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From two worlds to one: a Navajo (Diné) woman's path in herpetology

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Herpetology, like the species it seeks to understand, exists within relationships between land, water, and the people who have long cared for them. However, for generations, its roots in discovery, collection, and classification have silenced Indigenous voices and separated science from relationship. As a Diné (Navajo) herpetologist, I write from within these intersections, exploring how Indigenous Knowledge (IK) can transform the questions we ask and the ways we conduct research. First, I trace the colonial foundations of herpetology and how Indigenous cultural protocols, rooted in respect, have been misinterpreted as barriers to scientific engagement. Next, I examine how IK has guided wildlife science, from ethnoherpetology to conservation biology, offering frameworks of relational accountability, long-term ecological insight, and community care. I grounded these ideas in a case study of Northern leopard frog (*Lithobates pipiens*) research conducted with the Navajo Nation, where populations are threatened by interacting effects, including grazing and climate-driven hydrologic change. Guided by the 4 R's of Indigenous research practice (*i.e.*, Respect, Relevance, Reciprocity, and Responsibility), integrating Diné teachings produced tangible methodological outcomes, including culturally guided site selection, reliance on non-invasive approaches such as environmental DNA and acoustic monitoring, careful interpretation of uncertainty, and Tribal authority over data governance. These outcomes reframed conservation from documenting decline to preparing for restoration grounded in long-term stewardship. While shaped by Diné teachings, this approach does not offer a universal template. Instead, it demonstrates how conservation science can remain rigorous while becoming more relational, accountable, and responsive to Indigenous sovereignty and responsibility.

KEYWORDS

amphibian conservation, decolonizing herpetology, indigenous knowledge, indigenous methodologies, Navajo, relational accountability, traditional ecological knowledge, tribal sovereignty

Positionality

My name is Catrina Marie Alberts, and I am Diné. Throughout this paper, I use Diné instead of "Navajo." Diné more accurately reflects our language, worldview, and sovereignty. I am Tsi'naajinii (Black Streak Wood People Clan), born for Bilagáana (Caucasian), and my maternal grandfather's clan is Kinyaa'aanii (The Towering House Clan). I was raised in the city, far from my family's land and sacred places I now conserve through science. Early on, I

was told that my interests in amphibians and reptiles did not fit others' expectations of what it means to be Diné. In academic spaces, I feared that bringing my culture into science made my approach less objective or professional (Miriti et al., 2023; Todd, 2016).

I often describe this experience as “walking between two worlds,” reflecting how colonial and institutional structures force Indigenous scientists to navigate boundaries between cultural responsibility and scientific legitimacy (Castagno et al., 2022; Gervais et al., 2017; Williams and Shipley, 2018). While this framing risks reinforcing artificial binaries (TallBear, 2014; Todd, 2016), I employ it here to name the constraints placed on Indigenous participation in science rather than to suggest that these knowledge systems are inherently separate.

I did not grow up knowing I would be a scientist, but I was always drawn to wildlife. My grandparents' stories taught me that animals are our non-human relatives, aligning with Indigenous philosophies of kinship (Deloria et al., 1999; Kimmerer, 2013). I was taught that the horned lizard, our *cheii*, or grandfather, was sacred, and these teachings shaped my sense of responsibility to land and life. Yet, amphibians and reptiles hold sacred and sometimes taboo roles in Diné culture (Bulow, 1991; Crump and Fenolio, 2015) and engaging with them in academic settings often required silence or compromise. Like many Indigenous students, I consented to practices that conflicted with my values, fearing refusal would be interpreted as unprofessional (Moreno et al., 2020; Page-Reeves et al., 2019).

These tensions deepened after losing my parents to COVID-19. In grief, I turned to my culture for grounding, to stories, songs, and teachings that connect us (Smith, 2012; Wilson, 2020). This return clarified why I do this work. I study herpetofauna not only for their ecology, but because they carry stories and belong to a land my ancestors knew intimately. Protecting them is also protecting my heritage, grief, and healing.

1 Introduction

The first time I was told, “You must not be Navajo,” for studying amphibians, I understood that herpetology is not only a science of animals, but a question of belonging. My experiences raise questions that guide this article: *How can I, as an Indigenous scientist, carry both cultural and scientific responsibilities with care? Is there room in herpetology for Indigenous Knowledge, and what would it mean for our field if we made that space? How might integrating Indigenous perspectives challenge or deepen our understanding of herpetofauna and conservation?*

These questions reflect a broader truth: herpetology, like other sciences, has often excluded or marginalized Indigenous Knowledge (IK) (Deloria et al., 1999; Miriti et al., 2023; Smith, 2012), creating barriers for Indigenous Peoples who might otherwise contribute (Ash et al., 2015; Nadasdy, 1999; Pierotti and Wildcat, 2000). This piece explores what it means to walk within Indigenous and Western scientific worlds as a Diné herpetologist. My objectives are threefold:

1. To trace the colonial roots of herpetology and how they shaped IK exclusion.
2. To show what IK brings to herpetology, while acknowledging cultural barriers that Indigenous Peoples may face in this field.
3. To use my own research on Northern leopard frogs as a case study in practicing culturally responsive methodologies.

2 Colonial roots of herpetology and IK exclusion

Herpetology, like much of Western natural history, emerged from epistemologies that prioritized cataloging and control over relational ways of knowing, often excluding or exploiting IK (Mazzocchi, 2006; Miriti et al., 2023; Pierotti and Wildcat, 2000). Early field studies framed species as objects of “discovery,” overlooking centuries of Indigenous stewardship and relationships between communities and wildlife, positioning scientists as authorities while dismissing IK as irrelevant or superstitious (Deloria et al., 1999; Nadasdy, 1999).

These colonial legacies persist in herpetology today. Indigenous students are often questioned for their place in the field when they cannot or choose not to follow standard protocols, such as touching or directly observing animals. Cultural practices, rooted in respect and avoidance, were interpreted as incompetence rather than recognized as ethical engagement (Carjuzaa and Ruff, 2010; Williams and Shipley, 2018). I experienced this tension firsthand, learning to hide discomfort from practices that conflicted with my values.

Herpetology continues to measure legitimacy by conformity to Western norms (Smith, 2012; Todd, 2016), and Indigenous participation is often invited only after agendas are established, limiting influence on research design and outcomes (Ford et al., 2020; Yanou et al., 2023). As a result, research can unintentionally replicate extractive dynamics without returning benefits or authority to Indigenous communities (Walter et al., 2020; Walter and Suina, 2018). Addressing this legacy demands rethinking research questions, methodologies, and relationships with communities and landscapes (Kovach, 2021; Louis, 2007; Wilson, 2020).

3 What does IK bring to herpetology?

As a child, I learned the horned lizard is our grandfather, my *cheii*, teaching me that herpetofauna are kin, not objects. Many Indigenous communities share similar understandings: amphibians and reptiles are sacred, powerful, and rooted in place. These teachings guide research toward ethical, relational approaches (Kimmerer, 2013; Todd, 2016).

Indigenous Knowledge (IK) and Traditional Ecological Knowledge (TEK) offer complementary ways of understanding

the natural world. IK encompasses lived, place-based knowledge embedded in culture, language, and spirituality, while TEK often refers to the environmental dimensions of that knowledge, including long-term observations and ecosystem management (McGregor, 2004; Simpson, 2002). Both emphasize relationship, reciprocity, and respect. Approaches grounded in IK and TEK treat research as relationship-building with the land and its beings, generating knowledge through ongoing interaction—tracking migrations, seasonal patterns, and ecological shifts (Brooks et al., 2024). These frameworks deepen ecological understanding and translate into practical methods such as collaborative monitoring, adaptive management, and restoration aligned with community priorities. They have informed management of caribou, salmon, bison, and wolves, producing conservation outcomes that are culturally grounded and ecologically robust (Brooks et al., 2024; Ramos, 2022).

Herpetology, by contrast, has engaged with IK inconsistently, and in the United States especially, IK remains noticeably absent from mainstream herpetological research. Global ethnoherpetological work includes folklore about geckos in Portugal (Ceriaco et al., 2011), Nahua knowledge in Mexico (Linares-Rosas et al., 2021), teachings surrounding frogs and reptiles in South Africa (Phaka et al., 2023), and community use of herpetofauna in the Solomon Islands (Pollard et al., 2015). In North America, Williams and Shipley (2018) showed that Indigenous students' avoidance practices around reptiles—rooted in teachings of power, protocol, or danger—were misinterpreted as ignorance rather than cultural ethics.

Ethnoherpetological knowledge extends beyond peer-reviewed science. Some accounts are Indigenous-led, while others, though documented by outside researchers, reflect long-standing cultural relationships with herpetofauna. Examples include Nabhan (2003), writings documenting Hopi snake ceremonies (James, 1900), and broader cultural compilations such as Crump & Fenolio's *Eye of Newt and Toe of Frog, Adder's Fork and Lizard's Leg: The Lore and Mythology of Amphibians and Reptiles*. Regional programs—ranging from the Tucson Herpetological Society's collaborations with tribal nations to community-based snakebite initiatives in Ecuador (Save the Snakes, 2024)—integrate cultural knowledge into conservation. In the U.S. Southwest, Diné leaders have guided institutional decisions, including the removal of snakes from the Navajo Zoo, to align public spaces with cultural values (Fonseca, 2015).

These examples reveal robust Indigenous herpetological knowledge and leadership, yet within peer-reviewed herpetological science—where recognition and citation power accumulate—such work remains underrepresented. This reflects not a lack of Indigenous expertise but structural and linguistic barriers that privilege Western scientific formats and dissemination pathways over Indigenous-led contributions (Smith, 2012).

The absence of Indigenous perspectives in herpetological research has consequences. Studies may overlook culturally significant sites, disregard relational protocols, or misinterpret species' ecological and cultural roles. Integrating IK into herpetology brings at least three contributions: (1) place-based

ecological insights that complement Western datasets and extend monitoring beyond formal field seasons (Ford et al., 2020); (2) relational ethics that inform non-invasive methodologies and respectful engagement with powerful beings (Carjuzaa and Ruff, 2010; TallBear, 2014); and (3) community governance that ensures research aligns with cultural priorities and supports long-term stewardship (Latulippe and Klenk, 2020; Walter and Suina, 2018).

Despite these strengths, Indigenous Peoples feel constrained from pursuing herpetology due to sacred associations, fear of judgment, and lack of role models (Ash et al., 2015; Williams and Shipley, 2018). This tension shaped my own journey, which is why I prioritize non-invasive approaches, such as environmental DNA (eDNA) and acoustic monitoring, alongside sustained Tribal consultation.

4 Case study: amphibian research with the Navajo Nation

4.1 Background: species, place, and significance

Across the Navajo Nation (Diné Bikéyah), Northern leopard frogs (*Lithobates pipiens*) have declined markedly (Navajo Natural Heritage Program, 2020), particularly in montane wetlands, springs, and stream margins that historically supported breeding and larval development. Although the species has declined across much of the southwestern United States due to habitat loss, hydrologic alteration, disease, non-native species, and climate-driven aridification (Hayes et al., 2010; Stuart et al., 2004), within Diné Bikéyah, these pressures interact with local land-use practices that disproportionately affect amphibian habitat and culturally significant landscapes.

Livestock grazing and climate change jointly degrade amphibian habitat across riparian and wetland systems. Grazing reduces vegetative cover and increases erosion and sedimentation, leading to the loss of shallow margins essential for egg deposition and larval refuge, and reducing habitat complexity (Belsky et al., 1999). Climate change compounds these effects through warming, reduced snowpack, and prolonged drought, which shorten hydroperiods and convert perennial waters into seasonally intermittent systems (Dettinger et al., 2015; Seager et al., 2007). Earlier drying reduces reproductive success and increases vulnerability to disease and thermal stress (Carey and Alexander, 2003). Together, these pressures accelerate habitat loss, reduce connectivity among sites, and limit opportunities for recolonization (Campbell Grant et al., 2010).

For Diné communities, these waters and mountains are relatives, teachers, and storied places. Declines in amphibian populations signal broader disruptions to land and water systems that sustain both human and non-human life. Conservation of *L. pipiens* on Diné Bikéyah is not solely a biological concern but a relational responsibility tied to stewardship, balance, and long-term care.

4.2 Research governance and co-development with the Navajo Nation

This research is co-developed with the Navajo Nation Department of Fish and Wildlife (NNDFW) (NNDFW Permit 17NNC:23NNC 16USC:18USC; Northern Arizona University Tribal Consultation Number 9217431), which guides research design, site access, and data governance. Fieldwork focuses on identifying current distributions of *L. pipiens*, monitoring habitat conditions, and supporting future restoration in culturally significant landscapes. Data sovereignty is retained by NNDFW, with decisions regarding data storage, interpretation, and dissemination governed by Tribal authority. The project is grounded in the principle that research should prioritize the land and the Nation over external interests (Louis, 2007; Smith, 2012).

4.3 Frameworks for ethical Indigenous research

Multiple frameworks honor Indigenous research grounded in sovereignty and relational accountability. The CARE Principles (Collective Benefit, Authority to Control, Responsibility, and Ethics) emphasize Indigenous data sovereignty (Carroll et al., 2020), while Two-Eyed Seeing (Reid et al., 2021), trust-based models of transparency (Walter et al., 2020), and decolonizing methodologies (Smith, 2012) provide further guidance for ethical practice. Wilson (2020); TallBear (2014), and Todd (2016) emphasize relational accountability and critiques of Western epistemologies, while Mazzocchi (2006) highlights potential for mutual learning. These frameworks have been successfully implemented in fisheries, wildlife, and health research (Brooks et al., 2024; Ramos, 2022), though their use in herpetology remains limited.

While these approaches all provide valuable guidance, my case study centers on the 4 R's of *Indigenous Research Practice: Respect, Relevance, Reciprocity, and Responsibility* (Kirkness and Barnhardt, 1991). The number four carries deep meaning for the Diné worldview: we have our four clans, four sacred mountains, four cardinal directions, four seasons, and four worlds of emergence. Thus, the 4 R's resonate with my cultural grounding and research practice.

4.4 Implementation of the 4 R's of Indigenous research practice

Respect guided how I entered and worked within landscapes, emphasizing mindfulness, adherence to cultural protocols, and restraint. Wildlife was approached as non-human relatives rather than study objects, and disturbance and handling were minimized unless deemed necessary by NNDFW. Even in data reporting, respect shapes what is shared and what remains private (TallBear, 2014; Wilson, 2020).

Relevance was ensured through co-development of research questions and objectives with NNDFW, aligning scientific inquiry with community priorities, culturally important waters, and long-

term restoration goals rather than academic curiosity alone (Latulippe and Klenk, 2020; Louis, 2007).

Reciprocity was embedded in both field practice and governance. Efforts to minimize harm and give back were paired with Tribal authority over data storage, interpretation, and dissemination, ensuring that knowledge exchange remained bidirectional and responsive to community guidance (Kimmerer, 2013; Kovach, 2021).

Responsibility encompassed accountability to both cultural and scientific obligations. Research was conducted under Tribal permitting and governance, with adherence to biosecurity protocols and relational accountability to land, water, and community beyond data collection alone (Wilson, 2020).

Additional examples of how the 4 R's can be operationalized in research are summarized in Figure 1, which illustrates adaptable, non-extractive approaches for implementing Indigenous research principles in herpetological research conducted in partnership with Indigenous communities.

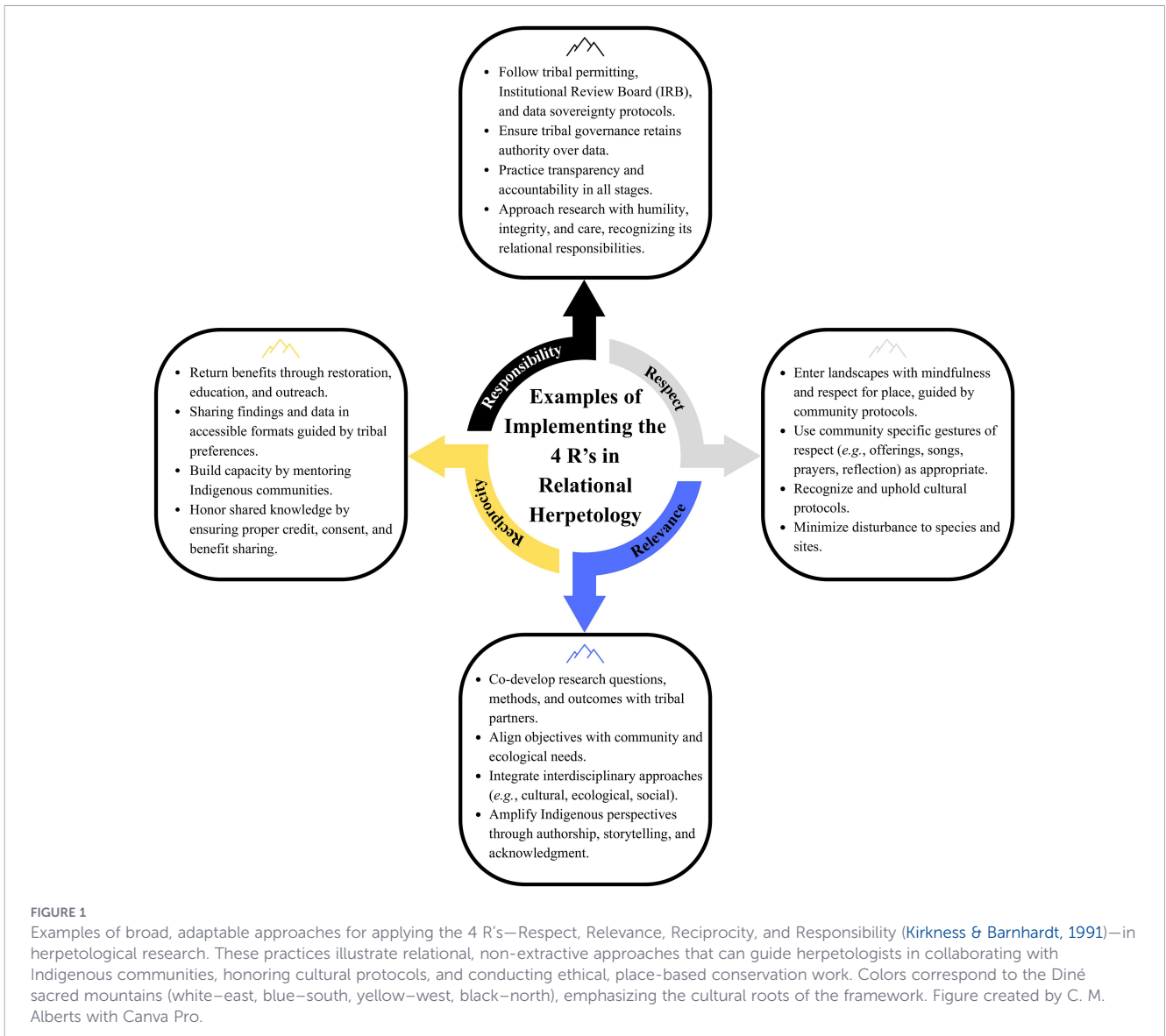
4.5 Methodological outcomes of integrating Diné teachings into western conservation science

Integrating Diné teachings into this research produced three interrelated methodological outcomes that reshaped how the project was designed, conducted, and interpreted. Rather than following a conventional conservation framework centered on efficiency, extraction, and definitive outcomes, these outcomes reflect teachings passed down from my parents, which I expand upon below: that research carries responsibility, that words and actions must be intentional, and that boundaries must be honored at every stage.

The first outcome was a strengthened commitment to reciprocity as a guiding principle. In many Western conservation studies, research is designed primarily to generate publishable data, whereas here, research was structured as a practice accountable to community priorities and future stewardship. Research questions, site selection, and long-term goals were developed with NNDFW to support restoration planning and decision-making, positioning scientific work as a form of giving back.

The second outcome was increased intentionality in communication and conduct. Where scientific practice often prioritizes speed, objectivity, and detachment, Diné teachings emphasize that words carry power, shaping how species, places, and results are described. This intentionality extended beyond writing to field presence and the pacing of work, reinforcing that research is defined not only by outcomes, but by how one moves through relationships with land, water, wildlife, and community.

The third outcome was the honoring of boundaries as a source of methodological clarity. Conventional field protocols often treat access, disturbance, and data sharing as logistical concerns, but here cultural and ethical boundaries shaped decisions about site access, seasonal timing, avoidance of sensitive areas, limits on disturbance, and data governance, including what information could be shared and under whose authority. These boundaries reshaped how scientific tools were interpreted. Environmental DNA provides a powerful, context-dependent tool for detecting rare species, with limits of detection and



quantification that influence how results should be interpreted and compared across studies (Klymus et al., 2020). Rather than equating molecular detection or non-detection with species presence or site occupancy, results were interpreted cautiously and contextualized through long-term observation of water persistence, seasonal patterns, and landscape history. Together, molecular tools and IK supported restoration-oriented decision-making rather than absolute claims about species presence or site status.

5 Discussion: toward an Indigenous future for herpetology

This perspective demonstrates that integrating Diné teachings and responsibilities into conservation science produces concrete methodological and epistemological outcomes. Rather than diluting rigor, this integration reshaped how research was designed, interpreted, and governed. Practices such as non-invasive sampling, intentional

language, and respect for boundaries were not symbolic additions but central to a research process grounded in responsibility to land, water, and community. In this way, methodology became inseparable from cultural practice, aligning with relational accountability frameworks that understand research as an ethical, place-based act (Kovach, 2021; Wilson, 2020).

These outcomes were made possible through collective governance with the NNDFW, which guided research priorities, permissions, and data stewardship. Tribal sovereignty was not an administrative layer added to the project, but the foundation that shaped how knowledge was produced and shared. This structure ensured that conservation science served long-term stewardship and restoration goals rather than extractive research outcomes.

Together, the methodological outcomes demonstrate that IK is not merely contextual or supplementary but actively shapes conservation practice. Rather than constraining inquiry, Diné teachings clarified ethical limits, reshaped how knowledge is communicated and interpreted, and oriented research toward revitalization and long-term care rather than documentation

alone. The result is a form of conservation science that is relational, cautious, and future-oriented, one that challenges assumptions about neutrality and efficiency without rejecting scientific rigor. In this way, integrating Diné teachings reshaped how conservation science is practiced and governed, while allowing me to practice science without setting aside my parents' teachings or my Diné responsibilities.

Currently, IK occupies a narrow place in herpetology, often treated as anecdotal rather than equal (Mazzocchi, 2006; Pierotti and Wildcat, 2000). Addressing this imbalance requires allowing Indigenous scientists and communities to participate without setting aside cultural responsibilities to be taken seriously (Ash et al., 2015; Miriti et al., 2023; Walter et al., 2020). Integrating Indigenous perspectives invites herpetology to critically examine its colonial foundations in extraction and control. Reframing herpetofauna as relatives rather than objects of discovery challenges assumptions about access, handling, and authority over knowledge (Todd, 2016). This approach does not offer a universal template; teachings and boundaries vary among Nations and must be approached with humility and responsiveness to local governance (Smith, 2012; Whyte, 2013).

For much of my life, I felt I was walking between two worlds: Indigenous and Western, spiritual and scientific. Over time, I have come to see they are one. Weaving Diné teachings into my research shows that science and culture can coexist without compromise. Embracing Indigenous perspectives can make herpetology more interdisciplinary, relational, and robust. It challenges the field to reconsider its foundations: What questions do we ask? Who decides the answers? Who benefits from the knowledge? Practiced with cultural care, herpetology can become a space of belonging, healing, and responsibility—one where future Indigenous scientists no longer walk a tightrope but stand firmly within a shared world.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

CA: Writing – review & editing, Conceptualization, Writing – original draft, Funding acquisition, Methodology. SR: Supervision, Conceptualization, Writing – review & editing, Writing – original draft.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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