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ANALYSIS

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Reflections on the future of European ethnobiology

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Abstract

In recent years, ethnobiology has undergone significant transformation. A renewed research framework has emerged that prioritizes an ethics of care—one that emphasizes relationships, interdependence, and responsibility towards both human and non-human others throughout all stages of research. This paradigm shift, led largely by Indigenous scholars and researchers from the Global South, invites European ethnobiologists to critically reflect on how they can engage with, contribute to, and learn from these evolving approaches in light of pressing environmental and social challenges. In this *Perspective,* we explore the future of European ethnobiology in two main ways. First, we reflect on the specificities of a European lens within global ethnobiology, considering how European ethnobiologists might participate more meaningfully in transdisciplinary and intercultural dialogues. Second, drawing on core principles of the emerging global paradigm, we outline five key avenues for future development: (1) deepening commitments to an ethics of care; (2) responding more directly to contemporary challenges; (3) expanding research contexts; (4) reimagining methodological approaches; and (5) enhancing the societal relevance and applied impact of European ethnobiologists, both within and beyond Europe. We highlight current examples of European ethnobiologists already advancing these directions and underscore the field's dynamic evolution. We conclude by identifying critical challenges faced by European ethnobiologists, including the need to engage with rapidly evolving digital technologies and to navigate institutional and epistemic barriers that hinder the co-creation of knowledge across diverse worldviews.

Science highlights

- European ethnobiology must engage with a global, care-centred research paradigm.
- European ethnobiology offers varied views, differing among ex-colonial powers and other European nations.
- European ethnobiology can expand by including cities, migrant communities, digital spaces, and conflict zones.
- Methodological innovation and applied impact are key to European ethnobiology's future.
- European ethnobiology should tackle institutional barriers to knowledge co-creation.

The European Network of Ethnobiologists (ENE) unites over 100 Europe-based ethnobiologists working both inside and outside Europe interested in the relationships between people and biota.

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Policy and practice recommendations

- Embed ethics of care in all stages of ethnobiological research and practice.
- Support cross-cultural knowledge exchange with Indigenous and Global South scholars.
- Fund research to co-create projects with communities, not just about them.
- Regulate digital tools to ensure ethical, community-centred use in ethnobiology.
- Reform institutions to enable co-creation and integration of multiple knowledge systems.

The ongoing paradigm shift in ethnobiological research

Ethnobiology explores the dynamic relationships between people, biota, and environments, emphasizing the interconnectedness of nature and culture rather than treating them as separate domains [1–3]. While much ethnobiological research focuses on contemporary interactions, it is deeply informed by historical processes and trajectories [4]. From its diverse origins, ethnobiology has grown into a multidisciplinary, ethically engaged field, enriched by contributions from scholars across the globe [1, 5, 6].

Over the past two decades, there has been growing recognition of the need for a paradigm shift in ethnobiological research [7, 8]. Central to this shift is a turn towards an ethics of care—one that emphasizes relationships, interdependence, and responsibility towards both human and non-human others throughout all stages of research [8]. This transformation, which also seeks to redress historical and ongoing injustices in knowledge production, has been largely led by Indigenous scholars and scholars from the Global South, who have challenged the structural and epistemic violence that has long marginalized their ways of knowing [9–11].

Considering this evolving landscape, this *Perspective* aims to contribute to the broader dialogue on how European ethnobiologists can more fully learn from, engage with, and contribute to the paradigm shift taking place in the field, while remaining responsive to contemporary pressing environmental and social challenges. We start by reflecting on the specificities of European ethnobiology, not to centre the discussion on the European perspective, but to explore how these specificities can be leveraged to more meaningfully support and align with global developments. Then, drawing from key elements of the ongoing paradigm shift in ethnobiological research, we propose five key directions for reflection and development within European ethnobiology: (1) deepening commitments to an ethics of care; (2) responding more directly to contemporary challenges; (3) expanding research contexts; (4) reimagining methodological approaches; and (5) enhancing the societal relevance and applied impact of European ethnobiologists, both within and beyond Europe. Many European ethnobiologists are already pursuing these directions, and where possible, we highlight existing examples to illustrate this ongoing work. In the last section, we highlight key challenges faced by European ethnobiologists, including the need for critical engagement with rapidly evolving digital technologies and the epistemic and institutional barriers to integrating diverse knowledge systems in cocreative ways.

Overall, this *Perspective* draws on both ongoing global epistemological renewal and emerging intra-European dialogue to outline key avenues through which European ethnobiology can develop to meaningfully contribute to a renewed global framework for ethnobiological research. This *Perspective* grew out of an online seminar titled *The Future of Ethnobiology* organized by the European Network of Ethnobiologists (ENE) and presented by the two main authors on January 30, 2025. It incorporates valuable feedback from seminar participants and ENE members. At the same time, we acknowledge that—given the complex histories, epistemic positions, and power dynamics shaping European Ethnobiology—this piece cannot fully represent the diversity of perspectives and positionalities within it.

Contextualizing European ethnobiology

European ethnobiology has developed through diverse and overlapping histories shaped by the co-evolution of biodiversity and human land management, reflected in the continent's rich linguistic and cultural diversity. These histories have unfolded within distinct and, at times, divergent intellectual, institutional, and national trajectories. More recently, EU-level governance and policy frameworks have also begun to shape the field, influencing both research agendas and funding landscapes. As a result, European ethnobiology cannot be viewed as emerging from a unified tradition; rather, it is shaped by a mosaic of disciplinary lineages, national contexts, and scholarly positionalities.

From classical antiquity, European scholars and travellers recorded the uses of plants and animals by different cultural groups. This tradition intensified with European expansion from the fifteenth century onward, when encounters with other societies were often mediated through European colonial ambitions. During this period, documentation of Indigenous Peoples' knowledge was frequently framed within

extractive, Eurocentric agendas—intended to serve trade, medicine, and agriculture in the imperial centres [12]. While some individuals demonstrated sincere engagement with local knowledge and lifeways [13], the broader legacy was one of asymmetrical power relations and epistemic domination. In colonial and settler-colonial countries—such as Britain, France, Spain, and later the USA, Canada, and Australia—ethnobiology (often emerging through anthropology) was deeply entwined with these dynamics. Studies conducted in colonized territories were formative for the institutionalization of ethnobiology and ethnoscience [14], but they also embedded enduring hierarchies of knowledge and authority [15, 16].

In contrast, in parts of Europe without a strong colonial legacy, such as in central and eastern Europe, the Nordic countries, and the Balkans, ethnobiology often developed along different lines. There, the field grew out of folklore studies, ethnolinguistics, and local ethnographies [17]. Anthropological inquiry focused largely inward, documenting traditional knowledge within rural or minority populations. In these contexts, educated members of rural communities, who often returned as teachers, doctors, or local scholars, played key roles in recording and preserving their own cultural and ecological heritage [17]. These scholars often occupied dual roles: both insiders with intimate knowledge of their cultural landscapes and trained observers able to translate this knowledge into academic discourse [17]. Their positionality offers important epistemic advantages, especially in ongoing efforts to reorient ethnobiology around relational, reflexive, and care-centred approaches.

Additionally, and owing to the presence of Indigenous Peoples or ethnic minority communities, some regions of Europe provide unique opportunities for cross-border comparative research. For example, the Sámi people in the Nordic countries offer a context for long-term research on biocultural diversity and resilience within European borders.

This mosaic of disciplinary lineages, national contexts, and scholarly positionalities may help explain why, until recently, there was no coordinated effort to organize ethnobiology at a continental scale in Europe. While national initiatives, strong research groups, and regional collaborations have long existed, it was only in 2023 that ethnobiologists across Europe came together to establish the European Network of Ethnobiologists (ENE). Today, the ENE connects over 100 researchers and practitioners across the continent, aiming to foster knowledge exchange, support interdisciplinary collaboration, and promote the preservation of biocultural diversity within and beyond Europe.

Grounding ethnobiology in an ethics of care

Central to the global renewed framework for ethnobiology is a turn towards an ethics of care [8–11]. For European ethnobiologists, this global shift invites reflection on how their work might more intentionally embody these values. We suggest three interrelated avenues through which European ethnobiologists could further cultivate such grounding: ethical practices, equity, and collaborative frameworks.

Ethical practices

While many ethnobiologists adhere to established ethical guidelines, such as obtaining institutional approvals, securing Free, Prior, and Informed Consent (FPIC), and adhering to the Nagoya Protocol on Access and Benefit Sharing, compliance alone is not sufficient to uphold the principles of justice, sustainability, and reciprocity. The International Society of Ethnobiology's Code of Ethics offers a broader ethical vision, one that resonates with Indigenous People's values of stewardship and relational responsibility towards land, animals, and ecosystems [18–20]. European ethnobiologists should strive to align with this perspective and be guided by a long-term vision that considers its consequences for human and non-human future generations [21, 22]. Such research should actively seek meaningful ways to benefit the communities involved, respecting local decision-making structures and fostering inclusive participation across gender, age, and social roles. Such ethical practices also demand that European ethnobiologists collaborate with communities to decide what knowledge should be shared, when, and how, and to protect culturally sensitive information with care and consent [23, 24].

Equity. Generally, ethnobiology has moved beyond earlier framings that treated Indigenous and local knowledge systems as mere repositories of data or resources, increasingly recognizing them as valid and vital in their own right [25]. An ethics of care reinforces this recognition by emphasizing the relational, holistic, and often spiritual dimensions of these knowledge systems—including the agency of non-human beings within them [26, 27]. European ethnobiologists can continue to learn from, and work alongside, Indigenous Peoples and local communities in ways that honour these perspectives. This also calls for greater reflexivity in confronting power asymmetries within research relationships and institutions. For example, care must be taken to ensure that the voices of Indigenous Peoples and local communities are not overshadowed by dominant scientific or institutional interests [28], and that partnerships are built on mutual respect and shared authority [29, 30].

Collaborative frameworks: Ethnobiology has traditionally emphasized participatory research, ensuring that Indigenous Peoples and local communities are active research collaborators. This approach has led to significant contributions from local communities to scientific knowledge [31, 32]. However, an ethics of care invites a deeper commitment, shifting from participation to genuine knowledge cocreation. This involves aligning research priorities with community needs [33], valuing diverse epistemologies, and nurturing relationships based on equity, recognition, and long-term reciprocity [34–37]. Such frameworks can help produce actionable knowledge that supports both cultural and ecological sustainability, especially in landscapes shaped by generations of traditional ecological practice. For example, conservation efforts in biodiversity-rich pastures and wetlands must be informed by the deep place-based knowledge of herders and other traditional stewards [38]. For European ethnobiologists, strengthening collaborative frameworks also mean engaging more deeply with ethnobiologists from other regions. This includes building equitable research partnerships, supporting the training and participation of early-career scholars from the Global South, and creating spaces for mutual learning. Ethnobiologists working in Europe have much to gain from the methodological innovations, ethical reflections, and community-based approaches developed elsewhere.

European ethnobiology can reflect on its own foundations and reorient its practices towards more relational, respectful, and responsible modes of engagement. While this path is ongoing and context-specific, reflecting on it offers meaningful ways to further embrace an ethics of care.

Engaging with pressing contemporary challenges

Ethnobiologists have long highlighted the social and environmental relevance of their research, often through sustained engagement with local communities and landscapes [39, 40]. As the field evolves, there is increasing recognition of the need to more directly address the root causes and consequences of interconnected global environmental challenges. In this context, European ethnobiologists are also invited to reflect on how their work might contribute—through learning, collaboration, and critical engagement—to ongoing efforts in areas such as biodiversity loss, climate change, and food system transformation.

Understanding drivers of and responses to biodiversity loss. Indigenous Peoples' and local communities' worldviews and practices often reflect deep, lived relationships with lands, waters, and non-human beings, relationships that underpin practices of sustainability and care [18, 41, 42]. These ways of life are closely linked to the high levels of biodiversity found in many of the territories they steward [43, 44]. Building on this foundation, European ethnobiologists can engage with culturally grounded strategies for sustaining biodiversity, while also reflecting on how conservation paradigms rooted in Western frameworks might unintentionally overlook or marginalize other knowledge systems. Steps in this direction have been taken documenting the biodiversity of traditional agroecosystems [45], supporting community-driven efforts to restore ecosystems [46], and exploring autochthonous human adaptation to biodiversity change [47]. In the European context, researchers may further contribute to this research line by documenting traditional land use systems, supporting local ecological knowledge holders [48], and facilitating dialogue in complex policy areas such as rewilding, where ecological goals intersect with cultural heritage concerns [49].

Addressing climate change impacts and adaptation. Climate change poses profound challenges to place-based communities across the globe, and ethnobiologists have begun to explore how such communities understand, experience, and adapt to its impacts [50, 51]. This includes examining climate-induced ecological changes and their implications for livelihoods, well-being, and cultural continuity [52]. Informed by this growing body of work, European ethnobiologists can reflect on how their research might support local adaptation strategies and amplify the voices of those already responding to climate change impacts. There is also scope to explore how traditional ecological knowledge contributes to climate resilience through practices such as agroforestry [53], rotational grazing [54], or crop selection [55]. In doing so, researchers can contribute not only to scientific understanding but also to more inclusive climate policies and locally grounded adaptation efforts.

Transforming food systems: Food systems represent another critical arena where ethnobiology can inform transitions towards sustainability. Indigenous peoples and local communities have long maintained biodiverse and resilient agricultural systems rooted in context-specific knowledge and values [56, 57]. Yet in Europe, many of these practices face challenges from regulatory constraints and socio-economic change [58, 59]. European ethnobiologists can contribute by documenting how local knowledge shapes farming and foodways, including in settings not typically associated with traditional practices. This includes analysing hybrid and adaptive strategies within conventional systems and exploring how farmers make decisions in relation to cultural, ecological, and economic factors [60, 61]. Ethnobiology can also help rebalance dominant food

system narratives by highlighting under-recognized biocultural practices, such as home gardening, seed-saving, and wild plant gathering, that continue to shape some European landscapes and livelihoods [62, 63].

By engaging with these and other urgent challenges, such as nutrition, environmental justice, and intergenerational knowledge transmission, European ethnobiologists can reflect on their own positionality and contribute to wider conversations about the role of ethnobiology in today's world while grounding their research in their local contexts.

Explore new research contexts

Ethnobiology has traditionally centred on human–nature relationships in settings where people maintain direct and often longstanding connections with their environments. These contexts have been foundational to understanding how knowledge systems, practices, and values contribute to the stewardship of biodiversity. Yet, as our societies evolve and face new challenges, there is a growing need to broaden the scope of ethnobiological research. Expanding into less-explored contexts—such as European landscapes, urban environments, migrant settings, digital arenas, and situations of armed conflict—can reveal how diverse knowledge systems continue to adapt, persist, and transform in the face of change.

European landscapes offer a rich yet underexplored terrain for ethnobiology. While many studies have addressed ethnobotanical practices and landscape transformations [64–66], deeper engagement with Europe's biocultural heritage remains needed [67]. Traditional practices, from terraced farming [68] and hay meadows [69] to wood pastures [70] and chestnut orchards [71], reflect complex ecological knowledge shaped by long-term human-nature interactions. However, the neglect or erosion of these systems often leads to both cultural and ecological degradation [68, 72]. Ethnobiology can play a constructive role by helping to surface and revitalize these practices, not as static traditions, but as dynamic systems that continue to shape and respond to changing landscapes. For example, the decline of Alpine home gardens, once reservoirs of crop and veterinary knowledge [73], raises important questions about continuity, identity, and land use change. In this space, European ethnobiologists are invited to explore how heritage and innovation intersect, and how their research might inform contemporary debates around conservation, rewilding, and landscape governance [74].

Urban environments: As urbanization reshapes how people interact with nature, there is much to learn from how traditional ecological knowledge adapts to city life [75, 76]. Ethnobiologists have begun to examine practices like urban foraging in European cities [77], and the role of urban green spaces, such as community and home gardens, in maintaining ethnobotanical and ethnomedical traditions [78]. But more nuanced understandings are needed—particularly of how social networks, cultural backgrounds, and mobility influence agrobiodiversity. For instance, rural migrants in African cities have been shown to concentrate genetic diversity by bringing plants like the African plum into urban gardens [79]. European researchers are well-placed to explore how migration, memory, and mobility intersect in cities to sustain knowledge traditions. Attending to urban wildlife, foodways, and medicinal plant use also opens new questions about belonging, adaptation, and cultural continuity in rapidly transforming urban ecologies.

Migrant contexts offer another promising and necessary space for deeper ethnobiological engagement. Migration involves not just the movement of people, but also of plants, animals, knowledge, and practices. While existing studies have documented some aspects of these processes [80, 81], there remains much to understand about how ethnobiological knowledge is adapted, recreated, or lost in new environments [82, 83]. Researchers can explore how migrants maintain cultural ties and ecological relationships through cultivation, gathering, or even symbolic engagements with familiar species. They can also examine barriers to adaptation, including legal, economic, or social constraints, as well as the shifting dynamics of intergenerational knowledge transmission. European ethnobiologists may be particularly well-placed to engage with these questions, fostering collaborative research that foregrounds migrant voices, respects knowledge pluralism, and contributes to more inclusive and responsive understandings of sustainability and belonging.

The digital arena is an emerging frontier for ethnobiological research. Digital tools, platforms, and media are reshaping how knowledge is shared, reinterpreted, and circulated [84]. Social media communities focused on foraging, plant medicine, or ecological gardening illustrate how traditional and emerging knowledge systems intermingle in digital spaces [85, 86]. These platforms may democratize access to knowledge, but they also raise questions about authenticity, authority, and the commodification of traditional knowledge and cultural practices. At the same time, technologies such as AI and machine learning are increasingly used to catalogue and interpret ethnobiological information, but these tools also come with large ethical complexity. European ethnobiologists are well-placed to engage with digital contexts as potential spaces of knowledge co-creation, while

remaining attentive to issues of consent, representation, and cultural sensitivity.

Situations of armed conflicts present some of the most urgent and underexamined contexts for ethnobiological research. In zones of violence, displacement, and ecological disruption, traditional knowledge can be a vital resource for survival, resilience, and healing [87–89]. Whether through wild foraging, traditional medicine, or informal food systems, communities often draw on place-based knowledge to navigate crises. Ethnobiologists can help document these practices and explore their roles in maintaining food security, health, and social cohesion in the face of conflict. Moreover, Indigenous and local systems of land and resource governance may offer culturally grounded pathways for peacebuilding, ecological restoration, and post-conflict recovery. This work requires sensitivity, ethical clarity, and long-term engagement, but it also holds the potential to illuminate overlooked dimensions of resilience and reconciliation.

As European ethnobiologists expand into new research settings, it is essential to reflect on who is being included and who is not. Research design and sampling strategies have often reproduced gender and age biases, whether by overrepresenting women in European settings [90, 91] or underrepresenting men in contexts where cultural norms restrict women's visibility [92]. Children, too, remain largely absent from ethnobiological studies, despite the crucial role they play in intergenerational knowledge transmission [93]. Attending to these often-overlooked voices can offer more complete and inclusive insights into how people relate to nature in a rapidly changing world.

By thoughtfully exploring new contexts and being mindful of who and what we centre, European ethnobiologists can help reimagine the field's role in navigating cultural and ecological transformation.

Transform ethnobiologists' methodological toolkit

The paradigm shift in ethnobiological research is also accompanied by changes in the methodological toolkit. Current developments in the field point to the need to transform methodological approaches in three key ways: abandoning outdated methods, adapting tools that have proven valuable, and exploring new techniques. This transformation is particularly relevant in the European context, where shifting socioenvironmental conditions and historical legacies call for renewed methodological reflection and innovation.

Abandon outdated methods: There is growing recognition of the need to move away from extractive research practices—approaches in which knowledge is collected from Indigenous Peoples and local communities without ensuring fair recognition, reciprocity, or benefit [28, 94]. Ethnobiologists in Europe can contribute to this shift by embedding ethical principles across all dimensions of their work, including as reviewers, educators, and mentors. For instance, peer review and funding assessments can explicitly consider whether research engages communities meaningfully, respects data sovereignty, and provides tangible benefits to those involved [9, 28]. In Europe, colonial-era collections housed in botanical gardens, herbaria, and museums contain vast repositories of biocultural knowledge derived from extractive methods [95]. Ethnobiologists can contribute to ongoing efforts to reassess, repatriate, or redeploy these collections in collaboration with source communities. Emerging museum scholarship offers ethical and practical guidance for such processes. Notable examples include the reconnection of 19th-century Amazonian plant specimens at the Royal Botanic Gardens, Kew, with Indigenous communities [96], the revitalization of Polynesian bark cloth traditions [97], and collaborative documentation of basketry with Bundjalung weavers at the National Museum of Australia [98]. These examples illustrate potential pathways for European institutions to engage with similar histories and foster respectful relationships around collections stewardship.

Adapt methods that have proved useful: Ethnobiologists have long been at the forefront of participatory research, and many of these approaches can be productively adapted to address contemporary challenges. For example, European archaeologists have successfully engaged local communities as active partners in excavations [99]. Through oral history approaches, they can reconstruct key drivers of landscape change and identify pathways to reverse undesirable trends [100]. European ethnobiologists can further build on these techniques to better understand cultural landscapes and their transformations. European ethnobiologists could similarly broaden their methodological toolkit by adapting methods from other disciplines. One promising avenue is social network analysis, which has been employed to explore how knowledge, resources, and practices related to biota circulate within and between communities [101, 102], and more recently, how climate change perceptions shape social and ecological responses [103]. Additionally, advanced statistical approaches drawn from ecology and evolutionary biology offer robust means of exploring patterns in human–plant relationships across regions and groups [104]. For example, research on European home gardens, seed exchange networks, or wild plant use could benefit from analytical methods that consider cultural and ecological phylogenies.

Explore new methods: Ethnobiologists working in Europe can also expand their toolkit by experimenting

with the growing range of digital tools now available. In parallel with platforms such as iNaturalist, Pl@ntnet, or eBird, digital applications can support mapping of traditional land use, plant distributions, and biocultural practices. Mobile devices offer accessible means of documenting local knowledge, and citizen science tools can engage wider publics in research and conservation efforts. Digital apps for plant identification can produce photographic vouchers, obviating the need for herbarium vouchers [105]. A range of initiatives, in Europe and beyond, have demonstrated how mobile technologies can support participatory environmental monitoring in ways that are scalable and inclusive. This includes the documentation of traditional knowledge in Spain [106], the study of participatory monitoring of bushmeat harvesting in Gabon [107], and community-based monitoring of forest resources in Cambodia [108]. Digital archives and databases curated by European institutions also hold significant potential for revitalizing historical biocultural knowledge. These resources may be used to trace forgotten practices, analyse long-term changes in species use, or recover knowledge once integral to regional ethnobotany and foodways. Moreover, emerging technologies such as artificial intelligence (AI) and machine learning offer possibilities for new modes of analysis—for example, through automated recognition of plant species in photographic data or interpretation of sound archives—provided their use is guided by ethical principles and local relevance.

By transforming their methodological toolkit, ethnobiologists in Europe can improve the rigour, inclusivity, and societal relevance of their work. Methodological innovation creates opportunities to include a wider diversity of perspectives, particularly those of underrepresented communities, and to respond more effectively to contemporary socioecological challenges.

Enhancing the real-world impact of ethnobiological research

The renewed framework for ethnobiology moves beyond the assumption that knowledge creation is neutral. Acknowledging the situated and partial nature of knowledge allows researchers to design studies that enhance the real-world relevance and policy impact of ethnobiological research. Ethnobiologists in Europe can contribute meaningfully to this regard by engaging with three key areas: informing local policy, advocating for just and sustainable global policy frameworks, and investing in dissemination, mentoring, and education.

Informing local policy making: Ethnobiologists have played a key role in shaping environmental and cultural policy at the local level, often by highlighting the relevance of Indigenous and local knowledge for addressing environmental and social challenges [8]. In European contexts, ethnobiologists can support municipalities, rural development agencies, or landscape managers by identifying culturally and ecologically appropriate strategies for managing local resources, conserving biodiversity, or revitalizing heritage practices. By engaging with local stakeholders, they can act not only as researchers but also as intermediaries—ensuring that place-based knowledge and community concerns are reflected in decision-making processes that affect landscapes, livelihoods, and cultural continuity.

Advocating for just and sustainable global policy frameworks: At the global level, ethnobiologists continue to advocate for the recognition of Indigenous and local knowledge in biodiversity governance and environmental sustainability. Their contributions to platforms such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have helped to elevate the status of plural knowledge systems in international conservation discourse [109, 110]. European ethnobiologists can support similar efforts by contributing to ethical debates around land rights, food sovereignty, biocultural heritage, and responses to biopiracy [111] and climate change [112]. By actively engaging in policy discourse, ethnobiologists can support Indigenous Peoples and local communities in amplifying their voices and ensuring that their knowledge is not only acknowledged but meaningfully embedded in decision-making at multiple levels, while always recognizing that these communities are fully capable to speak for themselves.

Dissemination, mentoring, and teaching: Ethnobiologists enhance the societal impact of their work through teaching, mentoring, and engagement beyond academia. In Europe, integrating ethnobiological knowledge into formal and informal education can foster a deeper sense of place, support biodiversity conservation, and contribute to cultural revitalization. Field trips, traditional food events, and workshops on local plant uses are examples of effective outreach strategies [113]. In Austria, for instance, ethnobotanical research on home gardens has evolved into participatory initiatives effective in engaging diverse groups of society, from gardeners to urban youth in biocultural conservation and seed-saving practices [114]. Culturally appropriate tools like "slow films" have also proven effective in engaging urban students with traditional knowledge systems [115]. In agricultural education, there is growing interest in integrating social and ecological aspects of sustainability. In France, agricultural high schools (*lycées agricoles*) have been encouraged since 2007 to adopt approaches that promote more sustainable farming, including

reduced reliance on synthetic inputs [116]. However, for such programmes to be transformative, they must move beyond technical solutions to embrace local knowledge systems and cultural dimensions of land use [117]. Ethnobiologists can contribute by designing and delivering education that bridges ecological sciences with traditional knowledge and practice. One example is the master's programme in "Organic Agriculture Systems and Agroecology" at the University of Natural Resources and Life Sciences (BOKU) in Vienna, which includes courses on ethnobotany, ethnopedology, ethnoclimatology, and ethnobiology.

By engaging with policy processes, supporting education, and co-producing knowledge with local actors, ethnobiologists working in Europe can significantly increase the real-world impact of their research.

Challenges for European ethnobiology in engaging with the renewed framework

In today's context, marked by the converging crises of biodiversity loss, climate change, and pollution, alongside widening social inequalities and the decline of democracy, even partial engagement with the new framework is challenging. For ethnobiologists working in Europe, we identify three key obstacles in advancing this renewed research agenda: the rapid spread of digital technologies, and epistemic and institutional barriers to change.

Rapid spread of digital technologies: The rapid proliferation of digital tools presents an opportunity but also a challenge for ethnobiological research. In Europe—as elsewhere—digital platforms often classify plant and animal knowledge through dominant scientific taxonomies, marginalising local naming systems and knowledge frameworks [118]. This can inadvertently reproduce epistemic hierarchies and exclude culturally meaningful classifications. Additionally, concerns around data sovereignty are increasingly relevant. Knowledge shared online may be removed from its original context, misused, or commercialised without appropriate consent or benefit-sharing [119]. European ethnobiologists must critically assess how digital technologies are used in documenting, storing, and disseminating knowledge. Ensuring that digital tools support, rather than exploit, the communities whose knowledge they capture will require careful design, ethical foresight, and ongoing dialogue with stakeholders. Balancing technological innovation with respect for data ethics and community control is especially important in the European context, where—despite varying cultural sensitivities—there are specific legal frameworks (e.g., GDPR, General Data Protection Regulation).

Epistemic barriers: A core challenge in ethnobiology lies in bringing together diverse knowledge systems that may lead to different interpretations, practices, and understandings. Indigenous Peoples and local communities have often been at the forefront of efforts to weave together different knowledge systems [36, 120, 121], and Indigenous scholars have increasingly shaped this agenda by advocating co-creative, relational approaches grounded in ethics, reciprocity, and accountability [122–125]. For European ethnobiologists, this means not only engaging with marginalised or minority knowledge systems across the continent but also recognising the rich and varied traditions of environmental knowledge found in rural communities. Successfully working across knowledge systems requires acknowledging their distinctiveness while seeking synergies, complementarities, and respectful collaboration [126, 127]. However, persistent challenges remain, particularly in relation to participation, power asymmetries, and the scalability of co-creation processes [128, 129]. Engaging equitably with these dynamics calls for a reflexive and humble approach, especially within increasingly multicultural European societies.

Institutional barriers: Implementing more inclusive, participatory, and community-centred research frameworks demands more than methodological change; it also requires time, financial investment, and, crucially, institutional commitment. Yet, European academic systems often prioritise individual achievement, publication metrics, and short-term outputs, which can discourage collaborative approaches. This makes it difficult to adequately credit community contributors and local experts [9]. Moreover, most research funding schemes in Europe still favour conventional project structures, with limited support for co-created, long-term, or transdisciplinary initiatives—though some promising changes are emerging [28]. Peer review processes also play a gatekeeping role, frequently reinforcing outdated norms regarding authorship, knowledge validation, and research design. Building trust, co-developing research, and ensuring mutual benefit require long-term commitment; yet, these elements rarely align with academic timelines or evaluation frameworks. Without substantial changes to funding models, academic incentives, and evaluation criteria, European ethnobiologists will face structural obstacles to advancing more equitable and impactful research.

Conclusion

The continued relevance of ethnobiology lies in its capacity to evolve—adapting to shifting ethical expectations, changing research priorities, and new methodological opportunities. In the context

of accelerating ecological degradation and social fragmentation across Europe and beyond, such evolution is not only timely but necessary. Without it, the discipline risks marginalisation; with it, ethnobiology can make meaningful contributions to broader efforts towards ecological justice, cultural resilience, and sustainability.

European ethnobiology, shaped by diverse disciplinary traditions and institutional contexts, is well positioned to engage with this evolving global framework. Its core strengths—interdisciplinarity, methodological flexibility, and an ethos of ethical engagement— offer valuable tools for addressing today's complex socio-environmental challenges. However, realizing this potential depends on a sustained commitment to humility, critical reflexivity, and plural, relational ways of knowing.

Building on ongoing global epistemological renewal—particularly calls to embed care and reciprocity not only in research, but also in education, institutions, and policy—and drawing on ideas emerging from intra-European dialogue, European ethnobiology can contribute to shaping more inclusive, engaged, and transformative futures—both within and beyond the academy.

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Publisher's Note

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