

Comments on “Mateus-Aguilar, B., Díaz-Salazar, A. F., Andrade-Rivas, F., Batista, N. M.,  
Cárdenas-Navarrete, A., Arenas, A. D., ... & Echeverri, A. (2025). Assessing Biocultural  
Diversity Across Scales Using Ecological Indicators. *Ecological Indicators*, 176, 113616.”

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## Introduction

Mateus-Aguilar et al. (2025) sought to develop a novel quantitative approach for measuring  
biocultural diversity. In this article, the authors evaluated the relationships among multiple  
measures of biodiversity and “cultural” diversity at municipal and ecoregional scales across  
Colombia. In addition, they accurately highlighted that biocultural approaches are increasingly  
used to frame and orient conservation towards addressing the interconnected relationships  
between people and the environment (e.g., Wu & Petriello, 2011). We applaud the authors’  
attempt to increase collective knowledge, utility, and accessibility of inherently complex  
biocultural relationships. However, we identified multiple issues with the conceptualization,  
application, and interpretation of this work. By directly drawing from the article, we highlight  
significant methodological and interpretive problems illustrating why this and similar efforts

may be misguided without more extensive methodological pluralism, collaborative engagement, and epistemic humility.

## **Reflections on methods and inferences**

First, the article uses the Shannon Diversity Index and its inverse to evaluate biological and cultural diversity based on six variables and seven variables, respectively. Although the six biological variables (e.g., species distributions) encompass widely accepted elements of biological diversity, six of the seven cultural indicators in this manuscript (e.g., UNESCO sites, museums, music festivals) are better proxies of formalized institutional capacity than they are of institutionalized cultural diversity. The authors themselves made this claim in explaining their results as measurements of “institutional visibility rather than exhaustive representations of lived or local cultural diversity” (p. 11). However, the repeated references to “cultural diversity” throughout the article are problematic because institutional capacity is not a proxy for culture. Rather, these indicators better represent dominant institutions’ willingness to devote resources to cultural recognition and survival, including potentially for economic benefit or social legitimacy (e.g. Askew, 2010; Bak et al., 2019). For example, UNESCO World Heritage Sites and Intangible Cultural Heritage designations require working collaboration between local community members and government representatives with project support from NGOs or academics, sometimes with minimal community involvement (e.g. Li et al., 2020). As a result, the use of these designations may more likely measure government capacity to engage with local communities to effectively initiate, develop, and pursue a UNESCO designation from start to finish. Calling the composite variables “cultural diversity” or even “institutionalized cultural diversity” therefore misrepresents culture largely as a byproduct of institutional processes rather than shared knowledge, practices, and beliefs.

Second, the authors partly justified their work by problematizing Loh and Harmon's (2005) Index of Biocultural Diversity for violating "statistical assumptions of variable independence" (p. 2). For this reason, they used indices that were not sensitive to variable dependence. On the surface, this choice makes statistical sense. However, we disagree that it makes the model "conceptually valid" (p. 10) on cultural terms. In particular, this omission raises questions as to why the authors chose not to use other more culturally representative census data, like religious or ethnic diversity--both of which were used by Loh and Harmon (2005) and correlate with biocultural conservation (Otamendi-Urroz et al., 2025). These variables would provide a more holistic view of cultural diversity than institutional variables that are often incomplete representations of distinct cultures. Indeed, their selected case study of Valledupar municipality supports this assertion. In the case study, the authors shared how the musical tradition of Vallenato has influenced a celebrated music festival, a UNESCO intangible cultural heritage designation, and a museum commemorating this musical tradition. Valledupar is also home to at least 4 distinct Indigenous groups, leaving an array of questions. Were these groups considered independently? Or were there cultural practices aggregated into one number? Do these composite measures capture the cultural significance of these practices to each group? The case not only highlighted the exact difficulty of finding truly independent cultural variables, but also the profound challenges underlying efforts to distill and disentangle co-dependent cultural indicators into reductive metrics (Reyes-García et al. 2007; da Silva et al. 2014; Gaoue et al. 2021). By making these mathematically motivated choices to conform to their indices, the authors took an implicit stance on what counts as "culture" and how it interfaces with biodiversity.

Third, the seventh "cultural" indicator, languages, is arguably the only indicator in this study not exclusively dependent on institutional capacity. Previous research has shown that institutional

capacity over time advances cultural survival through the funding and maintenance of language revitalization efforts (McIvor & Anisman, 2018). Language is not only inseparable from autochthonous expression, knowledge transfer, and livelihood practices, but decades of research has shown that language is directly connected to stabilized cultural knowledge and practices tied to species presence, diversity and richness (e.g., Garibaldi and Turner 2004). For instance, cultural keystone species (CKS)—biodiversity of profound significance to cultural groups—are directly linked to the language people use to label, describe, and invoke certain animals (Mattalia et al. 2024). Language is also an essential pathway for transmitting cultural knowledge (Reyes-García et al. 2023). This is likely why linguistic diversity notably correlated with the majority of biological variables, whereas the other institutional variables mostly showed partial to insignificant correlations.

Fourth, we do firmly agree with the authors' call for more synergistic biocultural research, aligning with years of biocultural scholarship (Gavin et al. 2015; Sterling et al. 2017). Synergy hinges on multiple forms of engagement and collaboration with Indigenous and non-Indigenous knowledge holders, which could have enabled the research team to identify culturally relevant biocultural indicators. The *Local Indicators of Climate Change* project collaborated with local and Indigenous knowledge holders to develop indicators based on local environmental observations (Reyes-García et al. 2024). Other researchers have engaged in iterative processes with knowledge holders to co-create context-specific biocultural indicators (Dacks et al. 2019). As Sterling et al. (2017) emphasized, “Biocultural...approaches are those that explicitly start with and build on place-based cultural perspectives—encompassing values, knowledges, and needs—and recognize feedbacks between ecological state and human wellbeing” (p. 1800). These examples demonstrate that the work of understanding biocultural relationships requires

co-development with knowledge holders and other members of specific cultures as part of the research process from its onset. The lack of engagement with local and Indigenous knowledge keepers may have informed Mateus-Aguilar et al.'s selection of institutional proxies independent of their local cultural importance. Collaboration with knowledge keepers would also have helped determine the cultural validity of these proxies, lending more credibility to their inclusion as cultural indicators.

Fifth, by extension, the selected variables combined with the statistical logic fueling this manuscript may reinforce the nature-culture dichotomy the authors claim to challenge. They suggest that their “findings contribute to the ongoing nature-culture debate by questioning the notion that ecosystems like the Amazonian rainforest are ‘untouched’ or pristine” (p. 10). They then state that “this challenges the traditional ecological view that human presence necessarily degrades ecosystems” and “this biocultural approach challenges the conventional “wilderness” narrative” (p. 11). How do the authors come to this conclusion based on correlative data? The mere presence of humans says little about their environmental impacts and stewardship practices without detailed understanding of their lived social realities. It also communicates minimal information about how ecoregions mediate cultural change (Rivera-Núñez et al., 2025). The limited explanatory depth appears to result from the exercise of converting “biodiversity” and “culture” to zeros and ones rather than determining ways to quantify the mediating relationships between the variables. Moreover, it creates a window for future scholars to independently distill the elements of biocultural diversity to potentially problematic presence-absence data (MacKenzie, 2005)—a window the authors inch open by recommending “future studies should prioritize quantifying culturally significant elements, such as local myths, legends, songs, and artisan crafts...” (p. 12). Overall, the methodological and interpretive limitations demonstrate

how aggregate correlational data in biocultural research can inform a wide range of loosely connected implications that separate humans from nature if not rooted in context.

And sixth, the context is not only geographic, but historical, political, and intellectual. For instance, if this study design introduced a temporal element to trace these indicators across time, we would likely see that institutional capacity (i.e., “cultural diversity” in this article) across the country has increased over the past few decades. The absence of this wider context obscures the hard-won rights of Indigenous, Afro-Colombian, and Campesino communities to secure land rights and cultural recognition (Rojas Herrera, 2025). In addition, biocultural theory and many related efforts to conceptualize human-environment relations stem from Indigenous struggles for recognition and sovereignty (Lukawiecki et al. 2022; Roué et al. 2022). Yet, this study overlooked decades of intellectual progress, in particular by Indigenous scholars and activists, towards comprehensive representations of and protections for the complex interdependencies of people and the environment (e.g., Ellam Yua et al. 2022; M’sit No’kmaq et al. 2020). The inclusion of these wider contexts would have allowed the researchers to more fully account for important aspects of “the lived experiences, meanings, and abstract dimensions that give culture its richness” (p. 10).

## **Conclusion**

Biocultural diversity is more than a portmanteau of “biodiversity” and “cultural diversity”. It is a profoundly rich relational construct built on acknowledgement and accommodation of different ways of knowing, institutional frameworks, political realities, and species distributions (Otamendi-Urroz et al., 2025). Efforts to develop culturally appropriate and conceptually representative biocultural indicators have been ongoing for years (e.g., Dacks et al. 2019). Yet ongoing attempts to generate overly simplistic metrics of biocultural diversity constrain its

inherent multidimensionality, and by extension, how and why scholars and practitioners seek to understand and conserve it. The push for the use of easy-to-use or readily-available datasets can also divert critical resources from efforts towards meaningful conservation outcomes—work done in community and across different ways of knowing. These efforts risk unintentionally reinforcing long-standing practices and assumptions that attempt to instrumentalize “culture” as a conservation tool rather than leverage “culture” as a lens to reinvent top-down conservation projects. Working in collaboration with local institutions or community leaders to develop fair and mutually beneficial research is the work that benefits biocultural conservation. It is paramount for future endeavors to develop biocultural indicators to resist the appeal of shortcuts when engaging and analyzing culture.

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