Indigenous Peoples and Climate Scientists: Assessing Knowledge, Power, and Practices in Collaborative Climate Change Networks

by

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DEDICATION

Dedicated to family: my mother, father, sister, brother, nieces, nephews, good friends, and animals. To all our relations—past, present, and future.

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ABSTRACT

Indigenous peoples concerned about climate change have sought collaborative partnerships to address disproportionate impacts, and support their adaptations to environmental change. One emerging approach involves collaborative networks formed directly with climate scientists. Collaborations are often assumed to bring benefits, yet they also carry challenges and risks. There is a need to better understand how these environmental networks address issues of concern to Indigenous peoples. Employing a framework from Indigenous environmental justice studies and a mixed-methods social network approach, this dissertation analyzes dynamics of collaboration in US climate change boundary organizations along three lines of inquiry.

The first paper assesses not only knowledge transfers frequently found in climate change networks, but also integrated decision-making, policy, and place-based climate adaptation partnerships in a national scale case study organization formed specifically to bring together Indigenous peoples and climate scientists. Through measurements of relational ties and network structures, results indicate the network supported climate knowledge transfers. Types of collaboration well attuned to transfers of power such as joint decision-making and advocacy were minimally present. Though critical to strengthen Indigenous peoples' climate change capabilities, place-based climate adaptation partnerships between participants in the network were scarce.

The second paper asks: how do central actors in the cross-cultural organization represent intersections of race, ethnicity, indigeneity, gender, and age? Climate change collaborations run the risk of reproducing some forms of inequality while challenging others due to interconnections between colonialism, racism, and patriarchy. This study analyzes central actors based on relational ties between participants and organizational leadership. In both cases, Indigenous women and youth were underrepresented in central roles. White women and elder Indigenous men held most central positions. However, Indigenous women consistently served as bridges between otherwise unconnected participants, and provided less visible labor to support the network. These did not translate to decision-making roles.

The third paper investigates how bringing together Indigenous peoples' and climate scientists' knowledges and practices carry benefits and risks for Indigenous collectives. It analyzes participant perspectives in the case study network, and organizational practices of eight climate change boundary organizations. A majority of collaboration members identified simultaneous high benefits and high risks to Indigenous peoples when sharing their knowledges with climate scientists. A noted minority was less convinced of the benefits involved. This paper reveals a wide range of approaches by boundary organizations at the intersection of multiple knowledge and practice systems. It found greater benefits and reduced risks when Indigenous peoples were among core governance positions in collaborative endeavors.

Overall, this research demonstrates how climate change boundary organizations variously resisted and reproduced socio-ecological injustices. The dissertation contributes to debates about how to assess environmental collaborations, and broadens conceptions that bring together climate science, climate justice, and adaptation to environmental change. Key recommendations call for climate change boundary organizations to deepen advocacy and place-based climate adaptation actions that benefit Indigenous peoples, and to ensure Indigenous participants—including diverse members such as Indigenous women and youth—are among central governance roles.

CHAPTER 1

Introduction

Indigenous peoples are concerned about and greatly affected by climate change, while minimally contributing to its causes (Burkett 2009; Abate and Warner 2014a).[1] As a result, Indigenous collectives have sought collaborative partnerships to address disproportionate impacts and support their adaptations to environmental change. In the US, a growing set of networks bring together Indigenous peoples and climate scientists for this purpose. Yet cross-cultural collaborations carry challenges and risks, and may not benefit all parties (Nadasdy 1999; Whyte 2013b; Coombes 2012; Richmond et al. 2013; CTKW 2014). Broadly, this dissertation seeks to understand how climate change networks address injustices of concern to Indigenous peoples. Using a framework from Indigenous political theory and environmental justice, the work analyzes dynamics of collaboration in US climate change organizations that bring together Indigenous peoples and climate scientists. Employing a mixed methods social network approach, I assess knowledge, power, and practices in recent collaborative boundary organizations.

Few empirical studies investigate climate change boundary organizations in light of political and ethical issues that emerge in critical scholarship, even less addressing contentious cross-cultural concerns. Studies have looked at their role to support transfers of climate

[1] I utilize a definition of Indigenous peoples as pre-invasion inhabitants of lands now dominated by nation-states (Anaya 1996), who continue to exercise political and cultural self-determination, and derive their identities in part from the landscapes that give them distinct cultures (Wildcat 2009). This includes a diverse range of groups such as federally recognized tribes in the US, Indigenous peoples forcibly removed from lands, and others not formally acknowledged as sovereigns.

knowledge, co-production of knowledge, and support for decision-makers at various scales (Parris et al. 2016). The boundaries in focus often include those between climate scientists and elected leaders, municipal staff, or non-governmental organizations (NGOs). Concerns of diverse Indigenous populations such as self-determination, sovereignty, and good living on ancestral lands infrequently come into play in climate change adaptation fields (Grossman and Parker 2012; Marino 2012; Cameron 2012; Whyte 2013b; Williams and Hardison 2013). Very active in climate change arenas, many Indigenous peoples have much to contribute and gain from collaborative processes (Bennett et al. 2014; Chief et al. 2014; Whyte 2014, 2016). However, little empirical research has addressed the workings of cross-cultural climate change networks with focus on the benefits and risks involved in these collaborations (Coombes 2012).

This dissertation employs social network and qualitative methods to measure actual collaborative ties between participants, instead of relying on organizational intents to understand partnership processes. It fills a gap on how to assess climate change boundary organizations, including questions about who holds leadership roles and makes decisions in cross-cultural endeavors. Few studies have taken up social network approaches in the areas of climate change, environmental justice, or Indigenous studies. Thus far, empirical social network studies have not combined these important areas of concern. This study also draws from Native feminisms, intersectionality, and science studies where these supplement theoretical, methodological, or explanatory contributions.

Broadly, this dissertation asks: how are US climate change boundary organizations addressing key issues that arise in Indigenous studies and environmental justice fields? Three papers explore this question. First, in a national scale network formed specifically to bring together Indigenous peoples and climate scientists, I measure relational ties between participants

and network structures for various types of collaboration, including those that signal sharing of power relations. Second, I evaluate central actors in this boundary organization to assess leadership representation across intersections of race, ethnicity, indigeneity, gender, and age. Third, I analyze participant perspectives on the benefits and risks of knowledge sharing, and the relationship between Indigenous knowledges and climate science. The third paper also studies how eight boundary organizations engage diverse knowledges and practices. Overall, I show how climate change boundary organizations variously reproduced and resisted injustices highlighted by Indigenous environmental scholarship. Assessing dynamics of knowledge, power, and practices in cross-cultural networks between Indigenous peoples and climate scientists revealed implications of these collaborations for environmental science reforms, and for Indigenous peoples' self-determination, governance, and climate adaptation capabilities.

This introductory chapter next provides a brief overview of background literatures in two areas. The first offers context around Indigenous peoples' actions and obstacles related to climate change. The second section outlines literatures on the politics and ethics of collaborative climate change networks between Indigenous peoples and climate scientists. I follow the introductory literature with overviews of the climate change boundary organizations, methodological approach, and the three dissertation papers. The next three chapters each contain a dissertation paper with its own literature review, methods, research results, discussion, and conclusions. The final chapter of the dissertation brings together overall conclusions, recommendations, and contributions.

Indigenous Peoples' Climate Change Actions and Obstacles

In relation to other forms of social organization, Indigenous collectives have been minor contributors to the causes of anthropogenic climate change (Burkett 2009; Abate and Warner

2014a). In contrast, European and settler state colonialism have played central roles through hundreds of years of industrial-economic practices, land dispossession and modification, and resource extraction (Grove 1995; LaDuke 1999; Guha 2000; Wildcat 2009; Whyte 2016).[2] In the US, settler colonialism is intricately tied causes of climate change and to reasons why Indigenous peoples experience climate injustices (Whyte 2016).[3] Many contemporary Indigenous populations are actively contending with climate change and experience various obstacles in their efforts. I describe some of these actions and obstacles below.

Environmental justice as a movement and scholarly field addresses a vast set of concerns, including but not limited to unequal distributions of environmental goods and harms based on race, ethnicity, indigeneity, gender, class, nationality, space, and place (Principles of EJ 1991; Taylor 2000, 2009). Research in the growing field of climate justice highlights uneven responsibilities for climate change (Roberts and Parks 2006), and the work of grassroots climate movements (Martinez-Alier et al. 2014). Other studies propose equitable actions moving forward (Burkett 2009; Whyte 2013b). Notions of justice are multi-faceted and take on particular dimensions in Native North America. These highlight self-determination of Indigenous collectives, fair government-to-government relationships between tribes and the US, land

[2] There is a difference between historical emissions, nation-state annual emissions, and per capita annual emissions (see Roberts and Parks 2006). Emissions measurements alone do not provide a view of historical processes that gave rise to anthropogenic climate change.

[3] Settler colonialism is a form of colonialism that seeks to remove original inhabitants through normalizing the legitimacy and practices of domination. Settler colonial formations use political, military, and economic force, alongside the actions of settler societies (Coulthard 2007; Simpson 2014). The denial of violence, past and present, "emerges through the interaction of structural (collective violence and modernity) and affective (collective emotions and events) elements of time and across space" (Göçek 2014, 12). Those closest to a nation-state's foundational violence are heavily silenced and harmed because accountability would delegitimize the dominant state and society (Göçek 2014).

restitution, and removing obstacles to the continuance of Indigenous cultures, languages, and practices (Weaver 1996; LaDuke 1999; Wildcat 2009; Whyte 2011).

One challenge in contending with climate change is the role science fields play in producing, reproducing, and normalizing social inequalities. Privileged forms of science are hinged to colonialism that produces damaging results to Indigenous peoples and others, often without acknowledging the connections (L. T. Smith 2012; TallBear 2013; Harding 2008). These include, for example, uses of science for social control, racial classification, and experimentation (TallBear 2013; Benjamin 2016a). Science discourses and practices tend to obscure their underlying values and assumptions (L. T. Smith 2012; Harding 2008). In the US, this leads to normalization of perspectives that support the North American settler majority (TallBear 2013). There is a need to reconfigure science knowledges and practices by transforming the sciences from within and without (L. T. Smith 2012; TallBear 2013; Whyte 2013a; Benjamin 2016a, 2016b). Climate change boundary organizations are accountable to counter the harms of privileged sciences. Turning sciences to benefit Indigenous collectives involves active resistance to long-standing inequalities and connection to Indigenous political goals of self-determination and land restitution.

There is vast diversity among Indigenous peoples globally, within the current 573 federally recognized tribes in the US, and among other Indigenous collectives without federal recognition. All have specific histories, cultures, and important species and places. Despite these diversities, Indigenous peoples share experiences of harm and loss due to ongoing colonialism (Abate and Warner 2014b). Many Indigenous peoples are leading efforts to address climate change through mitigation, adaptation, and social movements (Native Peoples Native Homelands 2009; Middleton 2011; Chief et al. 2014; LaDuke 2014; Whyte 2016; TallBear 2016). Diverse

Indigenous populations also share long histories of ecological resilience using feedback processes that respond to cultural, bio-physical, and governance disturbances (Berkes, Colding, and Folke 2000; Trosper 2003; Grossman and Parker 2012). However, there is a need to further strengthen contemporary adaptive capabilities in the face of climate change hinged to colonialism (Bennett et al. 2014; Chief et al. 2014; Whyte 2013b; Williams and Hardison 2013).

Ecological and political challenges affect the well-being of Indigenous peoples, their relationships with each other, and relationships to important species and places (Chief et al. 2014; Whyte 2013b; Williams and Hardison 2013). Researchers have been interested in intertwined colonialism, fossil fuel industries, and climate change in Indigenous communities in coastal areas, particularly Louisiana and Alaska (Shearer 2011; Marino 2012; Cameron 2012; Maldonado 2014). Other work has focused on human rights issues around displacement from sea-level rise (Maldonado et al. 2013; Bronen 2009). Studies also document impacts to food, fire practices, and forests among Indigenous peoples from Interior Alaska to the Pacific Northwest, Hawai'i to Eastern tribal marine environments (Voggesser et al. 2013; Bennett et al. 2014; Mason et al. 2012; Norgaard 2014; McNeeley 2012). Much of this research also highlights the contributions of Indigenous peoples' knowledges and lifeways for attending to climatic destabilization, and suggest actions moving forward.

Some Indigenous peoples have sought collaborative partnerships as one way to contend with these climate impacts and risks. Scholars in Indigenous studies have argued that cross-cultural environmental collaborations must benefit Indigenous peoples, yet they encounter obstructions due to ongoing harms of colonialism (Coombes 2012; Whyte 2013b). Obstacles occur when tribes are treated as stakeholders, instead of sovereigns (Williams and Hardison 2013). Indigenous sovereignties pre-date the establishment of current nation-states. There are

pressures in the US for federally recognized tribes to accept bureaucratic management practices in order to engage in government-to-government relationships and enforcement of environmental protections (Ranco et al. 2011). Forms of spatial containment and restricted access to culturally important species present additional obstacles, as do exclusions of Indigenous peoples from climate policy and science at various scales of governance (H. Smith 2007; Whyte 2013b, 2016). This dissertation seeks to understand how cross-cultural collaborative networks within scientific fields may work against climate injustices, including the constraints and limitations on doing so.

The Politics and Ethics of Collaborative Climate Change Networks: Indigenous Peoples and Climate Scientists

Conflict and collaboration are standard features of environmental issues having contentious multi-party origins and uneven sources of responsibility. Potential benefits of collaborations in climate science include harnessing networks, knowledges, and resources to strengthen Indigenous peoples' climate change capabilities (Whyte 2013b; Chief et al. 2014). Collaboration also focuses diverse knowledges toward solving complex problems (Bodin and Crona 2009). It can broaden exposure to a group's goals through increased member participation or interest by the media (Taylor 2000, 2009). Cross-cultural environmental collaborations open possibilities to improve relations between the parties involved (Middleton 2011; Whyte 2013b; Richmond et al. 2013). Cross-difference partnerships may support reform of science practices by those working within these fields. Reform efforts will not attend to the most problematic obstacles experienced by Indigenous peoples, yet everyday interactions are one part of pressing for social change. Climate science fields offer robust scientific knowledge, but lack sufficient engagement with diverse perspectives (Castree et al. 2014). At the same time, broadening diversity without transfers of decision-making power further stunts the potential of change

making within everyday practices. Collaborations may help sharpen climate change organizations' sense of responsibility toward human and ecological liberatory agendas.

However, alongside the benefits of collaboration come a set of risks and challenges. Collaborations can lead to assimilation or cooptation, including Indigenous knowledge-practices becoming commercialized, patented, used without permission, or improperly attributed (L. T. Smith 2012; McGregor 2004; Williams and Hardison 2013). Revealing the location of resources or sacred sites can bring looting through criminal activity, or through research and extraction deemed lawful, but unethical (Middleton 2013). Scholars argue for ethical protocols that ensure respect and benefit accrued to Indigenous collectives through collaborative processes (L. T. Smith 2008; Coombes 2012; Whyte 2013b; CTKW 2014). Giving of consent may require collective decisions and relate only to specific circumstances, times, or projects. There is constant risk of unintended disclosures (L. T. Smith 2008; Williams and Hardison 2013).

Challenges also involve overcoming distrust due to past and ongoing colonial relations that harm Indigenous peoples. Collaborative efforts too often expect Indigenous peoples to use colonial languages, meanings, and practices (Nadasdy 1999, 2003; Richmond et al. 2013). There is the risk of not strongly connecting outcomes to broader Indigenous political and land rights (L. T. Smith 2012; Tuck and Yang 2012). Collaborations with climate scientists can also result in Indigenous participants becoming alienated from their own communities, where working closely with outsiders may introduce new threats (L. T. Smith 2012). Colonial education and science systems have worked against Indigenous ways of life, and turning them to benefit Indigenous communities is a momentous task (L. T. Smith 2008, 2012). Research has infrequently benefited Indigenous collectives, therefore the need to create alternative science practices is urgent, but "tricky" and draws skepticism (L. T. Smith 2008, 113). Free, prior, and informed consent

(FPIC), a core tenet of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP 2007), must include the right of Indigenous peoples to refuse collaboration and other activities that affect their knowledges and livelihoods (Williams and Hardison 2013; CTKW 2014).

At their best, collaborations are invitations to co-existence that build trust, and respect government-to-government relationships (Whyte 2013a). This means focused attention on the risks and benefits that collaborations pose to Indigenous participants (L. T. Smith 2012; Whyte 2013b). Leadership and decision-making by Indigenous peoples are core features of mutually respectful collaborations, which should seek to directly transfer knowledge production and resources to Indigenous collectives (Coombes 2012). Collaborations are an inevitable part of contending with environmental problems. As such, everyday collaborative efforts by organizations working largely outside existing institutions offer one context where partnership practices could advocate for Indigenous land, knowledge, and cultural sovereignty. How are these issues being viewed and enacted through cross-cultural climate change efforts? This dissertation seeks to understand the ways climate change boundary organizations are engaging these core concerns from Indigenous studies and environmental justice fields.

Three Papers Assessing Knowledge, Power, and Practices in Indigenous Peoples-Climate Scientist Networks

This section provides brief descriptions of the climate change boundary organizations, the methodological approach, and the three dissertation papers.

The Climate Change Boundary Organizations

The climate change boundary organizations associated with this research are national or large regional-scale groups that capture a range of approaches at intersections of Indigenous knowledges and climate science. The eight groups have varying proportions of Indigenous and

climate scientist participants among membership and leadership. The groups' core emphases fall into three broad categories: tribal environmental, climate adaptation, or conservation.[4] As boundary organizations, these groups do not situate themselves fully within federal government, tribal government, non-governmental organizations (NGOs), or academic institutions.[5] Participants carry deep environmental expertise. Many have advanced degrees, and those who do not are also environmental experts and knowledge holders. Because boundary organizations function largely outside established institutions, they have opportunities for innovative practices that may work against systemic inequalities. But how and to what extent do they?

To understand dynamics of knowledge, power, and practices in these climate change collaborations, I conducted surveys and participated in the networks from June 2014 to June 2017. This dissertation focuses in greater depth on one national scale group formed specifically to bring together Indigenous knowledges and climate science. The group has met annually since mid-2013 for active workshops, and maintains an email list-serve, a Facebook page, and monthly teleconference calls on particular topics. Attendance at events vary from around 50 to 120 network participants. The group contains visible actors working on Indigenous peoples' climate change concerns across the US. Indigenous participants come from many tribes and regions, including Native Hawai'i and Native Alaska, and work on climate change as scientists, educators, government leaders, community members, through NGOs, and other contexts. Non-

[4] The tribal environmental boundary organizations function largely outside formal tribal governments. They are not tribal environmental departments within governments.

[5] Environmental boundary organizations frequently operate at intersections between science, politics, policy, and publics. David Guston (2001) argues these groups seek to be accountable and responsive to both sides of a boundary through hybrid governance and active maintenance of internal stability. Shared uses of boundary objects, norms, and practices help provide this stability, even when holding different meanings for diverse sets of actors (Star and Griesemer 1989). Working across socio-cultural differences can involve common goals that are mutually intelligible, but not entirely the same.

Indigenous participants primarily work for the US government, NGOs, academic institutions, or tribal governments. The group explains its overarching identity as a knowledge-to-action network with goals to support Indigenous peoples' climate adaptation capabilities. A few advocacy statements released over the years have aimed to influence US and international climate policy in support of Indigenous peoples' climate adaptation. Formal organizational statements focus on integrated collaborations through relational trust development and cross-cultural research initiatives. The case study group also emphasizes use of respectful and inclusive approaches to climate science communication within scientific institutions.

Among the remaining seven climate change boundary organizations, four started in the 1990s and another in the early 2000s. The other three groups began around 2011-2012, as the professional field of climate adaptation started to grow. The networks generally consist of a few hundred people, although two are closer to one hundred participants. Overall, these organizations' funding come from many sources: tribal governments, the US government, non-governmental organizations, colleges and universities, corporations, foundations, professional societies, consultant companies, utility companies, and publishers. The groups' memberships vary from almost entirely Indigenous to almost entirely non-Indigenous participants. In the majority of cases, these organizations have core governance members who are both Indigenous and non-Indigenous persons. All the groups carry significant climate change expertise, although the level of professionalization within them varies. The organizations use many approaches at intersections of Indigenous peoples' knowledge-practices and climate science, and examining these are part of this dissertation. I do not provide names of the organizations to maintain confidentiality of individual participants.

Overview of the Methodological Approach

My empirical mixed methods approach, informed by socio-political and historical understanding, drew from sociological and Indigenous research methodologies. Combining social network analysis (SNA) with qualitative methods had particular advantages, while Indigenous methodologies informed research design and goals. SNA coupled with qualitative approaches emphasize the embeddedness of social action, combining measurements with interpretive explanations and network practices (Hollstein 2014). Mixed methods SNA bridges relational and structural phenomenon, offering potential views of the interplay between social structures, culture, and agency (Emirbayer and Goodwin 1994; Mische 2011). These advantages are offset by research complexity. The sample size becomes limited by the skills and resources required to conduct mixed methods network studies (Hollstein 2014).

Social network methods assess relationships between actors or groups in social systems. For example, they can focus on network structure, the roles of specific actors, or flows of information, things, or influence through a network (Borgatti, Everett, and Johnson 2013). Network formation and structure are among key factors in collective action (Taylor 2009, 2014a). Collective action also interfaces with political opportunities, cultural and individual predispositions and values, resource mobilization, issue framing and salience, and cognitive liberation of participants (Taylor 2009, 2014a). On their own, SNA methods are limited with respect to history, culture, actor agency, emotions, and why some connections and networks develop, while others do not (Emirbayer and Goodwin 1994; Mische 2011). Notwithstanding, they are reliable methods to measure and illustrate relational connections, including social positions and meso-structures (Wald 2014). Using SNA allowed this work to move beyond identity categories for social understanding, looking also to relationships (illustrated by connections between network members), network structures, and spatial-regional considerations.

The social network survey instrument is included in the appendix with organization and participant names removed for individuals' confidentiality. The survey included questions about members' collaborations and attributes. It also surveyed participant perspectives about bringing together Indigenous knowledges with climate science.

Qualitative methods included participation and secondary data sources associated with a set of eight North American climate change boundary organizations. Engaged participation spanned from June 2014 to June 2017. It included observations of the networks over time, and attendance with ethnographic notes for 11 national or large regional-scale events. Secondary data sources included organization reports, policy or advocacy statements, promotional materials, email listserves, websites, and social media pages. Regular engaged participation and secondary sources helped formulate the social network survey and interpret results.

Indigenous methodologies informed research design and purpose, although this may not be readily apparent due to ample use of quantitative data. Some Indigenous scholars have argued that both quantitative and qualitative research approaches developed through the academy have strong colonial origins (L. T. Smith 2008; Walter and Andersen 2013). They further emphasize the need for Indigenous studies to engage with quantitative research in order to shift power relations around what, how, and why measurements take place (L. T. Smith 2008; Walter and Andersen 2013). Observing, measuring, and adapting are parts of everyday life and facets of Indigenous knowledge-practices (Trosper 2003; McGregor 2004; Kimmerer 2012). This dissertation engages with goals proposed in Indigenous methodologies by connecting research to the broader interests of Indigenous collectives, including the benefits and risks of cross-cultural engagements (L. T. Smith 2012; Coombes 2012; Whyte 2013b). I focused on actual collaborations taking place in climate change boundary organizations. This required assessments

of leadership and decision-making, among other features such as place-based climate adaptation practices. Academic research has functioned as a colonizing tool. However, with shifted goals and approaches, it can also find uses toward Indigenous collectives' self-determination, governance, good living, and pursuits of justice (L. T. Smith 2012).

Overview of the Three Dissertation Papers

The three dissertation papers investigate how US climate change boundary organizations address core issues of concern that arise in Indigenous studies and environmental justice fields. The empirical work approaches the enactments of collaboration through measurements, interpretations, participant perspectives, and organizational practices.

Chapter 2 examines how partnerships in a national scale Indigenous peoples-climate scientist organization in the US resonate with scholarship on the politics and ethics of collaboration. The study uses a social network approach to assess not only knowledge transfers frequently found in climate science networks, but also integrated decision-making, policy efforts, and place-based climate adaptation collaborations. The study measures network ties and network structures for these four types of collaboration to understand the cross-cultural organization's dynamics of knowledge and action around climate change. Results indicated the network supports climate knowledge transfers, but types of collaboration well attuned to transfers of power such as joint decision-making and advocacy were minimally present. Though critical to strengthen Indigenous peoples' climate change capabilities, place-based climate adaptation partnerships between participants in the network were scarce in reported outcomes.

Chapter 3 asks: how do central actors in the boundary organization represent intersections of race, ethnicity, indigeneity, gender, and age? Collaborations in climate science run the risk of reproducing some forms of inequality while challenging others due to interconnections between

colonialism, racism, and patriarchy. This paper employs social network analysis and qualitative methods to analyze central actors based on relational ties between participants and organizational leadership. In both cases, Indigenous women and youth were underrepresented in central roles. White women and elder Indigenous men held most central positions. Yet Indigenous women consistently had bridging ties between otherwise unconnected participants, and provided less visible labor to support the network. These did not translate to decision-making positions.

Chapter 4 investigates how bringing together Indigenous peoples' and climate scientists' knowledges and practices carry benefits and risks for Indigenous collectives. It analyzes participant perspectives in the case study organization on the benefits and risks of knowledge sharing, and the relationship between Indigenous knowledges and climate science. The chapter also focuses on organizational practices of eight climate change boundary organizations. Participants demonstrated diverse perspectives on the relationship between Indigenous knowledges and climate science, and a majority identified simultaneous high benefits and high risks to Indigenous peoples when sharing their knowledges with climate scientists. A contingent was less convinced of the benefits involved. This paper revealed a wide range of practices and protocols among boundary organizations. It found greater benefits and reduced risks when Indigenous peoples were among core governance positions in collaborative networks.

Chapters 2, 3, and 4 provide implications and conclusions associated with each respective research paper. Chapter 5 then synthesizes key findings from the dissertation, overall conclusions, and recommendations.

CHAPTER 2

More than Knowledge Transfers in an Indigenous Peoples-Climate Scientist Network: Assessing Collaborative Decision-Making, Policy, and Climate Adaptation

Abstract

Despite growing climate change collaborations between Indigenous peoples and climate scientists, few studies have examined how these partnerships resonate with scholarship on the politics and ethics of collaboration. This paper argues that to benefit Indigenous collectives, collaborations must move beyond transfers of knowledge. Partnerships also require integrated decision-making, collective advocacy, and place-based climate adaptation actions. The study employs a social network approach to analyze collaborations in a US climate change organization formed specifically to bring together Indigenous peoples and climate scientists. This work assesses not only knowledge transfers frequently found in climate science networks, but also integrated decision-making, policy, and place-based climate adaptation partnerships. The study measures network ties and network structures for each of these collaboration types to understand how the national scale cross-cultural organization engages climate change injustices. Results indicate the network supported climate knowledge transfers, including for diverse Indigenous participants from different tribes and regions experiencing climate-related challenges. Types of collaboration well attuned to transfers of power such as joint decision-making and advocacy were minimally present, reflecting marginal connections to Indigenous political goals. Though critical to strengthen Indigenous peoples' climate change capabilities, place-based climate adaptation partnerships between participants in the network were scarce. This paper describes implications for climate change organizations, and contributes to debates on how to assess environmental collaborations.

Introduction

Indigenous peoples concerned about climate change and its disproportionate impacts have sought collaborative partnerships of various kinds to strengthen the impact of Indigenous responses, and capabilities to respond.[6] One emerging approach involves collaborative networks formed directly with climate scientists. Collaborations are often assumed to bring benefits, yet they also carry challenges and risks (Nadasdy 1999; Whyte 2013b; Coombes 2012; Richmond et al. 2013; CTKW 2014). There is a need to better understand how cross-cultural climate change networks address injustices of concern to Indigenous peoples. Of particular importance are actions that challenge knowledge and power differentials, including the strengthening of Indigenous collectives' capabilities to contend with climate change. Using a framework from Indigenous political theory and environmental justice, this study employs a social network approach to analyze collaborations in a US climate change organization that formed specifically to bring together Indigenous peoples and climate scientists. I evaluate the quantity and quality of actual relational ties between organizational members based on forms of collaboration attuned to shared power.[7] This paper argues these features are essential to influence uneven contexts in climate change knowledge and action (Coombes 2012; Whyte 2013b). As a result, I assess not

[6] I utilize a definition of Indigenous peoples as pre-invasion inhabitants of lands now dominated by nation-states (Anaya 1996), who continue to exercise political and cultural self-determination, and derive their identities in part from the landscapes that give them distinct cultures (Wildcat 2009). This includes a diverse range of groups such as federally recognized tribes in the US, Indigenous peoples forcibly removed from lands, and others not formally acknowledged as sovereigns.

[7] For this paper, I define power as combinations of *relational*, *historical*, and *socio-structural systemic* influences that have the capacity to produce action or inaction (Lukes 2005; S. Hall 1986). Power operates alongside agency and resistance. Inscribed on our bodies, emotions, and sub-conscious, power is also hinged to civic participation, decision-making, critical consciousness, mobilization of grievances, resources, consent, and coercion (Lukes 2005; S. Hall 1986; Göçek 2014). While power is pervasive, my use argues it has horizontal *and* vertical dimensions; this means constructed hierarchies, such as racial categories, continue to have real effects through institutions, ideologies, cultural practices, and relational interactions (Connell 2007; Taylor 2009; TallBear 2013; Göçek 2014; Simpson and Smith 2014).

only knowledge transfers frequently found in climate science networks, but also integrated decision-making, policy, and place-based climate adaptation collaborations. This article asks: what are levels of collaborative decision-making, advocacy, and climate adaptation actions in a national scale cross-cultural climate science organization?

Few empirical studies investigate climate change boundary organizations in light of political and ethical issues that emerge in critical scholarship, even less addressing contentious cross-cultural concerns. Studies have looked at the role of climate change boundary organizations to support transfers of climate knowledge, co-production of knowledge, and support for decision-makers at various scales (Parris et al. 2016). The cultural boundaries in focus often include those between climate scientists and elected leaders, municipal staff, or non-governmental organizations (NGOs). Concerns of diverse Indigenous populations such as self-determination, sovereignty, and good living on ancestral lands infrequently come into play in climate change fields (Grossman and Parker 2012; Marino 2012; Cameron 2012; Whyte 2013b; Williams and Hardison 2013). Very active in resisting and addressing climate change, many Indigenous peoples have much to offer and gain from collaborative processes (Bennett et al. 2014; Chief et al. 2014; Whyte 2014, 2016). However, little empirical research has addressed the workings of cross-cultural climate change networks with focus on the benefits and risks to Indigenous peoples in these collaborations (Coombes 2012).

In relation to other forms of social organization, Indigenous collectives have been minor contributors to the causes of anthropogenic climate change (Burkett 2009; Abate and Warner 2014a). In contrast, European and settler state colonialism have played central roles through hundreds of years of industrial-economic practices, land dispossession and modification, and

resource extraction (Grove 1995; LaDuke 1999; Guha 2000; Wildcat 2009; Whyte 2016).[8] In the US, settler colonialism is intricately tied causes of climate change and to reasons why Indigenous peoples experience climate injustices (Whyte 2016).[9] Many contemporary Indigenous populations are actively contending with climate change and experience various obstacles in their efforts.

Environmental justice as a movement and scholarly field addresses a vast set of concerns, including but not limited to unequal distributions of environmental goods and harms based on race, ethnicity, indigeneity, gender, class, nationality, space, and place (Principles of EJ 1991; Taylor 2000, 2009). Research in the growing field of climate justice highlights uneven responsibilities for climate change (Roberts and Parks 2006; Abate and Warner 2014a), and the reach and potential of grassroots climate movements (Martinez-Alier et al. 2014). Studies offer myriad proposals for equitable actions moving forward (Burkett 2009; Shonkoff et al. 2011; Whyte 2013b; Boyce and Pastor 2013), and case studies by and about those impacted first and worst (Chief et al. 2014; Shearer 2011; Wright 2011; Maldonado et al. 2013). Notions of justice are multi-faceted and take on particular dimensions in Native North America. These highlight self-determination of Indigenous collectives, fair government-to-government relationships between tribes and the US, land restitution, and removing obstacles to the continuance of

[8] There is a difference between historical emissions, nation-state annual emissions, and per capita annual emissions (see Roberts and Parks 2006). Emissions measurements alone do not provide a view of historical processes that gave rise to anthropogenic climate change.

[9] Settler colonialism is a form of colonialism that seeks to remove original inhabitants through normalizing the legitimacy and practices of domination. Settler colonial formations use political, military, and economic force, alongside the actions of settler societies (Coulthard 2007; Simpson 2014). The denial of violence, past and present, "emerges through the interaction of structural (collective violence and modernity) and affective (collective emotions and events) elements of time and across space" (Göçek 2014, 12). Those closest to a nation-state's foundational violence are heavily silenced and harmed because accountability would delegitimize the dominant state and society (Göçek 2014).

Indigenous cultures, languages, and practices of *reciprocal relationships* with important species and places (Weaver 1996; LaDuke 1999; Wildcat 2009; Whyte 2011).[10]

One challenge in contending with climate change is the role science fields play in producing, reproducing, and normalizing social inequalities. Privileged forms of science are hinged to colonialism that produces damaging results to Indigenous peoples and others, often without acknowledging the connections (L. T. Smith 2012; TallBear 2013; Harding 2008). These include, for example, uses of science for social control, racial classification, and experimentation on marginalized populations (TallBear 2013; Benjamin 2016a). Science discourses and practices tend to obscure their underlying values and assumptions (L. T. Smith 2012; Harding 2008). In the US, this leads to normalization of perspectives that support the North American settler majority (TallBear 2013). There is a need to reconfigure science knowledges and practices by transforming them from within and without (L. T. Smith 2012; TallBear 2013; Whyte 2013a; Benjamin 2016b, 2016a). Climate change boundary organizations must actively counter the harms of privileged sciences despite structural constraints. Reforming sciences to benefit Indigenous collectives involves resistance to long-standing injustices and connection to political and ecological goals of importance to Indigenous peoples.

This paper highlights the importance of climate change boundary organizations' support for Indigenous self-determination through advocacy and transfers of decision-making, and for Indigenous collectives' place-based climate adaptation capabilities. I argue for actual measurements of shared decision-making, policy, and place-based climate change partnerships, not merely transfers of knowledge in collaborative science processes. Who benefits, how, and to

[10] For additional references on various dimensions of environmental justice see Shrader-Frechette (2002) and Schlosberg (2009, 2012).

what extent? Apart from knowledge transfers, what are climate change boundary organizations achieving when bringing together Indigenous peoples and climate scientists? The research found the network supported climate knowledge transfers, including for diverse Indigenous participants from different tribes and regions experiencing climate-related challenges. Types of collaboration well attuned to transfers of power such as joint decision-making and advocacy were minimally present, as were place-based climate adaptation partnerships.

This research contributes to debates on the politics of knowledge and practice around climate change in four ways. First, studies have not yet assessed a national-scale climate change boundary organization formed specifically to work across Indigenous and Western ways of knowing. This boundary organization operates largely outside formal governments and non-governmental organizations (NGOs). This creates potential for unusual governance and goals to be shared by Indigenous and non-Indigenous participants. Second, I use social network analysis to measure actual ties between actors in the network because these may differ from stated organizational intents. While some would argue that measurement is akin to problematic hierarchical classification processes, there are examples of quantitative methodologies in Indigenous studies to shift power relations over what, how, and why measurements take place (Mills, Reid, and Vaithianathan 2012; Walter and Andersen 2013; Wikaire et al. 2017). This leads to a third contribution: the research intervenes in how to assess environmental collaborations. The selection of measures are grounded in Indigenous environmental justice scholarship and engaged participation. Lastly, the conclusions inform climate change boundary organizations, and other environmental groups, of challenges to anticipate in cross-cultural engagements. This opens possibilities to attend to problematic dynamics up front in collaborative processes.

The next section of this paper provides background literatures in three areas. First, I discuss scholarship on environmental collaborations. This includes efforts in the field of applied climate science to move from knowledge to action. The second set of literatures focus on contexts of collaboration between Indigenous peoples and climate scientists, and why some collaboration literatures fail to address important concerns of Indigenous collectives. Third, I briefly introduce social network methods as a means to analyze knowledge, advocacy, and collective action networks. The background section is followed by the research context, methods, and results, including information on the case study climate change boundary organization. The final section further discusses research findings and conclusions.

Background

Uneven Knowledge and Power in Cross-Cultural Environmental Collaborations

The benefits of cross-cultural environmental collaborations can be far-reaching. These have the potential to diversify knowledges, improve intergroup relations, assist with complex problem solving, and broaden a network's political reach (Bodin and Crona 2009; Taylor 2000, 2009; Whyte 2013b). Research on collaborations indicate varying levels or layers of integration in partnership processes (Mattessich, Murray-Close, and Monsey 2001; Taylor-Powell, Rossing, and Geran 1998). These follow a trajectory that generally moves from intergroup communication, to knowledge exchanges, then coordination, cooperation, or coalition. Deeper collaborations may then progress to mutual trust, shared vision, shared governance, and shared resources (Mattessich, Murray-Close, and Monsey 2001; Taylor-Powell, Rossing, and Geran

1998). These literatures argue that integrated cross-cultural collaborations involve joint decision-making and actions based on commonly understood goals.[11]

A body of research specific to environmental conflicts and collaborations around natural resource and land management emphasizes processes of decision-making, inclusion of broad stakeholders, and environmental managers' attention to diverse perspectives and values (Wondolleck and Yaffee 2003; G. B. Walker, Daniels, and Emborg 2008). These studies turn important focus on participatory procedures and cross-difference communication strategies. This field does not discount the benefits of local knowledges when combined with scientific expertise. But such approaches imply environmental managers remain the key decision-makers, even if to determine how negotiation processes unfold or to mediate conflicts between competing stakeholders. Some Indigenous studies scholarship argues this type of collaborative frame assumes a level field of communication, as if competing knowledge systems and values need primarily to be represented and translated (Coombes 2012). Even heavily facilitative or participatory approaches have been shown to bypass Indigenous self-determination and Indigenous ontologies, i.e. ways of knowing (Johnson 2008; Middleton 2011; Richmond et al. 2013).[12] This frame can neglect the importance of trust and addressing injustices in collaborations. The approach downplays the transfer of agenda-setting and decision-making to Indigenous collectives, which is necessary to counteract enduring attempts to subjugate

[11] Environmental boundary organizations frequently operate at intersections between science, politics, policy, and publics. David Guston (2001) argues these groups seek to be accountable and responsive to both sides of a boundary through hybrid governance and active maintenance of internal stability. Shared uses of boundary objects, norms, and practices help provide this stability, even when holding different meanings for diverse sets of actors (Star and Griesemer 1989). Working across socio-cultural differences can involve common goals that are mutually intelligible, but not entirely the same.

[12] For further discussion on Indigenous ontologies see Vanessa Watts (2013), Sarah Hunt (2014), and Emilie Cameron, Sarah deLeeuw and Caroline Desbiens (2014).

Indigenous sovereignties and ways of knowing (Coombes 2012; Whyte 2013b). I return to this discussion shortly, after a brief background on the field of climate change science.

Broad research on the science of climate change and the field of climate adaptation have grown exponentially in the past decade. Climate change deeply transforms ecological and geophysical systems, and exacerbates extreme weather events (IPCC 2014). Human uses of fossil fuels coupled with colonialism and extractive economies unevenly bolster and disrupt socio-cultural and political systems (Mitchell 2009; Whyte 2016). Debates around causes, consequences, and actions tend to acknowledge there are no easy solutions but much at stake (Shove 2010; Castree et al. 2014; Dunlap and Brulle 2015). Some of these debates directly address corporate, economic, political, and socio-cultural constraints on action, and denials about climate change (Norgaard 2006; Mitchell 2009; Dunlap and McCright 2015). Climate adaptation, "the process of adjustment to actual or expected climate and its effects" (IPCC 2014, 1), includes the ability to cope with climate variability and extremes. Calls to adapt reflect already changed climates, not as alternatives to mitigation measures intended to curb the intensity of extreme impacts (Parris et al. 2016). Particularly important are ongoing discussions about the challenges of moving from climate knowledge to climate adaptation actions (Roberts and Parks 2006; Dilling and Lemos 2011; Parris et al. 2016).

Climate science models use observational data and computational simulations, both predictive and historical reconstructions, to converge on a range of future climate change scenarios (Edwards 2010). Paul Edwards (2010) outlines the knowledge infrastructures, or knowledge circulation networks and technologies, that facilitated comparison and evaluation of global climate simulation models toward standardized climate science practices in the 1980s. The field of *applied climate science* emerged later, in the mid-1990s. It began in response to the

emphasis in the US Global Change Research Act of 1990 on making climate change information accessible to and usable by decision makers (Parris et al. 2016). This field has grown in the past decade, particularly through the Department of the Interior and US Geological Survey Climate Science Centers (CSCs), and the National Oceanic and Atmospheric Administration Regional Integrated Sciences and Assessments (RISAs).

Applied climate science aims to translate climate model outputs into *usable knowledge* for adaptation responses that fit particular places, decision contexts, and spatial scales (Lemos and Morehouse 2005; Dilling and Lemos 2011). Usable data includes, for example, observed and anticipated changes to precipitation, temperatures, vegetation, and invasive species in particular places. Climate science data outlines annual averages, season-by-season measures, and extreme events. In addition to usable knowledge transfers, the field focuses on *climate change decision tools* for local to large-scale decision makers (Parris et al. 2016). These bring contextually appropriate climate adaptation strategies into ongoing and everyday governance processes. In some cases, applied climate science also involves co-production of climate knowledge with governments, civic organizations, or community groups. Studies show these iterative processes and shared responsibilities, for example between RISAs and local or regional NGOs, improve climate responsive actions (Lemos and Morehouse 2005; Dilling and Lemos 2011).

Some social scientists argue that climate change fields emphasize natural science agendas, and bypass important contributions from the humanities and social sciences (Castree et al. 2014; Dunlap and Brulle 2015). The focus on usable knowledge and decision-support in applied climate science tends to normalize current institutions and governance structures (Castree et al. 2014; Dunlap and Brulle 2015). Similarly, critical scholars maintain climate change fields offer insufficient attention to racism, ethnicity, indigeneity, colonialism, and

imperialism (Cameron 2012; Marino and Ribot 2012). Castree et al. (2014) call for bringing together scientific, interpretive, and critical knowledges to improve climate change debates. Elizabeth Shove (2010) argues somewhat differently. Shove agrees climate policy operates from a "thin account of the social world" (2010, 277). At the same time, Shove argues that environmental social theorists overlook developments emerging from other fields and through everyday attempts on the ground to address climate change. Aversions to the *usefulness* of research and to studies of everyday practices hinder understanding and responding to climate change (Shove 2010).

In this paper, the need for useable knowledge is not in question; it is a valuable part of moving from climate science to action. Yet I harness scholarship on the politics and ethics of collaboration to better understand emerging climate adaptation approaches, in this case through a boundary organization focused at intersections of Indigenous and Western ways of knowing. Bringing diverse perspectives to bear on the workings of applied climate science leads to assessment of more than knowledge transfers; this involves critical engagement with integrated decision-making, policy advocacy, and place-based climate adaptation actions.

Contexts of Collaboration between Indigenous Peoples and Climate Scientists

Indigenous studies scholars have argued that cross-cultural environmental collaborations must benefit Indigenous peoples, and encounter obstructions due to ongoing harms of colonialism (Coombes 2012; Whyte 2013b). For example, environmental co-management efforts often assume Indigenous knowledges are new forms of data to incorporate into dominant environmental knowledges and practices (Nadasdy 1999, 2003; Richmond et al. 2013; Williams

and Hardison 2013).[13] Tribes are sometimes viewed as stakeholders instead of sovereign nations, and Indigenous land and treaty rights ignored (Ranco et al. 2011; Whyte 2013b; Williams and Hardison 2013). There are pressures in the US for federally recognized tribes to accept bureaucratic management practices such as Treatment as a State (TAS) status to engage in partnerships and enforcement around environmental protections and environmental health.[14]

Ecological and political challenges affect the well-being of Indigenous peoples, their relationships with each other, and relationships to important species and places (Chief et al. 2014; Whyte 2013b; Williams and Hardison 2013). Researchers have been interested in intertwined colonialism, fossil fuel industries, and climate change in Indigenous communities in coastal areas, particularly Louisiana and Alaska (Shearer 2011; Marino 2012; Cameron 2012; Maldonado 2014). Work has focused on human rights issues around displacement from sea-level rise (Maldonado et al. 2013; Bronen 2009). Studies also document impacts to food, fire practices, and forests among Indigenous peoples from Interior Alaska to the Pacific Northwest, Hawai'i to Eastern tribal marine environments (Voggesser et al. 2013; Bennett et al. 2014; Mason et al. 2012; Norgaard 2014; McNeeley 2012). Much of this research also highlights the contributions of Indigenous peoples' knowledges and lifeways for attending to climatic destabilization, and suggest actions moving forward. [15]

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[13] I use *dominant* in a vein similar to Maggie Walter and Chris Anderson's notion of "colonial habitus of the settler majority" (2013, 15), meaning dispositions of perception, thought, and action that appear natural to a numerical majority in a settler colonial state and society (building on Bourdieu 1984). My use does not imply social homogeneity or lack of resistances to dominant discourses and practices.

[14] Treatment as a State (TAS) authorizes the US Environmental Protection Agency (EPA) to treat federally recognized tribes that meet certain governance and programmatic criteria in a manner similar to states for implementing and managing environmental programs such as the Clean Air Act, Clean Water Act, and Safe Drinking Water Act. TAS implies power and resources for tribes, yet subordinates them under the EPA with problematic implications for government-to-government relationships, and tribal political and cultural sovereignty (Ranco et al. 2011; Whyte 2013b).

[15] Indigenous peoples' knowledges and sciences are diverse and therefore written in plural form (CTKW 2014). Some Indigenous peoples consider their knowledges as more-than-science, integrated within reciprocal

Ample cases describe Indigenous peoples leading efforts to address climate change through mitigation, adaptation planning, land restoration projects, tribal resolutions, uses of renewable energies, and movements against extractive industries and practices (Native Peoples Native Homelands 2009; Middleton 2011; Chief et al. 2014; LaDuke 2014; NCAI 2016, 2017; Whyte 2016; ATNI 2017). Indigenous knowledges and sciences are of interest to climate scientists for their long-term observations, and can draw environmental organizations and scientists to seek out collaborative projects. Long histories of Indigenous cultural and ecological resilience include feedback processes that respond to cultural, bio-physical, and governance disturbances (Berkes, Colding, and Folke 2000; Trosper 2003; Hatfield 2009; Grossman and Parker 2012). Ronald Trosper (2003) uses an example of the potlatch system among Pacific Northwest Tribes to connect iterative feedbacks and social learning to important features of climate adaptation. Strengthening adaptive capabilities, including associated network relationships, is central not only to environmental boundary organizations, but for Indigenous peoples' goals in contending with climate change hinged to colonialism (Bennett et al. 2014; Chief et al. 2014; Whyte 2013b; Williams and Hardison 2013).

Examining collaborative practices in various places and contexts, Richmond et al. (2013) find environmental managers tend to ignore or minimize self-government by Indigenous collectives that pre-exists the formation of current nation-states. These researchers also argue that co-management interactions warrant strong dialogue between parties about Indigenous rights, perspectives, and environmental practices (2013). Studies have also evaluated

relationships with human and nonhuman entities, particular places, and ceremonial practices (McGregor 2004; Kimmerer 2012). These go beyond information and data. An extensive discussion on the contents, meanings, practices, similarities, differences, assemblages, histories, and adaptability of multiple knowledge and science systems is beyond the scope of this paper. See also Nadasdy (1999, 2003), Watson-Verran & Turnbull (1995), Harding (2008), Whyte (2013a), and Weaver (2014).

partnerships between Pacific Northwest Tribes and the US Forest Service (USFS) to improve collaborative approaches (Vinyeta and Lynn 2015). Central recommendations are to better align goals, and for USFS agency staff to improve their understanding of tribes' rights. This includes tribal access to traditional lands and resources. While these studies focus on government-to-government partnerships, Beth Rose Middleton (2011) examines cases of tribal conservation through private land trusts. Many of these cases involve tribal collaborations with NGOs, and Middleton (2011) also emphasizes the role of communication, mutual trust, tribal land rights, Indigenous sovereignties, and shared goals.

In the context of environmental boundary organizations seeking to innovate mostly outside formal governments and NGOs, Indigenous scholarship offers political and ethical considerations rarely discussed in climate science fields. Brad Coombes (2012) argues collaborations focused on cross-cultural communication and knowledge exchanges are less beneficial than those transferring knowledge production, decision-making, and resources directly to Indigenous peoples. Even efforts focused on shared knowledge production or respectful translation across differences fall short of transformative or liberatory goals (Coombes 2012). Along similar lines, Kyle Powys Whyte (2013b) outlines how climate change scientists and professionals have ethical responsibilities toward Indigenous peoples' climate adaptation due to formal government-to-government trust relationships and climate injustices. These involve transfers of political power and tribes' inherent rights outside reservation boundaries. Whyte (2013b) describes cross-cultural collaborations as unavoidable aspects of contending with climate change. Multi-party environmental challenges require strong relationships and institutional accountability. Such arguments animate the selection of shared decision-making,

policy efforts, and place-based climate adaptation as measures of collaborative outcomes in a climate change network between Indigenous peoples and climate scientists.

Analyzing a Cross-Cultural Climate Science Network

Social network methods assess relationships between actors or groups in social systems. For example, they can focus on network structure, the roles of specific actors, or flows of information, things, or influence through a network (Borgatti, Everett, and Johnson 2013). Örjan Bodin and Beatrice Crona (2009) argue the structural patterns of a network have significant implications on environmental governance, including social processes such as knowledge transfer and power relations. For example, more ties in a network often lead to more communication and knowledge development. These can improve collective action. Yet very dense networks may reduce effectiveness based on high homogenization and slow movements of knowledges. Highly centralized network structures where a relatively small number of actors predominate in relational connections are not as effective at complex problem solving (Borgatti, Everett, and Johnson 2013). The structure and function of centralized networks can change significantly with removal of a few central actors. At the same time, centralized networks may move information quickly through these same central actors if they choose to transfer the information.

Research on climate change networks focused on knowledge production or policy efforts is growing. Studies have discussed national climate change policy networks as functions of cultural frameworks and institutions (Broadbent and Vaughter 2014), and ideological networks among US political elites (Fisher, Leifeld, and Iwaki 2013; Jasny, Waggle, and Fisher 2015). Other works address patterns of authorship and membership nominations in international environmental scientific assessment bodies (Corbera et al. 2016; Leifeld and Fisher 2017). Yet

little empirical research has focused on dynamics *within* a climate science boundary organization working across socio-cultural differences. Scientific collaboration networks, already mobilized around mutually intelligible reform goals, often function more like advocacy networks than oppositional social movements (Broadbent 2017). Still, innovative collective actions within scientific fields have potential to open up new avenues that work against uneven knowledge and power relations.[16]

Therefore, this paper is testing the extent to which a cross-cultural climate science boundary organization is a knowledge network, an advocacy network, and an action network. One network might function well in all three areas. I assess how the network partnerships resonate with scholarship on the politics and ethics of collaboration, in part to compare the results with the organization's stated goals outlined in the next section. In light of the need for shared decision-making, equitable climate policy, and place-based climate adaptation actions, this paper measures actual levels of collaborative ties and the whole network structures. With growing research on climate change collectives between Indigenous peoples and other governments or NGOs, I empirically analyze a large-scale climate science boundary organization to understand the politics of knowledge and action in an Indigenous peoples-climate scientist network.

[16] All knowledges situate in time and space as efforts to understand socio-material worlds, as do forms of knowledges such as sciences (Bauchspies, Croissant, and Restivo 2006; TallBear 2013). Although knowledges and sciences are infused with values and politics, this does not preclude differentiation between competing truth claims (Bauchspies, Croissant, and Restivo 2006; Castree et al. 2014; Simpson and Smith 2014). While implicated in colonizing knowledges and practices that produce damaging results to Indigenous peoples and others, sciences can also play a role in disrupting colonialism and contributing everday benefits (L. T. Smith 2012; TallBear 2013; Walter and Andersen 2013).

Methods

I employed social network analysis, engaged participation, and secondary data to analyze and compare network ties and network structures for four types of collaboration in a US climate change organization that brings together Indigenous peoples and climate scientists. This section describes the research context, data collection, and data analysis.

Research Context

The boundary organization focuses on bringing together Indigenous knowledges with climate science toward culturally relevant and scientifically sound climate adaptation solutions. For this paper, I use the pseudonym *Bridging Climate Action* for the name of the organization. The group has met annually since mid-2013 for active workshops that focus on co-production of sciences and knowledges, and building Indigenous peoples' climate adaptation capabilities. Bridging Climate Action maintains an email list-serve, a Facebook page, and monthly teleconference calls on particular topics. Regular discussion topics include climate change issues around water, community relocations, health hazards, livelihoods, food security, and phenology. (Phenology is the study and understanding of interdependencies among plants, animals, seasonal timings, and bioclimate.) Bridging Climate Action also emphasizes use of respectful and inclusive approaches to climate science communication within scientific institutions. As explained earlier, the organization does not situate itself fully within a federal government, tribal government, non-governmental organization (NGO), or academic institution. Although loosely housed within a federally-funded climate science research center run by a non-profit, it partners with other NGOs and research organizations year by year to sponsor gatherings or side events at workshops.

Bridging Climate Action offers a compelling case study for various reasons. First, it explicitly seeks to link knowledge to collaborative climate adaptation action, as do the research questions posed herein. Second, it contains key actors working on Indigenous peoples' concerns and experiences with climate change in the US. Other networks also do this, particularly through tribal and federal governments, NGOs, and research institutions. Yet Bridging Climate Action is active as a national boundary organization with a loose set of ties to other groups that have strong prior overarching goals and practices. I have already noted this opens up innovative possibilities, although it may constrain others, such as access to resources. Formal statements by Bridging Climate Action indicate the network seeks to build integrated collaborations through relational trust development and cross-cultural research initiatives. Finally, this group sought out a social network study as part of its own evaluation process. Bridging Climate Action members are interested in the research results.

While Bridging Climate Action is not explicitly a policy-development entity, climate policy implications and advocacy are integral to this research context. Bridging Climate Action utilized past workshops to produce and submit written statements to decision-makers in US and international climate policy. Similarly, the group's reports discuss support for decision-making around climate adaptation and weather extremes. Yet it has not intentionally developed activities or workshops to foster decision-making *within* the group. My study evaluates decision-making and policy development because these are important dynamics in transfers of power, even if less explicit as organizational goals than knowledge transfer and placed-based climate adaptation capabilities building. In summary, Bridging Climate Action identifies itself as a knowledge and action network, with some advocacy goals and two past policy statements.

Data Collection and Data Analysis

This study uses social network analysis, participant observation techniques, and secondary sources to measure ties between actors that form organizational structures for different collaboration types. I conducted the social network survey in July 2016 during the annual workshop of Bridging Climate Action; this is an active working meeting. For the 2016 workshop, participants completed an online application of their interest to attend and key organizers made final selections of invitees. In this way, organization leaders define the network boundary. I participated in the 2015, 2016, and 2017 annual workshops, and worked on two collaborative projects with members of the organization that began before the 2015 workshop. Ongoing engaged participation and secondary sources informed the development of the social network survey and discussion of the results. Secondary sources included organization reports, policy statements, websites, emails, and social media. I also drew from academic literatures and government reports on climate change actions by Indigenous collectives, particularly in North America. Survey methods involve variable interpretations of questions by participants and potential attempts to give honorable responses. I minimized these effects by pre-testing the survey with a small group ahead of time, and incorporating their feedback into the final design. I administered the survey in person where I offered instructions and answered queries.

In the 2016 survey, each participant identified their past or current collaborations with every other participant for knowledge sharing, decision-making, climate policy, and community-based climate adaptation. The survey included a name roster of all participants in the workshop with check boxes next to names for each type of collaboration. Specific questions asked for the four collaboration types were:

- *I have shared, received, or developed climate change knowledge with this person.*

- *I have participated in climate change decision-making with this person.*
- *I have engaged in climate change policy efforts with this person.*
- *I have participated in local community-based climate adaptation work with this person.*

The survey included other questions, such as participant identities, region of focus in their climate change work, employment affiliations, and how long participants have known each other. Of 52 participants, 50 returned their handwritten paper survey during the workshop or shortly after, for a 96% response rate. I used data matching techniques to determine the collaborative relationships of the remaining two network participants. Secondary sources determined the two participants' identities, regions, and employment affiliations. Therefore the survey results account for all 52 participants.

For data analysis, I entered the survey data into an Excel spreadsheet directly creating a 52x52 matrix for each of the four social network relations. Using UCINET and Netdraw software, I analyzed and graphically illustrated whole network features of the four types of collaborations.[17] Analysis included sociometrics; these are quantitative measurements about items such as the number of ties and density of the network. In a series of sociograms, I visually represented network structure for each collaboration type, and compared them. These measurements and visualizations emphasize the relations between actors that form meso-level social structures in a way that other qualitative and quantitative measures typically do not. Social network analysis methods are limited with respect to cultural and historical situation, interpretive meanings, actor agency or emotions, and why some connections and networks develop (Emirbayer and Goodwin 1994; Mische 2011). Notwithstanding, they are reliable methods to

[17] UCINET and Netdraw software are created by Borgatti, Evertt, and Freeman (2002).

measure and illustrate relational connections for comparison of different collaboration types within an organizational network (Wald 2014).

This study focuses on the quantity of ties and overall network structures across different types of collaborations, therefore significant details about individual actors is not necessary. Still, a few points will facilitate interpretation of results. Of 52 participants, 35 (67%) identified as Indigenous.[18] Sociograms in the results differentiate Indigenous and non-Indigenous participants. This is done to illustrate cross-cultural collaborations taking place in the network. Participants come from many tribes and US regions, although some work in multiple regions or primarily at the national scale. In the results, I also provide tests for homophily (tendencies for in-group selection) based on Indigenous/non-Indigenous identity and on regional focus area.

Results

In this section, I provide measurements and visualizations of relational ties and whole network structures for each collaboration type. Additional comparisons and discussion of results are in the final section alongside conclusions. During analysis, policy collaborations were almost the same as decision-making collaborations, therefore results on decision-making offers an accurate approximation for both types.[19] Figures 2.2 through 2.4 show the network measurements and graphic images of actors and the ties between them in each of the three relations: knowledge sharing, decision-making/policy, and community-based climate adaptation. In the visualizations, each square or circle represents an actor and the lines between them are the

[18] Includes Native American, Alaska Native, Afro-Indigenous, Native Hawaiian, Polynesian, and multi-racial Indigenous.

[19] Correlation of 97.1% on the 52x52 matrix.

reported collaboration ties. Using UCINET and Netdraw software for analysis and visualizations, arrows illustrate the direction of the tie, i.e. which actor selected toward another actor.[20]

Whole network measurements include network density, average degree, centralization, percent of reciprocated ties, and the number of isolates. *Density* identifies the percent of ties present in the network as the number of actual ties in relation to the total number of possible ties. For example, a 100% density indicates all possible ties between actors are present, and zero percent reflects no ties present in a network. *Average degree* provides the average number of ties going into or out of all network members, based on the total number of ties and total number of actors. This is not a percentage but a count of actual reported ties. *Centralization* is a measure of the extent to which a network is dominated by a single node, or small set of nodes, in relation to the total number of actors. High centralization means a few actors connect the others, while low centralization indicates there are many paths in the network that do not run through a small set of central actors (Borgatti, Everett, and Johnson 2013). The percentage of *reciprocated ties* measures how many relational ties are reported present by both parties. In these results, I report and compare reciprocated ties to *one-way ties*, also called *directed ties* in social network analysis because they show the direction of a single tie from one actor to another. The number of *isolates* defines the number of actors with zero ties to other actors.

Figure 2.1 illustrates that knowledge sharing flowed between 20.7% of all possible ties connecting the 52 actors; this represents 548 one-way relational ties. In other words, about one-

[20] Visualizations use a layout algorithm that locates actors based on how close they are relationally to the actors around them, yet separates nodes at approximately the same distance to improve visual readability. This is called a graph theoretic layout algorithm based on geodesic distances with node repulsion and approximate similar lengths of lines (see Borgatti, Everett, and Freeman 2002).

fifth of all possible pairs of actors reported knowledge transfers.[21] On average, participants were sharing, receiving, or developing climate change knowledge with 11 other people in the network. Overall, I anticipated levels of knowledge transfer would be higher given the organization's explicit focus in this area. Still, this indicated a solid flow of knowledge visually represented by the dense cluster of tie lines in Figure 2.1. Around 43% of ties were reciprocated. I discuss the implications of this value later in this section. Knowledge-based collaborations were decentralized and robust, with no isolates. Therefore, removing any few actors would not affect the network patterns much because of the density of collaborations and the way actors connect around central actors. The visualizations differentiate between Indigenous and non-Indigenous participants. The results visually indicate that knowledge sharing occurred cross-culturally, and later in the results I confirm this using tests for homophily, i.e. in-group selection.

[21] The survey asked about knowledge shared, received, or collaboratively developed. Therefore Figure 2.1 shows the direction of actor selections, but not the direction of knowledge actually transferred between each pair.

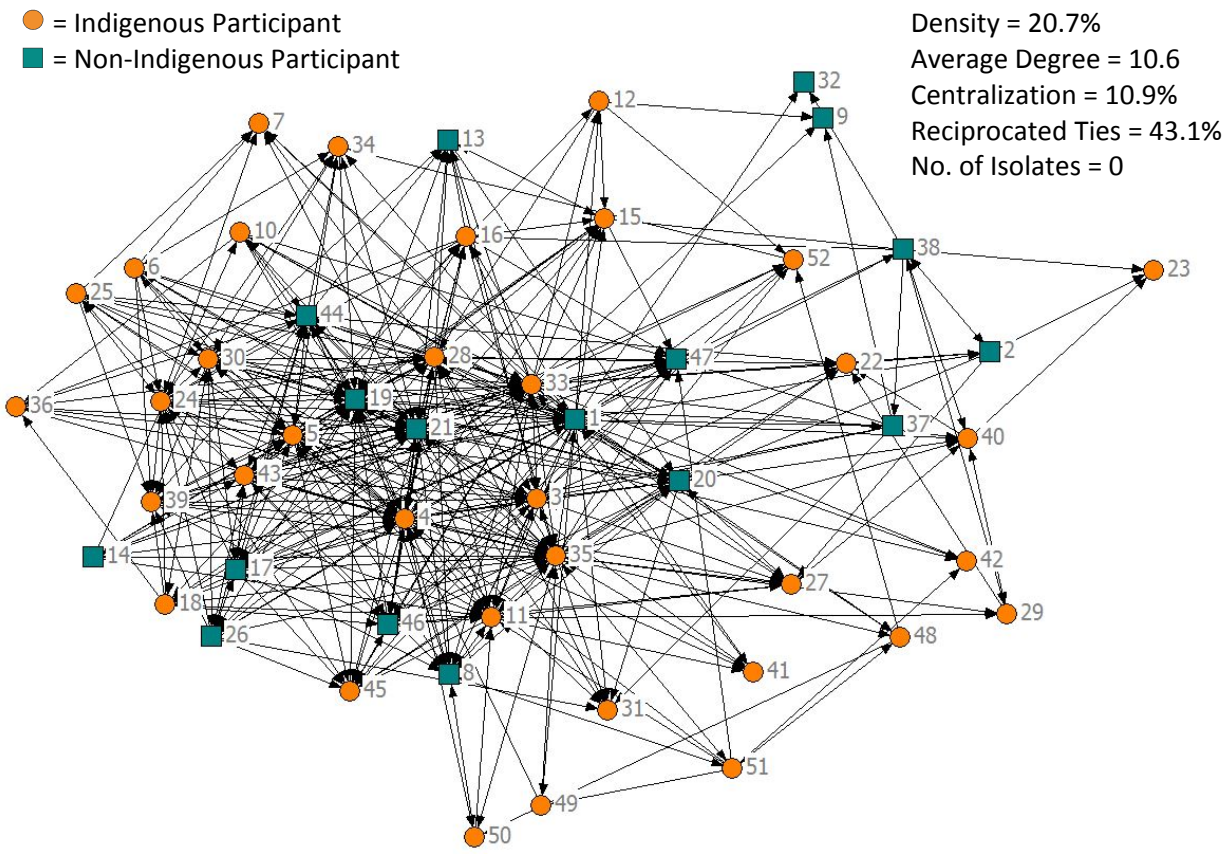

Figure 2.1: Network Visualization for Knowledge Sharing One-Way Ties (n=52)

In Figure 2.2, decision-making and climate change policy efforts revealed 196 one-way relational ties, at 7.4% of all possible ties. On average, participants were part of climate change decision-making and policy work with around four others from the network, and there were eight isolates with no collaborations of this type. While difficult to anticipate a level of integrated decision-making, I expected joint policy development to occur at higher rates given the organization's release of policy statements at national and international levels. The lower than anticipated ties may be due to participants' levels of personal involvement in constructing the policy statements or awareness of these efforts. The statements emerged from broad group discussions during annual workshops, but not written during the meetings as this would take considerable time. Findings also indicated low network centralization (15.2%). This means

actors could generally reach each other around central actors. Still, the relations were not very robust due to the low density of ties. The removal of even two central actors (No. 4 and 35) would significantly affect the network structure, create additional isolates, and increase path lengths for actors to reach each other.

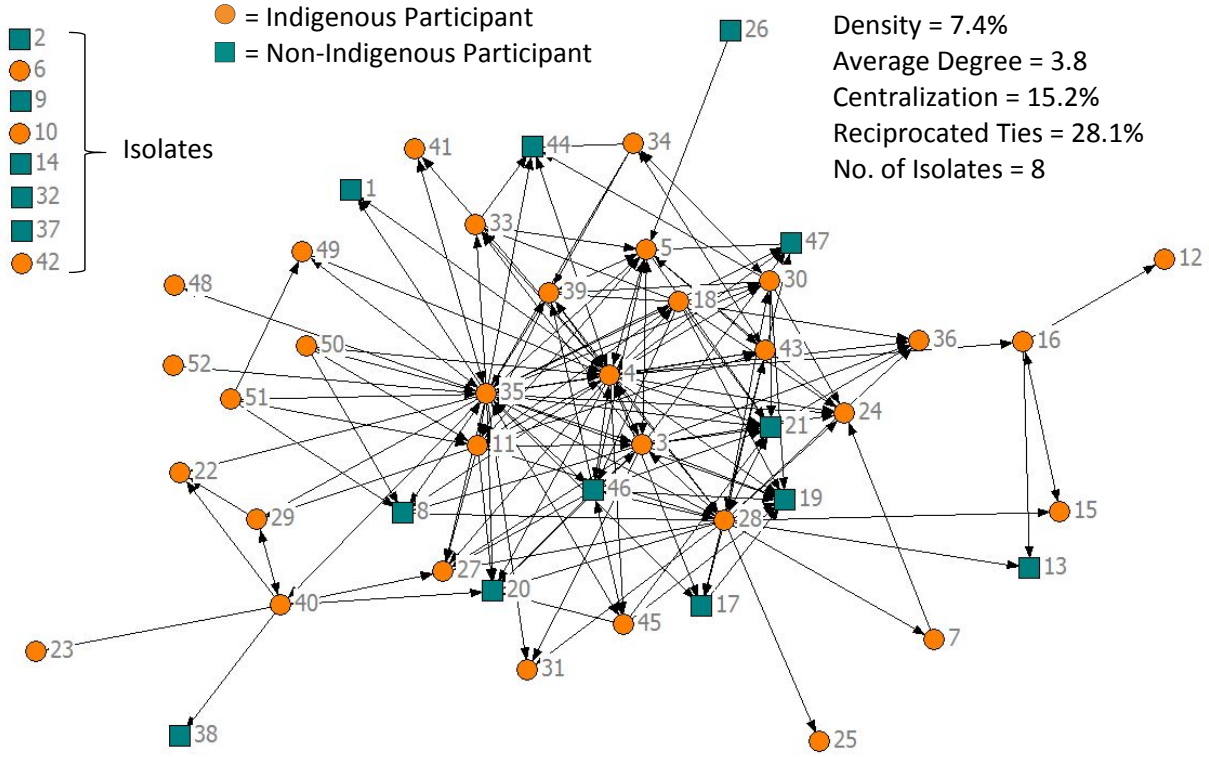

Figure 2.2: Network Visualization for Decision-Making/Policy One-Way Ties (n=52)

The results illustrate that decision-making and policy ties were significantly less prevalent in the network than knowledge transfers (7.4% compared to 20.7%). The emergence of eight isolates means 15% of participants reported no decision-making or policy activities. Decision-making and policy collaborations signal levels of shared power and integrated collaboration in cross-cultural boundary organizations.

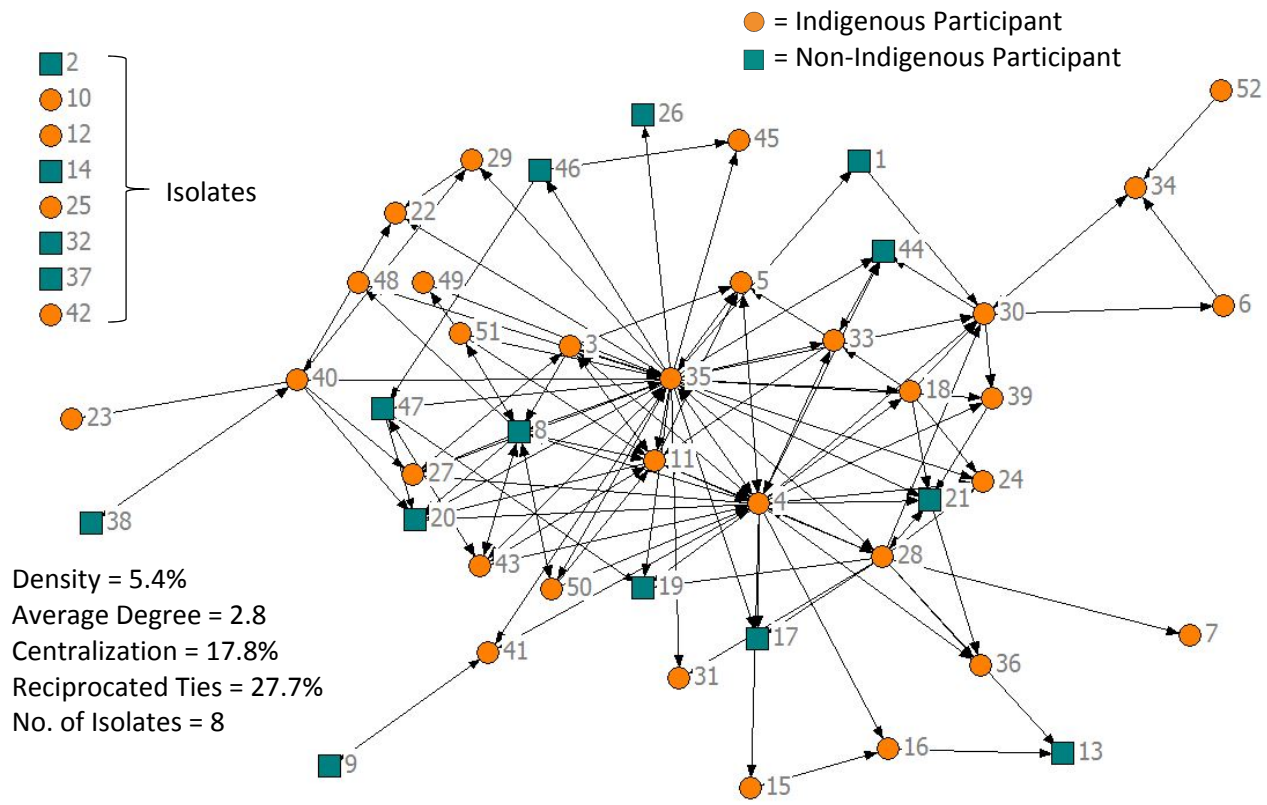

Figure 2.3: Network Visualization for Community-Based Climate Adaptation One-Way Ties (n=52)

Figure 2.3 shows 143 one-way ties in community-based climate adaptation. This amounts to 5.4% of all possible connections. Participants reported connections of this type with an average of three other people, and there were eight isolates. Relational ties in community-based actions were the least dense and less robust of the collaboration types evaluated. The low values signify an important finding due to the organization's goal to link knowledge to climate action. Again, the network was not a highly centralized structure at 17.8%. Yet it was not robust based on the low number of ties and impacts from potential removal of the same two central actors (No. 4 and 35).

Table 2.1 summarizes the network measures for each of the three collaboration types to facilitate side-by-side comparisons. The top half of the table provides values given in the

previous figures for the directed networks, i.e. one-way ties. The bottom rows present network measures based only on reciprocated ties, where participants mutually reported the tie.

Table 2.1: Whole Network Measures by Type of Collaboration

	Knowledge	Decision-Making/Policy	Climate Adaptation
Network Measure	One-Way Ties (see Figure 2.1)	One-Way Ties (see Figure 2.2)	One-Way Ties (see Figure 2.3)
Density	20.7%	7.4%	5.4%
Average Degree	10.6	3.8	2.8
Centralization	10.9%	15.2%	17.8%
Reciprocated Ties	43.1%	28.1%	27.7%
No. of Isolates	0	8	8
	Reciprocated Ties (see Figure 2.4)	Reciprocated Ties (see Figure 2.5)	Reciprocated Ties (see Figure 2.6)
Density	12.4%	3.2%	2.3%
Average Degree	6.4	1.7	1.2
Centralization	10.8%	11.5%	4.3%
No. of Isolates	8	25	27

Both one-way and reciprocated ties assist understanding of network structure. One-way ties may point to the presence of popular actors, or varied levels of memory or detail when participants complete the social network survey. The data cannot tell us why some ties in the network were not reciprocated, yet implications emerge from the values. First, the quantities of reciprocated ties again indicate greater knowledge sharing collaborations when compared to other measures (43% of knowledge ties were reciprocated, with around 28% for other collaboration types). Second, reciprocated ties for decision-making, policy, and climate adaptation actions are particularly important based on the questions asked. As described in the methods section, the survey asked about knowledge that was shared, received, or collaboratively developed. Therefore, the direction of knowledge flow did not matter when respondents made their selections. In contrast, the other collaboration types asked who each actor had *participated or engaged with* in that activity. This signified a joint action taken, not a transfer of some kind

from one actor to another. Reciprocity matters a good deal when making claims about collaborative actions. This dynamic is less pronounced in knowledge ties, where a one-way tie may represent a transfer, but a reciprocated tie illustrates dual transfers or co-production of knowledge. Yet with joint decision-making, policy, and community-based climate adaptation actions, the event either happened or it did not. While two-way ties best reflect the presence of collaborations, this paper does not entirely discount the one-way ties. Requiring a reciprocated tie to acknowledge any relational connection is too narrow.

Overall, moving from one-way to reciprocated ties lowered knowledge collaborations by 40%, and decision/policy and climate adaptation by over 55%. This reduced the network densities and average degrees accordingly, and increased the number of isolates (see Table 2.1). Network measurements, then, for reciprocated ties significantly changed network values and structures, illustrated in Figures 2.5 through 2.7.

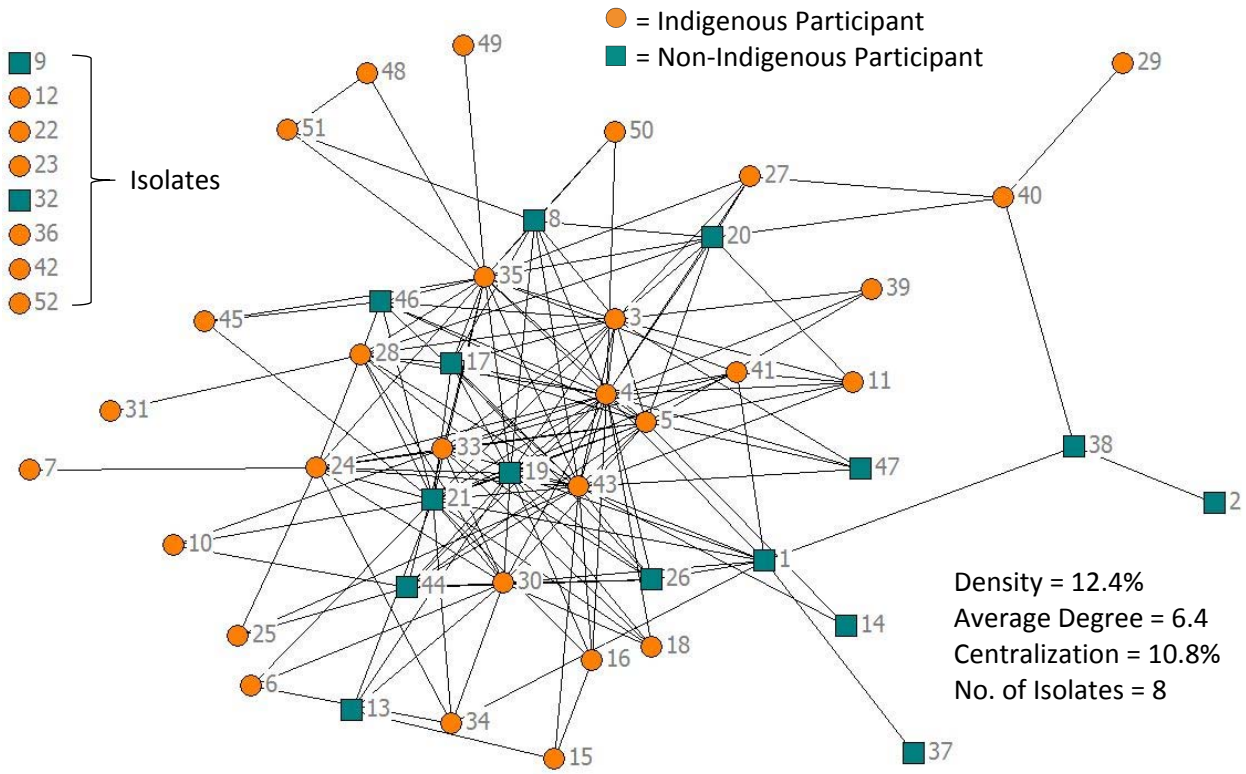

Figure 2.4: Network Visualization for Knowledge Sharing Reciprocated Ties (n=52)

Figure 2.4 depicts only reciprocated ties in knowledge sharing collaborations, i.e. a closer representation of dual transfers and co-produced knowledge. The network density dropped from 20.7 to 12.4%, and eight participants became isolates from the network. The graphic no longer shows arrows because all reciprocated ties are two-way. Average degree reduced from 10.6 to 6.4. This reflects the average number of collaborators for each participant. Network centralization remained about the same. In spite of reduced quantity of ties and the introduction of eight isolates, the knowledge network was still active and robust, evidenced by the density of ties and the average number of collaborators. Figure 2.4 also illustrates that many potential paths of knowledge transfer remain between actors.

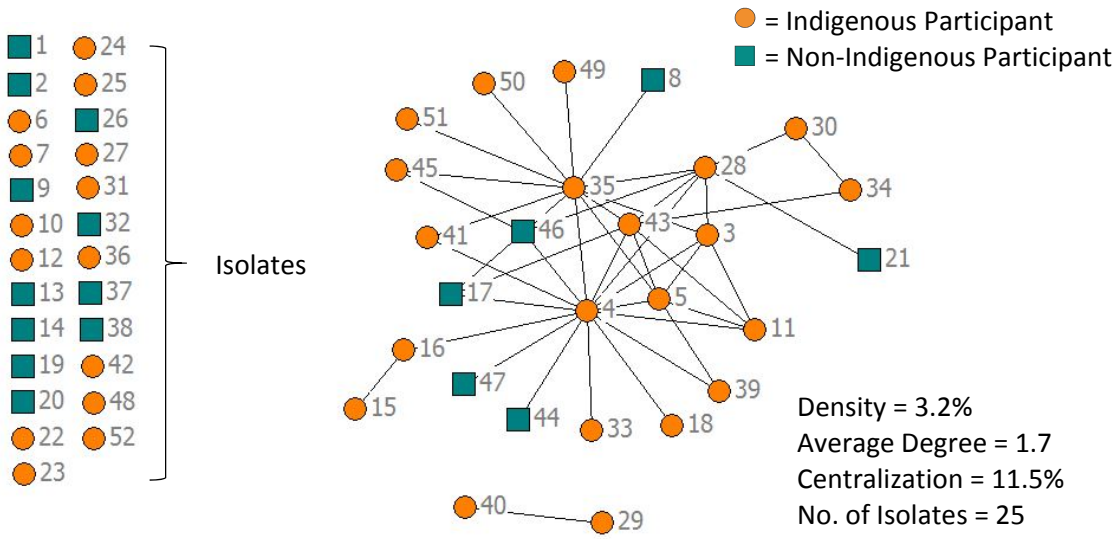

Figure 2.5: Network Visualization for Decision-Making/Policy Reciprocated Ties (n=52)

In contrast, Figure 2.5 shows that the decision-making and policy network changed drastically when considering only reciprocated ties (compare to Figure 2.2). Almost half of all participants dropped out of the network entirely and became isolates. Two other actors (No. 29 and 40) disconnected from the larger network. Referring back to Table 2.1, network density dropped from 7.4% to 3.2%, and average degree from 3.8 to 1.7. The low network density and 25 isolates for reciprocated ties indicated minimal decision-making and policy collaborations actually taking place in the organization as understood mutually by actors. Further, the potential removal of two actors (No. 4 and 35) significantly transforms the network structure. Given the importance of shared decision-making and policy engagements, these low levels reflected limits on Bridging Climate Action to move from knowledge to action as a collective.

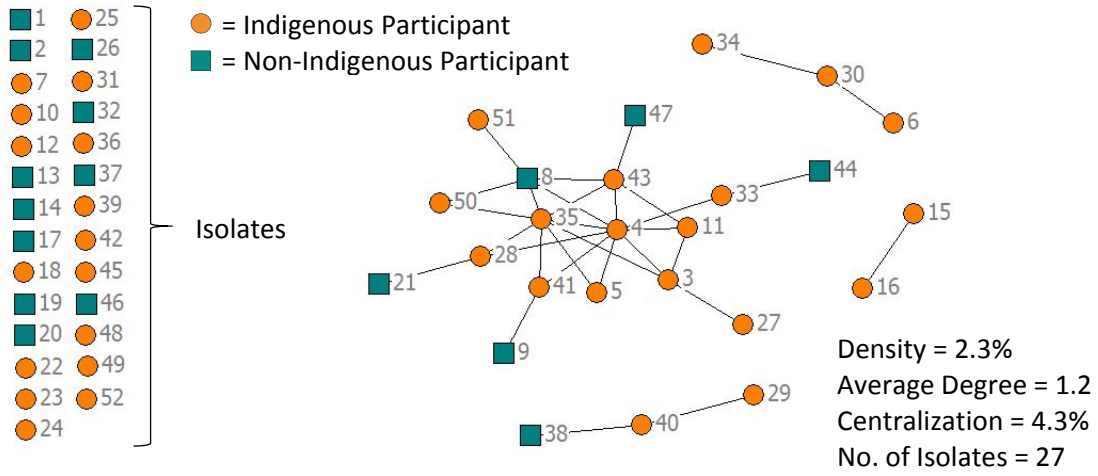

Figure 2.6: Network Visualization for Community-Based Climate Adaptation Reciprocated Ties (n=52)

Figure 2.6 reveals similar trends for community-based climate adaptation collaborations as described for decision-making and policy efforts. The lowest density was found here; the density merely 2.3%, and there were 27 isolates. The actors in the network further disconnected into four unattached clusters. Analysis based on reciprocated ties between actors indicated that climate adaptation collaborations were scarce in the network.

Measures for Homophily

Homophily tests measure actors' tendencies to select others who are like them, i.e. in-group selection. These tests also reveal where there may be heterophily, a measure of tendencies to select others outside a group. Table 2.2 presents homophily measures based on participants' Indigenous or non-Indigenous identities. It also designates homophily based on participants' primary region of focus in climate change efforts. These tests determine the extent to which cross-cultural tie selections occured in the network between Indigenous and non-Indigenous participants. They also evaluate whether actors' collaborations were primarily with others from the same region, or from different regions of the US.

Table 2.2: Permutation Tests for Homophily by Participant Indigenous/Non-Indigenous Identity and Region

	Indigenous/Non-Indigenous			Region		
Ties	Homophily Measure	In or Out-Group Tendency	*p*	Homophily Measure	In or Out-Group Tendency	*p*
One-Way Ties						
Knowledge	-0.091	In-Group	0.578	0.135	Out-Group	0.005***
Decision-Making/Policy	-0.242	In-Group	0.135	0.617	Out-Group	0.027**
Climate Adaptation	-0.286	In-Group	0.114	0.571	Out-Group	0.004***
Reciprocated Ties						
Knowledge	-0.067	In-Group	0.618	0.645	Out-Group	0.086*
Decision-Making/Policy	-0.535	In-Group	0.038**	0.674	Out-Group	0.192
Climate Adaptation	-0.355	In-Group	0.152	0.548	Out-Group	0.060*

Note: Permutation tests of expected versus observed in-group and out-group selections based on 5,000 random permutations. Homophily measures range from -1 (homophily) to +1 (heterophily). Permutation tests require symmetrized data, therefore, symmetrized maximums approximate measures for directed one-way ties.
*$p \leq .10$, **$p \leq .05$, ***$p \leq .01$

Homophily tests indicate there was a slight, but not significant, tendency for actors to select like others based on Indigenous/non-Indigenous identities. One exception was significant in-group selection for decision-making and policy collaborations based on reciprocated ties. Overall, these measures indicate that cross-cultural ties were indeed present in the network in spite of minor in-group tendencies.

For participants' regions, the tests found significant out-group tendencies, i.e. heterophily. This means actors primarily identified ties with others outside their own region. Again, decision-making/policy reciprocated ties presented one exception. These ties also exhibited out-group tendencies but not at a significant level. I had anticipated in-group selection by region for decision-making and community-based climate adaptation collaborations; I expected a correlation with regional place-based projects. This was not the case. Therefore being

from the same region was not a strong indicator of collaborations. The heterophily across regions shows knowledge was traveling across space to the various places where participants live and work. The homophily tests indicate potential for the network to increase integrated collaborations in the near future because cross-cultural and cross-regional ties were already established.

Discussion and Conclusions

The goal of this research was to assess how well a national-scale collaborative network between Indigenous peoples and climate scientists countered climate change injustices through integrated decision-making, advocacy, and place-based climate adaptation. Social network measurements and visualizations supported analysis of collaboration types at the level of ties between participants and network structures. These also provided insight on how potential gaps between organizational intent and collaborative actions played out in the network.

Overview of Findings

In summary, results indicate the network supported climate knowledge transfers, including for diverse Indigenous participants from different tribes and regions experiencing climate-related challenges. Types of collaboration well attuned to transfers of power such as joint decision-making and policy development were minimally present, as were place-based climate adaptation partnerships.

Knowledge collaborations were most prevalent of the collaboration types analyzed. Using one-way ties to measure knowledge transfers, 20.7% density reflected significant knowledge moving in the network between actors. The density for reciprocated ties, a better reflection of co-produced knowledges, lowered to 12.4% with eight actors isolated from the network. Yet this still involved 165 reciprocated ties in a network of 52 people. The network

structure for knowledge transfers and two-way knowledge collaborations revealed robust layouts where actors could reach each other in a couple steps using multiple paths. Knowledge transfers occurred within and across Indigenous and non-Indigenous participants as shown by slight but not significant in-group selection tendencies. Knowledge moved across regions with significant out-group selections. This indicates knowledges were traveling across geographical places.

For decision-making, policy, and place-based climate adaptation, reciprocated ties best represented a collaboration between two members of the network because these were not transfers but events. Reciprocated ties occurred at a low density of 3.2% for decision-making/policy and only 2.3% for community-based climate adaptation. This amounted to only 43 and 31 reciprocated ties, respectively, in the network. About half of all participants became isolates from the network relations. With the exception of knowledge transfers, the network structures for measured types of collaboration were not robust and the overall partnership levels were minimal.

Conclusions

This research finds that Bridging Climate Action, as primarily a knowledge network, marginally connects to broader Indigenous political goals. Types of collaboration well attuned to transfers of power such as joint decision-making and advocacy were marginally present. These are necessary, in concert with knowledge transfers and production, to counter climate injustices. Inclusion of Indigenous peoples within sciences, even where there may be respect for multiple knowledge systems, cannot substitute for transfers of decision-making and resources to Indigenous participants (Coombes 2012; Whyte 2013b). This requires cross-cultural collaboratives to have significant engagement with goals as defined by Indigenous peoples. In boundary organizations, goals across cultural groups may not be the same, but must be

sufficiently overlapping to maintain legitimacy. This finding is problematic given Bridging Climate Action was formed specifically to work at the intersection of Indigenous knowledges and climate science.

The low levels of climate adaptation collaborations are of particular concern because place-based climate adaptation actions are critical to further strengthen Indigenous peoples' climate change capabilities. While collaborations are an inevitable part of contending with multi-party environmental problems, these results point to limited benefits afforded to Indigenous collectives (L. T. Smith 2012; Whyte 2013b). Interpreting *action* through outcomes and not merely activity, Bridging Climate Action's measured adaptation collaborations vary from their organizational intents. Moving from climate knowledge to action translates to increasing climate adaptation collaborations among this network.

Various conclusions can be drawn about the dynamics of knowledge in this network. First, while knowledge transfers were plentiful and robust, there remains significant room for growth, particularly in reciprocal collaborations between members. Second, knowledge is strongly traveling across US regions. This includes among Indigenous participants from different regions and tribes, signaling one practical value for Indigenous climate change networks. Third, this research demonstrates climate knowledge transfers that move across cultures: in this network, knowledge is shared by Indigenous and non-Indigenous peoples. Some Indigenous participants are also formally trained climate scientists; all network members carry signficant environmental knowledges. The study shows that co-production of climate knowledge does not necessarily take place between applied climate scientists and supposedly non-scientific communities. Climate scientists are not the only parties with climate knowledges.

The study's primary limitations center on the sample size. Social network methods coupled with qualitative approaches emphasize the embeddedness of social action, but advantages become offset by research complexity. The skills and resources required to conduct mixed methods network studies tend to limit sample size (Hollstein 2014). Network dynamics may work differently in other organizations, as Chapter 4 demonstrates for climate change boundary organizations. Further, conducting whole network studies requires a moderate number of network members, yet very high member participation. Both requirements were satisfied in this research.

On their own, SNA methods are limited to engage historical factors, cultural meanings, emotions, and why only some connections and networks develop (Emirbayer and Goodwin 1994; Mische 2011). Notwithstanding, they are reliable methods to measure and illustrate relational connections and social structures present (Wald 2014). This study does not explain how the network changes over time. Employing a mixed methods social network approach allowed focus beyond identity categories for social understanding, looking also to relationships (illustrated by connections between network members), social positions, and spatial-regional considerations. This paper does not address the content of knowledge transfers or organizational practices. Chapter 4 focuses on some of these features.

The findings recommend that climate change boundary organizations deepen advocacy and place-based climate adaptation actions that benefit Indigenous peoples. This may involve partnerships with other social and political movements, greater policy work, or direct resource support for tribes' own climate change activities. The recommendation extends to other kinds of environmental collaborations. Organizations should attend up front to themes identified in the research. This includes efforts that connect to broader political goals: Indigenous peoples'

governance, well-being, and land restitution. It cannot be assumed that collaborations will bring benefits for all parties. Benefits and risks include, but extend beyond, the knowledge realm into partnership actions and outcomes. The low results for climate adaptation actions raise questions about how climate change boundary organizations might accomplish goals that operate at multiple spatial scales; in this case, a national scale group had local place-based goals that proved challenging to accomplish. The results of this study are crucial for Bridging Climate Action's self-evaluation process and serve to inform priorities of other environmental collaboration efforts.[22]

This paper employed social network and qualitative methods to measure actual collaborative ties between participants, instead of relying on organizational intents to understand collaborative processes. It fills a gap on how to assess environmental boundary organizations in light of climate injustices. The work foregrounded the minimal levels of collaboration types that signal shared power such as advocacy and integrated decision-making. Few studies have taken up social network approaches that combine studies of climate change and Indigenous environmental justice.

This study assessed cross-cultural dynamics in a national-scale climate change boundary organization formed to work across Indigenous and Western ways of knowing. The research contributes to debates on the politics of knowledge and practice around climate change. Although cross-cultural collaborations are often assumed to bring benefits, my research reframes environmental collaborations based on ethical beneficial outcomes and inevitable risks highlighted in Indigenous environmental scholarship. Knowledge transfers, cross-cultural communication, and progressive participatory processes have limited benefits in uneven climate

[22] The results have been provided to the climate science boundary organization.

change partner relations. Environmental management discourses have colonial origins that are largely discordant with Indigenous peoples' knowledges and self-governance. The research informs other collaborative contexts and urges action on the part of environmental and climate science groups. Climate change boundary organizations and other environmental groups can anticipate the challenges identified in this study and attend to problematic dynamics up front. This involves the responsibilities of collaborative endeavors to engage with Indigenous ecological and political goals, including self-determination and land rights. Countering the reproduction of inequalities requires more than inclusion of historically marginalized populations and knowledge systems. While cross-cultural climate science collaboratives are likely to diversify and improve the sciences, efforts must also ensure broader benefits beyond science organizations.

Innovative collective actions within scientific fields have potential to counter the reproduction of uneven knowledge and power relations. By assessing actual partnerships between Indigenous peoples and climate scientists, this study contributes to discussions in climate change fields about moving from climate science to action. In efforts to bring knowledges together to improve complex problem solving, collaborative endeavors also require strong advocacy based on key concerns that emerge from Indigenous politics and ethics. Cross-cultural collaborations must move beyond knowledge transfers toward integrated decision-making, policy, and climate adaptation actions because reconfiguring climate science is only one facet of beneficial outcomes.

This research makes interdisciplinary contributions by broadening conceptions of how to bring together climate science, climate justice, and adaptation to environmental change. There has been little success thus far engaging all three areas simultaneously, whether through

scholarship or practice. Ultimately, I argue that climate science, climate justice, and climate adaptation all need to be taken seriously. In that process, normalized relational and structural injustices, such as those experienced by Indigenous peoples, are central to understanding environmental change and any proposed solutions. Further, Indigenous peoples' knowledge-practices are critical for their own ongoing actions to contend with climate change connected to colonialism; these are also important to reform privileged forms of science. The research speaks largely to climate scientists and professionals about unavoidable dynamics in collaborative processes, in order to widen possibilities to act otherwise.

CHAPTER 3

Intersectional Representation among Central Actors in an Indigenous Peoples and Climate Scientist Boundary Organization

Abstract

Indigenous peoples harness collaborative networks with climate scientists to counter uneven power relations in climate change fields, and to contend with environmental change in Indigenous communities. However, these collaborations run the risk of reproducing some forms of inequality even as they challenge others. Few empirical studies consider the impact of interconnections between colonialism, racism, and patriarchy in the environmental sciences. In a national scale climate science boundary organization that brings together Indigenous peoples and climate scientists, how do central actors represent intersections of race, ethnicity, indigeneity, gender, and age? This paper employs social network analysis and qualitative methods to analyze central actors based on relational ties between participants and organizational leadership. In both cases, Indigenous women and youth were underrepresented in central roles. White women and elder Indigenous men held most central positions. However, Indigenous women consistently had bridging ties between otherwise unconnected participants, and provided less visible labor to support the network. These did not translate to decision-making roles. The findings carry implications for Indigenous women and youth, and for broader collective goals related to Indigenous self-determination and governance. The results also challenge the climate science organization's legitimacy, and limit its potential for social and scientific reforms. This paper contributes to debates about interconnected forms of oppression in environmental science fields. It also contributes to the field of intersectionality by illustrating the utility of social network methods, and the ongoing need for dialogue with Native feminist theories.

Introduction

Indigenous peoples harness collaborative networks with climate scientists in the US to counter uneven power relations in climate change fields, and to contend with environmental change in Indigenous communities.[23] Organizations that span these boundaries often seek to diversify environmental science knowledges and practices. However, these collaborations run the risk of reproducing some forms of inequality even as they challenge others. Further, cross-cultural science partnerships also need to benefit Indigenous peoples by actively supporting individual and collective self-determination. Few empirical studies consider the impact of interconnections between colonialism, racism, and patriarchy in the environmental sciences. This paper studies central actors in a national scale climate science boundary organization to understand representation at the intersections of race, ethnicity, indigeneity, gender, and age.

I employ social network analysis and qualitative methods to analyze central actors based on relational ties between participants and observed organizational leadership in a group formed to bring together Indigenous peoples and climate scientists. The organization is well connected within broader US climate change networks but maintains loose formal ties to established institutions. This may create innovative openings to alter science practices, which makes the group a valuable case study. In this paper, I argue that Indigenous women and youth in climate science organizations contend with compounding systems of disadvantage, therefore I evaluate their representation among central actors in a national scale network. Analysis of leadership and

[23] I utilize a definition of Indigenous peoples as pre-invasion inhabitants of lands now dominated by nation-states (Anaya 1996), who continue to exercise political and cultural self-determination, and derive their identities in part from the landscapes that give them distinct cultures (Wildcat 2009). This includes a diverse range of groups such as federally recognized tribes in the US, Indigenous peoples forcibly removed from lands, and others not formally acknowledged as sovereigns.

central actors provides indicators of power relations and influence processes at work.[24] This research asks: how do central actors in an Indigenous peoples-climate scientist network represent intersections of race, ethnicity, indigeneity, gender, and age?

Representation of diverse actors promises to improve scientific outcomes and reconfigure science fields (Connell 2007; Harding 2008; TallBear 2013; Taylor 2015). Those in leadership roles generally have greater decision-making power, and can serve as role models and mentors (Taylor 2015). Options emerge for central actors to advance individual and collective self-determination, alongside a long line of liberation and Indigenous sovereignty movements (L. T. Smith 2012; Connell 2007; Arvin, Tuck, and Morrill 2013). I use an intersectional approach to engage layered differences in this context. At first glance, there may be interest to merely ensure representation by Indigenous peoples among central positions. Yet an intersectional study using social network analysis and engaged participation assists deeper understanding of leadership processes, and the everyday workings of settler colonialism.[25] Despite the value of diversity goals in environmental science, these initiatives may unevenly bolster representation of some participants but not others. Further, do such initiatives extend to decision-making roles?

[24] For this paper, I define power as combinations of *relational*, *historical*, and *socio-structural systemic* influences that have the capacity to produce action or inaction (Lukes 2005; S. Hall 1986). Power operates alongside agency and resistance. Inscribed on our bodies, emotions, and sub-conscious, power is also hinged to civic participation, decision-making, critical consciousness, mobilization of grievances, resources, consent, and coercion (Lukes 2005; S. Hall 1986; Göçek 2014). While power is pervasive, my use argues it has horizontal *and* vertical dimensions; this means constructed hierarchies, such as racial categories, continue to have real effects through institutions, ideologies, cultural practices, and relational interactions (Connell 2007; Taylor 2009; TallBear 2013; Göçek 2014; Simpson and Smith 2014).

[25] Settler colonialism is a form of colonialism that seeks to remove original inhabitants through normalizing the legitimacy and practices of domination. Settler colonial formations use political, military, and economic force, alongside the actions of settler societies (Coulthard 2007; Simpson 2014). The denial of violence, past and present, "emerges through the interaction of structural (collective violence and modernity) and affective (collective emotions and events) elements of time and across space" (Göçek 2014, 12). Those closest to a nation-state's foundational violence are heavily silenced and harmed because accountability would delegitimize the dominant state and society (Göçek 2014).

Indigenous and decolonial researchers argue that the sciences, including the social sciences, have contributed to producing, reproducing, and normalizing social inequalities (L. T. Smith 2012; Bhambra 2007; TallBear 2013). Yet in their broadest sense, sciences reflect efforts by peoples in their situations and places to understand their worlds. Scholars working in these areas have emphasized turning the research lens back onto scientific practices not only for critical analysis, but to challenge institutions in specific ways (L. T. Smith 2008, 2012; TallBear 2013; Benjamin 2016b, 2016a). Linda Tuhiwai Smith calls this "unraveling research" in order to transform its focus (2008, 135). Ruha Benjamin rejects the trope of scientific groups reaching out to distant or untrusting others, instead calling on science organizations to increase their own trustworthiness in interactions (2016b, 970). And Kim TallBear in a section of her book entitled, "Who Studies? Who Gets Studied?", describes the decision to research non-Native scientists who track Native peoples' DNA (2013, 7–29). TallBear writes, "the sciences are not only a culprit, they are a site for change" (2013, 29). These refusals (see also Simpson 2007, 2014) focus on sources of inequalities instead of a deficit frame that turns blame onto recipients of discrimination. They also call on scientists to modify their actions (see also Whyte 2013b).

This paper employs a framework from intersectionality and Native feminist theories to understand inequality dynamics in contemporary climate change sciences through the case of a cross-cultural collaborative network. Indigenous women and men already in this network are well poised to create change within climate science institutions. I found that Indigenous women and youth were underrepresented in central roles in the national scale organization. White women and elder Indigenous men held most central positions. However, Indigenous women consistently had bridging ties between otherwise unconnected participants, and provided less visible labor to support the network. These did not translate to decision-making roles. The

findings carry implications for Indigenous women and youth, and for broader collective goals around Indigenous self-determination and governance. The results also challenge the climate science organization's legitimacy, and limit its potential for social and scientific reforms. Some Indigenous scholars, while wary of research methods formed in the academy, conduct quantitative research to influence what gets measured and how (Mills, Reid, and Vaithianathan 2012; Walter and Andersen 2013; Wikaire et al. 2017). Through actual measurements of central position holders, this paper contributes to debates about interconnected forms of oppression in environmental science fields. It also contributes to the field of intersectionality by illustrating the utility of social network methods, and the ongoing need for dialogue with Native feminist theories.

The remaining sections of this paper outline background literatures, methods, results, and conclusions. The background literatures engage three areas. I begin by discussing the concepts of intersectional representation and Native feminist theories. Next, I explain gender, racism, indigeneity, and age as interconnected systems of oppression that infuse privileged science fields. The third set of literatures introduce central actors as features of social networks with attention to the climate science boundary organization context. Next, I describe my research approach and methods. Results are presented in two groups. First, I employed a social network analysis of central actors. This includes a series of visualizations and data tables. Second, I used participant observation techniques to analyze leadership in the organization. Additional discussion of research findings, conclusions, and contributions follow the research results.

Background

Intersectional Representation

The term *intersectionality* was coined by Kimberlé Crenshaw (1989, 1991) to describe facets of African American women's experiences where forms of discrimination interact in law and society. Crenshaw also highlighted the role of single-issue movements such as feminism and anti-racism in exacerbating the marginalization of Black women. Patricia Hill Collins (2000) outlined interlocking systems of oppression as relational and structural, where the overlapping of race, gender, class, sexuality, nationality (and so on) take specific forms.

Scholars and activists in the field of Native feminist studies have focused on intersectional inequalities using other language. These theorize and resist interconnected systems of colonialism, heteropatriarchy, and racism that serve the US settler state and settler society (Arvin, Tuck, and Morrill 2013). Native feminist theories counteract US efforts to dominate Indigenous lands, bodies, and cultures.[26] Scholars emphasize related spatial features, including goals to contain Indigenous peoples (Goeman 2009), sexual violence against women and unjust marriage laws (A. Smith 2005; Simpson 2007, 2014; Deer 2015), and the impacts of Indian boarding schools (Goeman 2009; Jacob 2013; Dhillon 2017). Others focus on intertwined ecological violence (A. Smith 2005) and imposed gender and sexuality norms (Arvin, Tuck, and Morrill 2013; Rifkin 2014). Works also address how various pressures have been placed on tribes to adopt patriarchal and bureaucratic forms of governance (Green 2007; Goeman and Denetdale 2009). These relational and structural systems continue to bolster US colonialism set

[26] Following Arvin, Tuck, and Morrill (2013), I use the term *Native feminist theories* to reflect a broad and growing intellectual field that centers, but is not limited to Indigenous, feminist, or woman identified people.

against Indigenous sovereignty, and to disadvantage Indigenous women in broad society and some tribal contexts.

Here, I emphasize immense diversity within and between the 573 federally recognized tribes in the US, and other Indigenous peoples with state recognition or no formal recognition. I also emphasize the many resistances against interconnected systems of disadvantage from the first moment of colonization through today. Despite slow, but growing, visibility in academic arenas, Maile Arvin, Eve Tuck, and Angie Morrill explain, "The experiences and intellectual contributions of Indigenous women are not on the margins: we have been an invisible presence in the center, hidden by the gendered lens of settler colonialism for over 500 years" (2013, 14). Native feminist endeavors interact with everyday actions by Indigenous individuals and collectives such as through cultural revitalization activities (Jacob 2013).

Although diverse, many North American tribes were matrilineal pre-colonization and shared mutual respect across genders (Denetdale 2006; Green 2007). Women had influence over decision-making, including around collective political and economic decisions, not only in domestic affairs (Denetdale 2006; Goeman and Denetdale 2009). Indigenous women have always been knowledge keepers (Green 2007; Goeman 2009; Jacob 2013).[27] Described and enacted by Robin Kimmerer (2012, 2015) and Deborah McGregor (2004, 2012), many Indigenous women regenerate culturally important practices and places. These knowledge-practices honor reciprocal relationships between humans, with plants, animals, the land, and other entities (McGregor 2004, 2012; Kimmerer 2012, 2015). Additional studies have examined

[27] These theories generally do not ascribe to a traditional/modern binary. They call for justice as understood differently by contemporary Indigenous peoples. History and political-cultural distinctiveness of Indigenous peoples may translate justice as sovereignty and the return of land governance to Indigenous collectives in North America. Native feminist theories are cognizant of partial incommensurabilities between various liberation strategies, but this does not preclude seeking out connections across various forms of difference (Goeman 2009; Arvin, Tuck, and Morrill 2013; Simpson and Smith 2014).

how colonialism and ecological destruction also affect Indigenous masculinities using an intersectional lens (Vinyeta, Whyte, and Lynn 2015; Norgaard, Reed, and Bacon 2018).[28] Colonial US policies mandated bureaucratic patriarchal governance for tribes as a means of domination that disrupt collective governance, women's influences outside the home, and land-tenure systems (Denetdale 2006; Green 2007; Arvin, Tuck, and Morrill 2013). Indigenous youth contend with intense ongoing structural and colonial violence that disrupts dignity, well-being, and empowerment (Dhillon 2017). The influences remain pronounced and intertwined with maintenance of current nation-state legitimacy (Denetdale 2006; Rifkin 2014).

There are ongoing debates about appropriate conceptualizations of intersectionality. Some argue a need to step beyond analysis based on identities and groups, toward affinities, processes, and social systems (Sandoval 2000; Dhamoon 2011). Others maintain that while identities and groups do not essentially determine perspectives or actions, diverse representation plays a role in contributing to social change (Carbado et al. 2013; Collins 2015a). Disadvantages, privileges, embodied experiences, and responses to oppression manifest themselves differently by place and time (Dhamoon 2011; Carbado et al. 2013; Collins 2015a). Continued debates about intersectionality theory and praxis reveal the importance of related concepts to understanding contemporary social dynamics. Recent scholarship exhorts fewer attempts to define universal notions of intersectionality; instead, the focus has turned toward what it reveals about systems of power in specific place-times (Dhamoon 2011; Carbado et al. 2013; Collins 2015a).[29]

[28] The goals of Native feminist theories are not to dominate men. Interconnected systems of oppression take differentiated forms that affect, for example, Indigenous and racialized men and two-spirit persons.

[29] While these studies discourage essentialized notions of experience for individuals with similar identities, they also warn of depoliticizing the theory in ways that sideline African American women and other women of color. These works also emphasize the importance of practical actions that unhinge interconnected systems of

An empirical study on *intersectional representation* by Meredith B.L. Walker (2011) looks at the role of Black male representation, as teachers and on school boards, for African American male student outcomes. Walker found that intersectional representation was significant, yet student outcomes were mixed. So while increased diverse representation can improve outcomes, there are cases that show otherwise. Intersectional approaches attend to layered differences although peoples' experiences are not simply the addition of corresponding identities. In *The Concept of Representation*, Hanna Pitkin (1967) outlines two forms of representation: descriptive (when belonging to the group represented), and substantive (when responsive to the group represented). Other scholars emphasize the inadequacies of representative inclusion without corresponding power to set the terms of participation and decision-making (Coulthard 2007; Simpson 2007; Arvin, Tuck, and Morrill 2013). The systematic neglect or distortion of people and perspectives marginalized in privileged accounts results in two related problems: the failure to deliver accurate histories leading to a lack of understanding about the present (Bhambra 2007, 2014; Connell 2007, 2011, 2014).

Diverse representation contributes to multi-faceted dynamics of seeking social change from within places of power.[30] Representation has potential to influence the everyday lives of diverse Indigenous peoples as they live well, individually and as collectives. When coupled with decision-making power, diverse representation can change institutions from within. It can affect institutional legitimacy and trust building, positively or negatively, depending on the situation

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oppression. See also Vanessa Watts' (2013) challenges to Euro-Western discourses on essentialism. And see Chandra Talpade Mohanty (2003) on connecting struggles for justice across place-times.

[30] This discussion highlights ever-present tensions between strategies that seek social change from within, outside, and as independent alternatives of existing social structures (Sandoval 2000; L. T. Smith 2012). The inadequacies of inclusion, participation, and recognition are particularly poignant in Indigenous-settler relations where Indigenous peoples' sovereignties resist and revise terms of recognition proposed by North American states, courts, and settler majority (Coulthard 2007; Bruyneel 2007; Simpson 2007, 2014).

(Taylor 2009, 2015). Diverse representation may open paths to individual empowerment and collective action (Taylor 2009, 2015).

Interconnected Systems of Oppression and the Sciences

A set of studies on oppression and the sciences draw from critical race theory, Indigenous studies, and feminist science studies. Collins (2015b) highlights this relationship, arguing that tackling racism in science continues to be a challenge because science narrates insider practices as color-blind. Pervasive implicit racist codes, just as in color-blind racism, adapt over time and exist not only in attitudes and the products of science, but through scientific practices. Both Collins (2015b) and Anthony Hatch (2014, 2016) describe bioscience approaches focused on racial categories that slide back toward eugenics, as a modified scientific racism. Ruha Benjamin (2013, 2016b, 2016a) and Alondra Nelson (2013, 2016) take up similar themes on intersecting inequalities bound up with the sciences, and the many ways people reclaim the benefits of science. Benjamin proposes, "we consider how an *abolitionist consciousness* is a way of conceptualizing efforts to exercise freedom and agency with and against sciences and technologies" (2016b, 151). These studies describe structural workings of racism in science with connections to systemic violence. They also focus on forms of surveillance and commercialization that undercut equitable benefits of science. Reconfiguring science practices involves simultaneous engagement with and resistance against them.

Linda Tuhiwai Smith (2012) and TallBear (2013) address dynamics of ongoing colonialism at work through sciences joined to settler states and societies. TallBear (2013, 203) explains,

> We indigenous peoples have been forced to confront the sciences and all of the disciplines for the benefit of our communities. We do this to make our and our families' lives more livable, and often because we see such engagement as somehow aiding the survival of our collective peoples. Frankly, we have had little choice but to engage at

> some level if we are to survive. Science has certainly traded in assimilation, marginalization, and genocide. But it has also been steered toward indigenous goals of self-determination, cultural vitality, and environmental restoration, for example.

Education has played a role in colonization through, for example, boarding schools, the content of the sciences, and normalizing particular economic and governance systems (L. T. Smith 2012). Still, these scholars encourage Indigenous scientists and researchers to persist. This is not merely to foster diversity or to improve science outcomes, but to harness research for the benefit of Indigenous collectives.

In hopes to transform scientific knowledge production and practices from within and without, Collins argues insider-scientists may trek far to unhinge systemic inequalities "hidden in plain sight" (2015b, 51) within the sciences. This is due to constant expert gatekeeping and difficulties of gaining insider status among scientists. Research by Dorceta Taylor has addressed diversity within environmental fields, including race and gender in environmental organizations (2014b, 2015), and among environmental science students (2017). A recent study found significant gains for White women in mainstream environmental organizations, while people of color remain underrepresented (Taylor 2015). Representation of women now matches or exceeds men from intern to senior staff levels, although women remain underrepresented at top positions such as president or board chairperson. In contrast, racial diversity remains very low at all levels of environmental staff and hiring, particularly at highest leadership levels with averages between 3-6% (Taylor 2015). Especially underrepresented are Black, Latinx, and Native American peoples, although environmental justice organizations are exceptions (Taylor 2015). Therefore, in mainstream environmental fields, diversity initiatives of recent years have largely benefitted White women (Taylor 2014b, 2015).

Other studies also show the environmental sciences have low diversity based on race and indigeneity. The Ecological Society of America's (ESA) last published report showed miniscule gains in their membership percentage of Native Americans, Blacks, and Latinos between 1992 and 2005, moving from 4.1 to 4.6% (Perkins 2006; Ortega et al. 2006). Native Americans represented 0.3% of ESA membership in 2005 (Ortega et al. 2006). Among students, Taylor's (2017) study shows that students of color were equally interested in and prepared for environmental careers. These students strongly valued organizational focus on diversity initiatives, although diversity factors were more salient to women than men, and specific initiatives were valued differently by various racial and ethnic groups (Taylor 2017). In general, environmental organizations and sciences still lack diverse representation, particularly by Indigenous, Black, and Latinx populations.

Central Actors in Climate Science Boundary Organizations

This climate science boundary organization brings together Indigenous peoples and climate scientists in part to diversify the climate science field. The network focuses on knowledges and actions that strengthen Indigenous peoples' capabilities to contend with and adapt to climate change. Environmental boundary organizations interface between science, policy, and politics with accountability to those on both sides of a boundary (Guston 2001). Shared governance is an integral feature of boundary organization legitimacy. Analysis of central actors provides insight into governance, diversity, and structural-relational influences.

Social network analysis is a tool that can assess, for example, meso-level social structures and features of relationships between individual actors or groups. Within networks, the approach might illustrate the movement of knowledges, levels of trust or interaction, or actor roles (Borgatti, Everett, and Johnson 2013). In this study, I focus on central actors because they often

influence network flows, the legitimacy of governance, and how things get done (Borgatti, Everett, and Johnson 2013). While it cannot be assumed that central actors have greater power, visibility, or influence than other network members, where relational ties represent a positive type of connection, this is often the case (Borgatti, Everett, and Johnson 2013). For positive relational connections, there are likely advantages for central actors. (A negative example would be an infectious disease network, where peripheral actors may have an advantage.) In networks, actor status relates to the status of those one connects to, therefore measures sometimes consider the centrality of adjacent actors (Bonacich 1987). Social network studies might also address how actors came to be in central positions.

Network methods posit various approaches to identify central actors. They also reveal benefits and drawbacks of different kinds of network ties. Bonding ties between those with similar characteristics or positions can signal strong trust and mutual influence. Conversely, these actors may lack exposure to diverse ideas. Their similarities can bring constraining effects through imposition of norms or perspectives (Newman and Dale 2005). Bridging ties connect diverse actors, groups, or resources. These might be weaker ties that sever more easily, although they often bring innovation by linking otherwise distant actors and ideas (Burt 2004). I describe the specific centrality measures used in this research at the beginning of the results section, which derive from these basic network concepts.

Although applications of social network analysis in environmental fields is growing, social network studies have not investigated features of cross-cultural environmental boundary organizations, particularly using an intersectional lens. Network studies have focused on natural resource governance (Bodin and Crona 2009; Frank et al. 2011), and stakeholder selection in resource management (Prell et al. 2008; Prell, Hubacek, and Reed 2009). Others look at social

capital and social learning among environmental scientists and managers (Fischer et al. 2014, 2014). Broadly, these studies support the idea that diversity in networks helps broaden knowledge and the ability to adapt to changes, while clustered subgroups may lead to in-group and out-group conflict dynamics. Cross-difference ties are necessary to increase governance legitimacy, belief in collective action, and confidence to solve complex problems.

Another emerging set of social network studies investigate climate change networks, including echo chambers in US climate policy (Fisher, Leifeld, and Iwaki 2013; Jasny, Waggle, and Fisher 2015). Other works address authorship and membership nominations in environmental scientific assessment bodies (Corbera et al. 2016; Leifeld and Fisher 2017). These studies show how prior contact and similarities between actors produce insular dynamics heavily shaped by particular people, institutions, and ideologies (Corbera et al. 2016; Leifeld and Fisher 2017). These similarities can reduce friction, but include drawbacks such as lack of diverse viewpoints and reduced trust by those on the peripheries.

This paper empirically examines diverse representation among central actors in a national scale climate science boundary organization. It assesses leadership patterns within the network that reflect relational and structural processes. This group consists of deep knowledge holders about environmental change across tribal and US regions. Certain benefits accrue to its central actors, while the weight of colonial science and governance inevitably constrain reform of climate science practices. The research asks: in this organization, what is the intersectional representation among central actors based on race, ethnicity, indigeneity, gender, and age? In efforts to revitalize Indigenous traditional ecological knowledges, other forms of inequality can persist. Colonial influences have linked notions of tradition to heteropatriarchy and racism, in particular. Common values in Indigenous protocols, such as reciprocal responsibilities, trust, and

collective flourishing, can provide guidance for respectful meanings of *traditional* in partnership processes. To many Indigenous peoples traditional means time-tested, practically appropriate, and infused with wisdom (Denetdale 2006; Hatfield 2009; Jacob 2013). Indigenous knowledge-practices are simultaneously deep-rooted and dynamically adaptive. Respect for tradition does not equate to inaccurate notions of history that subvert Indigenous peoples' collective or individual well-being. This paper seeks to understand how evenly this organization's efforts to diversify climate science benefitted various parties. Cross-cultural environmental collaborations run the risk of reproducing some forms of inequality even as they challenge others.

Methods

I employed social network analysis, engaged participation, and secondary data to assess central actors in the climate science boundary organization. I use the pseudonym *Bridging Climate Action* for this network that emphasizes inclusion in climate knowledge production. The boundary organization formed in 2013 to bring together Indigenous knowledges with climate science, and to build Indigenous peoples' climate adaptation capabilities. Formal organizational statements focus on integrated collaborations through relational trust development and cross-cultural research initiatives. As a national scale network that contains visible actors working on Indigenous peoples' climate change concerns across the US, study of its leadership representation explores features of cross-cultural power relations in climate science. People in the group all have significant knowledge about environmental change, even if not formally trained as climate scientists through academic institutions. As a boundary organization situated largely outside established institutions, Bridging Climate Action has opportunities for innovative practices that may work against systemic inequalities. The group's overarching identity encompasses a knowledge-to-action network (see Chapter 2). A few advocacy statements

released over the years aimed to influence US and international climate policy in support of Indigenous peoples' climate adaptation.

Data Collection and Data Analysis

In July 2016, I administered the social network survey in person as part of the annual workshop for Bridging Climate Action. Key organization leaders defined the network boundary by selecting participants from among a set of applicants. The social network survey included questions about participants' identities, and collaborations with others in the group. Engaged participation and secondary sources informed the survey, observational results, and discussion of research results. Secondary sources included organization reports, policy statements, an email listserve, related websites, and social media pages. My participation in the network began in January 2015. Since that time, I have had access to ongoing activities in the organization including attendance at three annual workshops and regular interactions with network members.

The social network survey queried participants for the following identities and attributes: gender; age; racial, ethnic or indigenous identity; employment affiliation; and regional focus and spatial scale of climate change work. The survey used a roster of all attendees at the workshop where participants identified their collaborations with everyone in the network. Types of collaboration surveyed include knowledge-sharing, joint decision-making/policy efforts, and community-based climate adaptation partnerships. These collaboration types represent equity concerns in climate science, including the level of network integration, advocacy, and place-based projects as described in Chapter 2. Fifty of 52 participants returned the paper survey (a 96% response rate). Data matching determined the network ties for the remaining two participants, while secondary sources established their identities and attributes. The survey results, therefore, include all 52 participants.

In data analysis, I used an Excel spreadsheet to create the 52x52 matrices for the collaborative relationships in the network, and a 5x52 matrix for actors' identities and attributes. I imported these into UCINET and Netdraw software to determine central actors based on different measurement approaches.[31] I then exported analysis results back into an Excel spreadsheet for examination, including central actors' identities. Based on these examinations, I found that gender, age range, and racial/ethnic/indigenous identities produced strong patterns among central actors. Network visualizations in Netdraw coupled with centrality measurement data illustrated these features. In the results, I supplemented these network measurements of central actors with participatory observation over three years about leadership positions in the organization.

Table 3.1 provides descriptive statistics for participant identities to aid interpretation of results.[32] These summarize gender, age range, and racial/ethnic/indigenous identities of all actors, whereas visualizations and data tables in the next section focus on participants that emerge as central actors. A few items bear mention here. Thirty-five of 52 participants (67.3%) identified as Indigenous, with 42.3% as Indigenous women and 25.0% as Indigenous men. Nine actors (17.3%) of any gender are under 30 years old. The two most populous gender and age groups are women, aged 31-50 (18 actors at 34.6%) and men, aged 51-70 (11 actors at 21.2%).

[31] UCINET and Netdraw software are created by Borgatti, Everett, and Freeman (2002).

[32] The survey contained a write-in box for gender and for racial, ethnic or indigenous background to allow for many ways persons self-identify. Zero participants noted non-binary gender identification. One participant wrote in their racial/ethnic/indigenous background as, "None, race is a social construct". Secondary data identified this person as a White man. Fourteen participants (27%) described multiple racial/ethnic/indigenous identities. Due to many combinations, I grouped Indigenous participants together for social network analysis, but note here a variety of ways multi-heritage persons self-identified. Multi-heritage Indigenous persons identified combined backgrounds as Afro-Indigenous, Asian, European, and Latinx.

Each of these data become important in research results and discussion of intersectional representation among central actors.

Table 3.1: Social Network Analysis Participant Demographics

		Women		Men	
Demographic Characteristics	*n*	No.	%	No.	%
Racial, Ethnic, or Indigenous Identity					
Indigenous[(1)]	35	22	42.3	13	25.0
White/Caucasian/European	10	5	9.6	5	9.6
Asian/Asian-American	4	1	1.9	3	5.8
Multi-heritage (Non-Indigenous)	2	1	1.9	1	1.9
Latinx/Hispanic	1	1	1.9	0	0.0
Total	*52*	*30*	*57.7*	*22*	*42.3*
Age Range (years)					
18-20	2	1	1.9	1	1.9
21-30	7	3	5.8	4	7.7
Total 18-30	*9*	*4*	*7.7*	*5*	*9.6*
31-40	12	9	17.3	3	5.8
41-50	12	9	17.3	3	5.8
Total 31-50	*24*	*18*	*34.6*	*6*	*11.5*
51-60	11	4	7.7	7	13.5
61-70	8	4	7.7	4	7.7
Total 51-70	*19*	*8*	*15.4*	*11*	*21.2*

Note: (1) Includes Native American, Alaska Native, Afro-Indigenous, Native Hawaiian, Polynesian, and multi-heritage Indigenous.

To provide a broader view of network participants, I briefly summarize their types of employment, regional foci, and spatial scales of climate change work. About half of all participants worked for either the US federal government, non-Indigenous NGOs, or non-tribal academic/research institutions. Another third primarily affiliated with tribal governments, tribal communities, tribal NGOs, tribal colleges and universities, or tribally owned companies. Secondary data indicated many participants identified with multiple roles, for example through their employment and tribal or community affiliations. Group members were well distributed from across US regions. Indigenous participants from many tribes worked on climate change as

scientists, in governments, through education, NGOs, and so on. Non-Indigenous participants were primarily from federal government programs, NGOs, or academic/research institutions. Few participants were formal representatives from their tribes to the group. Many many actors indicated they work on climate change in multiple regions and at various spatial scales, from the local to national to international.

Results

The results document measurements of central actors and network visualizations for each collaboration type part of this study: knowledge sharing, decision-making/policy efforts, and place-based climate adaptation partnerships. Participatory methods describe intersectional representation among visible, and less visible, leadership in Bridging Climate Action. The final section of this paper provides additional discussion of results alongside conclusions.

With multiple ways to assess which actors are central in a network, I focused on and compared three approaches that yield a range of results: (1) degree, (2) eigenvector centrality, and (3) betweenness (Borgatti, Everett, and Johnson 2013). First, I ranked actors based on their *degree*. This is the quantity of ties to other actors. Those with high numbers of ties have potential to mobilize the network or diffuse information quickly. These often appear in network visualizations as the most central actors.[33] A second approach, *eigenvector centrality*, additionally considers the centrality of adjacent actors. In this measure, actors connected to other highly connected actors receive higher rank. Lastly, I ranked actors by *betweenness*, a measure of who has more links between otherwise unconnected groups of actors. High betweenness

[33] Visualizations use a layout algorithm that locates actors based on how close they are relationally to the actors around them, yet separates nodes at approximately the same distance to improve visual readability. I use a graph theoretic layout algorithm based on geodesic distances with node repulsion and approximate similar lengths of lines (see Borgatti, Everett, and Freeman 2002).

means removal of that actor, even if they do not have the highest number of ties, results in disconnecting other actors from each other. These play bridging roles that tend to diversify the network. They may offer broader views of problems or solutions, or connect others to the network who do. Actors can be high in one kind of centrality but low in another, necessitating comparisons between measures.

For each collaboration type assessed, I provide a network visualization and two data tables identifying central actors. The visualizations assist explanation of the more detailed information provided in the data tables, and highlight cases where central actors varied based on the three measurements used. In the figures, red circles draw attention to central actors using degree and eigenvector centralities. The yellow circles identify central actors with high betweenness centrality, but generally low centrality using the other two measures. Each square represents a woman and a circle represents a man. The node colors provide the age range of each actor. Lines between actors show relational ties, and the number next to each node is the actor's identifying number which remains constant throughout this study. Actors listed in a column to the left of an image are isolates with zero ties to other participants.

The data tables identify the most central actors for each of the three centrality measures, along with corresponding gender, age range, and racial, ethnic, or indigenous identity. Additional information on each actor is not provided to maintain participant confidentiality, and because the other variables did not produce patterns among central roles. I placed a dashed line below the eight most central actors based on a combination of the three measures. In some cases, a few additional actors are shown below the line. Those below the dashed line represent participants not among the most central based on degree or eigenvector centrality, but with high betweenness.

The results indicated Indigenous women predominate in these bridging roles, with implications explained later in this paper.

I chose to focus on the top eight actors corresponding to the most central 15% of all participants. Where less relational ties were present or there was a large drop in degree between the first to eighth actors, only six or seven participants could reasonably emerge as centrally located in relation to their peers. It is difficult to conclude an actor is most central to a network when having much lower relational connections than the top few actors. I identify these cases while moving through the research results and by placement of the red circles on the figures. The data tables provide actor centrality for both maximum and reciprocated ties. In maximum ties, all ties are deemed reciprocated, even if a tie runs only in one direction. For reciprocated measures, a tie is active only when noted by both participants. Assessing both maximum and reciprocated ties has value in the results. Reciprocated ties indicate a stronger connection between two participants, yet using these alone discounts many other selections made by network members.

Figure 3.1 illustrates central actors for knowledge sharing ties. Focusing on the most central shown inside the red circle, these were women and men from a wide age distribution between 31-70 years old.

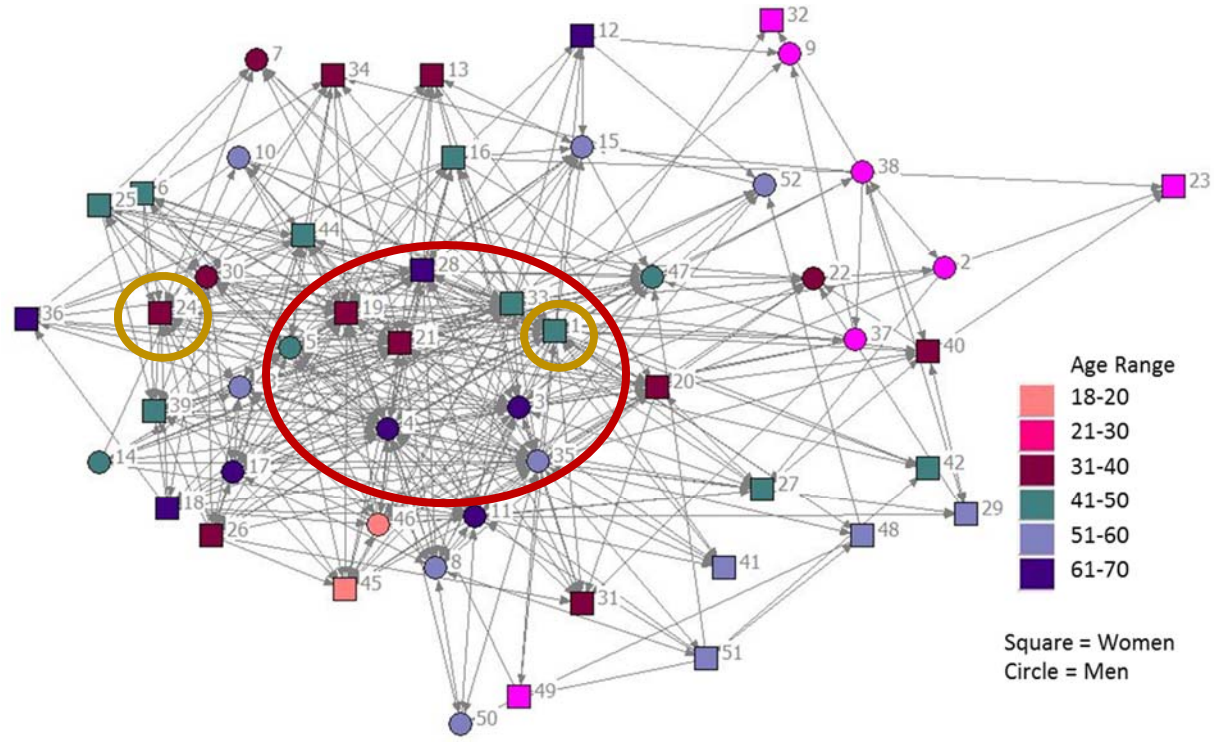

Figure 3.1: Visualization of Central Actors for Knowledge Sharing Ties (n=52)

Table 3.2 shows these central actors carried various racial/ethnic/indigenous identities, and two were Indigenous women. No central actor was under 31 years of age. For reciprocated ties, identified in Table 3.3, the most central actors in knowledge sharing were Indigenous men in the broad age range of 31-70, and White women, with a narrow age range between 31-40. Two actors in Table 3.3 (24 and 1) were not among those most central based on degree or eigenvector rankings, but did have relatively high betweenness centrality (ranking at 6 and 4 respectively). Both were women, circled in yellow on Figure 3.1.[34] The high betweenness rankings mean that while these women were not centrally located for reciprocated ties, they played bridging roles that connected disparate parts of the network.

[34] Note that actor 1 was central for maximized ties but not for reciprocated ties. Therefore, she appears inside the red circle in Figure 3.1. This case of high degree/eigenvector centrality in maximized ties, but low centrality and high betweenness in reciprocated ties was an exception.

Table 3.2: Central Actors for Knowledge Sharing Maximized Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
1	40	1	4	1	Latinx	woman	41 - 50
33	37	2	3	2	Indigenous	woman	41 - 50
21	36	3	1	5	White	woman	31 - 40
4	35	4	2	4	Indigenous	man	61 - 70
35	35	4	5	3	Indigenous	man	51 - 60
28	28	6	6	6	Indigenous	woman	61 - 70
19	27	7	7	10	White	woman	31 - 40
5	26	8	8	13	Indigenous	man	41 - 50

Table 3.3: Central Actors for Knowledge Sharing Reciprocated Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
4	25	1	1	2	Indigenous	man	61 - 70
43	21	2	2	3	Indigenous	man	51 - 60
21	20	3	3	5	White	woman	31 - 40
35	20	3	5	1	Indigenous	man	51 - 60
5	17	5	6	10	Indigenous	man	41 - 50
19	17	5	4	12	White	woman	31 - 40
3	16	7	7	14	Indigenous	man	61 - 70
30	14	8	10	13	Indigenous	man	31 - 40
24	12	9	11	6	Indigenous	woman	31 - 40
1	10	12	17	4	Latinx	woman	41 - 50

Overall, for knowledge sharing relational ties, Indigenous women and youth were underrepresented among central actors. Two Indigenous women were centrally located for maximized ties, but neither was central based on reciprocated ties. For reciprocated ties, central actors consisted primarily of elder Indigenous men, and 31-40 year old White women. Two women, one Indigenous and one Latina, emerged as bridge-builders that connected more distant actors to the main network.

Moving to decision-making and policy relational ties, Figure 3.2 identifies the most central actors as primarily Indigenous men, aged 51-70. One Indigenous woman and one non-

Indigenous youth also shared central roles. Tables 3.4 and 3.5 provide the background details where elder Indigenous men predominated in both maximized and reciprocated ties. Actors 40 and 16, both Indigenous women, emerged with low ties but higher betweenness measures. Interestingly, the women in bridging roles for decision-making and policy collaborations were different actors than those already noted for knowledge sharing ties. Figure 3.2 also shows that although two 18-20 year old participants connected to central actors, all those aged 21-30 landed at perimeters of the network. Further, four 21-30 year olds became isolates, and two connected only through bridging by an Indigenous woman, actor 40.

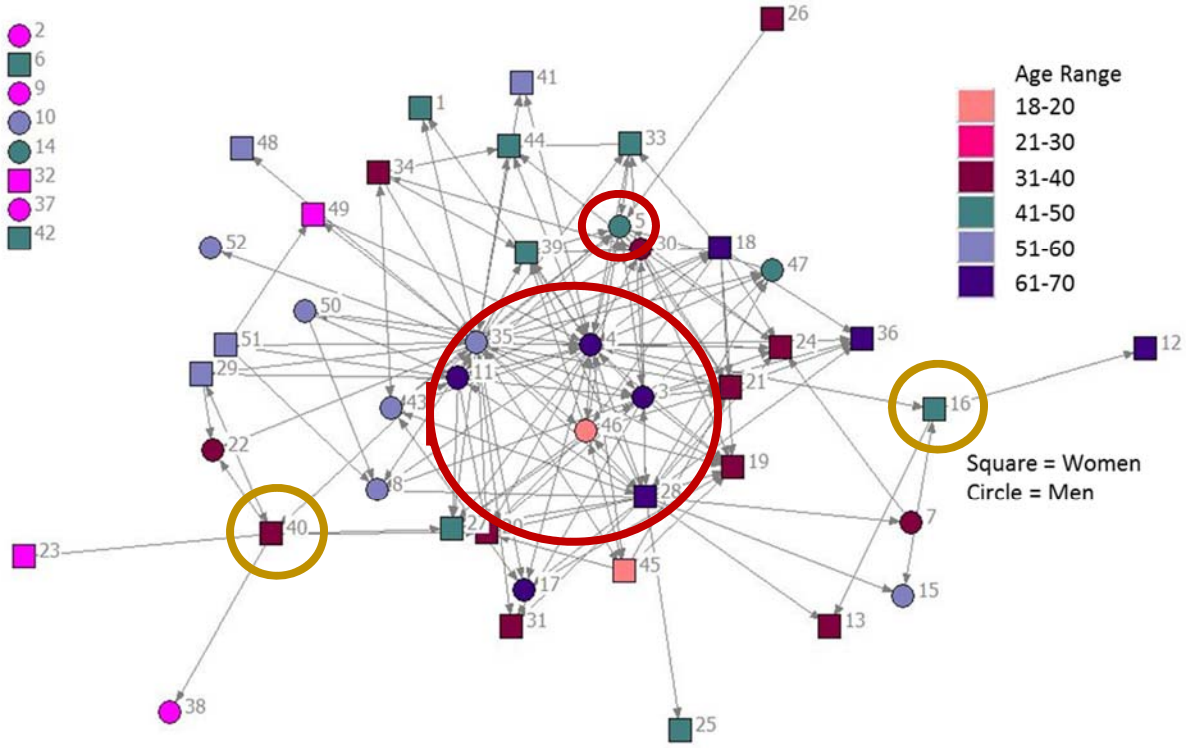

Figure 3.2: Visualization of Central Actors for Decision-Making/Policy Ties (n=52)

Table 3.4: Central Actors for Decision-Making/Policy Maximized Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
35	33	1	1	1	Indigenous	man	51 - 60
4	27	2	2	2	Indigenous	man	61 - 70
28	22	3	3	3	Indigenous	woman	61 - 70
3	16	4	4	8	Indigenous	man	61 - 70
11	13	5	6	7	Indigenous	man	61 - 70
5	12	6	7	6	Indigenous	man	41 - 50
46	12	6	5	13	White	man	18 - 20
18	11	8	9	14	Indigenous	woman	61 - 70
40	7	15	27	4	Indigenous	woman	31 - 40
16	4	26	35	5	Indigenous	woman	41 - 50

Table 3.5: Central Actors for Decision-Making/Policy Reciprocated Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
4	15	1	1	1	Indigenous	man	61 - 70
35	12	2	2	2	Indigenous	man	51 - 60
28	7	3	5	3	Indigenous	woman	61 - 70
43	7	3	3	4	Indigenous	man	51 - 60
5	6	5	4	6	Indigenous	man	41 - 50
3	5	6	6	8	Indigenous	man	61 - 70
11	4	7	7	12	Indigenous	man	61 - 70
17	3	8	8	13	White	man	61 - 70
16	2	10	13	5	Indigenous	woman	41 - 50

In summary, central actors for decision-making and policy ties were largely elder Indigenous men, yet joined by one elder Indigenous woman. Principally, Indigenous women and youth were again underrepresented. Two Indigenous women, different actors than before but in similar pattern, acted as bridges that connected isolated actors to the network.

Figure 3.3 illustrates central actors for community-based climate adaptation partnerships. As seen in decision-making and policy ties, the majority of central actors were elder Indigenous men. Actor 28, an elder Indigenous woman, was central in maximized ties yet dropped to a lower position for reciprocated ties. Interestingly, actor 28 did not appear in the same central cluster as

the Indigenous men but emerged as central based on connections to other participants. One White man, actor 8, also played a central role. Similar to the other collaboration types, four Indigenous women (33, 34, 40, and 41) reflected high betweenness which provided bridging to connect distant actors. Yet again, three of these four Indigenous women were not the same actors who played bridging roles in both sets of prior results. In Figure 3.3, the peripheral locations of all 18-30 year olds was particularly stark, and three became isolates. Collectively, the community-based climate adaptation partnerships revealed similar patterns as the decision/policy ties, although some of the specific actors moved positions.

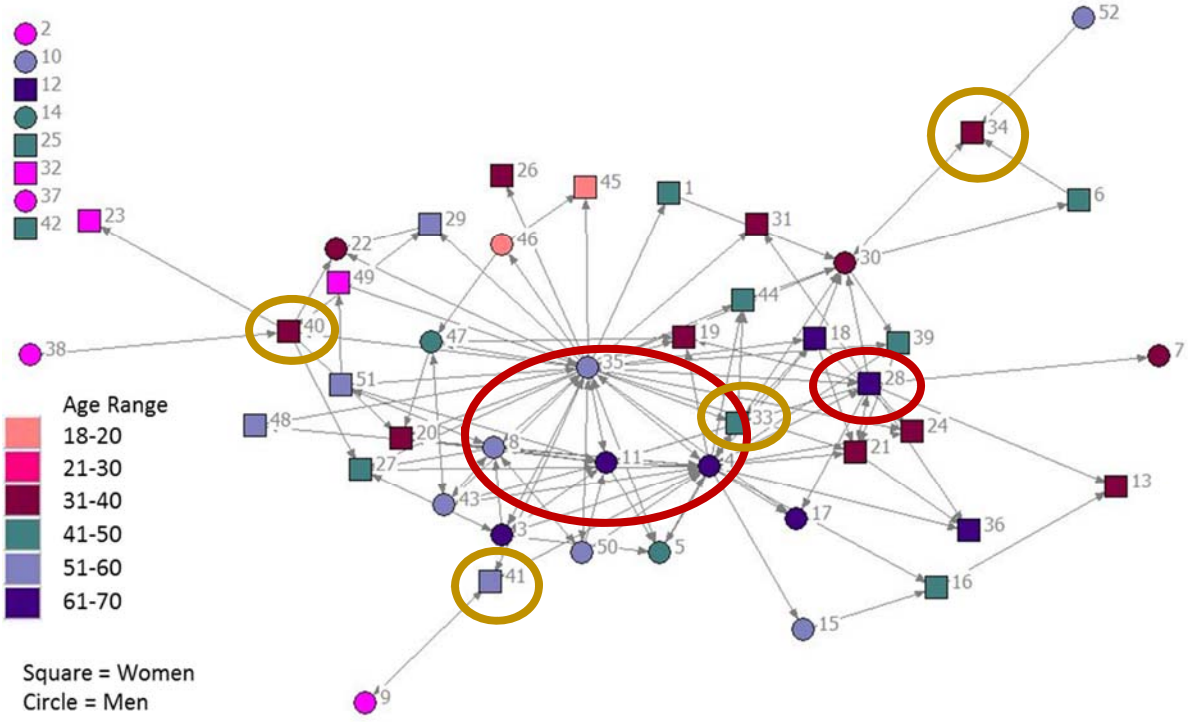

Figure 3.3: Visualization of Central Actors for Community-Based Climate Adaptation Ties (n=52)

Table 3.6: Central Actors for Community-Based Climate Adaptation Maximized Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
35	32	1	1	1	Indigenous	man	51 - 60
4	23	2	2	2	Indigenous	man	61 - 70
28	12	3	5	4	Indigenous	woman	61 - 70
11	11	4	3	8	Indigenous	man	61 - 70
8	10	5	4	9	White	man	51 - 60
30	9	6	7	3	Indigenous	man	31 - 40
40	7	7	23	5	Indigenous	woman	31 - 40
3	6	8	6	22	Indigenous	man	61 - 70
34	3	23	39	6	Indigenous	woman	31 - 40
41	3	23	24	6	Indigenous	woman	51 - 60

Table 3.7: Central Actors for Community-Based Climate Adaptation Reciprocated Ties

Actor No.	No. of Degrees	Degree Ranking	Eigenvector Ranking	Betweenness Ranking	Race/Ethnicity/ Indigeneity	Gender	Age Range (years)
4	9	1	1	1	Indigenous	man	61 - 70
35	8	2	2	2	Indigenous	man	51 - 60
8	5	3	4	3	White	man	51 - 60
43	5	3	3	4	Indigenous	man	51 - 60
3	4	5	5	5	Indigenous	man	61 - 70
11	3	6	6	9	Indigenous	man	61 - 70
28	3	6	7	6	Indigenous	woman	61 - 70
41	3	6	7	6	Indigenous	woman	51 - 60
33	2	9	11	6	Indigenous	woman	41 - 50

Overall, social network analysis of central actors indicated that Indigenous women and youth were underrepresented. Elder Indigenous men predominated, with some variance by type of collaboration. The knowledge network had more centrally located women, yet a closer look at reciprocated ties revealed most of these as non-Indigenous women. One elder Indigenous woman, actor 28, recurred in maximized ties' central positions. But in two of three cases she dropped much lower for reciprocated ties. It turns out this actor was selecting many collaborators who did not select her back. This was also the case for actor 33, an Indigenous woman shown central in one-way, but not reciprocated, knowledge ties. Indigenous women were the single

most predominant network participant (42.3%), further pronouncing their underrepresentation in central roles.

Grouping age and gender, the most populous participants were women aged 31-50 (34.6%), followed by men aged 51-70 (21.2%). These elder men were most central based on network ties. Women in the 31-50 years range emerged as central in other ways. In the 31-50 age group, White women were central actors in reciprocated knowledge sharing ties, and Indigenous women consistently emerged in bridging roles. Of the seven actors with lower numbers of ties, but high betweenness, all seven were women. Six were Indigenous and one, Latina. All but one of these seven women were in the 31-50 age group. This is significant because, as I will explain below, mid-aged Indigenous women also engaged in behind-the-scenes efforts to support the organization. Overall, the results present a pattern where these women connected actors to the network who would otherwise disconnect.

For the most part, those aged 18-30 were located at the network peripheries or dropped out of network ties entirely. The 18-30 age range constituted 17.3% of all participants with four women and five men. Therefore, young people had a measure of presence in the network, but not consistently among central roles. Here I note that I did not survey those under 18, and one or two additional teenagers were present.

Leadership Roles in the Organization

In this section I describe findings on visible and less visible leadership roles in the organization based on participatory methods. By visible, I mean key organizers of the network and those who ran events in up-front roles. Less visible leadership involved various supporting activities observed over time. In the discussion section, I combine these organizational leadership

results with social network results to draw conclusions about diverse representation among central actors in the group.

The most visible leadership roles were held by White women, aged 31-40, and elder Indigenous men. A small group of these actors started the network and offered leadership since its inception. They made core decisions about event attendees and the program. I found that various Indigenous participants discussed gender dynamics in this (and other) climate science networks. Indigenous women had voiced their experiences of patriarchy and colonialism related to the group in conversation and large group discussions. For example, three Indigenous women and one Indigenous man expressed their frustrations as they felt excluded from workshop attendance or involvement in the overall program. All four of these individuals work on climate change. Three have Master's degrees, each also working on their doctorates. One already has her doctorate. Their backgrounds appear a good match for this network that brings together Indigenous and Western ways of knowing. One of these individuals sought me out to discuss that she will not return to the group after having made consistent offers to participate in programming, and no opportunity given.

A tally over three years' events indicated the number of formal presentations by Indigenous women and non-Indigenous women in the network were approximately the same. Indigenous men made 50% more presentations than either group of women. White men made one-third the number of presentations than either group of women. A small set of about three youth generally presented their reflections or creative projects developed during events. Indigenous women and youth were not among up-front organizers, and were therefore underrepresented in visible leadership roles. Appearing on the program illustrates beneficial

representation during events. However, it does not equate to decision-making power that comes with representation in leadership.

Indigenous women engaged in other less visible leadership roles, such as facilitating a few of the breakout groups that focus on climate change impact areas. At each event, the organizers also solicited a group of largely mid-age Indigenous and non-Indigenous women to take extensive notes during gatherings. Organizers used these notes to construct event summaries sent out to network members and funders. As I participated with others in this note taking, I found some participants viewed the constant taking of notes as intrusive, and reminiscent of colonial practices. Two Indigenous women asked me questions about who benefits from these notes; who else uses them, and what are the protections for the knowledges shared? Less visible leadership provided by Indigenous men involved organizing side events, for example around disaster preparedness or ethics training for non-Indigenous climate scientists. Overall, those in leadership roles were White women aged 31-40 and elder Indigenous men. As I explain further in the next section, dynamics around leadership in the network have many implications.

Discussion and Conclusions

This research set out to determine intersectional representation among central actors in a national scale climate science boundary organization that focuses on bringing together Indigenous peoples and climate scientists. The network emphasizes inclusion in climate knowledge production, integrated collaborations, and cross-cultural research initiatives.

Overview of Findings

Results show that Indigenous women and youth were underrepresented in central roles based on social network analysis and organizational leadership positions. Yet Indigenous women consistently had bridging ties between actors who would otherwise become isolated from the

network. In addition to providing network cohesion, these bridging roles foster member and ideological diversity. Indigenous youth were generally situated at peripheries or dropped out of the network altogether due to a lack of ties. In a number of cases, Indigenous youth were bridged back to the overall network by Indigenous women. Of seven actors with low ties, but high bridging roles, all were women. Six were Indigenous women and one was Latina. All but one of these seven women were in the 31-50 age group. This is significant because Indigenous women also supported the network as session facilitators, extensive note takers, and formal presenters. Despite these contributions, Indigenous women did not have decision-making roles in the organization.

With a few exceptions, elder Indigenous men occupy most central positions based on network analysis, and give the most presentations. Women did appear among central actors for one-way knowledge ties, although only two women remained for reciprocated ties. Both of these were White women. White women and elder Indigenous men provided up-front leadership. Overall, the most central actors in the climate science boundary organization based on social network analysis and leadership roles were elder Indigenous men and White women aged 31-40. In efforts to diversify climate sciences, the group does engage Indigenous participants in central roles—only without gender or age diversity.

Conclusions

The results carry implications for Indigenous women and youth, and for broader collective goals related to Indigenous self-determination and governance. The findings also challenge the climate science organization's legitimacy and limit its potential for social and scientific reforms. Next, I discuss each of these implications, followed by the study's limitations and broader contributions.

This research found patterned absence of Indigenous women and youth among central actors in the network. Indigenous women significantly contributed to the group in less visible roles, but this labor went largely unacknowledged and unpaid. While making presentations illustrates beneficial representation during events, it does not equate to decision-making power that comes with representation in leadership. Some Indigenous women questioned requests for constant note taking as intrusive and of uncertain benefit to Indigenous participants. All these result in material and affective harms for Indigenous women, and for youth who are largely absent altogether. The compounding disadvantages of colonialism, racism, and patriarchy in environmental sciences were exhibited through a lack of participatory justice in the organization. Diversity gains in this intentional effort to bring together Indigenous peoples and climate sciences have opened leadership opportunities for Indigenous men and White women, but not for Indigenous women or youth. This is an example in environmental sciences where some forms of inequality were challenged, while others were reproduced.

The leadership by Indigenous men in the organization was also a significant finding. The environmental sciences persist with low racial and indigenous diversity, therefore leadership by Indigenous men is of value to climate science and to those participants. More importantly, Indigenous collectives working to revitalize traditional knowledge-practices have responsibilities to counter sexism, racism, and bureaucratic forms of governance brought through settler colonial heteropatriarchy (Denetdale 2006; Green 2007; Goeman and Denetdale 2009). Efforts to reclaim Indigenous traditions in a colonial patriarchal way ultimately harms Indigenous men, women, two-spirit persons, and collectives. The gains made by Indigenous men in climate science creates opportunities for change. Indigenous peoples' social networks are one means to revitalize Indigenous governance that respects all genders and ages. Shared decision-making with

Indigenous women and youth were lacking in the case presented. This has implications for future actions by central actors in climate science collectives; they have responsibilities through their organizational roles to dismantle inaccurate notions of tradition that reproduce inequalities. Already established networks can support reforms, yet are also bound by ethical intents that embrace inclusion of the broader community through mutual and respectful partnership. This contributes to disruption of settler colonial intents, and benefits individual and collective self-determination.

There are additional implications for the climate science boundary organization. As a network seeking to diversify climate science fields, the central actor patterns diminish the group's legitimacy. The boundary organization's legitimacy is challenged because the patterned absence of Indigenous women and youth in central roles was known among a set of central actors, and voiced by some participants in large group settings. Reduced legitimacy can formulate from within an organization, where some participants lose a sense of efficacy (Taylor 2009). Loss of legitimacy can also emerge from outside a group by those observing at some distance, or choosing to no longer participate. In this case, both occurred to some degree. This presents an opportunity for the boundary organization to actively adjust to ensure Indigenous women and youth are among core governance positions.[35]

The results also indicate limits on social and scientific reforms by the group. Homogenous leadership clusters miss deep practical engagement with important perspectives. Network studies in environmental fields have begun to illuminate these insular features that produce internally reinforcing meanings and practices (Corbera et al. 2016; Leifeld and Fisher 2017). This often affects the quality of the sciences produced, and attempts made at complex

[35] Research results have been provided to the climate science boundary organization.

problem solving. There is a failure of beneficence—not only for individual participants, but benefits that should accrue to the everyday lives of those affected by scientific practices. A key recommendation is for environmental collaborations to ensure Indigenous participants—including diverse members such as Indigenous women and youth—are among central governance roles. Visionary central actors from underrepresented groups may pursue alternative objectives. Boundary organizations would need to embrace modified goals that seek deeper Indigenous revitalizations and self-determination, alongside science reform efforts. This involves actively guarding against the reproduction of normalized colonial approaches; neither tradition nor innovation warrant injustices. This research finds that due to layers of disadvantage, climate science boundary organizations need to intentionally create space for Indigenous women and youth among central actors. Mentoring, paid employment, and other pipeline-development projects including grants and research opportunities could play a role.

Questions could arise about the value of Indigenous youth occupying central roles in the organization. Are they too young to share in decision-making? Yet, Indigenous youth and women have taken on central and powerful leadership roles in climate change social movements (LaDuke 1999, 2014; Whyte 2014, 2016; TallBear 2016; Dhillon 2016). An inter-generational emphasis permeates Native North American knowledges and practices (Cajete 2000; Jacob 2013; Kimmerer 2015). Despite many challenges faced by Indigenous youth today, it has been said that the perspectives of young people bring creative new knowledges and powerfully link to future generations (Cajete 2000; McGregor 2004). The strong leadership of Indigenous women and youth in environmental social movements contrasts sharply with the results from this study. Their decision-making could significantly alter group priorities and relational dynamics. This may better align climate science with goals toward climate justice. Results indicate that

leadership by women and youth exhibited in other Indigenous environmental collectives offers needed guidance for effective cross-cultural climate science initiatives.

Within the boundary organization, there was discussion about how non-Indigenous researchers and climate scientists engage with the network. Mostly absent in this paper so far are White men, due to their limited presence in central positions and to some degree, in the network overall. Despite the diversity gains this reflects, some network participants stated that non-Indigenous climate scientists are missing an opportunity to participate and learn effective collaboration with Indigenous peoples (see also Williams and Hardison 2013; Whyte 2013b; CTKW 2014). In addition to the ethics training already noted, organization members presented on ethical collaboration practices. With low attendance by non-Indigenous climate scientists in these trainings, how would they become respectful collaborators in practice? Further, what additional knowledges and connections could be harnessed in Indigenous peoples' climate adaptation efforts? What would motivate more non-Indigenous climate scientists to participate, while ensuring diverse Indigenous participants set key agendas? Central actors play crucial roles in decision-making, and environmental science fields continue to be dominated by White men (Taylor 2015). Climate scientists have a responsibility to engage these collaborative endeavors as learners and advocates (Whyte 2013b). Effective cross-cultural climate science organizations demand deeply modified relational interactions and priorities, particularly from non-Indigenous researchers and scientists.

The study's limitations relate to both methods and content. Mixed methods social network approaches tend to limit sample size based on the skills and resources required (Hollstein 2014). Whole network studies require very high member participation and a moderate number of members. Both conditions were met in this research. Comparative network studies

would reveal additional dynamics of collaborative processes. These could include studies in other nation-state contexts, with social movement organizations, or across different cross-cultural groups. Social network methods are reliable to measure and illustrate relational connections and group structures (Wald 2014). The mixed methods approach was particularly useful to assess central actors. Additional qualitative research will be part of future work to more deeply engage the experiences of network members. Longitudinal studies will also be conducted to understand how the network changes over time.

There are two primary contributions from this research. First, by taking actual measurements of central position holders, this paper contributes to debates about interconnected forms of oppression in environmental science fields. The research empirically demonstrates the differential benefits of diversity efforts, where advantages for some underrepresented groups in climate science did not accrue evenly to other groups. This calls for deeper attention to significant gains by White women in environmental fields when compared to Indigenous and women of color. The centrality of Indigenous men but not Indigenous women or youth also calls for attention. Because forms of oppression intersect in science fields, efforts to address injustices must gear initiatives to combat colonialism, racism, and patriarchy that connect to foundational colonial violence. Underrepresented groups will not experience or benefit from reform attempts in the same way. Not only do compounding systems of disadvantage require up front attention in environmental organizations, but insider-scientists from diverse backgrounds and attuned to these issues will be critical to reforming the sciences. Structurally embedded practices interact with relational dynamics and agency to *disrupt or reproduce* naturalized social inequalities. In this case, outcomes emerge that do both. This research informs cross-cultural environmental networks of problematic relational-structural issues they can expect and plan to counteract.

Second, the paper contributes to the field of intersectionality by illustrating the utility of social network methods, and the ongoing need for dialogue with Native feminist theories. The social network approach measured and illustrated intersectional processes based not only on actor identities but structural positions. It considered in concert many actor attributes, structural positions, collaborative relational ties, and meso-level social structures. As part of a mixed methods approach, social network analysis can be one among various tools to research intersectional dynamics in process, in this case through everyday practices of climate science. This paper also contributes to ongoing dialogues between intersectionality and Native feminist theories by harnessing their partially overlapping concepts in the study of an environmental boundary organization. The study analyzed centrality patterns with implications for reconfiguring the sciences from within. The paper contributes to understanding of climate science boundary organizations with cross-cultural intents, in light of concepts rarely engaged within environmental fields: intersectionality and Native feminist theories.

CHAPTER 4

High Benefit, High Risk: Bringing Together Indigenous Peoples' and Climate Scientists' Knowledges and Practices in Boundary Organizations

Abstract

Bringing together Indigenous peoples' and climate scientists' knowledges and practices carry potential benefits and risks for Indigenous collectives. This paper analyzes how eight climate change boundary organizations engage diverse knowledges and practices of Indigenous peoples and climate scientists. How aware are organization participants about the risks? What approaches respect Indigenous knowledges and protocols in these collaborations? In a case study of a national scale boundary organization formed specifically to bring together Indigenous knowledges and climate science, this research analyzes participant perspectives on the levels of benefit and risk to Indigenous peoples when they share their knowledges with climate scientists. It also surveys members' views on the relationship between Indigenous knowledges and climate science. Next, the paper situates this organization's practices within those of seven other climate change boundary organizations led by Indigenous and non-Indigenous peoples. Participants demonstrated diverse perspectives on the relationship between Indigenous knowledges and climate science, and which should guide the other. A majority of network members identified simultaneous high benefits and high risks to Indigenous peoples in collaborative knowledge sharing. A noted minority was less convinced of the benefits involved. This paper revealed a wide range of approaches by climate change boundary organizations at the intersection of multiple knowledge and practice systems. It found greater benefits and reduced risks when Indigenous peoples were among core governance positions in collaborative endeavors.

Introduction

The challenges of climate change, including efforts to communicate and act on climate-related knowledges, have produced a growing set of climate change boundary organizations. Existing ecological conservation and tribal environmental programs are also developing and using climate change science. To varying degrees, climate change boundary organizations focus not only on science-policy-publics intersections, but specifically on bringing together Indigenous peoples' and climate scientists' knowledges and practices to contend with climate change. While there are good reasons to do so, the integrations also carry a set of risks for Indigenous collectives. How aware are organization participants about these risks? What approaches respect Indigenous knowledges and protocols in these collaborations? This paper investigates how climate change boundary organizations engage the benefits and risks of collaboration for Indigenous collectives through analysis of participant perspectives and organizational practices.

In a case study of a national scale boundary organization formed specifically to bring together Indigenous knowledges and climate science, this research analyzes participant views on the levels of benefit and risk to Indigenous peoples when they share their knowledges with climate scientists. It also surveys members' perspectives on the relationship between Indigenous knowledges and climate science, because there are various conceptions about how these relate. To understand the benefits and risks for Indigenous collectives, I use social network analysis to measure the level of trust in the case study organization based on anticipated future collaborations as noted by all members. Trust is an important feature of cross-cultural collaborations and within Indigenous protocols. Next, the paper analyzes how eight climate change boundary organizations engage diverse knowledges and practices of Indigenous peoples and climate scientists. These national or large regional scale organizations have varying proportions of Indigenous and non-Indigenous persons among membership and leadership.

Although there is growing research on the impacts of climate change on Indigenous populations, empirical studies have yet to focus on the benefits, risks, and everyday practices of collaborative organizations that bring together Indigenous peoples and climate scientists. Utilizing survey data, engaged participation, and social network analysis, this paper combines participant perspectives with qualitative examination of organizational practices. The research focuses on political dynamics and respectful practices when integrating knowledge systems in climate change fields. I employ a framework from Indigenous environmental studies to understand climate change boundary organizations with their foci in one of three areas: climate adaptation, conservation, or tribally focused environmental groups. Collaborative environmental boundary organizations have responsibilities to benefit Indigenous peoples and attend to partnership risks (L. T. Smith 2012; Whyte 2013b). While those involved in these groups are deep knowledge holders, it cannot be assumed that cross-cultural collaborations will benefit all parties.

Results indicate that participants of the case study boundary organization demonstrated diverse perspectives on how to characterize the relationship between Indigenous knowledges and climate science, and which should guide the other. A majority identified simultaneous high benefits and high risks to Indigenous peoples when sharing their knowledges with climate scientists. A noted minority is less convinced of the benefits involved. Social network analysis revealed a moderate level of trust between participants in the overall organization, but fewer reciprocated ties for future collaborations (i.e. where two participants both selected each other). Boundary organizations engaged a wide range of practices and protocols. Some involved Indigenous peoples' governance and approaches, including focus on Indigenous self-determination and attitudes such as *reciprocal responsibilities* with non-human relations. Others

did not. The primary related factor was whether Indigenous participants were among central leadership in the climate change boundary organization. This paper found greater collaborative benefits and reduced risks when Indigenous peoples were among core governance roles. The research contributes to debates about the benefits and risks of cross-cultural collaborations, particularly in the context of environmental boundary organizations. It also engages discussions on the political and ethical dimensions of bringing together Indigenous knowledges and climate science.

This paper begins by outlining background knowledges in three areas. First, I discuss scholarship on bringing together Indigenous peoples' and climate scientists' knowledges and practices, with focus on diversity of Indigenous knowledge-practices. Second, the paper outlines literatures on practices and protocols of Indigenous peoples and climate scientists. Third, I explain political and ethical dimensions of collaboration, including how Indigenous environmental scholars describe the benefits and risks of cross-cultural engagements. Following the background section are the research approach and methods. There I describe the climate change boundary organizations related to this study. Next, research results fall into three groups: participant perspectives, the social network analysis on future collaborations, and boundary organization practices and protocols. The final section discusses research findings and conclusions.

Background

Bringing Together Indigenous Peoples' and Climate Scientists' Knowledges

Diverse ways of knowing about and experiencing the world situate temporally, spatially, culturally, and through relational interactions.[36] Indigenous peoples' and climate scientists' knowledges are neither the same nor entirely unconnected based on a history of interactions and appropriations (Watson-Verran and Turnbull 1995; Harding 2008; Whyte 2013a; Weaver 2014). Yet Indigenous peoples' ways of knowing have frequently been devalued, particularly among Western-trained scientists (L. T. Smith 2012; Nadasdy 1999, 2003; McGregor 2004). Differences in knowledge and science systems draw from diverse efforts across time and space to understand socio-material worlds. Climate scientists have recently grown interested in Indigenous peoples' knowledges based on long-term place-based observations of the land, waters, plants, animals, and the seasons (Chief et al. 2014; Bennett et al. 2014). However, ongoing colonial relations create partnership risks for Indigenous peoples whose ways of life have undergone violence, dispossession, and commercialization (L. T. Smith 2012, 2008; McGregor 2004; Coombes 2012). Efforts to bring together Indigenous peoples' and climate scientists' knowledges to combat climate change must consider the risks of collaboration, and how interactions will benefit Indigenous collectives (Whyte 2013b; Williams and Hardison 2013; CTKW 2014).

Indigenous scholars have argued that attempting one definition of Indigenous knowledges is neither fruitful, nor possible (McGregor 2004; Kimmerer 2012; Whyte 2013a). This is not only

[36] To acknowledge different knowledge and science systems is not an argument for relativism or universal constructions, because people are always discerning between competing truth claims grounded in more than perceptions (Simpson and Smith 2014). Situating knowledges allows us to highlight the modes of constructions, but these have material counterparts including outcomes. While all knowledges are situated, some knowledge claims are better than others.

due to immense diversity among Indigenous peoples and place-based dynamics, but knowledges as embodied processes. Processes of coming-to-know become bound up with knowledges themselves (Cajete 2000). Indigenous knowledges are important for their contributions to sustainable lifeways, including for robust climate science. But they are also important for Indigenous collectives in their own pursuits of self-determination and good living (LaDuke 1999; L. T. Smith 2012).

Indigenous peoples have demonstrated resilience through socio-ecological adaptation in many places and times, for example in active management of forests, fish, wildlife, waterways, and plants (Berkes, Colding, and Folke 2000; Grossman and Parker 2012; Trosper 2003). Yet Indigenous knowledges and sciences are not merely long-term observations coupled with adaptation over time. Some scholars emphasize knowledges also emerge from creator and from creation. These develop through reciprocal relationships with non-human species and entities who exhibit their own agency (Cajete 2000; McGregor 2004; Kimmerer 2015; Watts 2013; Cruikshank 2012). At times, spirituality plays a distinctive role in knowledge-practices that integrate ceremony, offerings, prayers, intuition, and dreams (McGregor 2004). Indigenous ways of knowing are incredibly diverse, and are not entirely translatable across dominant forms of climate science.[37] Still, scholars have argued that some communication is possible, however challenging (Kimmerer 2012, 2015; De la Cadena 2015). Instead of focusing on what Indigenous knowledges and sciences *are*, there is a need to focus on their function in collaborative processes

[37] I use *dominant* in a vein similar to Maggie Walter and Chris Anderson's notion of "colonial habitus of the settler majority" (2013, 15), meaning dispositions of perception, thought, and action that appear natural to a numerical majority in a settler colonial state and society (building on Bourdieu 1984). My use does not imply social homogeneity or lack of resistances to dominant discourses and practices.

that are an inevitable part of contending with environmental problems (Kimmerer 2012; Whyte 2013a).

Diverse Practices and Protocols in Climate Science

Tribes in North America are undertaking significant climate change actions, from tribal resolutions to adaptation planning, alternative energy use to leading climate justice movements (Native Peoples Native Homelands 2009; LaDuke 1999, 2014; NCAI 2016, 2017; Whyte 2016; TallBear 2016; ATNI 2017). Indigenous peoples also seek out collaborations to strengthen their climate change responses, including through land restoration and climate adaptation projects (Middleton 2011; Chief et al. 2014). In practice, there are myriad potential ways to bring together the approaches of Indigenous peoples and non-Indigenous climate scientists in collaborative climate change efforts. Yet some approaches illustrate greater respect for diverse Indigenous protocols by collaborators from dominant climate science fields. Science discourses and practices tend to obscure their underlying values and assumptions. This leads to reproduced normalization of perspectives and practices that support the North American settler majority.[38] Further, dominant sciences are implicated in colonialism that produces damaging results to Indigenous peoples and others, often without acknowledging such connections (L. T. Smith 2012; TallBear 2013; Harding 2008). There is an ongoing need, then, to reconfigure science practices both from within and through unusual engagements. Working across knowledge

[38] *Practices* have been defined as physical and discursive actions that take place in systems of rules, beliefs, and cultural codes, connected to material embodiment and not merely reasoned intentions (Bourdieu 1984). William Sewell (1999) maintains that cultures consist of *worlds of beliefs and practices*, alongside *systems of symbols and meanings* developed through social learning, institutions, and agency. Socio-cultural systems and practices are co-producing, shifting and informing each other, not fully coherent or separate (Sewell 1999). Practices do not emerge merely by intent, but require access to resources, argued by Bourdieu (1984) to include social, cultural, and economic capital. Social networks may be one way to increase access to forms of capital, but practices and outcomes can be hindered by socio-structural and cultural reproductions of inequalities (Bourdieu 1984; Taylor 2009).

systems can open possibilities to transform privileged sciences (L. T. Smith 2012; TallBear 2013; Whyte 2013a; Benjamin 2016b, 2016a).

There is no single explanation that captures the meanings of Indigenous practices and protocols (McGregor 2004; Hunt 2014). These too are diverse, embodied, place-connected, and entwined with knowledges, cultures, values, and agency. At the same time, partnerships between Indigenous collectives and environmental organizations engage the everyday question of what respectful engagements might look like in practice. Adapted from key literatures, Figure 4.1 outlines common themes relevant to respectful environmental partnerships involving Indigenous peoples (McGregor 2004; Kimmerer 2012; Matunga 2013; CTKW 2014; Whyte, Brewer, and Johnson 2015). Although Figure 4.1 illustrates an always-incomplete explanation of Indigenous approaches, it offers some guidance for cross-cultural climate science collaborations.

Figure 4.1: Themes in Indigenous Practices and Protocols Relevant to Environmental Boundary Organizations

Adapted from McGregor (2004), Kimmerer (2012), Matunga (2013), CTKW (2014), and Whyte, Brewer and Johnson (2015).

Interconnected Indigenous practices and protocols encompass features such as attitudes and trust, not only actions taken (McGregor 2004; Whyte, Brewer, and Johnson 2015). Attitudes inform how to approach each other and our environments, including commitments to other species and entities as relatives. This refuses commodification and commercialization, although imperfectly practiced within contemporary political and economic systems (LaDuke 1999; L. T. Smith 2008, 2012). Respectful relationships involve reciprocal responsibilities, centered on mutual care between humans and with other species (McGregor 2004, 2012; Whyte 2014). These active efforts work to renew ecologies and relationships. In uses of plant or animal life, there are diverse offerings, ceremonies, and ways of inquiring before taking (Hatfield 2009; Kimmerer 2012, 2015). Forms of inquiry also guide Indigenous science practices, including how people interact with each other around teachings, knowledges, harvesting, and stewarding activities. Relational trust centering harmony and connection plays a role, even as trust takes time to develop and changes over time (Cajete 2000; Whyte, Brewer, and Johnson 2015).

Another set of common themes in Indigenous practices and protocols relevant to environmental boundary organizations focus on beneficence, Indigenous governance, and Indigenous sovereignty. Beneficence highlights the need for ethical engagements and attention to favorable outcomes for Indigenous communities, not merely good intents (Matunga 2013; Whyte 2013b; CTKW 2014). For this research, Indigenous governance refers to support for collective flourishing of people, species, and places, with mutual respect between those that govern and the governed (Matunga 2013; Williams and Hardison 2013; Whyte, Brewer, and Johnson 2015). Indigenous governance supports self-determination and decision-making that benefits Indigenous communities (Coombes 2012). Finally, these practices and protocols prioritize Indigenous sovereignty, whether in knowledges, lands, bodies, or cultures (Matunga 2013; CTKW 2014).

Indigenous sovereignty is based on inherent rights that pre-date the formation of the US nation-state. The government-to-government relationships established between the US and federally recognized tribal nations complicate the legitimacy of US jurisdiction related to Indigenous peoples (Bruyneel 2007; Simpson 2014). Ongoing North American colonialism is rife with incoherencies, inconsistencies, and ethical challenges, however normalized in the settler colonial state and society (Coulthard 2007; Bruyneel 2007; Simpson 2014). Climate change scientists and organizations have responsibilities to advocate for Indigenous sovereignty and lifeways due to government-to-government relationships and based on ethical arguments (Whyte 2013b, 2016; CTKW 2014).

Turning to cultures of dominant climate science, I briefly consider three multi-faceted developments: historical climate reconstructions, global climate science, and applied climate science. Climate reconstructions by historians use sources such as logbooks, newspapers, weather observations, and public notices and petitions to reconstruct past climatic and cultural conditions (Carey 2012). As meteorology and climate models helped give birth to scientific studies of climate writ large, climatology by historians became overshadowed by the burgeoning work of computational climate scientists (Carey 2012). Global climate science emerged from early 20th century conceptual, fluid dynamic, energy balance, and convective models. These led to large-scale finite element models (FEMs) of increasing complexity and accuracy (Edwards 2010). Global climate science considers historical observations and predictive simulations, seeking future potential climate scenarios using complex FEMs (Edwards 2010). In the 1980s, science networks and these global climate models from various places converged towards standardized climate science practices (Edwards 2010).

Climate science boundary organizations emerged largely from the field of *applied climate science*, which began around the mid-1990s. Expanding significantly since 2006, applied climate science emphasizes making climate information accessible to, and usable by, decision-makers in place-based contexts (Parris et al. 2016). The Department of the Interior and US Geological Survey Climate Science Centers (CSCs) formed in 2010, and the National Oceanic and Atmospheric Administration Regional Integrated Sciences and Assessments (RISAs) became largely visible over the past decade. These institutions emphasize adaptation to climate change in light of limited success to mitigate its effects through curbing of greenhouse gas emissions. Applied climate science and the related field, human dimensions of climate change, play key roles to develop mainstream concepts of climate adaptation used in the United Nations Intergovernmental Panel on Climate Change (IPCC) reports. My use of *dominant climate science* refers to both global and applied climate sciences, where participants are primarily from research, academic, and professional environmental fields. Climate science institutions generally engage some discourse exhorting science towards the common public good, but largely disconnect from deep discussions around social justice (Cameron 2012; Marino 2012; Marino and Ribot 2012; Whyte 2013b, 2016; Castree et al. 2014; Dunlap and Brulle 2015).

Bringing together the knowledges and sciences of Indigenous peoples and climate scientists is not merely a merging of different cultures. Diverse ways of being in the world are not smoothly translatable, because stories, embodied experiences, socio-political positioning, and place influence understandings (McGregor 2004; Watts 2013; Hunt 2014). The practices that guide on-the-ground collaborations affect the types of expertise most valued and the balance of power between parties (Nadasdy 1999, 2003; Whyte, Brewer, and Johnson 2015; Benjamin 2016b). Who leads, and how they lead, matters for collaborators and for outcomes. This also

applies to how people participate. Understanding Indigenous practices and protocols, even as participants, does not turn outsiders into experts (McGregor 2004). Not all Indigenous knowledges are intended for those outside kin-based collectives, and peoples have the right, sometimes the obligation, to refuse high risk collaboratives (L. T. Smith 2012; Simpson 2007; TallBear 2013; Benjamin 2016b). Hirini Matunga (2013) argues that how and when to bring together customary and contemporary ways should be determined by Indigenous peoples themselves, not by outsiders or collaborators.

The Benefits and Risks of Environmental Boundary Organization Collaborations

Conflict and collaboration are standard features of environmental issues having contentious multi-party origins and uneven sources of responsibility. Potential benefits of collaborations in climate science include harnessing networks, knowledges, and resources to strengthen Indigenous peoples' climate change capabilities (Whyte 2013b; Chief et al. 2014). Collaboration also focuses diverse knowledges toward solving complex problems (Bodin and Crona 2009). It can broaden exposure to a group's goals through increased member participation or interest by the media (Taylor 2000, 2009). Cross-cultural environmental collaborations open possibilities to improve relations between the parties involved (Middleton 2011; Whyte 2013b; Richmond et al. 2013). As already noted, cross-difference partnerships may support reform of science practices by those working within these fields. Reform efforts will not attend to the most problematic obstacles experienced by Indigenous peoples, yet everyday interactions are one part of pressing for social change. Climate science fields offer robust scientific knowledge, but lack sufficient engagement with diverse perspectives (Castree et al. 2014). At the same time, broadening diversity without transfers of decision-making power further stunts the potential of

change making within everyday practices. Collaborations may help sharpen climate change organizations' sense of responsibility toward human and ecological liberatory agendas.

However, alongside the benefits of collaboration come a set of risks and challenges. Collaborations can lead to assimilation or cooptation, including Indigenous knowledge-practices becoming commercialized, patented, used without permission, or improperly attributed (L. T. Smith 2012; McGregor 2004; Williams and Hardison 2013). Revealing the location of resources or sacred sites can bring looting through criminal activity, or through research and extraction deemed lawful, but unethical (Middleton 2013). Scholars argue for ethical protocols that ensure respect and benefit accrued to Indigenous collectives through collaborative processes (L. T. Smith 2008; Coombes 2012; Whyte 2013b; CTKW 2014). Giving of consent may require collective decisions and relate only to specific circumstances, times, or projects. There is constant risk of unintended disclosures (L. T. Smith 2008; Williams and Hardison 2013).

Challenges also involve overcoming distrust due to past and ongoing colonial relations that harm Indigenous peoples. Collaborative efforts too often expect Indigenous peoples to use colonial languages, meanings, and practices (Nadasdy 1999, 2003; Richmond et al. 2013). There is the risk of not strongly connecting outcomes to broader Indigenous political and land rights (L. T. Smith 2012; Tuck and Yang 2012). Collaborations with climate scientists can also result in Indigenous participants becoming alienated from their own communities, where working closely with outsiders may introduce new threats (L. T. Smith 2012). Colonial education and science systems have worked against Indigenous ways of life, and turning them to benefit Indigenous communities is a momentous task (L. T. Smith 2008, 2012). Research has infrequently benefited Indigenous collectives, therefore the need to create alternative science practices is urgent, but "tricky" and draws skepticism (L. T. Smith 2008, 113). Free, prior, and informed consent

(FPIC), a core tenet of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP 2007), must include the right of Indigenous peoples to refuse collaboration and other activities that affect their knowledges and livelihoods (Williams and Hardison 2013; CTKW 2014).

At their best, collaborations are invitations to co-existence that build trust, and respect government-to-government relationships (Whyte 2013a). This means focused attention on the risks and benefits that collaborations pose to Indigenous participants (L. T. Smith 2012; Whyte 2013b). Leadership and decision-making by Indigenous peoples are core features of mutually respectful collaborations, which should seek to directly transfer knowledge production and resources to Indigenous collectives (Coombes 2012). Collaborations are an inevitable part of contending with environmental problems. As such, everyday collaborative efforts by organizations working largely outside existing institutions offer one context where partnership practices could advocate for Indigenous land, knowledge, and cultural sovereignty. How are these issues being viewed and enacted in cross-cultural climate change efforts? This paper seeks to understand perspectives and practices around the benefits and risks of collaborations for Indigenous collectives through study of environmental boundary organizations led by Indigenous and non-Indigenous peoples.

Methods

To understand how Indigenous peoples' and climate scientists' knowledges and practices are brought together in a set of US boundary organizations, I conducted surveys and actively participated in multiple networks from June 2014 to June 2017. A case study focuses on one national scale climate science group through surveys of participant perspectives and social network data. I also look at diverse practices and protocols for eight different groups to capture a range of approaches at intersections of Indigenous knowledges and climate science.

Data Collection and Data Analysis

I collected survey data, including social network data, in July 2016 at the annual workshop of the case study boundary organization with 52 participants present. The case study group is the same organization discussed in Chapters 2 and 3, where I use the pseudonym, *Bridging Climate Action*. The survey asked questions about participants' perspectives, identities, and their collaborations with all other members of the network. Engaged participation and secondary sources informed development of the survey, pre-tested with a small group from the same organization. The survey questions asked:

- *Which best describes your view on multiple knowledge systems in climate change?*
  (The survey provided four potential perspectives as described in the results section.)

- *How significant are the potential benefits to Indigenous peoples when they share their knowledges with climate scientists?*
  (The survey used a five answer rating scale from Not Significant to Very Significant.)

- *How significant are the potential risks to Indigenous peoples when they share their knowledges with climate scientists?*
  (The survey used a five answer rating scale from Not Significant to Very Significant.)

Additionally, two social network questions focused on future collaborations that each participant anticipated with every other member in the group. Chapter 2 reported on four other types of collaborative relational ties recorded in the same survey. I used a paper survey with a name roster that listed all participants at the workshop. Boxes next to each name allowed members to select their future collaborators using two responses:

- *I have plans to collaborate with this person in the future.*

- *I look forward to collaborating with this person in the future, but have no specific plans.*

Anticipated future collaborations approximate a measure of trust and positive affect between participants in the voluntary organization.

Fifty completed surveys yielded a 96% response rate. For the remaining two participants, I used secondary data to determine their identities, and matched their future collaborations based on how other members selected them. I do not have these two participants' perspectives on the survey questions, therefore I list their responses as, "did not answer". Given the different ways participants may interpret survey questions and potential efforts to discern honorable responses, I conducted the survey in person. I gave instructions and answered questions as participants completed the hand-written survey.

I entered the survey data into an Excel spreadsheet yielding statistical tables and a 52x52 matrix for each of the social network relations. I imported these and analyzed network measures for future collaborations using UCINET and Netdraw software.[39] Specifically, I look at the quantity and density of relational ties reported, and the percentage of ties reciprocated by receiving members. In data analysis, standard statistical approaches do not suffice because actors in networks are relationally connected, not independent participants (Robins 2015).

Engaged participation with the set of boundary organizations took place from June 2014 to June 2017. Over this time, I attended 11 multi-day events and participated in three additional collaborative projects with members of these groups (two with the case study organization). Two collaborative projects involved daily engagement over a nine-month period each. The third project involved monthly check-ins over one year. Participation with the case study organization began in January 2015, and I have been part of group activities since then. I attended Bridging Climate Action's annual workshops in 2015, 2016, and 2017.

During the three-year period, I recorded ethnographic notes on events and interactions within the boundary organizations. Qualitative analysis completed by hand using secondary

[39] UCINET and Netdraw software are created by Borgatti, Everett, and Freeman (2002).

documents and field notes utilized a color-coding scheme to identify repeated themes, comparisons, and contrasts that support research interpretations and conclusions (Hennink, Hutter, and Bailey 2010). Secondary documents include organizational reports, websites, promotional materials, social media, email listserves, and policy statements.

The Climate Change Boundary Organizations

The eight boundary organizations informing this research take diverse approaches. The boundary work performed by the various groups varied significantly, as did their emphases around Indigenous knowledges and climate science. Table 4.1 summarizes the spatial scale and primary governance of each group, i.e. whether primarily by Indigenous or non-Indigenous persons. In the majority of cases, these organizations have core governance members who are both Indigenous and non-Indigenous persons. *Large regional scale* refers to a multi-state area, although for organization/event number 3 this is a sizeable single state. I provide the year that boundary organization events took place. Event locations were spread across the US, including both coasts, the Great Lakes, the Upper Northeast, and the Pacific Islands. The groups' core emphases fall into three broad categories: tribal environmental, climate adaptation, or conservation.[40] All focus on climate science and boundary work, although their modes of integration between Indigenous protocols and climate science vary. These differences allow comparison between organizational approaches. I do not provide names of the organizations to maintain confidentiality of participants.

[40] The tribal environmental groups are not environmental departments within specific tribal nations. They function largely outside formal tribal governments. These are inter-tribal political and environmental networks engaging at the US national scale or within multi-state regions.

Table 4.1: Climate Change Boundary Organizations

Event No.	Year	Organization Emphasis	Scale	Primary Governance
1	2014	Climate Adaptation	large regional	non-Indigenous
2	2014	Tribal Environmental	national	Indigenous
3	2014	Climate Adaptation	large regional	non-Indigenous
4	2015	Conservation	large regional	mixed
5	2015	Tribal Environmental	national	mixed
6[a]	2015	Climate Adaptation	national	mixed
7	2016	Conservation	large regional	mixed
8[a]	2016	Climate Adaptation	national	mixed
9	2016	Tribal Environmental	large regional	Indigenous
10[a]	2017	Climate Adaptation	national	mixed
11	2017	Tribal Environmental	national	Indigenous

[a]Identifies case study boundary organization.

For additional information on the case study boundary organization refer to Chapters 2 and 3. These describe various reasons for selecting Bridging Climate Action as a case study, including its interest in self-evaluation. Of the other organizations, four started in the 1990s and another in the early 2000s. The remaining three groups began around 2012, as the professional field of climate adaptation started to grow. The networks generally consisted of a few hundred people, although two were closer to one hundred participants. Overall, organization funding came from many sources: tribal governments, the US government, non-governmental organizations, colleges and universities, corporations, foundations, professional societies, consultant companies, utility companies, and publishers. The groups' memberships varied from almost entirely Indigenous to almost entirely non-Indigenous participants. What the organizations had in common is their climate science boundary work. Each sought to connect environments, people, science, and policy or advocacy. All the groups carried significant climate change expertise, although the level of professionalization within them varied.

Results

Participant Perspectives on Bringing Together Knowledge Systems

In this section, I report participant perspectives from the case study organization on bringing together multiple climate change knowledge systems based on three different survey questions. I also provide social network analysis results on anticipated future collaborations between organization members. Next, I analyze the practices and protocols of the eight groups. The final section provides additional discussion on research results and conclusions.

Table 4.2 summarizes participant views about the relationship between Indigenous knowledges and dominant climate science. There are a number of ways to view this relationship, and the survey provided four options. In the most common response, 52% of participants indicated that Indigenous knowledge systems and climate science *should both be called sciences*. Another 27% selected that Indigenous knowledge systems *should guide climate science*. Only 19% selected the option that Indigenous knowledges are important *sources of information for climate science*. This view centers climate science, and values Indigenous knowledges primarily for what they offer to dominant science. Three participants, all Indigenous women aged 51-70, answered that Indigenous knowledges and climate science *are incompatible*. This answer noted the spiritual dimensions of Indigenous knowledges, sometimes considered as *more than science*. Understandings of Indigenous knowledges as ways of being and doing can result in a view that these knowledge systems cannot, or should not, be brought together. One participant did not select an answer, and five participants selected more than one response. Overall, these results illustrate that even within an organization formed specifically at intersections of Indigenous knowledges and climate science, there are diverse perspectives about how these relate. A slight majority emphasized both should be considered as sciences. More participants indicated that Indigenous knowledge systems should guide climate science than the other way around.

Table 4.2: Participant Views on Multiple Knowledge Systems in Climate Change

Which best describes your view on multiple knowledge systems in climate change?	No. (%) n=52
Indigenous knowledge systems and climate science should both be called sciences.	27 (52%)
Because Indigenous knowledge systems are many years older than climate science, they should guide climate science.	14 (27%)
Indigenous knowledge systems are important sources of information for climate science.	10 (19%)
Indigenous knowledge systems and climate science are incompatible because Indigenous knowledges are spiritual, and climate science is empirical.	3 (6%)[a]
Did Not Answer	3 (6%)[b]

Note: Some participants selected more than one option, therefore total does not equal 100%.

[a]These are Indigenous women, aged 51-70.

[b]Two of three participants who did not answer were those who did not complete the survey.

Table 4.3 reports participants' perspectives on the level of benefits to Indigenous peoples when sharing their knowledges with climate scientists. Overall, 73% viewed these benefits as *significant* or *very significant*. Another set, 16%, reported little benefit. Indigenous women predominate among the eight participants who viewed knowledge sharing as having little benefit for Indigenous peoples. While this represented a minority view, the result indicated these members had questions about the benefits emerging from the core purposes of the organization. Only four participants who completed the survey did not report a level of benefits, opting for *I don't know*. Therefore, a majority of participants perceived significant benefits from knowledge sharing, but a contingent recognized little benefit to Indigenous peoples.

Table 4.3: Participant Views on Benefits to Indigenous Peoples When Sharing Knowledges with Climate Scientists

How significant are the potential benefits to Indigenous peoples when they share their knowledges with climate scientists?	No. (%) n=52
Not Significant	2 (4%)[a]
Slightly Significant	6 (12%)[b]
I don't know	4 (8%)
Significant	17 (33%)
Very Significant	21 (40%)
Did Not Answer	2 (4%)[c]

[a]These were Indigenous women, aged 61-70.

[b]These were four Indigenous women, aged 41-70, and two non-Indigenous men, aged 21-60.

[c]Two participants did not complete the survey.

For the level of risks to Indigenous peoples when sharing their knowledges with climate scientists, Table 4.4 shows that no one indicated these risks are *not significant*. A majority of participants selected *significant* or *very significant*, for a combined 75%. Four members chose *slightly significant* risks, six indicated they *did not know*, and one did not answer.

In these two questions, a majority of participants in this network considered both the benefits and risks of knowledge sharing by Indigenous peoples as significant. Yet there was diversity among participants' views, particularly where 16% were uncertain of the collaboration benefits.[41]

[41] The survey's box checking approach was not popular among this group. Some surveys contained comments in the margins about the need for situational understanding in order to answer the questions, particularly on the benefits and risks of knowledge sharing. A couple participants noted their distaste for the option that the knowledge systems were incompatible. However, three elder Indigenous women made this selection. Some participants did not answer every question, and others selected more than one option, as noted in the tables.

Table 4.4: Participant Views on Risks to Indigenous Peoples When Sharing Knowledges with Climate Scientists

How significant are the potential risks to Indigenous peoples when they share their knowledges with climate scientists?	No. (%) n=52
Not Significant	0
Slightly Significant	4 (8%)[a]
I don't know	6 (12%)
Significant	22 (42%)
Very Significant	17 (33%)
Did Not Answer	3 (6%)[b]

[a]These participants were three Indigenous women, aged 41-70, and one non-Indigenous man, aged 61-70.

[b]Two of three participants who did not answer were those who did not complete the survey.

Social Network Analysis on Future Collaborations

The survey included measurements for trust between participants in the case study group employing a social network approach. Participants' anticipated future collaborations with all others in the network approximated trust and positive affect because few participants share the same employer, and this is a voluntary organization. Table 4.5 presents results in aggregate for the network, where each participant identified who they *plan to collaborate with* in the future, and who they *look forward to collaborating with* but have no specific plans. As worded, these selections were mutually exclusive therefore the two measures can be combined to consider trust and positive intention throughout the whole network.

Table 4.5: Network Measures for Future Collaborations

	Have Plans to Collaborate	Look Forward to Collaborating But Have No Specific Plans	Combined
Network Measure	One-Way Ties	One-Way Ties	One-Way Ties
Density	12.1%	16.2%	28.3%
Average Degree	6.2	8.3	14.5
Total No. of Ties	320	430	750
Reciprocated Ties	28.0%	18.8%	--
No. of Isolates	2	0	0
	Reciprocated Ties	Reciprocated Ties	Reciprocated Ties
Density	5.3%	5.1%	10.4%
Average Degree	2.7	2.6	5.3
Total No. of Ties	70	68	138
No. of Isolates	16	23	16

The combined relation showed that 28.3% of all possible pairs of people are either planning to collaborate, or looking forward to collaborating. Among the 52 participants, this amounted to 750 total selections from one person to another indicating anticipated future collaborations. Combining the two measures, there were no isolates for one-way ties. This means everyone was connected to at least one other person. On average, each participant anticipated future collaborations with 14 people.

There were fewer reciprocated ties where two participants mutually selected each other. The number of ties drop from 750 one-way to 138 reciprocated ties. Combined density drops from 28.3% to 10.4%. This indicates many people were selecting potential future collaborators who did not select them back. For isolates based on reciprocated ties, 16 of 52 people (31%) had no matched plans to collaborate with any specific person. Twenty-three of 52 people (44%) were isolates for relations that were *looking forward to collaborating*. In reciprocated ties, members anticipated collaborations with an average of five others.

Overall, participants indicated positive intention to collaborate with 14 others and one-way ties were fairly dense (28.3%). At the same time, much lower reciprocated ties means there

was marginal agreement on mutually intended future collaborations. Reciprocal future collaborations were anticipated with five others on average, although about one-third of participants had no matched future collaborator.

Boundary Organization Practices and Protocols

Assessing practices and protocols among a set of boundary organizations first involved clarifying important features of Indigenous approaches relevant to environmental boundary organizations. These I summarized in the background section as Figure 4.1. Again, these diverse interconnected dynamics include items such as attitudes and ethical responsibilities, in addition to discourses and practices. Table 4.6 lists the practices and protocols of each boundary organization, including identification of Indigenous approaches and foci where applicable. Items listed first occurred more often or received greater emphasis at events with the respective group.

Table 4.6: Boundary Organization Practices and Protocols

No.	Organization Summary	Practices and Protocols[b]
1	Climate Adaptation (regional, non-Indigenous)	Presentations; panels; webinars; facilitated small groups; listserves; trainings sessions
2	Tribal Environmental (national, Indigenous)	Presentations; panels; facilitated small groups; songs; ceremony; Indigenous sovereignty and governance; storytelling; not human-centric focus on all our relations
3	Climate Adaptation (regional, non-Indigenous)	Same list as 1; this is a different group than 1
4	Conservation (regional, mixed)	Presentations; panels; facilitated small groups; projects; place-based; trainings; listserves; ceremony; songs; talking circle
5	Tribal Environmental (national, mixed)	Presentations; panels; facilitated small groups; webinars; listserves; training sessions; tours; songs
6[a]	Climate Adaptation (national, mixed)	Presentations; panels; facilitated large and small groups; training sessions; listserves; teleconferences; social media; ceremony
7	Conservation (regional, mixed)	Same list as 4; this is the same group
8[a]	Climate Adaptation (national, mixed)	Place-based; tours; on the land; faciliatated large and small groups; presentations; storytelling; ceremony; sunrise ceremony; songs
9	Tribal Environmental (regional, Indigenous)	Interactive; group activities; place-based; on the land; offerings; ceremony; sunrise ceremony; art; poetry; songs; not human-centric focus on all our relations, reciprocal responsibilities, beneficience, trust, Indigenous sovereignty and governance
10[a]	Climate Adaptation (national, mixed)	Same list as 6; this is the same group as 6 and 8
11	Tribal Environmental (national, Indigenous)	Interactive; place-based; on the land; tours; group activities; talking circles; digial media; presentations; offerings; ceremony; poetry; not human-centric focus on all our relations, reciprocal responsibilities, beneficience, trust, Indigenous sovereignty and governance

[a]Identifies case study boundary organization.

[b]Items listed first were more frequent or given greater emphasis.

Next, I identify similarities, comparisons, and contrasts of the various boundary organizations in relation to each other, and in conversation with Indigenous practices and protocols. Table 4.6 outlines multi-day events hosted by eight different groups occurring between June 2014 and June 2017. Events 1 and 3 took place in different large regions, but were similar climate adaptation groups focused primarily on professional and academic approaches. One event had a single Indigenous panel presenter. The other had none, having scheduled their event during ceremony time for a set of large tribes in the region. Participants at events 1 and 3 discussed their role as boundary organizations in climate science, yet appeared unaware of the narrow scope defining their public engagements. Community groups were largely conservation organizations that did not partner with Indigenous populations. Government bureaucrats, environmental professionals, and academics working on climate adaptation heavily attended these events. These groups received sponsorship from large government agencies, non-profits, research centers, and corporations, including construction companies.

Events 2 and 5 also represent different groups, yet both emphasized tribal environmental contexts across the US. Indigenous peoples governed the organization in event 2, and event 5 combined Indigenous and non-Indigenous leadership. Both were primarily indoor conferences with formal presenters and panels. In event 2, the organization succeeded at times to bring the outdoors inside through storytelling, songs, and ceremony. There was core focus on Indigenous sovereignty and governance related to climate change concerns. The organization at event 5, with mixed governance, was significantly bureaucratic with presentations by the group's identified experts. It included many non-Indigenous speakers and trainers. There was one song, and an on-site tour of tribal projects. However, other participants stated songs and tours are not always part of the program. Well attended by tribal members and employees, both regional and

from across the US, the organization emphasized professionalization to support tribal environmental efforts.

The conservation organization identified in events 4 and 7 was one regional group with mostly non-Indigenous governance, but Indigenous leadership as well. These events informally held a *conference within the conference*. Indigenous-focused activities were plentiful, led by Indigenous persons, and open to all conference participants. This offered invitation to non-Indigenous members to learn about Indigenous protocols and tribal environments. At each conference, at least one keynote speaker was Indigenous. There were talking circles, songs, and ceremonies open to all attendees. Apart from these activities, the remainder of the conference contained standard presentations and panels by many non-Indigenous persons. Because of the many sessions and activities, it was possible to attend without significant participation in the Indigenous-focused portions. But the main program integrated a keynote, songs, and optional ceremony. This group had more ecosystem-based and practitioner-applied emphasis than the regional climate adaptation groups at events 1 and 3. The majority of participants at events 4 and 7 were non-Indigenous. Still, there was a strong regional contingent of Indigenous participants and tribal employees. These events opened collaborative opportunities through an informal, but inviting, Indigenous-focused conference-within-the-conference.

Events 9 and 11 provided another approach for Indigenous-led organizations. These were largely interactive and focused on ecologies of place. Activities included significant time outside and group activities rarely had a designated leader. General events included talking circles, art, poetry, and storytelling. Ceremonies built into the everyday program. Both focused on particular attitudes to environments such as reciprocal responsibilities with all our relations, beneficence, trust, and Indigenous sovereignty and governance. Participants at these events were primarily but

not entirely Indigenous persons. Leadership was Indigenous. While centered on particular ecologies, attendees came from a large regional area in one case, and from across the US in the other case. Knowledge sharing, advocacy, and network building occurred organically. The need to address boundary intersections between Indigenous knowledge-practices and climate sciences was integral to these organizations. They also uniquely centered Indigenous protocols. Both groups were more flexible with pre-determined schedules than the other groups. During both events, participants worked in groups to produce environmental advocacy or artistic projects.

The three events (6, 8, and 10) with the case study group varied. Table 4.6 explains how two of three events, 6 and 10, ran similar to other professional and academic forums. These involved frequent presentations and panels, and facilitated sessions in large and small groups. Short indoor opening and closing ceremonies were included, often combining cultural protocols by Indigenous peoples of various places. The overall focus of discussion was on intersections between Indigenous knowledges and climate science, yet Indigenous protocols were sparse. In contrast to events 6 and 10, event 8 included more tours, and place-based learning and ceremony. Event 8 occurred largely outside and included daily sunrise ceremonies. Some presentations and facilitated group sessions were also on the program. In the case study group, there was partial emphasis on Indigenous practices and protocols. At times, attitudes and foci in Figure 4.1 emerged. Other times, participants questioned during group discussions whether the level of emphasis on topics such as beneficence, trust, reciprocal relations, and Indigenous sovereignty and governance were sufficient. See Chapters 2 and 3 for additional information about the case study organization practices and leadership.

Discussion and Conclusions

This research set out to understand participant perspectives and organizational practices in climate change boundary organizations with focus on the benefits and risks of collaboration for Indigenous collectives. The paper outlined participants' views on the benefits and risks of knowledge sharing, and the relationship between Indigenous knowledges and climate science. It analyzed levels of trust between members in a national scale case study organization. Intersections between Indigenous peoples' and climate scientists' practices in eight groups highlighted a wide range of collaborative endeavors that explain how boundary organizations have recently aimed to bring diverse practices and protocols together.

Overview of Findings from Case Study

Case study organization participants identified diverse perspectives on how to characterize the relationship between Indigenous knowledges and climate science. Over half (52%) indicated both should be viewed as sciences. About one-quarter (27%) stated that because Indigenous knowledges are much older, they should guide climate science. Nearly 20% selected that Indigenous knowledge systems are important sources of information for climate science. Therefore, more participants indicated Indigenous knowledge systems should guide climate science than the other way around. Three participants (6%) noted that the ways of knowing are incompatible. These members question whether the ways of knowing should be brought together. The diversity of perspectives is neither problematic nor surprising in light of many understandings around Indigenous knowledge-practices (McGregor 2004; Whyte 2013a). Yet the view that Indigenous knowledges are primarily important sources of information for incorporation into dominant climate science is a problematic perspective (Whyte 2013a; CTKW 2014). This mischaracterizes Indigenous knowledges as mere information and centers the

primary intent to benefit already-privileged climate science groups. Almost one-fifth of participants (19%) still selected this option in a group focused on respectful collaborations between Indigenous peoples and climate scientists.

A majority of participants in this network identified simultaneous high benefit and high risk to Indigenous peoples when sharing their knowledges with climate scientists. The level of benefits were significant or very significant according to 73% of members. Risks were significant or very significant according to 75% of members. The group's strong recognition of risks to Indigenous peoples in knowledge sharing is consistent with ethical approaches identified in Indigenous studies (L. T. Smith 2012; Williams and Hardison 2013; CTKW 2014). While only four participants (8%) indicated the risks are slightly significant, and none selected not significant, some organizational discussions reflect tensions between sharing Indigenous knowledges openly versus protecting them. Sharing openly with little regard for the risks is revealed here as a minority perspective in this boundary organization.

Another minority view deserves attention: eight participants (16%) were uncertain of the benefits to Indigenous peoples when sharing their knowledges, noting benefits as not significant or slightly significant. In one sense, participation in a boundary organization that intentionally brings together Indigenous peoples and climate scientists may signify an anticipation of expected benefits, otherwise why participate? Yet it is possible some members engage the group at least in part to prevent further abuses toward Indigenous peoples and their knowledges. Results indicate boundary organizations should not only continue dialogues about potential benefits and risks, but regularly reassess how their efforts practically benefit Indigenous communities.

The social network data revealed a moderate level of trust between participants in the overall organization, where each person indicated future collaborations with around 14 others.

Yet much lower reciprocated ties, with a drop in density from 28.3% to 10.4%, means there was marginal agreement on mutually intended future collaborations. On average, members had about five reciprocated future collaborators, although almost one-third of participants had no matched future collaborator. The reduction in ties indicates participants were selecting potential collaborators who were not selecting them back. This may signal the presence of popular or dominant actors in the network. It could also mean lower levels of trust and reciprocal relationships than appear at first analysis.[42]

In summary, participants of the case study boundary organization demonstrated diverse perspectives on how to characterize the relationship between Indigenous knowledges and climate science, and which should guide the other. A majority identified simultaneous high benefits and high risks to Indigenous peoples when sharing their knowledges with climate scientists. A noted minority was less convinced of the benefits involved. Social network analysis revealed a moderate level of trust between participants in the overall organization, but fewer reciprocated ties for future collaborations (i.e. where two participants both selected each other).

Overview of Findings on Boundary Organization Practices and Protocols

The broader set of boundary organizations engaged a wide range of practices and protocols. A key indicator of outcomes was whether an organization's governance consisted of non-Indigenous persons, Indigenous persons, or a combination of both. Two climate adaptation groups with non-Indigenous governance (1 and 3 in Table 4.6) had practically non-existent engagement with Indigenous peoples and protocols. As explained in the results, one of these

[42] Network methods are limited to capture complex dynamics of trust or provide interpretive meaning of relations, yet reliable to measure what is present based on the questions asked (Emirbayer and Goodwin 1994; Mische 2011; Wald 2014).

groups scheduled their annual meeting during ceremony time for a set of tribes in the region, and the other had only one Indigenous panelist during its multi-day event. The practices of professional, academic, and bureaucratic environmental fields dominate these groups. Although conversant in the concepts and bridging goals of climate science boundary organizations, substantive engagement with diverse populations and discourses was not apparent in these climate adaptation groups.

The organizations with leadership that combined Indigenous and non-Indigenous persons were distinctly different from those with only Indigenous or non-Indigenous governance. However, these groups with mixed governance also took somewhat different approaches from each other. I group them in three ways. First, one tribally focused environmental organization (number 5) functioned similarly to other mainstream environmental groups, with inclusion of minimal Indigenous protocols. The event content focused on tribal issues, but approaches were substantively bureaucratic. Second, for the conservation group (events 4 and 7), the results described a conference-within-the-conference that created an Indigenous-focused track within a larger event. This track, run by Indigenous persons, included place-based ceremony, songs, speakers, and talking circles. It provided opportunities for co-existing foci during events, and invitation for non-Indigenous persons to learn from tribes within the larger regional area.

Third, the final group with mixed governance was the case study organization. Their events were not the same from year to year. Two events (6 and 10) operated largely similar to other dominant environmental organizations, with focus on indoor presentations. Very short opening and closing ceremonies were included, as were small and large group discussions. However, one event (number 8), enacted a more place-based, outdoors, and ceremony-focused approach. After event 8, some participants discussed disappointment that event 10 returned to

practices that largely reflected those of professionalized climate science. Discourses at all three events addressed the intersections between Indigenous knowledges and climate science. However, some participants questioned whether the case study group had strong enough focus on Indigenous practices, attitudes, beneficence, governance, and sovereignty. In these cases, the boundary organization's leadership emphasized that the group is not an Indigenous organization and seeks to represent both sides of the boundary.

Of all the organizations, the three groups with Indigenous governance had strongest focus on Indigenous practices and protocols summarized in Figure 4.1. One group (number 2) met in a large city, and entirely indoors, but brought the outdoors inside through frequent images, sounds, ceremonies, and songs. There were formal presentations and panels, although Indigenous persons constituted nearly all speakers. Attendees included many non-Indigenous participants from federal, non-profit, and other policy organizations. Indigenous protocols and Indigenous-led climate change initiatives infused the event. The remaining two groups (9 and 11) operated altogether different from the others. These were largely outdoor, place-based events in landscapes of importance to tribal nations in broad regional areas. Focused on group-based interactions, discussions functioned more like conversations or talking circles without much facilitation. Ceremony, art/design/poetry, and emphasis on particular attitudes such as reciprocal relations were common. Central in the organizations were overlapping concerns of Indigenous peoples' governance and sovereignty in relation to climate change topics. These two groups centered Indigenous priorities without significant use of bureaucratic practices, such as formal lecture presentations. Non-Indigenous scientists and other collaborators were present, but a minority of participants. Discussions regularly engaged boundary interfaces between Indigenous knowledges and environmental science.

Overall, boundary organizations engaged a wide range of practices and protocols. Some involved Indigenous peoples' governance and approaches, including focus on Indigenous self-determination and attitudes such as reciprocal responsibilities with non-human relations. Others did not. The primary determining factor was whether Indigenous participants were among central leadership in the climate change boundary organization.

Conclusions

This research finds that Indigenous governance is more likely to address collaboration risks, ensure priorities that benefit Indigenous collectives, and make decisions that respect Indigenous knowledge-practices in climate science boundary organizations. Indigenous led boundary organizations demonstrated ways to foster greater collaboration benefits and reduced risks in partnerships between Indigenous peoples and climate scientists. Both in content and approach, these groups focused on intersections between ways of knowing through a lens of respect for Indigenous beneficence, governance, and sovereignty. Processes of how people *come to know* play an important role in outcomes, or what *comes to be known* (Cajete 2000; McGregor 2004). The research results show how practices and attitudes employed in boundary organizations affect the kinds of expertise most valued, and whose voices permeate (Nadasdy 1999, 2003; Whyte, Brewer, and Johnson 2015; Benjamin 2016b). Some approaches by groups with mixed governance also illustrated moves towards beneficial collaborations, such as the conservation group's conference-within-a-conference, and the place-based event by the case study organization. In both groups, Indigenous peoples still led the collaborative features that reflected practices and protocols outlined in Figure 4.1.

The paper shows how bringing together the knowledge-practices of Indigenous peoples and climate scientists does not involve mere meshing of information. How collaborations unfold

matters greatly. This includes who makes decisions and how groups attend to benefits and risks for Indigenous communities (L. T. Smith 2012; Coombes 2012; Whyte 2013b). Ethical partnerships alongside Indigenous peoples carry responsibilities, however the identified features were not prominent where Indigenous participants were not among key leaders. This research sought to understand how recent climate change fields of practice engage benefits and risks, and illustrated the importance of Indigenous peoples' governance in collaborations. This was the case even as organizational and leadership formats varied. This paper shows how Indigenous governance mattered in climate change collaborations even with different proportions of Indigenous and non-Indigenous persons as leaders and participants. It found greater collaborative benefits and reduced risks when Indigenous peoples were among core governance roles.

Climate science is one feature of multi-faceted attempts to shape livable environmental futures. Narrow understandings of climate science require redefinition through engagement with diverse knowledge and science systems. However, Indigenous ways of life are centrally important for Indigenous peoples' own pursuits of self-determination and well-being. Indigenous knowledge-practices are time-tested, yet challenged by ongoing colonialism. Climate change fields have responsibilities to respect not only different ways of knowing, but particular approaches to partnership. Partnership responsibilities would centrally focus Indigenous governance, including land governance, and benefits for Indigenous collectives. In this study, collaborative climate change groups unevenly engaged everyday opportunities for reciprocal partnerships. This was illustrated by their wide range of practices, and manners of approaching one another and their environments. Some groups exhibited patterned exclusion of Indigenous peoples and practices. The case study group sought to integrate knowledges but to a lesser

extent, related practices. This paper demonstrates why it cannot be assumed that climate change collaborations will bring benefits, even with intentional cross-cultural goals.

The research contributes to debates about the benefits and risks of cross-cultural collaborations, particularly in the context of environmental boundary organizations. It engages political discussions at the intersection of Indigenous knowledges and climate science, where reciprocal responsibilities and trust play critical roles. The work informs future efforts that bring together Indigenous peoples' and climate scientists' knowledges and practices. Boundary groups must intentionally align Indigenous persons among core governance positions. This applies to the case study organization, and other climate adaptation, conservation, and tribal environmental collectives. The paper explains how boundary organization practices are taking place on the ground to broaden conceptions about the benefits, risks, and responsibilities of climate change collaborations. Climate change boundary organizations have responsibilities to guard against reproducing relational and structural injustices in their reform efforts. To benefit Indigenous collectives, innovative science practices must engage Indigenous peoples' collective self-determination, governance, and capabilities to contend with climate change, alongside science reform efforts.

CHAPTER 5

Conclusion

Summary of Key Findings

This dissertation sought to understand how US climate change boundary organizations engage with socio-ecological injustices against Indigenous peoples. It assessed dynamics of knowledge, power, and practices in cross-cultural climate change collaborations employing a mixed methods social network approach. One case study group figured prominently in the research; this organization formed specifically to bring together Indigenous peoples and climate scientists. The dissertation also analyzed how eight climate change boundary organizations approached diverse knowledge-practice systems of Indigenous peoples and climate scientists. This study examined everyday collaborations through measurements of relational ties, meso-level network structures, organizational practices, participant perspectives, and qualitative interpretations. The research consists of three empirical papers to address a gap at the intersection of social networks, climate change, and Indigenous environmental justice studies. It also draws from Native feminisms, intersectionality, and science studies to provide understanding of relational and structural features of cross-cultural climate change collaborations.

The dissertation examined three research questions organized into the three papers. First, for the case study organization: what were levels of integrated decision-making, policy, and

climate adaptation actions in the network? This study argues that to benefit Indigenous collectives, collaborations must move beyond transfers of knowledge toward types of partnership that counter injustices. The second paper asked: how much diverse representation was found among the organization's central actors across intersections of race, ethnicity, indigeneity, gender, and age? The second study argues that Indigenous women and youth experience compounding disadvantages in environmental science fields due interconnections between colonialism, racism, and patriarchy. It investigated how collaborations run the risk of reproducing some forms of inequality even as they challenge others. In the third paper, I examined how eight climate change boundary organizations brought together knowledges and practices of Indigenous peoples and climate scientists. How did participant perspectives and organizational practices engage the benefits and risks of collaboration for Indigenous collectives?

Findings for the first question indicate types of collaboration well attuned to transfers of power such as joint decision-making and policy efforts were minimally present, reflecting marginal connections to Indigenous political goals. Though critical to strengthen Indigenous peoples' climate change capabilities, place-based climate adaptation partnerships between participants in the network were scarce. The network supported climate knowledge transfers, including for diverse Indigenous participants from different tribes and regions experiencing climate-related challenges. The research demonstrated climate knowledge transfers that moved in many directions: for example, in this network knowledges were shared by Indigenous and non-Indigenous persons. Yet there were minimal integrated governance, advocacy, or climate adaptation actions.

The second paper showed that Indigenous women and youth were underrepresented in boundary organization central roles. White women and elder Indigenous men held most central positions. However, Indigenous women consistently had bridging ties between otherwise unconnected participants, and provided less visible labor to support the network. These did not translate to decision-making positions. The research empirically demonstrated the differential benefits of diversity and inclusion efforts, where advantages for some underrepresented groups in climate science did not accrue to others.

In the third question, a majority of participants identified simultaneous high benefits and high risks to Indigenous peoples when sharing their knowledges with climate scientists. A noted minority was less convinced of the benefits involved. This research revealed a wide range of approaches by boundary organizations at the intersection of knowledges and practices. It found greater benefits and reduced risks when Indigenous peoples were among core governance roles in collaborative networks. This result held true even with different proportions of Indigenous and non-Indigenous persons as leaders and participants in climate change boundary organizations.

Conclusions and Recommendations

Overall, this research demonstrated how climate change boundary organizations variously resisted and reproduced socio-ecological injustices. This section outlines primary conclusions, implications, and recommendations of the dissertation. I follow these with key contributions of the research, limitations of the study, and future directions.

Knowledge Dynamics

Knowledge transfers are a mainstay of climate adaptation fields. In this sense, it is unsurprising to have found significant knowledge movement in the networks. The case study organization provided a glimpse into knowledge dynamics for intentional cross-cultural climate

change organizations. Here, knowledge flowed between Indigenous and non-Indigenous participants, and across US regions. For one-way and reciprocated ties, the knowledge network was robust with more than a couple central actors. Although the case study network has room to grow in the quantity of knowledge ties, these were ample and sufficiently decentralized for information to move quickly and through multiple pathways. These knowledge transfers serve to diversify climate science. Diverse knowledge production carries potential for innovation, improved climate change problem solving, and a broader reach for benefits.

The case study organization illustrated significant respect for Indigenous knowledges in a scientific milieu that frequently dismisses Indigenous ways of knowing. While this is an improvement over disrespect often exhibited by privileged sciences, the result is not generalizable to other climate science and adaptation organizations. Even in a group formed specifically to bring these knowledge systems together, almost one-fifth of participants held views that privileged dominant climate science over Indigenous ways of knowing. This research found widely varied approaches at the intersections of Indigenous and Western ways of knowing. While climate science boundary organizations are likely to yield high movement of knowledges through network activities, this does not extend to broad respect for Indigenous knowledges and sciences in climate change arenas.

This dissertation recommends that climate science fields more deeply engage with diverse peoples' experiences of socio-ecological change and injustices. The study shows that co-production of climate knowledge does not take place between applied climate scientists and supposedly non-scientific communities who merely contribute local knowledges. Those outside professional and academic science fields can carry deep ecological knowledges, including many Indigenous peoples with time-tested environmental understandings. Broadly, applied climate

scientists need greater awareness of cross-cultural, political, and ethical concerns highlighted in this research. Sciences intertwine with particular values, even where well-hidden through normalized practices. Knowledge production cannot be disconnected from its benefits, risks, and outcomes for Indigenous collectives. Ethical co-production of climate knowledges demands that diverse Indigenous peoples are full partners. Apart from actions and outcomes, the knowledge work in climate change networks carries limited benefits. There is a need to activate collaborative network ties for a broad set of purposes; these move beyond the benefits to climate science or climate change organizations.

Advocacy and Policy Engagements

In the cross-cultural context of this research, advocacy and policy engagements were crucial. Greater network ties tend to foster communication and galvanize collective action. Yet in the national scale case study, solid knowledge sharing ties did not correlate with widespread collective action. The group produced two policy statements since its inception in 2013. Participants reported few ties for policy-related collaborations, and even fewer as reciprocated ties. It is unclear what set of factors contributed to this low advocacy. The small set of central actors in policy collaborations could be gatekeeping around which collective actions move ahead and by whom. Although science collaborations often have reform goals and function as advocacy networks, the case study organization did not have clear policy goals. This may stem from how leaders viewed the boundary organization's role within its context. Yet Indigenous scholarship identifies advocacy as critical, not only for climate change policy but also engagement with Indigenous political goals. Viewed through Indigenous ethics, these are non-negotiable features of cross-boundary environmental collaborations. Thus, the case study group must move from

nominal to concerted focus on advocacy goals that resonate with Indigenous participants to maintain legitimacy across cultural boundaries.

A few other boundary organizations in the study exhibited advocacy in relation to their key area of emphasis: climate adaptation, conservation, or tribal environmental networks. Some did not. Members of various networks noted their support for climate science in the face of climate change denial and recent federal policy around environmental issues. Most groups did not advocate collectively, even as individual members participated with other climate movement activities. The groups varied widely around Indigenous-centered advocacy. One tribal environmental group wrote a draft statement on Indigenous knowledges and climate change during a multi-day event. A couple groups shared information with members about climate policy and climate justice activities, although again not formally sponsored by the boundary organizations.

Without intentional advocacy goals, boundary organizations inadvertently become self-serving through reproduction of uneven power relations. The groups bypass potential opportunities to affect broader social and scientific change through harnessing their network ties, both strong and weak. The research finding of low advocacy in and by climate science groups illustrates the challenges of reforming science practices from within. Science advocacy networks are not oppositional social movements. Yet in absence of political direction, they reinforce structural inequalities already bound up with exclusive science practices. Climate science boundary organizations have responsibilities to specify and act on advocacy goals. Recommendations also include partnerships with other social and political movements. In cross-cultural networks, this involves climate policy, but also political movements that support Indigenous peoples' governance, well-being, and land rights. Climate science and politics are

entangled, as are climate change and colonialism. Whether working with or against science practices, and from inside or outside established institutions, organizations must contend with conjoined socio-ecological systems.

Climate Adaptation: Moving from Sciences to Action

As climate change networks broadly emphasize moving from knowledges to action, place-based climate adaptation projects are finding greater implementation. Still, practical application of adaptation measures at various scales and in many places has proved challenging. Some local, regional, and tribal governments are taking preparatory and responsive steps. In the case study organization, moving from climate sciences to action was a stated goal. Climate adaptation capabilities are also key collaboration outcomes for Indigenous peoples contending with climate change. For these reasons, the low levels of climate adaptation collaboration ties in the network are of particular concern. There is urgency and practical necessity to move from climate knowledges to action in order to curb substantial injustices experienced by Indigenous peoples who have minimally contributed to the causes of climate change.

This study found not only minimal climate adaptation collaboration ties between participants, but the network structure was not robust. Most ties connected to only a few central actors. Highly centralized networks often result in less collective action, and are not as effective at complex problem solving. In this case, there could be a mismatch of scale where a national network sought to translate ties into regional actions. Surprisingly, ties in the network were not correlated based on participants' region of focus in their climate change work. There was in fact regional out-group selection based on statistical tests for homophily. The dissertation cannot identify why place-based climate adaptation collaborations were not plentiful, although limited time and financial resources may contribute.

Without moves to action, climate change boundary organizations remain largely in the realm of knowledge discussions. Yet the cross-cultural context calls for approaches that lead toward outcomes that benefit Indigenous peoples. The findings have implications for organizational legitimacy as some members seek more active projects and less time in talk. Recommendations include greater project-based instead of presentation-based events. Climate science groups would need to secure grants and person power to enable climate adaptation collective actions. They should also provide direct resource support for tribally led climate change activities. Programs can strengthen research and project capabilities of Indigenous collectives and individuals connected to the network. Those with ties to privileged environmental fields and institutions have responsibilities to secure resources that support organizational goals focused on Indigenous peoples' climate adaptation outcomes.

Decision-Making and Governance in Collaborative Environmental Organizations

Collaborative environmental organizations are responsible to meet basic ethical requirements for participatory justice. This means more than inclusion of underrepresented groups. Justice extends to decision-making power that comes through governance positions. The dissertation found cross-cultural climate change organizations were challenging some forms of inequality, but not others. Diversity gains in the case study group opened up leadership opportunities for Indigenous men and White women, both underrepresented in privileged science fields. These gains did not extend to Indigenous women or youth. Research on the larger set of climate change boundary organizations found critical importance for Indigenous persons to be among core governance roles. Yet some climate organizations operated without Indigenous peoples among membership or leadership. This proves disconcerting not only for lack of

diversity but because Indigenous governance brought greater benefits and reduced risks for Indigenous collectives in partnership process.

Indigenous peoples' social networks are one means to revitalize Indigenous governance that respects all genders and ages. In the case study, the insular leadership cluster by Indigenous men and White women did not extend toward broader collaborative governance. The findings carry implications for Indigenous women and youth, who experience material and affective harms through patterned absences from decision-making. There are also implications for goals around Indigenous self-determination and governance. Indigenous men's gains in climate science fields creates opportunities for them to dismantle false notions of tradition that emerged through colonial oppression. Efforts to reclaim Indigenous traditions in a colonial patriarchal way ultimately harms Indigenous men, women, two-spirit persons, and collectives. As a network seeking to diversify climate science fields, the central actor patterns also diminish the group's legitimacy and produce insular relational dynamics.

A key recommendation is for environmental collaborations to ensure Indigenous participants, including diverse members such as Indigenous women and youth, are among central governance roles. Otherwise, there is a failure of beneficence—not only for individual participants, but benefits that should accrue to the everyday lives of those affected by scientific practices. This research finds that due to layers of disadvantage, climate science boundary organizations need to intentionally create space for Indigenous women and youth among central actors. Mentoring, paid employment, and other pipeline-development projects including grants and research opportunities could play a role. The issues described in this research should inform and transform environmental collaborations. Organizations need to meet basic participatory justice goals of fairness, labor compensation, and representative decision-making power.

Indigenous women and youth are already strong leaders in environmental and climate movements. Many are environmental scientists and deep knowledge holders who recognize the power of collective action. Climate science organizations would learn from these visionary leaders who have solid track records of participatory decision-making in other arenas.

Reconfiguring Environmental Sciences

Dominant environmental sciences persist with low diversity based on race, indigeneity, and to some extent, gender. Reconfiguring environmental fields demands greater diversity, equity, and inclusion—yet these are not merely to benefit the sciences. Benefits to underrepresented parties and to the everyday lives affected by science practices connects social with scientific reforms. Reform movements, and broader socio-structural transformations, can occur alongside revitalization of Indigenous lifeways. Various approaches to decolonization partially overlap and diverge; some question linear notions of time and progress. It follows, then, that a selection of climate science organizations sought Indigenous membership or governance, and there would be associated opportunities and constraints. Unsurprisingly, other climate change groups have not yet taken up these tasks.

This dissertation found that even progressive approaches in environmental sciences were limited in connecting social with scientific reforms. The case study group had insular leadership patterns and uncertain broad benefits for Indigenous collectives. In networks, both bonding and bridging ties are important. Strong bonding ties among similar actors assist with trust formation and mobilization around mutual goals. Bridging ties, on the other hand, diversify networks and keep actors connected who may otherwise not be. The study found homogenous leadership clusters that were likely to miss deep engagement with valuable alternative perspectives. The insularity tends to produce internally reinforcing meanings and practices. Ultimately, this affects

the quality of the sciences produced, and efforts at complex problem solving. It also impacts justice outcomes.

In reconfiguring climate sciences, organizations need to modify their own processes and practices. Recommendations were already made for environmental collaborations to ensure Indigenous women and youth are among central governance roles. Indigenous women demonstrated strong bridging patterns in the case study organization, illustrating clear contributions to diversify the network. As central actors, Indigenous women and youth would likely pursue alternative organizational objectives. Climate science groups require their own internal reconfiguring to embrace Indigenous revitalizations and self-determination in the ways they have power to do so. Engagement with traditional knowledge systems does not exempt organizations from pursuits of gender and racial justice. Disruptions of colonial orderings involves putting in place processes that, as much as possible, reconfigure hierarchies. It means no longer assuming uneven conditions will remain, with corresponding behaviors that follow. This transforms leadership and everyday interactions. Reconfiguring environmental science fields will require consistent focus on the political and ethical dimensions of inclusion, governance, and reciprocity.

Bringing Together Diverse Knowledges and Practices

Ethical approaches that bring together Indigenous and Western knowledge-practices respect common ground, differences, and partial incommensurabilities. Dominant climate science is a culture of practice with colonial origins that permeate everyday efforts to work within multiple ways of knowing. This research found that boundary organizations took variable approaches to benefits, risks, and practices that bring together Indigenous knowledges and climate science. Some attempts at these intersections were respectful and opened up inviting

spaces to improve intergroup relations. A few organizations centered team projects, relational interaction, and Indigenous sovereignties. The activities undertaken, who made decisions, and how people approached each other and environments were part of varying collaboration protocols. How collaborations unfolded mattered greatly in bringing together knowledge-practice systems.

As expected, participants in the case study group demonstrated diverse perspectives on the relationship between Indigenous knowledges and climate science, and which should guide the other. A majority described Indigenous knowledges as science, although a few elder Indigenous women viewed the knowledge systems as incompatible. These findings from the case study are not generalizable to other climate science boundary organizations, particularly those that marginalize Indigenous participation. Among the groups focused on resurgence of traditional ecological knowledges, again, the research showed greater need for inclusion of diverse Indigenous members. Common values in Indigenous protocols, such as reciprocal responsibilities, trust, and collective flourishing, can provide guidance for respectful meanings of *traditional* in partnership processes. Respect for tradition does not equate to inaccurate notions of history that subvert Indigenous peoples' collective or individual well-being. To many Indigenous peoples, traditional does not mean unchanging, but rather time-tested, practically appropriate, and wisdom-bearing.

Indigenous peoples themselves decide how and when to blend customary and innovative technologies and approaches. Indigenous knowledge-practices are simultaneously deep-rooted and dynamically adaptive. Cross-cultural environmental collaborations carry potential benefits, yet sacrificing Indigenous self-determination is non-negotiable. Although there is no single formula for bringing together diverse knowledges and practices to contend with socio-ecological

challenges, there are ethical guidelines. This dissertation engages these by highlighting the benefits and risks of collaborations for Indigenous peoples, and the principles of procedural equity.

Benefits and Risks of Collaboration for Indigenous Collectives

The central concern of this research examined how climate change organizations viewed and enacted dynamics of benefit and risk for Indigenous collectives through partnership processes. These extended from respectful intergroup relations, to diversifying knowledges and networks. The work focused on integrated decision-making, levels of advocacy, and ethical protocols. Participants in the case study organization largely acknowledged collaboration risks, a noted ethical perspective for cross-cultural endeavors. Yet the group did not have clear protocols to protect Indigenous knowledges. There was a problematic pattern for Indigenous women, who participated in behind-the-scenes and unpaid labor to support the network. These women questioned the benefits of these activities for Indigenous participants. The organization fostered transfers of knowledges cross-culturally and across regions. However, it nominally engaged with Indigenous political goals. There was a measure of focus, but little action, around advocacy and place-based climate adaptation partnerships. Concerted engagement with Indigenous self-determination or land rights were largely absent. All these results illustrate the mixed outcomes of cross-cultural climate science collaborations.

Climate change boundary organizations that had Indigenous peoples among core governance roles exhibited greater benefits and reduced risks when intersecting different knowledge-practice systems. Some organizations lacked attention to the benefits and risks of collaboration for Indigenous collectives. Two groups exhibited overall patterned exclusions; these are non-starters for cross-cultural respect. The other six organizations showed variable

approaches to bringing together diverse climate knowledges and practices. Attending to the burdens and risks of partnership for Indigenous peoples also varied among collaborative environmental networks.

Climate change boundary organizations cannot assume that environmental collaborations will bring benefits. Collaboration risks must be given attention up front. For example, informed consent protocols determine how and by whom Indigenous knowledges will be transferred. Cross-cultural engagements should consider outcomes, not merely organizational intents. Following the research results, having diverse Indigenous peoples among core governance roles would result in broader attention to the benefits and risks of partnerships. Climate scientists have a responsibility to engage these collaborative endeavors as learners and advocates, working against uneven knowledge and power relations. This means participation in spaces where they are not the majority and where diverse Indigenous participants set key agendas. It involves becoming proficient in the political and ethical dimensions of racism, sexism, and colonialism. Collaborations are an invitation to meaningfully engage reciprocal responsibilities in cross-cultural partnerships.

Summary of Key Recommendations

In summary, the dissertation makes two key recommendations: (1) for climate change boundary organizations to deepen advocacy and place-based climate adaptation actions that benefit Indigenous peoples; and (2) to ensure Indigenous participants—including diverse members such as Indigenous women and youth—are among core governance roles. The first recommendation could involve partnerships with other social and political movements, greater policy work, or direct resource support for tribes' own climate change activities. This recommendation extends to other kinds of environmental collaborations. Organizations should

attend up front to specific issues of importance identified in the research. This includes facets of participatory justice and reciprocity in day-to-day network processes. It also involves connection to broader political goals: Indigenous peoples' governance, well-being, and land rights. It cannot be assumed that collaborations will bring benefits; partnership risks should be attended to. Benefits and risks include, but extend beyond, the knowledge realm into organizational practices and outcomes.

The second recommendation involves ensuring Indigenous peoples are among core leadership in environmental collaborations, including diverse community members such as Indigenous women and youth. This means intentional space-making in governance and decision-making. Mentoring, paid employment, and other pipeline projects including grants and research opportunities could support the goal. Coalitions with climate change movements, already strongly led by Indigenous women, youth, and two-spirit persons, would provide guidance for collaborative climate change groups. These visionary leaders may pursue alternative objectives. Boundary organizations would need to embrace modified goals that seek deeper Indigenous revitalizations and self-determination, alongside science reform efforts. This involves actively guarding against the reproduction of normalized colonial approaches; neither tradition nor innovation warrant injustices. Bringing together Indigenous knowledges and climate science evokes active values around respect, reciprocity, and inclusion of diverse community members in governance.

Key Research Contributions

This dissertation makes four primary contributions. First, it contributes to debates about how to assess environmental collaborations. It used actual measurements of collaborations instead of relying on organizational intents to understand partnerships. The work foregrounded

the minimal levels of collaboration types that signal shared power such as advocacy and integrated decision-making. Although cross-cultural collaborations are often assumed to bring benefits, my research reframes environmental collaborations based on ethical beneficial outcomes and inevitable risks highlighted in Indigenous environmental scholarship. Knowledge transfers, cross-cultural communication, and even progressive participatory processes have limited benefits in uneven climate change partner relations. Environmental management discourses with colonial origins are largely discordant with Indigenous peoples' knowledges and self-governance. The dissertation informs other collaborative contexts and urges action by environmental and climate science groups.

Second, this research illustrates a productive debate at the intersection of social theory, ethics, and everyday processes. Indigenous and environmental justice scholars have long engaged with theoretical and ethical arguments taken up in this research. This includes tensions between reforms in unjust structural systems to benefit day-to-day lives, versus the limits of inclusion and recognition in decolonization. My work casts focus on these tensions through events actually taking place in climate change struggles. It refuses the idea that these tensions cannot be productive toward social change. The dissertation bridges across social theory approaches (Indigenous, critical, conflict-structural, and relational theories) to understand contemporary Indigenous science practices through interactions with environmental collaborators. It also deepens dialogue between Indigenous studies and social studies of science.

Third, the dissertation makes various methodological contributions. My mixed methods social network approach harnesses relational-structural insights by combining actor attributes, relational connections, structural positions, and spatial factors. It does this through fields infrequently in dialogue with each other, or with social network approaches: Indigenous studies,

environmental sociology, intersectionality, environmental sciences, social studies of science, and environmental justice. The research makes methodological contributions by illustrating the utility of social network methods in these fields. The dissertation also contributes to ongoing dialogues between intersectionality and Native feminist theories by utilizing their partially overlapping concepts in the study of a national scale environmental boundary organization.

Finally, this research makes interdisciplinary contributions by broadening conceptions of how to bring together climate science, climate justice, and adaptation to environmental change. There has been little success thus far engaging all three areas simultaneously, whether through scholarship or practice. Ultimately, I argue that climate science, climate justice, and climate adaptation all need to be taken seriously. In that process, normalized relational and structural injustices, such as those experienced by Indigenous peoples, are central to understanding causes of anthropogenic environmental change and any proposed solutions. Further, Indigenous peoples' knowledge-practices are critical for their ongoing actions to contend with climate change connected to colonialism; these are also important to reconfigure privileged forms of science. This research speaks largely to climate scientists and professionals about unavoidable challenges in collaborative processes in order to widen possibilities to act otherwise.

Limitations and Future Directions

This section describes the study's limitations and potential future directions. Social network methods coupled with qualitative approaches emphasize the embeddedness of social action, yet the advantages can be offset by research complexity. The skills and resources required to conduct mixed methods network studies tend to limit sample size (Hollstein 2014). Whole network studies require very high member participation and a moderate number of members. Both conditions were satisfied in this research, with 96% response rate and a network population

in the case study group not far over 50 members. Survey methods also involve variable interpretations of questions by participants and potential attempts to give honorable responses. I minimized these effects by pre-testing the survey with a small group ahead of time, and incorporating their feedback into the final design. I administered the survey in person where I offered instructions and answered queries.

The mixed methods approach was attuned to the varied dynamics of knowledge, power, and practices in collaborative climate change organizations. Employing SNA allowed a focus beyond identity categories for social understanding, looking also to relationships (illustrated by connections between network members), social positions, and spatial-regional considerations. On their own, SNA methods are limited to engage historical factors, cultural meanings, emotions, and why only some connections and networks develop (Emirbayer and Goodwin 1994; Mische 2011). Notwithstanding, they are reliable methods to measure and illustrate relational connections and social structures (Wald 2014). Qualitative assessments of organizational leadership and practices drew from engaged participation, ethnographic notes, and secondary data sources over three years. These contributed to analysis codes, descriptive processes, and interpretations. Research design and interpretations are conditioned, in part, by the standpoint and social position of the researcher. I engaged these through ongoing self-reflective cultural analyses and regular dialogues with members of the climate change boundary organizations. Research activities were also supplemented by adjacent participation in a place-based tribal climate adaptation project and social movement involvement. These dialogues and activities helped triangulate research findings.

Future directions as extensions of this work include additional studies and further reporting of results to environmental organizations. Subsequent qualitative and longitudinal

studies will be conducted. Semi-structured interviews with participants will deepen views on participant experiences in these large scale collaborative organizations. Longitudinal studies will address how the networks are changing over time. Research results have already been reported to the case study organization. Additional short summaries, presentations, and discussions will take place with networks affiliated with this work, and other similar groups in environmental fields of practice.

Through the process of conducting the dissertation, other possible research directions have come into view. Particularly, varieties of comparative network studies would reveal additional dynamics of collaborative processes and Indigenous climate justice. First, it would be useful to compare the funding sources and resource amounts available to each of the boundary organizations. This study did not address funding in depth, yet there may be relevant influences. For example, the two climate change boundary organizations that lacked engagement with Indigenous peoples appeared the most well-funded, including from corporate sources. Smaller tribal environmental groups looked to have much less sponsorship. The time, staff, and funding resources available to the case study organization were not available in detail, yet came from various sources. As boundary organizations, loose arrangements with established institutions brings flexibility on various fronts, and limitations on others. A detailed breakdown of access to different kinds of resources and their mobilization would reasonably supplement dissertation findings.

Second, the survey did not ask network participants about social class. I considered this, but decided against it. Measures such as formal education and salary range are not good indicators of Indigenous peoples' knowledge-practices. These measures imply gradations of expertise that do not correlate well in the research context. Further, asking for this information

may appear disrespectful to some participants. While I chose not to ask about class dynamics in the social network survey, there may be influences to consider. For example, diverse tribes have varying policies and resources for tribal members or employees to attend national network events. Similarly, those who work for NGOs rely more heavily on grant-funded opportunities than those who work for governments. I expect these dynamics would vary for each climate change network.

Third, comparative studies in other national contexts could be of interest. These might consider climate change collaborations in other settler colonial states such as Canada, Aotearoa, or Australia. Or, environmental change responses by Indigenous peoples who have endured imperial forms of colonialism and waves of internal colonialism such as in India (T. D. Hall and Fenelon 2009). Similarities and differences around environmental sciences and Indigenous populations across the Americas could reveal alternative collaboration dynamics, as in places with greater or lesser Indigenous population percentages. Further, varying forms of environmental conflict and violence against Indigenous activists would alter trust and partnership dynamics. The politics of tribal recognition and treaties specific to tribal nations in the US do not translate globally. While this dissertation focuses mainly on national scale networks in the US, the diversity within and between tribal nations limits broad generalization of results to collaborations between tribal governments and climate scientists. Still, Indigenous peoples share experiences of colonialism, climate change impacts, and tensions between Westernization and customary lifeways. Indigenous women and children are also exposed to widespread discrimination on all continents, a concerted focus area for the United Nations Permanent Forum on Indigenous Issues (United Nations n.d.).

Finally, comparative studies would be warranted with social movement organizations, other kinds of networks, and across additional racial and ethnic groups. Climate science networks are not oppositional social movements. Yet the science reform goals and frequent cross-cultural efforts of groups in this study implies some connection to advocacy. The dissertation recommends greater coalitions between climate science organizations and climate justice movements. However, studies could also compare relational and network dynamics with other movements largely led by women such as environmental justice or feminist organizations. Alternately, comparisons might focus on organizations frequently led by men, including civil rights, some anti-racism, or conservation groups. Still other movements have core governance that includes LGBTQ persons, such as Black Lives Matter. These studies could focus on collaboration dynamics based on varying central actors, network membership, resource mobilizations, or political opportunities and geopolitical context. Other approaches might compare collaborations between climate scientists and additional racial and ethnic groups. This could involve African-American, Latinx, or Asian-American environmental networks, or multi-racial coalitions. Climate change organizations would also have similarities and differences to explore with anti-nuclear movements around the urgencies of social response, collective apathy, and social constructions of denial.

APPENDIX

Social Network Survey Instrument

1) Please provide your first and last names below. Your name will be used to understand network collaborations. We will not publish your name, or list it with any results.

First Name:	
Last Name:	

For this Social Network Survey, we use the terms "Indigenous peoples" and sometimes, "Tribal" such as "Tribal government", recognizing these broad terms imperfectly describe a wide diversity of words and concepts that First Peoples/Native Peoples use to define themselves. We do not find one term that is appropriate in all contexts, so please bear with the imperfect terminology.

2) How do you describe your racial, ethnic and/or Indigenous background?

3) Please write in your gender identification:

4) Which of the following describes your age range?

17 & under - Please do not take survey	
18 - 20 years old	
21 - 30 years old	
31 - 40 years old	
41 - 50 years old	
51 - 60 years old	
61 - 70 years old	
71 - 80 years old	
81 - 90 years old	
91 - 100+ years old	

5) Which of the following describes the scale(s) at which you work (mark all that apply)?

International/global scale	☐
Indigenous/Tribal nation or government	☐
Intertribal scale	☐
U.S. national scale	☐
National scale (Outside the U.S.)	☐
Multi-state regional level	☐
State level	☐
Local (Indigenous/Tribal)	☐
Local (Non-Indigenous/Tribal)	☐
Within a single institution, organization, or school	☐

6) Which of the following best describes the geographical region in which you work (select one)?

Hawaii	☐
Other Pacific Islands	☐
Alaska	☐
Pacific Northwest	☐
Southwest Region (Including CA)	☐
Plains/North Central	☐
Midwest	☐
South Central Region (NM, OK, TX)	☐
Northeast	☐
Southeast	☐
Virgin Islands/Puerto Rico	☐
Entire U.S. (no specific region)	☐
Mexico	☐
Canada	☐
South America	☐
Caribbean	☐
Australia/Aotearoa	☐
Asia	☐
Africa	☐
Europe	☐
Other global region/international	☐

7) Please check one primary affiliation or employment description, and an optional secondary affiliation.

	Primary Affiliation (Check One)	Secondary Affiliation (Check One) (Optional)
Federal government	☐	☐
Indigenous/Tribal government (Employed by)	☐	☐
Indigenous/Tribal Council or Leadership	☐	☐
State government	☐	☐
Local government	☐	☐
Climate Scientist	☐	☐
Indigenous-run Non-Governmental Organization (NGO) or Non-Profit	☐	☐
Non-Indigenous Non-governmental Organization (NGO) or Non-Profit	☐	☐
Member of Indigenous Community, Tribe or Nation	☐	☐
Other Community Group	☐	☐
Tribal College/University	☐	☐
NonTribal Academic Institution (College, University)	☐	☐
Other Educators (K-12)	☐	☐
Research Institution	☐	☐
Student Groups	☐	☐
Youth Groups	☐	☐
Tribal Company (Owned by Individuals, Corporations, or Tribal Government)	☐	☐
Non-Tribal Company (Owned by Individuals or Corporations)	☐	☐
Activist Group	☐	☐

8) Which of the following best describes your view on mulitiple knowledge systems in climate change (select one)?

(a) Indigenous knowledge systems are important sources of information for climate science.	☐
(b) Based on your understanding of science, Indigenous knowledge systems and climate science should both be called sciences.	☐
(c) Because Indigenous knowledge systems are many years older than climate science, they should guide climate science.	☐
(d) Indigenous knowledge systems and climate science are incompatible because Indigenous knowledges are spiritual, and climate science is empirical. (The term empirical suggests direct observations or experiments about environments).	☐

9) There are potential benefits and risks to Indigenous peoples when they share their knowledges. In your view, how significant are the potential benefits to Indigenous peoples when they share their knowledges with climate scientists (select one)?

Not Significant	Slightly Significant	I don't know	Significant	Very Significant
☐	☐	☐	☐	☐

10) And how significant are the potential risks to Indigenous peoples when they share their knowledges with climate scientists (select one)?

Not Significant	Slightly Significant	I don't know	Significant	Very Significant
☐	☐	☐	☐	☐

11) Please fill in the boxes below to help us understand your network relationships with each workshop participant. Check all boxes that apply. Please leave the line by your name blank. If you don't know the person, please leave that line blank.

		About how long have you known this person? (Specify whether you mean days, months, or in years)	I have shared, received, or developed climate change knowledge with this person	I have participated in climate change decision-making with this person	I have engaged in climate change policy efforts with this person	I have participated in local community-based climate adaptation work with this person	I have plans to collaborate with this person in the future	I look forward to collaborat-ing with this person in the future, but have no specific plans
1	*Name of Participant 1*							
2	*Name of Participant 2*							
3	*Name of Participant 3*							
4	*Name of Participant 4*							
5	*Name of Participant 5*							
6	*and so on…*							

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