Upper Midwest tribal natural resource managers’ perspectives on chronic wasting disease outreach, surveillance, and management

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Abstract
Management strategies for chronic wasting disease (CWD) across tribal lands have varied in response to changing dynamics of CWD risk. As CWD continues to spread across the United States, concerns associated with the disease are increasing. We interviewed 19 natural resource managers representing Anishinaabe and Dakota tribes in Minnesota, Michigan, and Wisconsin with goals of understanding needs and opportunities for CWD engagement, surveillance, and outreach on tribal lands; the implementation of natural resources policy and management across tribal nations; and opportunities for tribal partnership-development to control CWD. Qualitative data analyses of interview responses revealed substantial variation in the number of tribal hunters, hunter regulation, and huntable tribal lands across our study area. Proximity of tribal lands in relation to CWD detections impacted tribal agency management strategies for CWD. Our results indicate a desire for CWD outreach and surveillance, mutually beneficial collaborations, and a need for incorporating cultural knowledge into CWD management strategies. We conclude that tribal CWD management and surveillance plans will be enhanced through strategic and thoughtful CWD outreach methods. Moreover, partnerships must recognize tribal sovereignty and respectfully integrate tribal values, knowledge, and worldview.

KEYWORDS
CWD, human dimensions, Indian, Michigan, Minnesota, Native American, partnership, tribal engagement, Wisconsin

1 | INTRODUCTION

Chronic wasting disease (CWD) is an increasingly important natural resources management issue across North America. Classified as a transmissible spongiform encephalopathy along with scrapie in sheep, bovine spongiform encephalopathy in cattle, and Creutzfeldt–Jakob disease in humans, CWD is caused by a misfolded prion protein...
Infected animals shed PrP\textsuperscript{CWD} through bodily fluids, excrement, and carcasses, which remain infectious in the environment for years (Prusiner, 1982; Rivera et al., 2019; Williams & Young, 1980). These misfolded prion proteins also accumulate in the body, resulting in neurological function loss, wasting or general weight loss, and associated complications such as pneumonia, always leading to death. CWD was first described in a cervid research facility in Colorado in the 1960s (Williams & Miller, 2002), and has since been detected in 30 US states, four Canadian provinces, Norway, Finland, Sweden, and South Korea (Mysterud et al., 2020; Richards, 2021; Williams & Miller, 2002).

CWD was first confirmed in the midwestern US in wild white-tailed deer in south-central Wisconsin in 2001 (Joly et al., 2003). Since that time, CWD has been detected in wild white-tailed deer throughout the upper Midwest states of Minnesota, Michigan, and Wisconsin and has become endemic in several areas. Subsequently, the dynamics of the disease have differed greatly in each of these states, leading to wide-ranging geographical and cervid population impacts (Richards, 2021; Rivera et al., 2019). Shortly after the discovery of CWD in Wisconsin, the federal government initiated coordinated efforts with state agencies, academic institutions, non-governmental organizations, and tribal nations to develop a plan in response to the serious threat of CWD as it spread into new regions (USDA APHIS, 2002). This national plan aimed for federal agencies to provide tools and financial assistance for research, surveillance, disease management, diagnostic testing, technology, communications, information dissemination, and education. Despite these early conservation efforts, CWD continues to spread and has changed how cervids are hunted, raised, managed, and consumed in these areas. Its presence is a serious, multifaceted threat to subsistence and recreational hunting, cultural ceremonies, tribal and state natural resources, and the economies associated with hunting and farming (Mysterud et al., 2020; Parlee et al., 2021; Rivera et al., 2019). The geographic expansion of CWD has increased the number of midwestern tribal communities directly or indirectly affected by the disease (Figure 1). CWD detections in Minnesota, Wisconsin, and Michigan, at the time of the interviews, affected ceded lands from 15 separate treaties, including nearly 180,000 km\textsuperscript{2} of ceded lands with expressly reserved tribal hunting rights. The 45 counties with CWD detections are within 40 km of 19 Indian reservation lands in Minnesota, Wisconsin, and Michigan. The 34 federally recognized tribes in the three states are impacted by CWD in the region.

Indians\textsuperscript{1} rely on and derive many cultural and life-supporting benefits from tribal lands and the associated natural resources, including food, shelter, physical and spiritual well-being (Maraud & Roturier, 2021; Parlee et al., 2021). Deer (waawaashkeshi in the Ojibwe language) are an integral part of many of these Anishinaabe tribes' culture as a source of food, shelter, and community connection (Great Lakes Inter-Tribal Council Snap-Ed Program, 2015). The harvesting of resources, including waawaashkeshi, is guided

**FIGURE 1**  A map of Minnesota, Michigan, and Wisconsin lands included in United States federal treaties with tribal nations. At the time of tribal natural resource manager interviews conducted between March 20, 2020 and December 10, 2020: Tribal reservation lands are indicated by hatched polygons; counties with wild cervid chronic wasting disease (CWD) positive detections are indicated by pink polygons, and tribal hunters exercised hunting rights in lands associated with the treaties of 1836, 1837, 1842, 1854.
by generations of protocols that ensure life is sustained for people and the environment (Awásís, 2021). These protocols are guided by community-based values systems that can be unique for different communities and tribes. The negative impacts of CWD on tribal nations parallel those of other local communities, however, traditional cultural practices and knowledge also bring unique perspectives and concerns.

Investigations by Parlee et al. (2021) and Maraud and Roturier (2021) in Alberta and Scandinavia, respectively, revealed complicated aspects of CWD management for Indigenous communities, including conflicts related to colonialism and tribal sovereignty, and traditional knowledge and western science. Specifically, Maraud and Roturier (2021) expressed that comanagement of the disease by Indigenous and governmental agencies within a colonial framework conflicted with traditional practices (e.g., current health standards vs. cultural practices, cervid population and land management practices). In addition, the Indigenous communities’ risk perception of subsistence deer hunting differed when western science-based CWD information was available as compared to when only traditional knowledge regarding animal disease was available. For example, CWD information availability and government engagement was linked to increased risk perception leading to a decrease in deer harvest and an increase in CWD testing (Parlee et al., 2021). Tribal communities weigh the perceived risk of CWD within the context of their cultural practices, while also managing CWD as sovereign nations in dynamic relationships with other governing bodies, regulators, and stakeholders (Donatuto et al., 2011; Donoghue et al., 2010).

Due to the increased risk and continuing spread of CWD, tribal natural resource departments and managers in the upper Midwest United States understand the need to develop CWD outreach, surveillance, and management plans that include the aforementioned factors. In response to growing risks of CWD to food safety, security, risk to effective exercise of treaty rights, and limited tribal engagement in existing CWD management and control, several tribal nations and intertribal organizations established a Tribal CWD Surveillance Network (network) with University of Minnesota researchers. This early network included natural resource managers from eight tribal nations in Minnesota, one tribe in Michigan, and two intertribal natural resource agencies. Early network discussions revealed that many tribal partners did not have a CWD policy or plan in place, nor sufficient resources to independently manage CWD on tribal lands. To strengthen this partnership and reinforce tribal participation in CWD control, our team conducted interviews with tribal natural resource managers to enhance understanding of (1) the needs, capacity, and opportunities for CWD engagement, surveillance, and outreach on tribal lands; (2) the implementation of natural resources policy and management in different tribal nations; and (3) opportunities for partnership-development with tribes in cosharing knowledge and building capacity to control CWD. This was the first of several steps to learn how each tribal nation approached natural resource management and to enable the codevelopment of future outreach, management, and surveillance plans such that community-specific cultural needs are met (Brook & McLachlan, 2008; Gratani et al., 2014; Lewis & Boyd, 2012; Maraud & Roturier, 2021).

2 | METHODS

2.1 | Study area

Study participants were tribal natural resource managers among the 34 federally recognized Anishinaabe and Dakota tribes from throughout Minnesota, Michigan, and Wisconsin. We targeted natural resource managers who were part of the aforementioned network, either directly or through representation by an intertribal agency, and included 20 natural resource managers from 16 tribes and 2 intertribal agencies. Staffing levels among these regional tribal natural resources agencies ranged from 4 personnel to more than 60. Interviewees consisted of 19 tribal professionals that agreed to be interviewed (for a response rate of 95%). Interviewees represented more than 50% of the 34 federally recognized tribes of the three midwestern states. They included nine tribal natural resource managers from eight Minnesota tribal nations, five tribal natural resource managers from five Michigan tribal nations, three tribal natural resource managers from three Wisconsin tribal nations, and two tribal natural resource managers from two intertribal agencies, 1854 Treaty Authority and Great Lakes Indian Fish and Wildlife Commission (GLIFWC). The 1854 Treaty Authority is an intertribal natural resource management agency that protects and implements the off-reservation hunting, fishing, and gathering rights of the Bois Forte Band and the Grand Portage Band of Lake Superior Chippewa in the lands ceded under the Treaty of 1854. GLIFWC is an intertribal agency representing eleven Ojibwe tribes in Minnesota, Michigan, and Wisconsin (Mille Lacs Band of Ojibwe, St. Croix Chippewa Indians of Wisconsin, Bad River Band of Lake Superior Chippewa, Lac du Flambeau Band of Lake Superior Chippewa Indians, Mole Lake Band of Lake Superior Chippewa, Fond du Lac Band of Lake Superior Chippewa, Red Cliff Band of Lake Superior Chippewa, Bay Mills Indian
Community, Lac Vieux Desert Band of Lake Superior Chipewa Indians, Keweenaw Bay Indian Community, Lac Courte Oreilles Band of Lake Superior Chipewa Indians). All of the identified tribes above reserved hunting, fishing, and gathering rights on ceded territory in the 1836, 1837, 1842, and 1854 Treaties with the US government. Tribal land that tribal members hunted consisted of reservations, ceded territory, private property, and state and federally owned lands. At the time of the interviews (see below), CWD had been detected in wild and/or farmed cervids in 13 Minnesota counties, 9 Michigan counties, and 38 Wisconsin counties (Figure 1).

2.2 | Interviews

We conducted interviews via video conference or telephone due to in-person limitations of the COVID-19 pandemic between March 20, 2020 and December 10, 2020. We used a semi-structured interview approach to optimize conversation to collect independent thoughts from each individual and allow latitude to expand on the topics as necessary (Newcomer et al., 2015). Each interviewee voluntarily agreed to be interviewed as participants in the aforementioned network. The opinions shared by these tribal government employees interviewed in this study were in the conduct of their employment. We used a 15-question open-ended interview guide to collect the interviewees’ professional perspectives on the local hunting community and practices, interactions with tribal leadership, CWD outreach, CWD surveillance, and CWD management within the tribal community they represented (see Supporting Information Materials S1). Questions were developed in cooperation with network leaders in order to gain an understanding of the CWD-based needs and opportunities across participating tribes for the purpose of future network initiatives. Project goals were presented to each interviewee prior to the interview. Written notes were transcribed during the interview on managers’ responses by two project team members (T.W. and M.S.) in a shared electronic document (i.e., Google Doc).

2.3 | Data analysis

We analyzed transcripts using open and axial coding methods (Charmaz, 2006; Holton, 2007) in the qualitative data analysis computer software package NVivo 12 Pro (QSR International) as described in Bernstein et al. (2021). Two researchers (N.P. and M.S.) independently reviewed two interviews, and, using these, codeveloped a codebook classifying the interview responses (see Table S1). They then independently analyzed the remaining interviews through axial coding according to the codebook, and collectively, along with a third researcher (L.B.), summarized the coded data, identified preliminary themes based on the data, and conducted a thematic analysis that consolidated the summarized data into main underlying themes that emerged from interview responses (Charmaz, 2006). We performed kappa and percent agreement statistical analyses to establish the interrater reliability of the coding by multiple researchers (McHugh, 2012). Statistical analyses were performed separately for interviews of Minnesota-based and Wisconsin/Michigan-based interviewees as these two groups were considered separate populations and the interviews were analyzed separately by group as described above. Specifically, Minnesota tribal professionals within the network were interviewed early on in the study period, whereas the Michigan and Wisconsin tribal professionals were interviewed at later dates within the study period and were all from GLIFWC member tribes. Interrater reliability demonstrated a strong level of agreement (Kappa = 0.80; percent agreement = 99.0%) and a moderate level of agreement (Kappa = 0.66; percent agreement = 98.3%) for the Minnesota-based group and the Wisconsin/Michigan-based group, respectively.

3 | RESULTS

Tribal natural resource managers reported that tribal hunters mainly hunted white-tailed deer. Few hunted other cervids such as moose or elk as opportunities for these species were limited due to small numbers of huntable populations in Minnesota, Michigan, and Wisconsin. Tribal hunters rarely hunted cervids in other states or provinces. Historically, very limited cervid farming occurred on these tribal lands, and at the time of the interviews there were few to no known cervid farms on tribal lands or in near proximity to tribal lands. For one tribal nation it was stated that, “The conservation code is being updated to remove the ability for tribal members to have cervid farms.” The few existing cervid farms were not owned or operated by tribal members and were managed through state and federal regulatory programs. Additional analysis of the interviews revealed four themes describing deer hunting, culture, and CWD within the tribal nations represented.

3.1 | Theme 1: Diversity across tribes

The number of tribal hunters estimated by tribal natural resource managers varied greatly, ranging from less than
100 to 5000 people per nation. Regulation of tribal hunters varied as some tribes required licensing, tagging, and/or reporting harvests, while others did not require formal licensing or reporting for tribal members. Some tribes allowed nontribal hunters access to hunt tribal lands, yet this was not common, with only four of the interviewees reporting legal nontribal hunter access. Tribal agency engagement was more developed and regularly occurred with nontribal hunters rather than tribal hunters. For example, in the few tribal nations that allow nontribal hunters on tribal lands, the nontribal hunters were required to purchase licenses and report harvests, which required visiting the agency and communicating with attending staff about regulations and registration of harvested animals.

Interviewees reported reservation areas of approximately 800–12,000,000 ha, which are not all huntable. Tribal members hunted on a diversity of land types including reservation, ceded territory, private property, and state and federally owned lands. Many reservations in the region were highly fractionated with some lands held in trust for the tribe, but also with significant mixed ownership by nontribal entities as a result of the Allotment Era (i.e., the physical break up of reservation land held in common by the members of a tribe into parcels granted to individuals of the tribe under the General Allotment Act of 1887, many of which have been transferred to nontribal parties over time) (Otis, 2014; Pevar, 2012). This was reported to complicate the management of both tribal and nontribal deer hunting as communicated by one interviewee, “(State) Department of Natural Resources (DNR) could come within the reservation boundaries to manage a CWD outbreak but not on tribal owned lands. Only about 16% of land within (the) boundaries are tribal owned lands.” The location of tribal lands in relation to CWD detections in wild or farmed cervids was distinct for each tribe, ultimately affecting tribal agency response and management of CWD. At the time of the interviews, CWD had been detected only on ceded territory lands of these tribes, which may potentially be a consequence of limited surveillance and tribal capacity (further acknowledged in Section 3.2).

Tribal natural resource agency capacity differed greatly between the tribes represented in the interviews. Overall, as stated by an interviewee who works with multiple tribes, “the tribes don’t really have staff and personnel with training and time needed for sampling and surveillance (for CWD).” In general, the Anishinaabe tribes, due to large ceded territories and their locations in more remote areas, had larger and more developed natural resources agencies than the Dakota tribes, which were in more developed areas and did not have reserved ceded territory hunting rights. Tribal natural resource agency infrastructure ranged from a few employees to much larger networks with multiple divisions; staffing levels among tribal natural resources agencies ranged from 4 personnel to more than 60. These dissimilarities stemmed from relative agency size and overall levels of program responsibility. Regardless of agency size, natural resource managers and agencies presented policy or regulation changes ultimately to tribal leadership (e.g., tribal council, chairman, board of directors) for approval of implementation. Some tribes incorporated a conservation/natural resources committee as an intermediary in this process. Most tribal councils allowed a comment period from tribal members to obtain public opinion on the proposed changes. One such example, a tribal natural resources professional stated that, “(The) advisory committee is a step between the natural resources agency and the tribal council (TC) where (the natural resource manager) gives recommendations and gets input. If the (advisory) committee agrees then TC goes along with it. Advisory committee is tasked to represent the community and get feedback from the community.” This process, along with agency capacity, affected the tribal natural resource managers’ potential ability to plan and respond to CWD in and around tribal lands.

### 3.2 | Theme 2: CWD outreach, management plans, and surveillance

Tribal natural resource managers collectively desired to strategically move forward in CWD-related actions of providing outreach to the community, creating management plans, and conducting surveillance on tribal lands. The envisioned procedures to achieve these goals were highly affected by the previously described variability in size and configuration of tribal lands, as well as agency capacity for implementation of CWD management activities across tribes. Specific CWD-related actions the participating tribal nations have previously performed and how the interviewees envision new action implementation are described below.

**Outreach**—Few tribal agencies represented in the interviews actively provided CWD outreach. Several tribal agencies delivered outreach and CWD information in the past, but with little reported interest from their constituents. Agencies provided informational pamphlets at license centers and conducted hunter surveys, for example, but interviewees stated that the efforts subjectively did not seem effective in raising awareness of CWD in tribal communities. This was explained as, the “disease has not been close, so people are not asking (about CWD), but it may become more important moving forward as (CWD) spreads.” Wisconsin and Minnesota
tribes that were geographically closer to, or had members hunting in ceded territories impacted by CWD detections, continued to provide some CWD outreach. In addition, interviewees largely concluded that it was necessary to raise awareness about, interest in, and understanding of CWD in the communities. Interviewees suggested that social media and presence at community events may be effective mechanisms of outreach and should ideally reach both nontribal and tribal hunters on tribal lands and within proximity to tribal lands. While the general opinion that “social media posts may be really effective in reaching community members and generating dialog around the issue” was raised in multiple interviews, a few Tribal communities lacked a “mechanism for quickly reaching (the) community” and they have been only reaching “resident members and nonmembers passively.”

Management plans—None of the tribal natural resource agencies had an active CWD management plan in place and thus if a CWD positive detection occurred on tribal lands, the managers described that they would likely be responding quickly with limited time for guidance and insight. The interviewees acknowledged that this would be a challenging scenario despite previous similar experiences and stated that developing a plan prior to conducting surveillance would ensure a streamlined, coordinated, and effective response. Tribes associated with GLIFWC did not have established tribe-level CWD management plans. However, several GLIFWC tribes located in Wisconsin were guided by a CWD Management Area plan that provided recommendations on carcass transportation, registration, testing, and disposal in CWD management areas, but did not offer guidance on management response to new detections (Great Lakes Indian Fish & Wildlife Commission, 2019). Interviewees agreed that the easiest approach to develop CWD management plans would be to adapt existing management plans or best practices to meet tribal needs and priorities.

Surveillance—The majority of the tribal natural resource managers had not recently conducted CWD surveillance on tribal lands. Approximately half of the interviewees reported historical CWD surveillance efforts through the previously referenced 2002 US Department of Agriculture (USDA) grant program over a short duration. Tribal natural resource managers collectively reported that past surveillance was minimal and largely unproductive because of minimal sampling, narrow geographical representation, year to year inconsistencies in design, and overall limited community participation.

At the start of this project, collaborative CWD surveillance among Minnesota tribes was in development. Michigan and Wisconsin tribes described growing surveillance efforts through state-tribal natural resource agency collaborations, although efforts were still limited by community participation, available funding, and tribal agency capacity. Most tribal natural resource managers indicated that they would like to expand surveillance programs prior to opportunistic CWD detection (e.g., discovery of a sick deer). A passive surveillance approach along with targeting regions with higher risk of CWD (e.g., cervid farm, detections in wild cervids) was preferred to confirm that the regions remain CWD-free. The “goal is to prevent (CWD) from becoming endemic, to detect (it) early.” The details of this strategy were not yet defined, but it was clear that mandatory testing of hunter harvested deer would not be well accepted in the communities and “opportunistic sampling of hunter harvested animals on reservation and ceded territory, roadkills, (and) sick animals” was a preferred way forward. Strategies considered by managers for enhancing community participation included implementing deer head drop-offs at key locations within the community that would allow a hunter to leave a deer head and associated metadata for agency staff to pick up and collect samples for testing, along with participatory incentives (e.g., lead-free ammunition, gas cards, gift certificates to tribal businesses, raffle entries), as these options could be inexpensive, appealing to hunters, and require minimal agency staffing time.

3.3 Theme 3: Nontribal collaborations

Interviewees indicated that tribes were interested in working with outside organizations including state, federal, and university partners when dealing with CWD, but such collaborations may be complicated. All interviewees and their representative tribal agencies had worked with state DNRS and other state entities in some capacity. To date, DNR engagement with tribal hunters on CWD was minimal. Most working relationships between state DNR and tribes were described as good and productive, but not all. All interviewees communicated that they would consider working with their state DNR again to comanage CWD. Some state agency or DNR partnerships were considered necessary for CWD-related management due to the state agencies’ larger capacity for wildlife disease related issues and for those tribal lands where comanagement of natural resources was already in place (e.g., ceded territory) and because “state, private, and forest service lands (are) within reservation boundaries.” Importantly, the need to begin these relationships as equal partnerships that recognize tribes as sovereign entities was noted in many of the interviews.

The federal Indian trust responsibility is a legal and moral obligation of the United States to “ensure the protection of tribal and individual Indian lands, assets, resources, and treaty and similarly recognized rights”
(US Department of Interior, 2014). Due to this trust responsibility of the federal government to federally recognized tribes, interviewees reported that tribes regularly work with the federal government on natural resources projects, including CWD, and managers indicated a willingness to continue work with federal agencies. States have never (and cannot) form treaties with tribal nations and thus have not assumed the overarching federal trust responsibility that developed when the treaties were originally signed between sovereigns. Tribal natural resource managers described the relationship with tribes and the federal government as a more equal partnership than their relationships with state agencies, and from that perspective, was more advantageous to tribes. The federal government relationship is a peer to peer relationship, with two sovereign nations working together as governmentally independent entities, which stems from the fact that treaties were signed as coequal sovereigns between the United States and each tribe that signed (Kalt & Singer, 2004; US Commission on Civil Rights, 2003).

All tribal natural resource managers explained that they would welcome university expertise for CWD outreach and planning. The interviewees explained the greatest benefit would be to explain CWD in a relatable and understandable way to the tribal communities. For several tribes, this type of collaboration with outside expertise was successful on issues such as deer and carnivore population management, CWD, and others that were not disclosed in the interviews.

### 3.4 Theme 4: Low impact, high value

It was apparent in summarizing the interviews that two points predominated regarding the ultimate success of CWD outreach, surveillance, and management efforts: (1) it cannot increase administrative and capacity burdens on tribal natural resource managers and tribal hunters, and (2) it must include tribal values, perspectives, and input. Surveillance needs to be logistically easy for hunters to participate in, easy for the tribal natural resource agencies to operate under limited capacity, and inexpensive for the tribal community. It is important to understand that most tribal natural resource agencies have a small percentage of the average state natural resources agency employee base, while incurring the same responsibilities over nearly the same size of landbase. Collectively, interviewees remarked that any success in managing CWD among tribal nations would require tribal community and agency cooperation with minimal negative impact to the individuals.

### 3.5 Thematic differences

There were many similar responses between Minnesota, Michigan, and Wisconsin tribes, however there were also notable differences, primarily related to proximity to CWD positive detections. In Minnesota, only three tribes had CWD detections near their tribal lands at the time of the interviews, while in Michigan and Wisconsin, numerous ceded territory lands had multiple and well-documented CWD detections. This demonstrated a greater experience of living and hunting with CWD among Michigan and Wisconsin tribes, leading to further differences in interview responses related to CWD outreach, management, and surveillance. The overall response to CWD by Michigan and Wisconsin tribes was more intentional and assertive, as it involved more engagement with tribal hunters on CWD and greater participation in CWD surveillance programs led or supported by state agencies. Despite state agency collaboration, less satisfaction with state agency partnership was reported in Michigan and Wisconsin as compared to Minnesota. In all three states, interviewees concluded that more could and should be done to counter CWD.

### 4 DISCUSSION

The overall goal of the project was to obtain current perspectives on existing CWD management approaches among tribal agencies and provide insight into how external partnerships can benefit needs as CWD continues to spread. Nearly 20 years after CWD was discovered in the Midwest, we interviewed 19 natural resource managers representing Anishinaabe and Dakota tribes within the upper Midwest region coinciding with the establishment of a Tribal CWD Surveillance Network. CWD management on tribal lands has historically been limited to intermittent surveillance when external federal governmental support has been available. Given growing CWD concerns and the limited CWD management efforts on tribal lands up to this point, tribal natural resource managers recognized the need to enhance CWD outreach to tribal communities, develop tribal-specific CWD management plans, and expand CWD surveillance on tribal lands.

Each tribe’s sovereignty and relationship with federal and state governments underlies limitations of past CWD management efforts and shapes the future of CWD response efforts. As Kalt and Singer (2004) stated, “Tribal sovereignty is recognized and protected by the US Constitution, legal precedent, and treaties, as well as applicable principles of human rights.” However, historical federal
funding, support, and treaty promises to tribal nations, including the management of natural resources, have been largely unfulfilled (Day, 2020; Donoghue et al., 2010; Kalt & Singer, 2004; US Commission on Civil Rights, 2003). In regard to CWD specifically, $1M in USDA funding to support Indian tribes was made available in federal fiscal year 2003 (US Commission on Civil Rights, 2003). Interviewees indicated that many of the tribal nations cooperated with federal agencies to conduct CWD surveillance at that time, but the program collapsed due to high administrative burdens in comparison to the available funding for each tribe and the lack of tribal hunter cooperation. Since then, specific federal funding for tribal nations to address CWD has been nonexistent until 2020. In addition, coordination with state-level CWD efforts has been difficult. These events, along with the continued spread and risk of CWD to tribal communities, have elevated the interest of tribal nations in the upper Midwest to further develop collaborations with state and federal agencies, while asserting their rights to self-determination, as the limited infrastructure of individual tribes restricts effective CWD management. Implementation will be enhanced by unity within and among tribal communities and coordination with state and federal agencies as CWD, like other diseases, does not respect jurisdictional boundaries. Importantly, the success of CWD collaborative efforts requires that they be sustainable, reflect the priorities of tribal nations, and meet the needs of tribal agencies. In the past (and presently), tribal community beliefs and practices were often overlooked by outside organizations, resulting in strained relationships (Bennett, 2019; Donoghue et al., 2010). The results from our study suggest that some tribal nations are still experiencing these same issues.

An important need identified through this project was that all tribal agencies represented did not yet have, but recognized the need for, a CWD management plan to be developed in order to successfully and effectively manage CWD on tribal lands and in tribal communities. Almost all felt that development of management plans would benefit from external coordination and support, including collaboration with scientific and management partners to develop plans based on best practices while also integrating tribal culture and priorities. This could be a next step for all tribes represented in this study since no plans were in place, and particularly useful for tribes potentially at risk for CWD detection. Developing a plan prior to initiating or expanding surveillance would ensure a streamlined, coordinated, and effective response to a CWD detection. Surveillance absent CWD management planning may lead to uncertainty of CWD management steps in the event of a positive finding. Available resources that could be adapted for this purpose include the aforementioned GLIFWC plan, the Association of Fish and Wildlife Agencies’ best management practices (Gillin & Mawdsley, 2018), and the associated states’ CWD response plans. The variability in tribal hunting regulations, interactions with tribal and nontribal hunters, and agency capacity will likely impact the type and extent of CWD surveillance and management that is realistic for each nation. The resources identified by tribal managers as not available include collective agency time, staffing, and capacity for long-term implementation. In all likelihood, tribal agencies geographically closest to the CWD positive areas will lead in the development of CWD management plans that may then be shared among other interested tribal agencies. This practice is regularly used by tribal nations, where providing assistance and sharing intellectual property for a greater good has been commonplace.

While there was strong interest in conducting CWD surveillance on tribal lands, hunter participation in surveillance may need to be bolstered with incentives or CWD outreach. Incentivizing harvest and sample submission for CWD surveillance has shown to increase participation, albeit minimally, in tribal and nontribal communities (Petchenik, 2006; Seth Moore, personal communication). In addition, engagement with tribal communities through CWD outreach may lead to greater awareness, interest, and understanding of the disease and management. This is especially important because the perception among interviewees was that CWD has not been geographically close enough to raise interest or concern in the communities, particularly in Minnesota. Outreach on CWD has the potential to garner support from the community to increase hunter participation in surveillance and other CWD management efforts (Amick et al., 2015). Outreach may also promote community buy-in and adoption of newly developed management plans if a CWD positive deer were found on local tribal lands. As CWD continues to spread, this scenario becomes more likely.

While tribal nations generally shared the same goals for outreach, management, and surveillance, our interviews revealed that each tribal nation is a unique entity with different needs and processes for their implementation. Interviewees largely agreed that although efforts could be shared at a high level across tribal nations, each sovereign nation must maintain the autonomy of more detailed actions that meet their own community needs, which is the basis for the additional information gathering described below. The coordination of these efforts and sharing of resources can facilitate management goals for each tribe, which is a key approach for the Tribal CWD Surveillance Network. Moving into the 2020 hunting season, many tribes represented in the interviews saw the Tribal CWD Surveillance Network and/or state CWD surveillance as opportunities for such cooperation.
Partnership among tribes and nontribal entities can be successful. Several Minnesota tribes, the University of Minnesota, and federal and state agency collaborators led efforts to sustainably manage wild rice in the Midwest (Matson et al., 2021), evaluate the zoonotic risk of parasite transmission from wildlife to domestic canids (Bernstein et al., 2021), enhance understanding of factors related to moose calf survival (Van de Vuurst et al., 2021; Wolf et al., 2021), and evaluate contamination by pharmaceuticals in fish, waters, and sediments (Deere et al., 2020, 2021; Servadio et al., 2021). These efforts provide examples where Indigenous people, with unified culturally-based goals, partnered with multiple groups and governments, ultimately leading to improving the state of knowledge in support of traditional harvest activities consistent with treaty rights.

Planning for CWD outreach, management, and surveillance must explore ways to equally integrate traditional ecological knowledge (TEK) with western science, particularly when it comes to understanding disease. TEK is a combination of the knowledge, cultural practices, and beliefs passed down from generation to generation of Indigenous communities that addresses how humans interact with all aspects of their environment (Berkes, 2017). The ecology of CWD fits this belief system perhaps better than any wildlife disease as aspects of human behavior, animal health, plants, water, air, and earth are all vital aspects of CWD transmission. Successful comanagement of CWD between tribes and outside entities can be enhanced when traditional knowledge and cultural values are equitably considered alongside western science-based management strategies. Parlee et al. (2021) and Maraud and Roturier (2021) described the complicated nature of this blending, but it is not an impossible endeavor. The Nunavet Wildlife Act incorporated the societal values, principles, and hunting practices of the Inuit into territorial ecological management practices (Government of Nunavut, 2003, 2013). Two decades later, this practice continues as TEK is woven into natural resource management through federal and tribal government collaboration (Eisenberg, 2019).

A theme surmised from the interviewees was the need to include tribal values, knowledge, perspectives, and input in future CWD management efforts. Therefore, results from this project directed a subsequent project that engages community members in the collection of additional data on community knowledge, perspectives, and behaviors related to CWD. This includes information on how traditional teachings facilitate understanding of CWD and other wildlife diseases. Results from this effort will inform the codevelopment of CWD outreach materials for these tribal communities that incorporate their values and traditional teachings and knowledge.

Furthermore, based on expressed interest by several tribal natural resource managers interviewed, we codeveloped a survey of tribal hunters to better understand their hunting behaviors, current CWD knowledge, and perspectives on existing and potential CWD management practices. This was disseminated through network tribes across Minnesota, Michigan, and Wisconsin during the 2021–22 hunting season. These survey data will directly inform CWD outreach to tribal hunters and the development of tribal CWD management plans that incorporate the values, beliefs, and culture of the unique tribal communities.

We appreciated a few limitations associated with this study. First, many of the interviewees were part of the network and had a vested interest in CWD management, potentially leading to acquiescence bias. Second, interviewees did not include representation from all tribes, limiting the scope of perspective from regional tribal nations, particularly those that are small and/or without treaty-reserved rights to hunt in ceded territory. Third, richer conversation would likely have occurred with in-person interviews. Finally, the perspectives gained were from natural resource professionals working for the tribal nations, and not the tribal community itself. While the latter would provide a broader perspective on the tribes' underlying values related to CWD management and external partnerships, the experiences and perspectives of the interviewees in the capacity of their profession provided key insights directly related to the goals of this study.

With the establishment of the network, university partners had limited experience with many of the partner tribal natural resource agencies and little direct knowledge of existing capacity, needs, or tribal policy and governance related to natural resource management. By engaging with tribal natural resource managers through this project, the university team obtained a better understanding of partner needs and priorities, and how a university-tribal partnership might be most productive. In follow-up of the interviews with tribal natural resource managers, a brief report was disseminated to the participants and has been utilized in planning by the network, as well as the development of additional efforts in tribal engagement to better understand community values and perspectives related to CWD. While our study demonstrated that tribal natural resource professionals were open to and in some cases welcomed external partnerships, critical next steps for any external partner of tribes includes building trust, transparently outlining tribal-partner needs and goals, acknowledging and respecting Indigenous knowledge and labor, and working toward a long-term, mutually beneficial relationship (Matson et al., 2021; Mohammed et al., 2012). This includes, but is
not limited to, establishing memoranda of understanding on communications and work, setting up data sharing and ownership agreements that protect Indigenous knowledge, as well as obtaining proper research clearances (e.g., Institutional Review Board approval, tribal research permits, etc.) that protect these vulnerable communities.

Our study provides insights for external partners of tribal nations (e.g., state and federal natural resource agencies and managers, university researchers) related to the comanagement and control of CWD. We have identified new opportunities where external partners can support tribes in CWD outreach to affected communities, concurrently with the development of management and surveillance plans. Partners should work closely with tribal members and natural resource agencies to ensure that materials and plans specifically address the cultural aspects of the communities affected by CWD. The uniqueness of each tribal nation and the numerous ways that cervids contribute to tribal culture and communities demonstrate that a “one size fits all” approach to managing wildlife diseases is inappropriate. These recommendations are not meant to discourage necessary disease management, but to urge the incorporation of tribal knowledge, values, and priorities in order to effectively advance long-lasting wildlife conservation and disease management.

AUTHOR CONTRIBUTIONS
Marc D. Schwabenlander, Nicole Potts, and Tiffany M. Wolf led the conceptualization and writing of the article. Marc D. Schwabenlander, Seth Moore, and Tiffany M. Wolf performed the interviews and acquired the data. Marc D. Schwabenlander, Nicole Potts, and Lauren A. Bernstein analyzed the data. All authors contributed to data interpretation, conceptual development, writing, and revisions.

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CONFLICT OF INTEREST
The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT
These qualitative data will not be made publicly available in keeping with tribal data sovereignty rights [see T. Kukutai, J. Taylor, Indigenous Data Sovereignty: Toward an Agenda (ANU Press, 2016; https://library.oapen.org/handle/20.500.12657/31875)]. The survey instrument is available in the supplemental materials. Researchers who would like access to the data can contact the corresponding author.

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ENDNOTE
1 While the terms Indian and Native American are often used interchangeably, we use the term Indian in this text rather than Native American based on the context provided by Pevar (2012), where Indian is often the term used in the names of Indian-led organizations and groups, federal laws and federal agencies. This terminology is conventionally used by the tribes that participated in this project.

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SUPPORTING INFORMATION
Additional supporting information may be found in the online version of the article at the publisher's website.

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