BUILDING CARNIVORE COEXISTENCE ON ANISHINAABE LAND: GOLD STANDARD NON-LETHAL DETERRENT RESEARCH AND RELATIONSHIP BUILDING BETWEEN LIVESTOCK FARMERS AND THE BAD RIVER BAND OF THE LAKE SUPERIOR TRIBE OF CHIPPEWA INDIANS

By

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Acknowledgments

The best way to express my gratitude is to tell my story of how I got here and who helped me. When I was in the 7th grade, we watched Living with Wolves in science class, and Jamie and Jim Dutcher inspired in me a deep desire to be with wolves, but I had no idea how I could make that happen. I remembered that young dream in college, and I began researching histories of coexistence with and persecution of gray wolves. During college, the Thanksgiving of 2016, I went to Standing Rock where the Oceti Sakowin Oyate taught me to know whose land I occupy, the ways that life depends on water, and to find my way of standing up to protect life.

After visiting Standing Rock, I came back to the Anishinaabe (Ojibwe) land, now known as mid-Michigan. I studied biology, environmental policy, and public affairs with Alma College professors, who instilled in me an appreciation for learning through diverse lenses and protecting the ecosystems we are a part of. In particular, Megan McCullen helped me learn about Anishinaabeg, whose land I had been on ever since I grew up on Lake Michigan. Megan also introduced me to Autumn Mitchell, an Eagle Clan woman enrolled with the Saginaw Chippewa Tribe, and Autumn generously shared about her life and culture with me.

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In my undergraduate research, I learned of the then-recent history of gray wolf hunts in the Great Lakes through a paper from the Little River Band of Odawa Indians, which also introduced me to the existence of Tribal sovereignty in conservation. I learned about the connection between Anishinaabe (Ojibwe people) and Ma'iingan (gray wolf) through the Saginaw Chippewa Tribe's Ziibiwing Center. I hoped to learn more from this ancient lens of coexistence- so I reached out to every Anishinaabe natural resources department I could find, requesting to be a self-funded intern to learn about Ma'iingan in exchange for volunteering. In 2017, Lacey Hill-Kastern, Naomi Tillison, and Mike Wiggins Jr. decided to give me this opportunity with the Bad River Tribe by inviting me to help update the Mashkiiziibii Ma'iingan Relationship Plan. My relationship with tribal members and the Mashkiiziibii Natural Resources Department grew and transformed over the past three years as I worked as an intern, wildlife technician, graduate student, and wildlife specialist. All the while, Lacey Hill-Kastern has mentored and supported me with her expertise and passion. Anishinaabe elders have enriched me with their knowledge and stories: Mike Legrew, Edith Leoso, Joe Rose Sr., Bob Wilmer, Joe Bates, Bob Shimek, Paul Demain.

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Abstract

Human-Wildlife Conflict (HWC) is a growing concern for the wildlife conservation field, as once-extirpated carnivore populations return to their native landscapes (Stone et al., 2017; Treves and Karanth, 2003). In contrast, the human population continues to grow and put pressure on shared ecosystems (Treves and Bruskotter, 2014). Much of HWC centers around real or perceived threats that carnivore species may pose to domesticated animals (Hogberg et al., 2015; Naughton-Treves et al., 2003; Shelley et al., 2011; Williams et al., 2002). We believe that improving carnivore coexistence globally requires both relationship building and gold-standard scientific experimentation. Specific demographics, including farmers, have a disproportionate influence on the survival of carnivores- yet it has been reported in the literature that some farmers are isolated from and in conflict with wildlife professionals (Browne-Nuñez et al., 2015). Farmers may develop negative attitudes toward carnivore coexistence if they feel that wildlife professionals have neglected their need to protect their livestock animals, and perspectives, in turn, can shape actions- including the legal or illegal killing of carnivores (Treves et al., 2013). Finding possible solutions to predation on livestock requires gold-standard experiments involving randomization, cross-over, and transparent discussion of assumptions. Through gold-standard research, we evaluate non-lethal deterrents' effectiveness in preventing or reducing carnivore visitation to livestock pasture. We tested the efficacy of Foxlights® and fladry at disrupting wildlife corridors and thus carnivore visitation to livestock pasture land surrounding the Bad River Reservation in what is now known as northern Wisconsin. We have striven to make our work reproducible by providing careful detail in the methodology section of Chapter 1. We used Chapter 2 to explore Abi Fergus's positionality in relationship building with the Bad River Band of the Lake Superior Tribe of Chippewa Indians and with livestock farmers and the need for wildlife professionals to do this work.

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Chapter 1

Introduction

Carnivore Coexistence

Human-Wildlife Conflict (HWC) is a rising concern worldwide as many carnivores are returning to landscapes from which they were once extirpated. Humans need to adapt to the return of carnivores, such as the gray wolf (Stone et al., 2017; Treves and Karanth, 2003). Human populations and the spread of agriculture have increased over time and are acting as the most significant cause of carnivore decline (Treves and Bruskotter, 2014; Treves and Karanth, 2003).

Carnivore coexistence solutions are not straightforward. Humans may perceive other animals as competitors or threats to livestock, crops, and humans (Browne-Nuñez et al., 2015; Treves and Karanth, 2003; Treves et al., 2013). There is a growing interest in the non-lethal methods of carnivore coexistence to uphold biodiversity and ecosystems rather than prioritizing human-centric development (Stone et al., 2017). The use of non-lethal deterrents may help facilitate carnivore coexistence better than lethal actions, since killing one carnivore individual or pack can lead to the source of depredation switching to a different carnivore, family unit, or individual (Mcmanus et al., 2014; Shivik et al., 2003; Stone et al., 2017; Treves and Naughton-Treves, 2009). Lethal control may also be ineffective in targeting the carnivores responsible for livestock depredations, especially if the lethal method is a non-targeted hunt of the species (Mcmanus et al., 2014; Treves and Karanth, 2003). Furthermore, the assumption USFWS made in the past that wolf hunts would increase human tolerance of wolves has been

undermined, and attitudes have worsened toward wolves following hunts (Browne-Nuñez et al., 2015; Treves and Bruskotter, 2014).

Finding non-lethal solutions for carnivore coexistence is complicated by the case-by-case nature of conflict with livestock. Livestock owners hold a great diversity of attitudes towards carnivores and livestock depredation, which may be influenced by early life experiences or membership of demographics such as "farmer" or "bear hunter" (Hogberg et al., 2015; Naughton-Treves et al., 2003; Williams et al., 2002). Furthermore, livestock operations are not uniform and can host a diversity of husbandry methods, fencing types, generational farming history, and surrounding topography. The HWC situation at hand calls for experimentation and relationship building specific to bioregional livestock rearing communities, as opposed to trying to extrapolate findings from other studies. In our study area, it was apparent that many farmers also held suspicion toward collaborating with a researcher on carnivore coexistence after they reported having negative experiences with state and federal government agencies. This sentiment has been reported in an attitudinal study that also took place in Wisconsin (Browne-Nuñez et al., 2015).

Beef Farming in Northern Wisconsin and Carnivore Risk

Carnivores may have access to domestic livestock without pursuing them as prey (Wydeven et al., 2004). In 2004, Wydeven et al. found that while all wolf packs in Wisconsin had access to domesticated animals, most packs did not kill any livestock. Still, livestock depredations did rise in Wisconsin and become more common in the 1990s as the wolf population recovered (Wydeven et al., 2004). This study reflects the case-by-case nature of carnivore coexistence, as most carnivore packs and individuals do not come into conflict with domestic animals.

Many factors go into whether a population of wolves shows a preference for livestock rather than for their natural prey. In some cases, high populations of a single natural prey species are less appealing to wolves than livestock predation, but multiple and smaller populations of native ungulates will draw wolves more than farm animals will (Treves et al., 2004; Meriggi and Lovari, 1996). One reason for this predation trend may be that a single species experiencing constant predation from a certain predator, may learn more quickly how to evade the predator. For example, white-tailed deer retain instinctual responses to lower their vulnerability to predation (Nelson and Mech, 1994). Many domesticated animals, though, have lost their ancestor's natural defenses against predation, thanks to selective breeding for tameness (Smith-Thomas, 2016).

A three-year Minnesota study of gray wolf movements showed that the majority of instances of wolves on pasture lands were by chance passing (Chavez and Gese, 2006). These results were based on comparisons to simulations of what random activity would look like in wolf movement. Not all wolf visits to livestock entailed a case of depredation. During the three years of the study, eight young or vulnerable farm animals were killed by wolves (Chavez and Gese, 2006).

Habitat variables and secondary prey may also influence whether wolves pursue livestock or natural prey. Studies have underlined the case by case nature of conflict as wolves have been found to both prey more heavily on livestock despite a healthy availability of natural prey (Treves et al., 2004) and to prey more heavily on natural, secondary prey despite livestock being more readily available (Chavez and Gese, 2005). In the first study, the reason for heavy livestock predation was hypothesized to be due to the landscape consisting mainly of pasture rather than being intermingled with forest, wetlands, and open water (Treves et al., 2004; Treves et al.,

2011). In the second study, muskrat (*Ondatra zibethicus*) made up the second-largest percentage of the gray wolf's diet, which may indicate that the presence of secondary prey helps to reduce livestock predation (Chavez and Gese, 2005).

Farms in Wisconsin that graze cattle tend to be small, family-owned operations with an average of about forty cattle (CIAS23, 2008). Losing a livestock animal to a carnivore causes small farmers emotional and financial hardship.

According to USDA APHIS WS Wildlife Biologist David Ruid, in 2019, twenty-four farmers in Wisconsin had livestock (excluding fowl) losses caused by gray wolves (Ruid, 2019). One event at one farm led to thirty-eight sheep being killed. Reports and instances of injuries to horses caused by wolves have increased on the Bayfield Peninsula, near our study area, according to Ruid. In Ruid's experience, most wolf complaints come from farmers concerned for beef cattle, as opposed to other livestock such as dairy cattle and sheep. While wolves do not have a large impact on Wisconsin cattle as a whole, Ruid emphasized what the impact means for an individual farmer and how predators may also have non-lethal but adverse effects such as stressing and scattering livestock. Comparative data for livestock depredation caused by other carnivores have not been historically collected due to the agency's focus on gray wolf depredations, which may also be field by cultural tendencies to disproportionately blame wolves for depredations (Ruid, 2019).

Tribal and Non-Tribal Attitudes toward the Gray Wolf

In 2009, Victoria Shelley, a graduate student of the Carnivore Coexistence Lab of the University of Wisconsin – Madison, conducted her graduate research in collaboration with the Mashkiiziibii Natural Resources Department (MNRD) of the Bad River Tribe: "The Influence of Culture on Attitudes to Wolves and Wolf Policy among Ojibwe Tribal Members and Non-tribal

Residents of Wisconsin's Ma'iingan Range" (Shelley et al., 2011). Shelley randomly mailed out questionnaires to Bad River Tribal members and randomly selected non-tribal members that live in the gray wolf range of Northern Wisconsin. The study found that Bad River Tribal members were more supportive of protective gray wolf policy and less supportive of a proposed gray wolf harvest than the non-tribal respondents. At the same time, attitudes toward the wolf are not completely homogenous among Bad River Tribal members, with some members being open or supportive to some hunting of the gray wolf for example (Shelley et al., 2011). A Tribal member supporting some hunting of the wolf also does not mean they disrespect or hate the wolf:

> "Wolves were harvested [historically] by Native Americans, however the wolf selected was harvested compassionately. Usually it was those wolves disconnected from the pack and scavenging. Those wolves were less likely to survive without the pack; just as an Anishinabe would less likely be Anishinabe with-out the tribe [anonymous Bad River Tribal member]" (Shelley et al., 2011).

This study also underlines the way in which livestock ownership, which was more prevalent among non-tribal member respondents, may influence attitudes toward the wolf (Shelley et al, 2011). Livestock owners may feel they have more at stake when it comes to carnivore coexistence while tribal members without livestock may have less reason to feel negatively or competitively toward wolves and other carnivores. Still, attitudes toward wolves are not uniform among Bad River Tribal members (Shelley et al., 2011) and in Abi Fergus's experience as wildlife specialist for the Bad River Tribe, some tribal hunters will attribute lack of success in hunting white-tailed deer to the influence of wolves.

Relationship Building/Outreach

Wildlife professionals may improve human tolerance toward carnivores with effort because changes in belief and emotion lead to changes in human behavior (Treves et al., 2013). Attitude, which influences behavior, can be shaped by experiences (Browne-Nuñez et al., 2015).

Building relationships with livestock farmers in which information is mutually built upon can increase those livestock farmers' tolerance toward carnivores that may pose a threat to domestic animals. This theory is exemplified in a study where participants exhibited an increased tolerance toward black bears (*Ursus americanus*) when they were given information on both the benefits of black bears and how to mitigate unwanted impacts by black bears (Treves and Bruskotter, 2014).

Non-lethal deterrents are one group of tools that may be used to enable carnivore-livestock coexistence along with good husbandry practices, guardian animals, and fencing. Habituation by carnivores is commonly sighted as an argument against non-lethal deterrents by skeptics. Adequate research and investment in non-lethal options do not exist to substantiate such claims. Our study set out to test the effectiveness of the non-lethal deterrents fladry and Foxlights® in reducing carnivore visitation to livestock farmland. We hope that this research will expand the scientific understanding of the efficacy of non-lethal deterrents, serve the farming community in the Northwoods of Wisconsin, and assist in relationship building toward carnivore coexistence between the Bad River Tribe of Lake Superior Chippewa Indians and neighboring livestock farmers.

Methods

Our Study of Fladry and Foxlights®

A primary repellent interrupts an animal's behavior with an undesirable stimulus (Shivik et al., 2003). These stimuli cause temporary fear or perceived danger in the target animal (Breitenmoser et al., 2005; Darrow and Shivik, 2009). Deterrents are a type of primary repellent that keep the target animal away from a specific area, such as grazing land, with a stimulus that might involve light, sound, or a chemical (Smith et al., 2000). We studied fladry and Foxlights as

non-lethal deterrent options on cattle and sheep farms. These deterrents have not yet been studied adequately and extensively with gold-standard research that involves randomization and crossover (Eklund et al., 2017; Miller et al., 2016; Shivik, 2006; Treves et al., 2016; van Eeden et al., 2017).

Fladry is made of flags sewn into nylon rope (Breitenmoser et al., 2005; Darrow and Shivik, 2009; Davidson-Nelson and Gehring, 2010; Eklund et al., 2017; Shivik, 2006; Shivik et al., 2003; Young et al., 2015; Zarco-González and Monroy-Vilchis, 2014). According to the manufacturing company, Foxlights are deterrents that flash two colors of LED light at 360 degrees, which can be seen from up to one km away (Foxlights International, n.d.). This deterrent is designed to simulate a human walking around with a flashlight and runs when the device detects nightfall. According to the manufacturing company, the flashes of light are randomized to prolong the period before predators habituate to the light (Foxlights International, n.d.). In Chile, Ohrens et al., 2019 found Foxlights to significantly reduce predation of llamas by mountain lions, but an insignificant effect on reducing predation of llamas by Andean foxes.

Achieving Gold-Standard Non-Lethal Coexistence Research

Treves et al., 2019 identified five types of bias commonly found in research, and which must be overcome to answer unresolved questions in carnivore coexistence, such as

- Do survivors prey on domestic animals at similar rates after removals?
- Do surviving predators compensate for vacancies by altered reproductive rates?
- How much is predation on domestic animals compensatory?
- How do sympatric species of predators respond to the removal of competitor species?
- Does one source of predator removal affect other sources of predator removal?

Bias may be introduced in research throughout the process, from hypothesis forming to what findings get published. Treves et al., 2019 categorized five common types of bias found in wildlife research. Selection or sampling bias occurs when treatment and controls are handpicked

rather than randomly assigned. Selection/sampling bias can also occur if a sample size is so small that the treatment and control groups differ significantly for reasons unrelated to the explanatory variable. We worked to avoid this form of bias by using an online application to randomly assign the sequence of treatment and control across farms and then evaluating whether there was any reason to believe that farms within the same treatment and control sequence would have any spillover effect on one another. For example, the two farms of closest proximity to each other ended up being assigned randomly by the simulator to different treatment and control sequences, supporting our assumption that the closer proximity of these two farms compared to the remaining farms would not introduce bias.

Treatment bias occurs when the researcher does not standardize the amount of time or intensity between setting up and maintaining treatment areas. We found this to be one of the most considerable challenges, as farm "Jav" clearly experienced greater carnivore conflicts than any other farms. Still, we worked to control treatment bias by allocating roughly the same amount of time to do treatment setup and take down on each farm. We spent about four hours with a crew of three or four, including Abi Fergus (hereafter "AF"), to install fladry and Foxlights on each farm. We did not record time spent on each treatment setup, but used the eight hour work day scheduleof the field crew to allocate half a work day to setup on each of the six farms. Rather than investing disproportionate time-altering setups at farm "Jav," AF invested extra time consulting and brainstorming for possible husbandry solutions with these farmers. When treatment areas needed to be visited to inspect fladry, AF put effort to visit treatment areas across farms equally by keeping a log of farm visits. At times controlling for treatment bias was limited by AF's physical capability, especially because she was in the process of building strength and stamina after acquiring a physical disability prior to the study.

Measurement bias is introduced when the measurement method is inconsistent between treatment and control. Ideally, blinding, in which the researcher and any participants are unaware of treatment and control assignment, is used to counteract this bias. Different stages of blinding can occur if a journal is presented only with methodology in accepting a paper, but not the results or if the person who conducts data analysis is unaware of the order of treatment and control. We did not find any of these blinding steps feasible, so measurement bias may be more prevalent than other sources of bias in our research.

Reporting bias occurs when research methods or findings are misrepresented in analyzing data, reporting results, or communicating findings- often biased toward a result the researcher desires. We avoided reporting bias by explaining all data exclusion and by conducting and reporting on data analysis conservatively.

Publication bias occurs when journal editors disfavor publishing work based on insignificant results, replication that affirmed previously reported results, and replication that contradicts previously published results. Registered reports in which methodology, but not results, are reported and serve as the basis of publication decisions can help overcome this form of bias. We did not find it feasible to create a registered report for this study because we needed the flexibility to make small methodological adjustments leading up to the experiment rather than being able to commit to a predetermined methodology as registered reports require.

In addition to these controls against bias we have detailed, ours was a crossover experiment in which all farms received both treatment and control and thus a farm could be compared to itself between these different phases, rather than introducing errors associated with comparing different but similar treatment areas or farms. We categorize our research as gold-standard.

Identifying and Examining Assumptions

In a developing research topic such as non-lethal carnivore coexistence, it is especially important to critically identify and examine assumptions that arise from the level of uncertainty in this research. We have striven to discuss our assumptions to reduce bias in our work and allow readers to evaluate these assumptions for themselves.

Ethics Review

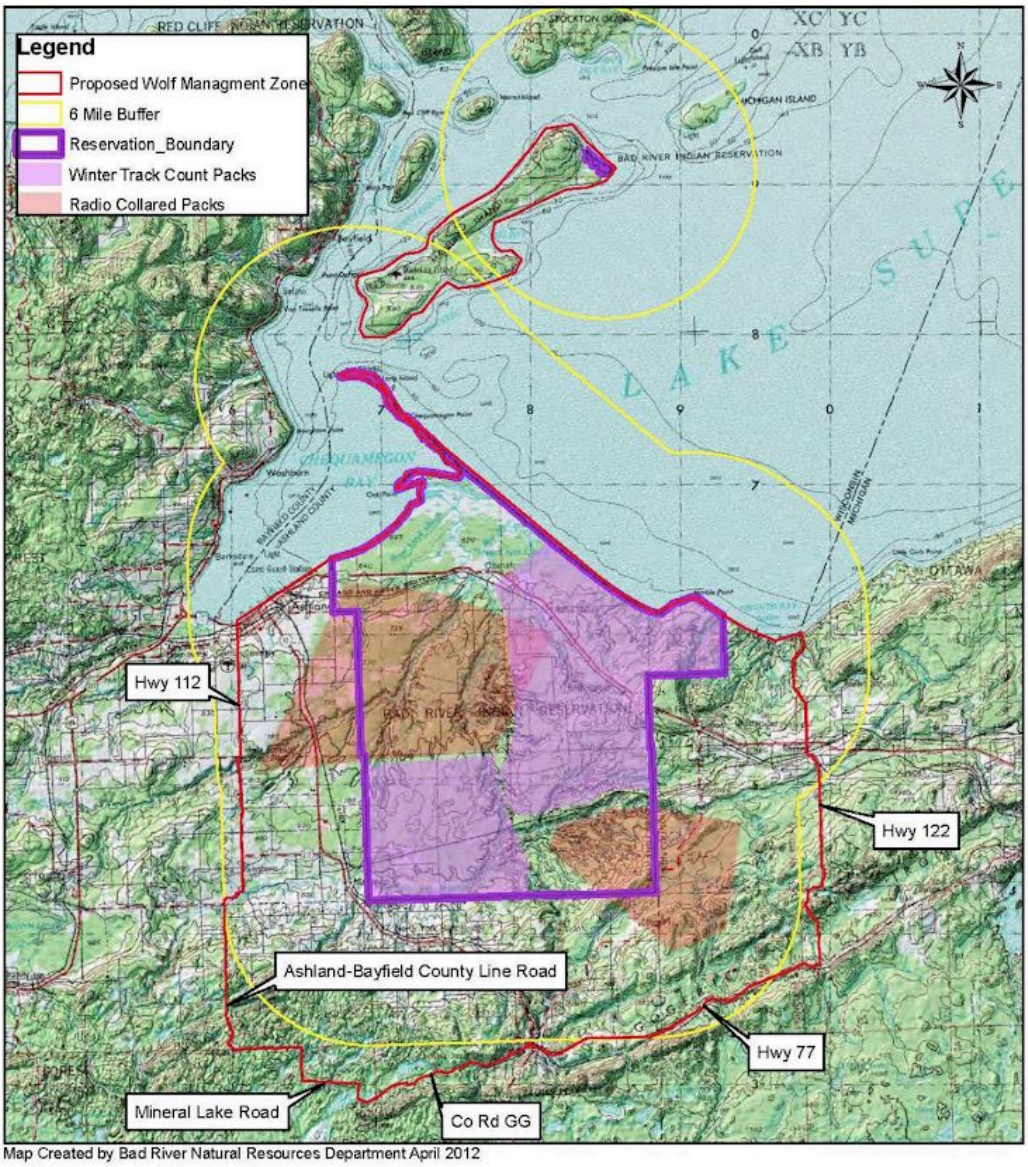
We received approval from the Institutional Review Board at the University of Wisconsin–Madison for human subject research. The study was performed in accordance with ethical guidelines from the Belmont Report, and verbal informed consent was obtained from all farmer participants. The animal protocol followed in this research was reviewed and approved by the University of Wisconsin–Madison Institutional Animal Care and Use Committee.

Study Area

Our study area consisted of six small cattle and/or sheep farms that bordered or were within the Mashkiiziibii Ma'iingan Relationship Plan buffer zone (Figure 1) (Fergus and Hill-Kastern, 2019).

Figure 1

Mashkiiziibii Ma'iingan Plan Buffer Zone Extending into 1837 ceded territory



This buffer zone extends roughly six miles out from the borders of the Bad River reservation and is demarcated by major roads (Fergus and Hill-Kastern, 2019). Within the buffer zone, the Bad River Band of the Lake Superior Tribe of Chippewa Indians (Bad River Tribe) is to hold co-management authority with the State of Wisconsin in accordance with the way the LCO vs. Voigt decision (No. 74-C-313-C) interprets and reaffirms the treaty rights of Anishinaabeg (Fergus and Hill-Kastern, 2019).

On study farms, acreage of grazing land ranged from twenty-five to two-hundred-forty acres, with a mean size of one-hundred-nineteen acres. Cattle herds ranged from thirty to ninety-four head of cattle, with a mean herd size of sixty-four cattle. Two of the six farms also kept sheep, having thirty and thirty-five sheep, respectively.

Our deterrent study ran from June through early September, roughly the average grazing period in this area- when snow cover is gone, the grass is growing, and farmers have their livestock out on pasture. In May and April, before the study, the region received above-average precipitation and below-average temperatures (Kilger, 2020). During the period of study, from June through September, precipitation and temperatures were average. Wind speeds were average throughout the study year, yet this region receives greater wind speeds and gusts than certain inland regions, because of the effect of Lake Superior. Additionally, pasture settings often entail large amounts of open land, where wind speeds tend to be even higher (Kilger, 2020). This is important to note for the fladry deployment, which we found to be influenced by strong wind gusts on multiple farms.

Comparable livestock grazing practices took place throughout the research period on all farms. We did not seek to control farmers' patterns in grazing their animals at varying distances from treatment areas, and we assumed this produced random error unrelated to experimental

treatment. Each farm varied in how frequently farmers moved livestock between paddocks (grazing units within the pasture, separated by temporary fencing).”All farms were subject to unique environmental conditions. Yet, all farms were within the Bad River Watershed and were surrounded by relatively similar wetland and mixed hardwood and pine forest habitat.

Farmer Recruitment

To recruit research participants, AF generated a contact list of about thirty small livestock farms in and around the Mashkiiziibii Relationship Plan buffer zone by cross-referencing Ashland County GIS websites and a phone book. Lacey Hill-Kastern (hereafter LH-K) and an Ashland county farm hand-reviewed this list for accuracy. AF also added farmers to her recruitment list when she received recommendations from farmers she spoke with or from peers who worked for farmers in the area. AF called every farmer on this list three times to try and recruit them for the study. We enrolled two of the six farms using this list and phone calls, but for the most part, farmers who received cold calls were unresponsive or uninterested. AF visited all farms that did not respond to phone calls and networked with enrolled farmers to recruit the remaining six farms. The first farm AF recruited had to withdraw from the study before the field season began for undisclosed reasons. This reduced recruitment from seven to six farms

Conducting Our Study

AF received verbal consent before enrolling each farmer into this study and conducted entrance interviews with each farmer to understand their husbandry practices and experiences with wildlife professionals and with local carnivores. During these interviews, AF used aerial imagery of the farm to collaboratively identify known or likely wildlife corridors which passed through livestock pastures and were assumed to be the most likely path of any carnivores that may visit the farm.

We established treatment areas near the conjunction of identified wildlife corridors and pasture and deployed trail cameras to detect carnivore occurrences. The strengths and limitations of working with trail cameras to study wildlife are well documented (Petroelje et al., 2019). Strengths include this method's non-invasiveness, passive data collection, and well-developed technology. One limitation of employing trail cameras is the time and personnel required to process the large quantities of data. However, computer learning programs are being programmed to facilitate faster and more effective trail camera photo processing to identify wolves and other species with 95 percent accuracy (Petroelje et al., 2019). AF installed trail cameras on garden posts to monitor predator activity. AF aimed trail cameras along animal trails and corridors in the pre-trial to enhance the likelihood of detecting wildlife presence. AF aimed trail cameras along the line of fladry, which was installed perpendicular to animal trails and corridors, identified in collaboration with farmers. AF replaced the SD cards and checked on the battery levels every time she visited a farm for another purpose (e.g. check on fladry, transition experiment).

Prior to treatment setup, AF constructed fladry using materials commonly available in farm supplier stores: polywire, plastic step-in posts, and flagging tape. AF was supported by two to three Wisconsin Tribal Conservation Advisory Council (WTCAC) and MNRD field crew members for treatment area setup. AF and the crew hung the polywire from step-in posts to create perpendicular lines of fladry across wildlife corridors. The crew assembled the fladry in the field by hand tying pre-cut strips of flagging tape at 10 cm apart. Ten centimeters is the width of the average coyote skull, so we tested narrow rather than traditionally spaced fladry, in line with recent studies' recommendations and methodologies (Skulls and Dental Formulas, n.d.; Young et al., 2019). AF ensured only a few centimeters of space existed between the bottom of

the fladry line and the earth to avoid the potential of animals crawling beneath the setup. In both the first and the second trials, AF ran a second line of polywire along the bottom of the flags to try and prevent the flags from furling in the wind. To further prevent fladry tangling, the field crew weed-whacked the vegetation beneath and surrounding the fladry on treated farms. When a treatment area was in the control phase, AF and the crew created a fladry placebo control by bunching up and tieing off each flag.

At all treated areas, we also installed one Foxlight roughly at the center of the fladry line to serve as a night time deterrent. Foxlights were installed above the top of fladry lines. When a treatment area was in the control phase, AF removed the Foxlight battery to serve as a placebo control for the active Foxlights.

Treatment areas refer to the locations that AF identified as wildlife corridors leading to livestock pasture. The distance between treatment areas and participating farms was naturally determined by where wildlife was traveling and what farmers were willing to participate, rather than being hand selected. In a larger study or on farms with too many identified wildlife corridors to feasibly treat, it would be prudent to randomly select which corridors would be treated. The nearest pasture on the closest two research farms was about 1,145 feet apart, and carnivore occurrences were not identical between these two treatment areas. These two farms were also randomly assigned to different treatment and control sequences. The nearest treatment areas on the same farm were about 700 feet apart, and carnivore occurrences were not identical between these two treatment areas.

AF manually inspected each trail camera picture for the presence of carnivores and re-saved these images with the common English name for the species and a number to denote unique occurrences for that individual or species. Ultimately, AF organized the data by

indicating how many independent occurrences of coyotes and black bears were detected in the treatment and in the control periods, by farm and by treatment area. No other carnivore species was detected via trail camera during the study period. However, a bobcat was detected by a trail camera on one farm following the study in a post-trial data collection.

The Browning BTC-8A trail cameras deployed seemed to be very sensitive and effective at picking up on wildlife activity based on the frequent detection of small arthropods such as Lepidopteran at distances up to the eighty feet (detection range of the cameras used). Most camera-related issues that AF encountered came down to human error or the learning curve of how frequently cameras should be checked and how their maintenance and data should be organized. In future studies, a checklist should be incorporated to avoid the human error of forgetting to turn trail cameras on.

Data Analysis

We removed all three treatment areas on the farm "Jav" from the data analysis because all treatment areas on this farm were subject to livestock displacing or damaging trail cameras and deterrents and a landscape in which wetlands were encroaching on the entire western border of the pasture land. This resulted in a possible compromise of our attempt to randomize the assignment of treatment and placebo control phase order. Order was randomly assigned at the farm level, so the removal of farm "Jav" from the data analysis resulted in a disproportionate number of treatment areas receiving a placebo control and then a treatment, instead of a relatively equal distribution between the two conditions. We removed one treatment area on the farm "Ady" from the data analysis because of a long data gap caused by an error of forgetting to turn on the trail camera.

We categorized each farm based on their treatment and control sequences: AB for treatment and then control or BA for control and then treatment. Eleven treatment areas made up the sample size for this analysis, with three AB treatment areas and eight BA treatment areas. This uneven distribution was due to the previously mentioned exclusion of the farm "Jav" and a single treatment area on the farm "Ady."

To control the seasons' potential impact on carnivore occurrences, we conducted a test of phase differences. To control for the possible impact of the order in which treatment and control were applied to a treatment area, we performed a Wilcoxon rank sum test (JMP® 2019).

We employed multiple statistical tests of effectiveness to be conservative in our data analysis. We calculated the difference in carnivore occurrence between the first and second phases for each treatment area on every farm. We tested for period effects and for any carryover effects (to test whether treatment or control periods influenced one another) (Díaz-Uriarte, 2002; Jones and Kenward,1989; Ohrens et al., 2019). We found our small sample of data to be non-normal, so we employed the non-parametric Wilcoxon rank-sum to test for differences in carnivore occurrences between treatment and control and between treatment periods. To test for the effect of Foxlights and fladry on carnivore occurrences, we used the Hills-Armitage ANOVA procedure (Díaz-Uriarte 2002; Jones and Kenward 1989).

Cutting off wildlife corridors with fladry lines

Fladry is typically used to enclose pasture or overnight pens (Musiani and Visalberghi, 2000). It was not feasible for AF to encompass the hundreds of acres of pasture on six farms with fladry. We assumed this would not be possible for small scale farmers or small natural resources agencies to accomplish based on AF's experience with both groups. Fladry was created as a tool

for hunters to coral wolves along the line of flagging (Shivik et al., 2003). We applied this concept in our use of fladry to perpendicularly cut across wildlife corridors leading to pasture.

Wildlife corridors are paths of low resistance between important locations for species, such as foraging or bedding areas (Wade et al., 2015). In our study, wildlife corridors were identified based on aerial photos which reflected natural corridors such as waterways and on the ground confirmation that wildlife trails were apparent based on trampled vegetation. Trail camera photos of black bears and coyotes confirmed the use by wildlife of these corridors (Table 1; Table 2). Fladry has historically been applied around the entire perimeter of livestock pasture, but this was not feasible for our study. Instead, we sought to disrupt the function of wildlife corridors, namely deer trails, which undisrupted serve as paths of least resistance for prey and predators alike (Wade et al., 2015). Our goal was to see if fladry lines and Foxlights could reduce the low resistance associated with corridors and thus reduce carnivore occurrences on livestock pasture. Wildlife make decisions in moving across landscape based on a mix of factors including energy expenditure, exposure to predators, and availability of forage (Gallagher et al., 2017). We sought to increase the perception of risk or the need for energy expenditure by cutting off deer trails, which led to pasture. It is reasonable to assume that we did not identify and treat every single wildlife corridor leading up to pasture. If a researcher uses trail cameras adaptively and works with a farmer over time, the ability to identify most wildlife corridors may increase.

Feasibility of Deterrent Use

This study proved to be physically and emotionally demanding for AF to coordinate due to numerous factors, including the learning curve of implementing the experimental design, the frequent turnover in field crew, and trail camera and deterrent ordering delays. Still, because the field research was done in coordination with the Mashkiiziibii Natural Resources Department

(MNRD), the study served as a realistic portrayal of a natural resource agencies' execution of a pilot study into the use of non-lethal deterrents.

The intense gusts that Lake Superior can create over the study landscape, wetland landscapes, thick vegetation, and the tendency in cattle to chew on their surroundings made fladry deployment difficult. The accessible flagging tape used to construct fladry had the downfall of being low friction on the polywire, leading to bunching. The level of maintenance required for the fladry may be unappealing to a farmer, but it may also be a valuable way to increase human presence via maintenance checks. It was a steep learning curve for AF to set up the experiment, and efficiency in setup was only developed over time. As a result, AF did not tie the bottoms of the fladry to the bottom polywire in the first trial, due to limited time. For the second trial, the field crew help was more consistent, and we were more efficient in deploying fladry, so we successfully tied the bottom of the fladry, which reduced the problem of bunching in the wind. We assumed the difference between phases caused by tying and not tying fladry bottoms would not have a significant impact on results, because AF visited fladry lines following windy events to correct bunching and because there did not appear to be large differences in how the fladry moved with the bottom tied or the bottom resting on a bottom polywire line. Sometimes untied flags would wind themselves around the bottom line, for example. The within-subjects analysis makes this source of error conservative, because it would tend to make treatment more similar to placebo. This is because wind makes fladry non-functional just as the bunching of flags makes the placebo non-functional.

In addition to fladry bunching and cattle destruction issues, constructing and deploying the fladry was time-intensive. Across all six farms, AF and the field crew installed about 1,800 feet of fladry. The length of fladry lines varied between treatment areas on farms based on how

much distance was required to cut off a corridor; fladry lines averaged 120 feet. While fladry line lengths varied between farms, one way AF worked to keep treatment and attention to farms relatively consistent was by allocating about the same amount of time to set up the experiment on each farm. Typically, the field crew of AF and two or three WTCAC or MNRD aides took about four hours to complete each farm's research setup. The cost of our fladry setup consisting of step-in posts, polywire, and forestry flagging tape came out to be about $0.40 cents/foot, which is consistent with the new Minnesota Non-Lethal Wildlife Specialist's recent work on installing fladry (Hart, 2019).

The flagging tape for fladry was precut by AF using a homemade spooling device that allowed five rolls of flagging tape to be cut to the proper length at the same time. It took AF about twenty hours to cut the amount of flagging she predicted would be needed to treat corridors based on the GIS measurements. Overall, the experiment setup could have been improved with better organization and time for attention to detail if supplies had been ordered and prepared during the winter months, but that was not possible for this study. We assumed the unpredictable circumstances that AF needed to adapt in order to conduct this experiment reflected the unexpected roadblocks a farmer would face if they tried taking non-lethal deterrent use into their own hands.

Relationship Building and Farmer Attitudes

We recommend relationship-building occur overtime ahead of intended research projects with livestock farmers to increase successful participant recruitment. AF began recruiting farmers four months ahead of the field research or cattle grazing period from June to September. AF attended farming community events like a dairy breakfast and dairy association meeting to recruit participants. Only one of the six farms that participated in the study was recruited at one of these events, which mostly consisted of dairy rather than meat producers.

The most effective means of recruitment was by showing up in person and having local connections- both of which take in-person time and effort. AF drove to farms she had not heard from over the phone to recruit participants and this led to two of the six study farms enrolling. One farmer was inclined to enroll because AF was acquainted with their son, who heard about the study. This farmer promptly asked AF to visit their neighbor, who also enrolled in the study. Most farmers expressed to AF that they would enroll in the study to help AF in her studies, as opposed to immediately seeing potential benefits for their farm. None of the participating farmers seemed to have the capacity or interest in personally helping monitor the deployed deterrents or to be involved in the review of the data, and AF assumed this mostly relates to the reality small livestock farmers face of being overburdened to make ends meet. This sentiment also reflects the role farmers have repeatedly told AF that government and academic scientists should play- finding solutions for preventing livestock depredations.

Results

Carnivore Presence

We confirmed the presence of coyotes (eight total occurrences) and black bears (four total occurrences) within the research area based on trail camera data (Table 1; Table 2). We did not detect period or carryover effects at the treatment area or the farm level using the traditional frequentist significance level $P<0.05$.

Table 1

Carnivore occurrences by farm, treatment area, treatment phase; order of control (A) and treatment (B); carnivore occurrences following the experiment (post-trial)

Farm	Treatment Area	Phase 1	Phase 2	Phase 1-Phase 2	Order	Post Trial
2 "Tig"	West Pasture	0	0	0	BA	0
2 "Tig"	West ATV	0	0	0	BA	2
2 "Tig"	East ATV	0	7	-7	BA	0
3 "Tik"	White River	0	0	0	AB	2
3 "Tik"	Triangle Wood	0	0	0	AB	
4 "Sor"	Tree Fall	0	0	0	BA	0
4 "Sor"	Wooded Pasture	0	1	-1	BA	2
5 "Eut"	North Pasture	0	0	0	BA	0
5 "Eut"	Feedlot	0	0	0	BA	1
5 "Eut"	Horse Pasture	0	0	0	BA	0
6 "Ady"	Ravine	3	1	2	AB	5

Table 2

Carnivore occurrences by farm, treatment phase; order of control (A) and treatment (B); carnivore occurrences following the experiment (post-trial)research trial

Farm	Phase 1	Phase 2	Phase 1-Phase 2	order	A-B	Post Trial
2 "Tig"	0	7	-7	BA	7	2
3 "Tik"	0	0	0	AB	0	2
4 "Sor"	0	1	-1	BA	1	2
5 "Eut"	0	0	0	BA	0	1
6 "Ady"	3	1	2	AB	2	5

Between all treatment areas on all farms, the occurrence of carnivores did not vary significantly (Wilcoxon two-tailed, $P > 0.05$; df=10; Z=1.1). Ignoring treatment areas, the occurrence of carnivores did not vary significantly between farms (Wilcoxon two-tailed, $P > 0.05$; df=4; Z=1.53). We established treatment areas based on unique deer trails, and farmers rotated their livestock throughout the experiment at different proximities to these treatment areas, supporting our assumption that all treatment areas and farms were independent. Still, the same carnivore individuals could have visited multiple treatment areas, undermining our assumption. Interestingly, two treatment areas on Farm 2 that could be reasonably visited by the same carnivore were not visited on the same night by the same black bear individual. Still, this assumption remains potentially violated, and our sample size was small after excluding all treatment areas of Farm 1 "Jav."

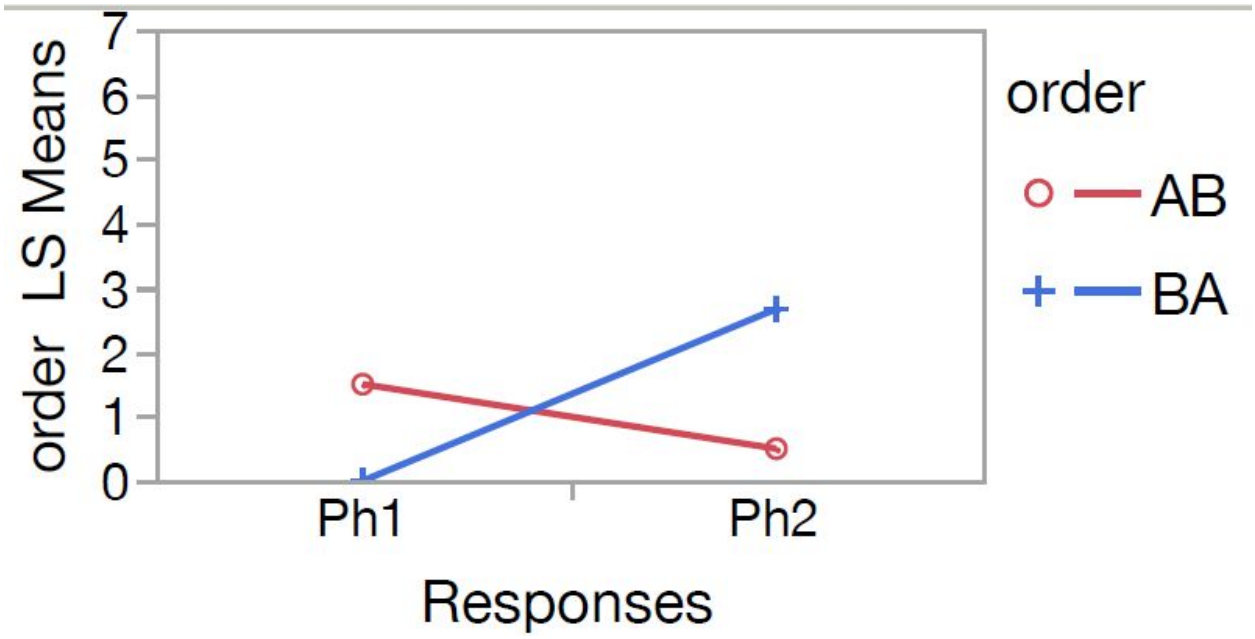
Deterrent Effectiveness

Given the possibility of the same carnivore individual visiting multiple treatment areas, we employed more conservative tests by running an ANOVA and an analogous Wilcoxon test on the five remaining farms (as opposed to on the treatment area level) where data collection and deterrent deployment were consistent.

During treatment periods, farms experienced one carnivore occurrence and eleven occurrences during the placebo control periods (Table 2). On average, there were 0.72 carnivore occurrences to a treatment area (SD=2.2) and two carnivore occurrences to a farm (SD=2.9). Predator occurrences were detected in both treatment and control periods, and the observed difference in occurrences between treatment and control on the farm level was insignificant (ANOVA type statistic df=1, F=0.53, P=0.3; Figure 2; Wilcoxon two-tailed, statistic $P>0.05$), although the direction of effects suggests the need for further testing with larger samples.

Figure 2

Carnivore occurrences by experimental phase (Ph) and order of control (A) and treatment (B). clarify if farms or treatment areas



Discussion

We found fladry and Foxlights to have insignificant effects on carnivore visitation of treatment areas near livestock pastures. During our study, the only livestock depredation reported was the chronic depredation of poultry on farm "Jav." This treatment area that was not included in the data analysis due to the Foxlight being repeatedly knocked down by barn animals. Still, it was apparent that the Foxlight was not deterring a red fox (*Vulpes vulpes*) or a domestic cat (*Felis catus*) repeatedly entering the poultry barn, which also had motion detection lights installed by the farmer.

Post Trial Deterrent Adoption

Following the study, AF established a non-lethal deterrent and camera lending program through the MNRD Wildlife Program and informed all participating farmers how they could contact AF to enroll in this program. Farm "Jav" was the only farm to enroll in this program the

following summer, while the remaining farmers weren't motivated to participate or continue using fladry and Foxlights. Farm "Jav" was the only farm to experience depredation of livestock (an estimated $800 of poultry) during the study. This farm was eliminated from the data analysis, due to camera and deterrent errors in all treatment areas. It was observed that motion detection lights and Foxlights failed to deter a red fox and a domestic cat repeatedly shown on camera entering the poultry barn. AF and this farmer continue to collaborate on brainstorming potential husbandry changes that may reduce future poultry losses.

Navigating farmer demographics

While the husbandry and backgrounds of farmers may vary substantially, trying to control for which "types" of farmers enroll in a study may not be very feasible, based on our experience. It is important for some level of farmer buy-in to accomplish carnivore coexistence research. If a farmer isn't convinced of any possible benefits they will not see it as worth their time, or any perceived risk to their livestock, to allow a researcher on their land and around their livestock. Additionally, conclusions and observations in research can be improved by a farmer's interest in the study and in informing the researcher of any carnivore sightings or encounters. We find it best to openly recruit farmers of any demographic (generational, first generation, organic, non-organic, etc.) and base enrollment on whether the farmer is interested rather than pushing to work with less interested farmers. Successful interpersonal communication is intrinsic to this work and it won't help a researcher to get off on an awkward start with a farmer or be in a position in which they feel added pressure to prove themself to the farmer who less than willingly joined a study.

If a researcher happens to recruit more interested farmers than the researcher actually has capacity to work with, then could be a good opportunity to qualitatively categorize farmers into

husbandry and background types and then randomly select an equal sample from each category, but the researcher should not sacrifice being able to effectively work with recruited farmers for the sake of "perfect" data. It seems reasonable to assume that if some farmers enroll and have a positive experience working with the researcher, that additional and varied demographics of farmers will become interested and participate in future studies, which can also provide more insight to how carnivore coexistence may vary between farming demographics.

Implications for Wildlife Professionals

Despite AF needing to overcome numerous roadblocks, from late supplies to physical challenges, this gold standard cross-over experiment proved to be achievable by a natural resources department, and future replication and experimentation can improve upon this study.

Our study served as a pilot into non-lethal deterrent research, and replication should be done in future studies. Our research can be improved upon with a larger sample size of farms- which could be easier to achieve in the future with continued relationship building with farmers and the troubleshooting that our study accomplished.

Future researchers in our study area should also examine the effectiveness of the local use of livestock guardian animals, including great pyrenees dogs for guarding sheep and donkeys for guarding cattle. Gold-standard research may be hard to accomplish with livestock guardian animals on farms which already train these animals, because it can be reasonably assumed that farmers will not want to put their livestock at risk by removing guardian animals as a control. If farmers are provided with the livestock guardian animals evaluated through the study, they may be more willing to participate in the treatment and control phases of crossover experimentation, but the researcher should keep in mind the financial and time costs of acquiring and training these animals. Researchers in our study area should also explore how specific husbandry

practices may impact livestock depredations, especially since the region hosts some farms with a history of chronic depredations.

Currently, USDA APHIS Wildlife Services is contracted by state agencies both for lethal and non-lethal responses to carnivore coexistence needs. In 2020, the Minnesota DNR established funding for the first time to have a non-lethal wildlife specialist to research and deploy non-lethal tools for carnivore coexistence (Hart, 2019). In Wisconsin, Dave Ruid has been researching non-lethal options for six years and recently has been focusing on developing a noise making deterrent (Ruid, 2019). This carnivore coexistence work can be improved on moving forward by developing researching and funding partnerships so that more diverse backgrounds and areas of expertise inform carnivore coexistence. USDA APHIS Wildlife Service biologists declined our request to share black bear translocation events with us, citing privacy concerns. We assumed this had little effect on our research, as none of the farms were surrounded by sweet corn fields where bears sometimes are trapped from to be relocated for foraging on the corn crop. Stil, future studies could be benefited by successful collaboration and involvement of more natural resource agencies such as USDA APHIS WS.

One effort that may help bring us to expand the carnivore coexistence field and better serve rural communities across what is now called North America is the current work of the Endangered Species Coalition to develop a model for a “gold standard wolf conservation plan.” This Master’s thesis helps to inform the development of this model plan-particularly on the subjects of carnivore coexistence research and outreach and relationship building with farmers and tribal members.

With the research field of carnivore coexistence growing, state and federal agencies have more ethical, scientific, and traditional ecological knowledge available. With this expansion of

the field we may move past the North American Model of Wildlife Conservation's (NAMWC) history involving the tyranny of the minority and failure to live up to Public and Indian Trust responsibilities (Lopez-Bao et al., 2017).

Wildlife managers should improve and increase outreach with farmers. Some of them have expressed distrust or resentment toward the WDNR for not engaging more with the public about mountain lion sightings and coexistence, for example. Wildlife professionals also should learn from and collaborate in the farmer relationship building that tribal agencies of Bad River Tribe, the Red Cliff Tribe, and the Ho-Chunk nation are accomplishing through consultation on carnivore coexistence and non-lethal deterrent use. The WDNR should also update its outdated wolf management plan from 1999 and, in doing so, reinstate the science committee with the inclusion of tribal experts (in addition to formal tribal consultation).

Success in Relationship Building

Prior to the deterrent study, none of the farmers reported having any kind of relationship with the Bad River Tribe. Following our research, two of the six farms explicitly shared that they would rather work with the Bad River Tribe than the WDNR, because of the carnivore coexistence values they came to learn the Mashkiiziibii Wildlife Program holds and because they felt they'd get more of a response from Bad River Tribe than WDNR for situations such as the sighting of mountain lions. The four remaining farmers seem to remain in good relationship with the Mashkiiziibii Wildlife Program, but as previously mentioned may not be motivated to adopt deterrents, related to a recent lack of depredation issues and a lack of capacity to deploy them.

Future Relationship Building

The study area includes a wave of young farmers, many of whom attended Northland College and do not come from a farming background or traditional views of livestock farming.

AF became connected with this younger population of farmers toward the end of our study. Many of these people draw values from permaculture and strive to farm in a regenerative way. One example of the way permaculturists address carnivore coexistence is illustrated by Michael Pollan in "The Omnivore's Dilemma:

> "That's the efficiency of a hedgerow surrounding a small field, something every farmer used to understand before 'fencerow to fencerow' became USDA mantra."... More birds on a farm mean fewer insects, but most birds won't venture more than a couple hundred yards from the safety of cover. Like many species, their preferred habitat is the edge between forest and field. The biodiversity of the forest edge also helps control predators. As long as the weasels and coyotes have plenty of chipmunks and voles to eat, they're less likely to venture out and prey on the chickens... It was all of a biological piece, the trees and the grasses and the animals, the wild and the domestic, all part of a single ecological system" (Pollan, 2006).

The up and coming farmer group in our study area seems to be a promising demographic to focus collaborative carnivore coexistence efforts on in the future by teaming up in documenting effectiveness and interaction that occur with coexistence methods, including both non-lethal deterrents and livestock guardian animals. The study area also hosts Northland College, Wisconsin Indianhead Technical College, a Lac Courte Oreilles satellite campus, and numerous high schools. Students may be good volunteers to assist small livestock farmers by deploying deterrents and running trail cameras on behalf of farmers and in coordination with the Mashkiizibii Wildlife Program. AF will explore this route in the future.

Future Land Use Study

As previously discussed, farm "Jav" had a western property border almost entirely overlapping with a growing wetland and was eliminated from the data analysis. The farmers attributed the growing wetland to a wildlife conservation easement they reported existed on this bordering land. This bordering wetland habitat seemed to render it difficult to fence off the farm's grazing land effectively from coyotes in particular. Farms "Eut" and "Ady" were also

reported to be in an area that had changed in recent history from forested land to developed agricultural land. These scenarios and other studies have underlined the potential impacts of land use and habitat type on carnivore visitation of farms and predation of livestock (Treves et al., 2004; Treves et al., 2011; Wydeven et al., 2004). Future studies should explore these potential influences and possible solutions that are less extreme than asking farmers to move their homes and operations. It is interesting to note the discussion cited above from Michael Pollan on the potential role of hedgerows in keeping certain native species traveling adjacent, but not through, livestock pasture. Given the historical tendency in NAMWC toward lethal control, there would seem to be fertile ground for wider prioritization and study of non-lethal options for coexistence.

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Chapter 2

Introduction

Relationship building can resolve challenges in carnivore coexistence and arguably all other issues created and faced by Western culture. The three years of carnivore coexistence research and outreach I have done on Anishinaabe Aki (Ojibwe land) in the 1842 treaty territory (Northern Wisconsin) has centered around relationship building with livestock farmers and with Bad River tribal members.

Positionality is the relationship a researcher has to their study area- true objectivity does not exist. Instead, it is important that we critically reflect on the values and experiences we hold, which shape our positionality and strive to select value systems that do the most good and the least harm. In my research, I worked to build a positionality of reciprocity by building good relationships with the Bad River Tribe and with small livestock owners to aid in efforts to move beyond the historical North American Model of Wildlife Conservation (NAMWC) that entails human-centric values that defer to killing and relocating carnivores, rather than studying ways that we can coexist in the same places.

In this chapter, I will outline why reciprocal relationship building is essential to carnivore coexistence and how I went about relationship building. It is my hope that this chapter may benefit the wildlife field with examples in how to do relationship building, which holds benefits for everyone- Tribes, livestock owners, and carnivores included.

Anishinaabe People

According to Anishinaabeg (Ojibwe people), they have been on Anishinaabe Aki (roughly the Western Great Lakes region) since time immemorial (Benton-Banai, 1988; E. Leoso, personal communication, October 8, 2020). Western science has only been a way of

knowing for four hundred years: since Sir Francis Bacon's publication of his scientific method in 1620 (Klein, 2003). At the same time as the birth of the scientific method, French explorers were arriving at Turtle Island (North America). This European settler contact with North America had been foretold to Anishinaabeg in prophecies which instructed them to move West until they found the place where the food grew on the water (About the Anishinaabe-Ojibwe; Benton-Banai, 1988; E. Leoso, personal communication, October 8, 2020). This understanding of the Anishinaabe migration timeline was shared with me by elders and knowledge holders including Midewiwin Society member and MNRD Historic Preservation Officer Edith Leoso.

> "Looking at Anishinaabeg timeframes in certain places, we recognize that the migration began at approximately 900 A.D. We completed the move in about 500 years, which was about 1400 A.D. Much has happened since then that shifted people here and there, but we have been in this general vicinity of the continent since the beginning of Creation. We have stories of how some Anishinabe moved to the south and west, stayed in the East, and went back east, as well, after the Migration. The Micmac Tribe in Maine has a place where all the Elders gather to meet. There was a big tree there. They have met there for so long, they don't know how long. The place was called Odanah. But they didn't know what the word meant because it wasn't their language until one Micmac Elder came here for ceremonies, and I told her. She was happy to know and took that story home to Maine. I was glad they kept the name. Oday – Heart; nuh, short for nong – indicating it is a locative, a place. Place of the Heart" (E. Leoso, personal communication, October 8, 2020).

Many indigenous people reject the Bering Strait Hypothesis, while it remains a prominent paradigm in Western science (Deloria, 1997). Recent archaeological research presented evidence for humans in southern South America at least 18,500 YBP, and Pierotti and Fogg (2017) contest this means that if humans had entered the Americas (accompanied by early dogs/wolves) at least 20,000 years ago, if not longer (Pierotti and Fogg, 2017). Anishinaabeg and other indigenous peoples have cultivated place-based knowledge over a longer time period than the existence of the refined Western scientific method.

Traditional Ecological Knowledge (TEK) and Western Science

Western science is certainly a powerful knowledge system, but it has its limitations and is most powerful when combined with additional, diverse knowledge systems. Lynn (2006) describes that the naturalistic model of science does not result in purely objective facts because Western science's strength lies in describing "tangible phenomena" in "closed systems". Studying and considering diverse knowledge systems, including indigenous knowledge systems, can benefit wildlife professionals in selecting value systems that result in the least harm (Lynn, 2006) to ecosystem and indigenous lifeways, for example. In other words, issues including carnivore coexistence are best addressed with the combined strengths of Western science in tangible fact-finding and other knowledge systems in making the necessary value-laden decisions with a strong ethical backing (Lynn, 2006). Some Western scientists seem to hold an underlying assumption that indigenous knowledge is not valuable or is not as valuable as Western science (Whyte, 2013). This misconception has been a mistake, as explained by Anishinaabe scholars Robin Wall Kimmerer and Kyle Powys Whyte, who practice both Western and Indigenous scholarship.

Anishinaabeg are well versed in passing down value systems that have guided them in living regeneratively, within ecosystems, through adaptation. Anishnaabe Scholar Kyle Powys Whyte explains TEK among his people:

> "For Anishinaabe peoples, our oldest stories and political systems speak to a key philosophical challenge: how can societies be organized to be as adaptive as possible to seasonal and interannual changes? Our ancient stories speak of extreme weather events, seasonality, trends of environmental change, migration across different ecosystems, and humans' capacity to influence entire regions through fire, flood control, trade, among other collective actions" (Whyte, 2019).

In some ways, Western science is different from TEK; Western science is often focused on measurable observations, technology to extend observations, hierarchical taxonomy,

reductionism, and mechanistic understanding, hypothesis testing, mathematical modeling, skepticism, and specialization (Gartner, 2019). Western science and TEK also have commonalities in focusing on empirical observation, pattern recognition, knowledge organization, cycles, and culturally specific biases, arguments, and explanations (Gartner, 2019). By understanding these commonalities and differences, we can better understand how to draw from both science and TEK to do effective research and outreach.

The knowledge and systems that Anishinaabeg and other indigenous people hold can take various forms, and there is no one definition of TEK (Whyte, 2013). TEK often seems to reflect phenological knowledge that land based people such as traditional hunters and trappers cultivate from experiences on the land. Just as Anishinaabe attitudes about Ma'iingan are not uniform (Shelley et al., 2011), TEK is not uniform and instead is shaped by an individual or group's learning with and from the land. One example of phenological TEK is a teaching I've heard among Mashkiiziibii Odana (the Bad River community) is that when Waawaatesi (Fireflies; Lampyridae) start flashing in the late summer hunting Waawaashkeshi (White-tailed Deer; *Odocoileus virginianus*) can begin. This is generally the same time of summer that fawns are independent enough to survive on their own if a doe was taken. Whyte proposes examining the role of TEK since a clear definition does not exist. Following this guidance, I will briefly examine how my understanding of the different shapes and roles of TEK has evolved throughout my work with the Bad River Tribe in using Western science and TEK to research and do carnivore coexistence.

An Outsider Approach to Traditional Ecological Knowledge (TEK)

> "In order to be involved with wolf conservation, the State and Federal government need to understand how to take care of wolves. That's what the Anishinaabe have done for years by observing and learning. Conservation of wolves is a part of our history. If we

> allow them to be killed, we allow ourselves to be killed." – Mashkiiziibii Elder Edith Leoso, 2017 (Fergus and Hill-Kastern, 2019)

Generally, indigenous peoples of North America lived sustainably before colonization occurred and influenced these ways of life (Gartner, 2019). Hunter-gatherer lifestyles gave many indigenous peoples an intimate knowledge of their dependency on other life, from predators to prey animals (Gartner, 2019). Anishinaabeg have learned skills and morals from animals (Benton-Banai, 1988). Anishinaabeg and their stories hold knowledge in coexisting with Ma'iinganag and other life. Mashkiiziibii Elder and Tribal Historic Preservation Officer Edith Leoso shared with me that her grandmother taught her to put out small amounts of food in the woods by their home to help coexist with other animals by keeping them away from the yard and their dogs.

In addition to the Anishinaabe creation story of Ma'iingan, various other stories involve Ma'iingan teaching lessons to Anishinaabeg (Benton-Banai, 1988; Usik, 2015). These stories often reflect what environmental values Anishinaabeg have traditionally held (Usik, 2015). The analysis of these stories and the lessons Anishinaabeg gain from them may also help shed light on how they successfully co-inhabited North America with Ma'iingan. One Anishinaabe value these stories exemplify is that humans are lesser than other members of their ecosystem because of the dependence humans have on other biotas to survive (Usik, 2015). This contrasts with Western attitudes of dominance over the natural world, which much of the scientific community is influenced.

In 2013, eighty-three percent of Ma'iinganag (plural form of Gray Wolf) in modern Wisconsin lived on Anishinaabe Reservations or ceded territory, underlining in part the important role Anishinaabeg play in Ma'iingan's fate (Sanders, 2013). When I began my

research with the Bad River Band of the Lake Superior Tribe of Chippewa Indians (hereafter Bad River Tribe), my early impression of TEK was that it had to be handed down by generations and was information that connected us directly back to ancestors. I thought the only route to TEK was talking to tribal elders, which I happily did weekly at the Bad River Elder lunch during my first two years of work with the Tribe.

Over the course of attending Bad River elder lunches, I learned how today's Anishinaabe Elders often grew up separated from their culture. Violent and deadly boarding schools separated indigenous children from their families for one-hundred years up until the 1970s, and it is in today's young generations that language and culture are being reclaimed and revitalized in immersion schools and programs (Ammann, 2019; Kebec et al., 2020; Kimmerer, 2015; Whyte, 2017; Zhaashiigid (Shimek), 2014). The slogan behind one of the first boarding schools, Carlisle, was "kill the Indian to save the man" and children were punished for speaking their language or practicing Anishinaabe culture (Zhaashiigid (Shimek), 2014).

I began to realize that learning TEK differs from my experience in learning Western scientific knowledge (WSK), because Western learning has been more predictable as I steadily extract teachings from lectures and readings. On the other hand, my TEK learning has been based in relationship building with knowledge holders. I can't predict when I will be gifted with new knowledge in return for what I can share about wildlife populations and coexistence efforts, but looking back I have learned a great deal of phenological patterns and natural history of the area from relationship building with tribal elders.

I have learned many ways Anishinaabe TEK can take shape by working as an intern, wildlife technician, and now wildlife specialist for Mashkiiziibii Natural Resources Department (MNRD) of the Bad River Tribe. Doing traditional skills outreach with Bad River youth has

caused me to reflect on my own city upbringing and how much I can learn from people with long running relationships to the land. When I work with the MNRD Wildlife Technician, who grew up hunting and trapping on the Bad River Reservation, I find myself taking lots of notes when he relays his updated tactics to trap Amik (beaver; *Castor canadensis*), because through these conversations I am learning the animal behavior of how a beaver can foil a trap set by carrying the right sized stick in its mouth and how a desperate beaver may try to overwinter in a mudbank.

Bad River continues to foster a strong tradition of learning and living off the land- despite the attempted assimilation of boarding schools. This has meant that any given conversation I have with a Bad River tribal member who practices hunting, fishing, trapping, or gathering holds a lot of valuable knowledge, such as where Ma'iingan corridors run through the Reservation or how families traditionally leave some food scraps out to help coexist with Ma'iingan and other animals, a traditional form of what's called "diversionary feeding" in the conservation field.

TEK takes many forms and comes from many sources. I engage with TEK in a similar way to how I scrutinize scientific information in order to assess whether the knowledge may hold true from my perspective. I consider the positionality of TEK holders and scientists alike. I explore what assumptions underlie the TEK or the science. When given the opportunity, I put the TEK or the science to the test in my own experimentation, research, and conservation work. This approach is in line with the approach of Anishinaabe Botanist Robin Wall Kimmerer.

I have learned to involve both TEK and WSK in my research from MNRD and from Anishinaabe Botanist Robin Wall Kimmerer. One of many ways to do this is by conducting Western scientific experiments based on questions surrounding TEK. Kimmerer's student did this in a study on Wiingashk (Sweetgrass; *Hierochloe odorata*); they researched the effect on

sweetgrass growth of two different traditional harvesting techniques and a control of no harvest. The sweetgrass harvesters of both methodologies wanted to know which harvest technique had a better ecological impact. Kimmerer's student found that both ways of harvesting led to better sweet grass regeneration than the control of no harvest. Kimmerer concluded that this is an example of how humans can benefit our ecosystems if we foster the right relationships (Kimmerer, 2013).

Braiding Sweetgrass is full of teachings from Kimmerer in how to honor and draw from both WSK and TEK. I will now elaborate on reciprocity and the importance of incorporating it in working with land-based peoples, including indigenous folks and small farmers.

Reciprocity at the Foundation of Collaborations

Now that I have explored some of the ways TEK can take shape and be drawn upon, I will explain reciprocity, which is central to research partnerships with Anishinaabeg. Anishinaabe Botanist Robin Wall Kimmerer explains the Anishinaabe value of reciprocity by describing the plant responsibilities in the Iroquois three sisters' garden (Kimmerer, 2013).

> "The corn stands eight feet tall; rippling green ribbons of leaf curl away from the stem in every direction to catch the sun. No leaf sits directly over the next so that each can gather light without shading the others. The bean twines around the corn stalk, weaving itself between the leaves of corn, never interfering with their work. In the spaces where corn leaves are not, buds appear on the vining bean and expand into outstretched leaves and clusters of fragrant flowers. The bean leaves droop and are held close to the stem of the corn. Spread around the feet of the corn and beans is a carpet of big broad squash leaves that intercept the light that falls among the pillars of corn. Their layered spacing uses the light, a gift from the sun, efficiently, with no waste. The organic symmetry of forms belongs together; the placement of every leaf, the harmony of shapes speak their message. Respect one another, support one another, bring your gift to the world, and receive the gifts of others, and there will be enough for all."(Kimmerer, 2013).

I have worked to show reciprocity to the Bad River Tribe for the lessons I am continuously gifted by honoring and addressing TEK along with Western science. I follow Kimmerer's work in, because she is renowned for her ability to see through the Western

scientific and the Anishinaabe lenses in her studies of the natural world. She explains Western science's historical exclusion of TEK, which we can move past. In an interview, Kimmerer summarized how her embrace of both science and TEK contrasts with how many scientists treat TEK:

> "Both Western science and TEK are methods of reading the land. That's where they come together. But they're reading the land in different ways. Scientists use the intellect and the senses, usually enhanced by technology. They set spirit and emotion off to the side and bar them from participating. Often science dismisses indigenous knowledge as folklore — not objective or empirical, and thus not valid. But indigenous knowledge, too, is based on observation, on experiment. The difference is that it includes spiritual relationships and spiritual explanations. Traditional knowledge brings together the seen and the unseen, whereas Western science says that if we can't measure something, it doesn't exist" (Tonino, 2016).

Why Relationship Building Matters for Carnivore Coexistence

> "Consent, trust, accountability, and reciprocity are qualities of relationships that are critical for justice‐oriented coordination across societal institutions in any urgent matter. Yet they are precisely the kinds of qualities of relationships that take time to nurture and develop" (Whyte, 2019).

I have pursued my graduate education with an approach that embraces Western science and Indigenous Knowledge systems. I learned this approach to education and research from MNRD and the work of indigenous scholars such as Robin Wall Kimmerer, Winona LaDuke, Vine Deloria Jr., Kaitlin Curtice, Basil Johnston, and Kyle Powys Whyte. To adopt this approach in my education and research, I had to deconstruct certain messages I grew up with: that Western science always leads to solid and unbiased conclusions, that stories and Western science are incompatible, and that indigenous peoples existed only in the past.

In my work, I have strived to understand how my life and work has depended on the colonization of indigenous peoples and to address constructively the systems that continue to perpetuate settler-colonialism, as explained by Kyle Powys Whyte:

> "Settler colonialism is not entirely a matter of when or how one's ancestors came to the U.S.. Having settler privilege means that some combination of one's economic security, U.S. citizenship, sense of relationship to the land, mental and physical health, cultural integrity, family values, career aspirations, and spiritual lives are not possible—literally!—without the territorial dispossession of Indigenous peoples" (Whyte, 2018).

The colonization of Turtle Island (North America) is directly tied to the near or complete extirpation of wolves and other carnivores (David, 2009; Zhaashiigid (Shimek), 2014). The population of wolves and Anishinaabeg followed the same violent drop following European colonization, and in more recent history, have seen the same recovery (David, 2009; Zhaashiigid (Shimek), 2014). The colonization of indigenous peoples, including the Anishinaabeg, and the extinction threats faced by wolves and other carnivores are tied together. The Anishinaabe creation story of Ma'iingan and Anishinaabe (meaning spontaneous man in Anishinaabemowin) illustrates this connection and demonstrates the importance of indigenous knowledge systems.

The Creator put Ma'iingan and Anishinaabe together as brothers to travel the earth and name all of creation (Benton-Banai, 1988; Isham, 2019; Zhaashiigid (Shimek), 2014). Ma'iingan and Anishinaabe lived together and grew close, but when their job of naming all of creation was over, the Creator separated the two but told them that they would walk parallel paths (Benton-Banai, 1988; Isham, 2019; Zhaashiigid (Shimek), 2014). Ma'iingan and Anishinaabe are connected, what happens to one happens to the other (Benton-Banai, 1988; Isham, 2019; Zhaashiigid (Shimek), 2014). The root of the issues that threaten and endanger animals is the same as the issue faced by indigenous people: Western colonization and the broken relationships it has caused.

Indigenous peoples have survived colonization just as wolves survived near extinction in the continental U.S. (David, 2009; Zhaashiigid (Shimek), 2014; Whyte, 2017). Indigenous peoples have lessons to teach as the conservation field addresses climate crisis and mass

extinctions (McGregor et al., 2020). The colonization of Turtle Island and the rapid destruction of habitat and displacement of indigenous peoples has been called a form of climate change that indigenous peoples have survived (Whyte, 2019). Indigenous declarations have called for this respect, inclusion, and attention to indigenous knowledge for decades (McGregor et al., 2020).

The climate and extinction crises, which indigenous peoples hold unique knowledge about from being disproportionately affected by them, are quickly worsening. Building the needed trust and accountability to stop undermining the solutions of indigenous peoples takes time (Whyte, 2019). For more than 500 years indigenous perspectives on Turtle Island have been colonized or silenced (often with the help of our Western scholar predecessors), and we do not have time or justification to continue this trend.

It's a recent phenomenon that Indigenous governments are being engaged as the sovereigns they are in conservation by state and federal agencies (Whyte, 2013). And yet from my direct experience as a wildlife specialist for the Bad River Tribe and in the realm of wolf conservation in particular, state and federal governments have much to improve upon in honoring treaties with and inherent sovereignty of Tribes. Potawatomi Scholar Kyle Powys Whyte's work underlines a need for collaboration between indigenous and non-indigenous entities for environmental justice for both human and non-human beings (Whyte, 2013).

Coevolutionary Hypothesis of *Homo sapiens* and *Canis lupus*

> "The enemy of science is not religion. Religion comes in endless shapes and forms… The true enemy is the substitution of thought, reflection, and curiosity with dogma" (deWaal, 2013).

I have outlined how indigenous culture is embedded with long running and ecological knowledge. Thus, TEK and science can often converge. A historical connection between wolves and humans is not only supported by Anishinaabe culture, but also supported by some

evolutionary theory. In The First Domestication: How Wolves and Humans Coevolved, Pierotti, and Fogg work to support their hypothesis of coevolution/self-domestication with the wolf (Pierotti and Fogg, 2017). Pierotti is a professor at the University of Kansas and specializes in the evolutionary and behavioral ecology of mammals, including wolves. Fogg received her master's degree in Indigenous Nations Studies at the University of Kansas. The authors draw upon indigenous knowledge, evolution and systematics, and personal knowledge of coexisting with wolves to argue that Gray Wolves greatly shaped the human species.

> "These two species [Gray Wolves and Ravens (*Corvus corvax*)] helped code the memories of various peoples and cultural traditions as they adapted to the new environments they encountered. Even more important, these two species helped humans survive in lands about which the nonhumans knew far more than did the humans. Since most of these survival skills involved hunting and scavenging, it is hardly surprising that the most intelligent and social hunter [Gray Wolves] and the most intelligent and social scavenger [Ravens] are the two nonhuman species most often recognized as creators by the peoples of North America or that they also seem to be each other's closest allies.
>
> "Wolves may have been a major force that shaped human evolution, creating a territorial, cooperative, group-living species with strong family bonds from an intelligent ape which had been none of these. One major reason that Wolf (and Dingo) are viewed as creator figures is that they may literally have made us the humans we are today" (Pierotti and Fogg, 2017).

Pierotti and Fogg underpin their coevolutionary hypothesis by addressing the outdated conception in Western science that competition, rather than cooperation, is more prominent in ecology and evolution (Pierotti and Fogg, 2017; deWaal, 2017). One study found that in non-human animal species, cooperation composed 85 to 95 percent of recorded behavior (Pierotti and Fogg, 2017; Shouse, 2003). The Roman Catholic church was responsible for shaping some of the attitudes of the competition and dominion held by Western peoples towards carnivores.

> "The Roman Catholic church, however, attacked relationships between Europeans and the non-domestic animals with which they had cultural and emotional ties. When the

> church was solidifying its hold on European imaginations, it demonized European shamanic traditions and rituals in which animal spirits were invoked.
>
> "After the bears were all gone, the church turned to wolves with frightening efficiency. Such traditions emerged from the odd argument, endorsed by Augustine, Aquinas, and Descartes, among others, that animals lacked souls and the fostering confusion between human and animal nature was an abomination" (Pierotti and Fogg, 2017).

Pierotti and Fogg also criticize the outdated field of taxonomy, because the Linnaean system is reductionist and shaped by Christian creationism (Pierotti and Fogg, 2017). They warn of the ways creationism continues to influence some Western science and attributes this to the limited, human-centric way some researchers continue to view domestication, despite the fact that Charles Darwin argued that domestication and evolution were connected (Pierotti and Fogg, 2017).

Pierotti and Fogg's work is helpful and interesting in considering how humans and other animals may have shaped one another over evolutionary time- but some vulnerabilities in their arguments include the argument that apes are not communal or territorial and the contested way they define domestication.

Great Lakes States Failures to Consult Tribes and Honor Treaties

Some scientists have dismissed indigenous knowledge for being value-laden, but in actuality, the idea of objectivity taught to many Western scientists is flawed (Lynn, 2006). Lynn points to the Nuremberg trials and the Tuskegee study to exemplify the dangerous outcomes that result when we pretend science is free from human bias or can be truly objective. Additionally, the erasing, denial, or stealing of indigenous knowledge has serious consequences as the global loss of culture is tied to the global loss of biodiversity (Bannister, 2007; LaDuke, 1999; Lynn, 2006).

The way scientists have erased and denied indigenous knowledge has been damaging to Great Lakes Anishinaabeg (Johnston, 2012;Sanders, 2013; Zhaashiigid (Shimek), 2014). As an example, Anishinaabeg have been harmed by the way that state natural resource agencies have excluded Tribes in decision making around wolf conservation. In Wisconsin, under the Walker administration, the Wisconsin DNR ignored multiple Tribes' assertions of buffer zones in which Ma'iingan was not to be hunted within a buffer around reservations of ceded territory, in order to protect Reservation wolves (Sanders, 2013). In 2012, Bad River wrote to former WDNR Secretary Cathy Stepp and requested that Ma'iingan be protected from the planned state wolf hunts not only on the Bad River Reservation but also within a roughly 6-mile buffer zone beyond the reservation boundaries in order to adequately protect reservation Ma'iinganag which don't abide by the political boundaries of the reservation.

> "The [Wisconsin] DNR asserted that the tribal usufructuary right is 'a resource harvesting right, not a resource preservation or enhancement right infringing on the State's management authority'" (Sanders, 2013).

This reasoning provided by WDNR in actuality has infringed on the treaty rights of the Great Lakes Anishinaabe bands. Before colonization, part of the Anishinaabe traditional lifeway was protecting their brother, Ma'iingan.

> "For the Anishinaabe, wolves are revered for their caretaking. Wolves masterfully take care of their own families. Wolf pups are taken care of by an entire pack, and are well cared-for, even if the biological parents of those pups die. Wolves also masterfully take care of the other animals and the land. They cull diseased prey animals and keep grazing to an appropriate level to ensure the continued availability of important plant species" (P. Kebec, personal communication, December 12, 2020).

The State of Wisconsin needs to honor the treaties and trust responsibilities toward Tribes and the burden of proof is legal on the state to show that policies and decisions are the options which do the least harm to the Great Lakes Anishinaabeg (Sanders, 2013). Anishinaabeg ceded land to the Federal government in 1837 and 1842, before the State of Wisconsin existed, in

exchange for the promise that Anishinaabeg would be able to maintain their traditional way of life through explicit and implicit rights, which are still being parsed out between GLIFWC and the State of Wisconsin today (Sanders, 2013). The treaties are to be interpreted in the way the signatory Tribes would have understood the agreement. The 1842 treaty ensures the "usual privileges of occupancy" meaning that to this day, Anishinaabe lifeways must be protected.

> Article II of the 1842 treaty: "The Indians stipulate for the right of hunting on the ceded territory, with the other usual privileges of occupancy" (Treaty, 1842).
>
> Article V of the 1837 treaty: "The privilege of hunting, fishing, and gathering the wild rice, upon the lands, the rivers and the lakes included in the territory ceded, is guaranteed to the Indians" (Treaty, 1837).

GLIFWC Wildlife Biologist Peter David has been one of my mentors since 2017 and I have learned a great deal from his experience representing Anishinaabe bands' ceded territory rights in the drafting of the Wisconsin Wolf Management Plan. David describes the historic and current problems with the Wisconsin plan, pertaining to Anishinaabe lifeways and sovereignty:

> "One of the reasons GLIFWC has focused its efforts in Wisconsin is because relative to Minnesota, the approach in Wisconsin is much more draconian in terms of the impact it will have on the wolf population. In particular, Minnesota is not looking to substantially alter the population this first season, while Wisconsin has that as a specific goal. And that's one of the biggest issues that remain in the Wisconsin wolf-management plan; not only is it out of date—failing to incorporate what we've learned over the last 15 years [now 21 years] —but it also has this somewhat poorly defined population goal of 350 animals. As someone who was part of the team that drafted that original management plan, I can tell you that 350 was supposed to be a management threshold above which certain management activities would be permissible. Others, however, have glommed onto that 350 figure and said, 'That's our goal for the state, and we need to reduce the population down to it.' That's a position the tribes are very much at odds with" (Johnston, 2012).

The Minnesota DNR in the past has openly dismissed Anishinaabe wolf management input as a "cultural concern" and decided it should not have an influence in related decision making (Usik, 2015). This line of reasoning fails to recognize the ways in which European culture and thinking dominate wolf management in the U.S.. Values that can be traced back to

Europe before colonization, such as livestock husbandry, exploitation of the feminized earth, a Christian right to dominion, preference for the "more useful" domestic animal over wild animals, and an Aristotelian hierarchy that places humans above all wild animals, are often upheld by modern wolf management goals. The logic employed by the Minnesota DNR also reduces Anishinaabe nations from the sovereigns they are to a cultural interest group (Usik, 2015).

Ethicist Bill Lynn recommends using science for what it's best at, explaining tangible phenomena (Lynn, 2006). Scientists need ethics for guidance in the value-laden decisions related to how to conduct research and how the research findings may affect people, animals, and ecosystems. According to Lynn "ethics is a cross-cultural and cross-disciplinary dialogue that uses reason and evidence while discriminating between moral values" (Lynn, 2006). The more cultures and disciplines that inform a scientist's selection of moral values to conduct research with, the closer they can get to true objectivity since various lenses and experiences are drawn upon to reach evidence-based conclusions.

To the extent that co-management has occurred between the Great Lakes States and Anishinaabe Bands, wildlife populations have been better off when the Anishinaabe are included (Busihan and Gilbert, 2009). Ethical, scientific, traditional, and legal understanding all point toward the importance of states improving from the historic lack of respect for Anishinaabe sovereignty and values in the wolf hunts that occurred in the early 2010s (Sanders, 2013; Zhaashiigid (Shimek), 2014). Six Bad River Ma'iinganag were killed in 2013 hunts and two were killed in 2012 hunts according to GIS mapping by Lacey Hill Kastern during her time as MNRD wildlife specialist.

Federal Failure to Honor Trust Responsibility to Tribes

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) is a natural resources agency with delegated authority to represent and protect traditional lifeways on behalf of 11 Anishinaabe Tribes including the Bad River Band of the Lake Superior Tribe of Chippewa Indians (Isham, 2019). GLIFWC wrote a letter detailing the Great Lakes Anishinaabe Tribes' opposition to the United States Fish and Wildlife Service's (USFWS) proposed delisting of the Great Lakes Gray Wolf. The underlying reasoning for the Great Lakes Anishinaabe Tribes' opposition to delisting is that without federal protections, the Great Lakes states' lack of preparedness and the public's lack of tolerance and great responsibility in Ma'iingan mortality pose an imminent threat to the wolf. This merits the gray wolf at least the status of threatened under the Endangered Species Act (Isham, 2019).

The federal government, through the Endangered Species Act, has historically failed to fulfill its trust responsibility to Tribes in order to support traditional, indigenous lifeways (Zygmunt, 2004). Endangered Species Act listings and delisting are most often determined by litigation rather than informed by science, ethics, and trust obligations (Zygmunt, 2004). For the gray wolf and Anishinaabe treaty rights to truly be protected, it seems a new framework is needed moving forward:

> "In recognition of the importance of Ma'iingan as an iconic animal of North America, and an animal which suffers from human misconceptions about its dangerousness to human interests, GLIFWC, and its member tribes seek partnership with the Service to consider management frameworks outside the parameters of the Endangered Species Act, including the Tribes' reserved rights. Ideally, we would work together to change public perceptions about Ma'iingan and cooperate to ensure its ability to persist and thrive within the Great Lakes region, and other suitable areas within the United States, at the natural carrying capacity of these places" (Isham, 2019).

Relationship Building with Bad River Tribe

Now that I have laid a foundation for the importance of reciprocity, decolonization, and legal and ethical considerations in conservation, I will recount exactly how I did relationship building with the Bad River Tribe and with small livestock farmers in Northern Wisconsin to improve carnivore coexistence. Building rapport with the Bad River members and with livestock owners was central to my carnivore coexistence research. The trust I built with these groups and the knowledge I gained from them helped me design this study.

I designed my study to expand the scientific knowledge on non-lethal deterrents in a way that could be reproduced by a livestock farmer or a small natural resources agency. My rapport with the Tribe was built over a span of a year and a half, prior to my enrollment in graduate school. My background knowledge in livestock husbandry was built over a year prior to beginning my field research and aided in building rapport with farmers. I spent an unprecedented amount of time relationship building with the Tribe and farmers, compared to what would have been possible if I had not begun this work until I started pursuing my Master's degree. My graduate schooling, however, came out of the relationship I started building with the Tribe during my undergraduate studies. As a result, I have insider knowledge on issues, culture, politics, and ways on and off the Bad River Reservation that enriched my research.

I began my work with the Bad River Tribe as an intern for the Mashkiiziibii Natural Resources Program (MNRD) to gather input for the update of the Mashkiiziibii Ma'iingan Relationship Plan. I interviewed wolf biologists, white livestock owners, and tribal members about their attitudes toward wolves and asked for their input on the Tribe's Ma'iingan plan. The plan outlines protections for gray wolves within the reservation and within a six-mile buffer zone surrounding the reservation.

In addition to this work, I shadowed the wildlife, warden, and invasive species programs within MNRD. MNRD gave me a place-based learning experience that established my ability to conduct my graduate research by teaching me skills in wildlife tracking. Bad River Tribal Chairman Mike Wiggins Jr. has explained the approach taken by me and my mentor (also non-tribal) Lacey Hill Kastern as mimicking Anishinaabe approaches to our work as wildlife specialists for MNRD.

Through my internship with MNRD, I also gained an education in treaty rights and Anishinaabe culture. Thanks to my continuous education in treaty rights, I am able to better conduct research in a way that can support Anishinaabe bands in gaining full recognition of their treaty and inherent rights to hunt, fish, gather, relate, and live in a traditional way.

I wanted to work with an Anishinaabe Tribe because I wanted to gain a radically different and more complex understanding of the wolf than what was available in my own culture as a Western scientist. Western cultures portray the wolf as vicious in stories such as Peter and the Wolf or Little Red Riding Hood (Lopez, 2004; Zhaashiigid (Shimek), 2014; David, 2009; Williamson, 2011). In Europe, the forested habitat of the wolf was cleared and livestock replaced native prey, causing some European agricultural people to come into conflict with wolves and carry these fearful images of the wolf to the "New World" (Linnell and Cretois, 2018; Lopez, 2004). In more recent history, the wolf was nearly eradicated from the United States by the 1970s, leaving generations of farmers to learn their practice on a landscape with fewer predators. Today, some generational farmers may be wary of changing their husbandry practices, as a result of growing up farming in a way that didn't entail thinking about carnivore coexistence. Today, Bad River Tribal leadership and many livestock farmers in modern northern Wisconsin have a common interest in successful coexistence with predators: no predators killing livestock and no

humans killing predators in retaliation. Additionally, the farming community in the 1842 ceded territory seems to be shifting and growing as organic and regenerative farming is popular among Northland College graduates and other white settlers who end up on the Chequamgon Bay.

I translated my internship into an undergraduate thesis outlining recommendations for the update of the Mashkiiziibii Ma'iingan Relationship Plan and relocated to Ashland, WI- next to the Bad River Reservation. I spent a year between undergraduate and the beginning of my Master's working as a wildlife technician for MNRD and working with Lacey Hill-Kastern to acquire federal funds to sponsor my graduate education and research and to solidify the skills in wildlife tracking and outreach I began developing as an intern.

Relationship Building with Livestock Farmers

I grew up in a city and I had a lot of learning to do about farming culture before I could conduct my deterrent research. During my internship with MNRD, previous wildlife specialist Lacey Hill-Kastern emphasized the importance of understanding the diversity of people and lifeways in the Northwoods, in order to work together on common interests- including carnivore coexistence. Hill-Kastern grew up near the Bad River Reservation, is a hunter, and participated in 4-H as a student. Learning from Hill-Kastern's perspective and eight years as a wildlife specialist for MNRD prepared me to engage with people of diverse perspectives toward carnivores.

During my internship with MNRD, when I met with cattle farmers to interview them about their attitudes toward wolves and the aspects of the Mashkiiziibii Ma'iingan Relationship Plan, I was given a window into the history of livestock owner-government relationships in the area. Livestock farmers painted a picture of government scientists being out of touch with the everyday needs and lives of farmers (Fergus, 2017). One farmer told me that a government

scientist asked if he could just keep his cattle indoors during the black bear mating season. This was out of touch with the realities of livestock grazing whenever grass is growing (Fergus, 2017). This example demonstrates that some scientists may lack sufficient understanding of livestock husbandry to effectively troubleshoot conflict with farmers.

When some farmers recounted the loss of livestock animals to carnivores, they spoke with a mix of emotions including sadness for the lost animal and frustration, but not hatred toward the carnivore. Many small farmers hold a meaningful connection with their animals, that shouldn't be ignored by those trying to promote carnivore coexistence (Fergus, 2017). Many natural resource issues beyond carnivore coexistence, such as water quality and wetland preservation, depend on collaboration with farmers and scientists ought to build understanding and relationships with farmers. The insights I gained in engaging with cattle farmers of the Northwoods was essential for what was a prolonged task: recruiting farmers for my graduate research despite the bad taste in many farmers' mouths when it comes to government scientists.

During my first year in the Northwoods, I was also diving into agriculture outside of my studies and employment. I befriended a small, regenerative beef farmer who taught me about rotational grazing: a healthy way to move livestock across a landscape to make carbon sequestering grasslands, just as many extinct megafauna such as the mastodon once did (Savory and Butterfield, 1999). Carbon is sequestered by the healthy plants and soils that result from rotational grazing (Savory and Butterfield, 1999); the cattle are in reciprocity with the grasses they digest in their rumen and the soil they puck under their hooves.

In addition to showing me where the Tribe and livestock owners might have common interests, my cattle farmer friend taught me how to milk cows and move cattle to different pastures. This hard work gave me a small taste of the reality of a cattle farmer in the

Northwoods. This experience guided me in designing a research project that would take up as little of a farmer's stretched time as possible. Thanks to receiving lessons in livestock rearing, I was able to relate better with farmers and conduct effective outreach during my field research as unexpected carnivore situations arose.

Doing Carnivore Coexistence Outreach with Farmers

During my field research on non-lethal deterrent effectiveness, one farming community reported two sightings of a mountain lion. The Wisconsin Department of Natural Resources (WDNR) maintains a policy that they will only investigate mountain lion sightings if pictures of the animal or its tracks are provided, giving the rationale that people may mistake another large carnivore for the big cat. When members of the farming community first reported a mountain lion sighting to me, I stayed up into the night texting one member of the neighborhood. I sent her resources from other states with established mountain lion populations which contained advice on how to be safe on the same landscape as lions.

The next day, I traveled to the community to search for sign of a mountain lion, despite the fact that tracking conditions were abysmal following a lack of rain and in some places the compacted nature of the clay soil. Predictably, I failed to find mountain lion sign, but I was able to conduct some outreach with the members of the farming community to help them understand mountain lion behavior and how to keep their children and animals safe given the circumstances. One farmer opted to attach bells to horse saddles to keep her kids safer on their regular horseback rides through the woods, by warning any avoidant carnivore of their approach. The initial alarm experienced by farmers following the first mountain lion sighting subsided when they were given resources and when I assumed their sighting was plausible. I took time to consider what the farmers were experiencing emotionally, and based the actions I took on

helping ease stress by providing resources about the carnivore they may be sharing the landscape with. Ethologist and primatologist Frans deWaal's definition of cognition is the ability to take on another's perspective (deWaal, 2017) and this reminds me of the importance of wildlife professionals being able to put themselves in the boots of a farmer in working toward carnivore coexistence.

Later that summer, a different family within the same farming community reported a mountain lion sighting to me. Youth in the family were putting the chickens in for the night when they looked over about twenty-five yards away along a vegetated ditch to see what they reported as a mountain lion watching the chicken coop. While my trail cameras in this community and my tracking never produced mountain lion sign, at the end of summer a mountain lion was caught on camera thirty-seven miles north in the same county (well within one lion's range) with a dead coyote in its mouth (Myers, 2019).

It seemed effective to approach farmers with the assumption that their carnivore sightings were plausible, even if it is eventually discovered that a misidentification happened. The summer after my deterrent research, I continued consulting with a farmer who experienced significant poultry loss to a red fox and a feral cat during the deterrent research. One day in the summer of 2020, she and her family came home from a day trip and looked out the back sliding door of the house to see what they believed was a mountain lion eating a chicken. The farmer ran outside to shout it away and caught a clear view of it after it crossed a highway and stood in the neighbor's driveway, flicking its tail, looking back at the farmer, and not displaying fear.

The same week, some of the farmer's neighbors caught one of two very large bobcats on camera. The photo, along with the reported behavior consisting of lack of fear towards a shouting human and the targeting of chickens as prey, led me to conclude that the chicken-eating

culprit was most likely one of the large bobcats. Even though the farmer's initial impression of what carnivore she was interacting with was off, this farmer still required assistance reflecting on and learning from her sightings and then understanding bobcat behavior. Not only did the farmer need help to learn about coexisting with cats, whether a mountain lion or a bobcat, but I also needed the education. My background has been in studying gray wolves specifically and I held an unexamined assumption going into this research that I would not be potentially responding to interactions with mountain lions and bobcats. Responding to farmer reports when I have the capacity to is the most valuable training and learning I get toward doing carnivore coexistence and I encourage others in my field to take these opportunities for learning and outreach.

Following my own relationship building with the Bad River Tribe and northern Wisconsin livestock farmers, I worked to build relationships between these two groups. I also began my work in teaching other wildlife professionals how to do similar relationship building and learning when I co-organized the 2020 Mashkiiziibii Ma'iingan Symposium. I will conclude this chapter by reflecting on some of the lessons I gained from the symposium which pertain to the work natural resource professionals and carnivore researchers have ahead of us.

Lessons from the 2020 Mashkiiziibii Ma'iingan Symposium

> "After hundreds of years of interaction, many Euro-Americans do not understand the complexity of the relationship Anishinaabe (original man) in the region [the Western Great Lakes] have with the wolf (Ma'iingan). Nor do some Anishinaabe understand the Euro-American relationship to the world we all share. We have been neighbors for many years; we still have much to learn about each other. To start gaining ground on a mutual understanding, some tough issues and questions have to be raised" (Zhaashiigid (Shimek), 2014).

On January 31, 2020, Bad River Chairman Mike Wiggins Jr. welcomed scientists, tribal citizens, elders, farmers, veterans, and Chequamegon community members to the 2020 Mashkiiziibii Ma'iingan Symposium hosted by the Mashkiiziibii Wildlife Program at the

Northern Great Lakes Visitor Center. During this three day gathering, ahead of the anticipated 2020 delisting of the gray wolf, tribal, state, and federal employees, as well as citizens of the Chequamegon Bay area, came together to discuss Ma'iingan and the varying relationships and responsibilities we hold with and to the wolf.

I co-organized the Ma'iingan Symposium with a team from MNRD, Red Cliff Band Forestry & Wildlife Department, and GLIFWC. The Bad River Tribal Council saw a need for Anishinaabe-centered conversations about Ma'iingan after the painful experiences that led up to modern Ma'iingan hunts in the Great Lakes in the early 2012 and 2013.

Anishinaabe approaches to protecting Ma'iingan, a brother to Anishinaabeg, have not been historically embraced by the Wisconsin or federal government agencies (Sanders, 2013; Johnston, 2012). Under the Scott Walker governmental administration, the WDNR ignored Tribes' assertion of sovereignty in protecting Ma'iinganag (wolves) in a buffer zone, extending into ceded territory, around reservations. The protection of these buffer zones would more adequately protect reservation wolves as carnivores with a large territory and no regard for political boundaries (Sanders, 2013). At the time of the Ma'iingan Symposium, the Tony Evers governmental administration had just taken over from Walker's openly anti-wolf era. The symposium facilitated Great Lakes Anishinaabeg to remember and discuss trials and successes in protecting brother Ma'iingan in coordination with state and federal government actions or inactions. The symposium also greatly served non-tribal natural resources personnel- especially myself.

Aurora Conley, member of Ma'iingan Dodem or Wolf Clan and of the Bad River Band, co-organized the symposium with me. The symposium would not have been possible without Conley's charisma and knowledge of Anishinaabe ways. Conley ensured the symposium took

place in a honorable way, from providing gifts and hospitality to our guests to understanding how to respectfully and successfully "schedule" an Elder to share knowledge at a public event. Co-organizing the Ma'iingan Symposium was my first responsibility as Wildlife Specialist for MNRD and Aurora taught me how to honor and learn from the Anishinaabe ways in engaging with the community about our place in nature and about our relationship with other carnivores. I heard first hand from academic scholars and federal wildlife managers how the symposium held lessons that touched them and taught them. I will now summarize some lessons offered by Anishinaabe elders and scholars at the Ma'iingan Symposium that hold important implications for those in the natural resources field.

Rematriation

> "Some in the Anishinaabe community would ask, how can the state of Minnesota legislate the killing of my Wolf Brother? How can the state of Minnesota, after years of hard lessons, legislate a new variety of colonialism and racism directed at Anishinaabeg without consultation or consent? The statewide wolf hunting, trapping, and snaring season has been problematic for tribes to manage their resources as they see fit. Minimally, if there is something rare, endangered, special, or sacred to the Minnesota Ojibwe tribes, they should be allowed to care for it within Indian Reservations boundaries" (Zhaashiigid, 2014).

Western culture and colonization have stolen a great deal from indigenous peoples including land, technology, and kin. One example, raised at the symposium, of this theft that should be rematriated is the way in which the University of Minnesota stole and genetically modified the sacred food and medicine Manoomin (Wild Rice; *Zizania palustris*). I am using the relatively new term rematriation rather than repatriation intentionally. Many indigenous groups have adopted the term to better reflect their own culture rather than Western culture:

> "The Indigenous concept of Rematriation refers to reclaiming of ancestral remains, spirituality, culture, knowledge and resources, instead of the more Patriarchally associated Repatriation. It simply means back to Mother Earth, a return to our origins, to life and co-creation, rather than Patriarchal destruction and colonization" (Muthien, n.d.)

Manoomin can be translated to mean the good berry. Anishinaabeg found manoomin in the Great Lakes region, following prophecies that warned of danger from new people arriving at Turtle Island, if Anishinaabeg did not migrate as earlier discussed (About the Anishinaabe-Ojibwe; Benton-Banai, 1988; E. Leoso, personal communication, October 8, 2020).

In contrast to popular Western culture, Anishinaabeg understand the life and inherent value that exists in all the members of an ecosystem and that humans depend on other beings for our own life (McGregor et al., 2020). Altering the genome of a sentient being is generally unacceptable in Anishinaabe culture, so the history of University of Minnesota's work to "domesticate" manoomin for growing in agricultural systems was done without consent from Anishinaabeg.

At the symposium, White Earth Elder Zhaashiigid Nooding (Robert Shimek) shared about his ongoing conversations with the president of the University of Minnesota about the Manoomin that was stolen from Anishinaabeg and genetically modified. Zhaashiigid Nooding has been involved in Indigenous treaty rights battles since 1975, starting with the Boldt Decision, which affirmed Samish, Snoqualmie, Steilacoom, and Duwamish treaty rights to fish. Zhaashiigid Nooding has told the University of Minnesota president that an acceptable form of rematriation for this theft and botchery of a sacred food and medicine would be to assist in drafting a Tribal Endangered Species Act on behalf of the White Earth Band of Ojibwe.

There has been a history of the federal government influencing what plant and animal relatives can be afforded certain legal protections within reservations. The establishment of Tribal Endangered Species Acts, similar to Tribal Clean Water and Air plans, would improve recognition of tribal sovereignty in wildlife conservation. Tribal Wildlife and Natural Resources agencies are generally small and do both the work of engaging in the North American Model of

Wildlife Conservation (NAMWC) and all of its bureaucracy in addition to upholding and revitalizing traditional ways of relating with and stewarding ecosystems and all the animal and plant relatives that make up the ecosystem. This example highlights an area where non-tribally affiliated academics and professionals in wildlife can build good relations and perform rematrition, by supporting the improved recognition of Tribal sovereignty.

It is not logical for indigenous peoples to be held to solving problems such as biodiversity loss with Western governance and systems, when time tested indigenous knowledge systems exist that better aided indigenous people to live in balance with nature before colonization (McGregor et al., 2020). Additionally, environmental degradation and biodiversity loss continue and indicate that the NAMWC and other Western approaches to conservation are not proving to be effective (Lopez-Bao et al., 2017). Reducing the burden and work put on Tribes by the federal and state government as well as academia can better enable Tribes to focus on revitalizing traditional ways that can restore ecosystems.

Studying Indigenous Language and Culture

> "*The spirits announced that the Anishinaabeg would have the same voice as them. They were going to have to share the same language as the spirits. The language of the Anishinaabeg would be spiritually driven. And that was the only thing left to be done if the Anishinaabeg wanted to have a voice in the matters of the earth and the spiritual universe. This voice of the Spirits is the language Ojibwe Anishinaabeg continues to use today"* (Zhaashiigid (Shimek), 2014).

Indigenous culture and language are embedded with knowledge about the land- the same voice as the spirits (Zhaashiigid (Shimek), 2014; Mills, 2019). While we can translate to an extent between languages, there are often concepts that don't directly translate to Western concepts in the English language (Mills, 2019). Anishinaabemowin (Ojibwe language) and culture has been formed over millennia on the landscape that I now research carnivore

coexistence. As an outsider to this culture, Mashkiiziibii Tribal Chairman Mike Wiggins Jr. described my approach to carnivore coexistence work between the Tribe and neighboring livestock farmers as mimicking Anishinaabe ways. I do not claim to hold a deep knowledge of Anishinaabe ways and there will always be more that I do not know than what I do know, but it is an honor to be told that I've been a good enough student of Anishinaabeg to be respectfully drawing from their knowledge alongside my background in Western science. Any mistakes within this chapter are solely my own.

Incorporating Anishinaabemowin and culture in my work not only helps in my relationship building with the Tribe, but it also enriches the work that I do. The historic fear and persecution of the wolf by European pastoral people is well known and it is thanks to studying and mimicking Anishinaabe understanding of and love for Ma'iingan and other carnivores that I am effectively expanding carnivore coexistence.

One example of how we can study traditional knowledge held by Anishinaabeg is to study common root words (Lee, 2020). Ma'iinganiminaatig (Wolf Berry; *Symphoricarpos occidentalis)* translates into Wolf Berry Tree and grows in open forests and in prairies across Anishinaabe ceded territory (Lee, 2020). I hypothesize the reason this plant was named after Ma'iingan is the ecological benefits the plant provides for many other members of its ecosystem, similar to the way that Ma'iingan balances and improves the health of ecosystems. Ma'iinganiminaatig provides food, cover and nesting for birds, small mammals, and browsers (Lady Bird, 2009).

The Anishinaabemowin word for muhsroom is Wazhashkwedoons. Wazhashk means Muskrat. This connection reminds me of the Anishinaabe flood story about muskrat diving through the waters until they found earth. When they submerged where the other water animals

waited, the muskrat had drowned but had a fist of soil that was used to build the new earth on the turtle's back. The story of Wazhashk reminds me of the evolutionary story of how fungi made terrestrial life possible by subsisting on minerals from rocks and creating the soil that formed the earth. Wazhashkwedoons create life through decay just as Wazhashk gave life through death in the Anishinaabe story.

I came to these ways of thinking through Anishinaabemowin (Ojibwe language) after the past few years of learning Anishinaabe stories and from Anishinaabe Aki (Ojibwe land). Learning Anishinaabe stories and language opens me up to more lenses and ways of fulfilling my own roles to my ecosystems as a professional wildlife specialist and as a student of carnivores.

Language use also has implications for the way we treat the natural world. Robin Wall Kimmerer discusses the extractive implications of referring to beings such as plants as "it" and offers the pronoun "ki" like "kin" instead (Kimmerer, 2015).

> "Grammar is how we chart relationships through language, including our relationship with the Earth… And yet in English, we speak of our beloved Grandmother Earth in exactly that way: as "it." The language allows no form of respect for the more-than-human beings with whom we share the Earth. In English, a being is either a human or an 'it'" (Kimmerer, 2015).

After I complete my Master's education I intend to take the study of Anishinaabemowin more seriously so that I can support the Bad River community in revitalizing the language and so that I can pursue the deeper understanding that is only available when you can think in the language of a land.

Respecting Life with an Ecosystem Level Understanding

> "*One by one, individually, in pairs, flocks, herds, etc, the different plants and animals described how they would help Anishinaabeg. Some said, I will offer myself if they are hungry. Others said they would help if Anishinaabeg were sick one sort of way or*

> *another. Some even said they would give Anishinaabeg an itchy butt if she/he sat down on them. When asked how this was to help, poison ivy and stinging nettle said it would teach Anishinaabeg to always be aware of what was around them. A few even said that if they caught Anishinaabeg out in the bush by themselves, they would eat them. When asked how this was to help, grizzly bear and cougar said they would teach them to be respectful of all. And so it was, each member of the creation described to the Spirits and to Anishinaabeg how and what they would do to help."* (Zhaashiigid (Shimek), 2014)

Carnivore coexistence does not mean the complete absence of conflict. Instead, carnivore coexistence in part is about understanding the reasoning behind occasional conflict and how to avoid and navigate it. Carnivore coexistence may also require accepting some level of loss, but the cost of coexistence should not all fall upon farmers.

Some conflict is more avoidable than others. It is not uncommon for a hunting dog to be killed by wolves, but many cases involve hunters sending their dogs into wolf territory unattended for training or to hunt black bears. It seems that these hunters ignore the high conflict risk maps available on the WDNR website and from Treves and Rabenhorst (2017).

A federal wildlife biologist in attendance at the Ma'iingan Symposium had recently lost his canine companion to a wolf in what the biologist described as an uncommon accident. The wildlife biologist had been very close to his dog and they were not hunting when the dog got ahead of the biologist, happened upon a wolf, and was killed. At the tail end of a breakout session the wildlife biologist shared this story with attendees of the symposium. He explained that initially he was struggling with anger toward the wolf that killed his friend. Midway through the symposium, he shared that the conversations about Ma'iingan helped him to be more at peace with the situation. He explained that the symposium helped him remember that the wolf was doing their job by protecting their home from another, unknown canine. In the end, the wildlife biologist said that he could not remain mad at the wolf for doing what it was supposed to.

This experience demonstrates how if we look at coexistence issues on an individual or even species scale, it can be hard to process the emotions or ethics of a situation. Lynn discusses this issue as he points out the importance of recognizing the inherent value of living beings and doing away with human centric lenses (Lynn, 2006). His recommended solution aligns with the Anishinaabe way of considering things on an ecosystem level, so that the guiding ethic can be what is good for an ecosystem as a whole rather than debating over how valuable each sentient being is in comparison to one another. With this geocentric lense, or the consideration of what is best for an ecosystem and all its members as a whole, we can better understand how it is often for the best of the ecosystem and all of its individuals to have wolves, even if a side effect is the occasional killing of a domestic dog brought into wolf territory by humans.

There is an Anishinaabe story that tells of how humans have responsibility in conflict between undomesticated and domesticated animals. Animoosh (Dog; *Canis lupus familiaru*s) had run to warn Anishinaabeg that the animals were very tired of the way Anishinaabeg disrespected and abused them- some animals were even threatening to kill Anishinaabeg. Ma'iingan caught Animoosh in the act and revealed to the rest of the animals what had happened:

> "Turning to the dog, the bear speaking on behalf of his brothers said, 'For your betrayal, you shall no longer be regarded as a brother among us. Instead of man, we shall attack you. Worse than this, from now on you shall eat only what man has left, sleep in the cold and rain, and receive kicks as a reward for your fidelity.'
> "The bear turned again to the crowd. 'To make it difficult for man to enslave us again, no longer will we speak the same language. Instead we shall speak in different languages. From now on we shall live to ourselves, for ourselves. Let them learn to fend for themselves without our help'" (Johnston, 1976).

<u>Reciprocity in Community Engagement</u>

> "*Soon, Wenaboozhoo began pleading for Ma'iingan to help him out of the freezing water. He was getting so desperate that he told Ma'iingan that he would do anything he wanted in order to get assistance back to dry land. After a period of deliberation and listening to*

> *the increasingly pitiful pleadings of Wenaboozhoo, Ma'iingan finally turned his tail to Wenaboozhoo. After considerable effort, he was able to drag Wenaboozhoo out of the icy water to safety. In exchange for his assistance, Ma'iingan told Wenaboozhoo they now had to give names to all the plants, trees, animals, birds, fish and all gifts of the creation. When agreement was reached, they began their journey. This was one of the final steps in making sure Anishinaabeg had a comfortable life on earth."* (Zhaashiigid (Shimek), 2014)

When I entered into carnivore coexistence research, I held an unhealthy assumption that the only way I could benefit farmers and not waste their time was if I personally discovered effective solutions for their carnivore coexistence needs. Food subsidies in the United States, shaped by corporate interests like McDonalds, make it hard for small livestock farmers to get by. Both UW-Extension and USDA NRCS are understaffed in Northern Wisconsin and associated resources don't fully permeate the farming community. I knew conducting my research would benefit me, but I also wanted to try and benefit the farmers.

Even when I do not have concrete science or answers to offer, it has been apparent that sharing resources, listening, thinking and experimenting together makes a difference to livestock farmers and helps provide some piece of mind. Humans are communal animals and just as I don't want to feel like this problem is solely on my shoulders in the 1842 ceded Anishinaabe territory (northern Wisconsin), farmers don't want to feel they have no one to turn to when they run into conflict with carnivores

During a symposium break out session, one of the farmers I conducted the deterrent research with shared her story and philosophy behind the way she coexists with carnivores while rearing diverse livestock. She accepts that some mortality will happen, but works with me to explore whether there are ways to free range poultry despite them being an easy target for many carnivores. She understands that if she were to kill carnivores like red foxes or bobcats that come onto the farm, they will only be replaced by a new individual. It is better to work to establish an

understanding of coexistence with carnivores through means including non-lethal deterrents, human presence, and husbandry practices.

This farmer lost about $800 in poultry to a red fox during our study and Foxlights proved to be ineffective, in this situation, at keeping the fox from repeatedly taking chickens. During the breakout session the farmer also solicited advice from the group about ways we could try and improve coexistence the next summer. The group included other farmers, students, wildlife professionals, and generally interested community members. The farmer came away from the session feeling heard and energized to try again the next summer, and our partnership in learning carnivore coexistence continues to this day

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Conclusion

> "Decisions regarding wolf management should take into consideration the effect that decisions will have on the ecosystems that tribes depend upon, including the ceded territories in which tribes have usufructory rights. The exercise of reserved rights is dependent upon the existence of healthy and diverse landscapes and waterways. In our region, the presence of Ma'iingan is essential for the presence of many other important harvested species" (P.Kebec, personal communication December 12, 2020).

On October 29, 2020, the United States Fish and Wildlife Services (USFWS) removed the gray wolf from the Endangered Species Act list, excluding only the Mexican gray wolf population, despite five scientific reviewers underlining failures of science and ethics in this move. This move turns authority in making decisions which impact gray wolves, and thus the ecosystems they serve as keystone species in, over to states and Tribes. The delisting makes it even more important to note the failing history of state natural resource agencies in living up to gray wolf conservation and tribal trust responsibilities. As previously discussed, WWisconsin law pertaining to gray wolves is of particular concern.

Wisconsin law mandates that a wolf hunt must be hosted by the WDNR if wolves are off the Endangered Species Act list (29.185: Wolf harvesting licenses; (5) Seasons; zones). On September 23, 2020 the current WDNR board composed of hunters and farmers made it clear they want a hunt to take place at the start of 2021 (Wisconsin Natural Resources Board, 2020). Wisconsin law also mandates that if a landowner participates in the state wildlife damage abatement program, they must open up their land to the public for "hunting the type of wild animals causing the wildlife damage on that land and on contiguous land under the same ownership, lease or control" (29.889: Wildlife damage abatement program; (7m) Wildlife damage claim program).

It's also pertinent to note that the Wisconsin Wolf Management Plan is outdated, as it has not been updated since the 1999 publication of the plan. One of the many areas of concern

around the out of date nature is the inclusion and interpretation of a wolf population goal of 350 individuals. This outdated goal has been far surpassed by the current gray wolf population in Wisconsin- estimated to be between 1,034 and 1,057 individuals as of winter 2019. This means that Wisconsin wolf hunt quotas could entail the death of more than two-thirds of the current wolf population in the state.

Most tribal reservations within what is now Wisconsin offer protections for Ma'iingan against being killed under most circumstances, so it is reasonable to assume that after delisting many of the remaining wolves will be on or around reservation land, where they are not persecuted to the same degree if at all. This continues a history of a disproportionate burden Tribes carry to protect Ma'iingan and seems to weaken the USFWS position that wolves should be delisted.

> "This Order is issued by the Secretary of the Interior and the Secretary of Commerce (Secretaries) pursuant to the Endangered Species Act of 1973, 16 U.S.C. 1531, as amended (the Act), the federal-tribal trust relationship, and other federal law. This Order further acknowledges the trust responsibility and treaty obligations of the United States toward Indian tribes and tribal members and its government-to-government relationship in dealing with tribes. Accordingly, the Departments will carry out their responsibilities under the Act in a manner that harmonizes the Federal trust responsibility to tribes, tribal sovereignty, and statutory missions of the Departments, and that strives to ensure that Indian tribes do not bear a disproportionate burden for the conservation of listed species, so as to avoid or minimize the potential for conflict and confrontation" (Secretarial Order #3206).

While state and federal agencies demonstrate a failure to live up to wildlife conservation law or to craft laws supported by ethics and science, many Tribes continue to reclaim sovereignty in caring for their relationships to ecosystems in traditional ways and in employing Western science.

> "We know when we look at a global map of biodiversity hotspots- if you map the homelands of indigenous people and the diversity of indingenous languages- they map almost one for one. It is in our homelands where biodiversity is safeguarded. Our spiritual

> traditions and governance toward one another and our living world underline this way of life that protects and generates biodiversity" (Kimmerer, 2020).

Indigenous technologies like working with Ishkode (fire) to increase landscape biodiversity and wildlife habitat is one of many examples of the knowledge indigenous people hold- a pertinent example as climate change and extractive human practices increasingly threaten humans and other animals as wildland fires grow in frequency and deadliness.

In the 1842 ceded territory, there has been a cyclical history of collaboration between white settlers and Anishinaabeg to protect ecosystems and lifeways. Some white settlers have stepped up to support Anishinaabeg during the walleye wars leading up to Anishinaabe treaty rights affirmations (Nesper, 2002). White settlers also joined Anishinaabe led opposition during the successful fight against the proposed GTAC taconite mine in the penokees (Pearson, 2017).

Today this cycle continues; Bad River hosted the Ma'iingan Symposium ahead of the 2020 gray wolf delisting and has been asserting the Tribe's sovereignty in ordering the 63-year-old Enbridge Line 5 pipeline be removed from the Bad River Reservation. These histories and my studies have shown me the importance in relationship building to protect the biodiversity and climate we rely on from extractive, special interests. Improving carnivore coexistence can be done in relationship building outside of deterrent experimentation. In the immediate future, I plan to develop outreach to provide livestock owners and other rural people with information to help understand carnivores they share the landscape with and to better equip them to make informed decisions in realms including livestock husbandry and the disposal and storage of food, trash, and carcasses in the county.

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