

Cultural and linguistic diversities are underappreciated pillars of biodiversity

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Alongside climate change, the current rapid loss of biodiversity is one of the biggest threats that humanity faces to its own survival (1). With up to a million species at risk of disappearing within decades, human activities are reshaping life on Earth with no precedent in recent history. Biodiversity encompasses all life forms and their variation across the landscape. As one of the most important measures of environmental quality, high biodiversity is often linked with better provision of ecosystem services (2) and also helps assist and promote ecological conservation. Natural parks, national reserves, protected areas, and other measures for preserving the natural world are concerned first and foremost with the protection of biodiversity. But there is a critical and overlooked aspect of this important concept: its link with human cultural and linguistic diversity.

Recent studies reveal how cultural and language diversities are intrinsically linked to the protection of biological diversity (3–6). Some of the largest countries on Earth, including Canada, Brazil, and Australia, are home to hundreds of languages and cultures, many of which are endangered. But the Indigenous-controlled lands represent only 6% and 13% of the territory in Canada and Brazil, respectively, and 52% in Australia. Still, these indigenous-controlled lands typically contain much higher biological diversity than that found in non-Indigenous-controlled areas, both protected and nonprotected, in the same countries (7).

Languages and cultures from Indigenous and Traditional Peoples are of critical importance, because they carry with them alternative yet equally valid ways of knowing and interpreting biodiversity (8, 9). Yet modern societies often fail to consider alternative views and interpretations of the natural world. Making the transition from a system that often monetizes nature to one that takes into account biodiversity as well as cultural

and linguistic diversity as important pillars to society is not easy. Nonetheless, ways forward have been addressed by many scholars, including alternatives to growth-based economies (10) and to the development discourse (11). Here, we highlight ways of living that do not compromise biodiversity and which are at the heart of many Indigenous societies. Developed nations do not normally consider these methods when managing natural systems, often ignoring cultures as part of their macro political and economic agendas. However, these approaches offer a valuable reminder of the need to reconnect to and decommodify nature to protect societies from climate and ecological breakdown.

Case Study: The Mangagoulack

In the Casamance region, fishers from the villages of the Mangagoulack Rural Community, with the help of international nongovernmental organizations (NGOs), registered their fishing territory as an Indigenous and Community-Conserved Area (ICCA) in 2009. This ICCA, called Kawawana, constitutes an institutional recognition of the local, traditional customary rights and the governance systems in these estuarine ecosystems (12). In Kawawana, the diverse vernacular nomenclature for the local fish shows the empirical focus on some taxonomic groups. The same local name can refer to different fish species showing similar traits and behavior. For example, “Essegnaile” refers to three species from the Carangidae taxonomic family, *Caranx hippos*, *Caranx Senegallus*, and *Hemicaranx bicolor*, whereas *Chloroscombrus chrysurus*, from the same family, does not have a common vernacular name because it is usually rejected when caught. This linguistic diversity, tightly co-evolved with the use of the fish, can also be found in the Capitaines group (Polynemidae family): The three

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Indigenous and traditional cultures and languages are the backbone of biodiversity conservation across the globe. Nonetheless, the rich knowledge found in these languages and cultures is not used in standard monitoring or conservation projects, and they face constant perils from parts of society with economic and political power. (Top Left) Evenki reindeer herders, Russia. (Top Right) Skolt Saami old growth forests Finland. (Bottom) Guarani community and local ecosystem vegetation, Brazil.

species present in the Kawawana ICCA are considered as sought-after commodities and are used in traditional ceremonies.

- “Elanc” (*Polydactylus quadrifilis*) is considered as powerful and respected by other fish
- “Amata Elanc” (*Pentanemus quinquarius*) is considered a shepherd for other fish
- “Apou Elanc” (*Galeoides decadactylus*) is considered a young Elanc

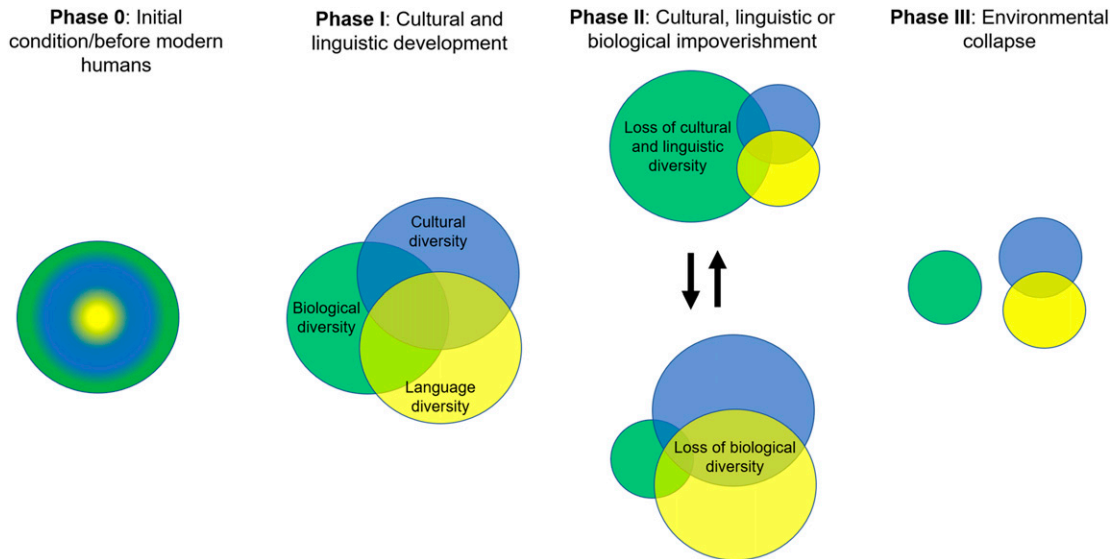
This local traditional ecological knowledge is at the core of the success of the Kawawana ICCA, where fish stocks have been increasing significantly after the implementation of concrete conservation measures by the local fishers (12). Catches are estimated to be around three times higher than before, and dolphins have settled again in the ICCA, possibly because of higher food availability. As a consequence of the healthier fisheries, young boys are now managing to benefit economically from their catches, allowing them to, among other things, buy materials for school.

Case Study: The Guarani

The Guarani people live in rural and semirural areas in Argentina, Bolivia, Brazil, and Paraguay, sharing closely related cultural and language identities across this vast

territory. Their lifestyle, which relies on the tropical and seasonal forests, makes them vulnerable to the urban and farmland developments in the region. The Guarani traditionally subsist on hunting, fishing, and small-scale farming, which yields sacred food items such as “avaxi” (corn), “kumandá” (beans), “mandió” (manioc), “jety” (sweet potato), “pety” (tobacco), “manduvi” (peanuts), “xanjau” (watermelon), and “yakua” (a calabash used for making gourds). Guarani territory is known as the “Yvyrupá”, the land where we stand, the one land. There, the Guarani embrace the “teko porã,” the good way of living. They manage local biodiversity by bestowing different spiritual or common usage status to distinct forest formations, including:

- “Yvy waté”: Sacred hill and mountain tops, where natural springs are located and any use of the area is forbidden.
- “Yvy anguy”: Plane fields suitable for dwellings.
- “Kagüy ete”: Pristine forest where medicinal herbs and other important materials are to be found.
- “Kagüy porã”: Healthy forest with abundant resources, including the native animals.
- “Kagüy poruey”: Untouched and untouchable forests where the forest beings find protection. “Itaja” (the lord of stones) will throw rocks at those who try to get closer to these forests.



Conceptual codevelopment (and subsequent loss) of language and culture with biological diversity. At some point in human history much of our cultural and linguistic diversity would have been intimately related and even derived from biological diversity, as humans depended on the natural world for survival. Phase 0: The ancestral condition of *Homo sapiens*, where culture and language are simple manifestations of the local environment. Phase I: Across all extant human populations, the progression of language and culture has partially disconnected the human diversity components from biological diversity, but such developments do not necessarily impoverish any diversity components. Phase II: Cultural and linguistic impoverishment may happen, for example, when locally diverse human populations are overcome by larger culturally and linguistic homogeneous populations. Biological impoverishment may follow the loss of cultural and linguistic diversity or may be a cause for the loss of cultural and linguistic diversity. Phase III: The disconnection between cultural and linguistic diversity, and biological diversity, is complete, leading ultimately to impoverishment of the three components.

- “Kagü yvin”: Open forest patches used for farming or harvesting of natural resources.

The Guarani constantly work to increase the local biodiversity by sowing seeds of native plants used for food, medical or spiritual purposes, and handcraft work. Whereas wild animals are often viewed as a nuisance in surrounding rural and urban communities, the Guarani praise the return of wildlife. In their restoration approach, trees need to be planted until birds re-establish in the forest. Other animals will then naturally repopulate the area. Thanks to the community’s willingness to simultaneously consider biodiversity and ecosystem services, Guarani-restored areas show higher biodiversity than the surrounding landscape (13).

Case Study: The Nellim

Nellim is a small Inari Sámi Indigenous community located in the boreal region in northeastern Finland, next to Lake Inarijärvi. Inari Sámi is an extremely endangered language amongst the Sámi languages, with speakers located only in present-day Finland. The Nellim community has been living traditionally from freshwater fishing, small-scale reindeer herding, and hunting. This is reflected in the names they assign the months and seasonal events in nature, as well as the associated indicators and activities. Whitefish (*Coregonus lavaretus* sp.), with its range of subspecies in the Lake Inari catchment, is an iconic species that holds meaning for the Nellim community, which is reflected in a nuanced knowledge of the sub-Arctic fish stocks. Because subtle changes to the keystone

species can have cascading effects with both ecological and social impacts, the Inari Sámi vocabulary about the whitefish is very detailed.

- “šapšâ” = overall concept for whitefish
- “kyeli” = whitefish in colloquial conversation
- “rijgá” = old and thin whitefish
- “sáávjâš” = a small whitefish
- “riäská” = a dwarf whitefish endemic to the lake Inarijärvi
- “reevâ”s = another dwarfed stocks of whitefish endemic to the lake Inarijärvi

Inari Sámi knowledge systems have also saved remaining old-growth pine forests as a result of their cultural self-assessment, which led to a moratorium against clear cuts in key habitats in their home village, Nellim (14); this moratorium was later sanctioned by the United Nations. Oral stories and knowledge continue to offer highly relevant baselines for the management and ecological restoration of natural pastures and habitats following forestry impacts.

Case Study: The Evenki

The Evenki are an Indigenous reindeer herding and hunting nation in Siberia, Russia. They are one of the most widely distributed of the Eurasian nomadic herders and refer to their homeland collectively as the larger “Evenkia,” stretching an immense land area from lake Baikal to the shores of the Pacific Ocean in the east. The Evenki, a Tungus language, has adapted and codeveloped with the forest and the reindeer

(*Rangifer tarandus*), which serves as a keystone and cultural species. The Evenki use their reindeer for transport, handicrafts, and food security. Wild reindeer populations are prized as food and game. There are at least 71 distinct endemic concepts for the domesticated and wild reindeer. When accounting for dialects and synonyms, this equates to hundreds of specific reindeer-related concepts. The language differentiates the animals according to age characteristics, fur color, as well as their character and behavior:

- “sonnga” = newborn calf
- “ukoto” = calf during breastfeeding period
- “epchakan” = female reindeer, one to two years old
- “ektana” = bull reindeer, two to three years old
- “semeki” = female reindeer that does not let people approach it during calving
- “arkichan” = old riding (on saddle) reindeer
- “kongnomo”, “kongnorin” = black color and fur color of reindeer
- “igdiama”, “igdyama” = ginger fur color
- “kurbuki” = reindeer that has become wild
- “sungnaki” = restless reindeer

Through the nomadic herding, the Evenki maintain an Indigenous knowledge-monitoring network of taiga habitats, water quality, climate events, and other indicators in extremely remote wilderness areas. For example, the once abundant wild deer is now reported to have migrated away from the Evenki home areas in Southern Yakutia, indicating both levels of intolerance to industrial and infrastructure projects currently under way, or perhaps, a change in distribution related to climate (15).

Case Study: Tao

In Taiwan, Tao people’s oral tradition of storytelling contains the teaching of “mavaheng so panid” (the noble black-wing flying fish, *Hirundichthys rondeletii*) to their ancestors. The teaching includes two major parts: first, the interspecies pact for the survival and sustenance of peoples and fish, and the eco-calendar “ahehep no tao” that defines the arrangement of works and ceremonies throughout the year. Second, there is the knowledge about migratory fish, such as some species of flying fish and their predators, for harvest and ways of eating. For example, some species should not be roasted, and some should never be cooked together. In the Tao marine governance institution, fishing is allowed in the “rayon” season, from about March to June, for migratory species only. Coral reef fishing is absolutely prohibited during this period. The Tao stop harvesting flying fishes when the animals’ reproduction event peaks. In the other seasons, the coral reef fishes are divided into three categories: “oyod” (good), “rahet” (bad), and “jingangana” (inedible). These categories evenly distribute and mitigate the pressure on the food chain. Good fishes are first for women and children, and less valued fishes are reserved only for men. Some fishes in the “rahet” (bad) category are even specified as “kakanen no rarakeh” (food for the Elders). The Indigenous governance that

builds on these indicators is alleviating stock harvesting pressure on the coral reefs using self-sanctioning and preservation of both quality and quantity of stocks. These constitute an alternative and effective system for the management of ecosystem services and conservation of natural resources. This has been called locally “a basis of tribal community sustainability with diversity and vitality” (16).

Our examples highlight the rich and nuanced ways of thinking that can underpin conservation of natural resources and the environment and that form the basis of Indigenous notions of sustainability. They also highlight the role of cultural indicators, often missing in science-based surveys. Yet we have been able to demonstrate only a small fraction of the ways these Indigenous and local languages know their land, nature, waters, and weather, the seen and the unseen. Although biological conservation has traditionally focused on natural systems, considering the socio-ecological system—where place-based languages and Indigenous knowledge have codeveloped with natural systems and evolutionary pathways—can yield highly satisfactory results. Reframing the western notion of humanity’s place in nature, such that it is more aligned conceptually with the way of being in the world exhibited by Indigenous and Traditional Peoples, may result in more connected ways of living with oceans and lands and promote a better quality of life for human populations in light of the current biodiversity and climate crisis.

The cultural and linguistic diversity of Indigenous Peoples continuously face threats (17, 18), from land use change and monetary-based impositions from parts of society with economic or political power to global cultural processes and generational gaps where the younger generations often no longer have the means or the opportunity to maintain this linguistic diversity from a position of power. Their knowledge and language is also under threat given climate change and the ongoing climate-driven shifts in species distributions (15) prompting the question: How will this cultural and linguistic diversity adapt when species are no longer found in their current territories?

Fortunately, the use of traditional ecological knowledge has already been encouraged by organizations such as the International Union for Conservation of Nature and several researchers who argue for the urgent need to integrate Indigenous knowledge into biodiversity assessments and management (19–21). Although these organizations make genuine efforts to include Indigenous and traditional communities in these important discussions, we may achieve better outcomes if the emphasis shifts towards making biocultural characteristics the core of these discussions rather than an afterthought.

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