts (IPBES terminology for Coordinating Lead Authors, Lead Authors, and Fellows of the reports), assessment references, assessment comments, and the approved assessment document (see **Graphical Abstract**; **Figures S1-3**). The metrics include: (i) nationality/ies of each expert (*927 total experts*), (ii.a) language of each reference in the approved assessment report (*22,778 total references*), (ii.b) country/ies of affiliation of the first author of a subsample of references (*1,401 references across all assessments*), (iii) nationality/ies of affiliation of each reviewer (*42,107 total comments*), and (iv) languages in which the approved assessment reports are available for the public to view and download (**Table 1**). In our analysis, we define Anglophone countries as those identified by the UK government as being 'majority native English speaking' (listed in **Note S2**).

We acknowledge some limitations with this approach. First, defining Anglophone countries as those in which a majority are native English speakers is a strict interpretation; many other countries (e.g., Bangladesh, Hong Kong, India, Singapore, South Africa), have large English-speaking contingents, too, but are excluded from the definition of 'Anglophone.' Second,

affiliations of authors referenced and, in some cases, nationality of experts do not necessarily represent the individual's native cultural background as they may be working in a foreign country or naturalized citizens. Additionally, sharing the same language does not necessarily imply sharing a similar culture (i.e., language is not fully representative of cultural diversity). However, we assume that individuals, at minimum, have a working fluency in the spoken language of the country of their affiliation and nationality. Consequently, we recognize that we are likely *underrepresenting* diversity with tagging individuals by their nationality or affiliation as many may be multilingual. Despite these necessary assumptions, our methodology, by focusing on language from multiple dimensions (e.g., experts, references, comments, document), goes further than previous approaches that only looked at the regional and national coverage of experts and information sources[e.g., 48].

Acknowledgments

We thank all the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Fellows for an enriching experience and discussions. We thank Editor Andrew and the three anonymous reviewers as well as Logan E. Neu (U. of Minnesota) for conducting an internal review of this manuscript for the U.S. Geological Survey. ÁFLL is funded by the Academy of Finland (grant agreement nr. 311176). IP was supported by the Programme d'Investissements d'avenir (19-MPGA-0009). PJ was partially funded by the InterAmerican Institute for Global Change Research. TA is funded by the Australian Research Council Future Fellowship (FT180100354) and the University of Queensland strategic funding. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Author Contributions

Conceived and designed the exercise: AJL, ÁF-L, IP. Defined the methodology: AJL, ÁF-L, IP, PJ, OS. Coded the data: AJL, ÁF-L, IP, TA, ZB, PJ, THM, AS, OS. Analyzed the data: AJL, PJ, TA, ZB. Wrote the manuscript: AJL, ÁF-L, IP, TA, ZB, PJ, ML, THM, AS, OS.

Declarations of Interest

The authors declare no competing interests.

References

1. Montgomery, S.L. (2013). Does Science Need a Global Language? English and the Future of Research (University of Chicago Press).
2. Gordin, M.D. ed. (2015). Scientific Babel: How Science Was Done Before and After Global English (University of Chicago Press).
3. Di Bitetti, M.S., and Ferreras, J.A. (2017). Publish (in English) or perish: The effect on citation rate of using languages other than English in scientific publications. Ambio *46*, 121–127.
4. Vasconcelos, S.M.R., Sorenson, M.M., Leta, J., Sant'Ana, M.C., and Batista, P.D. (2008). Researchers' writing competence: a bottleneck in the publication of Latin-American science? EMBO Rep. *9*, 700–702.
5. Van Noorden, R. (2012). Global mobility: Science on the move. Nature *490*, 326–329.
6. Woolston, C., and Osório, J. (2019). When English is not your mother tongue. Nature *570*, 7760.

7. Meneghini, R., and Packer, A.L. (2007). Is there science beyond English? Initiatives to increase the quality and visibility of non-English publications might help to break down language barriers in scientific communication. EMBO Rep. *8*, 112–116.
8. Tietze, S., and Dick, P. (2009). Hegemonic practices and knowledge production in the management academy: An English language perspective. Scand. J. Manag. *25*, 119–123.
9. Vila, F.X., Bretxa, V., and Comajoan, L. (2014). ¿En qué lenguas se hace ciencia? La gestión del multilingüismo en el Parc Científic de Barcelona. Rev. Int. Organ., 111–134.
10. Grandjean, M. (2014). Le rêve du multilinguisme dans la science : l'exemple (malheureux) du colloque #DH2014.
11. Gradim, A. (2018). Políticas da Língua e Comunicação de Ciência: a importância do multilinguismo no espaço Lusófono de conhecimento. Missões Rev. Ciências Humanas e Sociais *4*.
12. Du Bois, W.E.B. (1903). The Souls of Black Folk (A. C. McClurg & Co.).
13. Meer, N. (2019). W. E. B. Du Bois, double consciousness and the 'spirit' of recognition. Sociol. Rev. *67*, 47–62.
14. Chilisa, B. (2017). Decolonising transdisciplinary research approaches: an African perspective for enhancing knowledge integration in sustainability science. Sustain. Sci. *12*, 813–827.
15. de Pina Cabral, J. (2007). Língua e hegemonia nas ciências sociais. Análise Soc. *42*, 233–237.
16. Haße, W., Peters, S., and Fey, K.H. (2011). ¿Lingua franca impuesta o lenguas europeas de la ciencia en medicina? La opción del multilingüismo. Panace@ *XII*, 267–272.
17. Amano, T., González-Varo, J.P., and Sutherland, W.J. (2016). Languages Are Still a Major Barrier to Global Science. PLoS Biol. *14*, e2000933.
18. Thaman, R., Lyver, P., Mpande, R., Perez, E., Cariño, J. and Takeuchi, K. (2013). The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies with Science. IPBES Expert Meeting Report.
19. Cámara-Leret, R., and Dennehy, Z. (2019). Information gaps in indigenous and local knowledge for science-policy assessments. Nat. Sustain. *2*, 736–741.
20. Mondada, L. (2002). La science polyglotte: conditions et possibilités des interactions scientifiques plurilingues. Langues Prod. du savoir. Actes du Colloq. L'Académie Suisse des Sci. Hum., 33–42.
21. Martins, M. de L. (2012). Revistas científicas de ciências da comunicação em Portugal: da divulgação do conhecimento à afirmação do Português como língua de pensamento. Intercom Rev. Bras. Ciências da Comun. *35*, 233–251.
22. Konno, K., Akasaka, M., Koshida, C., Katayma, K., Osada, N., Spake, R., and Amano, T. (2020). Ignoring non-English-language studies may bias ecological meta-analyses. Ecol. Evol. *10*, 6373–6384.
23. Fernández-Bellon, D. (2020). Limited accessibility and bias in wildlife-wind energy knowledge: A bilingual systematic review of a globally distributed bird group. Sci. Total Environ. *737*, 140238.
24. Illner, H. (2011). Comments on the Report "Wind Energy Developments and Natura 2000".
25. Amano, T., and Sutherland, W.J. (2013). Four barriers to the global understanding of biodiversity conservation: wealth, language, geographical location and security. Proc. Biol. Sci. *280*, 20122649.

26. Barath, H. (2019). Indian initiatives aim to break science's language barrier. Nature *571*, 7764.
27. Lafforgue, L. (2005). Science & actualité-Point de vue-Le francais au service des sciences. Pour Sci. *329*, 8–9.
28. Bortolus, A. (2012). Running Like Alice and Losing Good Ideas: On the Quasi-Compulsive Use of English by Non-native English Speaking Scientists. Ambio *41*, 769–772.
29. Carli, A., and Calaresu, E. (2007). Language and Science. In Handbook of Language and Communication: Diversity and Change. Handbooks of Applied Linguistics (HAL), vol. 9, M. Hellinger and A. Pauwels, eds. (Mouton de Gruyter), pp. 525–554.
30. Flowerdew, J. (1999). Problems in writing for scholarly publication in English: The case of Hong Kong. J. Second Lang. Writ. *8*, 243–264.
31. Flowerdew, J. (2001). Attitudes of Journal Editors to Nonnative Speaker Contributions. TESOL Q. *35*, 121.
32. Nuñez, M.A., Barlow, J., Cadotte, M., Lucas, K., Newton, E., Pettorelli, N., and Stephens, P.A. (2019). Assessing the uneven global distribution of readership, submissions and publications in applied ecology: Obvious problems without obvious solutions. J. Appl. Ecol. *56*, 4–9.
33. Ramírez-Castañeda, V. (2020). Disadvantages of writing, reading, publishing and presenting scientific papers caused by the dominance of the English language in science: The case of Colombian PhD in biological sciences. bioRxiv, 2020.02.15.949982.
34. Laitin, D.D. (2000). What is a Language Community? Am. J. Pol. Sci. *44*, 142–155.
35. Kassam, K.-A.S. (2011). Biocultural Diversity and Indigenous Ways of Knowing: Human Ecology in the Arctic (University of Calgary Press).
36. Turnhout, E., Metze, T., Wyborn, C., Klenk, N., and Louder, E. (2020). The politics of co-production: participation, power, and transformation. Curr. Opin. Environ. Sustain. *42*, 15–21.
37. Méndez García, M. del C., and Pérez Cañado, M.L. (2005). Language and Power: Raising Awareness of the Role of Language in Multicultural Teams. Lang. Intercult. Commun. *5*, 86–104.
38. Goyanes, M. (2020). Editorial boards in communication sciences journals: Plurality or standardization? Int. Commun. Gaz. *82*, 342–364.
39. Alves, M.A., and Pozzebon, M. (2013). How to resist linguistic domination and promote knowledge diversity? Rev. Adm. Empres. *53*, 629–633.
40. Rose, D.C., Sutherland, W.J., Amano, T., González-Varo, J.P., Robertson, R.J., Simmons, B.I., Wauchope, H.S., Kovacs, E., Durán, A.P., Vadrot, A.B.M., et al. (2018). The major barriers to evidence-informed conservation policy and possible solutions. Conserv. Lett. *11*, e12564.
41. Meneghini, R., and Packer, A.L. (2007). Is there Science beyond English? EMBO Rep. *8*, 112–116.
42. Tengö, M., Brondizio, E.S., Elmqvist, T., Malmer, P., and Spierenburg, M. (2014). Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach. Ambio *43*, 579–591.
43. Sutherland, W.J., Gardner, T.A., Haider, L.J., and Dicks, L. V. (2014). How can local and traditional knowledge be effectively incorporated into international assessments? Oryx *48*, 1–2.

44. Diaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A., Adhikari, J.R., Arico, S., Baldi, A., et al. (2015). The IPBES Conceptual Framework - connecting nature and people. Curr. Opin. Environ. Sustain. *14*, 1–16.
45. Stevance, A.S., Bridgewater, P., Louafi, S., King, N., Beard, T.D., Van Jaarsveld, A.S., Ofir, Z., Kohsaka, R., Jenderedijan, K., Rosales Benites, M., et al. (2020). The 2019 review of IPBES and future priorities: reaching beyond assessment to enhance policy impact. Ecosyst. People *16*, 70–77.
46. Hill, R., Adem, Ç., Alangui, W. V, Molnár, Z., Aumeeruddy-Thomas, Y., Bridgewater, P., Tengö, M., Thaman, R., Adou Yao, C.Y., Berkes, F., et al. (2020). Working with indigenous, local and scientific knowledge in assessments of nature and nature's linkages with people. Curr. Opin. Environ. Sustain. *43*, 8–20.
47. McElwee, P., Fernández-Llamazares, Á., Aumeeruddy-Thomas, Y., Babai, D., Galvin, K., Guèze, M., Liu, J., Molnár, Z., Ngo, H.T., Reyes-García, V., et al. (2020). Working with Indigenous and Local Knowledge (ILK) in Large-Scale Ecological Assessments: Reviewing the Experience of the IPBES Global Assessment. J. Appl. Ecol. *57*, 1666–1676.
48. Montana, J., and Borie, M. (2016). IPBES and Biodiversity Expertise: Regional, Gender, and Disciplinary Balance in the Composition of the Interim and 2015 Multidisciplinary Expert Panel. Conserv. Lett. *9*, 138–142.
49. Timpte, M., Montana, J., Reuter, K., Borie, M., and Apkes, J. (2018). Engaging diverse experts in a global environmental assessment: participation in the first work programme of IPBES and opportunities for improvement. Innov. Eur. J. Soc. Sci. Res. *31*, S15–S37.
50. Heubach, K., and Lambini, C.K. (2018). Distribution and selection of experts in the intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES): the case of the regional assessment for Africa. Innov. Eur. J. Soc. Sci. Res. *31*, S61–S77.
51. IPBES (2013). Report of the second session of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
52. Beck, S., Borie, M., Chilvers, J., Esguerra, A., Heubach, K., Hulme, M., Lidskog, R., Lövbrand, E., Marquard, E., Miller, C., et al. (2014). Towards a reflexive turn in the governance of global environmental expertise the cases of the IPCC and the IPBES. Gaia *23*, 80–87.
53. Song, F., Parekh, S., Hooper, L., Loke, Y., Ryder, J., Sutton, A., Hing, C., Kwok, C., Pang, C., and Harvey, I. (2010). Dissemination and publication of research findings: an updated review of related biases. Health Technol. Assess. (Rockv). *14*, iii, ix–xi, 1–193.
54. BORDONS, M., and GÓMEZ, I. (2004). Towards a single language in science? A Spanish view. Ser. J. Ser. Community *17*, 189–195.
55. Lebel, J., and McLean, R. (2018). A better measure of research from the global south. Nature *559*, 23–26.
56. Fazey, I., Fischer, J., and Lindenmayer, D.B. (2005). Who does all the research in conservation biology? Biodivers. Conserv. *14*, 917–934.
57. Powell, K. (2018). These labs are remarkably diverse — here's why they're winning at science. Nature *558*, 7708.
58. AlShebli, B.K., Rahwan, T., and Woon, W.L. (2018). The preeminence of ethnic diversity in scientific collaboration. Nat. Commun. *9*, 5163.
59. Díaz-Reviriego, I., Turnhout, E., and Beck, S. (2019). Participation and inclusiveness in

the Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services. Nat. Sustain. *2*, 457–464.
60. Thielmann, W. (2009). Deutsche und englische Wissenschaftssprache im Vergleich. Hinführen – Verknüpfen – Benennen (Synchron Publishers).
61. Gajo, L. (2013). Introduction Français, plurilinguisme et science: une problématique émergente. Synerg. Eur. Sylvains les Moulins, 7–10.
62. Cerquiglini, B. (2013). Le Plurilinguisme en faveur de la Science. Synerg. Eur. *8*, 11–17.
63. Ortiz, R. (2004). As ciências sociais e o inglês. Rev. Bras. Ciências Sociais *19*, 5–22.
64. Alogali, A. (2018). World Englishes: Changing the Paradigm of Linguistic Diversity in Global Academia. Res. Soc. Sci. Technol. *3*, 54–73.
65. Pérez Ortega, R. (2020). Science's English dominance hinders diversity—but the community can work toward change. Science (80-.).
66. Nordling, L. (2018). How decolonization could reshape South African science. Nature *554*, 159–162.
67. Black Lives Matter in ecology and evolution (2020). Nat. Ecol. Evol. *4*, 893–894.
68. Armstrong, C.G., and Brown, C. (2019). Frontiers are Frontlines: Ethnobiological Science Against Ongoing Colonialism. J. Ethnobiol. *39*, 14.
69. Zainub, A. ed. (2019). Decolonization and Anti-colonial Praxis (Brill).
70. Sefa Dei, G.J., and Lordan, M. eds. (2016). Anti-Colonial Theory and Decolonial Praxis (Peter Lang).
71. Nyamnjoh, F.B. (2019). Decolonizing the University in Africa.
72. Chaudhury, A., and Colla, S. (2020). Next steps in dismantling discrimination: Lessons from ecology and conservation science. Conserv. Lett., e12774.
73. Tengö, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M., Danielsen, F., Elmqvist, T., and Folke, C. (2017). Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability. Curr. Opin. Environ. Sustain. *26–27*, 17–25.
74. Sutherland, W.J., Taylor, N.G., MacFarlane, D., Amano, T., Christie, A.P., Dicks, L. V., Lemasson, A.J., Littlewood, N.A., Martin, P.A., Ockendon, N., et al. (2019). Building a tool to overcome barriers in research-implementation spaces: The Conservation Evidence database. Biol. Conserv. *238*, 108199.
75. IPBES (2020). EM/2020/15 Call for Indigenous and Local Knowledge Contributions for 3 Ongoing IPBES Assessments.
76. Walpole, S.C. (2019). Including papers in languages other than English in systematic reviews: important, feasible, yet often omitted. J. Clin. Epidemiol. *111*, 127–134.
77. Baethge, C. (2013). The production and recognition of psychiatric original articles published in languages other than English. BMC Psychiatry *13*, 102.
78. Egger, M., Zellweger-Zähner, T., Schneider, M., Junker, C., Lengeler, C., and Antes, G. (1997). Language bias in randomised controlled trials published in English and German. Lancet *350*, 326–329.
79. Grégoire, G., Derderian, F., and Le Lorier, J. (1995). Selecting the language of the publications included in a meta-analysis: Is there a tower of babel bias? J. Clin. Epidemiol. *48*, 159–163.
80. Neimann Rasmussen, L., and Montgomery, P. (2018). The prevalence of and factors associated with inclusion of non-English language studies in Campbell systematic reviews: a survey and meta-epidemiological study. Syst. Rev. *7*, 129.
81. Paez, A. (2017). Gray literature: An important resource in systematic reviews. J. Evid.

Based. Med. *10*, 233–240.
82. IPBES (2018). The IPBES Guide on the Production of Assessments.
83. Turnhout, E., Dewulf, A., and Hulme, M. (2016). What does policy-relevant global environmental knowledge do? The cases of climate and biodiversity. Curr. Opin. Environ. Sustain. *18*, 65–72.
84. Lillis, T., Magyar, A., and Robinson-Pant, A. (2010). An international journal's attempts to address inequalities in academic publishing: developing a writing for publication programme. Comp. A J. Comp. Int. Educ. *40*, 781–800.
85. Meyer, E. (2014). The Culture Map: Breaking Through the Invisible Boundaries of Global Business (PublicAffairs).
86. Murphy, J., and Zhu, J. (2012). Neo-colonialism in the academy? Anglo-American domination in management journals. Organization *19*, 915–927.
87. Turnhout, E., Bloomfield, B., Hulme, M., Vogel, J., and Wynne, B. (2012). Listen to the voices of experience. Nature *488*, 454–455.

FIGURES AND TABLE LEGENDS

Figure 1. **Linguistic diversity metrics analyzed across assessments**. (A) References in English across all eight Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) assessments compared to Amano et al.'s (2016) extensive review of literature on biodiversity conservation. (B) Proportion of country/ies of affiliation for first authors of a subset of references analyzed in the eight IPBES assessments compared to Scimago country rank for scientific output in environmental sciences. (C) Proportion of nationalities for IPBES experts (all eight assessments) and comments (seven assessments) compared with United Nations member states.

Supplemental Information

Table 1. **Summary of metrics, methods, results, and recommendations regarding linguistic diversity representation**. Linguistic diversity was examined in eight assessments of the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES).

Metric	Methodology	Summary of results	Recommendations for representation
Assessment experts	For each of the eight assessments included in the analysis, we recorded: (a) nationality/ies of each expert. The expert list included chairs, coordinating lead authors, lead authors, review editors, and fellows.	The Americas assessment had the fewest nationalities overall (25) and highest proportion of Anglophone affiliations (7). The Global assessment had the highest number of nationalities (54). The Europe and Central Asia assessment had the smallest number of Anglophone affiliations (3).	- Invite diverse expert teams through representative nomination and selection processes, including Indigenous and Local Knowledge (ILK) holders and experts. - Add contributing authors to fill in expertise gaps and broaden diversity of knowledge sources consulted. - Provide best practice guidelines for improving group dynamics developed by those for whom English is not a first language. - Facilitate training opportunities for active participation among multicultural teams.
Assessment references	For each of the eight assessments included in the analysis, we	References totaled 27,891 across all eight assessments,	- Facilitate searches for literature and

	randomly selected approximately 150 references and recorded: (a) country/ies of affiliation of the first author; and (b) language of the references.	corresponding to 28 languages. English was, by far, the most common language (96.6% of references). The Europe and Central Asia regional assessment had the highest total number of languages represented by references (21 different languages), but the Americas regional assessment had the highest proportion of references in a language other than English (7%), and the Asia and the Pacific regional assessment had the least (0.15%). See **Figure 1**. In the subsample of references examined for first author country of affiliation, across all assessments 51% of references had a first author from an Anglophone country. The Scenarios assessment had the highest proportion of Anglophone first authors (62%) and the Europe and Central Asia assessment had the lowest (27%).	knowledge in languages other than English. - Enable systematic review protocols that include local language search terms. - Provide guidance on how to include diverse forms of knowledge and evidence, including grey literature and ILK.
Assessment comments	For each of the seven assessments included in this analysis (comments were not publicly available for the Global assessment), we recorded country/ies of affiliation of the reviewer. We examined all reviewer comments for the First Order Draft	Ninety-four countries were represented by reviewer affiliation. 32.9% of comments across all assessments came from Anglophone countries. The United Kingdom provided the highest number of reviewer comments (16%), followed by	- Actively encourage non-Anglophones to provide comments. - Support submission of comments in any language. - Facilitate translation of

	(FOD), Second Order Draft (SOD), and the Summary for Policymakers (SPM). We separately noted the number of reviewer comments made by government representatives and external reviewers. A total of 42,126 comments were coded.	Germany (8.6%), the United States (8.5%), Canada (5.50%), France (5.49%), South Africa (5.4%), and Switzerland (5.2%). The Pollination assessment received the highest number of comments (11,306) and the Scenarios assessment received the lowest (3,116).	input into multiple languages.
Assessment document	For each of the eight assessments included in this analysis, we recorded the languages in which the approved assessment reports are available for the public to view and/or download. Three versions of the assessment reports exist: the SPM as plain text, the SPM as a laid-out version (i.e., visually friendly version), and the full report as plain text only.	All plain text versions of the full reports and SPMs were available for download in English. All the SPMs could also be downloaded in the other five United Nations languages as plain text. Laid out versions of the SPMs were available in English for all assessments. Additionally, the Pollination assessment was also available in Chinese and French, while the Scenarios and Modeling SPM could also be downloaded in Chinese and the Global assessment was available in Czech and Japanese. None of the full reports (i.e., the detailed documents sustaining the findings reported in the SPMs) were available in any language other than English.	- Publish assessment reports, or at minimum extended abstracts, in multiple languages. - Encourage synchronous interpretation during plenaries.

Note S1. '**Science for Society**' section text in Bengali (Bangla), Chinese, English, French, German, Japanese, Sepedi, Spanish, and Swahili.

সমাজের জন্য বিজ্ঞান

বিজ্ঞান ও জ্ঞানের সংশ্লেষণে একাধিক স্কেল এবং বিবিধ উৎস থেকে প্রাপ্ত তথ্যের সংহতকরণ প্রয়োজন। বৈজ্ঞানিক সম্প্রদায়ের মধ্যে অন্তর্নিহিত পক্ষপাত এবং কাঠামোগত বৈষম্য ইংরেজি-ভাষা সাহিত্যের এবং ইংরেজি ভাষাভাষীদের বিশেষজ্ঞদের অগ্রাধিকার দেয়। এটি সীমাবদ্ধ করতে পারে বৈজ্ঞানিক মূল্যায়নে অন্তর্ভুক্ত করা জ্ঞানকে। আমরা মূল্যায়ন বিশেষজ্ঞদের ভাষাগত বৈচিত্র্য, তাদের ব্যবহার করা তথ্যসূত্র, তারা যে প্রতিক্রিয়াসমূহ/মন্তব্য পেয়েছেন এবং জীব বৈচিত্র এবং বাস্তুতন্ত্র নির্ভর পরিষেবাদির (আইপিবিইএস) এর আন্তঃসরকারী বিজ্ঞান-নীতি প্ল্যাটফর্ম দ্বারা সম্প্রতি সংকলিত আট বাস্তুতন্ত্র মূল্যায়নের চূড়ান্ত প্রতিবেদন পরীক্ষা করে দেখেছি। আমরা দেখেছি যে উৎসাহ সত্বেও, অ-ইংরেজি-ভাষা সাহিত্য ভাষাগতভাবে বিভিন্ন লেখক দল থাকা সত্বেও, বৈজ্ঞানিক মূল্যায়নে খুব কমই আলোচনা করা হয়েছিল। এই জাতীয় বাদ দেওয়া সম্ভাব্যভাবে বৃহৎ আকারের মূল্যায়নের পক্ষপাত করতে পারে এবং বিজ্ঞানে ক্ষমতায় বৈষম্য স্থায়ী করতে পারে। বৈজ্ঞানিক সম্প্রদায় ভাষাগত বৈচিত্র্যের আরও অন্তর্ভুক্ত হওয়ার জন্য কাজ করতে পারে। এই বিশ্বব্যাপী মূল্যায়নের লেখকদের জন্য পদ্ধতিগত দিকনির্দেশনাগুলি এই রূপান্তরটিকে সহজতর করতে পারে, তবে শেষ পর্যন্ত, বিজ্ঞান এবং জ্ঞানের সংগ্রহ এবং উপস্থাপনাকে গণতান্ত্রিকীকরণের জন্য পদ্ধতিগত পরিবর্তন প্রয়োজন।

为社会的科学

科学与知识的合成需要综合各种规模以及多样化的信息源。科学群体里的偏见及结构性的不平等表现为对英语文献与英语为母语的专家的偏好。这可以限制什么样的知识会被应用于科学评估。我们考查了8**个生物多**样性和生态系统服务政府间科学政策平台（IPBES）**的**专家背景，他们使用的参考文献以及收到评论的语言多样性。我们发现，我们发现，即使在语言背景多样化的专家组，尽管**被鼓励使用**，**非英**语文献也很少在评估中被参考。

这种对其他语言文献的忽略有可能会使大型评估结果存在偏见，并继续巩固科学领域中的权力不平衡。科学家群体可以努力对语言多样性更加包容。制定评估方法指引可能帮助作者更加重视国际评估中使用语言的多样性。但是，我们更需要的是通过系统性变化来推动科学及知识的收集与代表的民主化。

Science for Society

Synthesis of science and knowledge requires integration of information from multiple scales and diverse sources. Inherent biases and structural inequities within the scientific community favor English-language literature and Anglophone experts. This can limit what knowledge is included in assessments. We examined the linguistic diversity of assessment experts, references they consulted, comments they received, and the final reports of eight ecological assessments recently produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). We found that, despite encouragement, non-

English-language literature was rarely consulted in the assessments, even in linguistically diverse author teams. Such omission can potentially bias large-scale assessments and perpetuate unequal power dynamics in science. The scientific community can work to become more inclusive of linguistic diversity. Methodological guidelines for authors of these global assessments can facilitate this transition but, ultimately, systemic change will be needed to democratize the collection and representation of science and knowledge.

Science pour la société

La synthèse de la science et des connaissances exige une intégration d'informations provenant de sources diverses et à échelles multiples. Les biais inhérents et les inégalités structurelles au sein de la communauté scientifique favorisent la littérature en anglais et les experts anglophones. Nous avons examiné la diversité linguistique des experts, des références consultées, des commentaires reçus et des rapports finaux de huit évaluations écologiques récemment conduites par la Plateforme intergouvernementale scientifique et politique sur la biodiversité et les services écosystémiques (IPBES). Nous avons constaté que, malgré les encouragements, la littérature non anglaise était rarement consultée dans ces évaluations, même dans des équipes d'auteurs linguistiquement divers. Une telle omission peut biaiser les évaluations à grande échelle et perpétuer des dynamiques de pouvoir inégales dans la science. Cependant, la communauté scientifique peut travailler pour être plus inclusive de la diversité linguistique. Les directives méthodologiques pour ces évaluations mondiales peuvent faciliter cette transition mais un changement systémique est finalement nécessaire pour démocratiser la collecte et la représentation des connaissances scientifiques.

Wissenschaft für die Gesellschaft

Die Synthese von Wissenschaft und Wissen erfordert die Integration von Informationen aus mehreren Skalen und verschiedenen Quellen. Inhärente Vorurteile und strukturelle Ungleichheiten innerhalb der wissenschaftlichen Gemeinschaft begünstigen englischsprachige Literatur und anglophone Experten. Dies kann sich einschränkend auf das in Assessments beinhaltetes Wissen auswirken. Wir haben die sprachliche Vielfalt der Assessment Experten untersucht, die von ihnen konsultierten Referenzen, die eingegangenen Kommentare sowie die Abschlussberichte von acht ökologischen Assessments, die kürzlich von der Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) erstellt wurden. Wir haben herausgefunden, dass trotz Ermutigung selbst in sprachlich diversen Autorenteams kaum nicht-englischsprachige Literatur in den Assessments konsultiert wurde. Ein solches Auslassen kann groß angelegte Assessments potenziell beeinflussen und eine ungleiche Leistungsdynamik in der Wissenschaft bewirken. Die wissenschaftliche Gemeinschaft kann daran arbeiten, die sprachliche Vielfalt stärker einzubeziehen. Methodische Richtlinien für Autoren dieser globalen Assessments können diesen Übergang erleichtern, aber letztendlich wird ein systemischer Wandel erforderlich sein, um die Aufarbeitung und Repräsentation von Wissenschaft und Wissen zu demokratisieren.

社会のための科学

科学とその知見を適切に統合するためには、複数のスケールにおける多様なソースからの情報を統合することが必要となる。科学コミュニティに内在しているバイアスや構造的な格差は、英語文献や英語圏の専門家に有利に働いており、結果として、限られた知見のみが科学的評価で利用される可能性がある。そこで本研究では、生物多様性及び生態系サービスに関する政府間科学ー政策プラットフォーム（IPBES）が最近作成した8つの生態学的評価を対象とし、評価に携わった専門家、引用文

献、評価に対するコメント及び最終報告書に反映されている言語多様性を調査した。その結果、英語以外の言語の文献利用が奨励されており、また言語的に多様な専門家が報告書を執筆しているにも関わらず、英語以外の言語の文献はほとんど引用されていないことが明らかになった。英語以外の言語の文献を参照しないことにより、このような大規模評価にバイアスが生じ、科学界に見られる不平等な力関係を継続させてしまう可能性がある。科学コミュニティは言語的多様性をより包括的なものにするためにさらに努力する必要があるだろう。世界規模の評価を行う際に、適切な手法を定めたガイドラインを作成することで、評価における言語的多様性を高めることも可能だと考えられるが、最終的には、科学とその知見を偏りなく収集・利用するために体系的な変化が必要となるだろう。

Saense ya Sechaba

Khutšofatšo ya saense le tsebo e hloka kopanyo ya tshedimošo gotšwa makaleng le mafapheng a a fapaneng. Kgethollo, lego se lekane ga sebopego mo badiring ba saense, era gore go akaretšwa fela bao ba bolelang leleme la seisimane, le bao ba tšwang nageng tšago bolela seisimane. Se seka fokotša tsebo ye e berekišiwang go hlahloba lego kutšafatša tsebo. Re hlahlobile phapano ya maleme a ditsebi tša khutšofatšo ya saense, maleme a mangwalo a saense ba baa hlahlobileng, maleme adi keletšo gotšwa go bao ba badileng khutšofatšo ye, le ditokumente tše seswai tše di ngwadilweng go hkutšofatša saense le tsebo ya hlago le tikologo gotšwa Sethaleng sa Leano la Saense le Pholisi mabapi le Mehuta-huta ya diphoofolo le mehlare le Ditšebeletše tša Tikoloho (IPBES). Re humana gore, saense ye e ngwadilweng ka maleme ao aseng seisimane ga di hlahlobiwe gantšhi ke bao ba bolelang maleme ao aseng seisimane. Tlogelo ya malele ao aseng seisimane go hlola gore seisimane sebe le maatla a go feta maleme amangwe go saense. Badiri ba saense ba swanetše go berekela go tsentša maleme a a fapaneng mo khutšofatšong ya saense. Tataišo ya mokgwa wo o šomišwang ke bangwadi ba di khutšofatšo tša ttshedimošo oka thuša, eupša gotla hlokega phetogo ya tsamaišo go dira demokrasi mo kgobokantšong ya saense.

Ciencia para la sociedad

La síntesis científica requiere la integración de información de diversas fuentes y a múltiples escalas. Los sesgos inherentes y las desigualdades estructurales dentro de la comunidad científica favorecen la literatura en inglés y los expertos anglófonos. Esto a menudo limita lo que se entiende como "conocimiento" en las evaluaciones globales y reduce nuestra comprensión de temas importantes. Aquí examinamos la diversidad lingüística de los expertos, las referencias que consultaron, los comentarios que recibieron y los informes finales de ocho evaluaciones ambientales producidas recientemente por la Plataforma Intergubernamental Científico-Normativa sobre Diversidad Biológica y Servicios de los Ecosistemas (IPBES). Encontramos que, a pesar del estímulo, rara vez se consultó literatura no inglesa en las evaluaciones, incluso en equipos de autores lingüísticamente diversos. Tales ausencias pueden potencialmente sesgar los análisis a gran escala y perpetuar dinámicas de poder desiguales en la ciencia. Sin embargo, la comunidad científica puede trabajar para ser más inclusiva de la diversidad lingüística. Las pautas metodológicas para los autores de estas evaluaciones globales pueden facilitar esta transición pero, en última instancia, será necesario un cambio sistémico para democratizar la recopilación y representación del conocimiento en la ciencia.

Sayansi yenye Umuhimu kwa Jamii

Usanisi wa sayansi na maarifa unahitaji ujumuishaji wa habari kutoka ngazi na vyanzo tofauti. Upendeleo wa asili na ukosefu wa usawa katika jamii ya wanasayansi hupendelea

fasihi za Kiingereza na wataalam wanaotoka nchi zinazotumia Kiingereza. Hilo linaweza kuzuia ujuzi unaojumuishwa katika tathmini. Tulichunguza utofauti wa lugha uliopo kati ya wataalam wa tathmini, katika fasihi zilizozingatiwa kwenyetathmini hizo, katika maoni waliyopokea, na katika marejesho ya tathmini nane za kiikolojia zilizochapishwa hivi karibuni na Jukwaa la Kimataifa la Sera ya Sayansi Kuhusiana na Bayoanuai na Huduma za Mifumo ya Ekolojia (IPBES). Uchunguzi wetu unaonyesha kuwa, licha ya kuwahimiza wataalam kutumia fasihi za lugha tofauti, hawakuzizingatia sana kwenye tathmini, hata katika timu za waandishi wenye ufahamu wa lugha mbalimbali. Upungufu huu unaweza kusababisha tathmini pendelevu zisizo zingatia ufahamu uliopo kwenye fasihi za lugha anuai na kuendeleza mienendo ya ukosefu wa usawa katika jumuia ya sayansi. Wanasayansi wanatakiwa kufanya bidii ya kujumuisha zaidi lugha mbalimbali. Miongozo kwa waandishi wa tathmini hizi ya jinsi ya kuzingatia lugha tofauti inaweza kuwezesha mabadiliko haya lakini, mwishowe, mabadiliko ya kimfumo yatahitajika ili kuboresha demokrasia ya ukusanyaji na uwakilishaji wa sayansi na maarifa.

Note S2. **Anglophone countries**. The United Kingdom government considers the following 18 countries as "majority native English-speaking countries."

- Antigua and Barbuda
- Australia
- The Bahamas
- Barbados
- Belize
- Canada
- Dominica
- Grenada
- Guyana
- Ireland
- Jamaica
- New Zealand
- St Kitts and Nevis
- St Lucia
- St Vincent and the Grenadines
- Trinidad and Tobago
- United Kingdom
- United States of America

Figure S1. **Graphical abstract** in Bengali (Bangla).

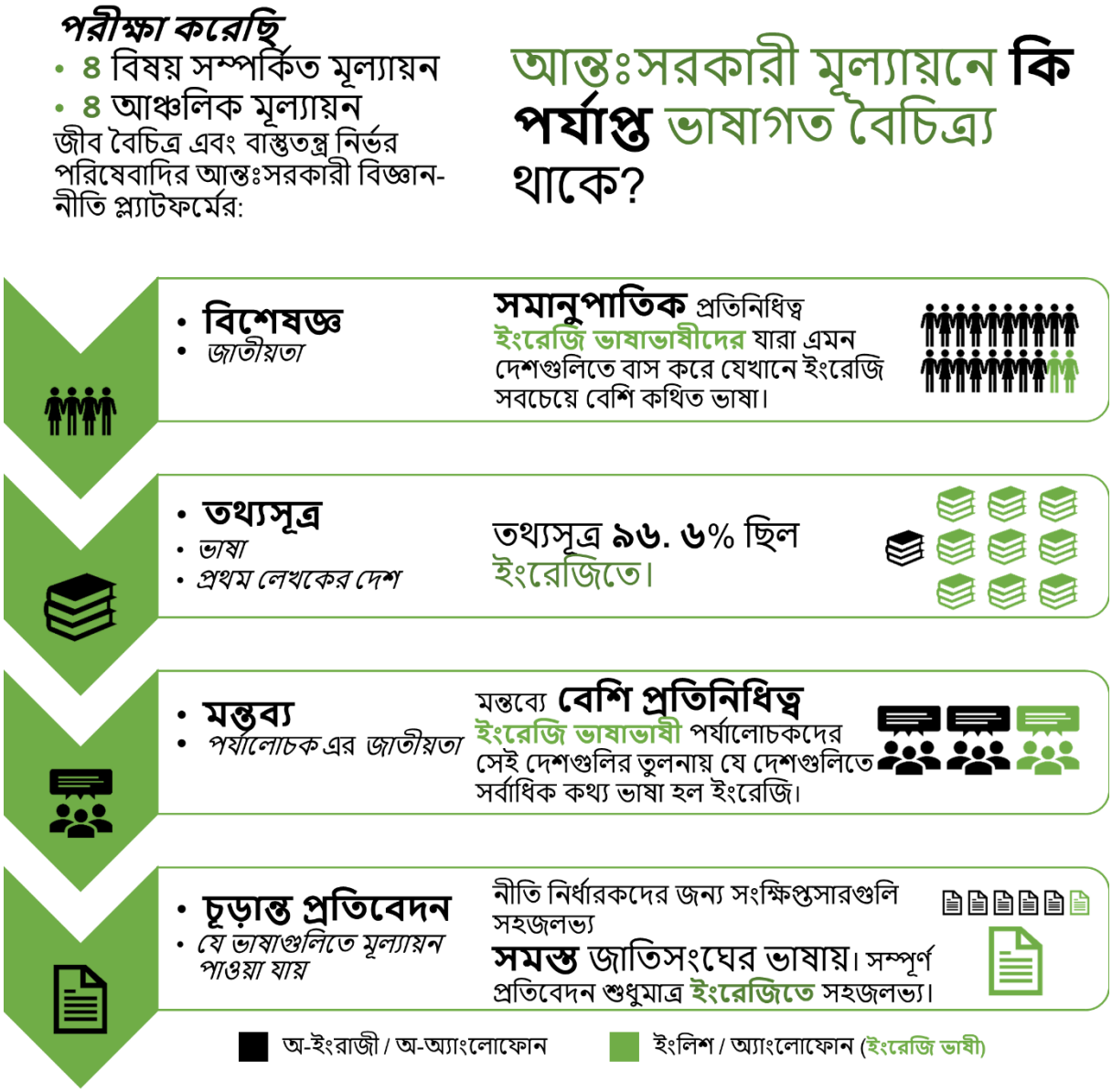

Figure S2. Graphical abstract in Chinese.

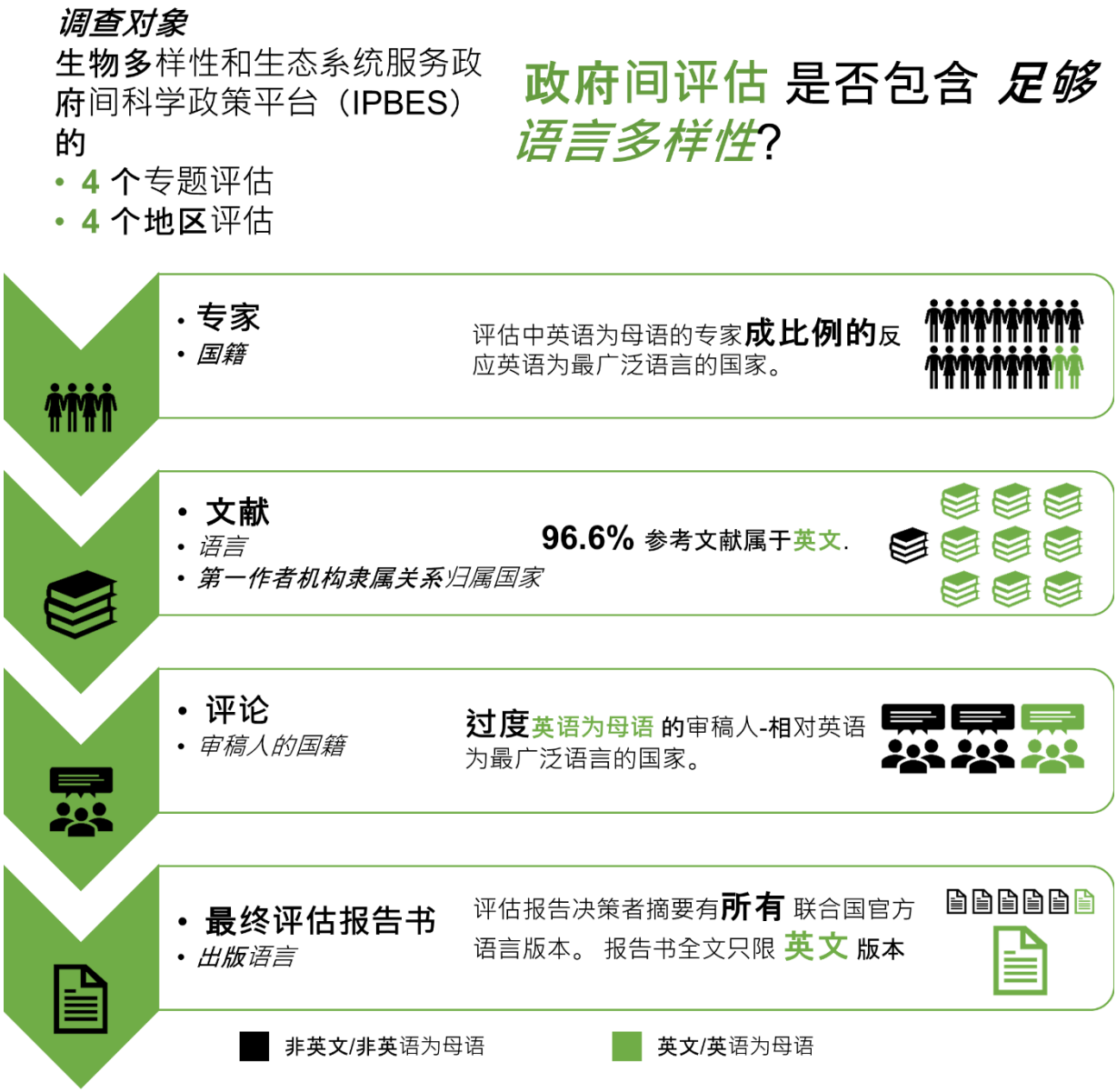

Figure S3. Graphical abstract in English.

Figure S4. **Graphical abstract** in French.

Figure S5. Graphical abstract in German.

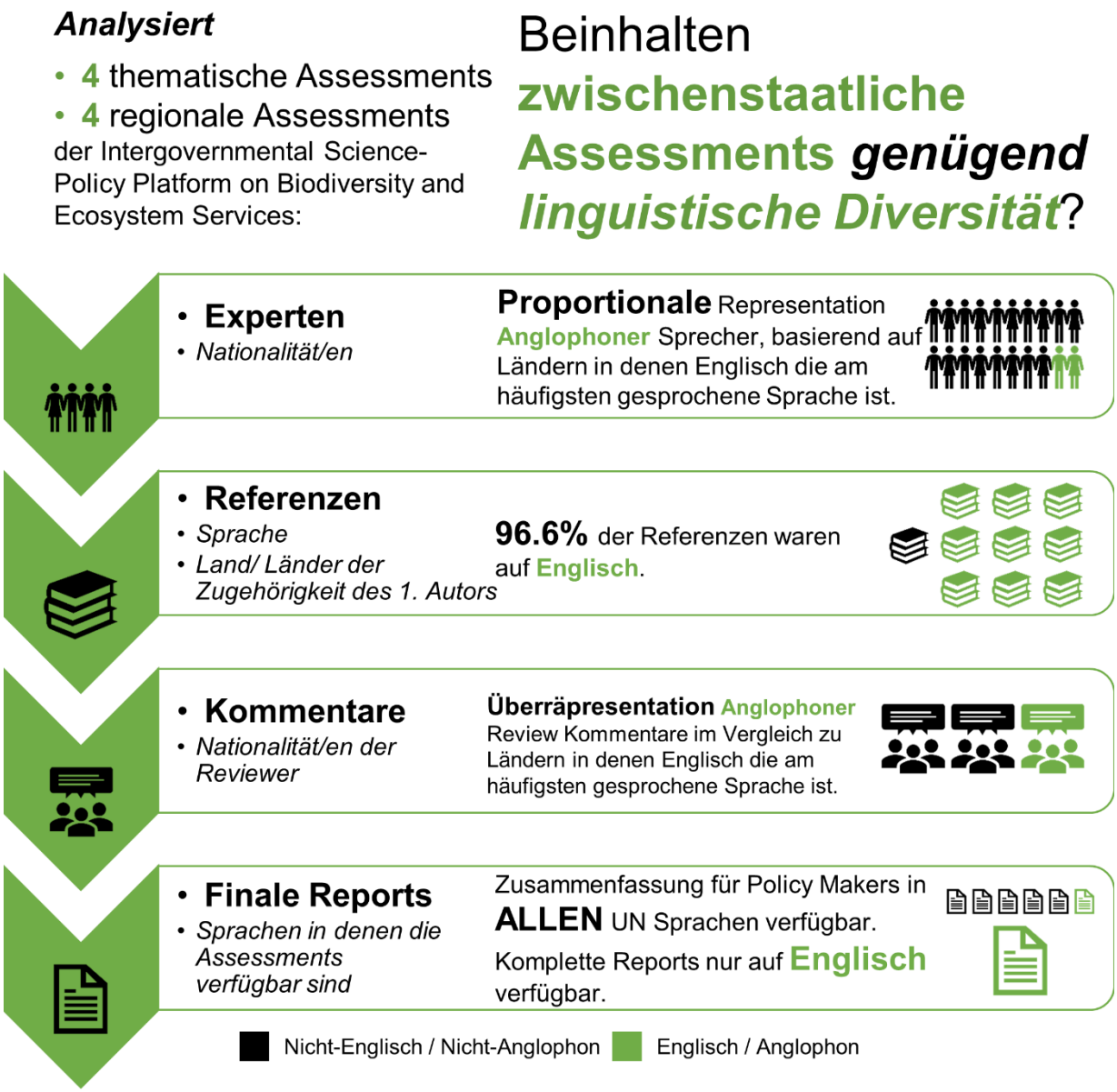

Figure S6. **Graphical abstract** in Japanese.

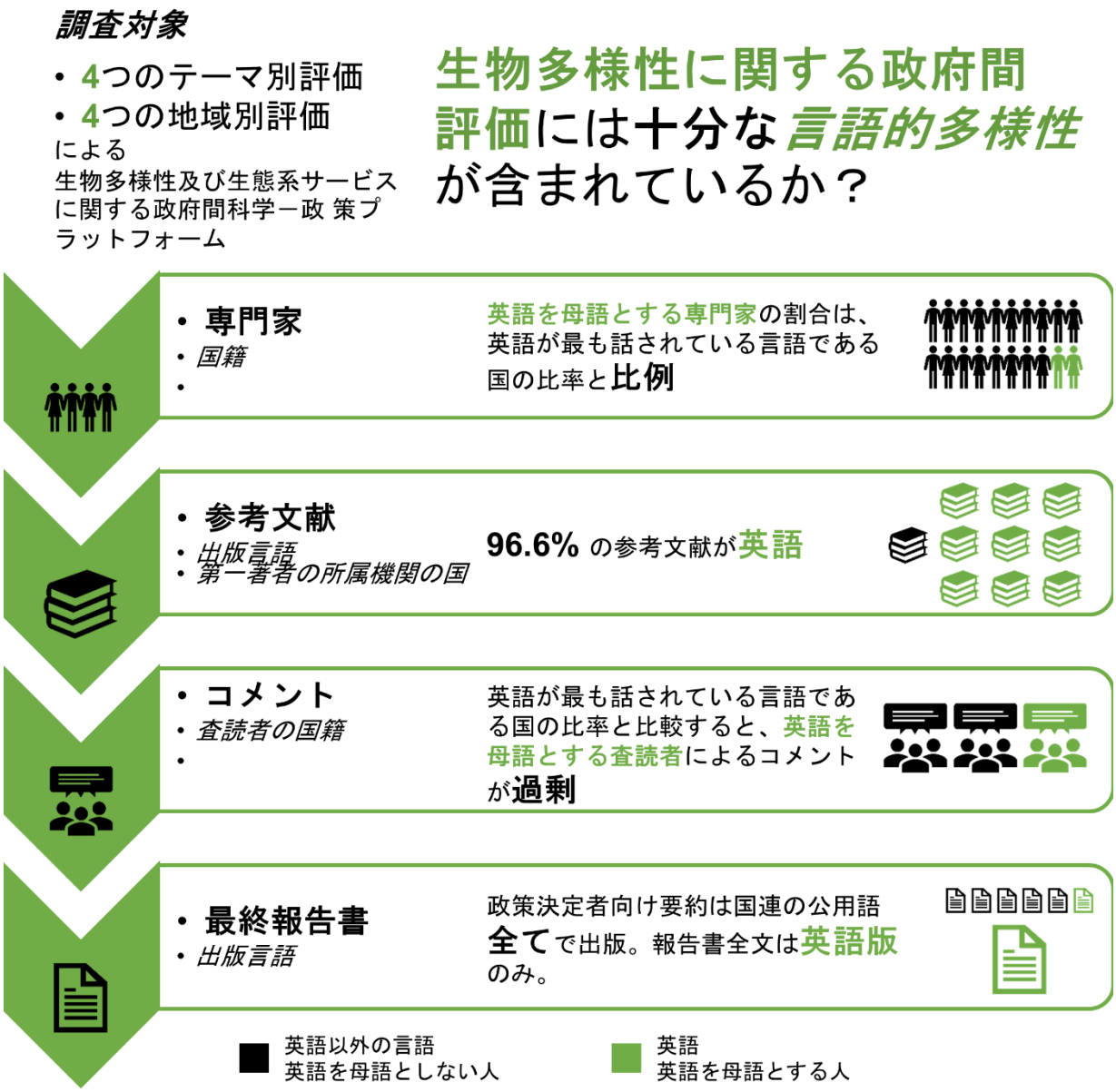

Figure S7. Graphical abstract in Spanish.

Table S1. Percentage of references in different languages. This analysis compared references in the eight IPBES assessments and their average to Amano et al.'s (2016)* extensive review of literature on biodiversity conservation.

	IPBES Assessment									
Language	Pollination	Scenarios and Models	Land Degradation and Restoration	Africa	Americas	Asia and the Pacific	Europe and Central Asia	Global	**Average**	**Amano et al. (2016)**
English	93.3	93.1	98.0	98.0	94.7	100.0	94.0	99.0	96.3	64.4
Spanish	3.3	1.3	0.7		5.3			0.5	1.4	12.6
French	2.0	3.1	1.3	2.0				0.5	1.1	3
Indonesian	0.7								0.1	-
Portuguese	0.7	0.6							0.2	10.3
German		0.6					0.7		0.2	0.8
Italian		0.6							0.1	1
Russian		0.6					4.7		0.7	0.1
Uzbek							0.7		0.1	-

***** Amano, T., González-Varo, J.P., and Sutherland, W.J. (2016). Languages Are Still a Major Barrier to Global Science. PLoS Biol. 14, e2000933.

Table S2. Comparison of country ranks. The comparison is between the Scimago (scimagojr.com) database of citable scientific documents published between 1996 and 2018 in 'All subject areas', 'Agricultural and biological sciences', and 'Environmental Science' (**A**) and the results of our reference analysis for the indicator country/ies of affiliation of the first author in four IPBES thematic assessments (**B**), and four regional assessments (**C**). Only the first 15 countries are listed.

A)	**Scimago Country Rank**					
	All Subject Areas		**Agricultural and Biological Sciences**		**Environmental Science**	
Rank	Country	% of total	Country	% of total	Country	% of total
1	United States	21.44	United States	19.05	United States	19.86
2	China	11.59	China	8.43	China	11.56
3	United Kingdom	5.88	United Kingdom	5.25	United Kingdom	5.74
4	Germany	5.58	Germany	4.73	Germany	4.64
5	Japan	5.27	Japan	3.93	Canada	3.89
6	France	3.94	Brazil	3.92	India	3.85
7	Canada	3.14	Canada	3.68	Australia	3.30
8	Italy	3.18	France	3.64	France	3.21
9	India	3.11	Australia	3.50	Japan	3.16
10	Spain	2.53	India	3.46	Spain	2.86
11	Australia	2.41	Spain	3.28	Italy	2.71
12	South Korea	2.14	Italy	2.75	Brazil	1.95
13	Russian Federation	2.11	The Netherlands	1.72	The Netherlands	1.91
14	The Netherlands	1.75	South Korea	1.48	South Korea	1.65
15	Brazil	1.78	Russian Federation	1.33	Sweden	1.50

B)	**IPBES Thematic and Global Assessments**							
Land Degradation and Restoration		**Pollination**		**Scenarios and Models**		**Global**	
Country	% of total	Country	% of total	Country	% of total		% of total
United States	30.63	United States	29.41	United States	22.70	United States	27.14
United Kingdom	11.25	United Kingdom	11.76	Australia	18.40	United Kingdom	12.38
Australia	5.63	Canada	5.88	United Kingdom	13.50	Canada	10.00
The Netherlands	4.38	Mexico	4.58	Canada	7.36	The Netherlands	7.14
Canada	4.38	Germany	3.92	France	5.52	Australia	5.71
Switzerland	4.38	France	3.92	The Netherlands	5.52	Germany	4.76
Germany	3.75	Spain	3.27	Germany	4.29	France	4.29
France	3.75	Sweden	3.27	Switzerland	3.68	Spain	3.81
Belgium	3.75	The	3.27	South Africa	3.07	Sweden	3.33

		Netherlands					
Italy	3.13	Brazil	3.27	Spain	2.45	Norway	2.38
Brazil	2.50	New Zealand	3.27	Sweden	1.84	Switzerland	1.90
South Africa	2.50	Australia	2.61	Finland	1.84	Argentina	1.43
Indonesia	1.88	Argentina	2.61	Belgium	1.84	Austria	1.43
China	1.88	Switzerland	1.96	Italy	1.23	Brazil	1.43
Austria	1.88	Japan	1.31	China	1.23	China	1.43

C) IPBES Regional Assessments

Africa		**Americas**		**Europe and Central Asia**		**Asia and the Pacific**	
Country	% of total	Country	% of total	Country	% of total	Country	% of total
United States	18.87	United States	36.65	United Kingdom	11.33	United States	16.35
United Kingdom	14.47	United Kingdom	10.56	United States	10.67	Australia	12.58
Italy	6.29	Canada	9.32	Switzerland	8.67	India	7.55
France	6.29	Brazil	6.21	Germany	7.33	United Kingdom	7.55
Australia	5.66	Argentina	3.73	Russia	6.67	Japan	7.55
Canada	5.66	France	3.73	Belgium	6.00	New Zealand	4.40
South Africa	5.03	Australia	3.11	France	5.33	Switzerland	4.40
Switzerland	4.40	Switzerland	3.11	Sweden	5.33	France	3.77
The Netherlands	4.40	Germany	2.48	Italy	5.33	Canada	3.77
Kenya	3.14	Bolivia	2.48	Norway	5.33	China	3.14
Cameroon	3.14	Italy	2.48	Spain	4.67	Singapore	2.52
Germany	1.89	Mexico	2.48	Denmark	4.00	Philippines	1.89
Egypt	1.89	Sweden	1.86	The Netherlands	2.67	Italy	1.89
Ethiopia	1.89	Spain	1.86	Canada	2.00	Sweden	1.89
Belgium	1.89	Chile	1.24	Australia	2.00	Netherlands	1.89