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ARTICLE

# Case study: Applying the *resist–accept–direct* framework to an Ojibwe Tribe's relationship with the natural world

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## Abstract

Ojibwe Tribes' approach to the natural world is guided by the original treaties between beings (species and spirits) and the Ojibwe people who reside in lands now known as the United States and Canada. Relationships with these beings, such as ogaa (walleye *Stizostedion vitreus*), are best characterised as taking care of a relative/gift for the next seven generations of Ojibwe. Initial denial of treaty rights by the state government has strongly influenced tribes' relationship with their relatives for over 100 years. Ogaa stocks and natural reproduction have declined in the Minocqua Chain of Lakes (Wisconsin, USA) over the last 20 years. Region-wide declines in ogaa have been attributed to many stressors such as overharvest by state-licensed anglers, invasive species and climate change. Here, we retroactively applied the *resist–accept–direct* (RAD) framework to the process used to create an interjurisdictional rehabilitation plan for the Minocqua Chain of Lakes. Specifically, we cover the following: progress to date on the rehabilitation plan; subsistence, cultural and spiritual challenges associated with *resisting* ecosystem change; unforeseen obstacles to rehabilitation; re-evaluation of the relationship with ogaa; unknowns; and contingency plans from a tribal perspective. Lastly, we discuss how the RAD framework could become more useful to tribes in the region.

KEYWORDS
ecosystem change, Indigenous, rehabilitation, resist–accept–direct framework, tribes, walleye

## 1 | OJIBWE WORLDVIEW

The Seventh Generation philosophy, which is shared by many Indigenous North American Nations, instructs us that we (Ojibwe people, part of the Anishinaabe Confederacy, which also include the Odawa and Potawatomi peoples in the Great Lakes Region [the United States and Canada]) must be mindful of those future unborn generations, seven generations into the future, when we hunt, fish and gather for our own sustenance and well-being (Loew, 2014). Anishinaabeg (natives) must make careful and wise decisions that will nurture and sustain a healthy and thriving natural environment for generations to come.

The Ojibwe today in the Upper Midwest of what is now known as the United States are the seventh generation of those early leaders who signed the treaties with the U.S. government that guaranteed to them the rights to hunt, fish and gather in the Ceded Territories (see the section on treaty rights). And so, it is today that Anishinaabe people must work to ensure that the foods and medicines are protected

and sustained seven generations into the future. All these teachings culminate into the term, Minobimaadiziwin—the good way of life.

Ogaa, which is the Ojibwe name for walleye *Stizostedion vitreus* (see Table 1 for species names in Ojibwe), is recognised not only as a relative but also as a prized food source. Being both a relative and a food source may be a difficult concept to comprehend for many Western-educated thinkers but is a fundamental perspective among many Indigenous nations. Some other well-known/iconic relatives of Indigenous North American Nations include namegos (salmon *Salmonidae*), bizhiki (bison *Bison bison*), and waawaashkeshi (whitetail deer *Odocoileus virginianus*). Ogaa is part of the cultural identity of Anishinaabe people. It is imperative according to Anishinaabe teachings that Anishinaabe people work to protect one of their closest relatives who they depend upon.

Many Ojibwe people believe that long before their ancestors signed treaties with the United States, humans entered into a reciprocal relationship with all the other orders of creation. According to the Anishinaabe Creation Story (Johnston, 1976), there are four orders of creation: the first order of creation was the earth: soil, rocks, winds and water; the second order of creation was the plants: trees, grasses, herbs and mosses; the third order of creation was the animals: four-legged, winged ones, swimmers and crawlers, each order of creation being dependent upon the former; and the fourth order of creation was human beings, the least of creation because humans are dependent upon all other orders of creation, while nothing depends on human existence. Original man was instructed to be humble, never take without need and always give thanks, recognising that without the gifts from the other orders of creation, he would not exist.

## 2 | OJIBWE RELATIONSHIP WITH OGAA

Tribal members (who, from a Western perspective, are citizens of a sovereign nation) rely on giigoonyag (fish plural) and specifically ogaawag (walleye plural) to meet subsistence, cultural and spiritual needs. Ogaawag are a gift from the creator that has sustained Ojibwe people early in the spring since time immemorial. Ogaawag spawn shortly after ice-out over shallow sand or gravel bars when agoozimakakiig (spring peepers *Pseudacris crucifer*) begin to sing (Panci et al., 2018). Ogaawag reproductive behaviour, along with their reflective eyes, makes them easy to see and spear at night with lights at a time when protein sources are often scarce. In exercising their treaty rights (see the next section), tribal members have risked their lives, and continue to experience physical and emotional trauma because of racism, inequities and conflict with other user groups when they harvest ogaawag in a manner consistent with their history and culture (Lac du Flambeau Tribal Communications Office, 2019). Tribes continue to fight hard to retain their relationship with ogaa, and tribes see it as their responsibility to take care of this gift (ogaa) now and for the next seven generations.

## 3 | TREATY RIGHTS

Prior to the formation of the states of Michigan, Minnesota and Wisconsin, the U.S. government entered into several treaties with Ojibwe Bands who lived in the upper Midwest. There were four cession treaties around Lake Superior (i.e. Treaties of 1836 [Michigan], 1837 [WI and MN], 1842 [MI and WI] and 1854 [MN]) that ceded or sold vast amounts of land to the United States (Figure 1). Included in these treaties were Articles in which the Tribes reserved their pre-existing right to hunt, fish and gather from the lands that were ceded (*Treaty of 1837*; *Treaty of 1836*; *Treaty of 1842*; and *Treaty of 1854*). Importantly, the Treaty of 1854, which ceded land in the NE of MN, also included the creation of reservations, or areas in which the tribes were to live away from white settlers.

Ojibwe people reserved these rights to ensure that they could continue to live in these areas and practise their cultural ways. The Ojibwe people expressed this as a desire to continue to hunt, fish and gather, but their intent was to continue their way of life. Thus "treaty rights" are not just the act of shooting a waawaashkeshi or spearing ogaawag, but the right to practise the lifeway of the Ojibwe.

Tribes were eventually relegated to reservation lands, thus preventing tribal members from practising their seasonal round (that is moving from resource to resource as it became seasonally available), having severe effects on their culture. The off-reservation rights that were reserved in treaties were ignored following the formation

**TABLE 1** English, Ojibwe, and scientific names of giigoonyag (fish)

| English | Ojibwe (singular) | Ojibwe (plural) | Scientific name |
|---|---|---|---|
| Walleye | Ogaa | Ogaawag | *Stizostedion vitreus* |
| Largemouth bass | Ashigan | Ashiganag | *Micropterus salmoides* |
| Black crappie | Gidagagwadaashi | Gidagagwadaashiwag | *Pomoxis nigromaculatus* |
| Smallmouth bass | Noosa'owesi | Noosa'owesiwag | *M. dolomieu* |
| Northern pike | Ginoozhe | Ginoozheg | *Esox lucius* |
| Muskellunge | Maazhi-ginoozhe | Maazhi-ginoozheg | *Esox masquinongy* |
| White sucker | Namebin | Namebinag | *Catostomus commersonii* |
| Salmon | Namegos | Namegosag | *Salmonidae* sp. |

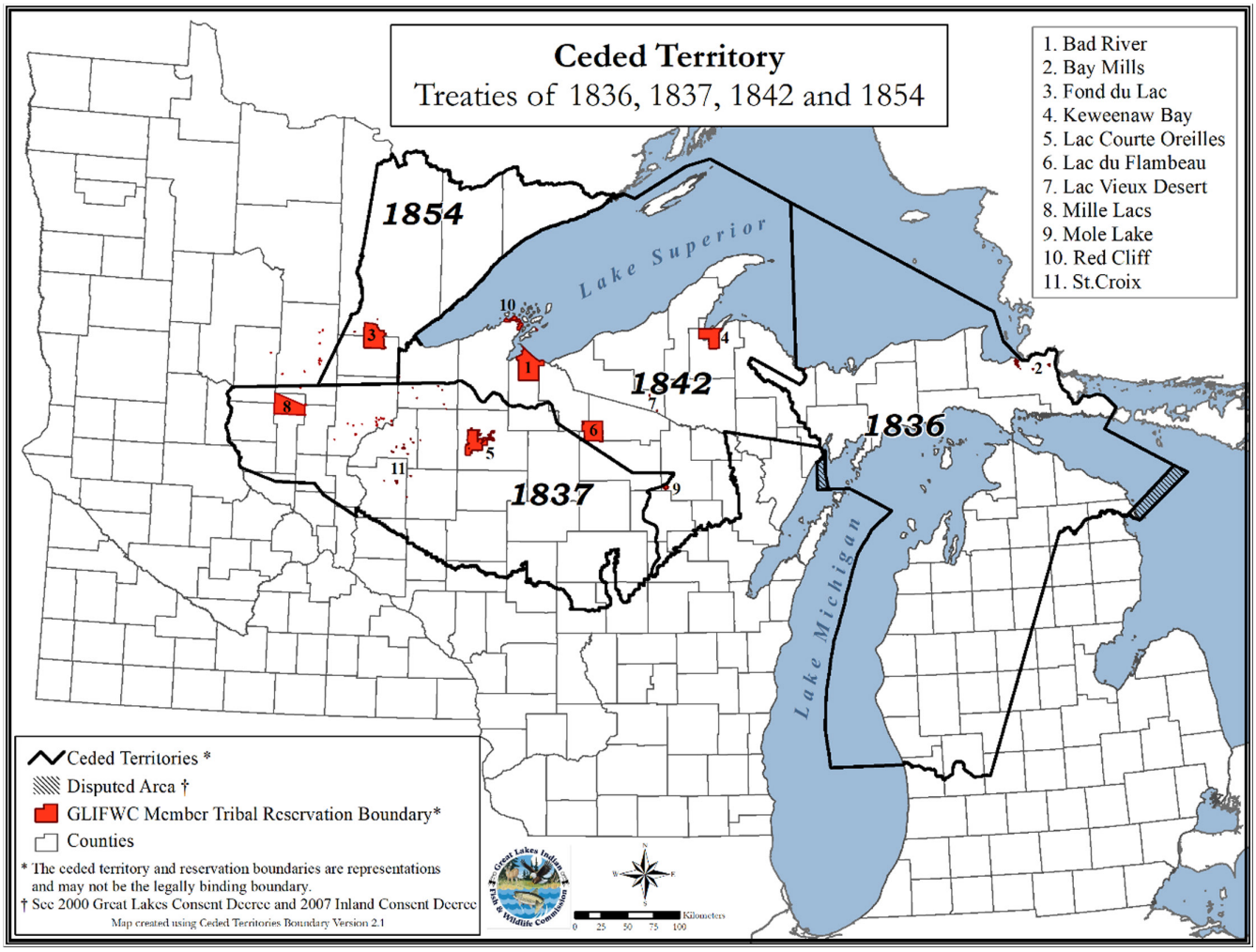


**FIGURE 1** Map showing the Ceded Territories and reservation boundaries of Great Lakes Indian Fish and Wildlife member tribes in the Upper Midwest

of Michigan, Minnesota and Wisconsin. Tribal members who continued to practise their off-reservation treaty rights were often arrested and jailed. The Ojibwe people were deprived of the exercise of these rights, and thus the ability to practice their culture, for more than 100 years.

Both litigation and intergovernmental agreements have been used to reaffirm and implement treaty rights in these cession areas. Intergovernmental agreements between several bands and the State of Minnesota have resolved issues in the 1854 ceded territory. Litigation and a negotiated Consent Decree have been used to address treaty rights implementation in the 1836 ceded territory. Litigation reaffirmed treaty rights in the 1837 and 1842 ceded territories in Wisconsin (see, e.g., *Lac Courte Oreilles v. Wisconsin*, 700 F2d 341 [7th Cir. 1983]) and in the 1837 ceded territory in Minnesota (*State of Minnesota v. Mille Lacs Band*, 119 S. Ct. 1187, 562 U.S. 72 [1999]). The remainder of this discussion will deal specifically with the two ceded territories in Wisconsin (i.e. 1837 and 1842) and the *LCO v. Wisconsin* lawsuit.

In 1983, the Seventh Circuit Court of Appeals in Chicago ruled that the rights reserved in the Treaties of 1837 and 1842 in Wisconsin continued to exist. Moreover, the court ruled that the six Ojibwe Tribes (Lac du Flambeau Band of Lake Superior Chippewa, Mashkiiziibii (Bad River Band of Lake Superior Chippewa), Red Cliff Band of Lake Superior Chippewa, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, Mole Lake Band of Lake Superior Chippewa and St. Croix Chippewa Indians of Wisconsin) in Wisconsin could regulate their members in the exercise of these rights without state interference as long as the tribes protected the resources and did not endanger public health and safety.

In response to this ruling, the Wisconsin Ojibwe bands formed the intertribal agency known as the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). The mission of GLIFWC is to assist member tribes in the implementation of treaty rights and self-regulation in a way that is biologically sound and culturally appropriate (A Guide to Understanding Ojibwe Treaty Rights, 2018). GLIFWC provides technical experts to the tribes in biology, ecology, law, public information and conservation enforcement. In addition, the Voigt Intertribal Task Force (VTF), a constituent committee of GLIFWC, concerns itself with treaty fish and wildlife matters in the inland ceded territories (not Lake Superior). It

operates under delegated authority from its member tribes to make decisions on intertribal harvests of fish and wildlife. The VTF provides advice and comment to other agencies regarding tribes' perspectives on proposed management actions. The VTF is comprised of 10 of the 11 member GLIFWC member tribes. It is important to note that GLIFWC only assists tribes in their off-reservation issues, unless technical assistance is requested by a tribe. Each tribe, as a sovereign government, is responsible for the relationships they maintain with on-reservation relatives.

In *LCO v Wisconsin*, the court found that the bands were entitled to up to 50% of the harvest of each species and that harvest methods and seasons could be tailored to meet cultural needs. One responsibility of GLIFWC is to ensure that harvest amounts are adhered to and that harvests are reported.

However, in addition to this harvest management, GLIFWC is also charged with co-managing resources with other state and federal agencies. To this end, investigations are launched to explore relationship (management) options with beings as circumstances change. Results from these investigations are incorporated into lake and fish community plans. The bands and the state agreed early on that a target adult ogaa population should be 6.7 per hectare (Report on Biological Issues. LCO et al. v. State of Wisconsin, 1988). State and Tribal fisheries management objectives have kept this adult density as the goal.

In the Minocqua Chain of Lakes, tribal, intertribal and state biologists found during recent surveys that mature ogaa populations were below the agreed-upon adult density. Thus, according to a co-management paradigm, the State of Wisconsin and the local tribe (i.e. Lac du Flambeau Band of Lake Superior Chippewa [LDF]) agreed to investigate and develop a rehabilitation plan for ogaawag in these ecosystems. The Minocqua Chain is off-reservation and subject to harvest by all Wisconsin Ojibwe bands; however, since it is close to LDF's reservation, the other bands typically defer to the local band to make decisions about relationships with their nearby relatives (i.e. make management decisions about natural resources).

## 4 | AN ECOSYSTEM UNDERGOING CHANGE

In the 1990s, the Minocqua Chain (Figure 2) was one of Wisconsin's premier ogaa fisheries. The Chain held 5.9–13.8 adult fish per hectare and continued to sustain natural reproduction until the mid-2000s, when natural reproduction began to decline across the lakes. By 2015, natural reproduction was no longer evident, and the adult populations had fallen to <3.7 fish per hectare in all lakes (Figure 3). Harvest by tribes, which is closely monitored by GLIFWC, remained relatively constant until 2014 (Figure 4). In 2015, tribal members indicated that harvest opportunities for ogaawag had decreased in the Minocqua Chain and that leadership should allow these lakes to anwebi (Ojibwe word for s/he rest) to improve ogaa stocks.

Tribal harvesters also made observations that the abundance of warmwater beings such as ashiganag (largemouth bass plural *Micropterus salmoides*) has increased while ogaawag have declined in the Chain. Creel surveys also indicated an onefold to fivefold increase in the abundance of ashiganag and noosa'owesiwag (smallmouth bass plural *M. dolomieu*, both warmwater beings, from 1992 to 2009; Figure 5). Taken together, the dominant fish beings in the ecosystem have been shifting from coolwater to warmwater beings, which has been disrupting traditional food sources for the LDF Tribe.

Ecosystem transformations are occurring more frequently and quickly over larger spatial extents because of numerous stressors such as climate change, habitat loss, overharvest, pollution and invasive species (Lynch et al., 2021). In this case, stressors may include but are not limited to warming water temperature, loss of optical habitat, loss of natural shorelines, overharvest and invasive species (e.g. rusty crayfish *Orconectes rusticus*, banded mystery snail *Viviparus georgianus* and Eurasian watermilfoil *Myriophyllum spicatum*), change in fish community composition, loss of spawning habitat and phenological mismatch (Embke et al., 2019; Feiner et al., 2021; Hansen et al., 2019, 2020; Isermann, 2021; Raabe et al., 2020; Sass et al., 2021). Which of these mechanisms and to what extent each played in altering the trajectory of the ecosystem in the Minocqua Chain of Lakes remains unknown. Moreover, lakes throughout the Ceded Territories are experiencing similar changes; ashigan (largemouth bass singular) populations are increasing, and ogaa populations are decreasing (Hansen et al., 2018). To date, human intervention to *resist* these changes in the ecosystem through whole-lake removals of ashiganag and other beings has been unsuccessful (Embke et al., in press). Projections indicate that these shifts in the aquatic ecosystem will be exacerbated under future climate conditions (Hansen et al., 2017). The LDF Tribe relies on ogaawag in the Ceded Territories of the Upper Midwest for cultural, spiritual, ceremonial and subsistence needs, so the reaction by tribal members and leadership was to *resist* these changes.

## 5 | CHOOSING A STRATEGY WITHIN THE RESIST–ACCEPT–DIRECT (RAD) FRAMEWORK

In 2015, LDF, Walleyes for Tomorrow, Wisconsin Department of Natural Resources, and GLIFWC (henceforth referred to as the Partners) created a Minocqua Chain of Lakes ogaa rehabilitation plan. LDF recognised that ogaawag would not be sustained for the next seven generations if steps were not taken to protect ogaawag. Similarly, state-licensed anglers and agencies realised that action needed to be taken if ogaawag were to naturally persist in the Minocqua Chain again. To develop the rehabilitation plan, the Partners organised public meetings among the tribes, stakeholders and the general public to discuss available biological data, current trajectory of the ecosystems, alternative trajectories, current fishing regulations and potential management actions. Drawing on different forms of knowledge, tribes discussed their long-standing connection with giigoonyag in the Minocqua Chain of Lakes and the cultural, ceremonial and spiritual importance of these beings. In addition,

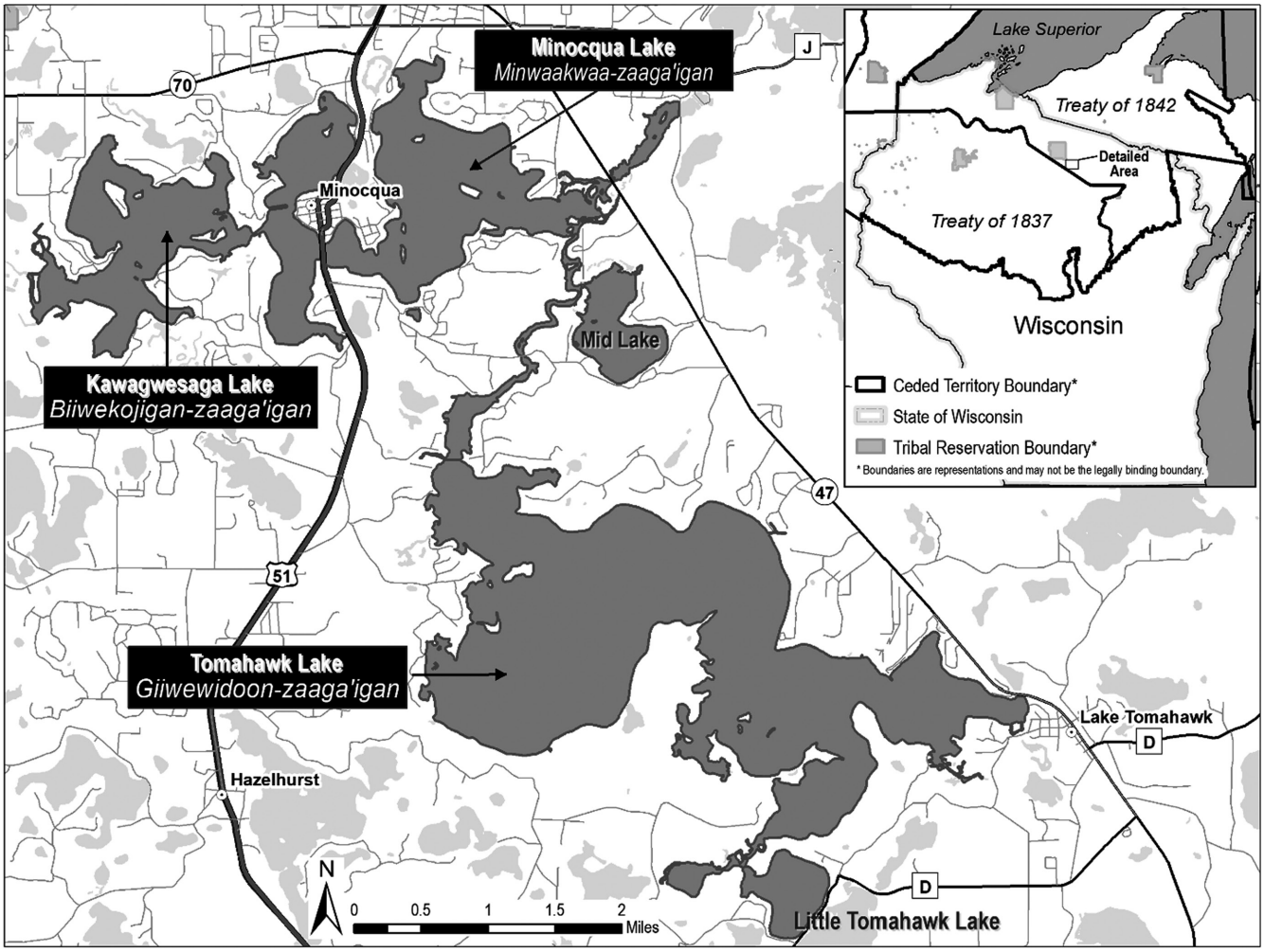


**FIGURE 2** Map depicting the location of the Minocqua Chain of Lakes in the 1842 Ceded Territory of Wisconsin. Minocqua Lake (area = 542 ha, depth = 18 m), Kawaguesaga Lake (area = 283 ha, depth = 13 m) and Tomahawk Lake (area = 1401 ha, depth = 26 m) are part of the Upper Wisconsin River watershed and form the headwaters of the Tomahawk River

stakeholders and the general public discussed the value of the fisheries in the Minocqua Chain. Unbeknownst to the Partners, two of the practices that can be used to implement the RAD framework occurred organically while building the rehabilitation plan for the Minocqua Chain of Lakes. Specifically, the Partners engaged with the public and tribal members in a multiway dialogue prior to taking management actions, and meeting participants envisioned ecological trajectories for the Minocqua Chain of Lakes (i.e. warmwater or coolwater fisheries) and the social consequences of those trajectories (Magness et al., 2022).

Ultimately, the Partners, with input from the public and tribal members, decided to *resist* ecosystem change (instead of *accepting* or *directing* the trajectory of change) because the best outcome (culturally, socially, spiritually) for all parties was to have ogaa populations similar to historical levels. None of the Partners had explicitly adopted the RAD framework (Lynch et al., 2021), an emerging tool developed for Western resource managers to clarify choices, intentions and expectations for ecosystems undergoing change (Schuurman et al., 2022). Within this framework, management strategies that guide the trajectory of an ecosystem include *resist* (i.e. intervention that maintains current or historical ecosystems), *accept* (i.e. no intervention that allows an ecosystem to transform unabated) or *direct* (i.e. intervention that steers the trajectory of an ecosystem in a new direction) (Lynch et al., 2021). Even though these management strategies were unfamiliar to the Partners, they developed a rehabilitation plan that considered three feasibility criteria found within the RAD framework: ecological, societal and financial (Lynch et al., 2021).

From an ecological perspective, eliminating the harvest of adult ogaawag would slow the decline in the population and leave adults in the ecosystem (i.e. precautionary harvest regulations; Lynch et al., in press), which would be needed for re-establishing natural reproduction. In conjunction with reduced harvest, the Partners planned to increase the adult population by stocking young ogaawag, another resist/maintain strategy commonly employed throughout the Ceded Territories. If the stocked fish survived (which can be highly variable depending on the lake and life stage of stocked ogaawag), the number of adult ogaawag

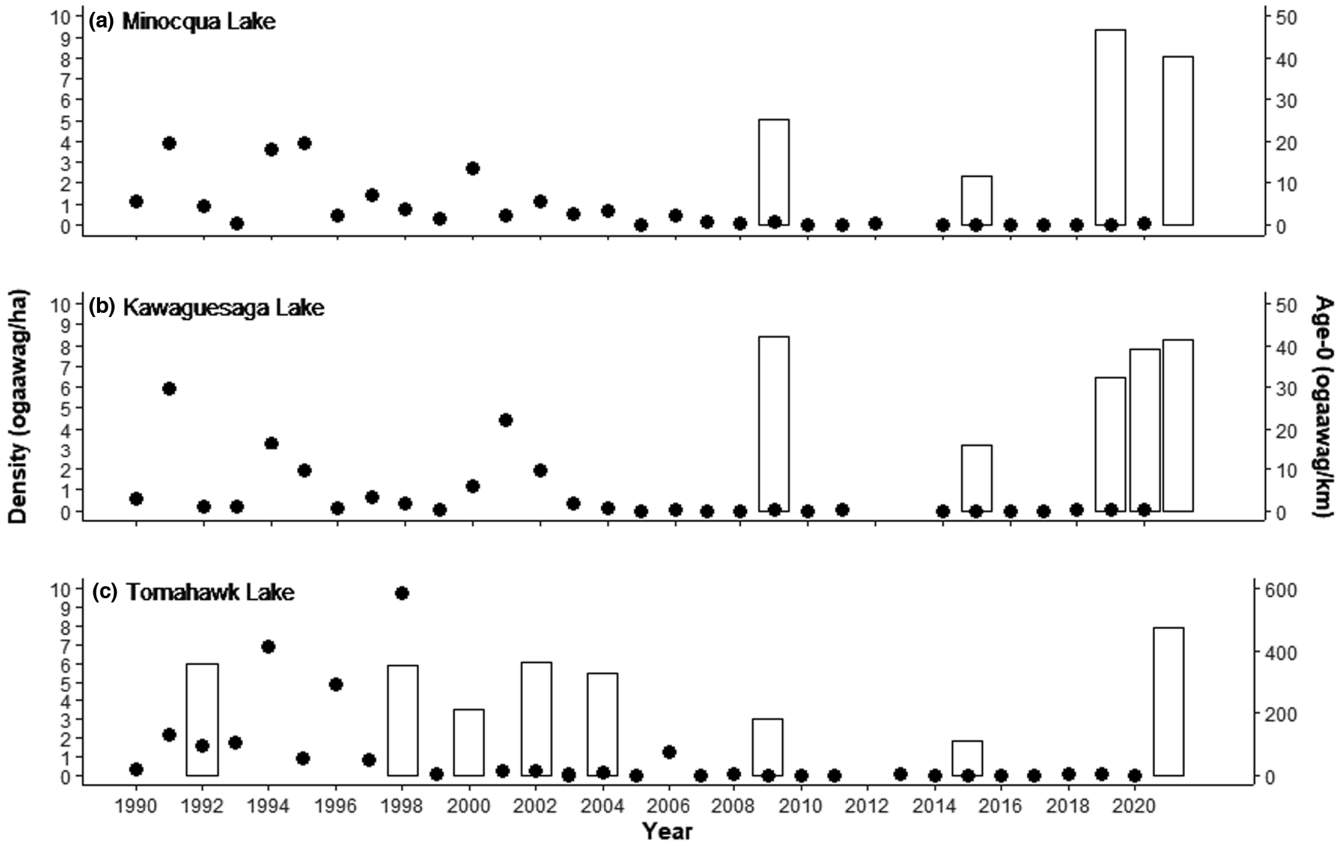


FIGURE 3 Adult density of ogaawag (walleyes *Stizostedion vitreus*; number of fish per hectare, indicated by the open bars) and catch per unit effort of age-0 ogaawag (indicated by closed circles) in electrofishing surveys from 1990 to 2021. No surveys were conducted in years without data. Small fingerling ogaawag were stocked prior to the autumn age-0 ogaa survey in Minocqua Lake in 1992 and 2012 in Minocqua Lake, and fry or small fingerlings were stocked prior to the autumn survey in Tomahawk Lake in all years before 2009 except for 2005, 2002 and 2003. Note the secondary *y*-axis scale is different across lakes

would increase once those fish matured in 3–5 years, which may improve the chances of natural reproduction occurring again in the Chain. Socially, LDF Tribe has relied on ogaawag for generations and angling for ogaawag has been a part of the culture in the Northwoods for state-licensed anglers (Dassow et al., in press; Gilbert et al., 2019). Moreover, the state and tribes agreed prior to the final treaty rights court decision to maintain ogaawag densities of greater than 6.7 adults per hectare in populations supported by natural reproduction (Report on Biological Issues, 1988), which may limit the ability of the Partners to deviate from the status quo (Lynch et al., in press). Lastly, stocking extended-growth ogaawag costs approximately $1–2 per fish, which amounts to a $50,000–$120,000 cost per year stocked. Both parties agreed these costs were reasonable given the societal importance of ogaawag in the Minocqua Chain of Lakes. Expenses that were not explicitly quantified but also considered were as follows: tribal members buying food (instead of harvesting it), tribal and state harvesters travelling further to harvest ogaawag, and the loss in revenue from tourists visiting the area. Collectively, the LDF Tribe and partnering organisations were able to develop a rehabilitation plan that was practical and feasible from social, ecological and financial perspectives, and that recognised the potential need to adapt as more information became available.

Together, the Partners created goals for the rehabilitation plan that included the following: re-establishing natural reproduction in Minocqua and Kawaguesaga Lakes, increasing the adult population to 6.7 ogaawag/hectare in those lakes and increasing ogaawag to 4.9 ogaawag/hectare in Tomahawk Lake. To accomplish these goals, harvest of ogaawag was discontinued by tribal members and state-licensed anglers for a minimum of 5 years with the option to extend the closure based on survey results. Of note, catch-and-release angling for ogaa was allowed during the harvest closure, which can result in post-release mortality of ogaa, particularly during the warmer months (Reeves & Bruesewitz, 2007). This was a substantial sacrifice and demonstrated how these Partners could work together towards a common goal. During the closure, progress was monitored through adult population estimates and recruitment surveys. In addition to monitoring efforts and harvest limits, the rehabilitation effort included stocking 25 extended-growth fingerlings per hectare every other year, an approach, coined here as "rehabilitative aquaculture," used in many lakes in the Ceded Territories to increase ogaawag densities to encourage the re-establishment of natural reproduction.

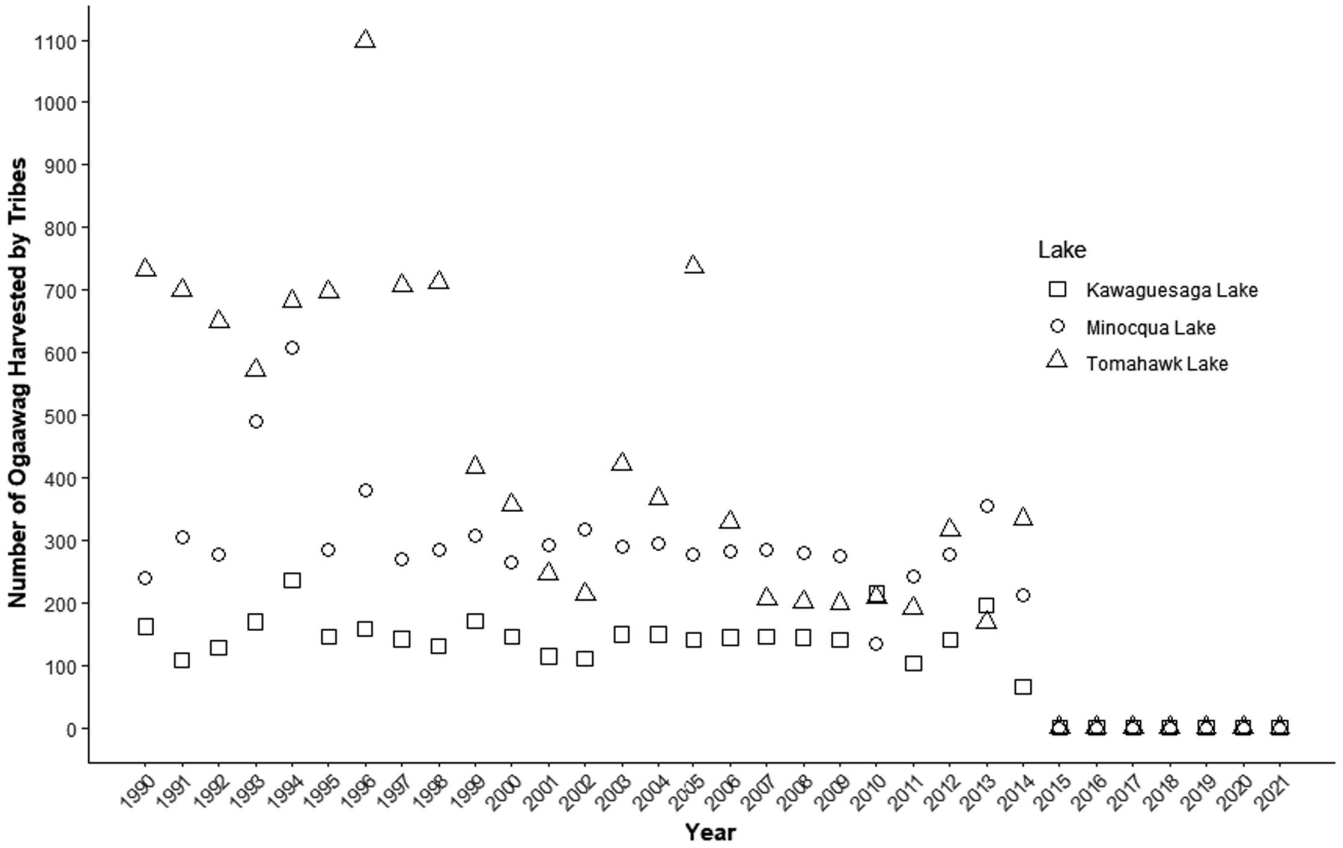


**FIGURE 4** Number of ogaawag (walleyes *Stizostedion vitreus*) harvested by Ojibwe Tribes from 1990 to 2021 in the Minocqua Chain of Lakes. Note from 2015 to 2021, harvest of ogaawag was zero in all three lakes

Before stocking, electrofishing surveys were conducted to check for evidence of that year's natural reproduction. This strategy, setting goals and annually or semi-annually conducting surveys to check on progress, allowed the Partners to regularly reassess progress, make course corrections and consider alternative actions if progress was not being made (i.e. maintain a flexible relationship with the ecosystem) (Aplet & Mckinley, 2017; Lynch et al., 2021).

## 6 | LDF'S CULTURAL, SPIRITUAL AND SUBSISTENCE CHALLENGES AND OPPORTUNITIES

Closing the Minocqua Chain of Lakes to harvest of ogaawag made it challenging for LDF to fulfil cultural, spiritual and subsistence needs. LDF's belief was that ogaawag had to be protected in the Chain, which meant LDF Tribe had to find other means of harvesting ogaawag and other fish in other lakes in the Ceded Territories.

Culturally, when a species is hurting, LDF and other Ojibwe Tribes tend to give that species a break and time to noojimo'iwe (Ojibwe for s/he recovers/heals). In practice, this meant the tribal members had the option to miinigooyaang (Ojibwe for we *accept* the gifts that were given) other beings/species such as ashigan, noosa'owesi (smallmouth bass singular), gidagagwadaashi (black crappie singular *Pomoxis nigromaculatus*) and ginoozhe (northern pike singular *Esox lucius*). This strategy was beneficial to those who enjoy harvesting and eating other giigoonyag, although not all tribal members were willing to *accept* other gifts. Even though the response to *accepting* other gifts was mixed, LDF members increasingly targeted other gifts as the ogaa population declined in the Minocqua Chain (Table 2). This social approach can be thought of as provisionally *accepting* ecological transformations (an approach that has been promoted for recreational anglers as well; Dassow et al., in press; Lynch et al., in press), and may be the initial step in a shift in the culture to use other species that will likely be available for harvest in future. This happened organically within LDF Tribe; that is, tribal council did not dictate that spearers had to harvest other beings. In addition, the Minocqua Chain of Lakes has been harvested by generations of LDF members, partly because these lakes were near the reservation. The loss of three good lakes where many spearers had learned how to harvest ogaawag was difficult but necessary to noojimo'iwe the waters. Spiritually, the decision to close the Chain was made based on the forethought of how decisions today may affect the next seven generations, that is in protecting ogaawag—children, grandchildren and great-grandchildren of the LDF Tribe will have access to this gift. Overall, tribal spearers changed their behaviour in hopes of preserving ogaawag for future generations.

From a subsistence perspective, ceasing all harvest in the Minocqua Chain of Lakes affected tribal members and the surrounding environment in the Ceded Territories. Tribal members had

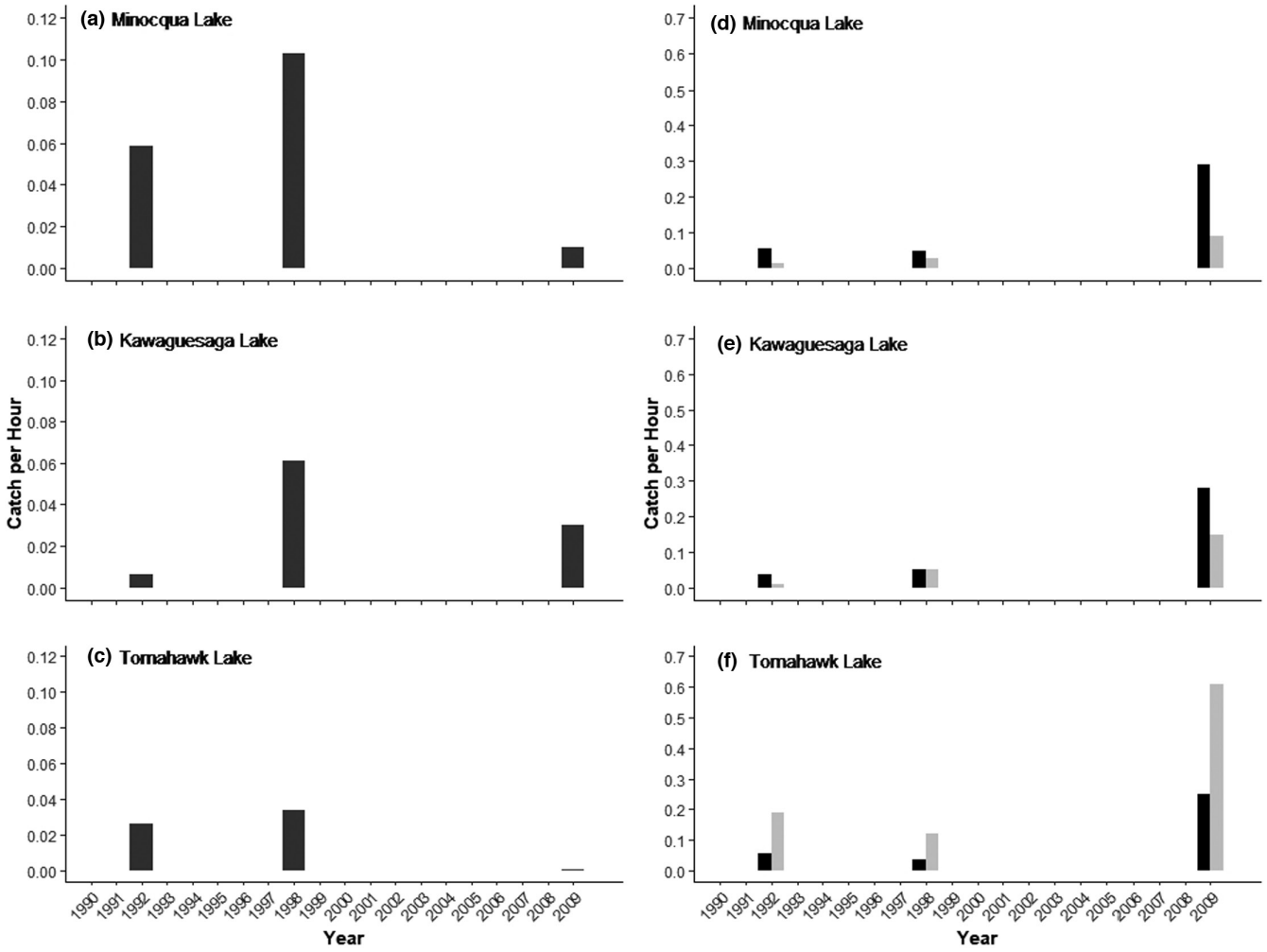


FIGURE 5 Angling catch per hour of ogaawag (walleyes *Stizostedion vitreus*; left panel), and ashiganag (largemouth bass plural *Micropterus salmoides*; black bars) and noosa'owesiwag (smallmouth bass *M. dolomieu*; grey bars; right panel) as estimated in creel surveys conducted by WDNR in 1992, 1998 and 2009. Note that the scale of the *y*-axis is different for left and right panels. More recent years are not shown on the graphs because the last creel survey was in 2009

to travel to new lakes to harvest ogaawag that were sometimes a greater distance away from the reservation, which cost more in fuel and time. Moreover, spearers targeted smaller lakes with lower quotas for ogaawag than the Minocqua Chain of Lakes. Spearers were unsure if they would be successful at harvesting ogaawag in these smaller lakes that they had never speared. If they were successful, the likelihood was higher that they would bring home smaller amounts of giigoonyag relative to historical harvest from the Minocqua Chain. Post-closure, some harvesters reported that they were able to fill their subsistence needs for the year, while others said they fell short of meeting their needs. It is unclear whether more effort was put into harvesting terrestrial beings such as waawaashkeshi, which would redistribute the effort to other beings on the landscape. This approach could be a successful way to maintain protein sources under changing environmental conditions. Closing the Minocqua Chain of Lakes to state-licensed anglers also redistributed their effort to surrounding lakes including several lakes that were within the boundaries of LDF's Reservation, which put more pressure on giigoonyag that LDF Tribe relies on (personal communication, Lyle Chapman, Voigt Intertribal Task Force Representative from Lac du Flambeau). The redistribution of effort appears to have happened organically (i.e. state-licensed anglers focused their efforts on lakes that had ogaawag and were near the Minocqua Chain and were not directed to these lakes by the Wisconsin Department of Natural Resources). Changes in harvest practices by state-licensed anglers and tribal members will have ripple effects on the communities that rely on these gifts and the surrounding ecosystems.

Interestingly, at least five more lakes within a 64-km radius of the Minocqua Chain of Lakes have rehabilitation plans that were being developed as of 2018. As with most lakes in the Ceded Territories, identifying which mechanisms were responsible for declining ogaa populations remains elusive, but the lack of recruitment over time has been one of the major factors in these lakes (see Walleye Lakes of Concern Rehabilitation Plan in the supplemental material, Dassow et al., in press). In addition, we cannot rule out the possibility that state-licensed anglers may have redistributed

**TABLE 2** Number of individuals from other beings/species harvested by LDF excluding ogaawag and maashkinoozheg (walleyes *Stizostedion vitreus* and muskellunge plural *Esox masquinongy*)

| Year | Harvest |
|---|---|
| 1990 | 44 |
| 1991 | 21 |
| 1992 | 55 |
| 1993 | 44 |
| 1994 | 52 |
| 1995 | 86 |
| 1996 | 53 |
| 1997 | 3 |
| 1998 | 34 |
| 1999 | 83 |
| 2000 | 25 |
| 2001 | 23 |
| 2002 | 16 |
| 2003 | 22 |
| 2004 | 30 |
| 2005 | 30 |
| 2006 | 46 |
| 2007 | 68 |
| 2008 | 55 |
| 2009 | 60 |
| 2010 | 104 |
| 2011 | 76 |
| 2012 | 336 |
| 2013 | 208 |
| 2014 | 140 |
| 2015 | 110 |
| 2016 | 220 |
| 2017 | 312 |
| 2018 | 279 |
| 2019 | 270 |
| 2020 | 254 |
| 2021 | 394 |

*Note*: Gidagagwadaashiwag (black crappie plural *Pomoxis nigromaculatus*), namebinag (white sucker plural *Catostomus commersonii*), ginoozheg (northern pike plural *Esox lucius*), ashiganag (largemouth bass plural *Micropterus salmoides*) and noosa'owesiwag (smallmouth bass plural *M. dolomieu*) comprised a majority of other species harvested,

their effort to surrounding waterbodies, potentially exacerbating the decline of ogaawag in these lakes (LDF did not have the option to increase harvest levels in other lakes due to the restrictions inherent in the safe harvest system). In fact, Beard et al. (2003) demonstrated that higher angling effort occurred on lakes with higher ogaawag bag limits. The lakes in need of rehabilitation had a daily bag limit of three ogaawag from 2015 to 2018, and the regulations for the Minocqua Chain of Lakes changed to zero ogaa per day during the same period. Limited creel data make it impossible to quantify changes in angling effort on these lakes. Future *resist–accept–direct* strategies for ogaawag should strive to incorporate regular creel surveys at the landscape level every 1–2 years to understand how angling pressure may be changing in response to management actions (Dassow et al., in press; Trudeau et al., 2021)

## 7 | EVALUATION OF THE REHABILITATION EFFORTS

Unfortunately, in 2020, the rehabilitation goals were still unmet. Despite adult population densities approaching the goal, there was little evidence of natural reproduction, motivating the Partners to continue the no-harvest period for another year. In April 2021, population estimates were conducted on the Chain and found that Minocqua, Kawaguesaga and Tomahawk had reached an adult density goal of a minimum of 6.7 fish per hectare; however, there continued to be minimal signs of natural reproduction (Figure 3).

A highly skewed sex ratio may be partially responsible for the low levels of natural reproduction. A meta-analysis of electrofishing survey data of naturally reproducing ogaa populations from 1989 to 2019 demonstrated a strong correlation between sex ratio and production of young ogaawag. Data for this analysis were collected by GLIFWC and WDNR from 1989 to 2019 and were used to calculate the male-to-female ratio of ogaawag. It is generally acknowledged that these surveys are typically biased towards males due to differences in their spawning behaviour (Schneider et al., 2007; Waterhouse et al., 2014), but because this bias is uniform throughout these surveys, the observed patterns still have merit. We aligned these spring adult surveys with corresponding autumn surveys to determine the reproductive success by calculating the number of age-0 ogaawag sampled per km. This analysis consisted of lakes that were, at least at one point in time, sustained by natural reproduction. Surveys were omitted from lakes that have been invaded by rainbow smelt *Osmerus mordax*, a primary driver of reproductive failure (Mercado-Silva et al., 2007), and/or if fry or fingerling stocking occurred before the autumn survey as this could artificially enhance the age-0 catch per effort.

Peak reproduction occurred at a ratio of approximately three males per female and decreased as the ratio became either skewed towards female or skewed towards a higher male ratio (Figure 6). When the Chain had significant natural reproduction, there was a sex ratio of approximately four males for every female compared with the last survey's 0.35 males per female (Figure 7). Sex ratio is an important population demographic for managers to consider as highly skewed ratios can lead to population decline, make populations more vulnerable to environmental conditions and potentially lead to the loss of genetic integrity (Stelkens & Wedekind, 2010; Waterhouse et al., 2014).

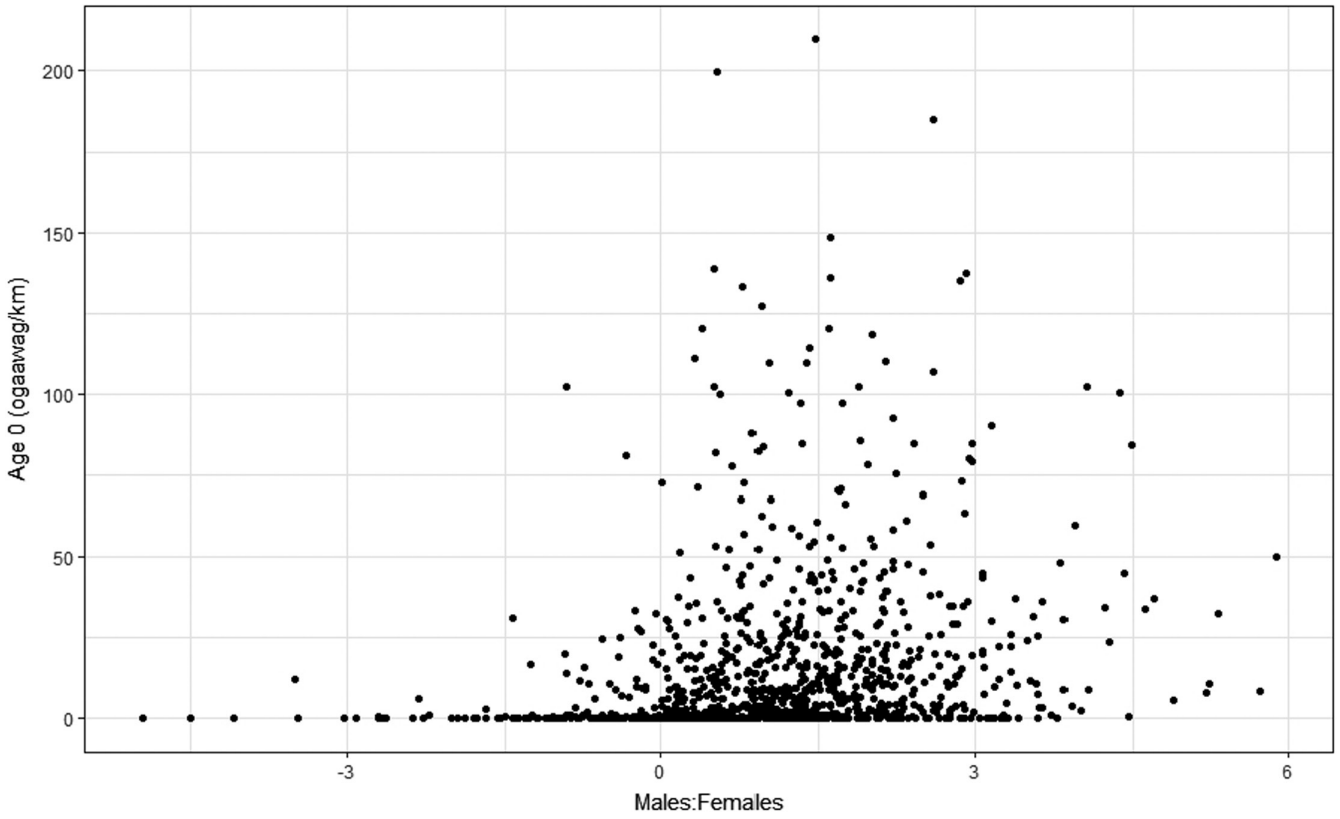


**FIGURE 6** Relationship between male-to-female ratio and age-0 ogaawag (walleyes *Stizostedion vitreus*) production for lakes with naturally reproducing populations from 1989 to 2019. The median sex ratio is ~2.9 males to females (untransformed). The *x*-axis has been log-transformed

Researchers examined potential causes for the shift in sex ratios and noticed that the extended-growth ogaawag from some of the hatcheries were predominately female (Sass et al., 2022). WDNR is currently investigating several mechanisms that may be skewing the sex ratio of hatchery reared fish, which include the effects of water temperature, oestrogen-mimicking compounds in water, density-dependent effects, sex ratios of naturally reproduced ogaawag, and historic adult ogaa sex ratios in stocked waters (Sass et al., 2022). Based on the current status of the rehabilitation efforts and the tribes' relationship with other beings, LDF Tribe had unanimous support to continue the closure from the Voigt Intertribal Task Force. The Wisconsin's Natural Resources Board also agreed to extend the ogaawag harvest closure until 2025, allowing the Partners to focus on achieving the second rehabilitation goal of re-establishing natural reproduction. By instituting a new sunset date, Partners are obligated to evaluate progress and adjust strategies accordingly (Aplet & Mckinley, 2017).

## 8 | A NEW RELATIONSHIP (ADAPTIVE MANAGEMENT)

Lake Superior Chippewa recommended that a new relationship may be needed with ogaawag in the Minocqua Chain of Lakes. From a Western adaptive management perspective, this means management actions may need to be adjusted to meet objectives (Lynch et al., 2022). In 2021, the Partners discussed potential issues that may be hindering rehabilitation efforts in the Minocqua Chain of Lakes. Collectively, they identified 11 issues (e.g. skewed sex ratio, changes in the fish community, habitat loss) and 27 mechanisms (e.g. most stocked ogaawag were female, habitat has changed to favour warmwater species, development has altered in-lake and shoreline habitat) based on experience with rehabilitation plans in other lakes, evidence from the scientific literature, and research on the Minocqua Chain of Lakes. For some issues, the Partners have no data or evidence that the issue exists in the Chain, which means additional studies will need to be conducted. Of note, the rehabilitation plan developed in 2015 was narrowly focused on ogaawag, and the Partners realised that habitat evaluations and potentially manipulations should be part of an ecosystem approach in an updated relationship (management) plan (Lynch et al., in press; Raabe et al., 2020). Even without evidence of an issue, the Partners identified potential solutions (all with the goal of rehabilitating ogaa populations, i.e. *resist* strategies) and challenges (social, political, institutional and practical), and they gave each issue an overall priority (Table 3). While a new approach to the rehabilitation plan is being created, biologists will continue to monitor the status of ogaawag in these lakes and recommend actions to achieve the agreed-upon rehabilitation goals (i.e. science-based stewardship). LDF Tribe will balance these recommendations with their teachings, such as “maintain resources for the next seven generations.”

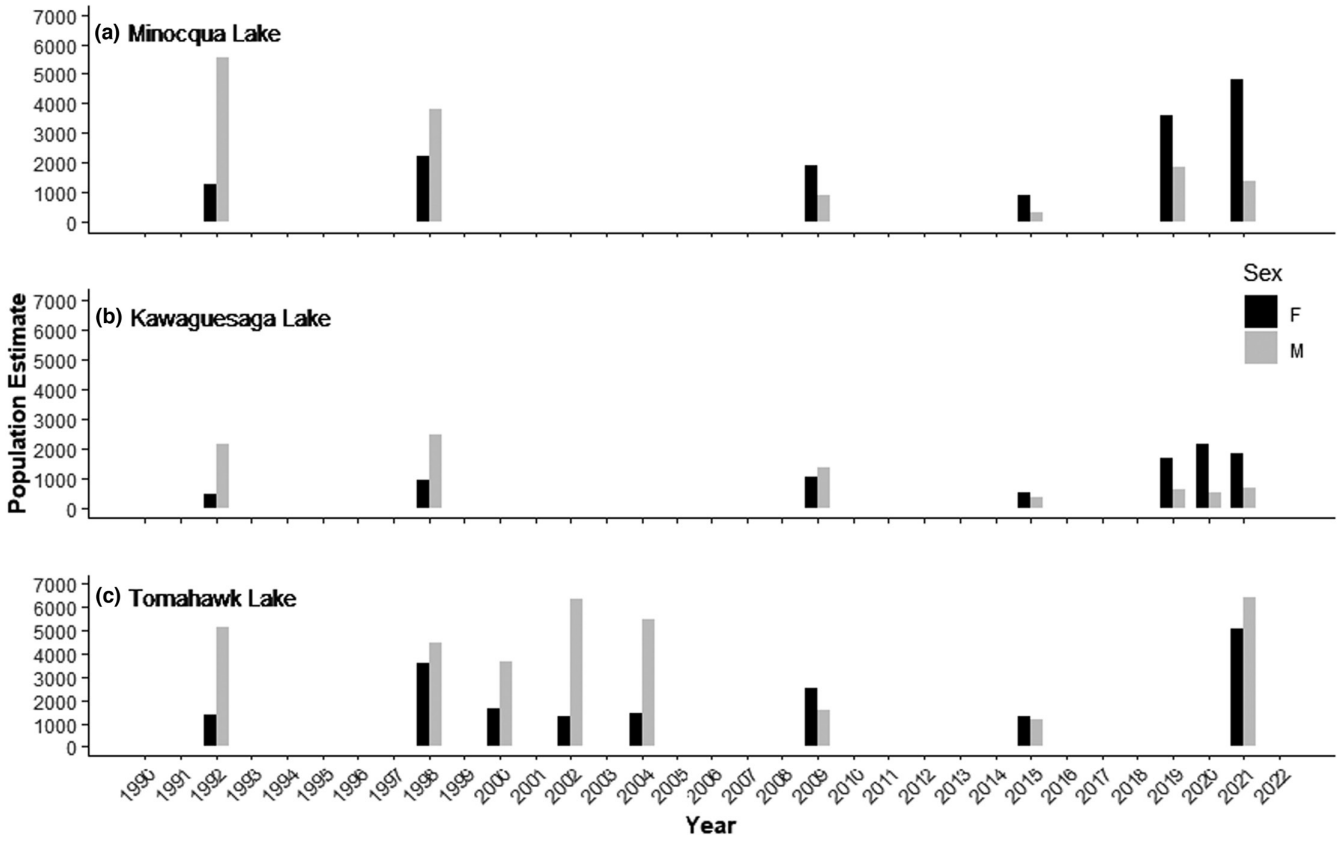


FIGURE 7 Population estimates of adult male and female ogaawag (walleyes *Stizostedion vitreus*) in the Minocqua Chain of Lakes from 1992 to 2021. No surveys were conducted in years without data. A 1:1 male-to-female ratio has been suggested as the minimum needed for natural reproduction

## 9 | UNKNOWNS

Many questions remain unanswered about the approach to *resist* ecosystem change in the Minocqua Chain of Lakes. For example, will foregoing harvest for 10 years be worth it for LDF Tribe and state-licensed anglers? If adult density goals are met and if natural reproduction is re-established, then yes, it was likely worth the sacrifice made by all parties. On the contrary, if the Partners do not accomplish the goals, LDF members and state-licensed anglers made a substantial sacrifice with little improvement in long-term ogaa sustainability in the Chain. Did stocking ogaawag help/hinder our ability to reach our goals? In terms of achieving our adult density goals, the answer is probably yes it helped. Yet, this strategy likely resulted in a highly skewed sex ratio that could be hindering the re-establishment of natural reproduction. This intervention in the ecosystem highlights how unpredictable management actions can be, often resulting in unwanted outcomes (Nguyen et al., 2016). Moreover, the limited responsiveness of these lakes to intervention suggests humans may have little control over this ecosystem and/or an incomplete understanding of the mechanisms guiding its transformation. Due to these unknowns, a broad suite of RAD strategies should be considered by the Partners and futile *resist* strategies (i.e. those that do not achieve desired outcomes) should be adjusted or discarded (Lynch et al., in press).

## 10 | CONTINGENCIES

What if the Partners have not reached their goals after 10 years? LDF and Partners will likely need to meet again to discuss strategies and develop a path forward that may continue to *resist* changes in the ecosystem. Alternatively, given strong directional climate warming and thermal sensitivity of ogaa (Panci et al., 2018), these lakes and the people that rely on their gifts may be put on a path where *resisting* the trajectory of change in ogaa abundance in these lakes is infeasible and where *accepting* or even seeking to "nudge" or *direct* the trajectory is more strategic. Moreover, the Partners could choose to implement a combination of strategies across the landscape to assess feasibility of these options (Lynch et al., 2021). For example, a *resist* strategy for ogaawag could be maintained/revised for Minocqua Lake and Kawaguesaga Lake, and an *accept* strategy could be employed on Tomahawk Lake, which would likely result in a change in that giigoonyag community to warmwater beings. Combined with monitoring, this portfolio approach would allow the Partners to experiment with multiple approaches simultaneously, and would give them the ability to assess changes in the ecosystem with different levels of intervention (and cost). Convincing Ojibwe Tribes and stakeholders that they should aaanawendan (Ojibwe for thinking something is unfit/give up on something) on rehabilitating ogaawag in a given lake will be a major hurdle in implementing such an approach.

**TABLE 3** List of issues that may be responsible for declining ogaa populations in the Minocqua Chain of Lakes

| Number | Issue | Evidence for this issue | Potential mechanisms |
|---|---|---|---|
| 1 | Adult density below historic estimates | 1. Natural reproduction occurred above 2.5 adults per hectare | 1. Low fertilisation rates<br>2. Low larval survival<br>3. Low young of the Year survival<br>4. Allele effects (cannot find a mate)<br>5. High predation pressure on young ogaawag |
| 2 | Minimal reproduction from stocked ogaawag | 1. No evaluation or evidence | 1. Stocked ogaawag are sterile<br>2. Stocked ogaawag cannot locate spawning grounds<br>3. Loss of local adaptation (outbreeding depression) |
| | Historical spawning areas are no longer productive | 1. No evaluation or evidence | 1. Density of ogaawag at spawning location is too low<br>2. Environmental factors are limiting productivity at these areas |
| 3 | Inadequate spawning habitat (Quantity or Quality) | 1. Limited gravel bars in Minocqua or Kawaguesaga | 1. Loss of spawning habitat (e.g. development, invasive species) |
| 4 | Water maintained at a set level because of dams | 1. Eurasian watermilfoil and other vegetation have increased in abundance<br>2. Water drawdowns have benefited ogaawag in reservoirs | 1. Loss of spawning habitat<br>2. Improved habitat for other beings/species (e.g. ashiganag (largemouth bass plural) |
| 5 | Skewed adult sex ratios | 1. Lakes in the region and historically, the Minocqua Chain had more adult males than females when natural reproduction was occurring.<br>2. Currently more adult females than males are present in the Minocqua Chain | 1. Low fertilisation rates<br>2. Low effective population size leading genetic drift<br>3. Females do not spawn every year due to a lack of adult male ogaawag |
| 6 | Shift in the fish community | 1. Increase in ashiganag correlates with decrease in ogaawag<br>2. Anecdotal increases in macrophytes | 1. Competition with all life stages of ogaawag<br>2. Predation of ogaawag by other top predators (e.g. ashiganag)<br>3. Habitat (e.g. macrophytes, temperature, optical) favours ashiganag<br>4. Decline in asaawe |
| 7 | Changes in aquatic vegetation (Eurasian watermilfoil EWM) | 1. EWM has increased in these lakes over time. | 1. EWM provides habitat for other beings (e.g. ashiganag)<br>2. Ogaawag may lose habitat as EWM spreads |
| 8 | Unnatural shorelines | 1. Substantial development has occurred around these lakes (e.g. second homes, marinas) | 1. Siltation of spawning habitat (see issues 2 and 3)<br>2. Lack of habitat for ashiganag and other species nearshore (e.g. coarse woody debris)<br>3. Stormwater run-off could be increasing contaminants and nutrient levels (ogaawag prefer mesotrophic lakes)<br>4. Changes in land use throughout the watershed may be leading to eutrophication |

| Potential solution | Challenges | Overall priority |
|---|---|---|
| 1. Increase stocking frequency and/or quantity<br>2. Diversify stocking efforts (e.g. fry and fingerlings)<br>3. Transfer adult ogaawag into the lakes (male ogaawag) | 1. WDNR only allows stocking in alternate years<br>2. Adult transfers require an agreed-upon source, testing for pathogens and a quarantine period | High |
| 1. Evaluate fertility of stocked fish<br>2. Track stocked fish to spawning grounds<br>3. Continue to use broodstock from the watershed (ogaawag in the Chain are mostly from hatcheries) | 1. Tracking broodstock and genetics requires a coordinated approach | Low |
| 1. Compare present and historical density of ogaawag at spawning sites<br>2. Increase adult density (see issue 1)<br>3. Manipulate environmental factors to increase productivity<br>4. Place fertilised eggs/fry in key spawning areas | | Low |
| 1. Improve existing spawning areas (e.g. reduce silt)<br>2. Add new spawning areas | 1. Cost<br>2. Effort<br>3. Permitting<br>4. Mixed success of ogaawag using new spawning habitat | High |
| 1. Control vegetation through drawdowns, manual removal and/or chemical application | 1. Change current flow regime<br>2. Chemical control adds stressors to the ecosystem<br>3. Mechanical control is labour-intensive | High |
| 1. Transfer adult male ogaawag into the Minocqua Chain<br>2. Diversify stocking efforts (e.g. eggs, fry, fingerlings)<br>3. Fix highly skewed female sex ratio in extended-growth ogaawag produced in hatcheries | 1. Adult transfers require an agreed-upon source, testing for pathogens and a quarantine period<br>2. Transferring enough adult male ogaawag to change the ratio<br>3. Survival rates of eggs, fry or fingerlings may be low | High |
| 1. Increase ogaawag population (stocking, transfers) to control other beings<br>2. Harvest more ashiganag<br>3. Decrease vegetation<br>4. Stock perch<br>5. Manual ashiganag and other beings removal | 1. See issues 1 and 5<br>2. Ashiganag removals are labour-intensive (compensatory response?)<br>3. See issue 4<br>4. Can enough perch be stocked to change the fish community? | Medium |
| 1. Manage EWM | 1. See issue 4<br>2. Management of EWM may affect native plants | Medium |
| 1. Shoreline rehabilitation (native species that are climate-resilient)<br>2. Voluntary shoreline projects with landowners | 1. Landowners need to support these projects | Medium |

(Continues)

TABLE 3 (Continued)

| Number | Issue | Evidence for this issue | Potential mechanisms |
|---|---|---|---|
| 9 | Climate change | 1. Fish communities are shifting from coolwater to warmwater beings (Minocqua Chain and regionally).<br>2. Ice-out dates have become more variable (regionally)<br>3. Warming water temperatures (regionally)<br>4. Low dissolved oxygen levels (regionally)<br>5. Water level changes (regionally)<br>6. Spread of invasive species (regionally)<br>7. Harmful algal blooms (regionally) | 1. Reduced thermal habitat for ogaawag<br>2. Increased thermal habitat for other beings (ashiganag)<br>3. Variability in spring water temperature and environmental variables (e.g. wind) may affect production and survival of young ogaawag<br>4. Reduction in optical habitat?<br>5. Reduction in well-oxygenated habitat?<br>6. Mismatch in food for young ogaawag |
| 10 | Increased water clarity | 1. No evaluation or evidence<br>2. Regionally, water clarity has increased in several lakes | 1. Reduction in sewage inputs in these lakes (Clean Water Act)<br>2. An increase in macrophytes cases a decrease in algal blooms<br>3. Ogaawag are better adapted to waterbodies with low water clarity |
| 11 | Application of chemicals to the water and watershed | 1. Little evaluation or evidence, but the City of Minocqua is built around the Chain of Lakes<br>2. Pesticides are applied to Eurasian watermilfoil | 1. Scientific literature indicates reduced survival of young fish exposed to pesticides<br>2. Endocrine disrupters (PFAS) may be present, may affect reproduction in giigoonyag<br>3. Road salt may affect water chemistry<br>4. Local residents may be applying herbicides to lawns |

*Note*: Evidence of the issue or lack thereof, potential mechanisms, potential solutions based on a *resist* strategy, and challenges to implementing solutions are included. Great Lakes Indian Fish and Wildlife Commission, Wisconsin Department of Natural Resources, Walleyes for Tomorrow, and Lac du Flambeau Tribe ranked each issue as low, medium or high priority (scores from each organisation are not reported) and developed an overall priority for each issue.

If *resistance* to ecosystem change is no longer viable, another pathway may be to *accept* changes in the ecosystem. Climate change is currently driving habitat loss, especially for coolwater beings such as ogaawag and shifting giigoonyag communities towards warmwater beings such as ashiganag, and projections indicate that by late century (2065–2089), many lakes in Northern Wisconsin will favour ashiganag over ogaawag (Feiner et al., in press; Hansen et al., 2017). As Lynch et al. (in press) described, *acceptance* may seem like the default choice; however, the Partners will need to actively form new relationships with other beings in the Chain such as ashiganag or other warmwater giigoonyag. For example, considerable effort is currently expended to chemically and mechanically reduce the amount of aquatic vegetation (targeting non-native Eurasian watermilfoil) in the Minocqua Chain (Hatleli, 2019), with the hope of favouring ogaa habitat and reproduction. Instead, the Partners could decide to *accept* changes in the ecosystem (in this example, no aquatic plant management—see Dunham et al. (in press) on applying the RAD framework to biological invasions), which would limit the input of herbicides and other chemicals into the chain, thereby minimising some negative effects on the ecosystem (Dehnert et al., 2019; Mikulyuk et al., 2020). The Partners could also actively *accept* change by encouraging lakeshore owners to increase tree growth along the shoreline, which would eventually increase the amount of coarse woody debris in the water, which creates more suitable ashigan habitat (Ahrenstorff et al., 2009). *Acceptance* to change in the Chain is not *accepting* change across the entirety of the Ceded Territories, but given the limited resources available to the Partners, it may be necessary to *accept* climate-driven changes in some waterbodies and redirect resistance efforts to other waterbodies that may buffer against climatic forces (i.e. refuge lakes; Feiner et al., 2021).

The final pathway, although not currently considered an option among the Partners, is to *direct* ecosystem change (Lynch et al., 2022). One potential option for *directing* this change could be the introduction of zhagashkaanaamikwesiwag (sauger *Stizostedion canadensis* or the naturally occurring hybrid, saugeye (ogaa × zhagashkaanaamikwesi *S. canadensis* × *vitreus*), beings that have many similarities to ogaa but are able to tolerate warmer water conditions (Budnik et al., 2021; Lynch et al., 2022; Zweifel et al., 2010). There is a long history of fisheries managers introducing new species into a waterbody in an attempt to establish a new fishery; however, this practice has fallen out of favour in recent history (Rahel, 2022). Although zhagashkaanaamikwesi, ogaa X zhagashkaanaamikwesi and ogaa fill a similar ecological niche, risk assessments in

| Potential solution | Challenges | Overall priority |
|---|---|---|
| 1. Address symptoms (e.g. oxygenate water)<br>2. Reduce or eliminate other stressors in the ecosystem (i.e. make the ecosystem ore resilient)<br>3. Begin long-term water monitoring programme (e.g. measure water temperature) | 1. Addressing the symptoms is labour-intensive and a long-term investment<br>2. Local solutions are limited<br>3. Difficult to identify which mechanism(s) are affecting the Minocqua Chain (lack of current or historical data, studying larval fish) | Medium, but Partners have little ability to address these issues locally |
| 1. Reduce macrophytes<br>2. Decrease water clarity (e.g. fertilise the lake)<br>3. Begin monitoring water clarity | 1. Unclear if water clarity is an issue (some historical data may be available)<br>2. Labour intensive to reduce macrophytes (see issues 3 and 4)<br>3. Fertilising the Minocqua Chain may have unintended consequences for the ecosystem and may be socially unacceptable (e.g. swimming in algal blooms may be unpleasant) | Medium |
| 1. Stop treating the lake with herbicides<br>2. Stop input of chemicals into the watershed<br>3. Add natural shoreline buffers that filter chemicals<br>4. Sewage treatment | 1. Stopping in-lake herbicides may increase Eurasian watermilfoil<br>2. Not sure which chemicals are present<br>3. Buy-in from local residents | Medium/high |

collaboration with jurisdictional Partners (Alofs & Wehrly, in press) and potentially pilot studies would be required to understand how the introduced beings would interact with the existing ecosystem (Lynch et al., 2022). Aside from the risks of introducing a non-native beings into the Chain (Karasov-Olson et al., 2021; Lynch et al., in press; Rahel & Smith, 2018), the ogaa×zhagashkaanaamikwesi have the ability to reproduce with other ogaa×zhagashkaanaamikwesi and with ogaa, which may compromise the genetic integrity of any remaining ogaawag in these lakes (Fiss et al., 1997). Triploid ogga×zhagashkaanaamikwesi should be sterile, but do not survive, as well as diploid ogga×zhagashkaanaamikwesi (Koch et al., 2018); however, stocking a triploid hybrid may be a way to preserve genetic integrity of remnant ogaa stocks. Stocking of either diploid or triploid ogga×zhagashkaanaamikwesi would likely be an ongoing cost for state and tribal agencies and would need to be factored into selecting this trajectory. Overall, discussions with tribal members about *directing* these ecosystems have not occurred, so resource managers do not know whether an introduction of a new, albeit similar but smaller, being would fill or replace the cultural and subsistence role of ogaawag for Ojibwe Tribes.

Ultimately, *accepting* ecological transformations may be difficult for Ojibwe Tribes because this strategy may go against protecting resources for future generations, although other lessons such as "*accept* the gift that was given" (in this case, harvest ashiganag instead of ogaawag) may help influence tribal members to use other resources. In RAD lexicon, "protecting resources for the next seventh generations" is similar to the *resist* strategy, while "accept the gift that was given" is similar to the *accept* strategy. *Directing* ecological transformations may be even more difficult for Ojibwe Tribes because relationships with other beings (e.g. ashiganag) may not be well developed, or may be non-existent (e.g. ogaa×zhagashkaanaamikwesi). Whichever trajectory the ecosystem is on in future, LDF Tribe and the Anishinaabe people have demonstrated over thousands of years that they have the ability to adapt to changes in a heterogeneous environment (Tribal Adaptation Menu Team, 2019).

## 11 | CONCLUSIONS

Overlaying RAD framework on the Ojibwe worldview may be challenging given its origins in Western Resource Management. For example, the foundational articles on this topic treat the ecosystem as separate from humans and an object that humans can and should manage (Schuurman et al., 2022). This is at odds with Ojibwe

worldview that humans are part of the ecosystem and that beings (species) are their relatives. However, recent articles have begun to explore social–ecological strategies within the context of the RAD framework, which falls more in line with Ojibwe relationships with the natural world (Lynch et al., in press). More discussions with tribal representatives and their tribal natural resource departments will likely cause the RAD framework to evolve and become more useful for Ojibwe Tribes. Overall, the utility of the RAD framework will likely depend on how well it integrates with individual tribes' relationship with the natural world.

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## CONFLICT OF INTEREST

All authors declare that they have no conflicts of interest.

## DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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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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