

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

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

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

24 **Reflections on methods and inferences**

25 First, the article uses the Shannon Diversity Index and its inverse to evaluate biological and
26 cultural diversity based on six variables and seven variables, respectively. Although the six
27 biological variables (e.g., species distributions) encompass widely accepted elements of
28 biological diversity, six of the seven cultural indicators in this manuscript (e.g., UNESCO sites,
29 museums, music festivals) are better proxies of formalized institutional capacity than they are of
30 institutionalized cultural diversity. The authors themselves made this claim in explaining their
31 results as measurements of “institutional visibility rather than exhaustive representations of lived
32 or local cultural diversity” (p. 11). However, the repeated references to “cultural diversity”
33 throughout the article are problematic because institutional capacity is not a proxy for culture.

34 Rather, these indicators better represent dominant institutions’ willingness to devote resources to
35 cultural recognition and survival, including potentially for economic benefit or social legitimacy
36 (e.g. Askew, 2010; Bak et al., 2019). For example, UNESCO World Heritage Sites and
37 Intangible Cultural Heritage designations require working collaboration between local
38 community members and government representatives with project support from NGOs or
39 academics, sometimes with minimal community involvement (e.g. Li et al., 2020). As a result,
40 the use of these designations may more likely measure government capacity to engage with local
41 communities to effectively initiate, develop, and pursue a UNESCO designation from start to
42 finish. Calling the composite variables “cultural diversity” or even “institutionalized cultural
43 diversity” therefore misrepresents culture largely as a byproduct of institutional processes rather
44 than shared knowledge, practices, and beliefs.

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

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

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

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

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

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

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

130 Conclusion

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

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

147

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