Indigenous One Health: Connecting Traditional Ecological Knowledge and Western Science

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Abstract

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The One Health approach, which assesses the interconnectedness of animal, human, and environmental health, fails to include and amplify Indigenous knowledge and Indigenous scientists. To effectively center Indigenous knowledge next to and within the One Health approach, which is historically based in Western science, the gaps and overlaps between Indigenous science, specifically Traditional Ecological Knowledge (TEK), and One Health must be explored. By encouraging the Indigenous method of Two-Eyed Seeing through collaboration between Indigenous and Western scientists, One Health must shift its framework to uphold Indigenous values. The objective of this project is to identify values in Indigenous science that are missing or underrepresented in Western science, and then collaboratively ideate actions that Western scientists can take as allies to center and support Indigenous sciences, models, and language so that Indigenous knowledge is elevated.

From January to March 2023, the study team conducted semi-structured interviews with Indigenous scientists and knowledge keepers via Zoom video calls. Indigenous participants in the

continental United States and Hawaiian Islands were recruited through Indigenous academic listservs, direct outreach to individuals interested in the project, and referrals from Indigenous leaders who had participated in a prior round of interviews in 2022. In that round of interviews, four themes emerged and called for further exploration of Indigenous perspectives on how 1) the natural world, 2) cultural heritage, 3) value expression, and 4) reflection influence worldviews and relationships to animals and other beings in the environment. These ideas were reframed into questions asked in a subsequent round of interviews in 2023. Theme identification methods were used to highlight recurrent and key ideas throughout the interviews. Participants noted gaps between their Indigenous worldviews and the One Health model, particularly relating to contrast with Western culture, holistic expression, power in action, identity and belonging, maintaining community and cultural practices, and sharing information/education. It was also noted that One Health must do more than uplift Indigenous values to support Indigenous scientists, such as collaborating with Traditional Ecological Knowledge keepers and encouraging practices that are inclusive and validating of other knowledge systems.

Interview responses highlighted Indigenous principles that are missing from One Health practice. These principles were transformed into actions items for Western researchers to recognize, support, and amplify Indigenous science and scientists. Adoption of the action items would foster and strengthen collaboration between One Health practitioners and TEK keepers. Scientific practice is dominated by Western perspectives, but all must work together to help promote and protect Indigenous ways of knowing.

1. Introduction:

A note on positionality:

My positionality as the lead author and interviewer is that of a female, White, non-Indigenous, Master's student-researcher trained within Western scientific institutions. I come from settlers and European immigrants, and I do not have lived experience as an Indigenous person. The study team members, my thesis committee members and myself, come from diverse academic backgrounds but are all trained in Western scientific practice. The study team members also do not identify as Indigenous. To recognize the lack of Indigenous representation amongst the study team members, I have assembled an Indigenous advisors' group of former study interview participants who helped adjust and guide aspects of the project, such as the interview questions and recruitment processes.

Background:

One Health explores the interrelationship of animal, human, and environmental health, and aligns with values like reciprocity that are central to Indigenous Traditional Ecological Knowledge (TEK) yet is rooted in Western science (Jack et al, 2020). Therefore, One Health can connect Western science and Indigenous science. The One Health approach strives to create a transdisciplinary space in which diverse perspectives can come together to advance knowledge and break down scientific siloing. One Health has increasingly been used in studies that assess human-animal-environment interfaces, yet it is less engaged in projects involving social and other non-natural sciences (Zinsstag et al, 2023). One Health, which became popularized around the early 2000s, has been praised for its innovative interdisciplinary and systems-thinking approach that is often lacking in other Western scientific pursuits. (Mackenzie and Jeggo, 2019).

Yet, it is also criticized for upholding settler colonialist influences in Western science while failing to recognize the Indigenous values that are clearly being exploited by Western science (Niahosa, 2019). As more scientists and scientific fields adopt the One Health transdisciplinary approach into their practices, highlighting and centering Indigenous voices is urgently needed (Zinsstag et al, 2022). This includes recognizing Indigenous knowledge, specifically TEK, and the history that built the foundation for One Health.

Indigenous knowledge, described in English language terms, is the unique and diverse knowledge system that Indigenous peoples use to understand the workings and intricacies of the natural world. Indigenous knowledge can vary greatly in the methods of observation, categorization, compilation, and notation of information collected through personal experience or passed down over generations. Maintaining Indigenous knowledge ensures that Indigenous peoples will prosper not only in community health and cultural livelihood, but also in Indigenous identity and determination (Whyte et al, 2016). Within Indigenous knowledge, TEK exists as an environmentally specified area with focus on topics similar to Western ecology, agriculture, and biology (Whyte et al, 2016) (Appendix A). It is important to recognize that TEK exists not only as a system for collecting and categorizing knowledge, but also as a process for spiritual resilience and resistance as well as environmental resilience to climate change, infectious disease, and biodiversity loss (Jack et al, 2020). A cornerstone theme in TEK is the holistic approach that health is both a collective experience and an individual experience that exists along an inter-generational continuum. This framework includes the four vital dimensions of life: intellectual health, emotional health, physical health, and spiritual health (Cediel-Becerra et al, 2022). Further, TEK recognizes the reciprocal relationships and stewardship that exists between humans and the natural world, in which humanity and nature are connected and bi-directionally

dependent (Ratima et al, 2019). TEK systems do not see a clear division between the health of the individual, the community, the ecosystem, and the planet. This connection, which is established at birth, exists on a macro-planetary level and on a microbial level. Some traditional practices in Australia involve placing a newborn baby on microbial-rich soil to facilitate an intimate relationship with the natural world (Redvers et al, 2020). The deep connection between humanity and the environment that TEK fosters has served Indigenous communities since time immemorial, but it has also made Indigenous communities vulnerable to capitalist-colonial exploitation from Western scientists and societies (Youdelis et al, 2021). For example, Indigenous forest stewardship and cultural burning practices are often adopted by forest management services during wildfire seasons, yet respect and reciprocity are not extended back to the Indigenous groups from which the knowledge was created (Kuhn, 2021).

Western science is derived from the principles of Western civilization, which highlights and prioritizes science and technology that is verifiable and rationalizable (Baquero et al, 2021). The Western world, also referred to as the Global North, is an imperfect umbrella term used to broadly group and distinguish societies and practices and will be used throughout this paper to represent non-Indigenous knowledge and customs (Khan et al, 2022). Western science is dependent upon scientific principles and philosophies that are provable and reductionist in their approaches (Baquero et al, 2021; Ratima et al, 2019). Western science also strives to measure metrics and identify truths, which can be difficult to produce for much of the knowledge that Indigenous leaders and scientists hold. In many cases, Indigenous science cannot be evaluated by the criteria and standards that Western science demands (Durie, 2004). Further, Western science is built within a rigid structure of domination which provides a framework for colonialism and racism to be upheld (Baquero et al, 2021). Western science upholds the modern expression of

"manifest destiny" - a need to control the narrative and direction of scientific effort so that white supremacy, settler colonialism, and racism can maintain a strong integration in science and society. This control is particularly expressed in Western-directed conservation efforts that exploit TEK (Jacobs et al, 2022). Western science also supports species hierarchies, in which all living beings are unequal in value and humans are the most important species (Padwe, 2013). Individualist thinking, a hallmark of Western science and a stark difference in approach compared to Indigenous science, views problems within a species as unconnected from other species and systems (Ratima et al, 2019). It is necessary to recognize that many Indigenous individuals live and work within geographically Western locations and in Western-dominated societies.

The overlaps between Western science and Indigenous science, specifically related to TEK, lay within the One Health paradigm: the interconnectedness of humans, animals, and the environment. Yet, these ideals in One Health were taken without giving credit to the Indigenous knowledge from which it was derived. Settler colonialists who stole Indigenous thought also rearranged the context in which TEK could be applied so that Indigenous science would be invalidated in the Western science space (Durie, 2004). Under the holistic approach that TEK upholds, health is seen as a composite measure of spiritual, mental, emotional, and physical health. On the contrary, One Health and Western science views health as the *absence* of illness or disease (Hillier et al, 2021). These differing viewpoints create a gap between Western and Indigenous science that limits collaboration and stunts advancements that could be made using strengths in both approaches. A collaborative compromise would need to avoid forceful assimilation of Indigenous peoples into Western culture and counteract Western ambivalence towards Indigenous peoples that has made current problem resolution laborious (Beauvais and

LaBouff, 1985). Rather than a compromise, merging and utilizing the strengths of both approaches through the "Two-Eyed Seeing" method can center and uphold Indigenous knowledge while being supported by Western knowledge and processes.

Two-Eyed Seeing is a framework that strives to connect Indigenous ways of knowing with Western ways of knowing. Two-Eyed Seeing is an Indigenous framework created by Elders Albert and Murdena Marshall from the Mi'kmaq community in Nova Scotia (Martin, 2012). Thus, practicing Two-Eyed Seeing centers Indigenous approaches while bringing together diverse worldviews (Hillier et al, 2021). Two-Eyed Seeing was created by a need to recognize that there are multiple forms of understanding, some of which come from Western science and some of which come from Indigenous knowledge systems, and that they coexist. When utilizing both perspectives simultaneously, the most useful elements of each can be selected to build a shared knowledge system (Martin, 2012).

The Two-Eyed Seeing lens simultaneously prioritizes cultural diversity within scientific practice, and recognition of alternative forms of knowledge that are carried through cultural diversity and are welcomed in a collaborative space. Without recognition of diverse ways of knowing, human, animal, and environmental health are susceptible to harm and sickness (Martin, 2012). The Two-Eyed Seeing framework introduces the idea that seeing out of one "eye," holding an exclusively Western perspective or an exclusively Indigenous perspective, will present only one incomplete way of viewing and understanding a situation. However, by seeing out of two eyes and approaching situations using an Indigenous and a Western perspective, a new way to view and process the world is created (Redvers et al, 2020). It is important to recognize that Two-Eyed Seeing does not create a "complete" picture of a problem, but rather a new way of seeing it.

There has been growing momentum in work to unite Western and Indigenous sciences. Two-Eyed Seeing appears to be one of the Indigenous frameworks that is most represented in studies, potentially due to its mission of employing both Western and Indigenous ways. In fact, there have even been protocols developed to work within a Two-Eyed Seeing framework (Milligan et al, 2022). Additionally, Two-Eyed Seeing can be applied when limitations or bounds are encountered when only one perspective is in use or if Western science is imposing restrictions on Indigenous knowledge and research methodologies. An unequal burden has historically been placed on Indigenous peoples to uphold relationships and stewardship practices, particularly for Indigenous women. For example, women may be more exposed to health or environmental risks due to their role as healers or health caregivers. Partnership between Indigenous knowledge keepers and Western scientists must be carefully navigated to avoid misuse of people and knowledge (Garnier et al, 2020).

Indigenous frameworks can be used to present, explain, and justify the importance of using Western and Indigenous perspectives jointly. A recent movement has introduced the Four R's into Western scientific practice as a way to guide collaboration: 1) respect, 2) reciprocity, 3) responsibility, and 4) relevance. To make certain that the Four R's are being upheld in partnerships and in higher education, Western-trained scientists must be responsible in ensuring that they are respecting Indigenous knowledge keepers and scientists for their perspective and their work and that the relationships maintain reciprocity. Western scientists must also make sure that Indigenous worldviews are being centered based on relevance to the work (Kirkness and Barnhardt, 1991). The Four R's are also sometimes extended by including rights, relationships, and reconciliation through redistribution into the framework (Jacobs et al, 2022). In the scientific efforts that have upheld Two-Eyed Seeing and the Four R's, there has been success in the

partnerships between Indigenous knowledge keepers who can improve relationships with the earth and other living beings, and Western health practitioners who are able to provide different perspectives and resources (Jack et al, 2020). This partnership has been seen to be most successful in spaces where Western scientists respect the earth stewardship and conservation methods and practices of Indigenous scientists, as well as contribute resources to support TEK (Whyte et al, 2016). Moreover, Western and Indigenous collaborations must establish bidirectional trust to sustain healthy working relationships. Importantly, it should be noted that many Indigenous cultures do not consider their practices as "conservation" or "sustainability work," as these words do not exist within their cultures and communities. Rather, it is expected that people uphold a reciprocal and healthy relationship with the earth and all its life and should therefore have no need for "conservation" (Hernandez, 2022).

Advancements are being made to center Indigenous voices and TEK within One Health to re-Indigenize Western science broadly, however, gaps remain, and strides need to be taken towards achieving recognition of the Four R's and Two-Eyed Seeing. (Re-) Indigenization has been defined as "the transformation of the existing academy by including Indigenous knowledges, voices, critiques, scholars, students, and materials as well as the establishment of physical and epistemic spaces that facilitate the ethical stewardship of a plurality of Indigenous knowledges and practices so thoroughly as to constitute an essential element of the university. It is not limited to Indigenous people, but encompasses all students and faculty, for the benefit of our academic integrity and our social viability" (Peltier, 2018; Pete, 2023), To make progress in conservation efforts, sustainability scientists and One Health practitioners need to express respect towards TEK keepers so that all participants can connect and learn from each other (Whyte et al, 2016). This respect must be actively recognized and practiced as Indigenous-led stewardship is

often encouraged in theory, yet not sustained. Cultural and methodology shifts need to be made where Western science no longer ignores and subjugates the value of Indigenous practices, authority, and independence (Yudelis et al, 2021). A strong need for increased community-based and community-led participatory research exists within Indigenous communities, where Indigenous people are no longer seen as scientific subjects but rather that Indigenous scientists have agency, platforms, and resources (Jones et al, 2018). One Health requires Indigenization as well as space in which TEK keepers can collaborate with Western One Health practitioners to create strengthened and liberatory efforts and relationships. The shared goals and vision amongst One Health and TEK can facilitate partnerships between Indigenous and Western scientists.

The objective of this project is to identify ways that Indigenous science, models, and language can be centered next to, and within , Western science broadly and One Health specifically through actions Western scientists can take to respect and help protect Indigenous science and scientists. The idea of amplifying Indigenous ways of knowing within and outside of Western science recognizes that some Indigenous individuals participate in Western science or customs, some practice Western science but maintain connections to Indigenous culture, and some individuals are not connected to Western science. Interviews will be used to name Indigenous values that need better representation and support in Western scientific practice generally, and in One Health efforts specifically. By elevating Indigenous principles and voices next to and centered in Western science, Western and Indigenous knowledge keepers may foster healthier and more meaningful collaborations. This inclusion and centering of Indigenous values in Western science and bonding One Health and TEK practices is an example of Two-Eyed Seeing in action: Indigenous and Western perspectives being unified to create a new and inclusive outlook and position for action.

2. Methods:

2.1 Preliminary Interviews:

This study takes a qualitative approach by using participant interviews to guide results and recommendations. To begin to understand Indigenous values, a prior round of interviews was conducted June-August 2022 in which twelve Indigenous scientists and knowledge keepers were asked to describe how the Four R's (respect, relevance, reciprocity, and responsibility) related to their life and worldviews. These responses were thematically explored using open coding without a qualitative analysis software program. The codes created from the interview response transcripts expressed recurrent and overarching ideas. The codes were consolidated into broad themed categories which were then transformed into semi-structured interview questions to be used in a second round of interviews with Indigenous scientists and knowledge keepers. The questions were constructed through a co-creative process between the study team members and former interview participants. This group of Indigenous participant-partners, referred to as the advisory group, provided guidance towards writing the questions with accessible and relevant language, which became the interview guide for the second round of interviews. The advisory group also offered advice on how to develop relationships and respectfully conduct interviews with Indigenous individuals.

2.2 Study Population:

The study population focused on self-identified adult Indigenous scientists and knowledge keepers. For both the first and second round of interviews, the participants resided across, yet within, the continental United States (Turtle Island) and the Hawaiian Islands. This was made possible due to the interviews taking place over Zoom. Demographic information of

interview participants was not systematically collected. Though demographic information was desired and asked as an interview question, some participants chose not to answer specific prompts. Due to the chosen recruitment and interview methods, all participants spoke fluent English and had technology access to connect them to the internet, email, and Zoom.

2.3 Participant Recruitment:

In the initial phase of this project in Summer 2022, twelve Indigenous scientists were recruited through a Google form sent to Indigenous academic listservs and were then interviewed. At the start of the second phase, the first phase participants were contacted for referrals (including contact information) of potential participants for second phase interviews, a recruitment method called snowball sampling. Nineteen referrals were contacted and eight were interviewed. These eight individuals who participated in the second round of interviews were also asked to provide referrals and contact information in another iteration of snowball sampling. Snowball sampling continued following each interview. Three referrals were provided and two completed interviews. Some interviewed participants shared the interviewer's contact information with their network and subsequently three participants reached out to the study team for recruitment, and all three completed interviews (Appendix B).

A non-referral-based recruitment strategy included convenience sampling, in which potential participants were directly contacted due to their interest in the project or personal goals that aligned with the objective of this work. Five individuals were contacted and four were interviewed. Finally, study team members revisited the Google form used to recruit participants for the first round of interviews, and reached out to all individuals who indicated interest in the first phase of the project but did not complete an interview. Eleven individuals were contacted

using information provided through the recruitment Google form and two participants were interviewed (Appendix B). In recruitment outreach, all participants were provided with the interview questions and were informed that compensation would be given following their interview.

2.4 Information Sources and Collection Processes:

The interview guide (questions) (Appendix C) was created to expand upon themes of the natural world, cultural heritage, value expression, and reflection, introduced in the first round of interviews. The guide was edited by the advisory group and changed to use language that was inclusive and accessible, particularly in Indigenous communities. Interviews were conducted over an eight-week period from January to March 2023. Participants were emailed a link to their Zoom meeting interview after establishing a convenient time for the interview. All interviews began with asking the interviewee permission to record the Zoom meeting. Next, an introduction about the interviewer and the Indigenous One Health project was given, including the interviewer's educational background and academic goals. Time was provided for questions and discussion about the project. Then, the interviewee was prompted to introduce themself, including sharing occupation, age, Indigenous community affiliation(s), and academic involvement. Participants who chose to share their Indigenous community affiliation were asked to type the name of their Indigenous community in the Zoom chat so accurate spelling could be ensured. Then, the five questions in the interview guide were orally shared and pasted in the Zoom chat. Following the interview questions portion, participants were again prompted to share questions or comments. No repeat interviews were conducted; however one individual was interviewed over two interview slots on different days (two hours total). Notes were taken during

the interviews for later reference. After the interviews, participants were contacted through a follow-up email to express gratitude for sharing their time, information, and language, and were provided with compensation of an e-gift card. Compensation, gratitude, and personal connection heed best practices to show respect and reciprocity in Indigenous communities. During follow-up communications, participants were also asked to share contact information of any potential participants to continue snowball sampling recruitment. Snowball sampling also follows Indigenous best practices by highlighting connectedness and relationality in research. Data saturation was neither considered nor discussed because each participant shared unique and personal experiences and perspectives.

2.5 Information Storage and Logistics:

Interview lengths ranged from 15 minutes to 2 hours with an average duration around 30 to 45 minutes, which was the target duration for the interviews. The interviews were conducted in English, though the interview guide was created with the intention of using language, phrasing, and structure consistent with non-English languages, particularly languages of Indigenous communities. Information collection for phase 2 occurred via Zoom meeting cloud recordings. Each interview was recorded to the Zoom cloud, which stored the .mp4 video file, .mp3 audio file, .vtt text transcript, and .txt Zoom chat capture. The four files from each interview were downloaded from Zoom and saved in a desktop folder and Google Drive folder on a password protected computer to protect the data.

To generate the transcripts used in thematic coding, the .mp4 files of each interview were individually uploaded to the web browser version of Microsoft Word which includes a transcription feature. The Word program generated a rough, “unclean” text transcription of the

.mp4. To “clean” the transcript, the Word “Spelling & Grammar" feature was used to eliminate duplicate words generated by speech stuttering and words misspelled by the transcription software. To further “clean” the transcript, the interview audio file was listened to while reading through the transcripts to identify instances in which the transcription software created mistakes. Transcripts were cleaned over the course of two weeks, with the cleaning and formatting process concluding in the first week of March 2023. Cleaned transcripts were not returned to participants for review or feedback, however, participants were later contacted for approval of quote use.

2.6 Coding Overview:

Coding describes the process of summarizing the main and/or recurrent ideas in transcripts into organized and defined “codes.” Researchers who participate in this process are called “coders.” The primary author of this paper served as the only coder for the qualitative thematic identification. Only one coder was used due to time constraints upon other members of the study team and because there was insufficient budget to hire other coders. The primary author also sought to learn and gain skills in qualitative analysis during this thesis work. Because there was only one coder, there was not a need to perform inter-coder consensus assessments nor inter-rater reliability checks. In coding the transcripts, the coder was reflective of their positionality as a white, Western-trained researcher attaching labels to Indigenous voices. To reduce bias, some codes were named based on wording and phrasing used within and throughout the transcripts. Additionally, to support the coder, the advisory group of Indigenous partners assisted in the creation and adjustment of codes, categories, and themes.

The prepared transcripts were imported into the ATLAS.ti software for coding and thematic identification (Appendix D). Inductive open coding was used in which a codebook was

created based on ideas that became apparent during coding, and no a priori codes were established. Codes and rules for coding were created as needed throughout the coding process. Coding followed standard inductive open coding procedures (Guide, 2014). The coding process spanned the first three weeks of March 2023.

After all the transcripts were coded, the codes were reviewed to ensure accuracy and relevance across all 19 interviews. Then, the codes were collected to form the codebook (Appendix E). In the codebook, each code was given a description that explained its use in the coding process. The definitions of the codes reflected how they attached to the quotes in the transcripts, as well as the broad ideas the codes encompassed. The codebook also contained inclusion/exclusion criteria for code use and additional notes about the codes.

Once the codes were created, they were grouped with related codes into broader categories. The categories were then synthesized into themes that explicated the powerful messages identified throughout the interviews. After the codes, categories, and themes were created, the advisory group consisting of participant-partners from the first and second rounds of interviews were gathered in a meeting. In this meeting, which occurred in April 2023, the preliminary codes, categories, and themes were presented to the participant-partners. Then, the partners and coder co-created new themes that bridged and were guided by Western and Indigenous scientific thought. The Indigenous advisors also provided support regarding broadcasting information, permission, and consent.

2.7 Ethical Considerations:

The Institutional Review Board (IRB) at the University of Washington determined that this project was not human subject research and therefore was IRB exempt. Due to this

distinction, participants were not provided with formal consent forms prior to their interviews. The full requirements of participation in the project were provided before the interviews, and continued participation in the interview and receipt of the compensation was determined to be consenting approval of participation in the project. One IRB submission covered the full scope of this project, including both phases of recruitment and interviews.

3. Results:

3.1 Study Population:

Each participant in the second phase of interviews was asked to share their age status (youth, adult, or Elder), their affiliation with academia (affiliated or non-affiliated), their Indigenous community affiliation(s), and their occupation. Amongst the participants, 57.4% (n=11) identified as an adult, 10.9% (n=2) identified as an Elder in their community, and 31.7% (n=6) of participants did not provide an age status. No participants identified as a youth in their community. 67% (n=12) of participants noted that they were a part of academia, 27.7% (n=5) noted that they were not affiliated with academia, and 5.3% (n=1) did not provide a response. Amongst the 19 individuals that participated in the second round of interviews, those who chose to indicate their Indigenous community affiliations included Apache, Blackfoot, Cowlitz, Hawaiian, Hidatsa, Lakota, Mandan, Mattaponi, Mayan, Seneca Cayuga, Turtle Mountain Band of Chippewa, Tsimshian, and Yaqui.

3.2 Thematic Results:

During the first round of interviews in 2022, Sixteen codes were created from the interview response transcripts expressing recurrent and overarching ideas. These 16 codes were consolidated into four themed categories:

1) The natural world
2) Upholding values
3) Cultural heritage
4) Reflection

In the second round of interviews which occurred in 2023, 20 codes were identified throughout the coding process (Appendix E). The 20 codes were used a total of 608 times with 327 quotes throughout the 19 transcripts. The most used codes were *values* (n=129), *connection to environment* (n=84) and *knowledge keepers* (n=43). The codes that co-occurred the most were *values-connection to the environment* (n=36), *values-knowledge keepers* (n=23) and *values-teaching youth* (n=19). The values code was the only code used in every transcript. *Connection to the environment* was used in 89.5% (n=17) of the transcripts and *knowledge keepers* was used in 84% (n=16) of the transcripts.

The 20 codes were grouped into six categories:

1. Identity and Belonging
2. Holistic Expression
3. Contrast with Western Culture
4. Sharing Information-Education
5. Power in Action
6. Maintaining Community and Cultural Practices

Each of these six categories was transformed into a theme aiming to encompass the important ideas attached to the codes, as well as the impact of the broader categories. The six themes were created to be action items for a Western researcher to incorporate into their life, work, and practice to better support and center Indigenous science and scientists. The thematic identification process was guided by the Two-Eyed Seeing framework. Two-Eyed Seeing was applied in this process by attempting to synthesize the themes utilizing Indigenous and Western perspectives in the advisory group meetings to create a new view on the content.

3.3 Themes:

- ★ Honor and acknowledge your identity and belonging in your work
- ★ Recognize community-based and land-based healing that takes care of us and needs care in return
- ★ Elevate Indigenous knowledge expression next to, and within, Western science
- ★ Use storytelling to teach and educate, especially from Elders to youth
- ★ Reclaim, revive, and protect Indigenous practices and set them into action
- ★ Participate in practices that contribute to community identity

<u>Honor and acknowledge your identity and belonging in your work</u>

Many participants noted in their interviews that it was important for them to uphold their Indigenous identity and bring their lived experiences into their work. Participants noted how this contrasts from the desired subjectivity often found in Western science. One participant who worked in Western academic spaces noted,

"I feel like we need to infiltrate [research] in a sense. To make it more representative, make it more… look like me and I think me being here changes that dynamic."

This quote highlights the need to support people with diverse experiences within academia, particularly Indigenous identities. This individual also notes that their presence in

research changes the dynamic typically consisting of white, Western, dominant voices. Another participant speaks to the importance of integrating identity in one's work:

"The work that we do as Indigenous people is so deeply relational that I can't just pull myself out of my research… it is an honor and it's a responsibility."

The quote demonstrates the importance of relationships in one's work, which differs from the unbiased, objective approach many Western scientists take. Moreover, including one's family and relationships in their work can be incredibly important. As the same participant continued,

"I'm always proud to have my family to turn to… it's been essential to my research. So not having that was real hard in the research place because I'm so used to it."

Further, another participant explains about family and identity in science:

"Standard objective science was very much like I'm this blank slate and positionality was kind of hidden… [Indigenous science] was very much the opposite, and that your position, your family, where you come from should be stated at the very beginning so your reader knows who you're talking to… people want to know who you come from so they can kind of gauge what school of thought you are coming from."

This quote provides an important example of drawing a parallel between one's family being similar to one's academic upbringing - both greatly influencing work and worldview. The quote also introduces the importance of family-based identity in many Indigenous cultures. Another participant states:

"In every community, in every family, there are cultures, there are beliefs, there are morals that have to be followed for a family to identify itself. There are still families that have tried as much as possible to uphold their traditional cultural beliefs and heritage, despite all these modern issues that are coming up as time goes by."

In addition to supporting individuals with diverse identities within research and academic spaces, it is also necessary to create a space where Indigenous peoples feel a sense of belonging. Several participants mentioned that representation matters, including encouraging youth to

envision themselves in academic spaces. Moreover, representation extends to Indigenous researchers taking control of the Western narrative about Indigenous peoples. As one participant says,

"The folks who were writing the history of Hawaiians and Hawaiian culture were not people of place…. It's really having a seat at the table, getting more Hawaiians…people of place, who are more invested in that community, in the people, to be doing the work."

These quotes work powerfully to broadcast the importance of representing one's identity and positionality clearly and proudly around their work.

<u>Recognize community-based and land-based healing that takes care of us and needs care in return</u>

One of the most prevalent themes to come out of the interviews, connection to the environment, made a clear statement of importance to Indigenous communities with nearly 90% of participants speaking of their connections to natural and social surroundings. Participants also noted that their relationship to land is closely tied to identity. One individual describes the deep connection their community has with taking care of the environment. They say,

"Environmental stewardship and conservation is woven into who we are as a people. We live it in our everyday lives, and is an integral part of who we are."

This quote serves as a great example of how environmental stewardship is intertwined to some Indigenous practices. However, not all participants shared the perspective of stewardship being a culturally shared responsibility. As one participant says,

"I guess there is this whole notion of stewardship. It kind of comes from a different cultural lens than our traditional understanding of our role… We aren't really superior to any other being so this whole notion of stewardship suggests that maybe there's a hierarchy… Our superiority as humans and us being the only entities on the planet who can really have the ability and wherewithal to understand the dynamics and balance that exists in the ecosystem…. We're very much in our traditional understandings of how we're co-located with all these other beings. We're just a part of the broader web or living things within our ecosystem."

This participant speaks of stewardship not as a responsibility that humans hold because they are capable of being caretakers of other species and their shared environment, but rather that humans are as integrated into the ecosystem as all other beings. Due to the connection that humans share with their environment, people are motivated to engage in practices that uphold environmental health such as stewardship initiatives. On communal actions and links between humans and other beings, another individual shares,

"With that connection, if you learn something from me, somebody else will learn something from you. And with that, we'll come up with the common responsibility for the environment."

This quote highlights the importance of learning how to take care of your environment from those around you and exploring the culturally necessary practices of environmental stewardship. As another participant notes,

"I think the mental health, the spiritual health, and connection that is meant to happen between humans, animals, and the environment is definitely going to happen because it's just natural. It's something that lives deep within us, but we never give it the chance or time to feel it or be connected to our surrounding."

Other participants also noted the connection between humans and the environment including connection and kinship with animals. As one participant says,

"When you talk about mutualism, it's about both species or organisms benefiting from each other. So in our efforts to, for example, plant trees, we give home to animals like birds and humans benefit from our environment being cleaner due to removal of carbon dioxide… We are working together to ensure that the ecosystem is maintained."

Similarly, another participant expands on the idea of mutualism, saying,

"These three aspects [of humans, animals, and environment] are things that have to mutually depend on each other in order to survive. The moment one is not protected, then either two of them are going to be extinct…Generally I think it's the responsibility of everyone to take care of the environment, to take care of the animals, to take care of the humans ourselves… The only thing they need is sensitization. I think most people don't know how to

take care of animals or the environment and so they end up thinking that maybe they're doing the right thing but it's practically the opposite."

The quote above particularly highlights the foundational concept of the One Health approach that humans, animals, and the environment are all connected and must support each other to survive and thrive. One participant specifically mentions the One Health paradigm, in that,

"In terms of community,... [we] can come together and ensure that the environment is safe for humans and also animals just to bring that sense of belonging and togetherness in society when it comes to One Health."

The participant introduces another meaning of environment, extending past the physical landscape and encompassing the social relationships that are driven by community, togetherness, and feelings of belonging. Regarding the social environment, one participant explains,

"We engage in the community by supporting community relationships. We do have some tenants of community care with some values like reciprocity… of being able to support one another in ways you know are really needed… [we] learn healing modalities and be in community where youth and Elders are all attended to."

These quotes show that sustaining social environmental health is as important as natural environmental health. And, by seeing all beings as being connected to humankind like a family network, supporting other beings by extension upholds social environmental wellbeing.

<u>Elevate Indigenous Knowledge Expression Next to, and Within, Western Science</u>

As the participants mentioned in Theme 1, Indigenous scientists can exist in Western-dominated scientific spaces. Thus, practice of Indigenous knowledge must be amplified for Indigenous researchers who work in Western scientific places, and for Indigenous scientists who live in Western-dominated cultures. As one participant provides the example,

"Evidence-based medicine is a tool but it does not embody a holistic Indigenous perspective whatsoever… I can easily see the link between how evidence-based medicine

weaponized against people and their individual health journeys and that's done with the environment as well."

This quote highlights the danger of focusing only on physical health (for example, evidence-based health concerns) and ignoring mental, emotional, and spiritual health. Another participant shared potential benefits within Indigenous cultures that support emotional, mental, spiritual, and physical health, in claiming,

"[Researchers] were able to document that American Indians noted more [A grades] than white participants in the study. They also noted that they had fewer mental health outcomes…they posited that that might be due to these cultural buffers that we have in place in our communities."

Though the aforementioned study was conducted by Indigenous scientist, Dr. Donald Warne, it brings up another challenge that Indigenous individuals face. Western and Indigenous studies attempt to extrapolate information pertaining to one Indigenous group out to a broader group of Indigenous individuals or communities. One participant speaks to this:

"We get lumped together often in data sets and in a lot of even Indigenous scholarly work that happens too. We still put ourselves together as American Indians and Alaska natives. However, it's important to call out."

Throughout the interviews, participants, such as the one quoted above, mentioned the disappointment and frustration of Indigenous people and communities being included in work, initiatives, or programs not relevant to their communities. Just as the needs of an Indigenous community are similar and different from that of a Western community, one Indigenous group may or may not differ entirely from another. Thus, it is important to highlight the diversity of Indigenous knowledge and people in science. One partner noted that white individuals are not assumed to be speaking on behalf of their whole community, though this occurs often for Indigenous peoples. As one participant says, the most effective way to make a difference for an Indigenous community is to create the solution from within that community. They explain,

"We're adapting a Western tool for an Indigenous community. What we need to do is start in the Indigenous community and build the tool, because then it's going to be effective because it's based in Indigenous knowledge… We need to start thinking Indigenously… I'm not discounting Western ways because we have to bridge, we have to come to the middle. That Two-Eyed Seeing approach so that we take the best of both worlds because we're living in that world."

Therefore, Indigenous methods and tools must be created for Indigenous communities by and for Indigenous communities with the assistance of Western resources and networks to elevate Indigenous knowledge next to, and within, Western science.

Use Storytelling to Teach and Educate, Especially from Elders to Youth

The themes of storytelling and education were significantly present, with 74% (n=14) of participants speaking about storytelling in their interviews, and 63% (n=12) talking about teaching youth. Three key values of storytelling emerged from the participant transcripts: education, intergenerational connection, and cultural teachings. Storytelling can be a powerful tool for education, as one participant explains,

"We can find meaning in stories from the old days and things that have been passed down through the centuries that is science. That's not just some fairytale story book."

This quote demonstrates the Traditional Ecological Knowledge teachings that storytelling can hold, and how it can relate with Western science. Another participant touches on this, urging,

"It's high time that you bring these things together, these things back and we involve the storytellers and all these people, all these traditional Indigenous communities. We have to bring them back to life because sometimes they just feel like they're not being appreciated, yet they are literally the ones that are making our environment healthy for us to live in. That is why I think it's just time to bring all the traditional concepts and everything back to the now society and train all or give all this information to the now generation, the current generation. Because I think they don't understand the connection between the environment, themselves, and the animals as well."

This quote introduces the second idea of using storytelling to connect generations of community members, to appreciate those who hold traditional knowledge, and to provide teaching to the youth. As one participant summarizes,

"***In a nutshell, it's acknowledging the depth of our ancestral knowledge, understanding and practicing it in a way that we can then share it with the next generation without it getting lost in translation. The passing of our ancestral knowledge to the next generation is how I uphold my responsibility in maintaining the bridge between the past and the future."***

Another participant touches on the important practice of valuing Elders and traditions, saying,

"We're losing our relationship with our Elders, our knowledge keepers… it allows us to call out and honor and respect the histories, the histories of research, the histories of environmental injustice… the biggest thing is reconnecting and making sure that those ties are there while we still have Elders here."

The quote above introduces how storytelling also carries and teaches traditional practices, the third concept to emerge from quotes related to storytelling. Another participant shares,

"People taught through stories. And it wasn't so much discipline where we know it today, of spankings or whatever it is… you taught through storytelling. And so there was different stories to demonstrate what we wanted our children to do or not to do."

Moreover, other participants shared how storytelling was able to educate and share culturally important knowledge. As another individual puts it,

"Storytelling is one of my favorite ways to just share information, to transit from, to embody it, and to share it, just to bring our stories and our songs to life."

Bringing to life, revival, and longevity are all values that highlight the necessity of using storytelling in culture and education. To underline the importance of supporting cultural and scientific education through stories and storytellers, a participant urges,

"The biggest thing that brings power is education. Especially to people that are underrepresented. So to know your history and to respect that."

These quotes identify how education, cultural knowledge, and intergenerational connection to community are empowering and nourishing.

Reclaim, Revive, and Protect Indigenous Practices, and Set Them Into Action

Just as traditional Indigenous knowledge needs to be revived through intergenerational education, interview participants also called for bringing back cultural practices through teachings and actions. Yet once knowledge is recognized, many participants noted that it must be protected from misuse, misinterpretation, and intellectual theft. In one interview, a participant says,

"I can't talk with you about many issues because I need permission of the community."

Asking for permission and consent to share and use information was raised as an issue of high importance, especially in research contexts such as this project. On this topic, the same participant noted,

"Many people [say] only 'I want the information' and they don't [give] back the results of that investigation with their community. [They] keep the information."

Further, some non-Indigenous researchers may not see the complexity and cultural value of the information they seek to gain. As one participant puts it,

"People will contact me and just be like 'okay, what were the sacred plants, which were the things we should grow in our garden' or just to try and oversimplify. How do I tell people that all plants were sacred? They all had a relationship."

Another participant raised the concern of extractive and manipulative research, saying,

"I know as an Indigenous person and researcher that a lot of our communities have mistrust because of historically being taken advantage of. So I think any researcher could learn that there should be more community involved, always."

This quote introduces the critical consideration of involving the community and not taking information away from the individuals who are sharing their knowledge. Another individual spoke to the sensitivity they feel about sharing information. They said,

"I think it directly relates to being incredibly protective of what we nearly lost. In our case, the erasure of our culture and traditional practices, our sense of identity, our language, and our ways-of-being. As far as permission goes, that is really important. Ensure that the people you're speaking to and getting information from are comfortable sharing and being very aware of that. Additionally, some information simply will not be shared, because it is not meant to be shared."

This participant brings up the importance of permission, which became a recurrent theme throughout the interviews. Another participant adds,

"If you were in Indigenous spaces or trying to center Indigenous voices, then that information and that permission needs to come directly from the source. It needs to stay there and never move."

This quote included the importance of not extracting knowledge, rather, keeping it with the source of information. Amplifying and centering Indigenous voices, a key outcome of this project, also presented in several interviews. One individual notes,

"[This] is such deep emotional work because we lose a lot, we're not listened to a lot, we're not heard a lot. And so a lot of times it's going to be specific people who can be those in-between voices… Unfortunately it means that those who are the most quiet are not going to ever be heard, let alone listened to."

Not being listened to or heard is highlighted in the preceding quotes and in the interviews of several participants. Participants brought up that some community members are more separated from Western society and therefore less heard by outsiders. These individuals may also be protected by that separation, which prevents their knowledge from being taken or misused. Due to the historic exploitation of Indigenous information, understanding how and why

permission and information is protected in Indigenous communities is necessary for working with Indigenous people and working closely with Indigenous knowledge.

Participate in Practices that Contribute to Community Identity

For many of the individuals interviewed, being active and engaged in their communities and traditional practices was a core part of their described experiences. However, some participants described challenges they face in participating in cultural activities. As one individual said,

"I've seen that busyness of life. We can lose sight of practicing and upholding these values [towards the environment]."

Another participant similarly spoke of the need to revive the presence of traditional actions into daily life. They said,

"Maybe [Mother Earth] sent that pandemic to make us stop and realize that we're taking her so much for granted and that we need to start implementing some of these practices into everyday life."

Other participants described ways that they remember their traditions and history, and how that relates to community identity. One participant explains,

"If we don't know our ancestor's history, we can't be good in our present for us. So history, memory, are always important for us to be remembering…You know your identity, and [if] your grandparents did good things or bad things. You have the responsibility to improve, to be better."

This quote introduces the key principle of responsibility, which was a value brought up throughout the interviews. Another participant expands on the actions they take to support the community and culture. They say,

"I feel like my role on the earth, doing the research that I do, is how I uphold responsibility and accountability within the stewardship of Mother Earth."

Similarly, some participants noted that their work is directed by being able to contribute to and support the needs of their community and community members. One individual says,

"My own career that I've driven has been relational. It has come from a request. It has come from cultural protocol of when your Elder says something to you or you see your path or they give you sort of a guidebook on what's next for you. You meet that request, you figure it out."

This quote, and the quotes above, carry the interwoven message that supporting and upholding traditions is personally and communally important. Another participant adds,

"We want to support one another in maintaining our unique tribal traditions, and we're able to join in in whatever way is appropriate…We're able to really come together as a larger community and to be able to continue to support and maintain that knowledge and those relationships. In whatever way we can reach across these community divides and support one another to ensure we're all able to access that special relationship that we have and our understanding of the world around us. That definitely varies from tribe to tribe, depending on what folks have gone through. I think there's a real strong need and interest in maintaining those traditions… I think we're kind of in a renaissance period right now, actually over the last 20 years and still the case moving forwards, of being able to bring those practices into research settings in a way that is respectful and that is appropriate and that is with community input and oversight so that way we can maintain those traditions and also leverage them as a way to improve overall public health and population health."

This quote excellently summarizes the critical concepts of supporting one another, protecting traditions and knowledge so that they can be honored and shared, and using relationships to maintain community. Everyone who participated in an interview shared their practices and knowledge that they use to contribute to their personal and community identity.

4. Discussion:

The goal of this project is to learn from Indigenous leaders about Indigenous models, values, and practices that can be united and supported next to and within One Health practice. This effort aims to create reciprocal and sustainable collaboration that centers and uplifts Indigenous voices in cooperative partnerships with Western science. To achieve this goal, two

phases of interviews were conducted to explore important aspects of Indigenous knowledge systems and Indigenous communities that are missing or underrepresented, and therefore not supported by, Western science and research. The partners who participated in interviews highlighted Indigenous values of identity and belonging, holistic expression, contrast with Western culture, sharing information-education, power in action, and maintaining cultural and community practices. These categories represent areas in which Western scientists must improve in order to support Indigenous principles and people.

Due to the broad scope of topics that the participants brought up in their interviews, there was not strong between-category similarity. However, most of the codes and categories are related to the feelings participants held for their surroundings, or of the impact that one's surroundings have on their emotional, spiritual, and physical experience of the world. Within specific codes, participants had responses that were similarly aligned, though details varied by context and participant. It is of paramount importance to listen to the needs of Indigenous communities, and these categories represent ways in which the Western world must improve and adapt to make space for Indigenous Peoples and ways of knowing. The themes explored in this paper are expressed as actions that Western scientists and One Health practitioners can and should take to re-Indigenize science, support Indigenous ways of knowing including TEK, and amplify Indigenous voices. In summary, the actions that are thematically recommended include 1) acknowledging personal identity within one's work, 2) centering Indigenous science and scientists, 3) supporting storytelling as a way to share information and strengthen intergenerational relationships, 4) reviving, protecting, and acting on Indigenous practices, 5) respecting the reciprocal caretaking of the social and natural environments, and 6) contributing to identity within a community by partaking in and supporting cultural traditions. These directives

were created with the advisory group to specifically guide how Western scientists can start to fill the gaps that separate Indigenous and Western approaches.

This project commenced with a call to listen, unlearn, and learn. Then, a guiding question emerged: in what ways are Indigenous science and Western science similar and different? In another sense, what are the overlaps between One Health and TEK that can serve as connecting points or bridges, and what are gaps that represent the differences between the two knowledge systems? One Health is specifically evaluated as it is considered an area of Western science that shares core values with some Indigenous scientific practices, particularly related to TEK. Ideals brought up in the interviews that bridged One Health and TEK, such as connection to the environment, being part of a larger system, and supporting animals and plants, were less represented in the proposed themes because the themes call attention to Indigenous values that are missing or underrepresented in Western science. Thus, the action items provide improvements and adjustments that Western researchers can adopt to become better allies for Indigenous scientists. Values determined to be present in both TEK and One Health practice represent concepts that act as a bridge between the two knowledge systems. Similarly, identifying principles that are missing from One Health work allows One Health practitioners to assess how to best introduce, center, and build from these Indigenous values and connect to Indigenous scientists who work within, and next to, Western knowledge systems.

As mentioned in the introduction, some work has been started to investigate shared values amongst TEK and One Health practitioners. The Four R's—respect, relevance, reciprocity, and responsibility—have been introduced as Indigenous principles found in Western work and therefore represent points of connection and collaboration. Further, literature demonstrates that centering Indigenous values, such as the Four R's or those found in this paper,

in higher education and Western-educated spaces could lead to better work and education outcomes for students (Kirkness and Barnhardt, 1991). One specific effect is that empowering Indigenous science and scientists encourages Indigenous youth to pursue sciences. However, it is necessary to recognize that integrating Indigenous science into higher education is not just to retain Indigenous students, but also to provide Indigenous students with a better education that is more respectful, reciprocal, relevant, and responsible towards their identities (Kirkness and Barnhardt, 1991). Another outcome of this work is that operationalizing the values and themes that emerged from the interviews lays the groundwork for creating research and broader community settings that re-Indigenize the current Western-dominated landscape (Jacobs et al, 2022). Lastly, though these examples are not exhaustive, this project adds to the rapidly growing collection of projects that demonstrate the strength and success of Two-Eyed Seeing.

This project is motivated by the Two-Eyed Seeing approach which promotes the use of Indigenous and Western perspectives simultaneously to create a new way to look at a problem, solution, or situation. The rationale for using a Two-Eyed Seeing approach in this project is supported by the similarity between the definition of Two-Eyed Seeing and the aim of this project: to create new and reinforced perspectives by acknowledging and including the strengths of Indigenous ways of knowing in collaboration with the assets of Western knowledge systems (Martin, 2012). Through the Two-Eyed Seeing approach, TEK keepers can collaborate with One Health practitioners to produce work that upholds Indigenous values and models like the Four R's. The action items in the themes presented in this paper represent efforts that Western scientists need to undertake to be more respectful and intentional collaborators when working with Indigenous people. A final goal of this project is to synthesize Indigenous models, language, and principles into a consideration checklist that can be distributed to One Health, and

more broadly, (Western) scientific organizations and institutions across the United States. This consideration checklist will iterate how to center Indigenous science and TEK, how to use a Two-Eyed Seeing framework as well as other Indigenous frameworks in collaborations between two or more knowledge systems, and the action items that should be integrated into scientific and personal pursuits of Western researchers. A driver of this work is to conclude the consideration checklist with recommendations of how Western institutions and organizations could better cross-culturally connect and collaborate with Indigenous communities. This work is important because it ensures co-creation between Western and Indigenous scientists rather than co-opting TEK in One Health work.

5. Limitations:

There are limitations that have impacted this project. One limitation that has influenced every process in this work is that the primary author and members of the study team identify as non-Indigenous and cannot contribute lived experiences to this body of work. Indigenous researchers and university faculty were contacted to be a part of the study team, however there were few Indigenous university faculty that could be a part of the study team, and Indigenous researchers are often busy with personal work. To mitigate continuation of Western-trained researchers maintaining dominant voices within science, the Indigenous interview participants were involved in many steps throughout the progression of this project following their interview. The partners that were involved shared and leant their languages, experiences, knowledge systems, and relationships for the initiatives that this project seeks to benefit. Further, Indigenous partners also contributed towards the editing of this paper.

Several limitations affected which participants were included and therefore whose voices were able to be amplified. The sample population was restricted to individuals who had internet connection, email addresses, and were responsive to their emails. Additionally, phase 2 participants were referred or directly contacted which meant some of those who were recruited for this project had a relationship with a phase 1 interview partner or a member of the study team. Further, many of the individuals who were referred or recruited to be a part of this project identified themselves as being a cultural bridge, someone who straddles Indigenous life and worldviews as well as Western life and worldviews. This was also considered a strength of the project because individuals who are cultural bridges can bring in values, ideals, and experiences held by people of their community which are more protected from Western researchers. However, this still posed a limitation as the voices that are less likely to be heard or listened to could not be amplified.

The partners that were interviewed shared impactful stories, traditions, and teachings relevant to their communities, however it is critical to recognize the limitation that the individuals that were collaborated with cannot speak on behalf of the beliefs and experiences of everyone in their community or Indigenous group, and especially cannot speak to the perspectives of all Indigenous people across the continental United States (Turtle Island) and the Hawaiian Islands. It is not possible to capture and summarize diverse experiences and cultural perspectives developed over generations since time immemorial. Thus, the objective of this work is instead to be guided by the shared knowledge of the participants, while avoiding oversimplification, to create objectives for Western scientists. Finally, one limitation that impacted the scope, richness, and extent of information that was shared was due to the lack of time and resources available to build relationships with individuals and communities.

Throughout the interviews, participants shared testaments to the importance and power of relationships in Indigenous communities. However, with the limited time and resources available for the scope of this project, members of the study team were not able to devote necessary time towards fostering relationships, trust, respect, and reciprocity with partners who participated in interviews. Therefore, the extent to which information was extended, as well as the content that was shared, was likely impacted by the Indigenous-Westerner dynamic that was present in the interviews and relationships. Relationships and trust influence everyone in a unique way, and as such it is difficult to assess the ways in which lack of relationship development impacted this project.

6. Conclusion:

Through the process of meeting with Indigenous leaders, knowledge keepers, and scientists, study team members and participant-partners were able to identify both overlaps and gaps between TEK and the Indigenous knowledge systems it comes from, and One Health along with the Western knowledge systems it is tied to. Due to common core values in One Health and in TEK, the One Health approach exists as a point of connection to TEK which brings together Western and Indigenous sciences. The themes that were co-created by Western and Indigenous scientists represent accessible and immediate ways that Western scientists can uphold and practice Indigenous values without assimilating and appropriating Indigenous knowledge into Western dominated sciences. This is important because it can help Western researchers be better collaborators with Indigenous researchers, and it can make Western science more inclusive of other ways of knowing. Additionally, this initiative demonstrates the success of applying the Two-Eyed Seeing approach, as well as considering the Four R's, in a One Health research

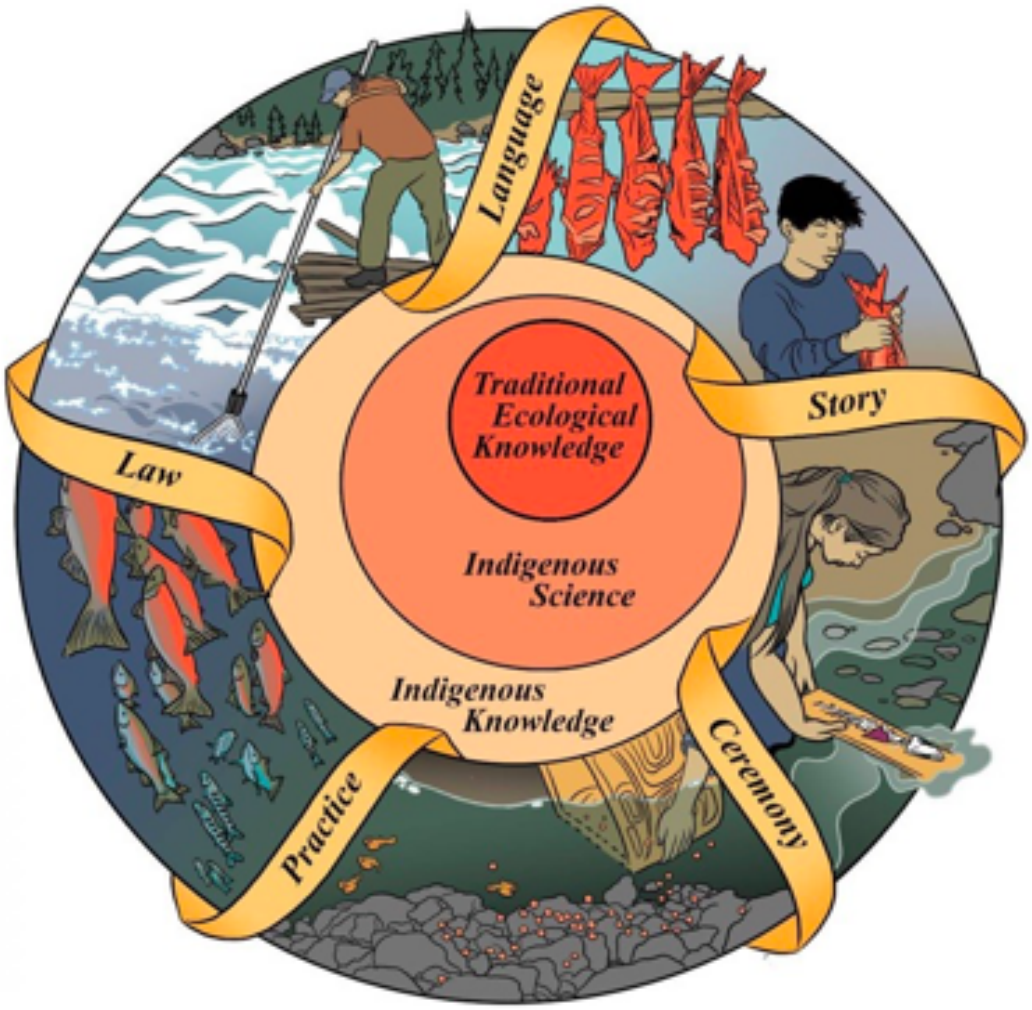
project because these Indigenous approaches facilitated a working and balanced partnership between Indigenous and Western researchers. In addition to the ideals and beliefs identified by partners during their interviews, this work highlighted the need to build relationships within scientific and social spaces. Finally, this paper serves as the first step in a process to educate Western scientists on One Health and Indigenous principles to introduce new, diverse perspectives into projects.

Acknowledgements

I'd like to acknowledge the 22 Indigenous leaders, knowledge keepers, and scientists who shared their voices, knowledge, experiences, and time with me and with this project.

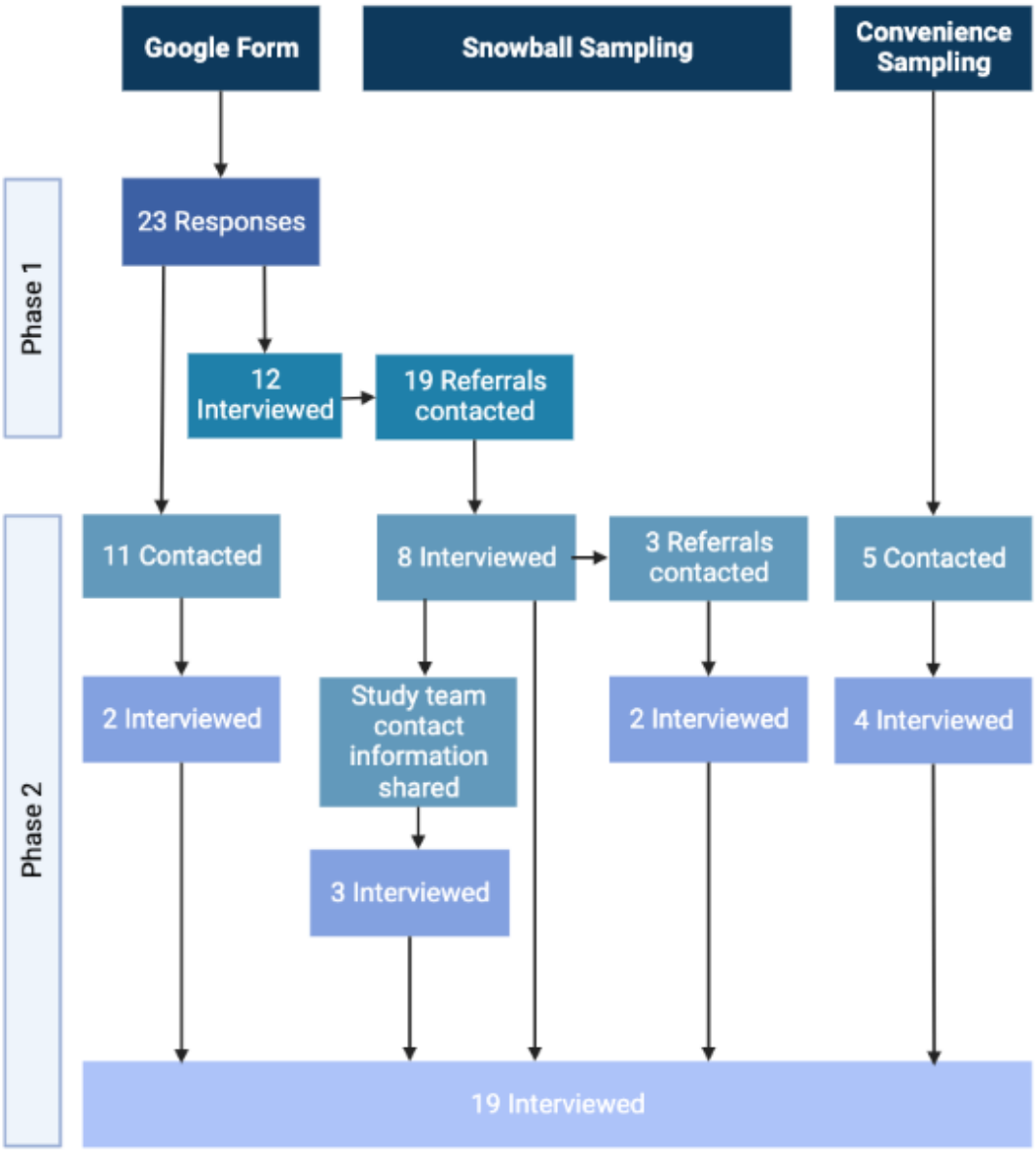
Appendix

A. Indigenous Knowledge, Indigenous Science, and Traditional Ecological Knowledge



Facebook. (2023). Facebook.com. https://www.facebook.com/IndigenousScie1/photos/a.123616776109213/2516289666641326/?type=3

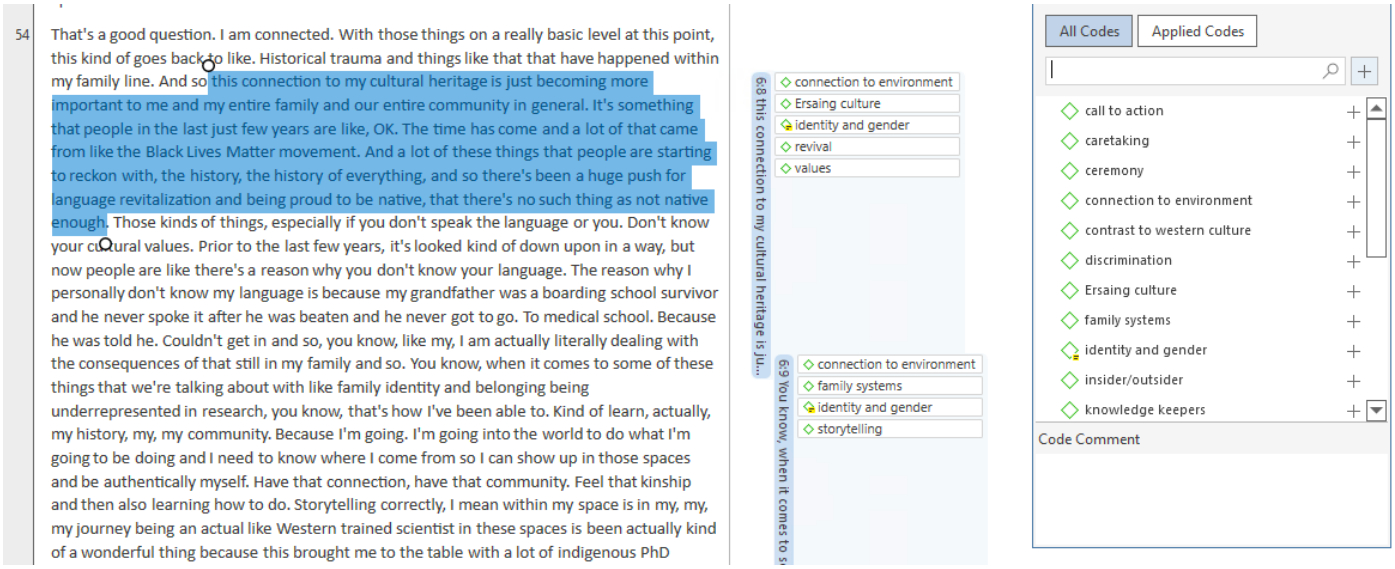
B. Recruitment Flowchart



C. Interview Guide

1. Working within the idea of One Health, I am interested in the connection and exchange of human, animal, and environmental health. I would like to learn about how you engage/take part in/connect with the natural world, your surroundings, and environmental stewardship.
2. Throughout our interviews, we have heard that stewardship is an example of practices and expressions that uphold values such as remembrance, identity, and honor. Can I learn about how you uphold responsibility, accountability, mutualism, and the values described above, towards other beings including the environment?
3. In our previous interviews, I learned that themes of family, identity, and belonging are underrepresented in research/ One Health. I would like to learn about your connection to cultural heritage, community, kinship, and/or storytelling.
4. To center Indigenous knowledge in One Health, One Health must align with Indigenous models and language. What can I learn from you about Indigenous information, permission, meaningfulness, and reflection?
5. We would like to make the results of this research available for communities. What channels and tools does your community use to introduce and share information? They may be physical such as a brochure, magazine, mail, in person conversation, or online like a forum, website, video, email list?

D. Photo of ATLAS.ti Example Coding Process



E. Codebook

	Code	Code Description	Notes	Inclusion/Exclusion Criteria
Identity and Belonging	Family system	Family identity, clan systems, and family structures within community	Family is specific and differentiated from social environment	Can include human or non-human relatives
	Gender and Identity	Roles that certain genders play, or social differences between genders. Also, mentions of identity, self perception, and/or reflections on self	Gender code was merged with identity after coding. Specific mention of 'identity' was not needed	
	Insider/Outsider	References of an individual or group not fitting into another group/social structure, or differences between two distinct groups.	Defined by the perspective of the speaker	Specific differences between Indigenous and Western identities may be categorized under "Contrast to western culture" code
Conflict with western world	Suppressing and erasing culture	Stories and descriptions of culture, practices, actions, language, and more being destroyed, censored, or discontinued	No quotes of this code will be used	Does not include codes that talk about differences/dominance of western ways
	Contrast to western culture	Indigenous values, practices, and ideas that differ or oppose that of the dominant/overpowering perspective.		Can also include ways western culture operates that differs from Indigenous ways
	Discrimination	Stories or details of experienced or implied discrimination	No quotes of this code will be used. Differs from storytelling based on content	
Storytelling information - Education	Storytelling	Mentions of the importance, value, and/or usage of storytelling (in education, communication, and more)	Some current quotes contain stories but do not refer to storytelling, and will be changed to be unlinked to the code	Discussion of storytelling was included. Stories that were told in interviews were not included.
	Knowledge Keepers	Elders, knowledge-keepers, leaders, ancestors, and other individuals (or groups) that hold knowledge and pass along important teachings	Though ancestors may not be around and involved in knowledge sharing, they are still are considered holders of knowledge and practices	Mentions of elders and ancestors were all included, but not all quotes included elders and ancestors
	Teaching youth	Describes the importance and encouragement of educating youth/younger generations	Some quotes say youth, some say now/current/modern generation, others infer youth	

	Code	Code Description	Notes	Inclusion/Exclusion Criteria
Power in Action	Call to Action	Encouragement or urge to speak, act, oppose, collaborate, educate, etc towards a goal or outcome	Some quotes provide specific actions to be taken and other amplify goals that need action to be taken	
	Revival	Description of actions that work to bring back engagement or practice in certain actions or values. Also includes topics that need revitalizing actions due to oppressive forces	Reinstating identity, culture, and practices; regrowth/repopulation of natural species; increase in practice, participation, or number	
	Protection	Explicit use of "protection" or references of guarding people, resources, practices, and other beings		Use of "protection" always included but not all quotes say protection
	Reclaiming	References taking back power, resources, land, and aspects of identity	Did not require specific word use. Also includes social and community movements. Some topics may overlap with revival but the action of taking back vs bringing back differ	
Holistic Expression	Caretaking	Descriptions of actions, emotions, movements, initiatives, and personal practices that care for, nourish, and support another entity	Mentions of "taking care" or "caretaking," but not necessarily stewardship	Use of "taking care" and "caretaking" always included but not all quotes say protection
	Connection to environment	Descriptions of relationships with one's' physical and social environment, and practices that foster relations	The quotes include a variety of actions, descriptions, stories, and sentiments that describe one's connections to their surroundings	
	Part of a bigger whole	References to a greater community, participation in a larger system, balance of the world, and humans being (equal) participants in greater ecosystem	May refer to being part of a greater unit, or the lack of separation between living beings in a larger system (ex. lack of hierarchy)	
	Oversimplification	References to generalizations or groupings that incorrectly or unnecessarily combine two separate groups/communities	Included when participants mention their observation of other people/groups (over)simplifying something	Does not include statements said by participants that may be defined as an oversimplification
Maintaining Community and Cultural Practices	Spiritual	Mentions of spirits or spirituality	Does not implicitly include ancestors, which may be categorized as knowledge keepers as well, depending on context. Could also be in the "holistic expression" category rather than the "maintaining community and cultural practices" category	Use of "spirit" always included but not all quotes say protection
	Ceremony	Descriptions of festivals, gatherings, ceremonious occasions, and intentional practices	Could describe celebratory and observance practices or occurrence of a ceremony for specific a purpose	
	Values	Descriptions of upholding specific cultural values, or mentions of values, practices, morals, and ideas that are important and defining to one's community and/or culture	Large umbrella category used when a personal, familial, or cultural value was referenced, encouraged, or questioned. Also used in some cases that described how values were integrated, upheld, or centered. Some examples include respect, reciprocity, mutualism, honor. May not have	

F. COREQ Checklist

Item	Guide questions/description	Included in text
Domain 1: Research team and reflexivity		
1. Interviewer/facilitator	Which author/s conducted the interviews or FGDs?	Introduction
2. Credentials	What were/are the researcher's credentials?	Introduction
3. Occupation	What was their occupation at the time of the study?	Introduction
4. Gender	Was the researcher male or female?	Introduction
5. Experience and training	What experience or training did the researcher have?	Introduction
6. Relationship with participants established	Was a relationship with participants established prior to study commencement?	Methods
7. Participant knowledge of the interviewer	What did the participants know about the researcher?	Methods
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator?	Introduction
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study?	Introduction
10. Sampling	How were participants or articles selected?	Methods
11. Method of approach	How were participants approached?	Methods

12. Sample size	How many participants or articles were in the study?	Methods
13. non-participation		Methods
14. Setting of data collection	Where was the data collected or what regions of articles are represented?	Methods
15. Presence of non---participants	Was anyone else present besides the participants and researchers?	Methods
16. Description of sample	What are the important characteristics of the sample?	Methods/Results
17. Interview guide or alternative data collection tool	Were examples from questions, prompts, guides provided by the authors?	Appendix
18. Repeat interviews	Were repeat interviews carried out, or were multiple articles from the same study reviewed?	Results
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods
20. Field notes	Were field notes made during and/or after the interview/FGD or article review?	Methods
21. Duration/Length	What was the duration of the interviews/FGDs or length of the articles?	Methods
22. Data saturation	Was data saturation discussed?	Methods
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	Methods

24. Number of data coders	How many coders helped code the data?	Methods
25. Description of the coding tree	Did authors provide a description of the coding tree (i.e: codebook)?	Appendix
26. Derivation of themes	Were codes/categories identified in advance (deductive) or derived from the data (inductive)?	Methods
27. Software	What software, if applicable, was used to manage the data?	Methods
28. Participant checking	Did, or will, participants or article authors provide feedback on the findings/results?	Methods
29. Quotations presented	Were participant quotations or article text presented to illustrate the themes/findings/results? Was each quotation identified?	Results
30. Data and findings consistent	Was there consistency between the data presented and the identified themes?	Discussion
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results/Discussion
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Results/Discussion

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