



Expanded Ethical Principles for Research Partnership and Transdisciplinary Natural Resource Management Science

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Abstract

Natural resource researchers have long recognized the value of working closely with the managers and communities who depend on, steward, and impact ecosystems. These partnerships take various forms, including co-production and transdisciplinary research approaches, which integrate multiple knowledges in the design and implementation of research objectives, questions, methods, and desired outputs or outcomes. These collaborations raise important methodological and ethical challenges, because partnering with non-scientists can have real-world risks for people and ecosystems. The social sciences and biomedical research studies offer a suite of conceptual tools that enhance the quality, ethical outcomes, and effectiveness of research partnerships. For example, the ethical guidelines and regulations for human subjects research, following the Belmont Principles, help prevent harm and promote respectful treatment of research participants. However, science–management partnerships require an expanded set of ethical concepts to better capture the challenges of working with individuals, communities, organizations, and their associated ecosystems, as partners, rather than research subjects. We draw from our experiences in collaborative teams, and build upon the existing work of natural resources, environmental health, conservation and ecology, social science, and humanities scholars, to develop an expanded framework for ethical research partnership. This includes four principles: (1) appropriate representation, (2) self-determination, (3) reciprocity, and (4) deference, and two cross-cutting themes: (1) applications to humans and non-human actors, and (2) acquiring appropriate research skills. This framework is meant to stimulate important conversations about expanding ethics training and skills for researchers in all career-stages to improve partnerships and transdisciplinary natural resources research.

Keywords Community · Indigenous data sovereignty · Reciprocity · Social science · Stakeholder engagement

Introduction

Partnership with land managers and natural resource-dependent communities is a longstanding tradition in the natural resource sciences. Natural resource systems are a

fertile space for transdisciplinary and collaborative science approaches because they are often managed as multi-functional systems, where managers seek to balance trade-offs for multiple goals and ecosystem services. Today, these partnerships are more important than ever, because

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management challenges unfold in rapidly changing and complex socio-ecological environments. One form of inquiry or knowing may be insufficient to understand and address complex problems (Briske et al. 2011). Researchers from multiple disciplines, practitioners, and local communities are increasingly working together in creative approaches to address ecosystem management, conservation, and agriculture production problems, and to understand the interrelated social, economic, cultural, and health dynamics of these issues (Meadow et al. 2015; Knapp et al. 2019; Reid et al. 2021). However, with the opportunities afforded by these partnerships come emergent challenges and risk, requiring a reconsideration of conventional research ethics. New conceptual tools are needed to enhance ethical practice in natural resource management and science partnerships. In this synthesis, we offer the natural resources science and management community an expanded framework for partnership and research ethics that accounts not just for studying people and ecosystems, but for working with them.

Generally, public participation in scientific research exists across a spectrum of partner involvement, researcher role, and resource needs (Biggs 1989; Shirk et al. 2012; Meadow et al. 2015), from contractual work, where scientists conduct an investigation and report results, to contribution, collaboration, co-creation, and, at the highest level of partnership, processes by which the public participates as colleagues. As reviewed by Knapp et al. (2019), engaged and transdisciplinary approaches have a long and diverse history across various fields and applications, including in sociology, development, agriculture, ecology, and most recently, conservation. Generally, transdisciplinary approaches are at the most inclusive, collegial end of the engagement spectrum, and seek to integrate multiple types of knowledge and actors in partnership. Transdisciplinary methods are action-oriented approaches to solving “wicked” socio-ecological problems, or the complex, uncertain challenges that include competing values and where no “finish line” appears in sight (Weber and Khademian 2008). Co-produced or transdisciplinary approaches that involve partners in project design, implementation, and reporting have gained attention from research organizations, communities, and public agencies. For example, the US Department of Agriculture Agricultural Research Service Long-Term Agroecosystem Research network and Climate Hubs, Department of the Interior Climate Adaptation Science Centers, and the National Oceanic and Atmospheric Administration-Regional Integrated Science and Assessments network have each worked to advance science–manager partnerships and co-produced science addressing economic, conservation, or climate adaptation questions.

Transdisciplinary research is variously defined, but generally moves beyond a western science tradition of focusing on separate, individual disciplines and instead

brings together perspectives from multiple people and groups, with differing disciplinary expertise, practical experiences, cultures, and epistemologies (i.e., ways of knowing). Transdisciplinary research is based on a democratic scientific practice of engaging multiple knowledges, through equitable and mutually respectful partnership for action, in the design and implementation of research objectives, questions, methods, and desired outputs or outcomes (Hadorn et al. 2008; Jahn et al. 2012; Mach et al. 2020; Norström et al. 2020). This paradigm of research engagement, including transdisciplinary approaches, raises important ethical questions about who gets to participate in these processes, how those processes are conducted, and how people’s contributions to research findings are used and shared. In this paper, we propose an ethical framework for natural resource-based partnerships and research that expands upon current practices and empowers the research community (ourselves included) to engage more effectively with community and policy partners, and with each other, to conduct more authentic, equitable, and just research.

To work in equitable and collaborative partnerships, researchers must expand our collective ethical understandings and practices. Our author team is comprised of researchers and outreach professionals from a variety of disciplines, including sociology, law, bioethics, climate adaptation science, Indigenous studies, environmental health, economics, social-ecological systems, and geography. We share the common experience of observing, in a number of transdisciplinary and partnership-based projects, a need for engagement with ethics frameworks from our areas of expertise as multiple disciplines and communities learn to work together in new spaces. Therefore, we propose an ethical framework that extends beyond traditional human subjects research ethics to address the unique processes and contexts of social-ecological research partnership and transdisciplinary research. We invite our colleagues to join us in an ongoing discussion of the following expanded set of ethical research principles for transdisciplinary research:

- Representation: mindfulness of how we represent other people and communities as well as non-human elements in our research.
- Self-determination: respect for inherent power and self-determination, as well as respect of Indigenous data sovereignty (IDSov).
- Reciprocity: maximizing benefits for collaborators and participants.
- Deference: respect for other knowledges and epistemologies, including those of our societal partners and collaborators from other disciplines.

We also explore two cross-cutting themes:

- Beyond-human sphere of interest and ethics: while our framework emerges from a human-subjects perspective, we explore how these principles apply beyond research with people to include various species, ecosystems, and landscapes.
- Acquiring skills as ethical practice: partnership and transdisciplinary approaches require that we undertake the hard work of expanding our skillsets to match the unique challenges of this type of research.

We will explore how each of these principles moves us toward the equitable research partnerships. These concepts are not rules, rather ideas researchers can use to better anticipate and think about complex ethical problems that are likely to arise in natural resource-based partnerships and transdisciplinary work. We seek to contribute to a rich conversation about ethics in ecology and conservation fields. This has recently included discussion of how human values drive monitoring and management priorities (Biermann and Mansfield 2014; Wallach et al. 2020), and conservation's relationship with human communities (Duffy et al. 2019). Researchers will benefit from embracing a "care-based ethics", which emphasizes attentiveness and responsibility in ethical decision making (Noddings 2013), and from willingly engaging in a wider community of ethical practice. Everyone, at every stage of the research process, can ask "Is this ethical?" and engage in attentive and responsible discussions of our underlying assumptions, values, and motivations in ways that respond to the complex problems and contexts of our transdisciplinary work (Vella et al. 2021). Our aim is to inspire engagement with new concepts and tools so that scholars of any career stage will feel capable of "doing the work" to build ethical partnership and research practice.

Background on Ethics in Social-ecological Research

Community-based social and ecological researchers have discussed ethical challenges for many years. Indigenous scholars and community-based health researchers, for example, have explored tensions between individual and community rights (Mikesell et al. 2013; Chief et al. 2016). Brittain et al. (2020) discussed the importance of ethical review processes when conducting research with people, given power dynamics and conflicts in values. David-Chavez and Gavin (2018) reviewed Indigenous community engagement in research relative to the benefits communities receive (or not) from such research. Foundational to past work have been the concepts of two-eyed seeing, i.e., the collaboration of Indigenous and western world views to advance problem solving (Bartlett et al. 2015), as well as ethical space, i.e., the abstract space between world views such as Indigenous and western science, wherein opportunities exist to negotiate new

possibilities (Poole 1972; Ermine 2000; Kimmerer, RW 2019). Finally, for the field of environmental social science, Martin (2020) discusses common shortcomings in research, including a lack of training in social science methods, lack of reference to literature, and inadequate reporting of results. What we take from these colleagues and build upon here is the importance of self-reflection in ethical transdisciplinary research, assessing current practices and finding ways to improve them as our awareness, context, and societal needs change.

Background on Human Subjects Ethics

Research involving human beings, whether as subjects, participants, or partners, requires us to consider how we treat people involved in it (Israel and Hay 2006). Most importantly, participants must suffer no harm. Furthermore, we must treat participants respectfully, or our research suffers when participants quit the project, stop being honest, and/or share their poor experiences with others. Michael Q. Patton summarizes the underlying principle this way: "A researcher's scientific observation is some person's real-life experience. Respect for the latter must precede respect for the former" (Patton 2015, p. 243).

Unfortunately, the history of research about humans is rife with examples of abuses which have left a legacy of mistrust and even outright hostility toward academics (Deloria 1969; Wilder 2013). Some of the most well-known cases of research abuses come from Nazi medical experiments during World War II. While these abuses are widely recognized, less well acknowledged is the continued influence of Nazi anatomical drawings in medical textbooks (Israel 1998). In the U.S., the Tuskegee Syphilis Study subjected African American men and their families to the disease without their consent, and withheld treatment from them (Jones 1993; Reverby 2009). More recently, Dr Therese Markow and her team from Arizona State University conducted research with the Havasupai Tribe in the southwestern U.S. Initially, upon the request of the Tribe, Dr Markow obtained informed consent from individuals to use their blood samples to study the diabetes epidemic afflicting the community. However, without consent, Dr Markow then reused and shared the blood samples for secondary research into migration, schizophrenia, and inbreeding. This unethical misuse of biological samples and data led to significant social, cultural, and spiritual harms for community members and resulted in civil litigation (Drabiak-Syed 2010).

Scholars have also portrayed Indigenous peoples and other groups in damaging and stereotypical ways (Deloria 1969; Lomawaima 2000; Estes 2019). Or, they may steal, appropriate and reveal protected community knowledge by making data publicly available about a location, species, or

geological feature. Even when researchers do not intend harm, they can inadvertently reveal information that is personal or private for an individual or community, especially if that information has not been collected and stored carefully. Oftentimes these harms go unaddressed.

Following the abuses of the Tuskegee Syphilis Study, the U.S. Congress passed the National Research Act (P.L. 93-384) in 1974, which created the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The Commission then wrote The Belmont Report in 1979, which identified a set of core principles for the protection of human subjects: Respect for Persons, Beneficence, and Justice. In 1991, the Federal Policy for the Protection of Human Subjects (aka The Common Rule) codified the Belmont principles in federal law and applied the law to (currently) 20 federal agencies (HHS Office of Human Research Protections 2016). Applying the Belmont principles in practice, through The Common Rule, means that researchers must gain informed consent from research participants, reveal any potential risks and benefits to participants, protect the privacy and confidentiality of participants, and ensure that participants are selected fairly and equitably. Although the Common Rule helps hold researchers to certain standards in their work with human research subjects, the origin of the Belmont principles was not a proactive recognition of the rights of people, rather a reaction to public exposure of misconduct. Many scientific disciplines have their own ethical principles. Setting clear standards for professional expectations is critically important to any research endeavor. However, the legal standards for research ethics are set by The Common Rule. To more effectively address the ongoing invisibility of harmful research practices, innovative mechanisms are needed for the protection and benefit of human research subjects (National Academies of Sciences, Engineering, and Medicine 2018), particularly for Indigenous Peoples.

Inadequacies of Human Subjects Ethics

Researchers who work at the intersection of western forms of scientific research and societal partners have been reconsidering the ethical standards outlined in the Belmont principles (and similar frameworks worldwide). For example, public health researchers have posed questions about the tension between protection of individuals at the (potential) expense of the community (Mikesell et al. 2013). Is infringement on individual rights acceptable when the rights of the community are at stake? What should health researchers do when evidence-based interventions are culturally problematic (Mikesell et al. 2013)? Indigenous scholars have frequently pointed out the power imbalances common to many research projects that seek to include

Indigenous knowledge (McGregor 2013) and thus the importance of researchers following protocols relevant to Indigenous project partners (Chief et al. 2016). Education researchers are reconsidering how to address ethics and consent when the researcher is embedded in the site of practice, such as a teacher undertaking research in their own classroom. How does this practice influence or affect informed consent? Does this practice alter a teacher's accountability to students (Campbell and Groundwater-Smith 2007)? Finally, action researchers have long discussed the role of research in democratic transformation grappling with the ways in which research can create social change versus adhere to western scientific notions of objectivity and distance (Brydon-Miller 2008).

We join a growing call to re-examine and redefine research ethics to better address collaborative, engaged, problem-based research now needed to find solutions to wicked socio-ecological problems (Cross et al. 2015). The Belmont principles are necessary, but insufficient, to support ethical research partnerships that involve multiple research disciplines; multiple societal partners, experiences, and knowledges; and humans' complex relationships to biophysical spaces (Cross et al. 2015). In this context of transdisciplinary research, we find the Belmont principles limited in a number of ways.

First, the Belmont principles are derived from a biomedical context and only address persons as research subjects. In contrast, transdisciplinary research occurs within culturally diverse research contexts and treats persons involved as equal partners in the research. The Belmont principles do emphasize the individual's right to choose whether to participate in research. However, they do not recognize non-academic researchers as partners who contribute or generate data, information, and knowledge that is their own. This weakness extends to the common assumption that research findings are the property of the research enterprise, failing to acknowledge community intellectual property rights or sovereign rights to control data. Because current ethics policies and practices provide minimal guidance once projects are approved, researchers are largely left on their own to negotiate ethical research and data practices (West-McGruer 2020).

Second, the Belmont principles include specific definitions of what constitutes human subjects research, yet not all social science (nor all interdisciplinary or transdisciplinary) science falls into this category, even if that research involves interacting with or gathering information from people. There are multiple situations in which a project is not covered by The Common Rule, but which do require ethical frameworks and guidelines to protect the rights of participants and partners (Doyle and Buckley 2017). For example, a transdisciplinary research team might engage with a societal partner because of their professional

expertise, which is not “human subjects research”, but the researchers should nonetheless exercise relevant ethical principles.

Third, the Belmont principles do not sufficiently prepare us for culturally diverse research contexts, in which outside researchers may fail to appropriately portray communities other than their own. The principles provide no guidance for researchers on the ethics of integrating diverse knowledges, epistemologies, and skills in ways that respect, protect, and preserve the integrity of each unique way of understanding and experiencing the physical and social world. For example, federal policy lists a number of vulnerable groups (e.g., pregnant women, prisoners, children, and Native Americans), yet considers such groups merely as aggregates of individuals, rather than acknowledging that each group may hold collective knowledge in addition to individuals’ knowledge (Saad 2018). This is particularly evident when considering the group “Native Americans”. Indigenous value systems seldom weigh the concerns of individuals directly against those of the collective. Rather, each individual is deemed to be an integral part of the collective with the implication that ethical decision making must address both individual and collective considerations (Buchanan 1993; Holder and Corn tassel 2002). Hence, in Indigenous settings, individual informed consent is necessary but insufficient for ethical research practice (Hudson 2009; Tsosie et al. 2019). In contrast, biomedical research often assesses benefits and risks in a manner that pits individual interests against the interests of “society” (Moore v. Regents of the University of California 1990), and furthermore fails to address collective rights and interests in research and data (Garrison et al. 2019).

Finally, the Belmont principles tend to passively consider the benefits of research. Human subjects do have the right to be told whether there may be direct benefits to them or broader society. However, the question of whether research should actively benefit participants is not clearly addressed. This leaves open the questions of what societal partners should expect to gain when they engage with researchers.

Current ethics regulatory processes are a baseline structure on which to build more complete ethical research practices and partnership. The existing principles and associated regulatory processes (e.g., institutional review boards, or IRBs) operate within research institutions that have largely failed to recognize and take direct actions to dismantle broader, intersecting systems of power (Hill Collins and Bilge 2020). We recognize that a rich discussion exists among the social sciences about the failure of IRBs to adequately regulate human subjects research, including concern that IRB processes can reinforce the hegemony (dominance) of positivism and exclude non-positivist methodologies (Heimer and Petty 2010). We



Fig. 1 An expanded set of ethical principles for transdisciplinary research practice

make no recommendations for increased human subjects research regulation in this paper, but expanded principles to the transdisciplinary research community to help us adapt to ever-changing research environments.

Expanded Ethical Principles

To address the shortfalls mentioned above, we offer four expansions to the necessary but insufficient Belmont principles, as well as two cross-cutting themes for partnership and transdisciplinary research (Fig. 1). We recognize that many natural resource-focused researchers may have little exposure to human subjects research ethics, and that some social scientists may also be constrained by ethical principles that reinforce the boundary between research and society, rather than question it. The following six additions are proposed in the spirit of building better research enterprises, in which multiple knowledges and experiences are included and valued as crucial components of potential solutions to wicked socio-ecological problems.

Representation

The first expanded principle involves the need for appropriate representation. Research involves representing people, places, species, ecosystems, and socio-ecological relationships. Doing research about someone or their environment will have real-life consequences for them, their community, and the ecosystems in which they live. Despite this, western scientific tradition presumes the right to study and write about the world around us, creating a tendency to ignore the ethical and real-life implications of

representation, as well as the value systems that shape the process (Mohanty 2003; Wallach et al. 2020). Representation of human voices is well discussed in the literature (Alcoff 1991). However, the discussion should also span representation of human communities living in relation to their ecological and geophysical systems. For example, Wallach et al. (2020) offer a critique of how human values shape which species are counted and which are excluded in biodiversity metrics. In a similar vein, Biermann and Mansfield (2014) critically evaluate conservation's use of concepts, like purity and diversity to distinguish among species, that rely on the same logic as socially constructed notions of human race. Researchers working across human and non-human communities must think carefully about representation by reflecting on the following: who we conduct (or do not conduct) research with, for, or on; how we conduct that research; and what we say about them (i.e., people, plants, animals, other life forms, or relationships among species and places).

An important concept within the discussion of representation is “orientalism”, which describes how European and American historians misrepresented, exoticized, othered, and appropriated the peoples and history of the West Asian world, and how this subsequently shaped realities, in ways that benefited the western world (Said 1978). Orientalism brings into focus how scholarship can create “The Other” as part of deliberate or subconscious oppression. This concept is often on display in environmental research about many ecosystems, from Amazonia to the Alaska National Wildlife Refuge, where orientalism has long been used to vilify, otherize, or erase local Indigenous and rural stewards of these places (Turner 1993; Cronon 1996; TallBear 2007; Norgaard 2014; Maezumi et al. 2018). Framing U.S. National Parks as “virgin” wilderness, for example, is hypocritical, given the U.S. government forcibly removed Indigenous peoples from those lands (Cronon 1996). Casting ecosystems as “pristine”, “uninhabited”, or “degraded wastelands”, or applying blanket policies such as fire suppression—while ignoring the larger historical, political, and economic context—creates a view of local peoples that can be leveraged to harm or exclude them in economic, cultural and spiritual ways (Turner 1993; Estes 2019; Norgaard 2014; Haycox 2020) often to the detriment of ecosystem function (Kimmerer and Lake 2001; Lake, Long 2014; Hoover et al. 2019).

Attention to ethical representation means considering how our findings bear out across various social contexts and material realities with implications for those we study and collaborate with, including “gatekeepers” (Alcoff 1991; Opie 1992; Tuhiwai Smith 2013; Sprague 2016). Gatekeepers are trusted partners we rely on for introductions, to vouch for a researcher's credibility, and to facilitate logistical details with local peoples. Researchers often forget that

gatekeepers put the hard-won trust of communities on the line when they introduce outsiders. Gatekeepers' roles in these communities often continue after our research concludes, leaving them to bear the long-term consequences of any negative effects from our research. We therefore have a responsibility to them to understand the history and cultural context of their communities and ecosystems, and to proactively consider how our actions and representations could lead unintentionally to harm.

For example, consider how creating, using, and publishing maps and studies that label people and communities as “vulnerable” or “at risk” has consequences for them. This issue is especially prominent in the climate adaptation literature, where narratives of vulnerability often portray people as living in static conditions, and lacking the capacity or agency to adapt (Bankoff 2001; Manzo 2010; Bettini 2013). This portrayal can reinforce and reproduce structural inequalities (Bettini 2013; Marino and Faas 2020) by ignoring the policies, actions, and ideas that create dynamic conditions of vulnerability, precarity, and dependent relationships (Dooling and Simon 2012). It can obscure the reality of dynamic social struggle and creative action, and perpetuate narratives of environmental determinism, victimization, and victim blaming, as well as saviorism.

Haalboom and Natcher (2012) argue that imposing the label of “vulnerable” on Arctic Indigenous communities has encouraged development of inappropriate policy interventions that reinforce uneven relationships of power and dependency between Indigenous communities and institutions of governance. One intervention involved plans to resettle a coastal Alaska Native community to urban areas. However, this plan did not consider community members' concerns about the effects on their social, linguistic, and cultural traditions (Haalboom and Natcher 2012). Policymakers marginalized the concerns of community members in the process of developing a resettlement plan “for” them. This harkens back to the “vulnerable populations” language in the Belmont Report, which fails in numerous ways to protect some populations from research-induced harm. As discussed above, the Belmont Principles reactively place some groups in the “vulnerable” category based on past research abuses without considering the implications of such a potentially pejorative label, yet fail to address the broader ethical issues communities may experience simply by being the subject of research studies.

As researchers, we have the privilege of entering and exiting our partners' world at will, but they inhabit that world, long before and after our research. We must therefore proactively contemplate, anticipate, and minimize any potential negative repercussions our research might have in their lives while we are there and after we leave.

Self-determination

In the context of research ethics, self-determination refers to the rights of communities, particularly Indigenous communities (who are sovereign peoples), to: (1) decide whether and how research is conducted within their territories and involving their citizens; (2) require collective consent (i.e., consent of the community) instead of just individual consent to participate in research activities; and (3) control data about the community, community knowledge, and the community's ecological relationship with its territory—a right referred to as IDSov. The concept of self-determination better allows transdisciplinary researchers to address limitations in the Belmont Principles and in most research regulations (Garrison et al. 2019), which otherwise consider only individual rights in research, fail to require community consent or protect collective privacy (Hudson 2009; Taitingfong et al. 2020), and fail to acknowledge or protect community intellectual property rights (Hudson et al. 2020).

The concepts of collective consent and intellectual property hold true for any community-based research partnership, but can be illustrated through the experiences of some Indigenous Peoples with western science practices. Historically plagued by data inequities and data exploitation, Indigenous Peoples have raised concerns about the need to integrate Indigenous knowledges and approaches into data practices and policies (Kukutai and Taylor 2016a, 2016b; Carroll et al. 2019; Garrison et al. 2019; Jackson et al. 2019; Kukutai and Cormack 2019; Rainie et al. 2019). These concerns have only grown as the volume and secondary use of data in research continue to increase. In light of these concerns, researchers need to have open, honest conversations with communities about consent and control of research data and products as well as associated representation issues (Chief et al. 2016).

Rights to self-determination in research contexts can be (and in some cases have been) addressed through community consent procedures, such as tribal research review boards and the integration of IDSov practices into research involving Indigenous Peoples. Some research institutions have formalized requirements for gaining consent from tribal governments prior to starting research. The University of Arizona, for example, requires researchers to provide documentation of Native Nation approval—demonstrating free, prior, and informed consent—before research activities can begin (Native People's Technical Assistance Office, University of Arizona 2012). IDSov draws on the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which reaffirms the rights of Indigenous Peoples to control data about their lands, resources, and people (particularly Article 31) (United Nations 2007; Davis 2016; Kukutai and Taylor 2016b; Snipp 2016). At an international

level, these rights are elucidated in legal documents such as the Nagoya Protocol to the Convention on Biological Diversity (Articles 7 and 12 require involvement and consent of Indigenous Peoples as collectives on matters of traditional knowledge and genetic resources) (United Nations 2009), and in the work of the UN Special Rapporteur on the right to privacy, which acknowledges IDSov in the context of health data (United Nations 2018, 2019).

IDSov and UNDRIP are grounded in Indigenous sovereignty and self-determination, so they shift the discussion about ethical research from minimizing the inevitable costs of scientific progress to rights-based relationships between research entities and Indigenous Peoples grounded in benefit and power sharing (Hudson et al. 2020). This rights-based framework facilitates more equitable terms of engagement, in this case related to data ownership, control, and use (Carroll et al. 2019). It also offers insights for other marginalized populations, minority groups, distinctive communities, or collectives who want to maintain high levels of accountability and trust in the use of data about their communities (Rainie et al. 2019). For example, it provides a framework for addressing deeper historical issues associated with barriers for underrepresented communities and knowledge systems in research environments (Rainie et al. 2019). Many researchers and institutions have adopted the “FAIR Principles” for making data more findable, accessible, interoperable, and reusable (Wilkinson et al. 2016), but in combination with the “CARE Principles for Indigenous Data Governance”—Collective benefit, authority to control, responsibility, and ethics (Research Data Alliance International Indigenous Data Sovereignty Interest Group 2019; Carroll et al. 2020)—researchers can center equity and ethics as core guiding principles for collecting, requesting, acquiring, using, or reusing data about individuals and collectives.

In summary, the concept of self-determination—is illustrated by IDSov, UNDRIP, and the CARE Principles—is critical for ethical engagement in transdisciplinary research where conventional research ethics otherwise fail to offer tools for meaningful, respectful, and equitable engagement with communities. Modern ethical theories are typically concerned with the rational defensibility of the actions of a moral agent (e.g., a researcher) in relation to other moral beings (e.g., research participants). The Belmont principles provide an example with their foundation in respect for participants, beneficence/non-maleficence toward participants, and justice in selecting participants. However, self-determination expands the terms of engagement by affirming the inevitably collective and legal aspects (i.e., sovereignty) of research in Indigenous communities. This expansion fosters partnership and equity by curbing the tendency to view research ethics as a mechanical application and balancing of principles by

moral agents. Rather, the expansion requires researchers to incorporate the community's collective rights and priorities in assessing the ethical nature of their projects—even when such projects survive a rigorous application of mainstream ethics principles.

Reciprocity

Research should not be an extractive activity, or only serve as a validation of science (Yeh 2016; Klenk et al. 2017). Reciprocity is a critical feature of ethical research (Tuhiwai Smith 2013; David-Chavez and Gavin 2018), and involves an ongoing exchange throughout the research process in which participants receive some benefit for participating in the work or sharing their experiences. Reciprocity can occur along a continuum from an interpersonal act (e.g., a researcher sharing her own experiences during an interview in order to connect with a research participant); to generating tangible outputs or findings from the research that benefit participants in some way (Maiter et al. 2008); to conducting research that directly alters the distribution of resources, power, or opportunities in the interest of greater social equity (Harrison et al. 2001; Shore 2006; Brydon-Miller 2008). Here we focus on ensuring tangible benefits to societal partners through the research process or findings. This involves consideration and attentiveness to the question of “Who benefits and how?” from research processes and products, and to what extent products are available to partners, colleagues, and participants.

The concept of reciprocity helps ensure that direct benefits from the research process are shared equitably among the researchers and our societal partners. We define equitable benefits to mean that each participant is able to take something directly useful to them from the project. Shared authorship—while certainly a noteworthy hallmark of transdisciplinary research—is not an act of equity if the societal partner is unlikely to gain similar career advancement or enhancement benefits from the publication as the researcher. Applying the principle of reciprocity means committing to research outputs and outcomes that meet societal partners' needs. Lomawaima (2000) provides an excellent list of suggestions, beyond coauthorship, to consider when planning an ethical research partnership: shared royalties; data that is useful to partner agencies; “expert witness” testimony or other legal assistance; reproduction of historic photos or documents from distant archives; training and employment for community members; mentoring of community students; development of educational curriculum or classroom materials; publication of community language texts; or improved medical procedures or treatments. Researchers can build reciprocity into our work in forms and practices that best match the context and needs of our collaborators.

Deference

Deference refers to an awareness and respect for expertise, methods, and different epistemologies (i.e., other justifications for knowledge, such as subjectivism, constructionism, objectivism, or local or Traditional knowledges) among your academic colleagues and societal partners (Moon and Blackman 2014). As researchers, we can practice deference by engaging in critical scholarship—i.e., critiquing the objectivity of science and recognizing the influence of historical and socio-political contexts on its subjectivity (Bauder and Engel-DiMauro 2008)—as well as by building our vocabulary about transdisciplinary methods (Kuhn 2012; Moon and Blackman 2014). Deference requires an awareness of the state of knowledge in fields other than your own, and the humility to know that awareness is not a substitute for having a disciplinary expert on your team.

Deference requires a willingness to trust, respect, and incorporate (rather than appropriate) others' expertise, experiences, and ways of knowing. The humility involved in practicing deference enables us to step aside, yield some level of control, and commit to listening to colleagues, community members, and collaborators from different disciplines. The practice of deference is essential for successful transdisciplinary research (Porensky *In press*), helping to build stronger teams, findings, and outcomes.

Building a research team's commitment to deference takes planning, trust, and patience. Transdisciplinary collaborators should collectively evaluate the epistemologies they bring to the table. This involves first defining each discipline's knowledge structure by examining its origins, limits of knowledge, and methods, including available techniques, variables and analyses. Next, teams should identify potential challenges, including absence of knowledge, absence of data, or mis-match of scale or precision among disciplines and in the research context. Finally, they identify and implement strategies to cope with identified challenges, including modifying research protocols in terms of the precision or dimensional scales of the project, or they may even eliminate a discipline from the proposed team (Benda et al. 2002). Acknowledging the limits of knowledge or knowledge validation approaches in one's discipline is antithetical to most western scientific training.

Researchers can take concrete steps to enhance the practice of deference within their transdisciplinary research teams. Experts studying these processes suggest that team members communicate openly and thoroughly at the onset of a project and become comfortable with not having all the answers (Eigenbrode et al. 2007). Partners and researchers must also know and be willing to admit the nature, advantages, disadvantages, and limits of the methods and truth-claims made by their own disciplines and their collaborators' disciplines (Repko and Szostak 2020). This may

feel like an “unwiring” of our previous western scientific training followed by a “re-wiring” of our way of thinking about knowledges, achieved through sharing, listening, learning, and mutual trust, respect, and deference.

Given the variety of epistemologies involved in transdisciplinary research teams, some differences among team members may not be resolved (Wilmer et al. 2018). Yet, successful team integration is not necessarily measured by the degree of fusion. Transdisciplinary research only requires individuals to make room for alternative ways of structuring and validating knowledge, and be willing to assess their own epistemic values, relative to and without imposing them on others.

Cross-Cutting Themes

In addition to the four expanded principles above there are two cross-cutting themes that inform ethical transdisciplinary research in the natural resource science and management realm: (a) the application of our expanded ethics framework beyond humans to other life forms, and (b) a set of key research skills required to advance ethical transdisciplinary scholarship.

Beyond-human sphere of interest and ethics

A large focus of our framework is to offer tools for scientists to ethically partner with other people. However, these the expanded ethical principles are meant to be applied holistically across scales, actors, and processes of socio-ecological systems, and can offer new tools for human-nature relationships in the conservation realm. This includes research on (and with) livestock, plants, wildlife, and other lifeforms at individual, ecosystem, and landscape scales. In the US, public law, regulation, and interpretive rules provide oversight of animal care, use, handling, and euthanasia, if needed, in veterinary medicine, animal and wildlife sciences (USDA-APHIS 2021; National Research Council Committee for the Update of the Guide for the Use and Care of Laboratory Animals 2011). For transdisciplinary researchers, the expanded principles we propose are intended to stimulate conversation about the agency and sentience of beyond-human actors and their communities, and how they are connected to human community well-being.

Regarding the concept of representation, biophysical scientists increasingly understand that the narratives they construct about systems and outcomes have real consequences for management, and that the institutions and fields they belong to have enabled ongoing settler colonial projects with violent consequences for non-human and human communities alike (Adams and Mulligan 2003; Woods 2017; Mildener 2019; Brinkley 2020; Lee and Ahtone 2020). Indigenous scholars and activists have been

making these points for decades (Estes 2019). One recent, encouraging example of this shift in thinking is that some grassland ecologists now challenge the settler colonial perspective of managing for “pristine” or “historical climax” vegetation, arguing instead for restoration processes such as fire and herbivory (of varying levels) to achieve heterogenous landscapes that promote biodiversity conservation (Fuhlendorf et al. 2006).

Regarding self-determination for beyond-human actors, this concept informs natural resource management research by encouraging respect for interrelated lifeways, and livelihoods, traditions and knowledges that are co-developed and communal with species and ecosystems (Cajete 2000; Haraway 2013; Kohn 2013; LaDuke 2017). Reciprocity for beyond-human actors links research practice to an ethic of care and mutual benefit for the land, water, animals, and ecosystems. Many partners already prioritize this way of relating to our environment in their management and stewardship roles (Kimmerer 2013; Wilmer et al. 2019), as do restoration ecologists in their work toward long-term ecosystem recovery (Young 2000).

Finally, the concept of deference is most needed and perhaps most challenging to practice when a research team’s discussions turn to the topic of beyond-human actors, and their agency and sentience. Various social science disciplines can bring research teams a suite of transdisciplinary methods for respectful engagement with humans and non-humans, including deference to non-western knowledges and the experiences of working-lands partners (e.g., Manfredo et al. 2017; Ives and Fischer 2017; Hintzen et al. 2020).

Acquiring skills as ethical practice

Constructing an ethical process for engaged research and partnership is complex. We owe it to our colleagues, societal partners, and the species we study to do the best, most ethical work possible. This requires a set of skills and proper resources that might be different from those developed in standard academic research programs (Rozance et al. 2020). We outline project leadership, methodological skills, engaged citation, reflexivity, and listing as core skills for ethical transdisciplinary research.

Partnership and transdisciplinary research can be management-intensive endeavors, and thus require adequate team leadership, planning, and communication skills from lead researchers and team members—on top of their already packed schedules and multiple responsibilities. Ethical partnership also requires adequate resources to facilitate and coordinate diverse teams over long distances and periods of time. Transdisciplinary research often requires scientists to use methodologies new to them to engage societal partners in the research planning process, to obtain individual and

community permission to collect data, and ultimately to co-develop useful outputs or conduct outreach in complex socio-ecological contexts. This can be a non-linear and emotionally challenging process, where existing power dynamics and emergent challenges may be amplified by more intense team dynamics. Doing transdisciplinary research ethically, so as to not waste funding, time, and social capital, requires doing extensive amounts of planning, as well as creativity, patience, and long-term investment in the development of trust and team culture (Ulibarri et al. 2019). This often requires training and experience in facilitation, mentoring, conflict resolution, and non-technical communication, as well as cultural competence (Allegretti et al. 2015; Djenontin and Meadow 2018; Rozance et al. 2020).

Furthermore, the traditional structure of research in academia often leaves graduate and early-career researchers, those with the least amount of research experience, on the front lines of ethical decision making, with much at stake. Luckily, a large body of research on the “science of team-science” and project planning is available for the willing learner, especially from the field of medicine (National Research Council 2015). In many institutions, organizations exist to bring this expertise and research to large research teams. The US Geological Survey’s Social and Economic Analysis branch, and Colorado State University’s Institute for Research in the Social Sciences are two examples of public organizations that collaborate with teams to improve skills, knowledge, methods, and evaluation related to team and social sciences. And, graduate and post-doctoral programs and multi-disciplinary research projects are increasingly recognizing the value of leadership and science management skills development and integrating these into grants and project timelines (Bosque-Pérez et al. 2016). These skills are critical for conducting and managing ethical research.

In cases where we work directly with people and ask them to share their lived experiences and knowledges with us, perhaps through interviews or focus groups, we must have appropriate methodological skills to avoid emotional or psychological harm to interviewees (Shore 2006). Qualitative data collection takes specialized training and practice to gather properly (Mackewn 2008). Key to data integrity avoiding leading questions or inserting your own agenda, passing personal judgment, or asking irrelevant or intrusive questions. If a transdisciplinary team does not include people with such skills, we put our societal partners at risk, as well as our reputations as ethical research partners.

A significant barrier to producing high-quality social-ecological research has been the omission of social science research from biophysical science literature reviews, when a wealth of relevant social science is readily available (Martin

2020). To ensure that our awakening to and presumed-novel integration of social science techniques into ecological research is not repeating existing social science studies, we must explore the full range of previous, relevant social science research so as to refine our questions and approach. For these reasons, we as transdisciplinary scholars must individually commit to reading more widely across each other’s disciplines, engaging with, employing, and citing the ideas of critical scholars, especially those from traditionally marginalized communities and oppressed groups in a fully engaged citation practice (see: #CiteBlackWomen, Smith et al. 2020). Many scholars have thought carefully about the concepts of representation, self-determination, reciprocity, and deference for many decades and have developed methods to enhance accountability, and to disrupt and reorient, rather than reproduce, social inequalities (Tuhiwai Smith 2013; Sprague 2016). For example, a growing literature has shed light on inequalities in drought relief and conservation funding for agriculturalists of color in the U.S., and resulting agroecological and environmental justice consequences (Álvarez-Berríos et al. 2018; Fagundes et al. 2019; Waddell 2019).

The critique raised in the previous paragraph highlights a need in natural resource management research to reflect upon our own motivations, biases, and even emotional experiences as scholars (Bourdieu 1992; Patton 2015; Townsend and Cushion 2020). This practice of reflexivity—conducting systematic and in-depth self-reflection as scholars—was developed in qualitative research, but is broadly applicable (Brittain et al. 2020). Reflexivity recognizes that research and knowledge are socially situated and shaped by the structures, historical contexts, individual biases, and cultural meaning of those involved (Haraway 1988). While researchers are carefully trained to ask if a study design is capable of testing our hypotheses, we are not typically trained to ask what justifies our study in the first place (Said 1978) and how our identities shape our methodological decisions. Such reflection challenges us to dig deeper into our motivations as researchers and the relation of our work and selves to broader social structures, assumptions, and outcomes.

Related to the skill of reflexivity is listening. Respectful, responsive listening refers both to how we listen and to whom. Listening involves developing personal and professional habits, research protocols, workshop agendas, and other mechanisms that create time and space for multiple voices, and to engage with these in a sincere, meaningful way. First and foremost, the how of listening means not talking. Western scientists are trained to be experts and are brought up in an academic culture that rewards taking charge, speaking up, being assertive, and offering expertise. This training is unhelpful when the task is to listen to and understand the experiences of others, which requires

empathy, emotional intelligence (Ulibarri et al. 2019), humility (Porensky [In press](#)), and ultimately, some silence. The act of listening is a powerful tool for building our awareness of ethical issues around power and risk.

The development of new skills can be a difficult and frustrating process—in sharp contrast to the romanticized depiction of knowledge-integration as beautifully braided, multicolored strands of expertise or perspectives leading to transformational change (Tengö et al. 2014). In reality, the process is much more challenging, and often involves conflict and non-linear progress (Fernández-Giménez et al. 2019). Even among well-intended and managed teams, each “strand” of knowledge is rarely valued equally—by society, funders, reviewers, or even individual team members. Skills development requires a shared commitment by team members to struggle and grow, to learn new vocabulary, and to read new and unfamiliar writing styles, methods, and traditions—all of which may challenge our deeply entrenched views of science and our place in the world. In the process of developing these skills together, transdisciplinary teams can create their own culture of self-improvement. This might not occur, however, if performance indicators for researchers do not incentivize mastery of these skills.

Conclusions

The ways we conduct natural resource research is changing rapidly to respond to complex, dynamic problems in social-ecological systems. As our methods change, so must our research ethics frameworks. Increasingly, engaged research partnerships and transdisciplinary research holds great promise for communities and scientists seeking to address highly complex, dynamic, and challenging food production, conservation, and social problems. The collaborative approach it envisions requires researchers to consider expanded ethical principles to better account for the processes and outcomes of working with individuals, communities, organizations, and associated ecosystems as partners. Building upon existing literature from across disciplines, we have offered four expanded principles and two cross-cutting themes to enhance ethical practice in transdisciplinary social-ecological research. These principles are: representation, self-determination, reciprocity, and deference. These principles are enhanced by a cross-cutting understanding of beyond-human actors and a commitment to acquire necessary research skills.

However, we recognize that many of the barriers to achieving these enhanced ethical principles are structural. Although institutions and funders increasingly incentivize transdisciplinary approaches to wicked socio-ecological problems, opportunities for such work emerge within an already competitive funding environment. Collaboration

alone will not attract more resources to conduct transdisciplinary projects in effective, ethical ways (Elliott-Engel 2018). Without adequate support for the complex, non-linear, and challenging processes, skillsets, and non-traditional products involved in transdisciplinary research, projects will continue to reflect, rather than dismantle, existing inequalities in the research enterprise and institutions.

In our efforts to synthesize these concepts, we sought to highlight compelling ideas and conceptual tools—from the many who have addressed this topic before us (Tuihawai Smith 2013; David-Chavez and Gavin 2018; Martin 2020; Brittain et al. 2020; Reed et al. 2020)—with the goal of advancing the conversation about ethical partnership. We hope this conversation inspires researchers to commit to the hard work of expanding and using their skillsets, resulting in more ethical and successful partnerships, knowledge generation, and natural resource management practice. The conversation speaks to a variety of research and practitioner communities, by offering tools for achieving more respectful, responsive, and productive research. We can all do more to challenge ourselves—through continual self-reflection, enhanced awareness, and active skills-building—to conduct more ethical research within the fascinatingly complex socio-ecological systems we study, inhabit, and affect.

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Compliance with Ethical Standards

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