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Networked Sovereignty: Polycentric Water Governance and Indigenous Self-determination in the Klamath Basin

Sibyl Diver

Department of Earth System Science, Stanford University, Stanford, USA; sdiver@stanford.edu

M.V. Eitzel

Science and Justice Research Center, UC Santa Cruz, Santa Cruz, USA; Center for Community and Citizen Science, UC Davis, Davis, USA; mveitzel@ucdavis.edu

Susan Fricke

Karuk Tribe Department of Natural Resources, Orleans, USA; susandfricke@gmail.com

Leaf Hillman

Karuk Tribe, Orleans, USA; leafhillman2@gmail.com

ABSTRACT: Water governance engages with complex collective action problems that typically involve a wide range of actors across multiple jurisdictions and large geographical areas. Scholars have conceptualised frameworks of collaborative and polycentric governance to reflect more democratic, devolved and diverse arrangements for governing complexity. What has often been overlooked, however, is the sociopolitical context of working with Indigenous nations and the distinct cultural and political perspectives they bring to polycentric water governance. Focusing on the Karuk Tribe in the Klamath Basin (western United States), this case study examines sovereignty and sustainability concerns that arise with collaborative, polycentric water governance initiatives that involve Indigenous nations. First, we leverage environmental justice frameworks to reveal tensions between collaborative, polycentric governance and social justice concerns. Second, using social network analysis, we examine Klamath water quality networks that involve the Karuk Tribe. Our analysis shows that the Karuk Tribe – as represented by five tribal natural resource managers – connected to 244 distinct organisations and 21 coalitions around water quality issues during the 2018/2019 study period. Social networks help us to visualise the labour required of tribal managers working on water quality issues across multiple centres of governance. Third, we develop the concept of networked sovereignty in water governance to consider both the opportunity and the burden that some Indigenous nations are taking on to advance self-determination in this moment of devolved governance – when tribal managers are building relationships with hundreds of agencies and organisations.

KEYWORDS: Collaborative governance, environmental justice, water quality, polycentric governance, Indigenous rights, Indigenous water governance, social network analysis, Klamath River Basin

INTRODUCTION

Our impetus to act on behalf of ourselves and the resources is about who we are as a people. It is a responsibility that we have had since we were put here in the beginning of time. All of these things are an exercise of responsibility to protect this place.

Leaf Hillman, Karuk Tribe

Much scholarship has been devoted to understanding complex water governance arrangements involving multiple jurisdictions and authorities (Schlager and Blomquist, 2008; Heikkila et al., 2011; Pahl-Wostl et al., 2012; Edelenbos and Teisman, 2013; Gupta and Pahl-Wostl, 2013; De Stefano et al., 2018). What is often overlooked is the role that Indigenous nations can play in restructuring water governance. Indigenous nations (a term that we use here interchangeably with Native American tribes) are sovereign peoples that maintain intimate, reciprocal relationships with land, water and natural resources (Wilson, 2008; Kovach, 2009; Wilson, 2014; Larsen and Johnson, 2017; Vaughan, 2018; Diver et al., 2019b). For many Indigenous peoples water is life, and stewardship of water resources is built into deeply held knowledge systems and political institutions (McGregor, 2014; Craft, 2017; Arsenault et al., 2018).

Indigenous peoples are widely resisting the ongoing dispossession of their lands and resources. Indeed, many Indigenous peoples continue to actively manage their lands and waters and are leading internationally recognised water protection and justice movements (Curley, 2016, 2019; Vaughan et al., 2016; Whyte, 2017, 2018; Estes and Dhillon, 2019). While some Indigenous water justice initiatives are internal, community-driven efforts, many are basin-wide efforts that connect to complex, collaborative governance processes. This means that Indigenous peoples are bringing culturally and politically distinct perspectives into a wide range of complex water governance processes that extend across multiple jurisdictions, with examples coming from the Great Lakes, Columbia River Basin, Salish Sea, Yukon River, the Southwestern US, and elsewhere (Pinkerton, 1989; Ebbin, 2002; Diver, 2012; McGregor, 2012; Chief et al., 2016; Norman, 2012; Arsenault et al., 2018; Wilson and Inkster, 2018; Cohn et al., 2019; Neville and Coulthard, 2019; Norman, 2019; Wilson, 2020; Fox et al., 2022). For Indigenous nations, such initiatives are often connected to long-standing place-based relationships held between Indigenous peoples and water that are rooted in mutually beneficial caretaking responsibilities and Indigenous law (Borrows, 1997; McGregor, 2012; Wilson and Inkster, 2018; Barker, 2019).

Indigenous water governance and collaboration

In the US collaborative water governance context, Indigenous peoples also bring a distinct set of legal rights to water governance processes, which shape environmental policy (Ranco, 2009; Anderson, 2018; Diver, 2018). Under Federal Indian Law, Native American tribes are positioned as a third sovereign (that is, tribal, state, and federal governments) with the authority to make and enforce their own laws (Suagee, 1994, 1998, Suagee and Stearns, 1994). Further, US legal frameworks direct the federal government to engage with recognised tribes in a government-to-government relationship (Wilkinson, 1987; Blackhawk, 2019). While far from perfect, the legal doctrine of trust responsibility stipulates that federal actions affecting tribal lands and resources must serve tribal interests and that federal agencies may be held legally accountable for doing so (Wood and Welcker, 2008; USEPA, 2011; Anderson, 2015).

Collaborative governance often involves informal environmental governance institutions that connect a broad set of stakeholders to better understand and respond to complex environmental problems (Sabatier et al., 2005). These institutions typically employ more devolved, participatory decision-making processes that involve a wide range of government authorities and community groups. Collaborative governance is thought to improve governance processes and outcomes by including local knowledge in decision-making, enhancing social learning opportunities among diverse stakeholders, and encouraging

more inclusive and democratic decision-making (Pinkerton, 2003; Carlsson and Berkes, 2005; Diver, 2016). This approach reflects the practical realities of governing water resources across large geographical areas and multiple jurisdictions. Collaborative water governance arrangements are often polycentric – involving multiple centres of authority that operate across overlapping jurisdictions (Ostrom et al., 1961; McGinnis, 1999). These arrangements are increasingly studied through social network methods that analyse complex relationships among social actors (Bodin and Prell, 2011; Lubell et al., 2014; Bodin, 2017).

Through a case study based in the Klamath River Basin (California and Oregon, US), we examine how some tribal governments are increasingly engaged in polycentric governance arrangements involving multiple levels of governance authorities. We recognise the diversity of Indigenous nations that bring their own distinct histories, cultures, and interests into natural resource management. Yet, the fragmentation of tribal land ownership is a common problem, which can require tribal leaders to work through highly networked governance processes that involve multiple local, state, federal, tribal, international and non-governmental entities (see Kickingbird and Ducheneaux, 1973; Galloway, 1995; Singleton, 1998; Vaughan et al., 2016; Wilson et al., 2018; Sarna-Wojcicki et al., 2019). Despite the importance of formal government-to-government consultation, this common scenario for Indigenous resource management leads us to consider the practice of sovereignty in collaborative, polycentric governance arrangements.

Klamath water governance is also unfolding in response to current trends towards devolved governance, where devolution refers to the transfer of governance authority from the central government to lower-level authorities or community organisations (Pahl-Wostl and Knieper, 2014). To critically examine tribal engagement in devolved, collaborative management, we develop the concept of networked sovereignty in water governance. Employing this concept helps unpack how Indigenous peoples are leveraging complex networks to ensure self-representation in collaborative, polycentric governance arrangements; in doing so, it builds on Duarte's (2017) insights on the role of Indigenous leadership in reconfiguring sociotechnical networks. Collaborative water governance raises particular concerns about the lack of awareness among local non-profit organisations and state or local agencies regarding the unique legal and political status of Native American tribes, and the broader significance of tribal sovereignty (Reo et al., 2017). Researchers have problematised collaborative processes that relegate sovereign tribes to 'stakeholder status', where tribes are viewed in a similar manner as non-profit organisations or community groups (Smith, 1996; von der Porten et al., 2016). When assumptions of equivalency among all stakeholders occur, collaborative institutions often overlook the self-governance authority, knowledges, and leadership of Indigenous nations (von der Porten and de Loë, 2013; Simpson, 2014; von der Porten et al., 2016; Diver et al., 2019a).

Collaborative initiatives can be viewed as community-driven collective-action processes that have the potential to repair relationships with Indigenous peoples. As legal and environmental justice scholar Sheila Foster (2002: 485) writes, however, "There is nothing inherent in collaboration (...) either as a norm or a practice, that ensures a resolution to the problems of unequal representation and influence that underlie conventional decision-making processes". This speaks to the long history of exclusion by dominant state agencies of tribal representation in environmental decision-making, prevention of tribal access to traditional lands and waters, and the disregard of Indigenous knowledge as a legitimate basis for management decisions (Nadasdy, 2003; Dupris et al., 2006; Wilkinson, 2006).

To engage with such inequities, this article uses social network analysis and environmental justice frameworks to explore whether and how collaborative, polycentric water governance arrangements can enable Indigenous self-determination and sovereignty in the Klamath River Basin. In our case study with the Karuk Tribe, we examine how sovereignty is practiced on the ground in this moment of devolved governance, when a small group of tribal managers is building relationships with hundreds of organisations to address complex water quality problems. By considering networked sovereignty in water governance, we discuss how Karuk tribal managers are reconfiguring institutional relationships in water quality networks – albeit through a laborious and uneven process – and the broader implications of pursuing

networked governance as a self-determination strategy. To better include a tribal perspective, this article is written in collaboration with Karuk tribal natural resource managers and community leaders.

The article is organised as follows. We first review the literature on collaborative, polycentric water governance and Indigenous environmental justice. Using social network analysis methods and semi-structured interviews, we then characterise the polycentric nature of Karuk water quality governance during the 2018/2019 study period, and explore whether and how the Karuk Tribe is leveraging collaborative water governance networks to advance self-determination. Finally, we consider whether and how networked sovereignty in water governance has become a strategic tribal response to collaborative, polycentric water governance institutions, and broader implications for environmental justice.

LITERATURE REVIEW

Collaborative, polycentric water governance in the US

After decades of federal and state agency domination of decisions over regional water bodies, watershed governance entered a collaborative era in the 1980s. Often viewed as an experiment in direct democracy, this new watershed protection movement was characterised by active participation and organisation by citizens around particular streams or river segments (Sabatier et al., 2005; Schlager and Blomquist, 2008; Lubell, 2013).

In contrast to top-down approaches, the collaborative watershed movement involved polycentric, multijurisdictional governance approaches that include local and regional organisations. Building on Vincent Ostrom, we use the term polycentric governance to signify the presence of multiple centres of decision-making that lack a consistent hierarchy of authority (Ostrom et al., 1961). Typically, polycentric governance authorities are formally independent, yet they remain functionally interlinked by operating within an overarching set of rules and within shared spheres of influence and/or shared jurisdictions (Aligica and Tarko, 2012; Schröder, 2018; Heikkila and Weible, 2018).

Polycentric governance was initially conceived as a model for advancing more democratic and diverse governance structures that transcend top-down, hierarchical structures. It was grounded in the practical challenges of managing complex natural resources in the arid ecosystems typical of the western US (McGinnis and Ostrom, 2011). More recently, governance scholars are using polycentricity to theorise an intermediate governance space located between fully centralised (top-down) and fully decentralised (bottom-up) governance approaches (Carlisle and Gruby, 2019; Baldwin et al., 2018; Heikkila et al., 2018). This reflects a current trend, where water governance has shifted away from centralised state control and towards collaborative water movements. This also follows a neoliberal turn in governance whereby decentralisation runs parallel to deregulation and privatisation as the dominant approach to governing complex systems (Bakker, 2010; Pahl-Wostl and Knieper, 2014).

Polycentric governance is further characterised by cross-jurisdictional governance arrangements (McGinnis and Ostrom, 2011), where "dealing effectively with complex water issues requires a high flow of information between involved actors, coordination and mutual alignment of a diversity of stakeholders" (Edelenbos and van Meerkerk, 2015: 27). Scholars suggest that successful polycentric governance requires effective coordination across multiple authorities and jurisdictions. Scholars, in fact, recognise degree of coordination as an important factor differentiating polycentric systems from ineffective, fragmented governance systems (Pahl-Wostl and Knieper, 2014; Heikkila et al., 2018). These scholars further emphasise the "gaps in horizontal and vertical integration [among governance institutions] as main obstacles to effective water policy" (Pahl-Wostl and Knieper, 2014: 147). To elaborate further, vertical integration involves linking local, regional and national institutions to "ensure the involvement of lower-level actors in the whole policy process", while horizontal integration involves institutional coordination across "diverse issues and provincial borders" to ensure accountability, transparency and effectiveness (ibid).

Governance scholars have recognised accountability as a central challenge to polycentric governance. Accountability problems can arise when connecting large numbers of actors through informal and often voluntary governance networks, when no clear authority can be held responsible for collective outcomes (Schlager and Blomquist, 2008; Heikkila et al., 2018; Carlisle and Gruby, 2019). Responding to this challenge, the polycentric governance literature anticipates that "vertical coordination may also be necessary for political and legal legitimacy" (Baldwin et al., 2018: 214). While local-level institutions are often well-placed to quickly detect and respond to emerging environmental problems, local organisations typically lack the capacity or political authority to fully address transboundary challenges. This argues for the importance of maintaining clear governance responsibilities across local, state and federal institutions to retain the funding and enforcement capabilities of higher-level authorities in collaborative processes (see, for example, Carlisle and Gruby, 2019).

Shifting from questions of accountability to equity and justice, the polycentric governance literature does not engage deeply with power, politics or contemporary social movement building (Tormos-Aponte and García-López, 2018). For example, the literature also does not address how polycentric governance affects Indigenous movements for land and water protection. As argued below, this requires engaging with the specific racialised histories of dispossession and exclusion of Indigenous peoples from resource management decision-making – colonial histories that continue to shape contemporary water governance processes. It also requires careful consideration of the politics of recognition, where Indigenous access to external governance processes is typically controlled by dominant state authorities that are empowered to "grant" authority to Indigenous nations that assert their inherent sovereignty to self-govern (see Kickingbird and Ducheneaux, 1973; Coulthard, 2007; Klenk et al., 2013). To further address such equity concerns, we ask the following questions around structural injustice within environmental governance: (1) how might power asymmetries be reproduced or amplified through polycentric governance mechanisms; (2) how do collaborative water governance institutions remain accountable to the rights and interests of Native American tribes as groups that hold particular legal and political rights, inherent sovereignty, and distinct cultural connections to water; and (3) with increased devolution of governance authority, how does the practice of sovereignty shift through polycentric governance?

Indigenous water governance, federalism and the US Clean Water Act

The historical and legal context of Native American sovereignty is a central part of Indigenous water governance. Native American tribes are distinct political entities that predate the US Constitution and have retained their inherent governance authority (Wilkinson, 2006; Blackhawk, 2019). Indigenous nations have their own governance institutions and legal systems and have long engaged in international diplomacy with outside governments to assert their interests and authority over tribal lands and waters (Borrows, 1997; Dupris et al., 2006; Craft, 2013; Norman, 2015). Indigenous legal systems are also tightly coupled with culturally embedded stewardship responsibilities that support reciprocal relationships between Indigenous peoples and the places they continue to inhabit (Borrows, 1997; Lake et al., 2010; Craft, 2013; Risling Baldy, 2013; McGregor, 2014; Chief et al., 2016; Simpson, 2017; Daigle, 2018; Yazzie and Risling Baldy, 2018; Barker, 2019).

While Native American tribes have their own self-governance structures, many are dealing with the US federalist legal system where they engage both with federal and state agencies on water governance decisions. In the US context, the Clean Water Act delegates selected federal regulatory authorities over water quality protection to state governments (Salzman and Thompson, 2014). Some Indigenous legal scholars have criticised such devolution of federal responsibilities on the grounds that state governments may be in direct competition with tribes for jurisdictional authority. Yet states do not have the same legally defined role in fulfilling trust responsibility to tribes as federal agencies (Williams, 1993; Rodgers, 2004; Corntassel and Witmer, 2008; Reo et al., 2017). In some cases, however, federal regulatory authority over water governance is delegated directly to tribal governments, thereby extending federalist prin-

principles to tribes (Anderson, 2015). Such delegation of authority has enabled some tribes to engage in formal co-governance institutions that regulate tribal waters, for example through "treatment as a state" provisions (Grijalva, 2006; Diver, 2018; Diver et al., 2019a). This legal context driving devolution of authority contributes to the multi-jurisdictional governance challenges faced by many tribes.

Environmental justice and devolved polycentric governance

Since polycentric governance was developed with democratic governance in mind, we ask: who benefits from more devolved governance processes, and how? We engage here with environmental justice (EJ) scholarship – as a starting point for analysing the questions of equity and power relations embedded within collaborative, polycentric governance. Environmental justice is a response to environmental racism (see Bullard, 1999). Thus, EJ leads us to interrogate questions of structural racism, fairness, and accountability: who is winning and who is losing when tribes participate in devolved water governance, and who carries the benefits and burdens of decision-making?

More specifically, environmental justice means ensuring equitable access to environmental benefits and preventing disproportionate impacts of environmental harms for all people, regardless of gender, class, race, ethnicity or other social positions. It also centres the experiences, leadership, and expertise of Black, Indigenous and People of Colour (BIPOC) communities. In doing so, EJ makes intersectional connections between environmental problems and the painful histories of environmental racism, as well as processes of restoration and repair (see Bullard, 1999; First National People of Color Environmental Leadership Summit, 1991; Polk and Diver, 2020; Whyte, 2011). EJ interventions seek to achieve greater procedural and recognition justice (where decision-making processes become more inclusive), and greater distributional justice (where policies prevent harm and provide benefits for all communities, especially historically marginalized groups) (Bullard, 1999; Mascarenhas, 2021). Recognising how environmental degradation is inextricably tied to histories of structural violence and oppression against communities of colour and economically disadvantaged groups, EJ frameworks call for reparations and corrective justice (Taylor, 1997, 2016; Pulido and Peña, 1998; Pulido, 2000).

Scholars and activists have also developed a distinct understanding of Indigenous environmental justice that centres Indigenous leadership, knowledges, cultures and legal traditions. Indigenous EJ scholars go beyond calling for reconciliation among human beings; their core goals include reconciliation between humans and the natural world (McGregor, 2015, 2018, McGregor et al., 2020; Oberholzer Dent et al., in press). Applying Indigenous EJ to water justice, McGregor (2018: 12) considers "the well-being of other living entities (including water itself) as equally vital to the discussion". In this relational context, Ranco et al. (2011) emphasise the importance of protecting tribal sovereignty, with the aim being to ensure the tribal authority and capacity to manage the lands and waters with whom they hold mutually beneficial or reciprocal relationships. Whyte (2011) extends this argument through his elaboration on "recognition justice"; this includes enabling Indigenous self-representation in decision-making processes that affect Indigenous peoples, such that they themselves bring their own distinct views, values, interests and legal orders into a more inclusive governance process. Wilson (2020) further considers how multidimensional engagement in environmental justice can help transform water governance relationships between Indigenous and settler governments, in part by linking or "braiding" their respective legal orders.

Devolved, collaborative governance can, on the one hand, create an entry point for local communities that are closest to a given environmental problem to participate in decision-making (Foster, 2002: 461; Pretty, 1995). A more critical EJ lens, however, highlights the potential negative impacts of polycentric, collaborative governance frameworks on Indigenous peoples and other historically marginalised groups. As discussed above, these governance institutions often fail to account for Indigenous sovereignty, Indigenous knowledge systems, and the colonial legacies that shape the sociopolitical realities of contemporary Indigenous land and water management (see Agyeman et al., 2002; Arsenault et al., 2019; Hartwig et al., 2022; Curley, 2019; Whyte, 2017). EJ thus demonstrates the importance of intentionally designing

decision-making processes that recognise the legitimacy of Indigenous knowledge systems and the sovereignty of Indigenous peoples on their own terms (Mascarenhas, 2007; Whyte, 2011).

EJ provides further insight into the accountability problems that occur with devolved, collaborative governance. Collaborative governance institutions, for example, often make their own rules about membership or about who is invited to the decision-making table, a situation that can reproduce racial discrimination. In addition, collaborative governance often depends on consensus-based processes which, as Foster (2002) points out, are typically dependent on mutually beneficial win-win solutions. A collaborative governance arrangement thus "provides a strong group incentive for limiting the diversity of participants, particularly in a way that excludes minority interests likely to express values of preferences inconsistent with those of other participants, or for demonizing such participants within the collaborative process" (ibid: 486).

EJ frameworks also help make visible how and why certain capacity problems shape the ability of Indigenous peoples and other disadvantaged groups to participate in informal collaborative governance. Inequities are layered onto broader accountability and enforcement problems. Such problems typically flow from decentralised, neoliberal governance approaches, where local ad hoc governance institutions take on primary responsibility for addressing complex governance problems – despite lacking adequate funding, enforcement and conflict resolution capacity, and/or the political authority typically held by state and federal agencies (Abrams et al., 2017). In cases where governance responsibility is decoupled from adequate provisioning of resources and infrastructure, devolution of authority to the local level can leave communities less protected than they were under top-down state control, a neoliberal phenomenon that has been referred to as a "hollowing out of the state" (Jessop, 2013; Norman and Bakker, 2013). This brings into question how and when Indigenous nations might prioritise investing limited time and resources on informal collaborative governance processes.

As emphasised by EJ scholars, overcoming colonial legacies to achieve more equitable decision-making requires reconfiguring sociopolitical relations between Indigenous and settler communities. This can occur, in part, by reorganising governance institutions and leadership (Holtgren et al., 2014; Whyte, 2018, 2020) to account for culturally specific ways of understanding and governing human-water relations (Weir, 2009). As a case in point, some Indigenous nations have built up their own internal capacity to create and lead their own coordinated water governance initiatives that centre Indigenous values for mutually beneficial, reciprocal relations – although gaining access to the resources needed to accomplish this can be highly challenging (Cronin and Ostergren, 2007; Diver, 2012; Norman, 2012; Chief et al., 2016).

Indigenous water governance, social networks and collective action

Social network analysis (SNA) offers a valuable tool for studying collective action in water governance. In this paper, we use SNA tools and the thinking behind them to evaluate a case of devolved water governance in the Klamath Basin. While social network analysis has previously been applied to multilevel water governance (Lubell et al., 2014), it is only just beginning to engage with the environmental justice and tribal sovereignty questions that arise with Indigenous water governance (see Diver et al., in press).

SNA is widely used to analyse relationships among actors and to consider novel social structures that emerge from these relationships (Bodin et al., 2006; Bodin and Prell, 2011; Bodin et al., 2011). This body of scholarship has included SNA studies of social relations that occur in natural resource governance (Bodin and Prell, 2011). SNA scholars study how social networks shape individual access to information and resources, as well as how actors influence group norms (Prell, 2012). Social network theory, for example, has famously uncovered the cumulative benefits of weak social ties that can facilitate access to novel information (Granovetter, 1983). Increased density of social ties within a network can also facilitate social learning and trust-building, an important element of collaboration and collective action (Bodin, 2017).

Water governance scholars use social network analysis to understand how watershed institutions and the vertical and horizontal linkages among them can respond to complex common pool resource management problems (Heikkila et al., 2011). Through such cross-scale linkages, individuals, organisations and institutions engage in collective action through self-organised structures across the multiple geographical scales and jurisdictional boundaries of a watershed, thereby contributing to complex adaptive systems (Lubell et al., 2014; Edelenbos and van Meerkerk, 2015; Bodin, 2017). Because water governance networks often include various levels of government operating at different geographical scales, SNA is used to analyse multi-scale interactions by considering "the degree to which multiple scales of action are linked or being coordinated" in a network (Guerrero et al., 2013: 43). Importantly, cross-level network connections can facilitate access to resources, information, and influence over decision-making (Heikkila et al., 2011).

SNA is also used to analyse the emergence of social capital through a network (Lubell et al., 2014; Ching, 2020; Prell, 2012; Sandström et al., 2014). Network connections can bring together social actors across asymmetric power relations; they can also reinforce top-down hierarchies, which are thought to limit the transformational potential of a governance system (Crona and Bodin, 2010; Westley et al., 2013; Bodin, 2017).

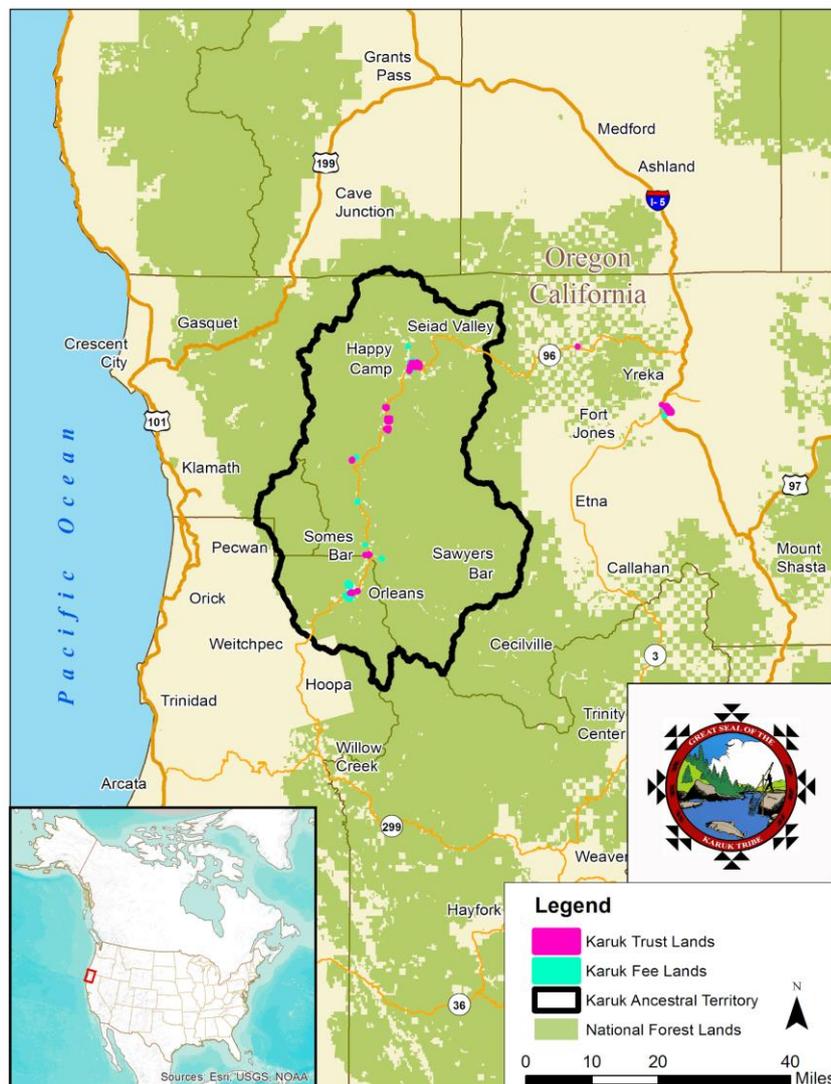
Karuk water quality governance in the Klamath Basin

Our case analysis discusses the Karuk Tribe and water quality governance in the mid-Klamath Basin (Northern California and Southern Oregon, US) in 2018/2019 – a time that was characterised by relatively high levels of collaborative engagement for Karuk natural resource managers. While acknowledging the importance of related water quantity issues in the mid-Klamath, this study focuses on water quality.

The Karuk Tribe is the second largest federally recognised tribe in California; as of late 2020, it had 3754 members (Karuk Tribe, 2020). Karuk ancestral territory is an ecologically diverse and mountainous area near the California-Oregon border. It includes the middle section of the Klamath River, which covers approximately 1.38 million acres (0.56 million hectares) (Figure 1). Karuk people are salmon people; their intimate, reciprocal relationships with salmon inform their culture, identity, spiritual beliefs and tribal law. For the Karuk, the ability to fish comes with an inherent responsibility to take care of the salmon and of the watersheds to which the salmon come home (Kroeber and Gifford, 1949; Reed and Norgaard, 2010; Lake et al., 2010; Karuk DNR, 2011).

Ongoing colonial legacies characterised by violence and distrust are the starting point of the Karuk Tribe's contemporary collaborative management efforts (Diver et al., 2010; Diver, 2014, 2016; Norgaard et al., 2011). The Karuk do not have a reservation area and the US federal government has designated most of Karuk territory as national forest (Bower, 1978; Salter, 2004) The US government has never ratified treaties that were negotiated in good faith with the Karuk people (Heizer, 1972; Hurtado, 1988; Johnston-Dodds, 2002; Madley, 2016). Karuk revitalisation initiatives are further hampered by a long history of state-sanctioned violence targeting Indigenous peoples across California (Norton, 1979, 2014; Madley, 2016), and extractive industries that have significantly impacted tribes on the Klamath River (Norgaard, 2014; Bowers and Carpenter, 2011; Diver et al., 2010; Marks-Block et al., 2019).

Figure 1. Map of Karuk ancestral territory, including locations of trust and fee lands.



Source: Jill Beckmann, Karuk Department of Natural Resources.

As a case in point, the 2002 Klamath fish kill – where between 34,000 and 78,000 adult salmon and steelhead died in the lower river (Belchik et al., 2004; CDFG, 2004) – occurred when ongoing resource extraction led to environmental injustice: specifically, disproportionate levels of harm to Indigenous peoples on the Klamath River (Pierce, 1998; Most, 2006, 2007; Norgaard, 2014). The fish kill followed federal policy decisions to approve water diversions for agriculture in the upper basin, despite drought conditions and inadequate in-stream flows. A primary factor in the fish kill was poor water quality, with dams contributing to an outbreak of fish disease in the lower river. Prior to the tragedy, upper-basin irrigators had protested water allocations for salmon and tribal fisheries, in a region that was already well known for its racial prejudice (Doremus and Tarlock, 2008; Reed, 2014; Sarna-Wojcicki et al., 2019). The agricultural diversions occurred when federal directives led agencies to sidestep Endangered Species Act (ESA) mandates for providing in-stream flows to fish (Paskus, 2003; Doremus and Tarlock, 2008). Throughout the

conflict – and despite tribal appeals to do so – federal agencies did not engage with tribal trust responsibility frameworks. For the Karuk Tribe, this re-emphasised the precarity of federal trust responsibility and the colonial legacies embedded within legal frameworks that discriminate against Indigenous peoples.

Responding to the 2002 fish kill crisis, the Karuk Tribe and its allies intensified their engagement in a wide range of science, policy and advocacy forums shaping Klamath water governance. Through their advocacy, tribal leaders achieved a major policy decision to remove four large dams from the Klamath River by 2023 – dams that contribute to water quality problems while providing little hydroelectric power, no flood control benefits, and no agricultural water (Gosnell and Kelly, 2010; Chaffin et al., 2016). Through its watershed science programmes, the tribe expanded its work on water quality, for example by participating in TMDL planning processes to set limits on the "total maximum daily load" for water pollutants. Since the inception of the Karuk Department of Natural Resources in 1989, the Karuk Tribe has been advancing water quality and fisheries protection through its science programmes. Currently, the Karuk Tribe Water Quality Program conducts scientific monitoring and research along 130 miles of the Klamath River and along several of its main tributaries. The tribe makes this data publicly available on the internet, where it is accessed by state and federal agencies (see <https://waterquality.karuk.us>).

METHODS

Building on a 12-year research collaboration between the lead author of this paper and the Karuk Department of Natural Resources (Karuk DNR), the study takes a community-based participatory research approach. Diver and Eitzel are interdisciplinary environmental scientists and community-engaged scholars who have worked with Indigenous communities from an allied position for over 10 years, with Diver partnering with the Karuk Tribe since 2009. Hillman is a Karuk community member, ceremonial leader, and the founder of the Karuk Department of Natural Resources. Fricke is a tribal manager leading Karuk water quality programmes, who has represented the tribe in watershed policy and science forums from an allied position since 2005. We began our study by discussing research questions, project significance and project scope with tribal natural resource managers. In January 2018, we received approval from the Karuk Tribal Council to conduct this research project.

Drawing on community-engaged research, we employed social network analysis and in-depth qualitative analysis as complementary approaches. During the study period of January 2018 to March 2019, we conducted semi-structured interviews of five tribal managers working on water quality issues at this time; we also observed four tribal manager meetings on this topic and conducted online research on relevant water quality coalitions.

To characterise Karuk water quality governance spaces, we first asked tribal natural resource managers about what water quality science and policy forums they engaged with. Tribal managers reported these to be fish disease, toxic algae, dam removal, nutrients, sediment, cannabis, and bacteria. We then asked tribal managers to name all the individuals or organisations with whom they were in direct contact (by phone, by email or in person) in addressing tribal water quality concerns. In this way, we bounded our network by Karuk tribal managers' connections to entities participating in water quality policy processes that managers identified as being relevant to the Karuk Tribe. While we did not record regularity of contact, tribal managers reported that they were in direct communication with the named organisations during the study period. To assist with recall, we asked tribal managers to name the organisations with whom they worked across the seven water quality policy forums. In our interview sessions, we talked to tribal managers about their experiences advocating and representing the tribe in the different policy forums.

When naming direct individual contacts, tribal managers listed many coalition groups with whom they engaged on water quality issues. These coalition groups provided tribal managers with an indirect connection to constituencies that extended beyond direct contacts alone. Coalitions ranged from more formal organisations where members had signed legal agreements (such as dam removal) to more informal

groups that were tasked with information-sharing on emerging science (such as fish disease and toxic algae). All Klamath water quality coalitions were comprised of a recognisable set of organisations. To identify coalition members, we collected membership data from online sources and consulted with tribal managers to fill in any data gaps.

We then created an egocentric network, which maps connections to a single node (the Karuk Tribe) and represents Karuk water quality governance across multiple policy forums. Although researchers recorded information at the finest scale possible (for example, connections between tribal managers and individuals working at an external organisation), we analysed data at a more generalised level (Karuk Tribe connections to those external organisations). This allowed researchers to better align data from multiple interviewees and protect individually identifiable information. To ensure consistency, we worked through multiple iterations of the dataset with tribal managers. For federal agencies and tribal governments, we listed the broader organisation instead of agency branches (for example, the US Forest Service was listed instead of multiple national forests). Neighbouring tribes were also listed at the tribal government level (for example, the Karuk Tribe was listed, rather than multiple tribal departments). While we acknowledge these simplifications and the changing nature of networks over time, these methods provided a useful snapshot for the purposes of our study.

We then worked with tribal partners to code attributional data for listed organisations. We first listed government type (federal, state, regional, municipal, tribal or non-governmental entity). For this study, we used the category of non-governmental entity broadly; it included universities, environmental non-governmental organisations (NGOs), consultants and industry groups. Second, we worked with tribal managers to identify organisations that were playing decision-making and/or funder roles for a given water quality issue. (Organisations were not consistently acting as decision-makers or funders across all policy forums.) In policy forums with multiple decision-makers, we asked tribal managers to identify a primary decision-maker.

Using the *igraph* package (Csardi and Nepusz, 2006) in R (R Core Team, 2018), we generated an egocentric network of Karuk water quality governance connections for all water quality issues combined. While we pursue a whole-network, quantitative analysis elsewhere (see Diver et al., in press), this study presents a descriptive analysis for the egocentric network of Karuk water quality governance. Drawing on our networks and on semi-structured interviews, we considered the role of direct individual ties between the Karuk Tribe and external organisations, as well as the role of indirect coalition-based ties. Given the existing legal frameworks in Federal Indian Law that support government-to-government consultations, we paid close attention to the role of the federal government in our networks.

RESULTS

Polycentric governance: Water quality policy forums

Our analysis demonstrates how the Karuk Tribe engages with Klamath Basin water quality governance through highly polycentric arrangements, where water governance involves multiple overlapping institutions that lack a consistent decision-making hierarchy. Key decision-makers and funders varied widely across the seven different water quality policy forums (fish disease, toxic algae, dam removal, nutrients, sediment, cannabis and bacteria). Water quality governance also operated at different scales (local to regional) across the different policy forums. For policy forums addressing bacteria, sediment and cannabis issues, we encountered smaller group sizes, with 20, 26 and 28 members, respectively. Fish disease, nutrients, dam removal and toxic algae forums were made up of larger groups, with 82, 86, 98 and 104 members, respectively (see Table 1).

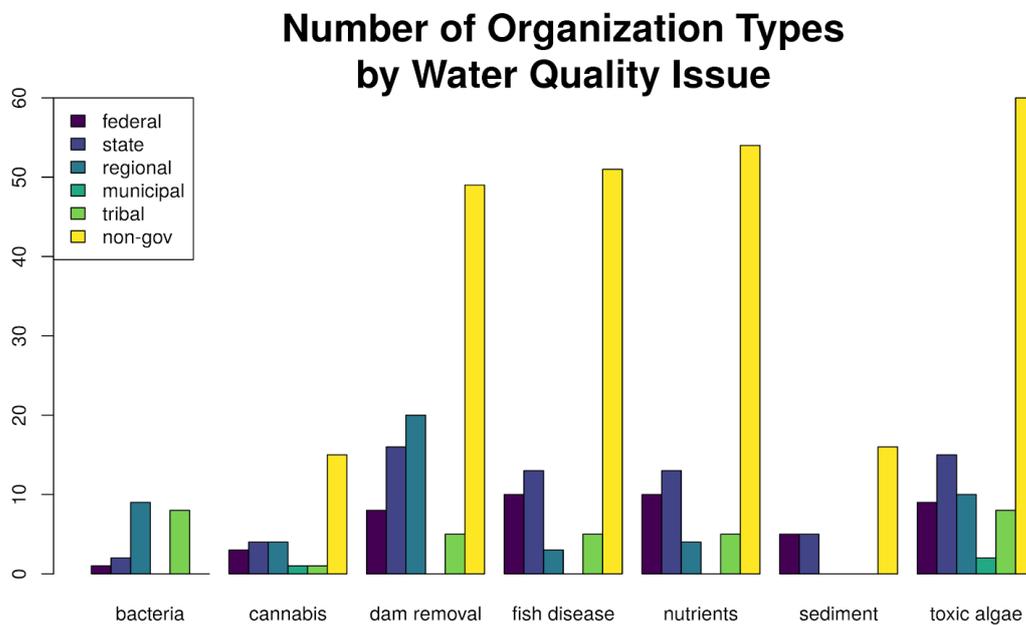
Table 1. Characterisation of diverse water quality policy forums analysed in our network.

Water policy forum	Size (number of unique organisations)	Number of coalitions reported	Number of federal organisations	Number of state organisations	Water policy forum description
Bacteria	20	1	1	2	Although the Karuk Tribe does not currently manage or monitor its community drinking water treatment systems, the tribe is involved in support efforts and infrastructure projects related to drinking water treatment and bacteria.
Sediment	26	1	5	5	Policy efforts seek to reduce sediment delivery to the river from runoff, often sourced from Forest Service roads, highway maintenance areas, and increasingly from severe wildfire burn areas with unstable soils.
Cannabis	28	1	3	4	Cannabis policy work addresses new regulations permitting state-sanctioned cannabis cultivation, as well as long-standing efforts to identify and clean up illicit grow sites on federal lands where operations have created water contamination problems from pesticides, faecal coliform, and solid waste.
Fish disease	82	4	10	13	Fish disease policy work is concerned with water temperature and emerging parasite problems that threaten the health of Klamath River salmon populations.
Nutrients	86	6	10	13	Policy efforts on nutrients are concerned with non-point source pollution, primarily coming from upstream agricultural uses.
Dam removal	98	8	8	16	Dam removal forums are facilitating an ongoing effort to take out four large dams on the Klamath River by 2023, to improve water quality and increase spawning access to high quality habitat for salmon.
Toxic algae	104	5	9	15	Toxic algae policy work pertains to cyanobacteria, which proliferate in dam reservoirs, release toxins under warm weather conditions, and pose a public health risk.

Note: Forums are listed in ascending order by size, with smallest at the top increasing to largest at the bottom.

In line with our expectations, larger policy forums corresponded with water quality issues being addressed at a broader geographical scale, with actors engaging from both the lower and upper Klamath Basin. Larger forums had more decision-makers and funding organisations, as well as a broader mix of government types. In contrast, smaller policy forums contained fewer funding organisations. Smaller forums were also more homogeneous, with a smaller mix of government types. We generally noted that multiple levels of government were involved in all forums, although non-governmental organisations dominated for many issues (see Figure 2).

Figure 2. Participation of different organisation and governance types (federal, state, regional, municipal, tribal and non-governmental entities) across different water quality policy forums.



Direct and indirect connections in the network

By analysing all water quality policy forums together in an egocentric network, we found that the Karuk Tribe, represented by five tribal managers, connected to 244 distinct organisations through both direct individual ties and indirect coalition ties. We also found that the tribe engaged with 21 coalition groups that included both formal and informal coalitions with distinct, but often overlapping, memberships.

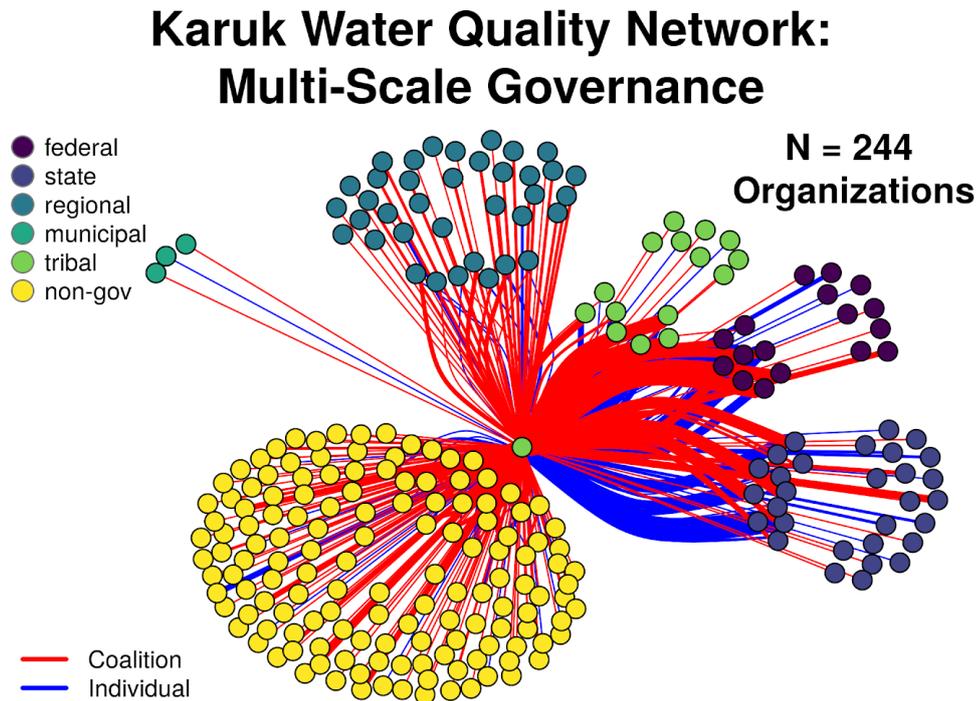
Representing both a burden and an opportunity, our network visualisation (Figure 3) illustrates the immense coordination task that the Karuk Tribe is taking on – with limited staff and resources – to address a wide range of water quality issues. It also reflects the Karuk Tribe’s long history of grassroots-level movement building and the coalition building leadership that tribal leaders have contributed through Klamath water justice movements.

In examining the egocentric network, we found that tribal managers have direct individual connections with 86 organisations and indirect coalition connections with 210 organisations (noting some overlap between these different kinds of ties). Individual connections enable direct channels of communication between tribal managers and external organisations; these typically represent stronger ties. In contrast, coalition connections include many weaker ties that entail less-intensive engagement such as attending the same meetings or receiving technical updates and reports.

Policy coalitions and the strength of weak ties

For the direct ties between tribal managers and external organisations, almost two-thirds were reinforced by coalition ties; that is, of the 86 individual ties between Karuk managers and organizations, 52 were reinforced by coalition ties. However, among the indirect ties via coalition membership, three-quarters represented new organisations that the tribe was not otherwise connected to; in other words, 158 out of 210 organisations had indirect coalition ties to Karuk managers that did not overlap with any individual ties. This indicates the important role that coalition connections play in expanding tribal manager connections on water quality.

Figure 3. Egocentric network with the Karuk Tribe as the focal node.



Note: Results show that the Karuk Tribe connects with 244 distinct organisations through its water quality work, either through direct individual contacts and/or indirect coalition contacts. Coalition ties (shown in red) can both strengthen individual ties (shown in blue) between tribal managers and external organisations, as well as create new ties expanding the tribe’s social network. The network visualisation software brings nodes with multiple ties to the tribe closer into the centre, and also groups together all organisations of a single type.

We also considered tribal access to federal and state agencies, which are more likely to have funding and decision-making authority across the different water quality policy forums. For larger policy forums (fish disease, dam removal, nutrients and toxic algae), there were more coalition ties to state and federal agencies, compared to smaller policy forums.

Connecting with federal agencies and beyond

Given the challenges of overcoming uneven power relations, we might expect more links between the Karuk Tribe and other tribes, or more tribal connections with NGOs. Our analysis, however, identifies a strong presence of federal and state agencies in Karuk water governance networks; for example, each of the seven policy forums included at least one state and federal organisation, with dam removal having the maximum number of federal organisations (8), and nutrients and fish disease having the maximum number of state organisations (10 each).

Further illustrating multiple centres of decision-making, we found that federal agencies were participating in all water quality policy forums. In all cases, however, state- or regional-level agencies were acting as decision-makers alongside federal entities. For most policy forums, the federal government was not reported to be a primary decision-maker (bacteria, cannabis, nutrients, sediment and toxic algae). These findings demonstrate polycentricity in the Karuk water quality network, as opposed to a highly fragmented governance system.

Tribal manager interviews: Reorganising political relationships through water quality networks

Interviews provided additional insight into how tribal managers have inserted themselves into water governance structures. Tribes do not represent the majority of organisations participating in Klamath water governance, yet interviews convey how the Karuk Tribe has consistently asserted its leadership. Importantly, the tribe has leveraged its networks to influence water governance at multiple scales and to shift dominant norms towards more meaningful inclusion of tribes. Below, we present three illustrative examples that represent institutional configurations created by the Karuk Tribe and its allies to increase tribal self-determination in water governance.

North Coast Resource Partnership: Accessing state funding for tribal water projects

First, the Karuk Tribe has worked through collaborative governance networks to reconfigure the North Coast Resource Partnership (NCRP), thereby improving tribal access to state funding for water projects. The North Coast Resource Partnership began as an initiative of California's Integrated Regional Water Management (IRWM) programmes. The North Coast IRWM planning group was initially comprised only of county government officials. Seeing an opportunity to address tribal needs through IRWM, Karuk and Yurok tribal representatives advocated for the inclusion of tribal representatives – a shift that was not initially supported by all parties.

To overcome the opposition of more conservative counties (Siskiyou and Del Norte), tribal leaders allied themselves with more liberal county governments (Sonoma, Mendocino and Humboldt), and ultimately, changed the NCRP governance structure. The NCRP is now co-led by tribes and counties and has adopted multiple mechanisms to facilitate joint county-tribal decision-making, additional transparency, and intertribal coordination. As a result, state funding decisions for North Coast water improvement projects can better respond to tribal community needs, with benefits for both tribal and non-tribal county constituencies.

Cannabis two ways: Preventing water quality impacts on federal and private lands from cannabis cultivation

As a second example, cannabis cultivation in Karuk territory creates significant concerns around water quality. This includes environmental contamination caused by illicit cannabis growing on federal lands. Sources of contamination range from pesticides (including insecticides), faecal coliform bacteria, solid waste, and increased sediment delivery to streams and rivers. Because tribal managers have experienced significant difficulties in working with federal law enforcement to clean up illicit cannabis sites on federal lands (see Bartolome et al., 2019), Karuk managers have pivoted towards working with broader coalitions and state authorities. They have, for example, partnered with a state game warden to pull out thousands of feet of abandoned water lines, secure toxic rodenticides left onsite, and locate illicit grow sites in difficult-to-reach areas. Often taking a lead role in its collaborations, the tribe has funded helicopter time to ensure clean-up and removal of toxic substances from abandoned cultivation sites and has also posted public health warnings at culturally significant creeks located downstream from illicit grows. In addition, Karuk managers have participated in a multijurisdictional task force to draft legislation to support the clean-up of illicit cannabis grow sites.

The Karuk Tribe is also participating in county-level permitting of cannabis cultivation on private land, specifically for jurisdictions within Karuk aboriginal territory that overlap with Humboldt County jurisdictions. To assert tribal interests, the Karuk Tribe has established its own system to levy fees and assess private grows for potential impacts to cultural resources. This arrangement affirms Karuk jurisdictional authority to monitor and ensure compliance over private grow sites located within Karuk ancestral territory – despite the Karuk Tribe lacking a reservation. County-level recognition of tribal jurisdictions and governance systems illustrates a significant reorientation in governance systems that supports tribal sovereignty.

Toxic algae and TMDLs: Tribal water quality programmes shaping science and policy

A third example is toxic algae or harmful algal blooms (HABs) that originate upstream of Karuk territory in dam reservoirs under warm water conditions. They produce a liver toxin which raises public health concerns. When HABs were first identified on the Klamath in the early 2000s, the Karuk Tribe became the primary organisation collecting water samples and monitoring potential impacts in the mid-Klamath. The tribe's high level of science-policy engagement was due, in part, to its concerns for cultural practitioners facing higher exposure risks; these included weavers who gather and process willow along the river corridor, as well as ceremonial leaders who drink from and bathe in the river.

To address community concerns, the Karuk Tribe became highly involved in state-driven TMDL planning processes that set the total maximum daily load for water pollutants. In initial TMDL planning sessions that occurred in the mid-2000s, agency officials and the tribe discussed the potential cultural impacts of impaired water quality. While agency officials initially misunderstood tribal cultural uses to be limited to yearly Karuk World Renewal ceremonies occurring over a two-week period, the Karuk Tribe demonstrated how cultural uses of water and exposure risks occurred year-round. Part of the tribe's contributions included developing the Karuk Water Activity Exposure Chart (Table 2), which clearly laid out how seasonal exposures coincided with a range of Karuk cultural practices, and how daily activities can expose tribal members to contaminated water *every month of the year*. In 2007/2008, tribal managers worked with state and regional regulatory bodies to develop new categories of water quality standards for beneficial uses, including Native American Cultural Use and Subsistence Fishing (North Coast Regional Water Quality Control Board, n.d.) – an approach that was later adopted at the state level (California State Water Resources Control Board, 2017 n.d.)

Since working on TMDLs, the tribe has continued to leverage its participation in technical working groups to shape state water quality policy. It has, for example, played a leading role in creating new science-policy coalitions to address toxic algae problems at the regional and state levels; these include the California Cyanobacteria Harmful Algal Bloom Network, the Klamath Basin Monitoring Program, and the Klamath Blue-Green Algae Workgroup.

DISCUSSION

Drawing on our social network analysis, we characterise Karuk water quality governance as a polycentric system. We observe that the tribe's adaptability and sustained engagement in collaborative water governance has enabled widespread Karuk participation in complex water quality networks. We apply environmental justice frameworks to consider the inequities and accountability problems that can arise when tribal governments such as the Karuk engage in polycentric, collaborative governance. The limited resources available to tribes and ongoing resistance to tribal sovereignty from external organisations are barriers; however, as Holtgren, Whyte, and colleagues have documented, "Communities with a history of cultural misunderstanding and political conflict can come together to steward a shared watershed" (Holtgren et al., 2014: 1). Our case demonstrates how reconfiguring water governance relationships to overcome colonial legacies is a slow, resource-intensive process, yet tribes like the Karuk are persistently driving change.

Networked sovereignty in water governance: Thinking with polycentric governance and social networks

To better understand tribal leadership in Klamath water management, we develop the concept of networked sovereignty in water governance – that is, where sovereign tribes strategically engage in water science, policy and diplomacy through collaborative networks with the aim of forwarding Indigenous self-determination and water protection. This concept intersects with previous research that explores how Indigenous peoples develop complex sociotechnical networks to intervene in dominant state structures

Table 2. Excerpt from Karuk Water Activity Exposure Chart, focusing on basket materials.

Basket materials activities and exposures	Time of use/exposure											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
<i>River and trail access</i>												
Travel (walking, transportation)												
Washing (cleaning materials)												
Camping (walking, transportation)												
<i>Roots</i>												
Willow (collecting, preparing)												
Wild grape (collecting, preparing)												
Cottonwood (collecting, preparing)												
Oregon grape (washing, preparing)												
<i>Sticks/shoots and bark</i>												
Willow (collecting, preparing)												
Alder bark (collecting, preparing)												
Maidenhair fern (collecting, preparing)												
Woodwardia chain fern (collecting, preparing)												
Mock orange (collecting, preparing)												
Wolf lichens (soaking for dye)												

Note: Additional categories of subsistence, ceremonial, and daily activity are not included in this table. The chart is adapted from materials prepared by Dr. Frank Lake and others as part of a multi-year coalition effort (approximately 2000-2007), and builds on interviews of many tribal elders and cultural practitioners conducted by Dr. John Salter and the Karuk Department of Natural Resources. The chart was developed in response to federal dam relicensing and state-led processes to establish TMDLs, and demonstrates contemporary, year-round Karuk cultural uses of water.

(Duarte, 2017). Here, we use networked sovereignty to engage with tensions that arise when Indigenous sovereignty intersects with polycentric water governance. This concept also enables us to critically examine how the increased fragmentation of governance authority that occurs with neoliberal governance approaches can affect Indigenous nations like the Karuk Tribe.

In the mid-Klamath context, we see the Karuk Tribe inserting itself into highly technical and multi-jurisdictional decision-making processes involving all levels of government. Through networked sovereignty in water governance, we see opportunities for increased knowledge exchange through dense, collaborative networks that include Karuk tribal natural resource managers. Social network visualisations also help characterise the Karuk Tribe’s engagement in polycentric water governance that lacks a consistent hierarchy of decision-making, and includes both local and higher-level authorities. In the Karuk water quality network, federal agencies are often the top-level decision-makers and funders, but they are never the *only* decision-maker or funder. There is also variation in decision-making authorities, which change depending on the type of water quality issue. For policy forums such as dam removal, funding and decision-making occur primarily at the state level; for others, such as with cannabis permitting and siting, decision-making occurs largely at the county level.

Some tribal community members, on the other hand, have pointed out that our visualisations of tribal water quality networks represent a "jurisdictional nightmare" (R. Reed, personal communication, 12 November 2020). The image of five tribal managers connecting with 244 distinct organisations makes visible the significant labour that the tribe puts into water quality governance, despite being under-resourced. It raises questions about resource distribution and what is required to attain a more level playing field in polycentric water governance systems. Similarly, if creating and maintaining connections with hundreds of organisations is necessary for tribal self-representation in contemporary water governance processes, this poses the difficult question of how other tribes with even less capacity can be expected to replicate this model to achieve meaningful participation in water governance.

While social network visualisations summarise the key equity challenges of polycentric governance, in-depth discussion with tribal managers provided helpful institutional history and context around ongoing negotiations concerning power relations. The North Coast Resource Partnership co-management structure, for example, provides one response to the conundrum of engaging with multiple authorities. In the NCRP context, institutional structures support joint county-tribal decision-making and intertribal coordination. Representation, leadership, and governance responsibilities are shared across multiple tribes – as institutional functions that are useful for supporting tribal assertions of sovereignty. We offer the caveat, however, that a range of strategies is needed given the wide diversity of Indigenous nations who are often dealing with very different water problems.

Social network theories on social capital can also inform questions around tribal assertions of sovereignty. Using social connections to build power, Karuk tribal managers leverage informal collaborative networks to increase internal capacity and external recognition for Indigenous self-determination. In contrast to barriers that often prevent formal reorganisation of bureaucratic agencies, informal collaborative governance networks often "require minimal restructuring" to make substantive change in authority, responsibilities and budgets (Foster, 2002: 483). Our case demonstrates how a networked sovereignty approach to water governance offers strategic moments for tribal leadership in reorganising relationships across multiple water quality issues and scales to advance Indigenous self-determination. Through multi-state networks, for example, the Karuk Tribe has gained additional influence in basin-wide management decisions. And by engaging in smaller and more regional networks, the Karuk Tribe has strategically restructured decision-making to support effective co-management with tribes.

Finally, Karuk engagement in science and policy networks has generated additional recognition for the Karuk Tribe as an authority in its own right. Tribal departments, managers and community members are *themselves doing the work of water governance*. In this case, it is tribal managers, staff and tribal community members who conduct scientific monitoring and produce key knowledge about emerging water quality problems, knowledge which is then used and supported by allied organisations. The tribe itself chooses who will represent its interests in science and policy forums to create new policy forums (such as policy committees on harmful algal blooms), or insert tribal expertise into existing forums to shift water policy frameworks (for example, the Karuk Water Activity Exposure Chart).

Environmental justice: Responding to inequity and accountability challenges

Environmental justice frameworks draw our attention to the structural inequities and power dynamics behind networked sovereignty in water governance, specifically the inordinate amount of labour required for tribes like the Karuk to engage in polycentric governance. Even while the Karuk Tribe is engaging with a diversity of decision-makers and funders, under-resourced tribal science programmes are not operating on a level playing field when compared to large teams of policy and science experts working for state agencies. While additional co-management partnerships are emerging, we note that tribal representatives are still rarely in decision-maker or funder positions within the Karuk water quality network.

EJ frameworks also speak to Karuk leadership strategies for working through larger networks to improve distributive justice outcomes for the tribe. In our study, larger interstate networks connected tribes

to a greater number of funders and decision-makers. Importantly, tribal managers report leveraging federal and state funding that is accessed through interstate collaborations to cover otherwise unfunded staff time for working on local issues, where funding is less available.

EJ frameworks further demonstrate the importance of having effective accountability structures, in part by including federal and state agencies in collaborative governance processes involving multiple local organisations. Without the involvement of more central authorities, collaborative governance efforts can result in unfunded mandates lacking the necessary capacity, resources, authority, and conflict resolution functions that are needed for effective cross-jurisdictional governance (Pinkerton et al., 2008; Norman and Bakker, 2013). Concern over the "hollowing out of the state" with devolved governance continues to be salient given neoliberal governance trends. In such cases, federal agency structures are consolidated, and local governments are asked to take on resource management responsibilities without having sufficient resources (Pinkerton et al., 2008; Abrams et al., 2017). Even when some funding sources are held at the local or regional level, maintaining the federal and state nexus with Indigenous water governance is still important, in part to resist the trends of decentralisation and deregulation that are associated with the defunding of public governance functions.

We also recognise how complex systems that require tribal governments to negotiate water governance decisions across multiple, overlapping centres of authority are not a desirable approach for all tribes. This is especially the case when tribes are already accessing federal decision-makers that are politically empowered to support and fund tribal needs and interests through direct government-to-government relationships. At the same time, our case anticipates that engaging solely with federal agencies to solve complex water quality problems may be untenable due to current trends with the devolution of water governance authority and the challenge of addressing water quality issues across large river basins. This case also highlights how, for tribes like the Karuk, existing federal accountability frameworks have often been ineffective in addressing tribal needs and interests.

Finally, EJ draws our attention to structural racism as an underlying condition of contemporary water management. Noting the colonial histories that shape our case context, collaborative governance is more of a necessity that has been forced on the Karuk Tribe than a choice: contemporary water governance institutions exist in the shadow of California's many unratified treaties. The resulting limitations on tribal jurisdiction over Karuk ancestral territory place significant constraints on the tribe's ability to access resources to support tribal resource protection.

Reclaiming Indigenous governance and diplomacy

Despite ongoing barriers, networked sovereignty in water governance emphasises the importance of Indigenous self-representation. Networks can provide a useful structure through which tribes can assert their sovereignty in relation to a wide range of external organisations. As demonstrated by the Karuk Tribe, this includes leveraging networks to renegotiate alliances with county governments, draft new legislation, and/or create new knowledge to inform emerging science and policy. Because the Karuk Tribe is strategically inserting itself into watershed management processes, we consider the tribe's action as a moment of overcoming the "politics of recognition", a concept that speaks to the subject-making nature of colonial recognition. As Coulthard (2007: 6) writes, the politics of recognition is bound up with colonial legacies, "where, 'recognition' is conceived of as a 'gift' bestowed from a 'privileged' group or entity (the liberal settler-state) to a dependent and 'subordinate' group or entity (Indigenous peoples) [citing Day, 2001: 195]". In this case, however, the Karuk Tribe is reclaiming a degree of leadership authority through Indigenous-led science and self-representation at multiple levels of water governance.

While collaborative governance processes are not in and of themselves Indigenous institutions, strategic interventions by tribes like the Karuk are carving out space within collaborative management to facilitate recognition justice, an important element of environmental justice (see, for example, Whyte, 2011). Thus, in the Karuk context, networked sovereignty in water governance engages with Indigenous-

led diplomacy that is actively reorganising complex interjurisdictional arrangements to improve tribal self-representation in water management and challenge ongoing barriers to meaningful tribal participation and leadership in decision-making.

CONCLUSION

Our study explores how Indigenous nations like the Karuk Tribe are navigating collaborative, polycentric water governance landscapes to protect tribal waters. They are doing so, in part, by creating and reorganising collaborative science-policy networks and building relationships with hundreds of agencies and organisations. In this case, the Karuk Tribe is asserting tribal self-determination and being recognised by external governments as a leader in environmental science and policy forums. At the same time, social networks and environmental justice frameworks demonstrate the huge amount of labour that is required for the Karuk to engage in basin-wide water governance networks. They also illustrate how injustices can be reproduced through collaborative, polycentric governance arrangements.

To understand the challenges of collaborative, polycentric water governance more deeply, we develop the concept of networked sovereignty in water governance to characterise both the opportunity and the burden that tribal managers take on in their work to advance Indigenous sovereignty and self-determination in this moment of devolved governance. Our study examines how institutional reform can help identify structural inequities and promote more inclusive environmental governance arrangements. For progress to occur, tribes still require sufficient resources to achieve a meaningful role in decision-making.

Additional work is needed to identify a range of institutional contexts that can support more equitable polycentric governing arrangements with Indigenous nations. We assert that collaborative governance can be improved by bringing Indigenous leadership into decision-making, and thereby increasing the responsiveness of polycentric governance to the context-specific needs of diverse Indigenous nations. A shift towards Indigenous leadership can help facilitate more respectful multijurisdictional water governance for collective action. In this way, we can begin to repair histories of cultural conflict, restore watersheds, and renew meaningful human relationships to water.

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