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

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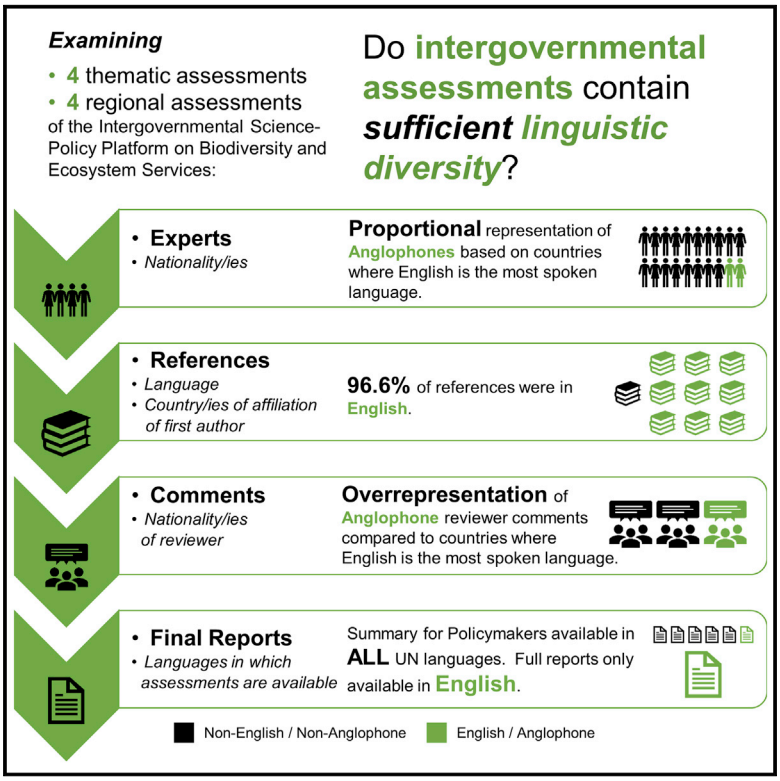
One Earth

Article

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

Graphical Abstract



Highlights

- Linguistic diversity is essential for comprehensive evidence-based decision making
- IPBES encourages linguistic diversity across its assessments
- Despite encouragement, non-English-language evidence sources are rarely referenced
- A systemic change in scientific culture can advance global assessment processes

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In Brief

Multicultural representation is a stated goal of many global scientific assessment processes. 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 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.

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

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SCIENCE FOR SOCIETY Synthesis of science and knowledge requires integration from multiple scales and diverse sources. Inherent biases and structural inequities within the scientific community favor English-language literature and Anglophone experts. 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, even in linguistically diverse author teams. Such omission can bias assessments and perpetuate unequal power dynamics in science. The scientific community can work to be more inclusive. Methodological guidelines for these global assessments can facilitate this transition but, ultimately, systemic change is needed to democratize collection and representation of science and knowledge.

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 examine 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.

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, see, e.g., Meneghini and Packer (2017)[7–11], Tietze and Dick (2009),[8] Vila et al. (2014),[9] Grandjean (2014),[10] and Gradim (2018).[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, see, e.g., Cámara-Leret and Dennehy (2019).[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] that 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 that 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 and 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–S7). We

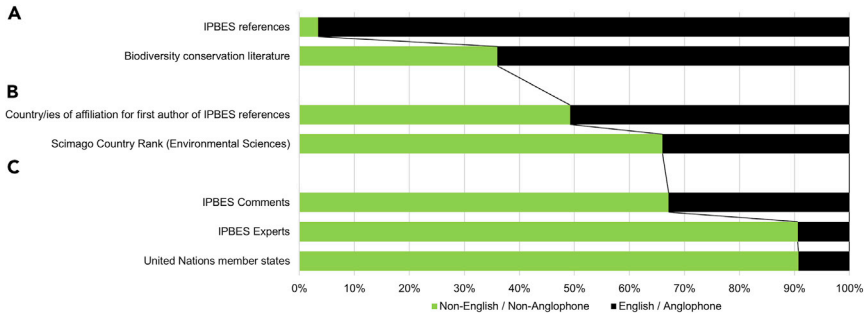

Figure 1. Linguistic diversity metrics analyzed across assessments

(A) References in English across all eight IPBES assessments compared with Amano et al.'s (2016)[17] 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 with 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.

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 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 program 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 with 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 US and UK, were disproportionately represented across all assessments compared with 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 with Scimago Country Rank (www.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 with 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 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) are 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

Table 1. Summary of metrics, methods, results, and recommendations regarding linguistic diversity representation

Metric	Methodology	Summary of results	Recommendations for representation
Assessment experts	For each of the eight assessments included in the analysis, we recorded the 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 the 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 recorded language of the available references. We also randomly selected approximately 150 references per assessment and recorded country/ies of affiliation for the first author of the references.	References examined totaled 27,891 across all 8 assessments, 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%).	- Facilitate searches for literature and 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 gray 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, Second Order Draft, and the Summary for Policymakers (SPMs). We separately noted the number of reviewer comments made by government representatives and external reviewers. A total of 42,126 comments were coded.	Ninety-four countries were represented by reviewer affiliation. A total of 32.9% of comments across all assessments came from Anglophone countries. The UK provided the highest number of reviewer comments (16%), followed by Germany (8.6%), the US (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).	- Actively encourage non-Anglophones to provide comments. - Support submission of comments in any language. - Facilitate translation of input into multiple languages.

(*Continued on next page*)

Table 1. *Continued*

Metric	Methodology	Summary of results	Recommendations for representation
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 SPMs as plain text, the SPMs 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. In addition, the Pollination assessment was also available in Chinese and French, while the Scenarios and Modeling SPMs 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.

Linguistic diversity was examined in eight assessments of the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES).

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 and 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 toward 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 regard to assessment references. Conversely, countries, such as 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 that 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; see, e.g., a *Nature Ecology & Evolution* editorial[67] and Armstrong and Brown.[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 gray 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 gray 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 Anglophone expert affiliations was consistent with global proportions (i.e., 9.4% of IPBES expert nationalities compared with 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 catalogs English-language journal articles, non-English-language journal articles, and gray 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). In addition, 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 gray literature can be evaluated appropriately.[81] In IPBES, for example, the current criteria for evidence assessment speak 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 (see, e.g., Lillis et al. [2010]),[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 (see, e.g., Meyer [2014]),[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., Alves and Pozzebon (2013),[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 toward 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

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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 the graphical abstract; Figures S1–S3). The metrics include (1) nationality/ies of each expert (*927 total experts*), (2a) language of each reference in the approved assessment report (*22,778 total references*), (2b) country/ies of affiliation of the first author of a subsample of references (*1,401 references across all assessments*), (3) nationality/ies of affiliation of each reviewer (*42,107 total comments*), and (4) 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. In addition, 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., Montana and Borie (2016)[48]

SUPPLEMENTAL INFORMATION

Supplemental Information can be found online at https://doi.org/10.1016/j.oneear.2021.01.002.

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AUTHOR CONTRIBUTIONS

A.J.L., Á.F.-L., and I.P. conceived and designed the exercise. A.J.L., Á.F.-L., I.P., P.J., and O.S. defined the methodology. A.J.L., Á.F.-L., I.P., T.A., Z.B., P.J., T.H.M., A.S., and O.S. coded the data. A.J.L., P.J., T.A., and Z.B. analyzed the data. A.J.L., Á.F.-L., I.P., T.A., Z.B., P.J., M.L., T.H.M., A.S., and O.S. wrote the manuscript.

DECLARATIONS OF INTERESTS

The authors declare no competing interests.

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