INCORPORATING TRADITIONAL ECOLOGICAL KNOWLEDGE IN CURRENT AND FUTURE MANAGEMENT PLANS: COEUR D'ALENE TRIBE AND WESTSLOPE CUTTHROAT TROUT (ONCORHYNCHUS CLARKI LEWISI)

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Science

with a

Major in Environmental Science

in the

College of Graduate Studies

University of Idaho

by

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May 2016

AUTHORIZATION TO SUBMIT THESIS

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ACKNOWLEDGEMENTS

First and foremost I would like to express my extreme gratitude to the Coeur d'Alene Tribe for allowing me to work with them. A special thank you to Leanne Campbell for helping me to navigate through the proper protocols, supporting me throughout the project, and taking the time out of her busy schedule to meet with me and help me create the original idea for this project. I am eternally grateful to Vince Peone and Caj Matheson who were willing to take time out of their day to teach me about their culture and beliefs.

This research would not have been possible without the guidance, support and encouragement of Dr. Rodney Frey. His knowledge of the Coeur d'Alene and proper protocols, as well as his Tribal connections made this research possible.

I must also acknowledge Dr. Ro Afatchao for helping me from day one, leading me in the right direction and being my biggest advocate throughout the research process.

A special thanks also needs to be given to Dr. Jeff Hicke for his many suggestions and questions that assisted me in developing the final product.

I would also like to acknowledge Laura Laumatia, who suggested I focus my research on wetslope cutthroat trout and put me in contact with John Firehammer.

I also owe much gratitude to John Firehammer for taking the time to tell me about the current westslope cutthroat trout management projects and took me into the field to see the restoration projects.

ABSTRACT

People across the United States are being impacted by climate change. One group in particular, Native Americans, are being affected disproportionately as their life is inextricably linked to the environment. As various species are being lost due to the changing climate, and management plans are being created to help preserve and restore the species, it is imperative to incorporate Native American's traditional ecological knowledge (TEK) in these plans.

Focusing on the Coeur d'Alene Tribe, located in the panhandle of northern Idaho, this research attempts to incorporate TEK in the westslope cutthroat trout management plan. Westslope cutthroat trout populations have been declining for years, and are projected to decline even more as climate change continues.

This research includes comprehensive background on the science and TEK surrounding westslope cutthroat trout along with the already seen and projected climate change impacts. This information is used to create policy suggestions that include focusing on access to ancestral fishing grounds, implementing a top-down approach to management, increasing educational opportunities and encouraging changes at the national level.

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CHAPTER 1: INTRODUCTION

In the United States, one of the most vulnerable populations to climate change are Native Americans (Cordalis & Suagee, 2008; Green & Raygorodetsky, 2010; Lynn et al., 2013; Vinyeta & Lynn, 2013; Wildcat, 2013). The United States has 566 federally recognized tribes, approximately 34 state-recognized tribes and 6.4 million American Indian, Alaska Native and Hawaiian Natives. Tribes span both the continental United States, Alaska and Hawaii, residing in habitats that range from coastal wetlands, to arctic tundras and the dry plains (Wildcat, 2013). A portion of the indigenous peoples in the United States resides on Indian reservations. There are 310 legally recognized Indian reservations in the United States, which encompass 6.3 million acres of forests, 43 million acres of rangeland and 3 million acres of farmland (Merchant, 2002). Native Americans rely on the environment for cultural practices, sustenance, and income. Researchers predict climate change will affect Native Americans in a more significant manner than the rest of the United States population because the environment is heavily incorporated into Native Americans' cultural practices and economy; losing key species will have grave consequences on tribes' cultural identities and on their income (Cordalis & Suagee, 2008). Some researchers have taken this claim even further, referring to climate change as a "culture killer," explaining that losing important species will make it difficult for elders to pass their knowledge on to the younger tribal members. In addition to the loss of plant and animal species, Tribal members with the most knowledge to share (elders) will be most at risk to the impacts of climate change including heat waves, food stress, and water stress, potentially causing premature death (Parker & Grossman, 2012, p 14). Loosing both key species and the holders of knowledge would have a grave impact on the indigenous peoples culture (Parker & Grossman, 2012).

One aspect of tribal life that will be negatively impacted by climate change is the tribe's traditional foods. Whether hunted, fished, gathered, or cultivated, the food resources tribes obtain directly from the land they live on will suffer as the climate changes. Impacts may include problems accessing, finding, harvesting, storing, and processing food in their traditional manner (Lynn et al., 2013).

However, Native Americans have demonstrated a strong adaptive capacity, meaning tribes may have the ability to adjust to the changing climactic conditions. Although on the surface this sounds contradictory, in reality Native Americans, while susceptible to the impacts of climate change, have been adapting to changing circumstances for time immemorial. Through the use of Traditional Ecological Knowledge (TEK), they have the potential to not only adapt to climate change, but also inform adaptation policy and plans for the rest of society.

There are many different definitions for TEK and numerous and diverse names, however, for the purposes of this research I will use the commonly accepted definition put forth by Fikret Berkes in his book *Sacred Ecology*. Berkes defines Traditional Ecological Knowledge broadly as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (2012, p 7). While TEK systems today are different than those from centuries before, "many indigenous individuals still retain not only key memories and experiences of transformation and variability in their homeland environments, but also important modes of knowledge transmission, approaches to decision making, and particular values and worldviews" (N. Turner & Spalding, 2013, p 1). This knowledge can be useful in policy and

management planning for important species, both by filling knowledge gaps in historical information, and through proposing different methodologies.

In an attempt to demonstrate how TEK can be incorporated into policy and management planning, I worked collaboratively with the Coeur d'Alene Tribe to determine if TEK can be integrated into the current westslope cutthroat trout (*Oncorhynchus clarki lewisi*) management plan, and assess if TEK could assist in future climate change management plans for this same species.

The Coeur d'Alene or Schitsu'umsh (the name they call themselves in their own language), historically lived throughout the Idaho Panhandle, into eastern Washington and western Montana, with Lake Coeur d'Alene at the "very heart" of their landscape (Frey, 2001). Historically, tribal members fished for both the adfluvial and resident cutthroat trout in Lake Coeur d'Alene, harvesting up to 42,000 fish a year. However, the westslope cutthroat trout population in the Coeur d'Alene basin has declined due to the construction of dams, introduction of species that are outcompeting the westslope cutthroat trout, habitat changes, and agriculture runoff (Firehammer, Vitale, Hallock, & Biladeau, 2013). In turn, Coeur d'Alene Tribal members have significantly reduced access to westslope cutthroat trout.

Adding to the current problems facing westslope cutthroat trout is climate change. Cutthroat trout reproduce in the coldest streams in the area. As the climate warms, cutthroat trout will have a difficult time finding streams that are cold enough for their survival. Warmer streams will also create more competition, as many of the introduced species in the area, such as rainbow trout, can tolerate warmer water than the westslope cutthroat trout. Changes in precipitation from snow to rain-on-snow events will cause lower summer stream

flows, decreasing suitable cutthroat trout habitat in streams (Northern Rockies Adaptation Partnership, 2014)

Beginning in 1990, the Coeur d'Alene Tribe's Fisheries and Water Resources Program dedicated its time and resources to the restoration of westslope cutthroat trout. Funded through the Bonneville Power Administration (BPA), the fisheries program focuses their efforts on six key actions, which were recommended by the Coeur d'Alene Tribe. The six actions include habitat restoration in four key watersheds (Alder, Benewah, Evans and Lake Creek), purchasing lands in the key watersheds, education and outreach, creating a fishery, creating and operating a trout production facility, and monitoring and evaluating the first five actions (Firehammer et al., 2013).

Research Goals

Working collaboratively with the Fisheries program and tribal members, the goal of the research was to develop comprehensive background on the scientific and traditional ecological knowledge (TEK) surrounding the species and the already seen and projected climate change impacts, to ultimately use this information to create policy suggestions with a main goal of portraying TEK alongside scientific knowledge as equally important. The final result of this project was to help protect, preserve and perpetuate the cutthroat trout for the Coeur d'Alene Tribe.

Methodologies

Prior to beginning research, proper Coeur d'Alene Tribal and University of Idaho protocol was followed. As this project involves both ecological data and cultural information,

permission from both the Coeur d'Alene Natural Resource and Culture Committees was obtained. All information acquired during this research proceeded through proper Coeur d'Alene Tribal protocols, and no information was or will be shared without the permission of the tribe.

The research for this project can be divided into two categories, (1) accumulation of scientific data from Coeur d'Alene Fish Biologists and peer-reviewed literature, and (2) gathering of traditional knowledge through interviews with Coeur d'Alene Tribal members.

To complete the research for the first category, I proceeded to: a) consult with Jon Firehammer, fish biologist for the Coeur d'Alene Tribe to obtain ecological data on current and past management practices for westslope cutthroat trout; b) make on site visits of the Benewah Creek and Lake Creek restoration projects with Jon Firehammer; c) obtain information from interviews with him; d) use information from the Fisheries' Coeur d'Alene Basin Annual reports which describe the yearly activities of the project entitled "Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation;" and e) analyze peer reviewed literature on westslope cutthroat trout.

To complete the interview portion of the research (Category 2), I first received approval from the University of Idaho Institutional Review Board to conduct interviews with Tribal members. I then began finding interview candidates by implementing snowball sampling. I interviewed two enrolled, Coeur d'Alene Tribal members, asking questions that focused on climate change, westslope cutthroat trout, and historical and current fishing practices. The interviews were qualitative, with a number of open-ended questions (see appendix), and additional follow up questions. I devised the questions with some input and additional question suggestions from Jon Firehammer. The questions were aimed at filling in

some of the gaps in historical westslope cutthroat trout data and ideally to aid in continued management and restoration of cutthroat trout. Each interviewee was presented with an Informed Consent Form to sign (see appendix 2). The interviewee had the option of remaining confidential or allowing his name to be associated with the information that he provided. The interviews were informal and included some participant observation including driving and walking around the Benewah Creek watershed. While there was a list of questions to guide the interview, follow up questions and additional questions were added depending on the information provided by the interviewee.

Once the interviews were completed, I compiled all of the material. Jon Firehammer has expressed concern about the validity of the knowledge provided by Tribal members, citing a common misconception he often hears from Tribal members that there are cutthroat trout that spawn in the Fall (which is not accurate). In an attempt to ensure validity, I compared responses from each of the interviewees to determine trends and patterns in the information provided. I sorted through the ecological data provided by Jon Firehammer, information obtained in peer-reviewed journals, as well as the TEK obtained through interviews.

I used the information to assess (1) if TEK can add to the current management plan, (2) where TEK can be incorporated into the current management plan and (3) how TEK can be incorporated into future climate change and policy management plans. The final product was written suggestions that incorporate the ecological data and TEK, as well as an analysis of the feasibility of these suggestions for both current management and future climate change management of cutthroat trout.

All information and conclusions obtained through the interviews will be given to the Tribe and the Fisheries department. The intent is for the Coeur d'Alene Tribe to be able to utilize this research to assist in protecting, preserving and perpetuating cutthroat trout, as well as creating a framework that could be used for creating management plans for other key species.

Research Motivation

I received my Bachelor of Science degree in Environmental Science from Stockton University in New Jersey. After receiving my BS, I served as a Community Environmental Conservation Extension Agent Peace Corps Volunteer in a small, rural town in the central mountains of Panama. Serving as a Peace Corps Volunteer in Panama, I was required to perform a Community Analysis by spending three months informally interviewing community members about community groups, the environment, and where community members felt their town needed improvements. While my community was not an indigenous community, there was an exceptional amount of local environmental knowledge. Most families had lived in this small rural town for generations, cultivating the same land every year. A majority of community members were taking note of the changes occurring due to climate change such as decreases in the length of the rainy season, but increases in the amount of precipitation occurring at once, and new epidemics that were plaguing their orange and coffee trees (their largest source of income). My 75-year-old host mother did not attend school past sixth grade, she was mostly illiterate, but her knowledge of the changing environment, and her methods for coping with these changes was both practical and impressive.

My largest project, chosen by my community, was to build thirty eco-stoves to assist in the mitigation of climate change. Traditionally, community members cook by placing a large pot on top of three rocks and creating a wood fire underneath. This technique utilizes large quantities of firewood, causing deforestation, and emits a great deal of smoke. Eco-stoves are built out of bricks and enclose the flame. The fire burns hotter, using less firewood and emitting less smoke. I trained community members on how to build the stoves; however, as we expanded the project throughout the community, local participants would add their own ideas and tweak the construction of the stoves. It was amazing to watch people, with at most a high school education, make effective and practical changes to eco-stoves that were designed by engineers.

Living in this community for two years, learning as much, if not more, from my community members as they learned from me, piqued my interest in how local, place based knowledge can be utilized to both mitigate and adapt to the impacts of climate change. It was while finishing my Peace Corps service that I decided I wanted to learn more about local and traditional knowledge and how varying types of knowledge can assist in the mitigation and adaptation of climate change.

My interest in working with indigenous people to incorporate different types of knowledge into climate change management was further advanced after I had the privilege of attending the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties 21 (COP 21) in Paris, France in December of 2015. At this international conference, I heard many indigenous people speak, witnessed indigenous protests and learned even more about the benefits of indigenous knowledge when combating climate change. While the Paris Agreement was agreed upon by 195 nations, indigenous

peoples were once again left out of this historic, and important global agreement. The agreement does make mention of indigenous peoples and indigenous knowledge; however, the clause "as appropriate" proceeds the encouragement of the use of indigenous knowledge when it comes to adaptation. This clause makes the incorporation of indigenous knowledge an option for countries, not a legally binding requirement. Participating in the conference and witnessing indigenous people once again pushed aside in an important global agreement, reasserted for me the need for further action on the part of researchers and indigenous people to encourage the incorporation of traditional knowledge in local climate change management plans. Attending this convention reaffirmed my interest in working with indigenous people and the importance of this research.

Working with indigenous groups can be a difficult task, and it can take years to build up a relation with a Tribe. I was afforded the opportunity to work with the Coeur d'Alene Tribe because of the relationship my advisor, Rodney Frey, already had with this group. His knowledge of the proper protocols and connections within the Coeur d'Alene Tribe afforded me the opportunity to complete my research with the Coeur d'Alene.

Traditional Ecological Knowledge: An Overview

Traditional Knowledge (TK) can be defined as "knowledge, innovations and practices of Indigenous Peoples" (Mclean, 2010, p 12). TK has been essential in varying fields of study including sustainable development, agroforestry, traditional medicine, applied anthropology, biodiversity conservation and natural resource management. Researchers now predict that Traditional Knowledge will become an integral component of climate change science, specifically in adaptation to the changing climate (Nakashima, D.J., Galloway McLean, K.,

Thulstrup, H.D., Ramos Castillo, A., Rubis, 2012). The ability to be adaptable and resilient can be more specifically traced to Native Americans Traditional Ecological Knowledge, political sovereignty and community ties (Parker & Grossman, 2012). Traditional Ecological Knowledge (TEK), can be defined as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 2012, p 7). However, it is important to note that there is no definition of TEK that is universally accepted. Fikret Berkes points out the problem, explaining the ambiguity of the term "traditional" and of the term "ecological knowledge". Traditional can imply something that is not changing; yet in the context of traditional ecological knowledge the information is always changing. If the term ecological knowledge were defined from the point of view of Western science, the expression "traditional ecological knowledge" would be an oxymoron. The definition Berkes uses takes the terms traditional and ecological knowledge at their broadest interpretations. Daniel Wildcat further explains TEK, "indigenous peoples draw on practical lifeway experiences—not one person's experience—but that of entire nations and communities to share multi-generational 'deep spatial' knowledge of empirical landscapes and seascapes." (Wildcat, 2013, p 501). While TEK has become an accepted term in the Western science world, many indigenous people would not describe their knowledge using this term. For indigenous people, knowledge is a process not an object, as the definition of TEK implies (T. Williams & Hardison, 2013). Indigenous knowledge is " a set of relations and relationships situated in our life experiences, which vary as we move through what physicists would call space-time." Indigenous people

do not view knowledge stringently through human constructions but also through collaborations (Wildcat, 2009, p 73).

The Coeur d'Alene Tribe is an excellent example of an indigenous group where the published definition of TEK is not entirely applicable. For the Coeur d'Alene Tribe, the overarching definition of TEK is not incorrect, but it is also does not properly convey the entirety of Coeur d'Alene culture.

Hnkhwelkhwlnet: A slightly different view on TEK

Hnkhwelkhwlnet means "our ways of life in this world" in the Coeur d'Alene Tribe's language. While *hnkhwelkhwlnet* is similar to traditional knowledge, it is not exactly the same (Campbell et. al. , 2005). In understanding *hnkhwelkhwlnet*, it is imperative to comprehend where Coeur d'Alene teachings originated. Spiritual beings including, *Amotqn*, or the Creator, and the First Peoples, prepared the world for the Coeur d'Alene, by imparting "gifts" such as food (deer, berries, roots, fish), and spiritual powers, and by conveying teachings. These teachings, passed down through oral tradition (stories), originated at the beginning of time and communicate "the understanding that the landscape is spiritually created and endowed" (Frey, 2001, p 9).

A recent project completed on *Sqigwts* (water potatoes) outlines the three major differences between the Coeur d'Alene *hnkhwelkhwlnet* and the more generally defined traditional ecological knowledge. The first difference entails understanding that with *hnkhwelkhwlnet,* knowledge and action are combined, focusing on "ways of living." The Coeur d'Alene do not separate doing from knowing in their teachings. Traditional ecological knowledge, on the other hand, as the name implies focuses only on "knowledge" (Campbell et

al., 2015)

The second difference relates to the adaptability of TEK versus the adaptability of *hnkhwelkhwlnet*. One of the characteristics of TEK is that it is adaptable; it changes and evolves over time. *Hnkhwelkhwlnet*, while adaptable, is distinctive in that the teachings don't change. The teachings passed down from the First Peoples through oral traditions continue to maintain their bones. The metaphor used is a tree; the trunk and roots of the tree continue to remain the same, however, the branches of the tree move as the wind blows and there are even branches from other trees grafted onto the trunk. Change occurs, but the roots, the teachings, continue to remain the same. This concept ties into another term that is central to the Coeur d'Alene way of life, *snukwnkhwtskhwts'mi'ls stsee'nidmsh* or empathetic adaptability. *Snukwnkhwtskhwts'mi'ls* directly translates to mean "fellow sufferer" and *stsee'nidmsh* translates to "adaptive." The Coeur d'Alene are able to understand and incorporate other ways of thinking and feeling (*snukwnkhwtskhwts'mi'ls)* and adapt (*stsee'nidmsh)* as necessary. Continuing with the tree analogy, this is what allows the Coeur d'Alene to graft more branches onto the tree. The Coeur d'Alene have been adapting to both social and environmental changes for years through the use of *snukwnkhwtskhwts'mi'ls stsee'nidmsh,* and will be able to use this same concept to continuing adapting successfully to climate change (Campbell et al., 2015).

The third difference between TEK and *hnkhwelkhwlnet* relates to the western definition of knowledge. Since the stories originated with the First Peoples, the teachings do not fit the western definition of knowledge, which generally refers to knowledge as something that is "acquired through human experience or education." TEK relies on the western definition of the word knowledge, implying the information involved in TEK originates with

humans. *Hnkhwelkhwlnet* doesn't necessarily conform to this definition of knowledge, since a central factor in the landscape of the Coeur d'Alene is that their teachings come from the Creator and the First Peoples (Campbell et al., 2005).

Past Research that Incorporates TEK and Western Science

The first time TEK was documented in western science climate change research, was in 1969, when Richard Nelson highlighted how Inuit hunters have vast knowledge of polar snow-ice regimes (Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A., Rubis, 2012; R. Nelson, 1969). Nearly a decade later, Robert Johannes paved the way for researching and implementing traditional knowledge in relation to artisanal and commercial fisheries. Johannes established that a majority of the traditional marine conservation techniques being used in the western world, originated hundreds of years ago in the tropical Pacific (Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A., Rubis, 2012). As a whole, Indigenous Peoples across the globe have used TEK to both adapt to the impacts of climate change and mitigate climate change. Strategies implemented "include application and modification of traditional knowledge; shifting resource bases; altering land use and settlement patterns; blending of traditional knowledge and modern technologies; fire management practices; changes in hunting and gathering periods and crop diversification; management of ecosystem services; awareness raising and education, including use of multimedia and social networks; and policy, planning and strategy development" (Mclean, 2010, p 14).

Researchers have asserted that TEK can be used as an "early-warning system for the rest of humanity" (N. J. Turner & Clifton, 2009, p 181) Tribal members that rely on their land have noticed changes in land and water prior to Western scientists (Parker & Grossman, 2012). For example, many tribes rely on phenological changes to alert members on when to harvest berries, fish, or hunt. When there is even a slight change in these indicators, the tribal members notice. As the climate is changing, the phenological indicators are deviating from their norms (N. J. Turner & Clifton, 2009).

In the most recent Intergovernmental Panel On Climate Change (IPCC) report, the IPCC acknowledges the importance of traditional ecological knowledge in the face of climate change, explaining, "Indigenous, local, and traditional knowledge systems and practices, including indigenous peoples' holistic view of community and environment are a major resource for adapting to climate change" (2014, p 26). However, the IPCC points out that current climate change adaptation efforts often neglect traditional knowledge. They assert that, "integrating such forms of knowledge with existing practices increases the effectiveness of adaptation" (Ipcc, 2014, p 26). Donald R. Nelson, Colin Thor West and Timothy J. Finan, further articulate this concern claiming that adaptation plans "historically focused on technologies and the elusive search for large-scale, cookie-cutter solutions, leaving aside the important role that individuals, cultures, and societies play in constructing and living out an adaptation dynamic" (Nelson, West, & Finan, 2009, p 271). Yet, the incorporation of TEK in climate change adaptation planning is still rare, and it is even more uncommon for scientists to treat TEK with the same importance as western science.

Deppisch and Hasibovic (2013) explain that when doing climate change research, it is imperative to utilize a trans disciplinary approach. They elaborate explaining that a trans

disciplinary approach utilizes scientific and non-scientific societal knowledge, combining abstract and case-specific information to resolve a problem. This concept can easily be applied to the idea of combining TEK and Western science. TEK and Western science can work together to assist both indigenous people and the rest of the population mitigate and adapt to climate change. However, it is imperative for researchers to have a comprehensive understanding of both knowledge systems, prior to beginning research. Western science "develops rapidly by testing the validity of hypotheses with experimental manipulation in a highly controlled setting via the application of standardized procedures, and is most often passed on via writing in an academic setting" (Vinyeta & Lynn, 2013, p 14) This contradicts with TEK, which "involves the accumulation of highly localized, experiential, place-based wisdom over a long period, most often passed down orally from generation to generation" (Vinyeta & Lynn, 2013, p 14).

Nevertheless, TEK and western science can be complementary instead of contradictory. One argument states "TEK systems are value-laden, consisting of inextricably integrated observation, experience, beliefs and philosophies. In this sense they differ from scientific knowledge, for which striving for objectivity is a key element" (N. J. Turner & Clifton, 2009, p 181) This way of knowing, through values and beliefs, could be a beneficial method for responding to climate change (N. J. Turner & Clifton, 2009). Another researcher explains TEK as being "how to," because the emphasis is on relationships between people and living and non-living entities. Western science focuses on "what is" because scientists emphasize facts (Cochran et al., 2013).

There are also similarities between TEK and Western science. Both use empirical observations, rely on recognized patterns and change as facts are proven, disproven or

improved. TEK and Western science have the potential to work together; TEK can provide qualitative data that spans long time periods that Western science lacks and Western science can provide quantitative data (Vinyeta & Lynn, 2013). It is important to realize that TEK and Western science do not need to be merged into a single framework when dealing with climate change, but instead should each be accepted individually as providing solutions (Cochran et al., 2013).

An important concept in indigenous worldviews is the concept of "kincentric ecology." "Kincentric ecology" refers to the view that "other life forms- both plant and animal- and even non-living entities such as the sun, mountains, waters and winds, are regarded as having human traits, and as being, in fact, our relatives: generous relatives who give of themselves so that humans may live" (N. J. Turner & Clifton, 2009, p 181). This is one of multiple indigenous worldviews that could help combat climate change, as this viewpoint instills the idea of everything being connected. This worldview allows indigenous peoples to understand how climate change is impacting the entire system (N. J. Turner & Clifton, 2009).

While incorporating TEK into adaptation planning can be beneficial to both tribes and the rest of society, there are some legal factors that need to be considered, factors many researchers ignore. It has been asserted that "the cultural, legal, risk-benefit and governance contexts in which knowledge exchanges occur have been under-examined" (T. Williams & Hardison, 2013, p 537). There are many customary norms regarding traditional knowledge including "who may use it, when it may be used, appropriate uses and the rituals, words or practices that must accompany its use" (T. Williams & Hardison, 2013, p 534). Once knowledge has been shared to someone outside the tribe, this person may share the

information with a third party. The third party is not obligated by law, and has likely not agreed to uphold social conventions and may not even know such social conventions exist. This makes the sharing of traditional knowledge risky for indigenous peoples, and causes a predicament. Sharing knowledge may mean losing control of that knowledge, but not disclosing traditional knowledge may mean the indigenous groups values will not be reflected or protected in climate change adaptation plans. One suggestion to assist with this problem is to use a governance mechanism when dealing with traditional knowledge exchanges (T. Williams & Hardison, 2013).

In 2014 a working group of indigenous peoples, staff of indigenous organizations and governments, and people with experience working with traditional knowledges created "Guidelines for Considering Traditional Knowledges in Climate Change Initiatives." These guidelines suggest a multitude of steps that can be taken when working with traditional knowledges including consulting with indigenous governments to develop an appropriate research agreement, disclosing any constraints on protecting sensitive or confidential information, using appropriate language when referencing the role and content of TKs, and not expecting indigenous peoples to share TK in return for sharing important data that could help indigenous efforts. (Climate and Traditional Knowledges Workgroup (CTKW), 2014).

Research related to the impact of climate change on American Indians, Native Alaskans, Hawaiian Natives and indigenous people across the globe is growing. Some researchers often feel they need to prove that TEK is comparable with western science. A study performed in Somoa evaluated traditional weather observations by using Somoan literature and speaking with a few Somoan elders. The researcher compared Somoan names and descriptions of clouds, wind and a seasonal calendar with the scientific equivalent,

asserting that the Somoan classifications of each climatic event are consistent with Western science classifications. Taking the comparison one step further, researchers compared traditional Somoan methods of climate analysis with western science equivalents, comparing the appearance of cockroaches to using a barometer, and hermit crabs entering their holes to the use of an anemometer. The research concludes that TEK is just as important as Western science in researching and planning for the impacts of climate change (Lefale, 2010). While western scientists feel it necessary to prove that TEK is comparable to western science, placing TEK into a western science framework often means taking TEK out of context. There needs to be a method that allows TEK and western science to be of equal significance , not molding TEK to fit into western science ideology. One approach to this is to utilize a Multiple Evidence Base (MEB) approach. Using this approach, TK is not forced into a western science framework; instead, TK and western science are validated independently of one another, and then used collaboratively (Climate and Traditional Knowledges Workgroup (CTKW), 2014).

Researchers have recommended a multi-pronged framework for including indigenous perspectives in climate change adaptation planning in five steps. While this framework was written with Alaskan Natives in mind, the general concepts can, arguably, be applied with other indigenous groups. Step one is to "engage communities in designing climate-change solutions." This includes allowing tribes to develop their own adaptation plans with the support of outside agencies. Step two is to "create an environment of mutual respect for multiple ways of knowing", where acceptance of TEK by western scientists and politicians is important, and understanding other forms of traditional knowledge that indigenous people rely on is valued. Step three is to "directly assist communities in achieving their adaptation

goals." Directly related to step one, step three encourages government agencies and non-governmental organizations to assist tribes in achieving their adaptation plans. Step four is to "promote partnerships that foster effective climate solutions from both western and indigenous perspectives." Many scientists use TEK in their research, but they do not actually apply TEK when problem solving; step four encourages the application of traditional knowledge. The last recommendation, step five, is to "foster regional and international networking to share climate solutions." Networking can include tribes working together, researchers working with tribes and other outside agencies working with tribes. There needs to be a collaborative effort (Cochran et al., 2013).

One report that has successfully incorporated western science and TEK is the Arctic Climate Impact Assessment (ACIA). Not only do the researchers use TEK, (though it is referred to as "special knowledge"), the project is also a collaboration between eight countries including Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States. Governments, non-governmental organizations and indigenous groups came together to create a detailed report on how climate change is impacting the Arctic (Hendry, 2014). This type of collaborative report represents excellent progress in incorporating not only TEK and western science, but also different nations and organizations.

This research attempts to incorporate TEK on a much smaller scale, assessing how TEK can be incorporated into local management plans for one specific species, westslope cutthroat trout. However, this assessment is arguably just as important as and relevant as incorporating TEK in large, multi nation climate change plans.

CHAPTER 2: WESTSLOPE CUTTHROAT TROUT

Life History of Westslope Cutthroat Trout

Cutthroat trout are part of the family Salmonidae, referred to as Salmonids and within the genus *Oncorhynchus* (Quinn, 2005). Generally cutthroat trout are identified by the two streaks of red located under their jaws (Trotter, 2008). There are fourteen subspecies of cutthroat trout, twelve still in existence today and located throughout the Rocky Mountains, Great Basin west and the Pacific Northwest Coast (Quinn, 2005; Trotter, 2008). The subspecies of cutthroat trout vary greatly in appearance (Quinn, 2005). Many of the cutthroat subspecies are isolated populations and never come in contact with other cutthroat subspecies. This creates great diversity among cutthroat trout. There are both anadromous (live part of their life in salt water) and freshwater forms of cutthroat trout (Quinn, 2005).

The westslope cutthroat trout (*Oncorhynchus clarki lewisi*), the subspecies of cutthroat trout located in the Coeur d'Alene Basin, are nutritionally and culturally important to the Coeur d'Alene tribe, and have a unique natural history. While the exact historical range of the westslope cutthroat trout is unknown, fish biologists have pieced together what is believed to be their native range throughout Western North America (Behnke, 1992). Westslope cutthroat trout span both sides of the Rocky Mountains including the "upper reaches" of the Colorado, Rio Grande and Missouri River systems (Quinn, 2005). West of the Continental Divide, westslope cutthroat trout can be found in the Columbia basin, including the upper Kootenay River from Libby, Montana into British Columbia where the headwaters of the Kootenay is located, along with the Idaho tributaries of this same river. Westslope cutthroat trout can also be found from the Clark Fork drainage in Idaho and Montana, down the Pend Orielle River to the Idaho-Washington border. They are also located above Spokane Falls in the Spokane

River and in both the Coeur d'Alene and St. Joe River drainages in Idaho (Behnke, 1992).

Some cutthroat trout populations are considered resident, some fluvial and some adfluvial or lacustrine (Quinn, 2005; Trotter, 2008). Resident fish live their entire life in the stream where they were spawned. While resident westslope cutthroat trout remain in the stream, this does not imply they do not move at all. As winter approaches, the resident trout will often travel downstream to find shelter for the impending cold months. Some resident populations are restricted by natural or manmade barriers and are in turn not able to travel very far (Trotter, 2008). Fluvial populations spend a short period of time in the stream where they were spawned, move to a larger river to grow, then return to the smaller stream to spawn. Fluvial westslope cutthroat trout will travel as far as one hundred miles from their spawning grounds (Quinn, 2005). During the fall, fluvial cutthroat trout move within the main channel to find an area with sufficient refuge to protect them during the winter. Fluvial westslope cutthroat trout generally only grow to approximately 18 to 20 inches and reach two to three pounds (Trotter, 2008). Adfluvial, also referred to as lacustrine, populations live for a short period of time in the stream where they were spawned, move to a lake to grow, then return to the stream to spawn (Quinn, 2005). Adfluvial populations can be found in lakes that were created when the last glaciers retreated, including Priest Lake, Lake Pend Oreille, and Lake Coeur d'Alene in Idaho, as well as Flathead Lake in Montana. The fish that live in these lakes travel up to one hundred miles from the lake to spawn in tributaries. The timing of their spawning is dependent on stream water temperature, but occurs anytime between March and July and females produce 1000 to 1500 eggs. Adfluvial westslope cutthroat trout remain in the stream for an average of two years before going to the lake, some remain as short as one year while others stay as long as four years. Adfluvial populations generally live to age seven or

eight, reaching a size of approximately 18 to 20 inches, and weighing 2 to 4 pounds (Trotter, 2008).

While most cutthroat trout species, along with rainbow trout, feed on kokanees and other baitfish "the westslope cutthroat is just not as much of a predator as the other salmonids and has not formed the well-defined predator-prey relationships that are characteristic of other cutthroat subspecies" (Trotter, 2008, p 63). Westslope cutthroat trout prefer insects, possibly an evolutionary adaption to assist them in avoiding competition with bull trout and Columbia River squawfish. In some lakes, such as Lake Pend Orielle, kokanee have outcompeted westslope cutthroat trout (Behnke, 1992; Trotter, 2008). The westslope cutthroat trout and kokanee both consume zooplankton, when the kokanee were introduced the population of westslope cutthroat trout declined. Meanwhile, bull trout and redband trout, known for eating other fish, experienced an increase in weight from the introduction of kokanee, which became a new food source for them (Behnke, 1992).

The range of westslope cutthroat trout once covered nearly 90,800 km, but their range as of 2005 had decreased to approximately 54,000 km or 58% of their historical range (Shepard et al., 2002). Of the current 54,000 km, nearly 39,355 km, about 72%, of the stream length has westslope cutthroat trout populations that are being managed as conservation populations (Shepard, May, & Urie, 2005). As of 2009, native cutthroat trout populations are fragmented into small, isolated populations in high elevation headwater streams and only occupy around 10-30% of their historical range (J. E. Williams, Haak, Neville, & Colyer, 2009). Currently, instream barriers are gravely impacting native westslope cutthroat trout populations, including culverts and dams. The introduction of nonnative fishes, degradation of their native habitats and poor management strategies are also causing a decline in

westslope cutthroat trout populations. Trotter lists four primary causes for the decline of westslope cutthroat trout; these include excessive harvest, habitat loss, displacement by introduced species and hybridization with introduced species. Trotter continues on to state that impending climate change is also projected to add to the decline of westslope cutthroat trout (Trotter, 2008).

Westslope cutthroat trout are also highly susceptible to anglers and populations have declined in highly fished areas (Behnke, 2002). A study performed in the late 1960s showed that westslope cutthroat trout are twice as easy to catch as brook trout living in the same stream. The initial decline of westslope cutthroat trout due to fishing was controlled with state regulations. Idaho placed catch and release restrictions on some streams and bag limits on other streams, with extremely successful results in the mid 1970s (Trotter, 2008).

The creation of reservoirs for power generation, irrigation and flood control also has negatively impacted westslope cutthroat trout. Westslope cutthroat trout that historically do not migrate to lakes are not capable of surviving in the lake-like reservoirs. Logging, the creation of forest roads, grazing and stream diversions, which degrade the habitat, have also negatively impacted west-slope populations (Trotter, 2008). All of these factors have made native west-slope cutthroat trout's range decline.

Species such as kokanees, lake trout, Great Lakes whitefish and yellow perch have been introduced to lakes, outcompeting and preying on the westslope cutthroat trout. This has critically impacted their lake populations (Behnke, 1992; Trotter, 2008). In the Columbia River Basin, the introduction of non-native fish caused a 90% decrease in native westlope cutthroat trout populations from their historical prevalence (Behnke, 2002). The introduction of brook trout and eastern brook trout in rivers and streams has triggered a decline in native

westslope cutthroat trout river and stream populations, while hybridization with other trout species is also causing problems for the westslope cutthroat trout. Rainbow trout and Yellowstone cutthroat trout have been introduced to many native westslope cutthroat trout territories and are now hybridizing with the native westslope cutthroat trout. Hybridization can be defined as "interbreeding between genetically distinct populations." (Trotter, 2008, p 133). In Idaho, many lakes were stocked with Yellowstone cutthroat trout and rainbow trout, causing a majority of Idaho's westslope cutthroat trout population to be a hybrid (Behnke, 1992). Historically westslope cutthroat trout and native rainbow trout have been able to coexist in the same rivers without hybridizing, however with the introduction of hatchery raised rainbow trout, the "reproductive isolation between the coevolved cutthroat and rainbow trout populations" breaks down (Behnke, 2002, p 160).

Although westslope cutthroat trout have decreased substantially from their historic range and population size, they are not currently listed as an endangered species. In 1997, a formal petition was given to the Fish and Wildlife Service, asking for westslope cutthroat trout to be placed on the Endangered Species list; however, the Fish and Wildlife Service deemed that westslope cutthroat trout were not at risk of extinction and did not include them on the list. In 1999, a suit was filed against the Fish and Wildlife Service claiming that there were numerous flaws in the reasoning for not including westslope cutthroat trout as an endangered species (Shepard et al., 2005). The suit claimed that the Fish and Wildlife Service included hybridized populations in their assessment of whether westslope cutthroat trout are endangered, in turn overestimating the westslope cutthroat trout population. The court then ordered the Fish and Wildlife Service to reconsider the listing with hybridization accounted for (Allendorf et al., 2004). As a result, a comprehensive analysis of westslope cutthroat trout

was completed in 2002 and it has been determined that westslope cutthroat trout are not at "imminent risk of extinction." This is because westslope cutthroat trout are still widely distributed, many of the westlope cutthroat trout populations are protected from the encroachment of nonnative species by physical barriers and nearly 42% of westslope cutthroat trout populations are being protected by land use restrictions (Shepard et al., 2005).

Traditional Fishing Practices

The Coeur d'Alene Tribe historically lived a subsistence lifestyle, moving with the seasons in a seasonal round. The Coeur d'Alene identified five seasons, spring, summer, autumn, late fall and winter. While Tribal members often had permanent dwellings along the shores of Lake Coeur d'Alene or alongside the St. Joe River, Coeur d'Alene River, Spokane River, St. Maries River and Hangman's Creek, they would travel with the changing of the seasons to hunt and gather various roots and berries. During the spring, Coeur d'Alene would use canoes to travel up river to their root digging grounds. Typically during this time of the year, the Tribal members would dig for camas using wooden diggers. Men often would begin fishing during the early spring (Woodsworth-Ney, 2004).

Traditionally, the Coeur d'Alene Tribe used various methods to fish for westslope cutthroat trout. Techniques included the use of hook and rod, spears, traps and nets. Hooks were generally made of bone, the lines fashioned out of hemp and the rods created from wood harvested from various bushes. Spears were generally three pronged and used for fishing from canoes. Often times large trout would be speared from a canoe while fishing by torchlight. Various types of traps were also used to catch fish. Traps included screen traps, special traps referred to as "moo" which were only used on flooded creeks, traps with rows of

sticks that created a trapdoor, and a cylindrical trap generally only used for smaller fish. Bag nets, often woven from rushes, were also employed. Tribal members would either stand on a rock along a stream or used the nets from canoes (Boaz & Teit, 1930).

As spring turned to summer, the Coeur d'Alene would transition from root digging to berry picking, and from fishing to hunting. Berries were plentiful in the mountains, including wild raspberries, blackberries, huckleberries, gooseberries, blueberries, currants, chokecherries and strawberries. While the women collected berries, the men would hunt for deer, bear, elk and mountain grouse. In late fall and early summer, the women would begin to preserve food for the winter months; they would cook the roots and then turn them into cakes which they dried. The meat hunted in the fall would be dried (Woodworth-Nay, 2004, 11).

Cultural Significance of Westslope Cutthroat Trout

> *"Losing cutthroat, oh my God, it's part of our identity, without identity we are nothing. Everything we lose from our land is part of our identity." – Interviewee 11/2/15*

Historically, westslope cutthroat trout have both cultural and nutritional significance to the Coeur d'Alene Tribe. As one Tribal member explains, "we use to swim alongside cutthroat trout, we are salmon people." Continuing he explained, "there is a legend that when streams no longer have salmon we will die, we are water people." He feels that westslope cutthroat trout are "one of the most important gifts from our creator." The loss of cutthroat trout will not only affect the Tribal members' diet, it will also impact their identity, "cutthroat trout is another loss of our identity and it hurts, it really hurts. We lost our salmon and now we are losing our cutthroat trout and it's huge. It's disheartening. It's sad." This same Tribal member worries about the lack of concern the Tribe has for the decline of the species, explaining that while westslope cutthroat trout are one of the most important gifts from their

creator, there is less recognition of this importance today.

Furthering this sentiment, another Tribal member describes how the Tribe is "losing the connection" to westslope cutthroat trout. He feels that westslope cutthroat trout are no longer as important to the Tribe as they once were, not because the species has lost cultural significance, or isn't important, but because the species is declining. For time immemorial, Tribal members would fish in the same locations where their ancestors before them fished. This ancient practice is being lost; Tribal members cannot take their children fishing for westslope cutthroat trout as their parents once took them. Tribal members aren't just feeling the loss of westslope cutthroat trout as a resource; they also are losing the shared experience. Fishing is not just about catching a fish, it is also about the custom of parents passing the experience onto their children and it is about the specific locations where families have fished for generations. However, as westslope cutthroat trout populations decline, as access to ancestral fishing grounds is limited, and with restrictions in place preventing the harvesting of the fish, the culture is being lost.

Tribal members recall when it use to be peaceful and quiet in the Benewah area as they went out to fish. Now, one Tribal member says "the older I get, the less fish there are to catch." Current restrictions don't allow any harvesting of cutthroat trout, "for our tribe to tell us you can't do one of the most ancient things to our people was appalling." However, Tribal members are willing to stop fishing now in the possibility that the cutthroat trout population can be restored and they don't lose cutthroat trout forever.

Tribal members used to be able to fish all the way from Benewah Creek up to Alder Crick, which runs into the St. Mary River and then into the St. Joe River. This area was the primary location for cutthroat trout, it was a "super spawning ground". Currently, without

runoff from snowpack the stream temperature is rising and the fish either retain their eggs or die. About thirty years ago, Tribal members could catch at least twenty westslope cutthroat trout in only an hour of fishing, recalls one Tribal member. Another Tribal member remembers easily catching five or six westslope cutthroat trout in an hour of fishing as a child. He also recollects stories of his ancestors being able to fill an entire canoe with westslope cutthroat trout after only one day of fishing. In present day, Tribal members would be lucky to catch one fish in an hour.

Tribal member recall that thirty years ago, the cutthroat trout weighed two to three pounds and measured nearly twenty inches; but now the trout are smaller, measuring maybe eight inches. In Chatcolet Lake, Tribal members were previously able to catch cutthroat trout that weighed up to five pounds. Hundreds of tributaries in the area have dried up including Fighting Crick, Lake Crick, Plummer Crick, and Evan's Crick. These tributaries are essential to the cutthroat trout, providing a place to stay until they mature and are large enough to move to the main stream or into the lake (Lake Coeur d'Alene). For example, Little Plummer Creek used to have a large population of cutthroat trout, but Tribal members describe why this is no longer the case. They cite problems such as the stream being overrun by invasive brook trout. Another problem is loggers. While the survival rate of small cutthroat trout has always been negatively affected by frogs, beavers, muskrats, birds and indigenous man, the advent of increased numbers of loggers damaging the land is making the survival rate even lower. The loggers are clear cutting hillsides, causing sediment to run into the streams and degrade the cutthroat trout spawnining grounds.

Historically, cutthroat trout would have sustained life until the salmon arrived, but that is no longer true. Tribal members explain that in the 1800s and 1900s "our native people

would have thought cutthroat trout would always be there, they didn't worry about them." However, now Tribal members are very worried. One Tribal member surmised that his sons likely could not even identify a cutthroat trout, in fact his sons are scared of fish. Tribal members worry about eating fish out of Coeur d'Alene Lake due to mining and the resulting chemicals such as lead, arsenic, acids and cyanide currently present in the lake. It is only safe to eat two pounds of fish from the lake a week due to dangerous toxins. If this was the case in the 1800s, the natives in the area may have died off, given a diet with such high reliance on fish from Lake Coeur d'Alene.

Tribal members cite multiple reasons for the declining westslope cutthroat trout population. They believe westslope cutthroat trout are being lost due to logging and the decrease of their spawning grounds. Another reason Tribal members think westslope cutthroat trout are on the decline is the introduction of nonnative fish, such as pike. The introduction of pike by the Idaho Department of Fisheries (IDF) contradicts what the Tribal members believe. A Tribal member described how the Coeur d'Alene do not view fish as the IDF views them. Pike were introduced primarily as a way to increase revenue from fishing. Tribal members, however,do not traditionally view fish as a source of income. In fact, they never even had paper money until it was forced upon them. This differing view causes a clash between the methods the IDF utilizes to manage the fisheries and what the Tribal members wish to see happening. The pike will eat any fish species in the lake. The Tribal member explained how the pike know how to adapt to various conditions and they are moving into the tributaries, including into the Spokane arm, which in turn is affecting westslope cutthroat trout populations.

Tribal members also believe that the amount of water in streams and the water quality

negatively impacts the westslope cutthroat trout. They explain how this past summer (summer of 2015), the creaks were very hot and the water level was extremely low. Ten years ago, there was snow in this area during November, now there is none. One Tribal member recalls the streams running a lot higher when he was a child. He also reminisced about one particular stream that ran near his childhood home. As a child, the stream had a lot of vegetation along the banks, but one day the farmers in the area decided they needed more land for agriculture, so they tilled up all the vegetation. After that, the stream became dirty.

Tribal members believe that the Fish Biologists work very hard to restore cutthroat trout populations. However, for Tribal members, it is not just about how many westslope cutthroat trout are now in the rivers, it is also about the experience of fishing.

CHAPTER 3: INCORPORATING TEK INTO THE CURRENT MANAGEMENT PLAN

Introduction

While the current management plan for westslope cutthroat trout is not entirely focused on climate change adaptation, incorporating TEK into this plan will assist with creating a westslope cutthroat trout population that is less vulnerable to climate change. The incorporation of TEK in the current management plan will also help the Coeur d'Alene Tribe maintain the cultural significance of westslope cutthroat trout, a factor that is arguably just as important to the Tribe as maintaining the number of westslope cutthroat trout found in the Coeur d'Alene Basin.

There are two areas where the current management plan could benefit from the addition of TEK (see Table 1). The first area revolves around the purchasing of land. While the current management plan does include the need to purchase land that the Tribe no longer owns, the ultimate goal of this acquisition is to allow fish biologists to restore the land directly adjacent to the streams and rivers. Tribal members feel that this buyback should also be occurring in an effort to restore ancestral fishing grounds, because without access to these fishing grounds an increase in the number of westslope cutthroat trout would not be as significant to the Tribe. The second area, where Tribal members view management of westslope cutthroat trout differently, is in the overall approach. Fish biologists view the problem from the bottom up, looking primarily at the fish population. Tribal members envision the ecosystem as a whole, starting at the top of the mountain and working down toward the stream. This ecological top-down approach can assist in seeing the bigger picture in relation to westslope cutthroat trout management.

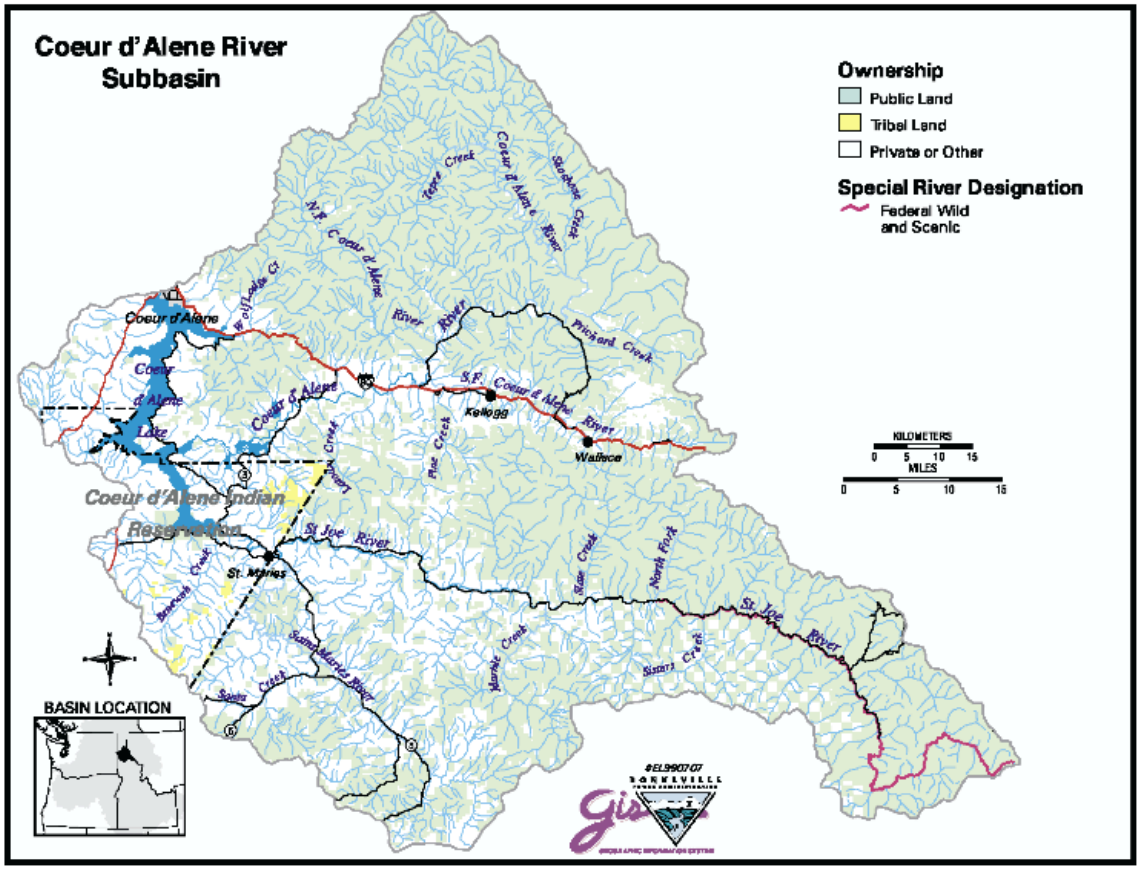
Table 1: Incorporating TEK into the Current Management Plan

Management Initiatives	Traditional Ecological Knowledge (TEK)	Current Management Plan
Purchasing of Land	Land should be purchased so Tribal members have access to ancestral fishing grounds	Land should be purchased so that restoration projects can take place
Overall Management Approach	Top- down; Tribal Members look at the problems occurring at the top of the mountain and work their way down	Bottom- up; Fish biologists begin with the fish and the stream and work their way up toward the top of the mountain

Westslope Cutthroat Trout in the Coeur d'Alene Subbasin

Lake Coeur d'Alene, the second largest lake in Idaho, is located in the panhandle of northern Idaho and is part of the Spokane River Basin and the Coeur d'Alene River Subbasin. The Coeur d'Alene River Subbasin is made up of roughly 9,946 square kilometers and includes four counties in Idaho; Shoshone, Kootenai, Benewah and Latah and includes thirty-six smaller watersheds. However, only approximately 760 square kilometers of the Coeur d'Alene Subbasin lies within the Coeur d'Alene Reservation. The rest of the subbasin is divided between the U.S Forest Service, Idaho Department of Lands, Idaho Department of Fish and Game, Idaho Parks and Recreation, Bureau of Land Management, Capital Forest Group, and Potlach Forest Cooperation. Water comes into the watershed from two main tributaries, the Coeur d'Alene River which originates in the Coeur d'Alene mountains and the St. Joe River which originates in the St. Joe Mountains. Each of these rivers has nearly seventy-eight tributaries feeding into the individual rivers and there are twenty-seven smaller tributaries feeding directly into Coeur d'Alene Lake (Northwest Power Council, 2005). There

are also four smaller lakes at the southern end of Lake Coeur d'Alene, Hidden Lake, Round Lake, Chatcolet Lake and Benewah Lake, that were flooded during the creation of the Post Falls Dam which controls the outflow of the entire river valley. The lake receives water from both the Coeur d'Alene River and the St. Joe River (Lillengreen, Vitale, & Peters, 1999).



Map 1: Coeur d'Alene Subbasin; image from (Northwest Power Council, 2005)

The Coeur d'Alene subbasin is home to twelve native fish species including; longnose sucker, bridgelip sucker, largescale sucker, shorthead sculpin, torrent sculpin, mountain whitefish, northern pikeminnow, longnose dace, speckled dace, redside shiner, bull trout and westslope cutthroat trout. There are also sixteen introduced species that also live in the Coeur d'Alene subbasin; lake superior whitefish, northern pike, tiger muskie, black bullhead, brown

bullhead, channel catfish, pumpkinseed, smallmouth bass, largemouth bass, rainbow trout, kokanee salmon, Chinook salmon, yellow perch, black crappie, brook trout and trench. Historically, the most abundant salmonid species in the Coeur d'Alene Subbasin was westslope cutthroat trout. The Coeur d'Alene Subbasin was home to all three types of westslope; resident, fluvial and adfluvial. While all three forms of westslope cutthroat trout still exist today, their numbers are drastically lower. (Northwest Power and Conservation Council, 2005).

Westslope Cutthroat Trout Population

The Coeur d'Alene tribe began to rely more on westslope cutthroat trout from Lake Coeur d'Alene after the construction of dams on the Spokane River in the early 1900s, followed by the construction of dams on the Columbia River. The construction of these dams prevented anadromous salmon and steelhead from reaching the Coeur d'Alene reservation, forcing tribal members to focus their fishing on resident cutthroat trout populations. It has been estimated that historically the Coeur d'Alene Tribe caught approximately 42,000 cutthroat trout a year. This number refers to the number of cutthroat harvested after contact with white settlers. There is no exact number for pre-contact annual catch, but it is assumed that the number of fish caught was much higher before contact, possibly three or four times more (Scholz et al., 1985) . As early as 1967, the number of cutthroat trout harvested by Tribal members dropped even lower; it was reported that only 3,329 cutthroat trout were caught in the St. Joe River and only 887 were harvested from Lake Coeur d'Alene by Tribal members (Firehammer et al., 2013). Present day, Tribal members are not allowed to fish for westslope cutthroat trout on the reservation, as the numbers are so low they could not sustain

being harvested.

Problems Facing Westslope Cutthroat Trout

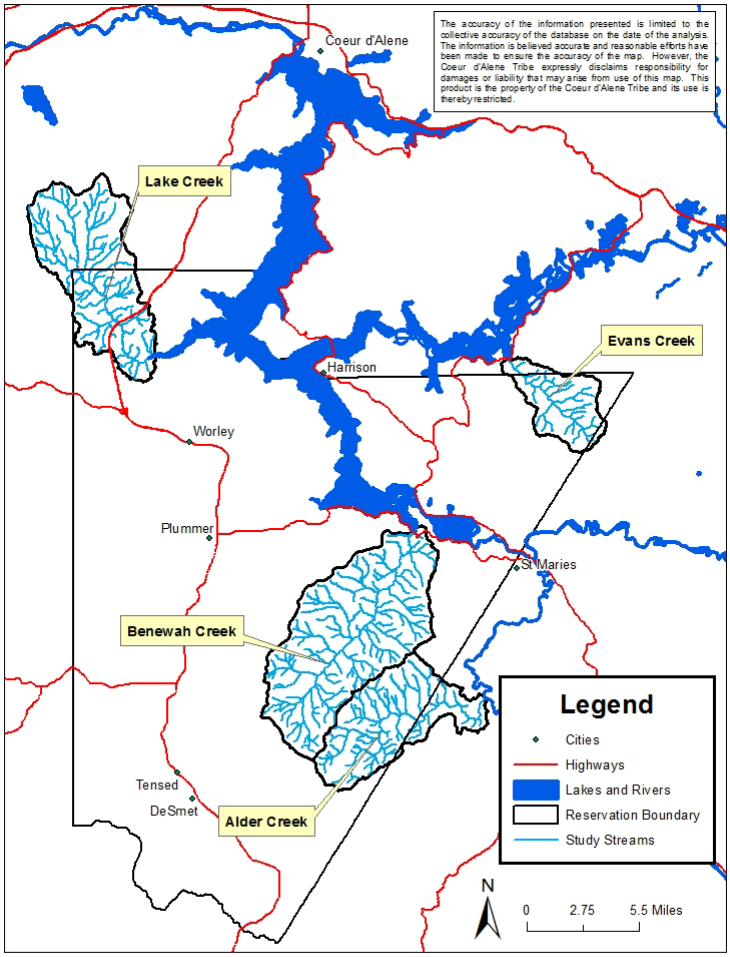
A Bonneville Power Company (BPA) funded study completed in 1990 showed some of the problems the Fisheries Department would face in restoring cutthroat trout populations which included "low-quality, low-complexity mainstem stream habitat and riparian zones; high stream temperatures in mainstem habitats; negative interactions with nonnative brook trout in tributaries; and potential survival bottlenecks in Coeur d'Alene Lake" (Firehammer et al., 2013, 6). One of the major problems in the Coeur d'Alene basin is the construction of roads which is producing severe erosion as the paved areas cause surface water to flow more rapidly. Along with road construction, the development of railroads in the 20th century triggered increased deforestation which negatively impacted the function of the riparian areas. The introduction of logging throughout the area also had a damaging effect on the watershed. Deforestation, along with flumes and splash dams built by lumber companies in 1915 to transport the timber to market, were significant factors changing the basin region. This has a lasting impact on the river system (Lillengreen et al., 1999, 8).

While hybridization between westslope cutthroat trout and rainbow trout is minimal in most regions of the Coeur d'Alene subbasin, the areas with the greatest risks of hybridization are in the St. Joe River and the Coeur d'Alene River. Risk is greatest in these rivers because these are the waterways where stocking occurred. Rainbow trout stocked after 1993 were all sterile, preventing the introduced rainbow trout from hybridizing with cutthroat. However, since hybridized rainbow trout and westslope cutthroat trout produce fertile offspring, any hybrids already in existence can reproduce with each other to create more hybrids. Stocking

of rainbow trout in the Coeur d'Alene Subbasin was terminated in 2003 (Northwest Power and Conservation Council, 2005).

Current Management Plan

The Coeur d'Alene Fisheries and Water Resources department has been working to "restore the cutthroat trout populations to levels that allow for subsistence harvest, maintain genetic diversity, and increase the probability of persistence in the face of anthropogenic influences and prospective climate change" (Firehammer et al., 2013, 6). The Coeur d'Alene



Map 2: Management areas from (Firehammer, 2013)

Fisheries Program began a project funded by the Bonneville Power Administration in the 1990s entitled "Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation" (Firehammer et al., 2013). The project focuses on habitat restoration and enhancement, biological control and monitoring and evaluation in an effort to restore the cutthroat trout populations. In 1993, in an attempt to restore westslope cutthroat trout populations, the Fisheries department closed Lake Creek and Benewah Creek to fishing.

According to Jon Firehammer, Coeur d'Alene Tribe Fish Biologist, as the project began in the 1990s up until around 2004 most of the project implementations were simply "Band-Aids, not solutions." However, in 2004 the Tribe was able to purchase the Johnson Property in Benewah Creek. The acquisition of this property gave the Fisheries more control over restoration. Now that the Tribe owned the land, the Fisheries could begin implementing projects on the streams in the area. As the project began to take off in 2004, the Fisheries department began focusing their habitat restoration in the four different watersheds where cutthroat trout have historically been present on the Coeur d'Alene reservation; Evans Creek, Alder Creek, Benewah Creek and Lake Creek.

Evans Creek watershed only has a resident westlope cutthroat trout population, meaning that the trout in this area never migrate into Lake Coeur d'Alene, but instead stay in the streams where they are born. This is likely because Northern Pike were introduced to Lake Coeur d'Alene, and would eat the westslope cutthroat trout that migrated into the lake.

Alder Creek watershed also only maintains a resident population of westslope cutthroat trout. The fish in this area likely don't migrate because there are natural falls that prevent migration to the lake. Previously, cutthroat trout grew to be a lot larger than their present size. The bigger fish, likely, could have made it over the falls; however, an

introduced species, Kokanee, along with Brook trout are now outcompeting the westslope cutthroat trout for the plankton that they both feed on. The smaller size of the westslope cutthroat trout makes it impossible for them to get over the falls and into Lake Coeur d'Alene, forcing the Alder Creek population to be a resident population.

The Lake Creek watershed population of westslope cutthroat trout is a migrant population. Because of this, the Fisheries program is putting more effort into their restoration. There are, however, still only around 200 to 300 spawners each Spring. This is not enough fish to support a harvest.

Benewah Creek watershed is where the most effort is being placed on restoration. This area also contains a migrant population, but there are only approximately 25 adults a year and the population is on the decline. The project in this area is occurring in two phases. The first phase, which occurred between 2005 and 2009, covered a one and a half mile stretch of the Benewah Creek. To complete phase one, the Fisheries program brought the channel up two to three feet, dug out pools for the trout, dug out new meanders and filled in the old channel and placed large rocks in the stream. This was a very invasive method, requiring machinery to physically move and change the stream. To complete Phase one, a substantial amount of money was spent per stream mile. Positively, the tactics used in Phase one appear to have borne positive results. As of late 2015, there are beavers recolonizing the area, there are approximately 10 to 12 naturally built beaver dams. These dams encourage much needed flooding in the Spring and Summer. Phase Two included less channel work, and instead attempted to emulate what beavers do naturally with man made structures in the stream channels. The Fisheries program facilitated the construction of choke structures. Choke structures are built by placing a large log across the bottom of the channel, two shorter logs on

top of the large log (leaving a gap in the middle), and a log completely across the top. This man-made structure is intended to act as a beaver dam, narrowing the stream so when there is a high flow, flooding can occur. The building of choke structures is much less invasive than the procedures completed in phase one, and is also more economical. The Fisheries department built approximately fifteen choke structures throughout the stream, but these structures have proven much less successful than the changes completed in phase one. There have also been attempts made to stabilize existing beaver dams to prevent them from being washed away during high flows. In this section of the stream, beavers vacated the area in 2009 and have not returned. The biologists and ecologists are not certain why beavers are not recolonizing the area. This has contributed to the ineffectiveness of Phase Two as the choke structures are proving much less effective than the natural beaver dams.

Image1: Phase 1 in Benewah Creek Watershed

Image 2: Phase 1 in Benewah Creek Watershed

Image 3 : Phase 2 Choke Structures

Image 4: Phase 2 Choke Structures

The Fisheries program has also attempted to account for erosion in the streams that is occurring due to forest service roads. During heavy rains, sediment is flowing from the roads directly into the streams. In 2012, in an effort to minimize this problem, a culvert was removed and wood and cross drains were added to direct the sediment.

The next step in cutthroat trout population recovery is an attempt to deal with the Northern Pike that have been introduced into Lake Coeur d'Alene and are eating the cutthroat trout. The adfluvial cutthroat trout that migrate to Coeur d'Alene Lake in the spring and summer have to pass through a section of lake that is a habitat with ample vegetation along a shoreline. This is a perfect habitat for northern pike. A study was done in four bays located in Coeur d'Alene Lake, Wolf Lodge Bay, Cougar Bay, Windy Bay and Benewah Lake, to determine the seasonal food habits of northern pike and the number of westslope cutthroat

trout the northern pike in each area are consuming. The highest level of predation on westslope cutthroat trout occurred during the spring, likely because this is when the greatest amount of westlope cutthroat trout are available (as they migrate into the lake) and it is right after northern pike spawn, a time when they are extremely hungry. In the summer and fall, when less salmonids are available and the northern pike have less of an appetite, fewer cutthroat were preyed upon. There was only a two-month period, April and May, when westslope cutthroat trout and Northern Pike overlap locations; however, northern pike are able to consume a large amount of fish during this small time period. While nonnative species are generally considered a problem, two nonnative species in Coeur d'Alene Lake, kokanee and yellow perch, actually act as a predation buffer for westslope cutthroat trout. Nearly 30% of the biomass consumed by northern pike came from these two species, however another 30% of the Northern Pike diet comes from the consumption of westsope cutthroat trout. Reducing the predation of Northern Pike on westslope cutthroat trout during the Spring has the potential to assist Coeur d'Alene Fisheries program in increasing the overall amount of cutthroat trout in the Coeur d'Alene basin (Walrath, Quist, & Firehammer, 2015).

In an attempt to learn more about the predatory relationship between Northern Pike and Westslope Cutthroat trout and to begin removing Northern Pike from the ecosystem, the fisheries have begun a removal program. They are currently focusing on the Windy Bay area, as this area is reported to lose nearly 50% of their adult cutthroat trout population to hungry northern pike, preventing the cutthroat from returning to the Lake Creek watershed to spawn. In Fall of 2015, the Coeur d'Alene Tribe in conjunction with the State of Idaho began offering a cash prize for any angler who catches a northern pike. This is a three-year pilot program intended to both remove pike from the area and attain more data on northern pike diet,

including when and where pike prey the most on cutthroat trout. The fish have tags in them, allowing researchers to know their origin. A reward of $5 will be mailed to the first anglers who drop off the northern pike at the drop station located at Heyburn State Park. There are also some tags with special numbers that will earn anglers anywhere from $50 to $500 (Coeur d'Alene Tribe, 2015).

Incorporation of TEK

Access to Ancestral Fishing Grounds

"No disrespect to scientists, but when you have an expertise in an area it becomes about the numbers, and we aren't about that." – Interviewee 3/7/16

While there is no doubt Coeur d'Alene Fish Biologists acknowledge that having access to private property and/or buying back land in the Coeur d'Alene Basin will aid in the recovery of westslope cutthroat trout, Tribal members view the importance of this access and buyback differently. For Fish Biologists it is about being able to restore the streams and riparian areas to help increase the amount of westslope cutthroat trout. Tribal members do not just look at the buyback and access to private lands as a way to restore the number of westslope cutthroat trout; they view this buyback as a cultural necessity.

In the 1999 Coeur d'Alene Tribe Fish, Water and Wildlife Program Fisheries Program Management Plan, there is a section entitled "Landowner Agreements." This section focuses on how the Tribal Natural Resources Department will work with private landowners to restore streams that are on private property. The plan states "Property rights is a sensitive issue, so it is the goal of the Coeur d'Alene Tribe Fish, Water and Wildlife Program to introduce stream restoration efforts as an opportunity for landowners, rather than an

imposition of regulation" (Lillengreen et al., 1999, p 31) The section continues on to explain how the Tribe Fish, Water and Wildlife Program has developed landowner agreements and various plans to encourage the landowners to participate in restoration. While there is no doubt that it is important that private landowners assist in the restoration of the streams, there is no mention of whether Tribal members will ever be able to access these restored areas again. Clearly this is a complex issue, but Tribal members feel that while restoration of the streams is obviously essential, and increasing the number of westslope cutthroat trout throughout the basin is imperative, access to ancestral fishing grounds also should be included in management plans.

This same 1999 Management plan contains a section entitled "Interim Harvest Opportunities." This section details how in order to allow Tribal members to continue to harvest fish for subsistence and to "satisfy cultural objectives", a number of ponds will be created and stocked with rainbow trout. The intent was to create a "put and take" fishery that would permit Tribal members to fish without depleting the already declining native trout populations while restoration efforts took place. These ponds were to be placed near population centers and traditional fishing areas on the reservation but far from restoration areas to prevent any unwanted interactions between the hatchery fish and the native fish. Only children under the age of twelve, enrolled Coeur d'Alene Tribal members and senior citizens would be permitted to fish in the ponds (Lillengreen et al., 1999). While a pilot project in 1995 proved the pond idea to be "successful," not all Tribal members feel this was an adequate solution. One Tribal member expressed his discontent, explaining how a man had once proposed a fish hatchery but "instead of getting the hatchery he got the ponds stocked with rainbow trout." While on paper having a location where Tribal members can

continue to fish for trout on the reservation and allowing Tribal members to continue to harvest fish for sustenance while simultaneously reducing the pressure on native trout populations seems to be ideal, in practice there is still a large cultural component missing. One Tribal member elaborated, "we are fresh, running water people, we don't eat fish from ponds." This statement clarifies Tribal members opinions that restoration of trout is not just about the numbers. Having access to trout (and in this case it was not the native westslope cutthroat trout, but rainbow trout), does not equate to maintaining the Tribes' cultural practices. To fully bring westslope cutthroat trout back, there needs to be enough trout in the streams for Tribal members to harvest them for subsistence as well as access to their ancestral fishing grounds. Access to ponds with stagnant water and an introduced species are not the equivalent to fishing for native fish in the running water of a stream, just as having thousands of native trout back in the rivers, but no access to fish for them is also not an acceptable solution.

One Tribal member explained that while he means no disrespect to the scientists, "when you have an expertise in an area it becomes about the numbers, and we [Coeur d'Alene Tribal members] aren't about that." This Tribal member's family came from a clan that lived near the St. Joe River. Benewah Creek, a major tributary to the St. Joe River, was of utmost importance to him and his family. While his family, along with most Coeur d'Alene families, used to travel to the prairie to collect roots and to the mountains to collect berries, they always returned to the rivers. Westslope cutthroat trout were a highly valued food source, but fishing for westslope cutthroat trout was never just about catching fish, "It's not just the fishing," he explained, "when you go out there it's about the whole experience." He continued to explain that much of the Coeur d'Alene culture is reliant upon locations. As a child he would go to

fish in specific locations with his family, but that is now impossible. Expressing his sadness, this Tribal member described his concerns, "I can't pass this on to my kids and I wish I could. I wish I could stop and show them where we collected crawdads and fished and I can't." While bringing back the westslope cutthroat trout population is important, if the Tribal members do not have access to the locations where their ancestors fished, their culture will still be lost. One Tribal member explained that when truly taking culture into consideration, "numbers returning are important, but so is access to trout." To further this, he justified that a good metric for determining if westslope cutthroat trout populations have returned to an acceptable level would be if Coeur d'Alene families begin camping in their old locations along the rivers and streams again. However, this can't happen with only an increase in the number of westslope cutthroat trout, this will only happen if the Tribe owns or at least has access to the land where Coeur d'Alene Tribal members have fished throughout their existence.

One of the recommendations set forth by the Tribe in 1994, and adopted by the Northwest Power Planning Council, included the "purchase of critical watershed areas for protection of fisheries habitat" (Firehammer et al., 2013). Efforts have been made to this effect, specifically with the aquisition of the Johnson Property, but this purchase should not solely be occurring in "critical watershed areas" with intent of "protection of fisheries habitat." There also needs to be emphasis on procuring lands that are culturally significant ancestral fishing grounds. It is likely that if Tribal families have fished in these locations for centuries, the ancestral fishing grounds were once thriving westslope cutthroat trout fisheries. In turn, while purchasing these locations will aid in protecting the Coeur d'Alene culture, these areas would likely prove to be excellent restoration locations as well.

While Tribal members do have sovereign rights to fish in the streams in the region, and most Tribal members fully understand these rights, the landowners often do not. One Tribal member recalls how prior to the Tribe purchasing the Johnson Property, "Old Lady Johnson would bring a shotgun out to chase off Indians who were trying to fish." Another Tribal member recollects similar stories of Tribal members being chased off people's properties with guns when they attempted to fish on their ancestral fishing grounds. Because of this, many Tribal members no longer feel it is worth attempting to fish in these areas. One Tribal member elaborated, explaining how most Coeur d'Alene try very hard to avoid these confrontations, but avoiding confrontations means not fishing on lands not owned by the Tribe. The result is the Tribe's loss of access to many of their ancestral fishing grounds.

Acquiring land needs to be a high priority in westslope cutthroat trout management plans, as does the education of local, private landowners. Convincing private landowners to participate in restoration programs is undoubtedly important, but these same landowners need to be made aware that Tribal members have sovereign rights to fish these waters, regardless of who owns the land around the streams, rivers and lakes.

A Brief History of Land Ownership

But why is access to fishing grounds so difficult? While the Coeur d'Alene Reservation encompasses approximately 345,000 acres, the Tribe only officially owns around 69,328 acres. It is also important to note that historically the Coeur d'Alene covered a territory of more than four million acres (United States Department of the Interior Bureau of Indian Affairs, 1976). While multiple attempts were made by the United States government to

force the Coeur d'Alene Tribe onto a reservation, it was not until 1891 that Congress ratified the agreements and the Coeur d'Alene Reservation was created.

The first attempt to create a reservation occurred in 1867, when President Andrew Johnson signed an executive agreement creating a 250,000-acre reservation. However, no action was ever taken to enforce this reservation. The Coeur d'Alene Tribe was not even informed of the creation of the reservation or its boundaries. In the end, this reservation only ever existed on paper (Woodworth-Ney, 2004).

In 1873, another attempt was made to create an official Coeur d'Alene Reservation. This reservation would span nearly 590,000 acres of land, incorporating many important waterways including a large section of the St. Joe River Valley, Lake Coeur d'Alene, a large section of the Coeur d'Alene River, part of the St. Joe and St. Maries Rivers, the southern portion of the Spokane River and a segment of Hangman's Valley. While this was a large increase from the 1867 Reservation, it still meant a loss of nearly four million acres for the Tribe, a loss that would be compensated with farm tools, buildings, reservation officials and $170,000. President Grant, on November 8, 1873, by executive order, agreed to the boundaries for the reservation, however the monetary compensation would not be sanctioned until Congress approved. The agreement never received congressional approval, leaving the Coeur d'Alene with the proposed 590,000 acres, but no reparation for the surrendered lands (Woodworth-Nay, 2004).

The Coeur d'Alene would not maintain their sacred waterways for long. While another attempt in 1887 at the creation of a reservation ensured the tribe would maintain the land agreed upon in the 1873 executive order, this attempt, once again, did not receive congressional approval. In 1891, once again, an agreement was reached. This reservation

was smaller than the area previously agreed upon in the 1873 executive agreement, pushing the borders of the reservation much further south and removing part of Lake Coeur d'Alene from the Tribe's ownership (Frey, 2001).

However, only a few years later, in 1893, the Reservation's size was decreased even further. A group of settlers began creating a small community, Harrison, at the mouth of the Coeur d'Alene River. Instead of forcing the settlers off of the land, the federal government bought the land from the Tribe for $15,000 (Frey, 2001). This was not the end of the loss of their ancestral lands. After the creation of the reservation, the Coeur d'Alene Tribe owned around 400,000 acres, and began building roads and infrastructure on their lands. While there were no individual titles to land holdings, Tribal members each had their own specific tract of land they tended to; individual tribesmen had holdings up to 2,000 acres (Cotroneo and Dozier, 1974).

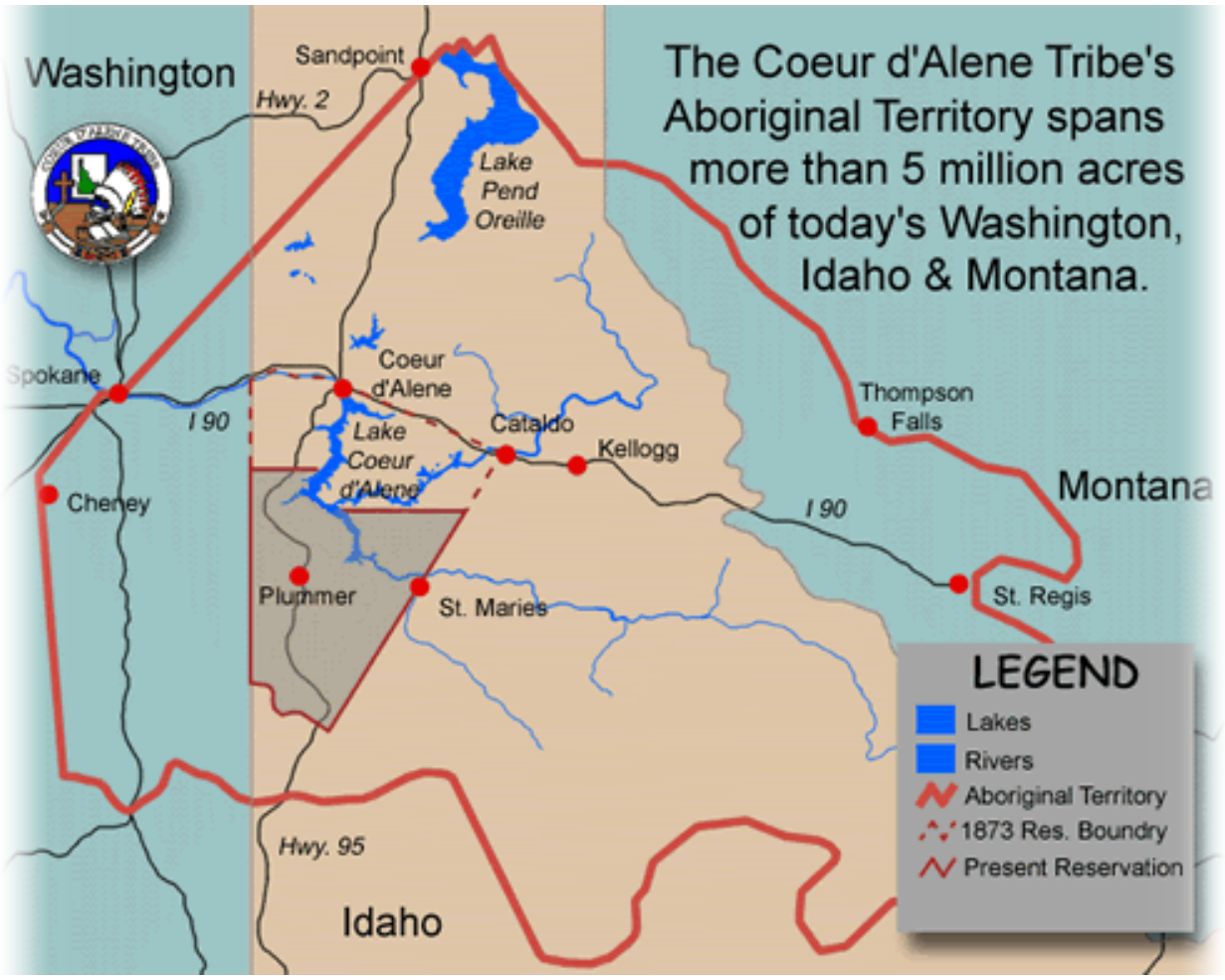
The Woodland Cemetery Association, the Milwaukee Railroad, the Secretary of the Interior and the University of Idaho made small land purchases in the early 1900s. The 8,000 acres purchased by the Secretary of the Interior, which included Chatcolet and Benewah lakes, was given to the state of Idaho, and eventually turned into Heyburn State Park (Cotroneo and Dozier, 1974). The creation of Heyburn State Park forced some of the last remaining Tribal members with land along the shores of Lake Coeur d'Alene off their land (Frey, 2001).

Ultimately, the Coeur d'Alene Tribe lost the most land due to the Dawes Act. In 1887 the General Allotment Act, also known as the Dawes Severalty Act of 1887, was passed. During this time period, the government felt that in order to "assimilate" tribes, the tribe "had to be destroyed as a political, social, and cultural entity" (Controneo & Dozier, 1974). Under

the Dawes Act, every tribal member would receive 40 to 160 acres of land. This allotment of land would be owned by the government for twenty-five years and after this time period the tribal member would own the land. Any land that was not allotted to a tribal member would then be sold to white settlers. The enforcement of the Dawes Act on the Coeur d'Alene Reservation resulted in the Tribe's loss of nearly 84 percent of their land (Controneo & Dozier, 1974).

The Dawes Act officially began to impact the Coeur d'Alene in 1906 with the passing of the Appropriation Act. Under this act each man, woman and child would be given 160 acres of land. Land was also set aside for an Indian school and agencies. Once every tribal member received land, an appraisal would be completed on the remaining land, dividing the land into sections; agriculture, grazing, timber and mineral. Then, the land would be opened up to white settlers, sold for an average of less than two dollars an acre (Cotroneo and Dozier, 1874). While Tribal members could choose their land allotments, there were some restrictions. One of the most notable and devastating restrictions prevented tribesmen from choosing land that bordered the lakes and rivers. Allotment lands were supposed to be agriculture and grazing lands, and since waterfront properties were susceptible to spring flooding, they were not deemed fit for agriculture or grazing, and in turn Tribal members were not allowed to receive these properties (Woodworth-Ney, 2004). When the allotment of lands was completed on July 13, 1909, the land owned by the Coeur d'Alene decreased to 104,076.53 acres. Along with the Dawes Act, the homestead laws allowed even more settlement on Coeur d'Alene Territory. While the intrusion of homesteaders did not cause the boundaries of the reservation to change, it still resulted in a loss of another 219,767 acres. The land loss continued through 1920, as fee patents were given for land after the passing of a

Tribal member. Another 31,080.87 acres of land was lost through fee patents. Through 1933, Indians also sold their land, for various reasons, for an average of thirty-five dollars an acre. By 1933, the land owned by the Coeur d'Alene had dwindled to 62,400.64 acres (Cotroneo and Dozier, 1974).



Map 3: The aboriginal territory, the proposed 1873 reservation boundary and the current reservation from (Coeur d'Alene Tribe, n.d.)

Allotment, homesteaders, and the selling of patents have left the Coeur d'Alene reservation looking like a patchwork quilt. As of the 2000 census, there were 6,551 people living on the Coeur d'Alene Reservation, yet the Coeur d'Alene Tribe had only 1,840 enrolled members. This means nonnative residents outnumber Tribal members on the reservation (Woodworth-Ney, 2004). Much of the land owned by Tribal members does not

border the waterways that are so important to the identity of the Tribe, and, in turn, makes the restoration of westslope cutthroat trout extremely difficult. The lack of land ownership along the waterways also makes access to the ancestral fishing grounds nearly impossible for Tribal members.

Top Down versus Bottom Up Approach

Tribal members also seem to view management of resources differently than the fish biologists. During my interview with one Tribal member, we began our discussion of westslope cutthroat trout at the top of the mountain. Concerns began with logging, logging roads, trash on the mountains, then moved down to the stream banks, then to the streams, and finally to the fish in the streams. Fish biologists, as their name describes, begin with the fish, and work their way out to the stream, to the banks, and then up the mountainside. The different approaches to management are logical, considering the backgrounds of the Tribal members versus the background of the fish biologists. Western trained scientists are generally specialists, in this case the fish biologists were hired to increase the amount of fish in the Coeur d'Alene basin, so it appears logical to initiate their study with the fish. Tribal members, however, view nature differently, and tend to look at the bigger picture. Starting at the top of the mountain and working toward the stream requires an analysis of the entire ecosystem. It also promotes the conservation and preservation of multiple species at once. For example, logging, according to a Tribal member, is negatively impacting westslope cutthroat trout as it creates excessive runoff and erosion that ends up in the streams while simultaneously removing tree cover that provides shade for the streams. Logging also impacts the elk, destroying their habitats, and the huckleberries and many other species that call the Coeur d'Alene basin home. If ecological management starts at the top of the

mountain, instead of at the bottom (in the streams), not only will westslope cutthroat trout benefit, but other species in the area will profit as well.

This issue, once again, ties into landownership. Since the Tribe does not own all of the land in the Coeur d'Alene basin, it is difficult to manage many environmental issues that occur. The fish biologists are focused on purchasing lands along the banks of the streams to perform restoration. While this is logical, westslope cutthroat trout live in the streams, purchasing the land closest to the streams will allow for the best restoration efforts, attention also should be focused on the land farther away from the streams. Purchasing land farther up the mountain could be proven just as beneficial to restoration efforts as purchasing the lands directly bordering the streams.

The fish biologists are not ignorant of the problems occurring farther up the mountain. They have added culverts to the logging roads to help redirect sediment flow and have attempted to plant vegetation along the stream banks (though so far there has been minimal success). Fish biologists would not deny the need to promote restoration efforts elsewhere, however, the system is set up to begin consideration with the fish and work outward. The management plan could benefit from taking a step backward and viewing the problem through the eyes and TEK of Tribal members; viewing the ecosystem as a whole by studying the problems originating on the tops of the mountains, in this case logging, and working down toward the streams. Unless lumber industry issues are addressed, efforts within the stream and along the banks will likely not be entirely successful. One Tribal member shared that he believes the loss of westslope cutthroat trout can be directly linked to logging and the loss of spawning grounds. The loss of spawning grounds, he explained, is occurring as sediment is

accumulating in the once clear, clean, streambeds. The streams no longer have optimal conditions for the westslope cutthroat trout to spawn.

Logging

"Logging is to the Earth like cancer is to man." – Interviewee 11/2/15

Tribal members tie many of the environmental issues in the Coeur d'Alene Basin to logging that has been occurring in the area. One Tribal member explained that when he was in his twenties, he was a logger. When he worked in the industry in the 1980's, the loggers would only work four to five days a week, and there was more caution and precision in the areas cleared. Now, in 2015, loggers are working seven days a week and using destructive practices. They are working at an exceptionally fast pace using herbicide that kills

Image 5: Deforestation in Benewah Creek Watershed

everything, both native and nonnative plants. Hand pulling would be a more effective (but much slower and more costly) method to remove the noxious weeds and protect the native grasses. However, the Tribal member pointed out that the owners of the logging companies do not live in the area and in turn are unconcerned about residents being impacted by the logging. These companies make decisions based primarily on increasing profits for the shareholders and for themselves.

Image 6: Deforestation in Benewah Creek Watershed

A Tribal member voiced his concerns in relation to logging, "We have lost so much timber, I am really afraid for my children." He continued, explaining that all the white pine trees are gone from the area, "when you take three hundred and four hundred year old trees away, our generation will never see that again." Only thirty years ago, the side of the mountain in Benewah Valley contained old growth and second growth trees. Now, there is only fourth and fifth generation timber that has been logged by four or five different companies. The timber isn't even marketable anymore. One of the timber companies has a

twenty year plan for the area, but the Tribal member said he doesn't believe there is enough timber left to last through twenty more years of logging, "it's just not feasible" he said. He recalls there being hundreds of elk in the area just 30 years ago, a time period he referred to as "just a blink in our lifetime," and now the number is drastically reduced and one must be an exceptionally experienced hunter with vast knowledge of the land to kill an elk. A Tribal member describes hunting with his father around White Tail Draw, "I used to hunt elk here with my father but now it is completely logged off. There used to be hundreds of springs, I used to chase elk down toward my father. You could smell elk here, a pure, earth smell."

Tribal Members cite logging as having an impact on the water in the area, explaining that logging is devastating the water table. In the 1920's and 1930's, there were less regulations pertaining to logging and the companies in the area utilized the streams as flumes to transport the timber. One Tribal member was hired to document the seeps and springs in the area, but he found they were all gone, "thirty years ago there was so much water in this area but it has disappeared completely in the last ten years." The logging companies spray chemicals along the sides of the roads that kill all of the ferns. When it rains, these chemicals are washed into the ditch and don't break down, eventually ending up in the stream.

Now many of the logging companies are selling off the land. One Tribal member explains "this is a big scar, like getting into a bike wreck as a kid and ripping off skin, it heals, but it leaves a scar." The land that the logging companies are selling off is scarred, it will never return to its original condition. The logging companies in the area also receive incentives, specifically tax breaks, to leave their land open to the public. This allows non-tribal members, specifically hunters, to come onto the lands. While conducting the interview a pick-up truck with hunters drove by, prompting the Tribal member to state, "they are

probably just driving around looking for something to shoot, they don't even work for it." A little while later another group of hunters drove by on an ATV, something that, the Tribal member explained, would not have happened one hundred years ago. But now, there are year round emissions, as people use trucks and ATVs to go hunting.

Incorporating a top down approach into the westslope cutthroat trout management plan will allow for the problem of logging to be addressed when creating solutions for the population decline of westslope cutthroat trout. Looking at the chemicals the loggers are using that are being washed into the streams and the environmentally destructive logging practices as vital components, and directing attention to where this is occurring higher on the mountain.

Image 7: Deforestation in Benewah Creek Watershed

CHAPTER 4: MANAGING FOR FUTURE CLIMATE CHANGE

Introduction

It is imperative to not only incorporate TEK into the current management plan in preparation for the effects of impending climate change, but to also integrate TEK into the future climate change management plans. Climate change is predicted to impact westslope cutthroat trout in a myriad of ways, from a decrease in available spawning habitat to an increase in hybridization with nonnative rainbow trout. Tribal members are seeing the impacts of climate change on their reservation; they have taken note of a change in precipitation and a decrease in various species including westslope cutthroat trout. Along with the actions that are already in progress as part of the current management plan, and the incorporation of TEK into those actions, there are several other steps that can be taken to assist in the Tribe's struggle against climate change. Education of youth, at the local level, is imperative. Tribal members feel that the Tribal youth are losing their connection to the environment as a whole and to westslope cutthroat trout specifically. As Tribal members state, climate change generally comes down to individual actions. While Tribal members can't necessarily change the actions of large corporations emitting fossil fuels, they can change the actions of Tribal youth.

However, it is also important to note, that when it comes to climate change and westslope cutthroat trout, there are also issues at the national level that need to be addressed. Westslope cutthroat trout are not currently protected under the Endangered

Species Act. A larger reason for this is that hybridized species of westslope cutthroat trout and rainbow trout are often counted as one species. As climate change worsens, and hybridization increases, the amount of cutbows (the hybrid species of cutthroat and rainbow trout) will increase. While researchers take into consideration the genetic differences in rainbow trout and westslope cutthroat trout, the cultural significance of westslope cutthroat trout has never been considered. If hybridized species of westslope cutthroat trout continue to be included in calculations that determine whether the species is listed under the endangered species act, purebred westslope cutthroat trout could potentially continue to disappear. Historically and traditionally, the Coeur d'Alene Tribe fished for westslope cutthroat trout, not wetslope-rainbow trout hybrids. These factors should be considered at the national level when listing the species.

Table 2: TEK and Future Climate Change

Level	Traditional Ecological Knowledge (TEK)
Local	Increased youth education
National	Incorporation of cultural considerations in Endangered Species Act Listing

Climate Change Projections

Temperature Changes

The Northern Rockies Adaptation Partnership: Vulnerability Assessment Report discusses the projected climate change impact on westslope cutthroat trout. The report

explains that the greatest climatic concerns in regards to fisheries are the increase in air temperature combined with a change in precipitation including the volume of precipitation that falls, when precipitation is occurring and the change from snow to rain. These changes have drastic effects on the streams where the fish are living and spawning. Changes include an increase in water temperature which will pose problems because cutthroat trout spawn in some of the coldest streams in the Northwest. Due to this, it would be difficult for cutthroat to find new areas to colonize as the streams where they currently reside become to warm for them. As the water warms, invasive species that are able to tolerate the warmer waters will likely move into the cutthroat trout habitat, further decreasing cutthroat habitat and potentially replacing the native species. Changes in precipitation will cause earlier snowmelt runoff, summer baseflows occurring earlier than normal, and changes in peak flows of the streams. These changes will likely favor resident populations over adfluvial or fluvial populations. Smaller populations sizes, caused by a decrease in suitable habitat will make cutthroat trout more vulnerable to disturbances such as floods and droughts. It is unlikely that cutthroat trout will be able to adapt to the warming water, as there is little evidence that fish species as a whole are capable of rapidly adapting to warming water temperatures. While it is possible for cutthroat trout to spawn in warmer water than other salmonids, there is still a limit to the temperature they can withstand. As a species, they will be negatively impacted by the encroachment of non-native species that are more adapted for the warmer conditions. The report concludes that the magnitude of risk for cutthroat trout by the 2040's is low, because they are able to reproduce in relatively small population sizes, but increases to moderate risk by the 2080's (Northern Rockies Adaptation Partnership, 2014).

Westslope cutthroat trout face many problems, which will be exacerbated by climate

change (T. Williams & Hardison, 2013). Climate change is causing a reduction in snow pack, spring runoff is occurring earlier than historic trends, and summer flows are reduced while both floods and droughts are increasing. Warming air temperature is causing increased evaporation rates along with earlier spring thaws, leading to an increase in wildfires. "Native trout and salmon are sensitive to habitat degradation and generally require streams and lakes with cold, high-quality water that are free of nonnative salmonids" (J. E. Williams et al., 2009, p 533). Alone, these occurrences may not have devastating impacts for cutthroat trout, however, combined with the current habitat degradation and declining population, floods and wildfires pose lethal risks (J. E. Williams et al., 2009). A study completed by Williams et. al. analyzed the impact a three degree Celsius temperature increase (added to mean July air temperature) would have on three subspecies of Cutthroat trout, westslope, Colorado and Bonneville. The researchers set out to determine if the various subspecies will be able to maintain their current geographical extent as the climate changes. Westslope cutthroat trout have a thermal limit of approximately 22 degrees Celsius, as do Colorado, while Bonneville's thermal limit is 24 degrees Celsius. Along with each species thermal limit, the researchers assessed which subwatersheds would be at risk for uncharacteristic winter flooding as the temperature increases. Results showed that west-slope cutthroat trout have a higher persistence than other species in the form of more contiguous areas of habitat. Despite this persistence, over 50% of westslope are at high risk for climate impacts, mostly due to an increase in flooding (J. E. Williams et al., 2009).

Drinan et. al. performed a study to determine if westslope cutthroat trout are thermally adapted to their local environment. They assessed five different populations of westslope cutthroat trout (four wild and one hatchery), looking at the responses of both embryonic and

juvenile westslope cutthroat trout to temperature. The results of the study showed that westslope cutthroat trout have adapted to be thermal generalists and specialists in the embryonic stage. It is during embryogenesis, when the cells of the fish are forming, that the species is most susceptible to changing temperatures. Populations that live in streams with extremely cold winters, and warm summers are considered thermal generalists, as they are able to adapt to the differing conditions. Other populations that live in streams that do not change as drastically are considered coolwater specialists. These results imply that westslope cutthroat trout adapt to the streams where they live, and are more impacted by how much the temperature changes as opposed to when the temperature reaches a specific number. If there is a large change in temperature due to climate change there will likely be high mortality rates for westslope cutthroat trout, a small increase in temperature will have less effect on westslope cutthroat trout, irrelevant of the current stream temperature (Drinan et al., 2012).

Hybridization

Westslope cutthroat trout are hybridizing with rainbow trout creating a fish commonly referred to as a "cutbow." While hybridization could potentially help a species adapt to climate change, in this situation hybridization has actually created a less fit species. Hybridization is occurring due to human influence in the form of stocking lakes with hatchery-raised rainbow trout. In turn the hybridization is occurring quickly and results in reduced fitness, a decreased genomic integrity, and lower native species diversity (Muhlfeld et al., 2014). When the introduced rainbow trout and the native cutthroat trout exist in the same location during spring-spawning, they are able to produce fertile offspring. These hybrid offspring will then reproduce and as this process continues, the native genome is

slowly lost. These factors make the hybrid "cutbows" more susceptible to climatic changes. Climate change is also influencing the rate at which hybridization is occurring (Muhlfeld et al., 2014). Hybridization is placing westslope cutthroat trout in danger of widespread genomic extinction which "results in the loss of the legacy of an evolutionary lineage" (Allendorf et al., 2004).

Rainbow trout are capable of tolerating warmer water, lower spring flows, earlier spring runoff and more disturbance than cutthroat trout. Research conducted in the Flathead River Basin assessed the impact climate change is having on hybridization of rainbow trout and west-slope cutthroat trout. Using data from 1978 to 2008, researchers discovered there has been a .36 degree Celsius increase in temperature per decade. Peak spring runoff has also been occurring two to three weeks earlier than the historical average and there have been lower spring and summer flows as compared to the historical average. Wildfires have also impacted the region, burning nearly 16% of the basin during the 1984 to 2008 time period. Wildfires can cause streams to warm as they burn the tree cover that once protected the streams. The research showed that while stocking of rainbow trout began in the Flathead River system in the late 1800s through 1969, hybridization of rainbow trout and westslope cutthroat trout was uncommon in samples collected in the 1970s and 1980s. However, in 2000, samples showed a sharp rise in the amount of hybridization occurring in the Flathead River system. Researchers found that the change in spring stream flow due to a change in precipitation and summer stream temperature had a direct impact on the increase in hybridization, while wildfire had very little impact. The study concluded, "climatic drivers and human-mediated introductions of an invasive species have interacted to increase introgressive hybridization in nature" (Muhlfeld et al., 2014, 621).

While westlsope cutthroat trout and rainbow trout have similar optimal growth temperatures, approximately 13 degrees Celsius, westslope cutthroat trout have a much lower thermal tolerance than rainbow trout overall (Bear, McMahon, & Zale, 2007).

Multiple studies on hybridization of native westslope cutthroat trout and introduced rainbow trout have shown that in colder, high elevation streams with significantly shorter growing seasons there was less hybridization. Generally pure introduced rainbow trout were found at the lowest elevations, pure native westslope cutthroat trout at the highest elevations and rainbow-cutthroat hybrids were found in the middle (Hitt, Frissell, Muhlfeld, & Allendorf, 2003; Rasmussen, Robinson, & Heath, 2010; Weigel, Peterson, & Spruell, 2003; Yau & Taylor, 2013). This may be due to the fact that there is less opportunity for the hybrid populations to reproduce, or because rainbow trout prefer wider, lower elevation streams and encroach less on the small higher elevation streams. A majority of the purebred westslope populations in the Clearwater Basin were located in high elevation streams, making the high elevation populations critical in maintaining pure native westslope cutthroat trout (Weigel et al., 2003).

Research conducted on westslope cutthroat trout and rainbow trout hybridization in Canada showed that on average, westslope cutthroat trout live to an older age than the introduced rainbow trout. When the hybrids were analyzed it was discovered that the more rainbow trout alleles the hybrids had, the shorter their life span. An increase in rainbow trout alleles also leaves the hybrids more suited for lower elevation, warmer streams. This is because the hybrids will follow more of a rainbow trout life cycle, requiring them to eat more, faster, as they will grow quicker and die younger than a purebred westslope cutthroat trout would. This research also showed that westslope cutthroat trout have the potential to maintain

their pure populations at high elevations where the rainbow trout and hybrid populations are not able to survive. However, this also implies, that as stream temperatures warm, hybrids and introduced rainbow trout will be favored over the native westslope cutthroat trout who require colder stream temperatures. (Rasmussen et al., 2010). Streams with barriers that prevent rainbow trout from encroaching upstream into westslope cutthroat trout territory show the least amount of hybridization (Rasmussen et al., 2010; Weigel et al., 2003)

Climate Change TEK

"I know every inch of all of these mountains. I've made it a passion of mine. I take white tailed deer, huckleberries, snow berries. It is all disappearing."- Interviewee 11/2/15

Coeur d'Alene Tribal members are exceptionally concerned about the changing climate. The climate has been changing before their eyes. Principally, Tribal members take note of how the precipitation in the area has changed, and continues to change. One example Tribal members give of the changing climate includes precipitation deviations.

The lack of snow worries Tribal members. In the last five years, Tribal members have taken note of a drastic decline in snowfall amounts, pointing out there should be snow on the ground in November, yet there wasn't any snow visible during this time. One Tribal member recalled building snow castles in five-foot drifts of snow as a child, something that his children no longer have the opportunity to do during the winters. Another Tribal member, further distressed about the absence of snow, cited the declining snowpack in the mountains as a large concern. He gave examples of a couple of local peaks that had minimal snow in recent years. When speaking about Plummer Butte, which is 3200 to 3600 feet, he explained that the butte had no snowpack which causes a decrease in huckleberries, an important species to the Tribe. He compared Plummer Butte to another peak, St. Joe,

explaining how currently the huckleberry bushes on St. Joe that are around two feet contain about fifty berries, while the huckleberry bushes found on Plummer Butte of a similar size only have about ten berries per plant. Huckleberries are found at about 2500 feet and above and they require a lot of snow to survive. As the snow decreases on the mountains, the Tribal members witness a steep decline in the number of harvestable huckleberries.

Tribal members also point out many other species in the area that appear to be on the decline due to the changing climate. One Tribal member believes that the animals, plants and insects in the area are disappearing at an alarming rate. This Tribal member gave multiple examples of species vanishing with the changing climate including the Idaho giant lizard and amphibians, as well as the water bug. Crawdads, a once abundant species in the local streams, appear to be nearly absent from the waterways today. Tribal members have noticed a steep decline just in the last five years. One Tribal member explained how in the past, someone would be able to walk into any draw and find big crawdads but there are no longer any crawdads to be found. Another Tribal member recalls an area named after crawdads, where he used to go as a child to catch them. This location now contains no crawdads; the area is completely devoid of the once prevalent species. Similarly, a Tribal member remembers two areas, the White Tail Draw and Benewah Creek, as being filled with crawdads, but these areas are also now barren of the species. Tribal members observed that the glaciers are receding at an alarming rate and that the freshwater resources in their area are drying up. One Tribal remembers sitting on a glacier in the saddle of a mountain he referred to as Freezeout, but today that glacier is completely gone. In recent years, even when it does snow, Tribal members have noticed that the runoff down the mountainsides occurs quickly because there are no longer trees and vegetation slowing down the runoff. He referred

specifically to the north facing drainage, a location that use to hold immense amounts of snow, but currently provides little shade and in turn the snow melts away at a rapid rate. One Tribal member went so far as to say that with all the impacts of climate change occurring, "the climate change problem is probably going to be the end of us."

Incorporating TEK into Future Westslope Cutthroat Trout Climate Change Plans

The plan for westslope cutthroat trout restoration projects on the reservation states "The overarching goals for recovery have been to restore the cutthroat trout populations to levels that allow for subsistence harvest, maintain genetic diversity, and increase the probability of persistence in the face of anthropogenic influences and prospective climate change" (Firehammer et al., 2013, p 6). While all of the restoration efforts currently occurring in the Coeur d'Alene basin will help to increase the westslope cutthroat trout populations, and some actions will even help combat climate change (increasing shade along stream banks), there is no direct plan in place for dealing with impending climate change.

Education

It is impossible to address the issue of climate change and the decline of westslope cutthroat trout without additionally focusing on the issue of climate change as a whole. One Tribal member blamed humans for the changing climate, "climate change is due to manmade materials in places they shouldn't be, these materials are throwing off heat." He pointed at an empty plastic bottle someone had carelessly thrown on the ground, and then to a can a few inches away, "a blade of grass with two drops of water that has a plastic bottle producing heat underneath of it will dry up and the grass may die." While one dead blade of grass may not seem like much, there is not just one bottle on the ground; there are immense amounts of

trash; he pointed out that there are one hundred acre landfills. He explained how opinions and attitudes have changed over the years. When he was a child, if he threw trash on the ground his parents and grandparents would scold him. Now, "it's embarrassing" he said, in reference to all of the garbage on the ground, "there is an unnatural ditch with human garbage, Mother Nature will only let us get away with it for so long. Our father taught us that throwing garbage on the ground would kill Mother Earth." He explained how in his opinion, trash is one of the largest problems; it is producing radiant heat that contributes to climate change and increased levels of toxins. This Tribal member doesn't just point the finger at people throwing trash on the ground, he also blames the current lifestyle most Tribal families are forced to live. He explained how the amount of trash his family produces is excessive, but it is very hard for them to limit their trash because of how dependent they, and most other Tribal families, are on the grocery store. His family tries to avoid eating meat from the grocery store, and only consume what he is able to fish and harvest, but that is difficult to accomplish. Climate change appears to be a double-edged sword for many Tribal members. Tribal members have been forced to stop fishing for westslope cutthroat trout because the numbers are so low. Not being able to harvest fish or hunt because elk populations are declining, or collect huckleberries because they are becoming harder and harder to find, forces Tribal members into a greater reliance on purchased, commercially produced food. As one Tribal member pointed out, relying on the grocery store causes Tribal members to produce more trash than they historically have, and this trash is contributing to climate change. This implies that expanding the ability of Tribal members to fish for westslope cutthroat trout could actually aid the Tribe in minimizing their contribution to climate change.

Tribal youth need to be educated as their parents were once educated. The Coeur

d'Alene Fish, Water and Wildlife Program Fisheries Management Plan does include Public Involvement and Education, stating that "the integration of social and cultural values inherent to a community is essential to the long-term success of a management plan" (Lillengreen et al., 1999, p 41). This education program, however; focuses on educating landowners about fish habitat and promoting awareness of "fish habitat and watershed health issues." These are important educational endeavors, but there also needs to be an increased focus on Traditional stories and teachings as a way to reconnect youth with the environment as a whole.

One Tribal member expressed his concern about how youth are being raised and taught about the environment in present day. He reminisced about his life growing up, "I remember being dropped off on top of the ridge and walking down to the Benewah. I was just twelve. There was expectation, responsibility, morality. That's the problem with climate change." He feels that among Tribal youth there is no longer expectation, responsibility and morality and the environment is being strongly impacted with grave consequences. He continued, explaining how many people have figured out that life is short, so they will just take and take and not think about future generations.

The focus of the education program cannot just be on westslope cutthroat trout specifically. As discussed earlier, Tribal members tend to view the environment as a whole, looking at the bigger picture. Tribal youth need to be educated about climate change, westslope cutthroat trout and the environment in a wholistic manner. There is an acknowledgement from Tribal members that youth do not know the cultural significance of westslope cutthroat trout, that their children are unaware of the importance of this species. Teaching about the cultural significance should be weighted just as highly as teaching about water quality and habitat restoration. From the perspective of the Coeur d'Alene it is

impossible to separate the cultural significance of the species from the species itself, therefore, Tribal youth need to be taught about the scientific and cultural importance of westslope cutthroat trout in combination. Similarly, Tribal youth need specific education about climate change with cultural implications and ancestral lessons in mind. Traditional teachings have a lot to offer in relation to preserving the land and species that are important to the Coeur d'Alene.

Furthering the idea that education of youth is imperative. Tribal members have expressed their belief that many of the problems occurring today come down to the individual. One Tribal member verbalized his concern, "all we can do is control ourselves," he stated when discussing how to put an end to climate change. He continued, explaining how many people chose to drive instead of ride a bike, people aren't thinking in the long term, instead they are thinking about the immediate convenience. Expanding, he explained how industry is taking a similar approach, large corporations are not looking toward the future, instead they are implementing immediate actions that provide instant and short term profit, but in the long run these actions are having serious and lasting effects on the environment. While spreading the teachings of TEK to corporations is still a remote goal, Tribal members, the fisheries program and the Natural Resource Program as a whole can focus on teaching Coeur d'Alene Tribal youth this concept.

Concluding the discussion on climate change, one Tribal member stressed that in order to put a stop to climate change, "my gosh, we will have to change." He was referring to society as a whole when he said that, but the best way to initiate change is with the individuals that the Tribe can influence, the Tribal youth. Educating youth about TEK surrounding climate change, and the impacts being seen across the reservation, including the impacts on

westslope cutthroat trout should be made a priority.

Cultural Considerations in the Endangered Species Act

When it comes to climate change, one cannot focus soley on management at a local level. For example, a large concern surrounding westslope cutthroat trout as the temperature warms is the pprobability of increased hybridization with rainbow trout. While rainbow trout are no longer being stocked on the Coeur d'Alene Reservation, except in ponds that do not connect to the waterways, historically rainbow trout have been introduced in the area. As the stream temperature warms, it is possible any rainbow trout still residing in the Coeur d'Alene basin will hybridize with westslope cutthroat trout, creating, cutbow trout. Hybridized species of westslope cutthroat trout have, in past research, been counted as westslope cutthroat trout when considering westlope cutthroat trout for the endangered species act. This practice has created an ongoing controversy.

According to the US. Fish and Wildlife Service, a westslope population with up to 20% rainbow trout admixture is included as westslope cutthroat trout when considering westslope cutthroat trout for the Endangered Species Act. However, individual states and Canada follow different standards. This is partially due to a lack of research on the differences and similarities between pure westslope cutthroat trout and varying degrees of hybridized westslope cutthroat trout and rainbow trout (Corsi, Eby, & Barfoot, 2013). Allendorf et al (2001) explains that "interpreting the evolutionary significance of hybridization and determining the role of hybrid populations in developing conservation plans is more difficult than is usually appreciated" (p 615). Natural hybridization is common among fish, and many fish species that hybridize are able to produce fertile offspring and eventually create "hybrid swarms." However, just as natural hybridization is common in fish

species, anthropogenic hybridization is common because the introduction of fish in nonnative habitats has occurred worldwide. This makes it difficult to have one standard regulation on how to deal with hybrid fish species because while natural hybridization can be beneficial to the species, anthropogenic hybridization often creates a less fit species. The three top reasons for hybridization include the introduction of plants and animals, fragmentation and habitat modification (Allendorf, Leary, Spruell, & Wenburg, 2001). Originally the Endangered Species Act had a policy of excluding hybrids, determining that hybrids could "jeopardize continued existence of that species." This policy was deemed too "rigid" and was changed in 1990. It was not until 1996 that a new policy was created, entitled the "Intercross Policy," a policy that was never approved. Creating a policy that can account for all situations where hybridization occurs has proven to be a challenging effort.

Allendorf et al. (2001) describe hybridization as occurring under two categories, natural and anthropogenic, and then divide these categories into a total of six different types of hybridization (three natural and three influenced by human actions). Distinguishing between natural hybridization and anthropogenic hybridization is important, as most natural hybridization is not a major issue and can often benefit the species, sometimes it is even an evolutionary adaptation. For the purposes of this research, the last three types, which are anthropogenic are most important. The most relevant classification is Type 5: Widespread introgression. This is what is happening to westslope cutthroat trout, they are hybridizing with introduced rainbow trout, but pure populations still exist, and there is little reason to conserve the hybrids. This contrasts with the description of a Type 6: Complete Admixture. A Type 6 implies that there are no longer any remaining pure species, and in turn conservation of the hybridized species is important. The last classification of anthropogenic

hybridization is a Type 4: Hybridization without introgression, implying that the species are hybridizing, but the hybrids are not reproducing, meaning there are only first generation hybrids. By removing the nonnative species, the hybridization could potentially be eliminated. This contrasts with Type 5 and 6 because it is much easier to stop the hybridization. In Types 5 and 6, hybrid swarms are forming, as hybrids reproduce with other hybrids or with the native or nonnative species. Allendorf et al (2001) cite three important factors in determining the importance of conserving the hybrid populations; first, one needs to determine how many pure populations still exist, if there are not many pure populations left there is value in protecting the hybrid population. Second, it is important to determine how different the hybrid population is from the original species. The more differences among the originals and hybrids, the greater the effort required to conserve the hybrids. Lastly, it should be established if the hybrid populations threaten the original species. However, in the end, there should be much less effort placed on conserving anthropogenic hybridization, and much more effort placed on preventing this type of hybridization. It is also important that hybridization of species not be lumped into one rigid policy, but addressed on a case by case basis related to the type of hybridization occurring and the results of the hybridization (Allendorf et al., 2001).

In the case of westslope cutthroat trout, following the standards Allendorf et. al. puts forth, westslope cutthroat trout should be protected as a pure population. But, to even further the case of wetslope cutthroat trout being protected as a purebred species, the cultural significance of the species should be included. Historically, the Coeur d'Alene Tribe has fished for westslope cutthroat trout in the Coeur d'Alene basin. To be able to continue this custom, this way of life, the Tribe needs to have continued access to pure westslope cutthroat

trout, the species their ancestors fished. Hybridized westslope cutthroat trout are not what Coeur d'Alene ancestors fished in their native region. When reflecting upon cultural significance, just as it is not only about the number or species in the streams and rivers, it is also not about what percent of the westslope cutthroat trout is hybridized.

Actions have been taken in the Coeur d'Alene basin to prevent hybridization, specifically putting an end to introducing rainbow trout. However, placing westslope cutthroat trout on the endangered species list and acknowledging, at a national level, that hybridized species should not be considered equal to purebred westslope cutthroat trout can help in the management of westslope cutthroat trout.

CHAPTER 5: CONCLUSION AND FUTURE CONSIDERATIONS

Conclusion

TEK can and should be incorporated into the westslope cutthroat trout current and future climate change management plan. Not only can the inclusion of TEK potentially assist in the restoration of the species, but it can also aid in maintaining the cultural practices and significance that for the Coeur d'Alene, cannot be separated from the species itself.

Fish biologists and managers need to acknowledge that numbers are not the only benchmark for bringing back westslope cutthroat trout. Being able to access ancestral fishing grounds is an imperative component of restoration for Tribal members. Tribal members also perceive westslope cutthroat trout as one component of a larger ecosystem, and acknowledge the grave impact that actions at the top of the mountain are having on the fish in the streams at the bottom of the mountain. While fish biologists do not deny the problems at the top of the mountain, there needs to be more focus on locations farther from the stream banks.

As climate change progresses, more attention needs to be placed on education, especially youth education. Tribal youth would benefit from learning how their actions are impacting the environment and also how their culture is tied traditionally to the various species. Restoring westslope cutthroat trout is important, but it is also imperative to ensure the culture and teachings surrounding this species are preserved. Lastly, in terms of climate change, actions need to be taken at a national level as well. Climate change is not merely a local problem, it isn't even just a national issue, it is an international concern. While the Tribe can take steps to change their actions and manage for the species on their reservation, policy changes at a national level can also help support the efforts of the Coeur d'Alene Tribe. Culture needs to be considered on a national level, especially in the Endangered Species Act.

Future Considerations

While this research shows there is potential for the inclusion of TEK in the management plan for westslope cutthroat trout, there is also opportunity to improve the knowledge base of TEK surrounding westslope cutthroat trout.

Both Tribal members that I interviewed work for the Coeur d'Alene Natural Resource Department, and in turn have vast knowledge of the westslope cutthroat trout management plan. While this, in some ways, was very beneficial, it is also important to acknowledge that this slightly skews their viewpoints. In continuing this research it would be useful to interview other Tribal members that are in no way affiliated with the Natural Resource Department to determine if involvement in the Natural Resource Department affects their knowledge and outlook. Along with interviewing Tribal members not affiliated with the Natural Resource Department, interviewing more Tribal members would also add depth to this research.

Westslope cutthroat trout proved to be a difficult species to obtain TEK on because Tribal members are no longer able to fish for this species, and much of the cultural significance is being lost. While arguably this makes it even more important to do research on westslope cutthroat trout and reestablish the species, it does make it difficult to create an in depth cultural background. I think this difficulty also highlights the need to initiate expanded research now, before climate change continues to worsen and cause a decline in more species, and to create management plans that incorporate TEK for other culturally significant species. For example, one of the species mentioned by both Tribal members that has greatly declined in recent years is crawdads. Their children do not have the opportunity to harvest crawdads. It is imperative to begin now, while there are still Tribal members alive who recall collecting

crawdads and who remember ancestral crawdad locations, to record TEK surrounding this species and to begin creating climate change adaptation and management plans.

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APPENDICES

Appendix 1: Research Questions

BACKGROUND QUESTIONS
What is your age?
What is your affiliation with the Coeur d'Alene Tribe?
Have you lived in this area your entire life?
    If not where else have you lived?
CLIMATE CHANGE
How would you define climate change?
What do you believe is causing climate change?
Who is most responsible for climate change?
Does climate change concern you?
    Why/Why not?
What evidence have you seen that proves climate change is or is not occurring?
Have you noticed the decline of any important species?
FISHING GROUNDS
Where are the most common cutthroat trout fishing locations that tribal members use?
    How has fishing in these locations changed over the years?
    Have tribal members stopped fishing in certain locations? Why?
    Have tribal members started fishing in new locations recently? Why?
Has anything been done in the past to preserve these fishing areas?
Do you believe extra attention should be focused on preserving cutthroat trout in specific locations? I.e. in the areas most tribal members fish
CUTTHROAT POPULATION
Have you noticed a change in cutthroat trout populations in your lifetime?
Have your ancestors told you about a change in cutthroat populations during their lifetime?
How well distributed were cutthroat?
Have you noticed a change in the size of cutthroat trout?
Did the tribe have fisheries programs in the past?
        Individuals that kept track?
        Fish managers?
Why do you believe the cutthroat population is declining?
Do you believe the cutthroat population will continue to decline?
IMPLICATIONS
What would it mean to you if the cutthroat trout population disappeared?
    What would it mean to your family?
    What would it mean to your tribe?
How important are cutthroat trout to your family?
Are cutthroat trout as important today as they were to past generations of Coeur d'Alene?
    Why or Why not?
What do you think should be done to protect, preserve or increase the cutthroat population?

Appendix 2: Informed Consent

Approval: The Coeur d'Alene Natural Resource and Cultural Committee have approved this project, and the University of Idaho Institutional Review Board has certified this project as exempt.

Project Title: Incorporating Traditional Ecological Knowledge in Current and Futre Management Plans: Coeur d'Alene Tribe and Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*)

Project Description: The purpose of this study is to develop comprehensive background on the scientific and traditional ecological knowledge (TEK) surrounding cutthroat trout, the already seen and projected climate change impacts, and ultimately use this information to create policy suggestions with a main goal of portraying TEK alongside scientific knowledge as equally important. The ultimate result of this project will be to help protect, preserve and perpetuate the cutthroat trout for the Coeur d'Alene Tribe.

Researcher: Jill Leaness

1. I, _____, (the interviewee's full name), state that I am over 18 years of age, and freely and voluntarily wish to participate in the research being proposed. **2.** I am aware that I will have an opportunity to review, modify, and approve of any specific information I share with the interviewer. **3.** As Coeur d'Alene knowledge is collective knowledge, I am also aware that the final definition, use and disposition of any information I provide for this project will be subject to review and approval by the Coeur d'ALene Tribal Cultural Committee and Natural Resource Committee before it can be fully articulated, given meaning and publically shared. **4.** A written copy of the Informed Consent Form has been given to me.

Benefits: The project is intended to aid the Coeur d'Alene Tribe in protecting a key species from the effects of climate change, as well as to serve as a framework for how ecological and traditional knowledge can be combined in an effective climate change policy and management plan.

Procedures: You will be asked to participate in an interview conducted by Jill Leaness. The study should take approximately an hour and a half.

For this project, interviews will be conducted with Coeur d'Alene Tribal elders and other interested Tribal members. Questions will focus on climate change, nutritional and cultural significance of cutthroat trout and history of cutthroat trout in the Coeur d'Alene basin. The interview will be recorded if the interviewee is willing and notes will be taken. The questions will take place in an informal setting.

Risks: There are minimal risks associated with the project, although some interviewees may feel uncomfortable divulging information about the culture and history of a species that they and their families hold to be important.

Voluntary: Participation in this study is completely voluntary and can be terminated by the interviewee at any time with no prejudice or penalty.

As a voluntary project, you have the right of confidentiality, i. e., your identity will not be revealed to anyone other than the project researcher without your consent.

If the participant has any questions about the research, subject's rights, related research, or any other questions, he or she may contact Jill Leaness, Rodney Frey, or the University of Idaho's Institutional Review Board. Contact information is provided below.

I acknowledge that Jill leaness, researcher, has fully explained to me the purposes and procedures, and the risks of this research; he/she informed me that I may withdraw from participation at any time without prejudice; and has informed me that I will be given a copy of this consent form. I freely and voluntarily consent to my participation in the avove mentioned research project.

_____ I waive my right to confidentiality, i. e., my name may be used in the research.

_____ I do not waive my right to confidentiality, i. e. my name may not be used in the research of disclosed to anyone other than the project researcher.

List any special stipulations or conditions established by the interviewee in the conduct or disposition of this project:

_____
_____
_____
_____

Signature of interviewee:

_____

Signature of principle Researcher:

_____

Date: _____

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