

RESEARCH ARTICLE

Examining Human-Nature Relationships Through the Lens of Reciprocity: Insights from Indigenous and Local Knowledge

Stimulating reciprocity: How human-plant relations support Indigenous cultural revitalization and stewardship in the Ecuadorian Amazon

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Abstract

1. Human-plant relations shed light on forms of reciprocity in Indigenous territorial stewardship. This article shows how Cofán, Siona and Siekopai (also *Secoya* or *Airo Pai* in Peru) Indigenous Peoples in the western Amazon collect, cultivate and use yoco (*Paullinia yoco*) to promote communal conviviality, reclaim once-threatened cultural practices and advance new forms of collective stewardship to promote social-ecological well-being. Yoco is a caffeine-rich liana closely intertwined with the daily life and spiritual practices of many Indigenous Amazonian Peoples, particularly within the tri-border region of Colombia, Ecuador and Peru.
2. We centre Indigenous storytelling as pedagogy and methodology, something common in the Amazon and relevant to yoco, as it is consumed socially and often while stories are shared.
3. Through collaborative transdisciplinary research, we assess the forms of relationality and reciprocity yoco fosters in three ways. First, we discuss histories, uses and cultivation of yoco. Second, we consider the divergent pathways that communities have had with yoco, from loss to recuperation of human-plant relations across time. Third, we show examples of how differentiated use of yoco in Cofán, Siekopai and Siona communities supports cultural revitalization, territorial defense and stewardship initiatives evidenced by renewed efforts to enhance intergenerational transmission of local knowledge.
4. Cofán, Siona and Siekopai stewardship of yoco is not merely ecological management of a plant but represents a dynamic interaction between cultural identity, spiritual practice and political resistance. As Siona, Siekopai and Cofán communities confront external pressures such as deforestation, extractive industries and socio-political marginalization, relationships with yoco facilitate

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pathways to sustain cultural and ecological relations in the face of profound change.

5. Reclaiming and maintaining human–plant relations is a form of self-determination that can inform effective and ethical biocultural conservation. Through yoco, the Cofán, Siekopai and Siona peoples demonstrate that biocultural conservation helps maintain social-ecological well-being while underscoring the importance of territory. The future of conservation must embrace Indigenous stewardship, where reciprocity and care for both human and non-human worlds are central.

KEYWORDS

biocultural conservation, Ecuador, Indigenous stewardship, medicinal plants, people–plant relations, reciprocity, social-ecological systems

1 | INTRODUCTION

Human–plant relations shed light on the forms of reciprocity in many Indigenous stewardship practices (Arnold et al., 2021; Barreau et al., 2023; Cardoso & Campos, 2023; Joseph, 2021; Kimmerer, 2013; Kimmerer, 2018; Miller, 2019; Ojeda et al., 2022; Virtanen et al., 2024; Zurita-Beanvides, 2017). This article shows how Cofán, Siona and Siekopai (also *Secoya* or *Airo Pai* in Peru). Indigenous Peoples in the western Amazon collect, cultivate and use yoco (*Paullinia yoco*) to promote communal conviviality, reclaim once-threatened cultural practices and advance new forms of collective stewardship to promote social-ecological well-being. The plant's cultivation and use are deeply rooted in the cultural practices of the Cofán, Siekopai and Siona peoples, who ubiquitously refer to this vine as yoco (Belaunde & Echeverri, 2008). Yoco is a caffeine-rich liana that is closely intertwined with the daily life and spiritual practices of many Indigenous Amazonian Peoples, particularly within the tri-border region of Colombia, Ecuador and Peru (Bolívar, 2007; Piaguage Lucitante, 2024; Vargas Roncancio, 2024; Zuluaga Ramírez, 2004).

For the Cofán, Siekopai and Siona, whose territories comprise much of this region, yoco serves as a botanical stimulant and a pillar of social and spiritual engagement (Belaunde, 2019; Piaguage Lucitante, 2024). Schultes described yoco as 'the most important non-alimentary plant in the economy of the Amazonian Natives' (1942: 301). To harness the caffeine-rich properties of yoco, users scrape the layer of phloem just under the surface bark and knead or squeeze it repeatedly in water, producing a bitter, invigorating infusion that is consumed communally, especially during morning gatherings (Weiss & Kearns, 2015; Zuluaga Ramírez, 2004). This daily ritual is more than a mere intake of a stimulant; it is a practice that fosters social cohesion and affirms cultural identity, especially among the Cofán, Siona and Siekopai (Belaunde & Echeverri, 2008; Piaguage Lucitante, 2024). Yoco thus facilitates vital forms of social and ecological reciprocity. We build from existing scholarship that shows how yoco enriches communal conviviality (Belaunde, 2019; Bolívar, 2007; Vargas Roncancio, 2024; Weiss & Kearns, 2015) by arguing that contemporary relations with yoco along the Aguarico River in Ecuador

strengthen adaptive territorial stewardship. For clarity, we use the term "community" to mean discrete villages. We use the term "territory" to mean land that Cofán, Siona or Siekopai Peoples control and hold title to or occupy [e.g. de jure or de facto]. Therefore, within each territory lies discrete communities. Moreover, our use of the term Indigenous territory in this article refers to the current land extent, yet we are cognizant that pre-colonial territorial extents were much larger and more spatially dynamic than present.

We focus on yoco because it reveals insights about processes of cultural revitalization through social-ecological reciprocity in an era of radical change that threatens biocultural diversity and Indigenous lifeways across Amazonia. The Cofán, Siekopai and Siona have all confronted violent processes of colonization and dispossession whereby outsiders have moved to the region in search of land for agriculture, to establish and expand oil wells, and eventually to live in the cities that have since emerged (Esbach et al., 2024; Lu et al., 2017). The growth of non-Indigenous populations and related extractive industries dramatically reduced Indigenous populations and territories in the study area. Yoco plays an important role in Cofán, Siona and Siekopai efforts to maintain healthy relations with their territories and among community members (Belaunde, 2019; Cepek, 2018; Piaguage Lucitante, 2024; Schultes, 1942; Weiss & Kearns, 2015; Zuluaga Ramírez, 2004). Yoco consumption often involves sharing stories and lessons that serve as pedagogical tools for intergenerational knowledge transmission (Belaunde, 2019; Bolívar et al., 2004; Vargas Roncancio, 2024). Furthermore, and as we describe below, caring for yoco promotes ecological well-being within Indigenous territories where it is cultivated. The plant–human relation is thus one of reciprocity where people enact care for yoco while yoco facilitates and strengthens social connection and cultural practice necessary to maintain the plant in a context where forest cover is highly threatened by development. These insights demonstrate how reciprocity as an ethic and practice enabled by strong territorial relations helps ensure social-ecological well-being and biocultural conservation.

Land and cultural loss are not unique among Siona, Siekopai and Cofán Peoples. These are grave issues that dramatically impact Indigenous Peoples across Amazonia (Walker & Simmons, 2018),

Latin America (Correia, 2024) and the globe (Scheidel et al., 2023). Hence, while we present a specific case study that highlights the effects of extractive development and colonialism on Siona, Siekopai and Cofán life, we also foreground Indigenous efforts to create more just futures that centre on their self-determination and grounded practices to enact well-being. These local experiences provide important lessons about the necessity of centering Indigenous leadership, visions, and priorities to inform global efforts to support biocultural approaches to conservation rooted in place-based stewardship.

Indigenous scholars across the Americas highlight grounded practices where land is a living entity, fostering reciprocal relationships and obligations (Gould et al., 2019; Liboiron, 2021; Simpson, 2014; Virtanen, 2019). Resource practices such as selective harvesting and rotational burning reflect this responsibility, maintaining the land's health and ensuring its continued generosity (Loayza et al., 2024). Reciprocity both fosters and stems from shared responsibility for social-ecological well-being, where individuals care for other-than-human nature not only for benefits like continued harvesting but also out of respect and obligation (Salomon et al., 2023; Teixidor-Toneu et al., 2023). Much Indigenous scholarship stresses the importance of relational responsibilities (McGregor, 2018; Middleton Manning, 2023; Whyte, 2020), which refer to the duties and obligations arising from relations among all beings. This includes the responsibility to decolonize scholarship and institutions, reflecting a broader commitment to upholding and integrating Indigenous knowledge and methodologies in conservation efforts (see also Fernández-Llamazares et al., 2021). Indigenous stewardship across the Americas often centers reciprocity through social institutions that engender connection, responsibility, and shared well-being with place and territory (Ojeda et al., 2023; West et al., 2018; Whyte, 2020).

In many Amazonian societies, reciprocity extends beyond reciprocal human–environment interactions to social relations, where obligations and reciprocities help sustain conviviality and social cohesion (Dev, 2018; Kopenawa, 2013; Penfield, 2017). Social-ecological reciprocity has historically informed collective decision-making, prioritizing communal well-being over individual profit in managing shared resources like hunting grounds, fishing spots and medicinal plant areas (Arantes et al., 2022; da Silva Medina et al., 2022; de Castro, 2016). Such practices ensure resource sustainability and reinforce reciprocal relations between human and non-human worlds. Spiritual practices among many Amazonian Indigenous peoples also reinforce reciprocity. The Achuar maintain reciprocal relations with forest spirits through rituals and offerings in efforts to ensure balanced exchanges with the other-than-human natural world (Descola, 1996). This spiritual dimension creates an ethical framework informing practices like hunting, gathering and agriculture, where the other-than-human environment is seen as an extension of the community. Moreover, anthropological research that centres on ontological plurality has shown that many Amazonian societies understand their relationship with the other-than-human world not as a bifurcation of nature/culture but as a relation between

beings who are equal (see e.g. de Viveiros Castro, 1998; Londoño-Sulkin, 2005; Kohn, 2013; Sá, 2019). Reciprocity is also evident in many Amazonian Indigenous governance structures. Hecht's (2003) research on Amazonian black earths details how communal Kayapo decision-making is guided by adaptive practices that link forest and community health (see also Athayde & Silva-Lugo, 2018).

Indigenous-led scholarship on reciprocity emphasizes ethical, responsible, and respectful relationships for social-ecological stewardship, especially regarding plant care and kinship (Brewer II & Johnson, 2023; Cajete, 2020; Henri et al., 2021; Hernandez, 2022; inter alia). Indigenous communities have long understood the deep reciprocity between humans, the land, and plants as kin (Miller, 2019). This kinship is not just metaphorical; it reflects a profound sense of relationality, recognizing land and plants' inherent personhood and agency (Dev, 2018; Kohn, 2013; Vargas Roncancio, 2024; Virtanen et al., 2024). Maizza's (2017, 206) ethnography of human–plant relations shows how Jarawara peoples in the southwestern Amazon equate care for plants as acts that transform them into their children, thus breaking down the human/non-human binary through care-based reciprocity. Vargas Roncancio (2024, 36) discusses how Cofán peoples in Colombia and Secoya (sic) in Ecuador view yoco as a doctor and teacher, 'Insofar as the physical properties of the plant prepare the human body to undertake different activities in the forest, the Yoco [sic], analogically, is considered a giver of advice who teaches children to perform such activities. She is a knowledge holder. She holds medicinal and pedagogical knowledge. The plant heals and teaches'. Vargas Roncancio (2024, 43) suggests that ingesting yoco leads to the co-emergence of human and plant relations as a form of reciprocity where the plant enables 'seeing through Yoco's eyes' that enables deeper understanding and relations with more-than-human beings in territory. Indeed, the animacy of plants and their agency is a vibrant field of research that centers Indigenous relationalities and their importance to human and more-than-human sustainability in the face of contemporary climate and biodiversity crises (Virtanen et al., 2024; Whitaker et al., 2024).

Our work shows that reciprocity is a form of praxis—theory-informed action—based on intergenerational knowledge transmission and adaptive management of vital resources in the face of radical territorial change. We show that reciprocity cannot be understood only as a concept but that it is intimately tied to material practice and dynamic relations that bring the human and non-human worlds together. We suggest that the reciprocal relations between Siona, Siekopai and Cofán communities in northern Ecuador and yoco are a form of adaptive praxis that supports cultural revitalization, territorial defense and social-ecological well-being.

Organized into the following sections, we adopt an approach that highlights social-ecological reciprocity fostered through and with the use and care of yoco. First, we detail author positionality, our methodological approach, and specific study methods and data. Second, we provide a brief overview of the study site context. Third, we share a case study to assess divergent pathways that Siona, Siekopai and Cofán communities have had with yoco, from losing and recuperating cultural practices associated with the plant to

maintaining human–plant relations across time. Doing so, we show diverse forms of reciprocity that yoco enables. Here, we also show how differentiated use of yoco by Siona, Siekopai and Cofán peoples supports community-led stewardship initiatives as evidenced by renewed efforts to care for and cultivate yoco to ensure intergenerational transmission of local knowledge. Finally, we conclude by discussing how experiences from northern Ecuador resonate with broader efforts to acknowledge and value Indigenous contributions to social-ecological stewardship.

2 | METHODS: THINKING WITH AN 'ECOLOGY OF KNOWLEDGES'

Our methodological approach seeks to stimulate conversations about grounded experiences of social-ecological reciprocity in an era of radical change. To do this, our methodology draws from and advances an *ecology of knowledges*, which is a lineage of scholarship rooted in the majority world, what some call the Global South, that troubles the boundaries of 'Western' science, 'traditional' knowledge, and the colonial temporalities of 'new' and 'old' world knowledges. In early works, de Sousa Santos (2007, 85) argued that an ecology of knowledges 'is rooted in the recognition of the plurality of heterogeneous forms of knowledge (one of which is modern science) and in sustainable and dynamic interactions among them without compromising their autonomy. The ecology of knowledges is based on the idea that knowledge is inter-knowledge'. At its core, the ecology of knowledge approach seeks to de-centre the epistemological hegemony of Western scientific knowledge as most valuable and authoritative by emphasizing the value of diverse insights (including generational and millennial knowledge) to deeper understanding (Henri et al., 2021; Johnson et al., 2016; Rahder, 2020). Hence, our work centres a grounded, inductive methodology informed first by Cofán, Siekopai and Siona worldviews and experiences with yoco and complemented by other scientific approaches. This approach respects Indigenous knowledge and relations with yoco while aligning with growing movements in academia to uplift relational science based on Indigenous values and priorities (David-Chavez et al., 2024; Spoon, 2014), braid and bridge knowledges (Alexander et al., 2019; Weaver, 2023; Wilcox et al., 2023), and 'two-eyed seeing' (Bartlett et al., 2012; Reid et al., 2021).

Given that the ritual of preparing and consuming yoco opens a site for dialogue and knowledge transfer (Belanude & Echeverri, 2008; Bolívar et al., 2004; Lasso Mejía, 2008; Piaguaje Lucitante, 2024; Vargas Roncancio, 2024), we bridge that tradition with academic scholarship on Indigenous storytelling as pedagogy and methodology (Kovach, 2010; Simpson, 2014; Ritenburg et al., 2014). Indeed, intergenerational knowledge transmission through storytelling that facilitates Indigenous science is common in the Amazon (Noroña, 2024; Uzendoski & Calapucha-Tapuy, 2012; Virtanen et al., 2021), and relevant to yoco, as it is consumed socially and often while stories are shared. Co-author Aníbal Biaguaje states,

'We learn with yoco everything we know about making handicrafts, and we ask the elders to talk, exchange ideas, because without that, the young people can get lost. Through exchange with the elders, we learn where we live, how we came here, and how our people passed. So, we keep those meanings, from many years ago, that come with yoco'

2.1 | Researcher positionality

In keeping with a methodology that foregrounds epistemological plurality and ecologies of knowledge, co-author positionalities are especially important because each contributor brings distinct experiences, skills and perspectives to this work. We collectively bring firsthand experience and deep knowledge about cultivating, caring for and consuming yoco, along with more traditional academic methods, sources and citations. Foremost, Piaguaje Lucitante, Narváez, Lucitante, Biaguaje, Piaguaje, Alicia Suale, Payaguaje, and Piaguaje are Cofán, Siona and Siekopai yoco practitioners, scientists and knowledge keepers from northern Ecuador who bring expertise rooted in years of applied social-ecological learning, experimentation and knowledge transfer. Non-Indigenous co-authors include Weiss, a scientist and social-ecological advocate who has lived for decades with Siekopai in Ecuador and has deep relations with Siona and Cofán communities. Esbach is a U.S.-based researcher affiliated with a leading conservation organization and has conducted transdisciplinary research with Cofán, Siona and Siekopai communities since 2015. Correia and Simmons are faculty members from U.S. research universities and have been working closely with Cofán, Siona and Siekopai communities through a transdisciplinary National Science Foundation-funded study operating since 2021. We leverage our respective skill sets and forms of authorship to contribute data and writing to the paper in distinct ways.

2.2 | Ethics statement

All research and writing for this paper have been conducted in accordance with community and national Indigenous Federation protocols and the Institutional Review Board (IRB) requirements outlined by Universidad San Francisco de Quito (Protocol #IE02-EX104-2022-CEISH-USFQ), University of Florida (Protocol #202101077) and Colorado State University (Protocol #4168). All participants included in this research voluntarily consented to participate following an informed consent procedure approved in the abovementioned IRB protocols. The consent process involved reading the approved research description and details about any potential benefits and harms of study participation, a process done in the preferred language of the research participant (if not done in Spanish, the consent was translated to the correspondent local language). After reading the research description and consent document, we openly discussed any questions, comments or concerns that research participants raised to ensure full

understanding and that each person had adequate information to voluntarily agree to participate. We obtained verbal, not written, consent because that process was what had been determined as most appropriate during preliminary workshops with community members and leaders before the study began. The verbal consent process was also approved by the three aforementioned university ethics committees.

2.3 | Data collection and data sources

Research for this article derives from a more extensive collaborative investigation focused on Indigenous stewardship and social-ecological resilience in the northern Ecuadorian Amazon (The project is, 'DISES: Resilient Socio-Environmental Systems: Indigenous Territories in the Face of Change', funded by the National Science Foundation (grant no. 2108308). It is a 5-year study, running from 2021 through 2025). However, our work here does not intend or purport to present the full findings of our broader study. Instead, this article is based on in-depth conversational interviews (ten primary interviews of 60–75 min followed by several clarifying conversations and co-writing) and ethnographic research (e.g. participant observation to understand cultural meaning and lived experiences) with Siona, Siekopai and Cofán knowledge holders who are central protagonists in ensuring future transmission of the knowledge and practice related to yoco; those people are also co-authors on this paper. Per the desires of co-author interviewees and their communities, we do not provide public access to the full transcripts of the interviews because community data governance protocols prohibit doing so regarding this topic. Our goal in this paper is not to present a scientific social-ecological analysis (e.g. controlled experiment and complementary statistical results) of yoco but to present a social-ecological analysis of reciprocity embedded in an ethnographic approach enacted through yoco stewardship. This paper discusses experiences from several Cofán, Siona and Siekopai communities. However, we acknowledge the heterogeneity across communities and do not purport to share a universal narrative about yoco or social-ecological reciprocity in this region. Instead, we aim to provide a descriptive assessment of the pathways through which the biocultural connection between people and place is established and perpetuated through the use of yoco.

We complement qualitative and ethnographic data with select focused insights from a structured social science survey administered during our broader study. The survey results from which we share descriptive statistics later were administered in the San Pablo de Katëtsiaya, Sotosiaya and Sinangoe communities where several authors on this paper reside, in addition to the neighbouring communities of Remolino and Aboqüehira. Our survey sample covered 90% of those sites' adult population, specifically 94 Siona, 179 Siekopai and 112 Cofán respondents. Surveys had significant gender and age representation as follows: Siona respondents were between ages 18 and 67 with a sample of 50% women ($n=47$) and 50% men ($n=47$); Siekopai respondents were between ages 18 and 88 with

50% women ($n=90$) and 50% men ($n=89$); Cofán respondents were between ages 18 and 65 with 44% women ($n=49$) and 56% men ($n=56$). The surveys were designed to assess a broad suite of questions pertaining to territorial stewardship, social-ecological change and governance; however, we only present descriptive statistics related to yoco use because the other data are not germane to the aim of this paper. We do not share the entire survey questionnaire here because only a few questions pertained to yoco. Those questions were (a) did your parents cultivate yoco? (b) do you cultivate yoco? (c) do you consume yoco regularly, at least once per month? (d) do you teach your children to consume yoco?. All survey questions were co-developed with Cofán, Siona and Siekopai community members and researchers who administered them in A'ingae (spoken in Cofán communities), Baicoca (spoken in Siona communities), Paicoca (spoken in Siekopai communities) and Spanish (the regional lingua franca spoken in all study communities) as appropriate between January 2023 and March 2024. Survey responses were recorded using Survey123 software and have been thoroughly reviewed and processed prior to inclusion in this paper.

2.4 | Writing with an ecology of knowledges

Our co-authorship process is guided by several Cofán, Siona and Siekopai practitioners who regularly consume, cultivate, and care for yoco revitalization in their respective communities. Together, we devised questions and prompts to guide an analysis grounded in lived experience with yoco. We employ direct quotations from authors on the paper who share specific insights that critically inform our collective analysis. Doing so underscores their intellectual weight, vital data akin to other cited and quoted peer-reviewed materials. The qualitative approach employed here provides deep insights about the meanings of yoco and its role in Indigenous forms of reciprocity and relationality manifest through adaptive stewardship in the context of rapid social-ecological change in Amazonia's frontier regions.

We attend to differential forms of authorship and knowledge production (Baker et al., 2024; Manuel-Navarrete et al., 2021) through a transdisciplinary approach that disrupts 'Western' science norms (Athayde et al., 2016; Londoño et al., 2023) and trends in conservation practice (Rahder, 2020) that have long framed Indigenous knowledge as 'traditional' and thereby relegated to the past (Tuhiwai-Smith, 1999). We collectively recognize the importance of Indigenous knowledge as scientific and emphasize the methodological robustness of adaptive stewardship practices, countering the misconception that 'knowledge' is somehow less rigorous than 'science' (Hernandez & Spencer, 2020; Kurtz, 2013; Risling Baldy et al., 2023). We contribute to efforts to normalize horizontal research practice that honours multiple ways of knowing and stewarding territory that also have important conservation outcomes (Fernández-Llamazares et al., 2020; Jennings et al., 2023; Strega & Brown, 2015; Wolf et al., 2024). Ultimately, we seek to foster an inclusive and respectful scientific paradigm

that acknowledges the depth and validity of Indigenous perspectives in understanding and interacting with the other-than-human natural world (Cajete, 1994).

3 | CONTEXT: RESEARCH SITES AND HISTORICAL OVERVIEW

Our work focuses on several Siona, Siekopai and Cofán Indigenous communities located on the banks of the Aguarico River (Figure 1) in the Northern Ecuadorian Amazon. This region hosts a mosaic of ecosystems, including tropical rainforests, cloud forests and wetlands, which collectively support exceptional biodiversity. With approximately 1400 bird species, 400 mammal species, and 6800 plant species, this region is one of the most species-rich in the Amazon (Alverson et al., 2008; Borman et al., 2007; Map of Life, 2025; Pitman et al., 2002; Vriesendorp et al., 2006). The ancestral territories of the Siona, Siekopai and Cofán historically spanned much further to include the San Miguel, Napo and Putumayo River basins and across Ecuador, Peru and Colombia (Cepek, 2018; Piaguage Lucitante, 2024; Vickers, 1976). Since the 1970s, this region has undergone significant social-ecological transformation because of the rapid expansion of extractive industries, namely oil production and agricultural commodity cropping (Lu et al., 2017; Sawyer, 2004). These development trends run parallel to the expansion of new roads and colonization, driving profound transformations in the environmental, cultural

and socio-economic fabric of Indigenous communities within this region (Cepek, 2018; Esbach et al., 2024; Sawyer, 2022). The Cofán, Siona and Siekopai Peoples of the Ecuadorian Amazon share a deep connection to their territories, rooted in centuries of resilience and resistance against external forces. Each has faced challenges such as colonization, resource extraction and environmental degradation, yet they have managed to preserve their cultural identities. A key component of their survival and resistance lies in their relationship with the land, expressed through the use of sacred plants like yoco (Piaguage Lucitante, 2024; Vargas Roncancio, 2024). Today, Cofán, Siona and Siekopai Peoples continue to defend their territories through direct action against intruders, leveraging existing Indigenous rights law, through direct actions and collective stewardship initiatives (Cepek, 2008, 2012, 2018; Esbach et al., 2024; Krøijer, 2024; Labrador & Ochoa, 2020; Langdon et al., 2023; Vargas Roncancio, 2024; Correia et al. *forthcoming*).

3.1 | Cofán of Sinangoe

The Cofán community of Sinangoe is located along the southern bank of the Aguarico River, nestled at the foothills of the Andes at around 600m in elevation (Figure 2). This region is known for its dynamic geological and climatic conditions, creating a unique biological convergence of Andean and Amazonian species (Pitman et al., 2002). Despite this rich biodiversity, the community has faced significant

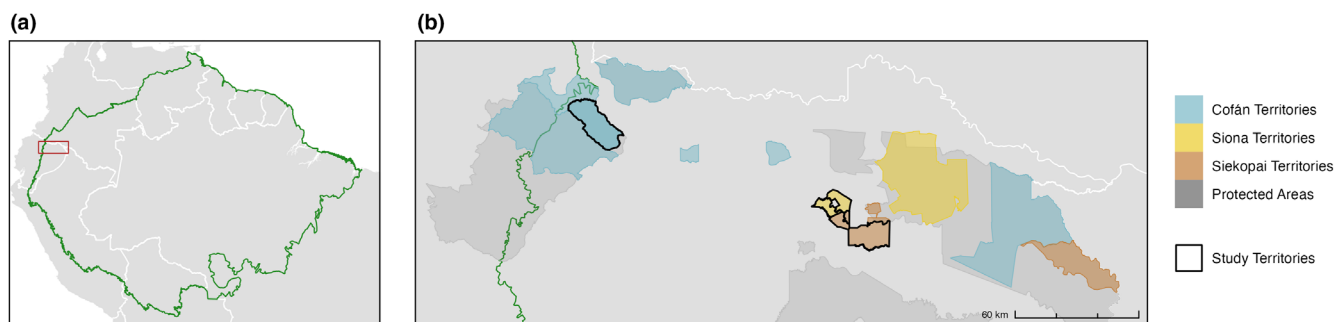


FIGURE 1 Panel (a) shows the Amazon biogeographic region (outlined in a green polygon) and our study region (outlined in a red rectangle). Panel (b) shows Cofán, Siekopai and Siona territories in the Northern Ecuadorian Amazon, with an emphasis on our focal study sites.

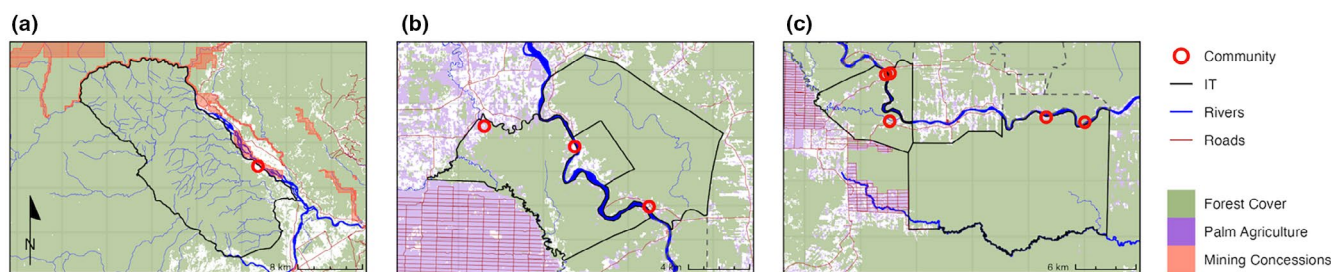


FIGURE 2 Map illustrating (a) the Cofán territory of Sinangoe, (b) the Siona territory of the Aguarico River and (c) the Siekopai territories of the Aguarico River. Each map also shows current forest cover (MapBiomas 2024) and development pressures from roads, mining concessions and palm agriculture immediately surrounding them.

threats from illegal mining and environmental degradation. In 2002, the Cofán were granted legal control over 32,000ha of their ancestral lands within the Cayambe-Coca Ecological Reserve. Sinangoe's Indigenous guard, equipped with drones and camera traps, patrol the territory to monitor illegal incursions. Their landmark legal victory in 2018 led to the suspension of 52 mining concessions, protecting their rainforest from gold extraction (Brown, 2022). Currently, about 200 people reside in Sinangoe, and their efforts towards Indigenous-led conservation have earned global recognition, including the Goldman Environmental Prize.

3.2 | Siona of the Aguarico

The Siona hold rights to two territories in Ecuador: a large area within the Cuyabeno Wildlife Reserve and another along the Aguarico River. Our research is focused on the Aguarico territory (Figure 2), which is jointly titled with the Siekopai, with whom they share deep cultural and linguistic ties, both speaking mutually intelligible languages (Vickers, 1976). The internal boundaries between the Siona and Siekopai within these areas are recognized, though the two groups once lived together before separating in the early 1980s (ONISE (Organización de la Nacionalidad Siona del Ecuador), 2021). Siona communities in the Aguarico territory include Biaña, Sotosiaya, Aboquëhuira and Orahueya, which cumulatively total approximately 200 people. Despite outside influences, such as missionaries, the rubber boom, oil extraction, palm plantations and land invasions (Vickers, 1983), which brought exploitation and violence, the Siona continue to safeguard their cultural identity, ecological knowledge and spiritual practices. They rely heavily on cultural plants like yoco, which are central to their connection to the land.

3.3 | Siekopai of the Aguarico

The Siekopai manage a mosaic of titled lands in Ecuador. Our research efforts focus on their jointly held territory with the Siona along the Aguarico River (Figure 2), which hosts the communities of San Pablo, Waiya and Bellavista, as well as a larger block to the east, which includes the communities of Remolino and Sewaya. Together these communities host approximately 700 people. Additional territories include a block of land to the west of the Cuyabeno Wildlife Reserve and a territory near the border of Peru within the Reserve (Labrador & Ochoa, 2020; Piaguage Lucitante, 2024). The Siekopai recently won a legal case to expand this territory, Pëkëya, from 5000ha to over 40,000ha. This victory is especially significant because it sets a legal precedent in Ecuador, acknowledging Indigenous peoples' rights to lands within protected areas (Gabay, 2024). The Siekopai are deeply connected to their land and are actively engaged in stewardship efforts. These include traditional medicinal gardens, the protection of sacred plants like yoco and yajé (ayahuasca) and grassroots initiatives to reclaim and protect their territories (Piaguage Lucitante, 2024).

4 | CASE STUDY: SHIFTING ROLES OF YOCO ALONG THE AGUARICO RIVER IN NORTHERN ECUADOR

In the early morning light, the sounds of the forest are muted, making way for the crackle of a small fire that illuminates the area where yoco is being prepared. An older man sorts through a pile of cut vines that he found and harvested during yesterday's hunt. Although he was unable to bring home an animal like he had hoped, he did find *ma yoco* (red yoco). After choosing a piece, he sits. With the yoco in his left hand and a knife in his right, he begins to peel away the outermost layer to expose and clean the inner cortex that contains the desired sap that we will drink. He then uses the knife to peel away the bright orange inner bark, which he gathers until his hand is full. The bark is then transferred into a small bowl made from a gourd. Once he is satisfied with the quantity, he pours water over the shavings then proceeds to squeeze and mix repeatedly until the liquid is a deep orange earthy colour (see Figure 3). He then discards the used bark shavings, tossing them on the ground. Before passing the yoco, he blows gently across the surface of the liquid to dispel any lingering bad spirits and invite yoco to impart its energy and knowledge in support of the work they must do today. The bowl is then passed to the first member of the work party who drinks until he is satisfied, letting out a sigh before passing the bowl to the next person. When the bowl is emptied, it is passed back so that more yoco can be prepared and shared with all who are present. The men spend the next hours quietly talking about yesterday's hunt and what today's work might bring as they weave *chambira* palm fibres that will eventually be used to make bags or hammocks. Yoco has been practiced in this way for generations along the banks of the Aguarico River and further into the Amazon forest.

In this section, we focus on the ways that yoco has been used over time in Siona, Siekopai and Cofán communities along the Aguarico River. We first discuss how the plant is propagated and harvested, then move to its social role in contemporary life.

4.1 | Yoco propagation

Existing studies document that yoco is not widely cultivated, but more frequently cared for where found in the forest (Bolívar et al., 2004; Schultes, 1951; Weiss & Kearns, 2015; Zuluaga Ramírez, 2004). Justino Piaguage, former President of the Siekopai Nation in Ecuador, prominent community leader, and advocate for cultural revitalization and territorial rights, has had much experience consuming and cultivating yoco. This experience has taught Justino how yoco thrives; 'yoco is also consumed by yoco. That is, when a yoco vine breaks and falls on itself, it falls and leaves its seeds [in place]' from which it sprouts and grows again. Similarly, Aníbal Biaguae, from the Siona community Sotosiaya observes that yoco 'first makes the flower. Then, the seeds grow. The seeds fall to the ground. From there, the yoco grows'. In the Sinangoe Cofán community, Luciano Lucitante notes that yoco grows best



FIGURE 3 Preparing yoco. Panel (a) shows how the bark is peeled. Panel (b) shows how the peels are placed in a bowl for preparation. Panel (c) shows peels being mixed with water. Panel (d) shows a drinking vessel with one last sip next to a peeled vine and used shavings. Photos by Joel E. Correia and Michael Esbach from 2024.

where there are fewest people, 'it grows fastest where it does not see people'. Yet finding yoco in the forest can be challenging if the vine is not in its flowering state. Hence, local knowledge keepers discuss the importance of birds in helping them find where yoco

is growing. Some Siekopai with deep knowledge of the forest can distinguish between the excited singing of specific bird species when they are feasting on the ripened yoco fruits. These songs help people identify where yoco plants are growing.

Across Siekopai, Siona and Cofán territories, knowledge keepers argue that birds are vital for seed dispersal. The *cuacuiyó* (Screaming Piha or *Lipaugus vociferans*) is perhaps the most important protagonist for allochory (see also Bolívar et al., 2004, 48–49). César Piaguaje observes that the site of adult yoco vines is frequently found near the bird's old nests where the seeds were regurgitated by a mother bird before feeding the sweet white pulp (mesocarp) of the fruit to the hatchlings (see also Belaunde & Echeverri, 2008, 102). Other Siekopai, like Delfín Piaguaje, contend that people most familiar with the forest can distinguish the excited singing of Phia birds when they are feasting upon the ripened fruits of Yoco and follow the calls to find the vine. Aníbal Biaguaje, from the Siona community Sotosiaya, also observes 'toucans and other little birds can swallow the seeds and can carry them to dry places. It [yoco] does not grow in the swamps [*pantanos*] because it is part of the drylands... So, the birds make the seeds fall, and that is where it grows. That is because birds know how to sow yoco.... Only the birds know how to sow yoco'. As with many bird dispersed seeds, the chances of seeds developing to maturity increases with distance away from the mother plant (García et al., 2007; Parolin et al., 2013); this point is relevant for the future of yoco given the increasing ecological fragmentation in the Amazon that threatens available habitat for birds and yoco (Esbach et al., 2024; Vargas Roncancio, 2024), a trend true for many plant seed dispersal across the Amazon (Hooper & Ashton, 2020; Figure 4).

4.2 | Yoco diversity: Types and their uses

Across this region of Ecuador, there are different types of yoco that grow in different ecological conditions. Distinctions between the varieties and their quality are often denoted by the colour of the infusion that results from mixing peeled bark with water. We know of at least five types of yoco that are commonly used in Siona, Cofán and Siekopai territories: white, red, *kěje* and two others more common to Siekopai communities along the Putumayo River: (1) *Sa'sa Sia* yoco has a less than desired quality of the liquid turning a dark grey *negra* instead of the typical rust-orange, (2) *Mi'u sikiri* yoco is identifiable by its characteristic of a phloem layer that can be stripped away from the stem, but it also does not produce the euphoria associated with the other types of yoco. However, Bolívar et al. (2004, 70) report having found records of as many as 11 varieties in herbariums across South America and identified six varieties in their field research with Siekopai peoples in Peru (see pp. 36–41).

Despite this diversity, fewer types of yoco are commonly used in Siona, Cofán and Siekopai communities along the Aguarico River in Ecuador. Luciano Lucitante notes, 'There are two kinds of yoco. There's one that's white, and there's another that's half-reddish. Some say that people used to call the white yoco *sapo yoco* and they called the red *tanto yoco*'. Indeed, Zuluaga Ramírez (2004, 33) affirms 'in general terms, the majority of descriptions conclude that there are always two types of yoco: white yoco and red yoco'. Speaking from Siona territories, Aníbal states that there are two types of red yoco that are primarily consumed, 'it is not that the skin

is red but that the liquid [from the yoco] is very red'. Each variety has distinct characteristics, specifically their flavour and bitterness, whereas Bolívar et al. (2004, 37) document types that can be consumed and others that cannot. The topic of what type of yoco is best is somewhat contested, as some people prefer the sweet flavour of red yoco to the more bitter white yoco. Luciano notes, 'white yoco is the best. It is softer to scrape, but red yoco is very hard and stronger.... Some of the red are a little sweet. They are not bitter. Yes, they're like candy. Even though it's [sap is] thick, it's sweet. When you scrape the white yoco, you put a little and do it fast because it becomes thick as you drink. It is very delicious and bitter'. Regardless, the infusion is generally quite strong and both varieties have distinctly bitter and earthen qualities. Downriver in Siekopai territories, Justino recalls that different types of yoco are suited to different environments and purposes, which highlight the adaptability and resilience of the plant. 'There are more or less three types of yoco. The yoco that we call "yoco" is from the lowlands. But there are types that live in the high grounds (*terra firma*) as well'. Here we clarify that 'lowlands' refers to *várzea* forest, which are temporarily inundated lands with highly fertile soils (Wittmann et al., 2004; For more extensive information on the ecology of yoco, see Bolívar et al., 2004; Weiss & Kearns, 2015; Zuluaga Ramírez, 2004 & footnote 73 in Vargas Roncancio 2024, 54).

The type of yoco consumed also impacts other uses of the plant. For example, many Siekopai, particularly whose territories lie in Peru, acknowledge a variety of *kěje* yoco (Bolívar et al., 2004, 37). The variety bears this name because its sap is akin to the copal tree's resin that is used as a traditional incense. *Kěje* yoco sap is especially sticky and does not come off with water alone which allows for faster *chambira* weaving for the person who rasps and prepares the yoco by handling the vine. As Justino Piaguaje states, 'our grandparents always said that [sticky yoco] is the best because it allows you to weave the *chambira* well. When you prepare yoco your hands get sticky so you can do your work better.' We also want to make clear the important relationships between yoco use and ayahuasca (*yajé*) use in Siona, Siekopai, and Cofán communities, which is a topic that we decided not to include in this article due to the scope of the work and sensitivity of sharing certain spiritual and ritual practices. Several other existing works discuss relations between the use of these plants in the region (see Belanude & Echeverri, 2008; Belaunde, 2019; Bolívar et al., 2004; Vargas Roncancio, 2024).

4.3 | Yoco harvesting

Yoco is mostly harvested from wild vines that climb to a support tree (Bolívar et al., 2004; Zuluaga Ramírez, 2004). This practice, as described by Justino Piaguaje, involves starting with the smaller, upper branches and progressively working toward the vine's base as needed. Yoco's harvesting involves leaving 2–3 feet of the vine's base to coppice, representing a primary traditional silvicultural management practice (Weiss & Kearns, 2015). As part of their cultural tradition, the men go to the forest to harvest yoco, carefully



FIGURE 4 Images of yoco: Panel (a) leaf detail; Panel (b) young plant; Panel (c) flower with pollinator and Pane (d) fruits. Photos by Luke Weiss (2022–2023).

choosing which parts to cut to ensure future regrowth. Historically, yoco was commonly present in the forest (Schultes, 1951; Zuluaga Ramírez, 2004). Today, finding yoco can be challenging, as more forest is felled for extractive development across the Amazon.

Finding yoco requires deep knowledge of the forest to distinguish the vine from the other 125–180 species of *paullinia* that grow in the region and look quite similar (Zuluaga Ramírez, 2004, 63), to know where plants have grown historically, to hear the Piha song

that indicates where fruiting vines are and to know what other bird species are searching for yoco seeds to eat. To aid in this process, some Siekopai knowledge keepers consume young yoco seedlings for the purpose of establishing a deep relationship with the plant, one that enables hunters to ‘hear the yoco voice’ during searches for the vine. Indeed, many Siekopai, Siona and Cofán regard yoco as a sacred entity (Belaunde & Echeverri, 2008; Piaguage Lucitante, 2024; Vargas Roncancio, 2024).

Here, we share limited details to protect traditional knowledge. Justino affirms that 'yoco always has a spiritual being, that's why it self-copies and that's why it's important'. In this regard, yoco is a plant that contains an entity of the forest that can reproduce and propagate itself in healthy environments where the conditions support its well-being, thus serving as a proxy for proper social-ecological relations. Across the river in Siona territories, Aníbal recounts that those with deep knowledge of the forest drink yoco to deepen their relationship with, and knowledge of, the forest and among Siona Peoples. 'In ancient times they [the elders] used to talk to *peina*, which they now call God. He [*peina*] taught us because he left these yoco plants so that they would be used, and that the territories, forests, rituals, respectfulness, and camaraderie would be heard... That is the dynamic left behind, so that yoco would be used for many years, because he left it and is watching those who fulfill it with the yoco'. The reverence for yoco is embodied in harvesting practices predominantly undertaken by men and elders. Such practices are not merely acts of collection but rituals that honour the plant's spirit. This spiritual connection to yoco is present in Cofán communities as well, where its role extends beyond the physical to encompass aspects of cultural identity and continuity.

4.4 | More than a stimulant

Yoco is a medicinal plant with several biophysical effects. It can be used to ward off illness and disease, to cleanse the body and mind and during menstruation (Vargas Roncancio, 2024). Yet, the plant is often noted for its effect as a stimulant with significant caffeine (Echeverri-Sanchez, 2019; Weiss & Kearns, 2015), with Bolívar et al. even naming their 2004 book *Botando Pereza* (shaking off laziness) that studies yoco use among Siekopai communities in Peru. Hence, yoco has long been used to energize people before long days of hunting or working in gardens (Kvist & Holm-Nielsen, 1987) because the infusion suppresses hunger and helps people find strength (Belanude & Echeverri, 2008). Justino explains, 'yoco is for energy... For example, yoco helps to develop work, to focus on work, but it also serves a strategic function when one goes for an activity, perhaps, or for combat, for war. The elders always used to pull up yoco, and if yoco was pulled out in one strike, it meant that the enemy would be weakened. And it is practiced with yoco by turning the cup to weaken the opponent. So, it also serves as part of a combat strategy to weaken the opponent'.

However, yoco is distinct from other stimulant plants like coffee or yerba mate. It is stronger and can have adverse physiological effects, from inducing vomiting to diarrhoea, if one is not well prepared to drink yoco. Preparation in this regard signifies following social rules and regulations about who can drink yoco and when—rules that vary among communities. Luciano recalls learning from Cofán elders about the responsibilities tied to drinking yoco, emphasizing the need to care for both the plant and oneself; 'The elders lived with yoco. That's why they took care of it and followed diets with yoco. Because yoco is

sacred. If you take it without care, you could get sick because of that. That's why yoco is important in reciprocity'. Regarding reciprocity, Luciano makes clear that he is referring to the agency of yoco to effect specific biophysical responses in people who do not reciprocate care for the plant. He states, 'Yoco harms you when you don't take care of yourself. If you're unwell, you must vomit anyway. Why? To get rid of everything bad that's inside. You scrape yoco and prepare a watery tea. You must drink a lot to vomit, but if yoco wants to punish you, even if you drink a lot, you won't be able to vomit to cleanse your stomach. It grips you there and punishes you, even if you fill yourself up with yoco and can't vomit... the yoco punishes you'. Notions of punishment indicate a multi-directional relationship with yoco, one that is not merely based on human harvest and use but based upon human responsibilities to care for oneself and the plant to ensure that yoco will treat those who commune with it well.

4.5 | Yoco and changing social-ecological relations

Changing social-ecological dynamics have long influenced the settlement patterns of Indigenous peoples along the Aguarico River who may have relocated to maintain proximity to wild yoco resources (Schultes, 1942). Thus, relationships between the Cofán, Siekopai and Siona peoples and yoco are not static but have evolved with broader social-ecological changes (Bolívar, 2007; Cepek, 2018; Echeverri-Sanchez, 2019). Moreover, yoco use and cultivation are not uniform across Cofán, Siona or Siekopai communities (see Table 1). These differences derive largely from broader social and cultural change, as younger generations have greater mobility for off-territory work opportunities and education that lead to changes in cultural practice. Whereas in some communities, yoco is seen as a vital and vibrant tool for cultural revitalization, consequently playing an important role in contemporary political struggles for land restitution. This section discusses these dynamics, tracing narratives of loss, adaptation and recuperation in the context of yoco.

TABLE 1 Descriptive statistics detailing the percentage of community members in Siekopai communities (San Pablo de Katêtsiaya, Bella Vista, Remolino), Siona communities (Sotosiaya, Aboquehüira) and Cofán communities (Sinangoe) above the age of 18 who use, cultivate and educate their children about yoco, as reported in surveys conducted in 2023–2024 (see Section 2 for discussion). Elaborated by authors.

	Siona	Siekopai	Cofán
Parents cultivated yoco in forest	63.6%	46.9%	24%
Currently cultivate yoco in forest	26.2%	16.7%	23%
Consume yoco at least monthly	82.83%	24.5%	53.8%
Teaches their children to consume yoco	73.74%	10.6%	23.2%
Total survey sample size	94	179	112

Colonization, cultural change in many Indigenous communities, and widespread land use change driven by extractive development have led to a drastic decline in wild yoco (Weiss & Kearns, 2015). For many Cofán, the traditional practices surrounding yoco have undergone significant transformation. For example, the shifting role of shamans and changes in harvesting practices indicate an adaptation to evolving social and environmental landscapes. Luciano recalls stories learned from his father who directly witnessed this change: 'In the past, since there were no settlers in the colonies, he [Luciano's father] raised yoco. When my father lived, he sat down at the mouth of the pier; when the Kichwas arrived, he did not let them cut the yoco. He always forbade them. Some listened. No, they wouldn't enter our forest. That's how it was before'. Further downriver on the Aguarico, Aníbal Biaguaie talks about the loss of yoco in Siona territory due to the expansion of extractive industries, 'At the time of our ancestors there was enough [yoco]. Now, because of colonization, because of companies, because the settlers were also in the jungle, they cut without knowing... Now, at this time, we always look for yoco far away, before there was quite a lot'.

Like yoco, many Siona, Siekopai and Cofán communities are struggling to survive and thrive amidst decades of ecological fragmentation and social colonization. At the same time, yoco has emerged as a key element in fostering resilience. This plant represents not only continuity with the past but also the ability to adapt and persist through changing circumstances. The practice of caring for yoco amid these changes exemplifies how Indigenous peoples maintain their cultural identity while confronting external threats. This dynamic is particularly evident in the resurgence of yoco-related practices today, where younger generations are re-engaging with this plant in ways that renew and reinforce cultural sovereignty. Communities are innovating within modern contexts while ensuring that traditional practices are preserved. This revitalization is not merely about maintaining the old ways; it is a conscious effort to renew cultural practices that were once at risk of being lost. By doing so, yoco has become a symbol of resistance, resilience and resurgence—a means of reclaiming cultural sovereignty and ensuring the transmission of knowledge to future generations.

We think with yoco as a metaphor for this dynamic: just as the vine clings to small branches with delicate tendrils that harden over time, allowing it to ascend into the canopy where it produces flowers and seeds, many Siona, Siekopai and Cofán communities are gripping to remnants of their ancestral lands and finding ways to grow, adapt and create a future. This metaphor illustrates the persistence and resilience of both the plant and the people. Reciprocity and resilience weave through themes of loss and recovery, reflecting the communities' enduring connection to yoco. As Justino recalls, '...young people are learning to drink. As a result, we are becoming aware of our culture'. The resurgence of yoco use, then, can be understood as a proxy for the resurgent political power and efforts to maintain cultural identity in the face of dramatic social-ecological change.

Yoco is integral to sustaining Cofán, Siona and Siekopai cultural identity and autonomy, both of which require the defense of titled territories to ensure the ecological conditions necessary for

continued growth. In response to yoco scarcity, several Cofán, Siona and Siekopai knowledge keepers have shown interest in developing cultivation techniques to provide an adequate supply for community consumption. For instance, in the last 5 years, many Siona families have begun planting yoco in forested garden plots near their homes, demonstrating a proactive approach to caring for yoco that aligns cultural preservation with ecological stewardship. As Aníbal from the Siona Sotosiaya community states 'Each family is planting a little because we are already losing that [yoco] in the forest. So, we started planting with other families'.

Siekopai and Siona's efforts to cultivate yoco within the community mark a shift from reliance on wild resources to proactive cultivation. Moreover, these communities are consciously providing opportunities for wild yoco to reproduce and re-establish itself in the forest by reducing the pressure on wild vines and facilitating seed dispersal from cultivated gardens to the forest. These efforts are a testament to the communities' commitment to preserving not only yoco but also their cultural and ecological heritage. The revival of yoco is not just a return to tradition but an active re-engagement with a living heritage, where the plant serves as a link between the past and present, between people and their territories.

Caring for and consuming yoco facilitates relations between Cofán, Siekopai and Siona peoples and their territories. This practice is a conduit for intergenerational knowledge transfer and conviviality that highlight the cultural and ecological importance of yoco. This transfer of knowledge extends beyond the use of yoco to encompass a broader spectrum of cultural practices, stories and spiritual beliefs. There is a broad effort among Siekopai, Cofán and Siona communities along the Aguarico River to protect and recover the role of yoco in cultural activities and rituals, underscoring its significance in maintaining a living tradition, including efforts to revive and sustain yoco practices among younger generations, underscoring the plant's role in the continuity of cultural identity. 'It's important to learn', commented Aníbal Biaguaie, 'to teach the young people, to teach the young ladies and the family. Because the children don't know the ancestral roots because other communities don't use yoco and those people lose the knowledge of our ancestors'. Justino Piaguaie also notes that 'yoco is part of the identity of youths. Yoco has been practiced for many years, since the time of our grandparents. That is why it's important that the new generation doesn't lose that identity, that relationship with the yoco'. On this point, Luciano Lucitante also makes clear the importance of yoco for youth to learn the proper ways of being, 'it is important to teach children, so they learn to get up without laziness... for that, you must teach them, even if it means that the children drink a little [yoco]. With that, they get well and always learn to drink. But you have to do that to take care of yourself'.

4.6 | Yoco, territorial reciprocity and resurgence

The story of yoco in the lives of the Cofán, Siekopai and Siona peoples has evolved over generations, adapting to new social-ecological conditions. During historic battles, groups of warriors would work

together to pull down yoco vines from the forest canopy before going into battle as a means of divination. Yoco was also used as a coping mechanism and a way to survive the brutal conditions that the Siona and Siekopai endured during the rubber era (Vickers, 1989; Wasserstrom, 2014). Following decades of land dispossession driven largely by expanding agricultural frontiers and oil extraction across their ancestral territories, the Cofán, Siekopai and Siona peoples have built newfound political power (Krøijer, 2024). Several significant legal victories demonstrate this political agency.

First, the Ecuadorian government issued 52 gold mining concessions in the Cofán Sinangoe territory without respecting the community's rights to free, prior, and informed consent, as outlined in Ecuadorian and international law. Sinangoe community members formed a territorial guard to document illegal incursions into their territory, to push out gold miners and to build evidence that could be used in courts to overturn the concessions. Yoco played an important role in the territorial defense, as the Sinangoe guards prepare and drink the infusion when patrolling their territories (see Figure 5). More than a symbolic form of resistance, this use of yoco both represents cultural resurgence and direct resistance to extractivism and land grabbing on Cofán territories. Sinangoe community member Nixon Andi Narváez displays this direct relation between yoco and political resurgence in the documentary film 'Yocó Cofán: Sabiduría y Territorio' (Nixon, 2023) that follows the work of the territorial guards and centers the importance of yoco to that work. Indeed, the film's trailer begins with scenes of the guards drinking yoco with the narrator stating, 'The yoco awakens the root connection with our origin as well as respect and discipline', before cutting to scenes

of community members patrolling their territory. Moreover, Luciano notes the importance of yoco in these efforts: 'It is good for them to take yoco to be able to care for the territory, but you must take care. As I always say, men are guards, they are there to take care of the territory, and that is why they must take yoco'. Although Luciano explicitly names men as guards, we want to acknowledge the central role that women play in organizing and leading the Sinangoe territorial guard. Indeed, Alexandra Narváez (along with Alex Lucitante) was awarded the Goldman Environmental Prize for her work to lead the Sinangoe territorial guard's resistance to gold mining and for her role in related court proceedings (Goldman Prize, 2022). The work of the territorial guard coupled with sustained community resistance resulted in the Cofán successfully cancelling all the concessions and pushed the Ecuadorian Constitutional Court to uphold FPIC as a actionable guaranteed right, what many now call the Sinangoe precedent (Amazon Frontlines, 2023).

Second, Siekopai peoples have long inhabited several territories along the Aguarico River, spanning current day Ecuador and Peru. However, histories of extractivism and conflict dramatically reduced Siekopai territorial control, including forced displacement from the important spiritual sites located around the Pë'këya River near the current Ecuador-Peru border during the 1941 war between both countries. Justino describes this time: 'During the armed conflict of 1941, confrontations between armies forced the Siekopai to seek new settlements and restricted their ability to move freely through the forest due to the military presence in the disputed area. The last permanent and uninterrupted Siekopai settlements in the Río Pë'këya (Lagartococha) region existed until 1941. They fled the area



FIGURE 5 A mural in the Cofán community Sinangoe that depicts the territorial guard (center) and to their left a bowl of yoco being offered to them. The text on the mural reads 'Our territory. Our decision'. The painting captures the symbolic power of yoco for cultural identity while indexing its material use in political mobilizations and resistance. Photo by Joel E. Correia (2024).

to avoid being used as porters for weaponry and exploited as soldiers in the war' (Piaguage Lucitante, 2024, 55). Subsequent territorial processes, like the creation of new protected areas for conservation, further restricted Siekopai access to their ancestral lands in Pë'këya. Hence, the Siekopai Nation began a legal struggle for territorial restitution per Ecuadorian law that resulted in the November 2023 court ruling determined that 42,360ha that comprise the Pë'këya territory near the Ecuador–Peru border should be returned to the Siekopai following their expulsion in 1941 due to war (Several studies provide detailed analyses of the history of these legal processes that we do not repeat here. See, for example, Krøijer, 2024; Labrador & Ochoa, 2020; Piaguage Lucitante, 2024; Schueman, 2023). Yoco played an important role in the Siekopai legal struggles (see Figure 6). Like the Cofán territorial guard, Siekopai used yoco as a symbol of cultural identity but also to sustain energy through political mobilizations and to directly appeal to legal authorities. Justino Piaguage Lucitante (2024, 103–104) describes one of the hearings with judges from the Sucumbíos Provincial Court in Siekopai territories, 'In accordance with our cultural identity, sense of belonging, and ancestral tradition, from the moment the hearing began, we harmonized the space so that the spiritual connection with our ancestors and the

spirits of the forest would accompany us and guide a day of peace and clarity. We shared the ancestral drink of yoko [sic], facial painting, and the ancient songs of the elders [with the judges]'.

The Siekopai and Cofán legal struggles and victories demonstrate active resistance to the threats of land grabbing, resource extraction, and the legacies of colonial territoriality. Moreover, both accounts illustrate how yoco has played an important symbolic and material role in sustaining these struggles, which may ultimately benefit the plant's future through territorial protection that ensures sustained sites for growth and cultivation. The use of traditional plants like yoco is linked to self-determination through territorial defense, which shifts the plant use from a cultural and medicinal practice to a political practice.

5 | DISCUSSION

The revitalization of yoco practices offers an example of how reciprocity is central to Indigenous stewardship and territorial defense. This process is not simply about the ecological management of a plant but represents a dynamic interaction between cultural identity, spiritual practice and political resistance. As Siona, Siekopai and Cofán communities confront external pressures such as deforestation, extractive industries and socio-political marginalization (Cepek, 2018; Esbach et al., 2024; Labrador & Ochoa, 2020; Lu et al., 2017), relationships with yoco facilitate pathways to sustain cultural and ecological relations in the face of profound change (Belanude & Echeverri, 2008; Bolívar, 2007; Echeverri-Sanchez, 2019; Vargas Roncancio, 2024).

A resurgence of yoco practices is deeply tied to Cofán, Siona and Siekopai self-determination in the face of historic and contemporary social-ecological threats. By maintaining and re-engaging with yoco, communities like Sinangoe, Sotosiaya and San Pablo de Katësiaya, assert their sovereignty over both cultural and natural resources. The consumption of yoco in public settings serves as a political act, reaffirming Indigenous identity and territorial rights in the context of external threats, but it is also materially significant in sustaining energies and health (spiritual and physical) for resistance. In legal battles and territorial defense efforts, yoco becomes a tool for asserting autonomy and demanding the recognition of land tenure and cultural practices. This demonstrates how maintaining cultural practices is itself a form of territorial defense (see also McGregor, 2018; Schuster et al., 2019). Stewardship transcends utilitarian approaches to land management, emphasizing instead the ethical responsibilities that come with inhabiting a shared world. In this way, yoco is not only a source of physical nourishment but also a conduit for the transmission of knowledge, the reinforcement of social cohesion and the enactment of spiritual care.

In a broader context, yoco stewardship sheds light on other ways of doing conservation. As Cofán, Siona and Siekopai knowledge keepers tend to yoco, the plant has become emblematic of a conservation ethic that prioritizes reciprocity and long-term sustainability over short-term exploitation. Cofán, Siona and Siekopai



FIGURE 6 Siekopai and Airo Pai men preparing yoco in the middle of a road closure protest demanding the return of Pë'këya territory near the Ecuador–Peru border. The sign in the background reads 'we demand comprehensive [land] titling'. The person identifiable in this photo gave consent for inclusion in this article. Photo by Luke Weiss 2023.

(a)



(b)



FIGURE 7 Paintings of yoco by Siekopai artist Wilfrido Lusitande. The image in panel (a) depicts the yoco's entanglement with Amazonian social-ecologies. The image in panel (b) depicts yoco harvesting in the Amazon forest.

stewardship practices, as demonstrated through yoco care and use, are rooted in the protection of both cultural identity and biodiversity. This stands in contrast to Western conservation models, which often neglect Indigenous knowledge systems and reduce conservation to economic metrics (Büscher & Fletcher, 2019; Nadasdy, 2005). Indigenous-led land stewardship rooted in reciprocity turns the tables on conventional conservation, promoting an approach that respects Indigenous rights and knowledge (Schuster et al., 2019). Indeed, growing scholarship shows that positive social-ecological outcomes result from Indigenous land stewardship in many contexts (Garnett et al., 2018; Ojeda et al., 2022; Zhang et al., 2023).

6 | CONCLUSION

By examining reciprocal human–plant relations embodied by yoco, our work shows how cultural resurgence, ecological stewardship and political resistance converge in place. Seen in this light, yoco is not just a plant or stimulant but a central element in social cohesion, spiritual practice, cultural identity and political mobilization among many Cofán, Siona and Siekopai communities. Yoco's story, as portrayed by members of the Cofán, Siekopai and Siona communities, is not just a botanical one; it is a symbol of resilience, a repository of generational knowledge and a cornerstone of cultural identity (see Figure 7). In these communities, yoco cultivates a catalyst for

biocultural continuity and adaptation. Its care and use become acts of cultural affirmation and self-determination.

Revitalization of yoco use and stewardship also represents a pathway towards biocultural continuity and resilience, ensuring that both cultural practices and ecological systems can thrive amid socio-ecological transformations. As we reflect on yoco's significance, it becomes clear that the future of conservation must involve an embrace of Indigenous stewardship principles, where reciprocity and care for both human and non-human worlds are central. Thus, the case presented here further highlights the importance of Indigenous leadership in conservation by reframing Indigenous practices and connections to place not as 'backward' but as essential for long-run biocultural sustainability. Indigenous stewardship practices, like those discussed here, challenge conventional conservation paradigms. Moreover, they demand a deeper integration of Indigenous leadership, knowledge and practices into global sustainability efforts (Mansuy et al., 2023; Zhang et al., 2023). Through yoco, Cofán, Siekopai and Siona peoples demonstrate that biocultural conservation helps maintain the social-ecological relationships that make life possible.

AUTHOR CONTRIBUTIONS

Joel E. Correia, Luke Weiss, Nelly Narváez, Yolanda Piaguaje and Michael Esbach conceived the ideas and designed the methodology; Joel E. Correia, Luke Weiss, Esperanza Piaguaje, Nelly Narváez, Yolanda Piaguaje, Alicia Suale, and Michael Esbach collected the

data; Joel E. Correia, Justino Piaguaje Lucitante, Luke Weiss, Nelly Narváez, Luciano Lucitante, Aníbal Biaguae, Yolanda Piaguaje, Alicia Suale, Adriano Payaguaje, Esperanza Piaguaje, and Michael Esbach analysed the data; Joel E. Correia, Luke Weiss and Michael Esbach led the writing of the manuscript, and Cynthia Simmons provided editing on one manuscript revision. All authors contributed critically to the drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The National Science Foundation (NSF) requires that data from studies they fund be made publicly available via open access repositories. However, NSF also recognizes the rights of Indigenous Peoples to determine how data about their communities and lives are used. Per our agreements with each participating community and the permission they have granted to us to conduct the research, we have developed data sovereignty protocols that ensure the communities retain access to the data derived from this study about their communities and that they have the authority to determine what information is shared and how. Hence, per our NSF-approved data management plan, data from this study will be embargoed through the end of the project funding period, then will be made publicly available via the University of Florida and Colorado State University repositories. Please contact the corresponding author for updates regarding the data repository, which should be available in 2026.

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REFERENCES

- Alexander, S. M., Provencher, J. F., Henri, D. A., Taylor, J. J., Lloren, J. I., Nanayakkara, L., Johnson, J. T., & Cooke, S. J. (2019). Bridging indigenous and science-based knowledge in coastal and marine research, monitoring, and management in Canada. *Environmental Evidence*, 8, 36. <https://doi.org/10.1186/s13750-019-0181-3>
- Alverson, W. S., Vriesendorp, C., del Campo, A., Moskovits, D. K., Stotz, D. F., Donayre, M. G., & Borbor, L. A. (2008). *Ecuador-Perú: Cuyabeno-Güepi. Rapid Biological and Social Inventories Report 20*. The Field Museum.
- Amazon Frontlines. (2023). The Sinangoe precedent: An instrument of protection for Indigenous rights and lands. <https://amazonfrontlines.org/chronicles/the-sinangoe-precedent-an-instrument-of-protection/>
- Arantes, C. C., Castello, L., Basurto, X., Angeli, N., Sene-Haper, A., & McGrath, D. G. (2022). Institutional effects on ecological outcomes of community-based management of fisheries in the Amazon. *Ambio*, 51(3), 678–690. <https://doi.org/10.1007/s13280-021-01575-1>
- Arnold, C., Atchison, J., & McKnight, A. (2021). Reciprocal relationships with trees: Rekindling Indigenous wellbeing and identity through the Yuin ontology of oneness. *Australian Geographer*, 52(2), 131–147. <https://doi.org/10.1080/00049182.2021.1910111>
- Athayde, S., & Silva-Lugo, J. (2018). Adaptive strategies to displacement and environmental change among the Kaiabi Indigenous People of the Brazilian Amazon. *Society & Natural Resources*, 31(6), 666–682. <https://doi.org/10.1080/08941920.2018.1426801>
- Athayde, S., Stepp, J. R., & Ballester, W. C. (2016). Engaging Indigenous and academic knowledge on bees in the Amazon: Implications for environmental management and transdisciplinary research. *Journal of Ethnobiology and Ethnomedicine*, 12(1), 26. <https://doi.org/10.1186/s13002-016-0093-z>
- Baker, V., Ataria, J., Ankeny, R., & Bray, H. (2024). Transdisciplinary science and the importance of indigenous knowledge. *Integrated Environmental Assessment and Management*, 20(3), 805–816. <https://doi.org/10.1002/ieam.4847>
- Barreau, A., Ibarra, J. T., Wyndham, F. S., Rojas, A., & Kozak, R. A. (2023). How can we teach our children if we cannot access the forest? Generational change in Mapuche knowledge of wild edible plants in Andean temperate ecosystems of Chile. *Journal of Ethnobiology*, 36(2), 412–432. <https://doi.org/10.2993/0278-0771-36.2.412>
- Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, 2, 331–340. <https://doi.org/10.1007/s13412-012-0086-8>
- Belanude, L. E., & Echeverri, J. A. (2008). "Como un padre que da consejo": *Paullinia yoco* entre los airo-pai del Perú. In M. Ienaerts & A. M. Spadofora (Eds.), *Pueblos indígenas, plantas y mercados Amazonía y Gran Chaco*. Zeta Books.
- Belaunde, L. E. (2019). O ninho do japu: Perpsectivismo, gênero e relações interespecies airo-pai. *Amazônica: Revista de Antropologia*, 11(2), 657–687. <https://doi.org/10.18542/amazonica.v11i2.7638>
- Belaunde, L. E., & Echeverri, J. A. (2008). El Yoco Del Cielo Es Cultivado: Perspectivas Sobre *Paullinia Yoco* En El Chamanismo Airo-Pai (Secoya-Tucano Occidental). *Anthropologica*, 26(26), 87–112.
- Bolívar, E. (2007). Consejos para vivir bien: Una perspectiva histórica sobre los diferentes usos del bejuco yoco, Amazonía noroccidental. In V. Nieto & G. Palacio (Eds.), *Amazonía desde dentro: Aportes a la investigación de la Amazonía colombiana*. Universidad Nacional de Colombia, Sede Leticia.
- Bolívar, E. E., López, W., Gallego, L. M., & Huérano, Á. A. (2004). "Botando pereza" *El yoco entre los secoya del Putumayo*. (Echeverri, J. Á. (Ed.)) (pp. 153–177). Universidad Nacional de Colombia.

- Borman, R. B., Vriesendorp, C., Alverson, W. S., Moskovits, D. K., Stotz, D. F., & del Campo, A. (2007). *Ecuador: Territorio Cofán Dureno*. Rapid Biological Inventories Report 19. The Field Museum.
- Brewer, J. P., II, & Johnson, J. T. (2023). Reciprocity: An ethos "more than human". *GeoHumanities*, 9(2), 315–332. <https://doi.org/10.1080/2373566X.2022.2158899>
- Brown, K. (2022). Ecuador's top court rules for stronger land rights for Indigenous communities. Mongabay. https://news.mongabay.com/2022/02/ecuadors-top-court-rules-for-stronger-land-rights-for-indigenous-communities/?mc_cid=6381ff0eb5&mc_eid=de3ebf80da
- Büscher, B., & Fletcher, R. (2019). Towards convivial conservation. *Conservation and Society*, 17(3), 283–296.
- Cajete, G. A. (1994). *Look to the mountain: An ecology of indigenous education*. Kivaki Press.
- Cajete, G. A. (2020). Indigenous science, climate change, and indigenous community building: A framework of foundational perspectives for indigenous community resilience and revitalization. *Sustainability*, 12(22), 9569. <https://doi.org/10.3390/su12229569>
- Cardoso, T. M., & Campos, M. A. d. A. (2023). Intimate relations: Multispecies stories of manioc social life. *Vibrant: Virtual Brazilian Anthropology*, 20, e20602. <https://doi.org/10.1590/1809-4341.2023v20a20602>
- Cepek, M. (2012). The loss of oil: Constituting disaster in Amazonian Ecuador. *The Journal of Latin American and Caribbean Anthropology*, 17, 393–412. <https://doi.org/10.1111/j.1935-4940.2012.01250.x>
- Cepek, M. (2018). *Life in oil: Cofán survival in the petroleum fields of Amazonia*. University of Texas.
- Cepek, M. L. (2008). Essential commitments: Identity and the politics of Cofán conservation. *The Journal of Latin American and Caribbean Anthropology*, 13, 196–222. <https://doi.org/10.1111/j.1548-7180.2008.00009.x>
- Correia, J. E. (2024). Land matters: How Indigenous land restitution can inform loss and damage policy and chart a path toward an otherwise climate justice. *Climate and Development*, 16(9), 811–825. <https://doi.org/10.1080/17565529.2024.2378027>
- da Silva Medina, G., Pokorny, B., & Campbell, B. (2022). Forest governance in the Amazon: Favoring the emergence of local management systems. *World Development*, 149, 105696. <https://doi.org/10.1016/j.worlddev.2021.105696>
- David-Chavez, D. M., Gavin, M. C., Ortiz, N., Valdez, S., & Carrol, S. R. (2024). A values-centered relational science model: Supporting Indigenous rights and reconciliation in research. *Ecology and Society*, 29(2), 11. <https://www.ecologyandsociety.org/vol29/iss2/art11/>
- de Castro, F. (2016). Local politics of floodplain tenure in the Amazon. *International Journal of the Commons*, 10(1), 1–20.
- de Sousa Santos, B. (2007). Para além do pensamento abissal: Das linhas globais a uma ecologia de saberes. *Novos Estudos*, 79, 71–94.
- de Viveiros Castro, E. (1998). Cosmological deixis and Amerindian perspectivism. *The Journal of the Royal Anthropological Institute*, 4(3), 469–488. <https://doi.org/10.2307/3034157>
- Descola, P. (1996). *In the society of nature: A native ecology in Amazonia*. Cambridge University Press.
- Dev, L. (2018). Plant knowledges: Indigenous approaches and interspecies listening toward decolonizing ayahuasca research. In B. C. Labete & C. Canvar (Eds.), *Plant medicines, healing and psychedelic science* (pp. 185–204). Springer. https://doi.org/10.1007/978-3-319-76720-8_11
- Echeverri-Sanchez, H. A. (2019). "Los caminos de la medicina": *The life of medicinal plants from the forest of Amazonia to the urban markets*. Dissertation. University College of London. https://discovery.ucl.ac.uk/id/eprint/10079590/7/Echeverri%20Sanchez_10079590_thesis_corrected.pdf
- Esbach, M., Correia, J. E., Valdivia, G., & Lu, F. (2024). Amazonian conservation across archipelagos of Indigenous territories. *Conservation Biology*, e14407. <https://doi.org/10.1111/cobi.14407>
- Fernández-Llamazares, Á., Benyei, P., Junqueira, A. B., & Reyes-García, V. (2020). Participation in biocultural diversity conservation: Insights from five Amazonian examples. In C. Baldauf (Ed.), *Participatory biodiversity conservation: Concepts, experiences, and perspectives* (pp. 165–183). Springer International Publishing. https://doi.org/10.1007/978-3-030-41686-7_11
- Fernández-Llamazares, I., Lepofsky, D., Lertzman, K., Armstrong, C. G., Brondizio, E. S., Gavin, M. C., Lyver, P. O'B., Nicholas, G. P., Pascua, P., Reo, N. J., Reyes-García, V., Turner, N. J., Yletyinen, J., Anderson, E. N., Balée, W., Cariño, J., David-Chavez, D. M., Dunn, C. P., Garnett, S. C., ... Vaughan, M. B. (2021). Scientists' warning to humanity on threats to indigenous and local knowledge systems. *Journal of Ethnobiology*, 41(2), 144–169. <https://doi.org/10.2993/0278-0771-41.2.144>
- Gabay, A. (2024). Historic land win for Ecuador's Siekopai sets precedent for other indigenous peoples. Mongabay Environmental News. <https://news.mongabay.com/2024/01/historic-land-win-for-ecuadors-siekopai-sets-precedent-for-other-indigenous-groups/>
- García, D., Martínez, I., & Obeso, J. R. (2007). Seed transfer among bird-dispersed trees and its consequences for post-dispersal seed fate. *Basic and Applied Ecology*, 8(6), 533–543. <https://doi.org/10.1016/j.baae.2006.11.002>
- Garnett, S. T., Burgess, N. D., Fa, J. E., Fernández-Llamazares, Á., Molnár, Z., Robinson, C. J., Watson, J. E. M., Zander, K. K., Austin, B., Brondizio, E. S., Collier, N. F., Duncan, T., Ellis, E., Geyle, H., Jackson, M. V., Jonas, H., Malmer, P., McGowan, B., Sivongxay, A., & Leiper, I. (2018). A spatial overview of the global importance of indigenous lands for conservation. *Nature Sustainability*, 1(7), 369–374. <https://doi.org/10.1038/s41893-018-0100-6>
- Goldman Prize. (2022). 2022 Goldman Prize Winner Alexandra Narvaez & Alex Lucitante. <https://www.goldmanprize.org/recipient/alexandra-narvaez-alex-lucitante/#recipient-bio>
- Gould, R. K., Pai, M., Muraca, B., & Chan, K. M. A. (2019). He 'ike 'ana la i ka Pono (it is a recognizing of the right thing): How one indigenous worldview informs relational values and social values. *Sustainability Science*, 14(5), 1213–1232. <https://doi.org/10.1007/s11625-019-00721-9>
- Hecht, S. B. (2003). Indigenous soil management and the creation of Amazonian dark earths: Implications of Kayapó practice. In J. Lehmann, D. C. Kern, B. Glaser, & W. I. Wodos (Eds.), *Amazonian Dark Earths* (pp. 355–372). Springer.
- Henri, D. A., Provencher, J. F., Bowles, E., Taylor, J. J., Steel, J., Chelick, C., Popp, J. N., Cooke, S. J., Rytwinski, T., McGregor, D., Ford, A. T., & Alexander Steven, M. (2021). Weaving Indigenous knowledge systems and Western sciences in terrestrial research, monitoring, and management in Canada: A protocol for a systematic map. *Ecological Solutions and Evidence*, 2, e12057. <https://doi.org/10.1002/2688-8319.12057>
- Hernandez, J. (2022). *Fresh Banana leaves: Healing indigenous landscapes through Indigenous science*. North Atlantic Books.
- Hernandez, J., & Spencer, M. S. (2020). Weaving Indigenous science into ecological sciences: Culturally grounding our indigenous scholarship. *Human Biology*, 92(1), 5–9.
- Hooper, E. R., & Ashton, M. S. (2020). Fragmentation reduces community-wide taxonomic and functional diversity of dispersed tree seeds in the Central Amazon. *Ecological Applications: A Publication of the Ecological Society of America*, 30(5), e02093. <https://doi.org/10.1002/eap.2093>
- Jennings, L., Anderson, T., Martinez, A., Sterling, R., Chavez, D. D., Garba, I., Hudson, M., Garrison, N. A., & Carroll, S. R. (2023). Applying the 'CARE principles for Indigenous data governance' to ecology and biodiversity research. *Nature Ecology & Evolution*, 7(10), 1547–1551. <https://doi.org/10.1038/s41559-023-02161-2>
- Johnson, J. T., Howitt, R., Cajete, G., Berkes, F., Louis, R. P., & Kliskey, A. (2016). Weaving Indigenous and sustainability sciences to diversify

- our methods. *Sustainability Science*, 11, 1–11. <https://doi.org/10.1007/s11625-015-0349-x>
- Joseph, L. (2021). Walking on our lands again: Turning to culturally important plants and Indigenous conceptualizations of health in a time of cultural and political resurgence. *International Journal of Indigenous Health*, 16(1), 165–179. <https://doi.org/10.32799/ijih.v16i1.33205>
- Kimmerer, R. W. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Penguin.
- Kimmerer, R. W. (2018). Miskos Kenomagwen, the lessons of grass: Restoring reciprocity with the good green earth. In M. K. Nelson & D. Shilling (Eds.), *Traditional ecological knowledge: Learning from Indigenous practices for environmental sustainability* (pp. 27–56). Cambridge University Press.
- Kohn, E. (2013). *How forests think: Toward an anthropology beyond the human*. University of California Press.
- Kopenawa, D. (2013). *The falling sky: Words of a Yanomami shaman*. Harvard University Press. <https://doi.org/10.4159/harvard.9780674726116>
- Kovach, M. (2010). Conversation method in indigenous research. *First Peoples Child & Family Review: An Interdisciplinary Journal Honouring the Voices, Perspectives, and Knowledge of First Peoples through Research, Critical Analyses, Stories, Standpoints and Media Reviews*, 5(1), 40–48. <https://doi.org/10.7202/1069060ar>
- Krøijer, S. (2024). Performing contested lands: Conservation and the conflictive enactments of Indigenous territoriality in lowland Ecuador. *Bulletin of Latin American Research*, 43, 120–131. <https://doi.org/10.1111/blar.13524>
- Kurtz, D. L. M. (2013). Indigenous methodologies: Traversing Indigenous and Western. *AlterNative: An International Journal of Indigenous Peoples. Worldviews in Research*, 9(3), 217–229.
- Kvist, L. P., & Holm-Nielsen, L. (1987). Ethnobotanical aspects of lowland Ecuador. *Opera Botanica*, 92, 83–107.
- Labrador, J. G., & Ochoa, J. (2020). Two ontologies of territory and a legal claim in the Ecuadorian upper Amazon. *Journal of Political Ecology*, 27(1), 496–516. <https://doi.org/10.2458/v27i1.23099>
- Langdon, E. J., Laffay, T., & Maniguaie-Yaiguaje, P. (2023). Resistencias, re-existencias y prácticas chamánicas: Las poéticas y políticas de una visión contemporánea. *Mundo Amazónico*, 14(1), 33–48. <https://doi.org/10.15446/ma.v14n1.104431>
- Lasso Mejia, J. I. (2008). *Geografía de un saber canto pintado*. Thesis. Universidad de Nariño. <https://sired.udenar.edu.co/12078/1/75886.pdf>
- Liboiron, M. (2021). *Pollution is colonialism*. Duke University Press.
- Loayza, G., Pozo, S., Lascano, M., Bilhaut, A.-G., Krainer, A., Teixidor-Toneu, I., & Montúfar, R. (2024). Dynamic reciprocal contributions between indigenous communities and cultural keystone species: A study case in Western Ecuador. *People and Nature*. <https://doi.org/10.1002/pan3.10684>
- Londoño, S. C., Semken, S., Brandt, E., Garzón, C., & Makuritofe, V. (2023). Understanding the geology of the Colombian Amazon through indigenous eyes: Useful metaphors and approaches for teaching earth sciences in the Colombian Amazon. In P. W. U. Chinn & S. Nelson-Barber (Eds.), *Indigenous STEM education. Sociocultural explorations of science education* (Vol. 29). Springer. https://doi.org/10.1007/978-3-031-30451-4_12
- Londoño-Sulkin, C. D. (2005). Inhuman beings: Morality and perspectivism among Muinane people (Colombian Amazon). *Ethnos Journal of Anthropology*, 70(1), 7–30. <https://doi.org/10.1080/0014184050048474>
- Lu, F., Valdivia, G., & Silva, N. (2017). *Oil, revolution, and indigenous citizenship in Ecuadorian Amazon*. Palgrave Macmillan.
- Maizza, F. (2017). Persuasive kinship: Human-plant relations in south-west Amazonia. *Tipiti: Journal for the Anthropology of Society of Lowland South America*, 15(2), 206–220.
- Middleton Manning, B. R. (2023). Geographies of hope in cultural resources protection. *Environment and Planning E: Nature and Space*, 6(3), 1543–1560. <https://doi.org/10.1177/2514848619875920>
- Mansuy, N., Staley, D., Alook, S., Parlee, B., Thomson, A., Littlechild, D. B., Munson, M., & Didzena, F. (2023). Indigenous protected and conserved areas (IPCAs): Canada's new path forward for biological and cultural conservation and indigenous well-being. *Facets*, 8, 1–16. <https://doi.org/10.1139/facets-2022-0118>
- Manuel-Navarrete, D., Buzinde, C. N., & Swanson, T. (2021). Fostering horizontal knowledge Co-production with Indigenous people by leveraging Researchers' transdisciplinary intentions. *Ecology and Society*, 26(2), art22. <https://doi.org/10.5751/ES-12265-260222>
- Map of Life. (2025). Map of Life. <https://mol.org/>
- McGregor, D. (2018). Mino-Mnaamodzawin. *Environment and Society*, 9(1), 7–24. <https://doi.org/10.3167/ares.2018.090102>
- Miller, T. L. (2019). *Plant kin: A multispecies ethnography in indigenous Brazil*. University of Texas Press.
- Nadasdy, P. (2005). Transcending the debate over the ecologically Noble Indian: Indigenous peoples and environmentalism. *Ethnohistory*, 52(2), 291–331. <https://doi.org/10.1215/00141801-52-2-291>
- Nixon, A. (2023). Yocó Cofán: Sabiduría y Territorio. <https://www.youtube.com/watch?v=E2jXBG6qdYY>
- Noroña, M. B. (2024). Storytelling dreams and life: Traveling across worlds in the Amazon of Ecuador. *Environment and Planning E: Nature and Space*, 7, 25148486241263397. <https://doi.org/10.1177/25148486241263397>
- Ojeda, J., Salomon, A. K., Rowe, J. K., & Ban, N. C. (2022). Reciprocal contributions between people and nature: A conceptual intervention. *Bioscience*, 72(10), 952–962. <https://doi.org/10.1093/biosci/biac053>
- Ojeda, J., Tauro, A., Contador, T., González-Calderón, J., Malebran, J., Rosenfeld, S., Massardo, F., Mansilla, A., & Rozzi, R. (2023). 'Pay attention, dive with eyes wide open': A field environmental philosophy activity to Foster reciprocity between people and nature. In R. Rozzi, A. Tauro, N. Avriel-Avni, T. Wright, & R. H. May, Jr. (Eds.), *Field environmental philosophy: Education for biocultural conservation* (pp. 87–100. Ecology and Ethics). Springer International Publishing. https://doi.org/10.1007/978-3-031-23368-5_6
- ONISE (Organización de la Nacionalidad Siona del Ecuador). (2021). Plan de vida de la nacionalidad Siona del Ecuador 2021–2031. <https://online.fliphtml5.com/evnkc/wiek/#p=1>
- Parolin, P., Wittmann, F., & Ferreira, L. V. (2013). Fruit and seed dispersal in Amazonian floodplain trees: A review. *Ecotropica*, 19(1), 19–36.
- Penfield, A. (2017). Dodged debts and the submissive predator: Perspectives on Amazonian relations of dependence. *Journal of the Royal Anthropological Institute*, 23, 320–337. <https://doi.org/10.1111/1467-9655.12609>
- Piaguage Lucitante, Á. J. (2024). *La naturaleza y el territorio según el pueblo Siekopai: Contenido, amenazas y resistencias*. Thesis. Universidad Andina Simón Bolívar. <https://repositorio.uasb.edu.ec/bitstream/10644/9996/1/T4379-MDNJI-Piaguage-La%20naturaleza.pdf>
- Pitman, N., Moskovits, D. K., Alverson, W. S., & Borman, R. B. (2002). *Ecuador: Serranías Cofán-Bermejo, Sinangoe. Rapid Biological Inventories Report 3*. The Field Museum.
- Rahder, M. (2020). *An ecology of knowledges: Fear, love, and technoscience in Guatemalan forest conservation*. Duke University Press.
- Reid, A. J., Eckert, L. E., Lane, J.-F., Young, N., Hinch, S. G., Darimont, C. T., Cooke, S. J., Ban, N. C., & Marshall, A. (2021). "Two-eyed seeing": An indigenous framework to transform fisheries research and management. *Fish and Fisheries*, 22, 243–261. <https://doi.org/10.1111/faf.12516>
- Risling Baldy, C., Reed, K., & Begay, K. (2023). Polytech to PolyTEK: Traditional ecological knowledge, indigenous science, and the future forward polytechnic university. *Humboldt Journal of Social Relations*, 1(45), 34–51. <https://doi.org/10.55671/0160-4341.1219>

- Ritenburg, H., Leon, A. E. Y., Linds, W., Nadeau, D. M., Goulet, L. M., Kovach, M., & Marshall, M. (2014). Embodying decolonization: Methodologies and indigenization. *AlterNative: An International Journal of Indigenous Peoples*, 10(1), 67–80. <https://doi.org/10.1177/117718011401000107>
- Sá, L. (2019). Endless stories: Perspectivism and narrative form in the native Amazonian literature. In F. Martínez-Pinzón & J. Uriarte (Eds.), *Intimate frontiers: A literary geography of the Amazon* (pp. 128–149). Liverpool University Press. <https://doi.org/10.2307/j.ctvhhhg12.12>
- Salomon, A. K., Okamoto, D. K., Kii'iljuus Barbara, J. W., Happynook, H. T., Wickaninnish, N., Mack, W. A., Davidson, S. H. A., Guujaaw, G., L Humchitt, W. W. H., Happynook, T. M., Cox, W. C., Gillette, H. F., Christiansen, N. S., Dragon, D., Kobluk, H. M., Lee, L. C., Tinker, M. T., Silver, J. J., Armitage, D., ... Augustine, A. (2023). Disrupting and diversifying the values, voices and governance principles that shape biodiversity science and management. *Philosophical Transactions of the Royal Society, B: Biological Sciences*, 378(1881), 20220196. <https://doi.org/10.1098/rstb.2022.0196>
- Sawyer, S. (2004). *Crude chronicles: Indigenous politics, multinational oil, and neoliberalism in Ecuador*. Duke University Press.
- Sawyer, S. (2022). *The small matter of suing Chevron*. Duke University Press.
- Scheidel, A., Fernández-Llamazares, Á., Bara, A. H., & Whyte, K. P. (2023). Global impacts of extractive and industrial development projects on Indigenous Peoples' lifeways, lands, and rights. *Science Advances*, 9(23), eade9557. <https://doi.org/10.1126/sciadv.ade9557>
- Schueman, L. J. (2023). Victory for the Siekopai: Reclaiming Pë'këya and protecting the Amazon. *One Earth*. <https://www.oneearth.org/victory-for-the-siekopai/>
- Schultes, R. E. (1942). *Plantae Colombianae II*. Botanical Museum Leaflets, Harvard University, 10(10), 301–324.
- Schultes, R. e. (1951). Le Paullinia yoco el son emploi comme stimulant. *Revue Internationale de Botanique Appliquée et d'Agriculture Tropicale*, 31(343), 279–290. <https://doi.org/10.3406/jatba.1951.6755>
- Schuster, R., Germain, R. R., Bennett, J. R., Reo, N. J., & Arcese, P. (2019). Vertebrate biodiversity on indigenous-managed lands in Australia, Brazil, and Canada equals that in protected areas. *Environmental Science & Policy*, 101(November), 1–6. <https://doi.org/10.1016/j.envsci.2019.07.002>
- Simpson, L. B. (2014). Land as pedagogy: Nishnaabeg Intelligence and rebellious transformation. *Decolonization: Indigeneity, Education & Society*, 3(3), 1–25. <https://jps.library.utoronto.ca/index.php/des/article/view/22170>
- Spoon, J. (2014). Quantitative, qualitative, and collaborative methods: Approaching Indigenous ecological knowledge heterogeneity. *Ecology and Society*, 19. <http://www.jstor.org/stable/26269613>
- Strega, S., & Brown, L. (2015). *Research as resistance second edition: Revisiting critical, Indigenous, and anti-oppressive approaches*. Canadian Scholars' Press.
- Teixidor-Toneu, I., Westengen, O., Ulian, T., McMillion, A., Lorimer, M., Grace, O., Caillon, S., Shrestha, P., & Kool, A. (2023). Co-conserving Indigenous and local knowledge systems with seeds. *Trends in Plant Science*, 28(12), 1370–1378. <https://doi.org/10.1016/j.tplants.2023.06.020>
- Tuhiwai-Smith, L. (1999). *Decolonizing methodologies: Research and Indigenous peoples*. Zed Books.
- Uzendoski, M., & Calapucha-Tapuy, E. F. (2012). *The ecology of the spoken word: Amazonian storytelling and the shamanism among the Napo Runa*. University of Illinois Press.
- Vargas Roncancio, I. D. (2024). *Law, humans and plants in the Andes-Amazon: The lawless of life*. Routledge.
- Vickers, W. T. (1976). *Cultural adaptation to Amazonian habitats: The Siona-Secoya of eastern Ecuador*. University of Florida.
- Vickers, W. T. (1983). Development and Amazonian Indians: The Aguarico case and some general principles. The dilemma of Amazonian development. In E. M. Moran (Ed.), *The dilemma of Amazonian development* (pp. 25–50). Routledge. <https://doi.org/10.4324/9780429310041>
- Vickers, W. T. (1989). *Los Sionas y Secoyas: Su adaptación al medio ambiente*. Abya Yala.
- Virtanen, P. K. (2019). Ancestors' times and protection of Amazonian indigenous biocultural heritage. *AlterNative: An International Journal of Indigenous Peoples*, 15(4), 330–339. <https://doi.org/10.1177/1177180119893132>
- Virtanen, P. K., Apurinã, F., & Facundes, S. (2021). Amazonian worlds of other-than-human beings and the Apurinã through the materiality of Oral stories. *Multilingua*, 40(4), 565–582. <https://doi.org/10.1515/multi-2020-0078>
- Virtanen, P. K., Whitaker, J. A., & Peemot, V. S. (2024). Animacy of plants: Indigenous relationalities in global landscapes. *Journal of Ethnobiology*, 44, 343–344. <https://doi.org/10.1177/02780771241289048>
- Vriesendorp, C., Pitman, N., Moskovits, D. K., Alverson, W. S., & Ruelas Inzunza, E. (2006). *Ecuador: Cabeceras cofanes-chingual. Rapid biological inventories report 16*. The Field Museum.
- Walker, R. T., & Simmons, C. (2018). Endangered Amazon: An Indigenous tribe fights back against hydropower development in the Tapajós Valley. *Environment: Science and Policy for Sustainable Development*, 60(2), 4–15. <https://doi.org/10.1080/00139157.2018.1418994>
- Wasserstrom, R. (2014). Surviving the rubber boom: Cofán and Siona Society in the Colombia-Ecuador Borderlands (1875–1955). *Ethnohistory*, 61(3), 525–548. <https://doi.org/10.1215/00141801-2681786>
- Weaver, K. (2023). Bridging Indigenous and Western knowledge-systems in knowledge co-production with Amazonian Indigenous communities: A systematic realist review. *Development Studies Research*, 10(1), 2203842. <https://doi.org/10.1080/21665095.2023.2203842>
- Weiss, L. M., & Kearns, J. K. (2015). Caffeine and theobromine analysis of Paullinia yoco, a vine harvested by indigenous peoples of the upper Amazon. *Tropical Resources: Bulletin of the Yale Tropical Resources Institute*, 34, 6–15.
- West, S., Haider, L. J., Masterson, V., Enqvist, J. P., Svedin, U., & Tengö, M. (2018). Stewardship, care and relational values. *Current Opinion in Environmental Sustainability*, 35(December), 30–38. <https://doi.org/10.1016/j.cosust.2018.10.008>
- Whitaker, J. A., Tamboli, V., Daly, L., & Lewy, M. (2024). Plant agency in the Guianas: Attraction, assault, and animacy. *Journal of Ethnobiology*, 44, 347–359. <https://doi.org/10.1177/02780771241277618>
- Whyte, K. (2020). Too late for Indigenous climate justice: Ecological and relational tipping points. *WIREs Climate Change*, 11(1), e603. <https://doi.org/10.1002/wcc.603>
- Wilcox, A. E., Provencher, J. F., Henri, D. A., Alexander, S. M., Taylor, J. J., Cooke, S. J., Thomas, P. J., & Johnson, L. R. (2023). Braiding Indigenous knowledge systems and Western-based sciences in the Alberta oil sands region: A systematic review. *Facets*, 8, 1–32. <https://doi.org/10.1139/facets-2022-0052>
- Wittmann, F., Junk, W. J., & Piedade, M. T. F. (2004). The Várzea forests in Amazonia: Flooding and the highly dynamic geomorphology interact with natural Forest succession. *Forest Ecology and Management*, 196(2), 199–212. <https://doi.org/10.1016/j.foreco.2004.02.060>
- Wolf, J. G., Ignace, D. D., David-Chavez, D. M., Jennings, L. L., Smiles, D., Blanchard, P., Simmons, E., Doan-Crider, D., Sweetgrass-She Kills, R. P., Montgomery, M., Nelson, M. K., Elk, L. B., Elk, L. B., Bridge, G., Chischilly, A. M., Deer, K., DeerinWater, K., Ecoffey, T., Vergun, J., ... Rattling Leaf, J. (2024). Centering Indigenous knowledges in ecology and beyond. *Frontiers in Ecology and the Environment*, 22(7), e2776. <https://doi.org/10.1002/fee.2776>
- Zhang, Y., West, P., Thakholi, L., Suryawanshi, K., Supuma, M., Straub, D., Sithole, S. S., Sharma, R., Schleicher, J., Ruli, B., Rodríguez-Rodríguez, D., Rasmussen, M. B., Ramenzoni, V. C., Qin, S., Pugley,

- D. D., Palfrey, R., Oldekop, J., Nuesiri, E. O., Nguyen, V. H. T., ... Agyei, F. K. (2023). Governance and conservation effectiveness in protected areas and Indigenous and locally managed areas. *Annual Review of Environment and Resources*, 48(1), 559–588. <https://doi.org/10.1146/annurev-environ-112321-081348>
- Zuluaga Ramírez, G. (2004). *El yoco (paullinnia yoco) La savia de la selva*. Editorial Universidad del Rosario.
- Zurita-Beanvides, M. G. (2017). Cultivando las plantas y la sociedad waorani. *Boletim Do Museu Paraense Emílio Goeldi. Ciências Humanas*, 12(2), 495–516. <https://doi.org/10.1590/1981.81222017000200013>

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