Centering Indigeneity of 21st Century Shoshone-Bannock & Oglala Lakota Worldviews Through Science & Policy

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by

Sammy L. Matsaw

Major Professor: Christopher C. Caudill, Ph.D.
Committee Members: Vanessa Anthony-Stevens, Ph.D.; Colden V. Baxter, Ph.D.; Barbara Cosens, J.D., LL.M.; Karla B. Eitel, Ph.D.; Brant G. Miller, Ph.D.

Department Administrator: Timothy E. Link, Ph.D.

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Authorization to Submit Dissertation

This dissertation of Sammy L. Matsaw submitted for the degree of Doctor of Philosophy with a major in Water Resources—Science and Management option titled "Centering Indigeneity of 21st Century Shoshone-Bannock & Oglala Lakota Worldviews Through Science & Policy," has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: _____ Date: _____
Christopher C. Caudill, Ph.D.

Committee Members: _____ Date: _____
Vanessa Anthony-Stevens, Ph.D.

_____ Date: _____
Colden V. Baxter, Ph.D.

_____ Date: _____
Barbara Cosens, J.D., LL.M.

_____ Date: _____
Karla B. Eitel, Ph.D.

_____ Date: _____
Brant G. Miller, Ph.D.

Department
Administrator: _____ Date: _____
Timothy E. Link, Ph.D.

Abstract

In a digital age we are afforded more ways to tell story than text alone. I'm including my defense as it was told to contextualize the four chapters herein as a guide laying the groundwork to what lies ahead. Storytelling of my defense can be found in two formats as a voice only, or video at the attached link here: https://www.northwestknowledge.net/cloud/index.php/s/dSbUzWqMAdgZvI1

Acknowledgements

Bena Nanewenee/Hau mitakuyape, hello my relatives. At this time, I would like to graciously thank those who supported my academic success and graduation. My wife, children, grandchildren and extended family and community members from Pine Ridge to Fort Hall Indian Reservations in all aspects of who we are as Indigenous Peoples on our Turtle Island.

The experience I had was healing from the sense of academia coming from my past life on another campus. To my committee I can say overall that each of you were in your own way helpful to the specific needs of me and my family as more than just a student but a family unit. Your appreciation for us has poured into appreciation from our family and understanding that some of the things needed to be completed for school were necessary and needed to get done. As a family approach to graduating your respect for my family turned into, '*we* need to get this done' for Chris, Colden, Karla, Vanessa, Barb, and/or Brant, not some elusive committee, advisor, or professor, my wife and kids know you. We will continue to keep you in our lives.

I've also received support from IGERT and ISTEM as a fellow and scholar. These two projects were important to us financially and as another support system of people. From the IGERT committee I was challenged to think more broadly and specifically about my cultural upbringing and rites of passage as an Indigenous man in an academic setting. IGERT assisted with funding the idea of River Newe, an Indigenous owned 501(c)3 non-profit organization located on the Fort Hall Indian Reservation. My wife and I are the co-founders and are currently launching an initiative to kick us off into the world. ISTEM committee was instrumental in a collaboration with connecting a cohort of Native American graduate students across institutions. Our meeting, presenting and consistent communication has been and is instrumental in how we are supporting one other in our given STEM disciplines.

Dedication

Bena Nenewenee/Hau mitakuyape, hello my relatives. At this time, I want to acknowledge my wife, children and grandchildren, and my father Sammy L. Matsaw Sr., his sister Christina K. Matsaw who were especially supportive of my education. My wife has been a healing spirit from another life where we were once together, two old souls, together again. She facilitates my role as a father and grandfather making sure my and our kids are equally considered in the decisions and contributions we make into their lives. To my children, each of you are so different and special in your own way. Each of you bring happiness into my life and challenge me as a father to grow into being a better man, and father for each of you. I'm so thankful for you and coming into my life, choosing me as your father. To my grandchildren and future grandchildren, we've met before in so many ways. As I spend time with each of you, I see the world different than I had expected. I held onto things that are now irrelevant, letting go is important and I see another form of healing with you. Hope.

To my family at large, I've been away from home working on things. Although we were away at school, Jessica and I, were working on our own healing. In that process we've come to find our truest selves and how to give back to our communities. Giving back is important to us both, we heard our elders, leaders and community members. Being away is difficult for us and for our family who rely on us when we are here. I want to apologize for being gone, sorry. We are home now and ready for the next steps we all take together.

To my relatives that passed since we were away. I will miss you dearly. My dear aunt Sharon, I miss you. Leksi Alvin, I miss you. Oyose nean naneweneeAho mitakuye oyasin—all my relations.

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Introduction

In a digital age we are afforded more ways to tell story than text alone. I'm including my defense as it was told to contextualize the four chapters herein as a guide laying the groundwork to what lies ahead. Storytelling of my defense can be found in two formats as a voice only, or video at the attached link here: https://www.northwestknowledge.net/cloud/index.php/s/dSbUzWqMAdgZvI1

Chapter 1: Teachings from the Land of my Ancestors: Knowing Places as a Gatherer, Hunter, Fisher and Ecologist

Matsaw S.L. (2020) Teachings from the Land of my Ancestors: Knowing Places as a Gatherer, Hunter, Fisher and Ecologist. In: Pontius J., Mueller M., Greenwood D. (eds) Place-based Learning for the Plate. Environmental Discourses in Science Education, vol 6. Springer, Cham. https://doi.org/10.1007/978-3-030-42814-3_6

Sammy L. Matsaw

The land of my ancestors has shaped my mind. From my mother's tribe, the Oglala Lakota who inhabit wide-open plains, I have inherited the ability to think broadly. From the Shoshone-Bannock on my father's side - peoples who live among river carved mountains - I have inherited the ability to explore the depth of thought. I often find myself crossing between different ways of knowing. My indigenous cultural understanding combined with my commitment to scientific research give me a unique set of perspectives through which I approach the world, simultaneously as a Sundancer (a sacred pipe carrier) and a scientist.

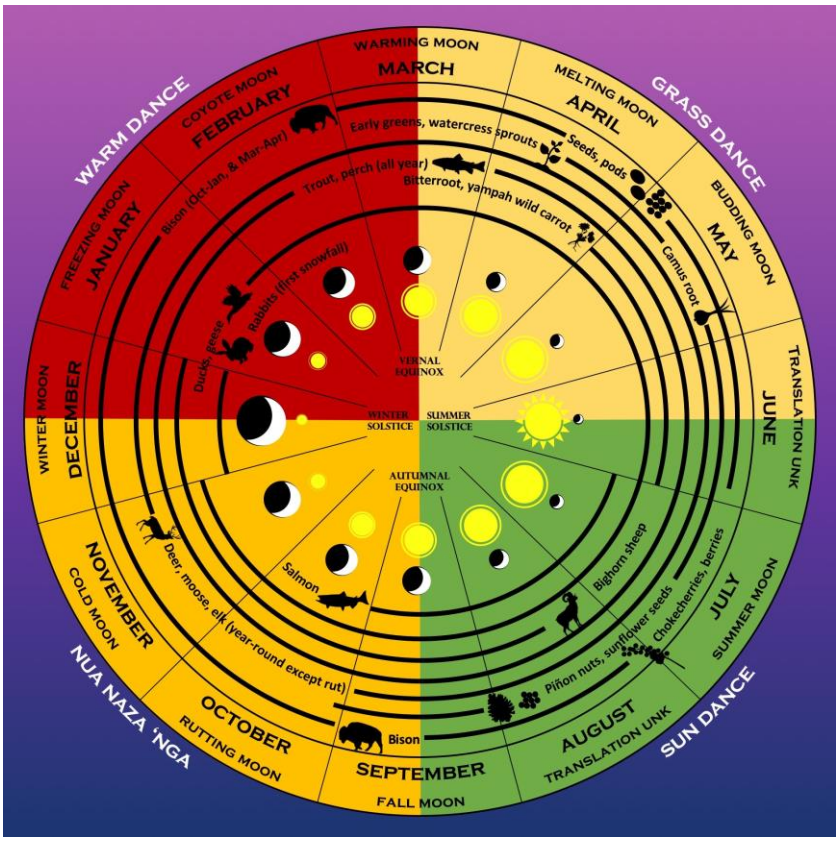

Figure 1-1. The hunting and gathering calendar of the Shoshone-Bannocks and the ceremonies complementing the seasons by moon phase and equinox and solstice of the sun. Note: the calendar is not an exhaustive list of foods rather a depiction of the most prevalent foods hunted and gathered (Drusilla Gould, Shoshone Language Instructor).

> *According to our belief, the Buffalo Woman who brought us the peace pipe, which is at the center of our religion, was a beautiful maiden, and after she had taught our tribes how to worship with the pipe, she changed herself into a white buffalo calf. So, the buffalo is very sacred to us. You can't understand about nature, about the feeling we have toward it, unless you understand how close we were to the buffalo. That animal was almost like a part of ourselves, part of our souls.* –John Fire Lame Deer (Fire and Erdoes 1973, p.119)

Symbolism and storytelling are the primary ways humans, as a species, explain the natural world and how we exist within it. Symbolically, the buffalo was central to a way of living and connected to a larger landscape of food, medicine and inter-generational

knowledge (teachings). I come from indigenous roots, and my family culture tends to understand from an indigenous perspective, but we also live in a dominant American society. So, we've learned to live between two cultures. Storytelling from our ancestors informs us of our social contracts with our living world. In that contract: ". . . *all of nature is in us, all of us is in nature*" (Fire and Erdoes 1973, p. 128). For my family and me, the Medicine Wheel serves as a heuristic to perceive complex issues holistically. By allowing for this holistic perception of an issue, there is space to approach it from a posture of humility because the issue is usually much larger than we are. This is similar to holistic ecological thinking and deep ecology minus the humility. The Medicine Wheel is a symbol embodied largely by hunting and gathering societies, and similarly, by other cultures and peoples in other forms such as the Kultrun of the Mapuche, and the Koru of the Maori.

One larger meaning of the Medicine Wheel is to find the relatedness of oneself through inter and intra relationships in the physical, mental, emotional and spiritual aspects of reality. The color arrangement and usage of the symbol varies from tribe to tribe; for instance, the Shoshones begin its ordinary and/or meditational usage facing the east, and Lakotas the west. I intend this artistic piece to be an interpretive invitation to the reader. It is meant to act as a symbol connecting a larger landscape through my ancestors who managed and passed intergenerational knowledge by eating and communing from their homelands, much like the symbolism gained from the buffalo on the Great Plains and the salmon in the Pacific Northwest. I would also suggest that readers look back at the Medicine Wheel as they read to see what meanings emerge.

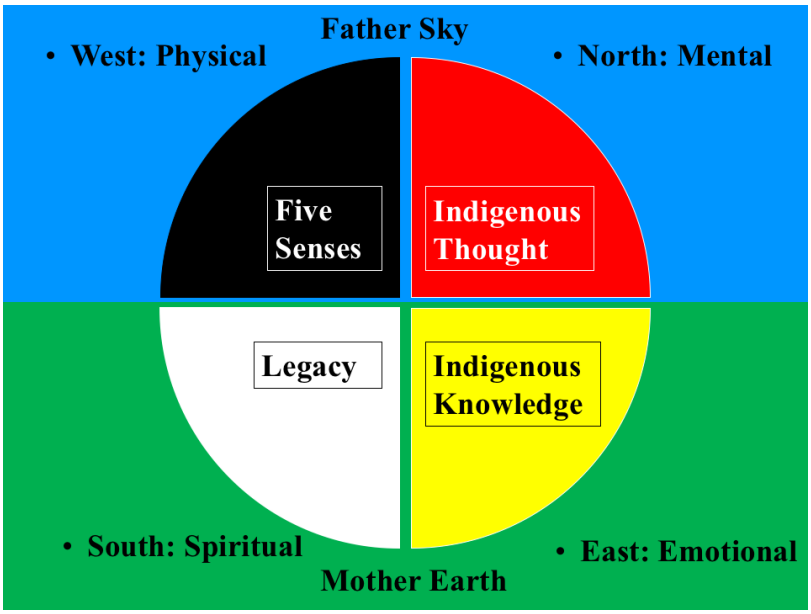

Figure 1-2.The Medicine Wheel depiction in the inter and intra relationships with each of the quadrants respectively represented by the four directions (West, North, East, South), colors (black, red, yellow, white), states of being (physical, mental, emotional, & spiritual), and perceptions (through five senses, Indigenous Thought, Indigenous Knowledge & legacy). A propensity to see the world in this manner is also to acknowledge an embodiment of both spirits in Father Sky (as physical-mental) and Mother Earth (as emotional-spiritual).

Gathering and Grandma's Place

> *They saw themselves as existing in a web of highly interrelated and interdependent "substances": air, water, other beings, and land. They maintained their life force by ingesting the life force of other beings. No less respect was due a wild onion than a deer. "Eat it," my father would say to us, "we took its life that we might continue our own." Eating was a holy sacrament; a thanksgiving to the creatures that provided us life.* (Viola Cordova 2001, p. 4)

When I was five years old, I lived in a small, dusty trailer court across from a rock quarry just outside Rapid City in the foothills of *Paha Sapa* - the Black Hills. Even in my childhood the Black Hills invited tourists to many attractions around Mount Rushmore and the Crazy Horse monument like Reptile Gardens, Flintstone Bedrock City and others. As a kid, I enjoyed these

places, although I heard my parents talking about Mount Rushmore as a great insult to such a sacred place. I spent most of my summer with my brother and sister, and mom's younger brother and sister, my uncles and auntie playing hide and seek or just visiting by a stream under a railroad bridge. But what I remember most vividly from those hot days is gathering chokecherries with my mom's family. Later in the summer we gathered Buffaloberries (*Shepherdia)* and chokecherries (*Prunis virginiana*) along Boxelder Creek and up higher along the bench of the streambed. As we foraged, juice dripped from our chins as we freely ate the delicious Buffaloberries. Chokecherries, which have a bitter flavor and more of an acquired taste, were easier to collect without eating.

At home, my grandmother cleaned them up for making wozapi (whoa-shzah-pee); a traditional chokecherry porridge. As the pot boiled on the stove, I would check it frequently. It smelled so yummy. How could chokecherries be so delectable in wozapi but bitter off the bush? Despite my initial impression of chokecherries, what my grandmother had going on the stove was inviting. Grandma mashed them with a potato masher as they boiled, and the rising steam filled the house with a sweet, thick cherry aroma. With a wooden spoon, Grandma mixed a scoop of government-issued commodity flour into some water, and then added it into the pot. The white slurry swirled into the deep cherry reduction creating a creamy, pastel purple pudding. She spooned some into bowls for us. I was perplexed; the chokecherries had taken on a new form, and to my surprise it was delicious! To some, "grandma's house" conjures memories of cherry pie, but for me, "grandmother's house" means thick, sweet, magenta wozapi!

As a young boy traveling into my mother's homelands, I was engulfed by the sky, and vast land seemingly without boundaries, coming into a complex web of relatives and ingesting generations of life force. Although my ancestors' times of freely hunting the sacred buffalo-*tatanka* on the Great Plains had long passed, I was greeted by a transformation of bitter chokecherries into wozapi. Today the Great Plains continue to teach me that some elements of life that seem bitter at first can become transformed into something else with careful nurturing and patience.

Gathering with my Daughters

I am a gatherer from a long matrilineal lineage. As I gather, I hear the stories and laughter of my aunties, mother and sister, and more recently my wife and daughters. Our early relationship with the land is to call the earth our Mother, Unci Maka in *Lakota* or Bia Sogope in *Shoshone*.

I feel that my intuition has been inherited from my mother and maternal and paternal grandmothers. As we gather huckleberries on our way home from spearing salmon in the South Fork of the Salmon River, there are a couple of places we like to stop. We use whatever containers are in our vehicle and just get to picking. Once we begin picking, several senses are aroused - I *smell* sweet fruit, woody-ness, composting earth, rain-like scents. I *taste* sweet, sour, bitter, and tangy fruits. I *see* ripe berries, not-so ripe berries, medium and smaller unripe berries. I *feel* cool breezes, warmth of the sun on my skin and an intuitive sense of comfort and safety. I *notice* rock outcroppings or logs and other plants growing where berries are bigger, sweeter and tastier, reinforcing how to read the land. Mother Earth, she speaks to me. As with the many relationships nurtured in an extended family, gathering reminds me that I am connected to a much larger community of life. It reminds me to believe that traditional and medicinal foods gathering is a layer of co-health, as in, my health is your health, your health is my health, from individuals to family to community to society and Mother Earth (land).

Figure 1-3. My youngest son and daughter gathering huckleberries, an offering from our Bia Sogope/Unci Maka in August and a treat awaits our next morning breakfast: cornflakes and huckleberries, easy and delicious!

Elk Blanket

> *Hunting rituals are performed before, during and after traditional Native hunting to acknowledge the transformation of the deer's life, spirit, and flesh into that of the human.* (Gregory Cajete 2004, p. 55)

I was six years old riding with my cousins in the back of my uncle's pickup truck. It was cooler than summer with chilly nights and I was wearing tattered jeans, tennis shoes, and a t-shirt. We were returning from South Dakota and joining my dad's large family for a hunt in Island Park, just west of Yellowstone National Park in Idaho. I was already feeling cooler from the hot noon temperature when we spotted a small herd of elk late in the afternoon. Sitting between my cousins just behind the cab, the truck came to a quick stop, dust was everywhere, and suddenly some yelling and rifle fire. As I rose from the commotion, I saw that my dad and uncles had killed two elk - a cow and a young bull. They were dead by the time I ran up to them. The men were happy, and spent some time in silence acknowledging the elks' deaths. Then we pulled the elk around to gut them. This was my first memory of experiencing the practice of our treaty rights and of manhood. I was experiencing death and life in the wealth of security found in being a provider. Carrying gut parts back to the truck, I felt proud to be with my uncles and father as they loaded the elk. On our cold, dark ride home in the bed of the truck, I laid on the elks' still warm bodies and fell asleep. When I awoke, it was to my father's proud smile as he lifted me out of the truck bed to take me inside. I was welcomed by life (reunion with my father's family) and death (hunting and killing elk) and life (feasting in celebration of reunion in Shoshone lands, through the elk's body we are welcomed home) as we ate elk meat that night back home.

Figure 1-4. Much gratitude for this deer's life and we continue to honor it by preparing it well as seen here: braised deer ribs, seared corn and onions, mashed potatoes with a deer-mushroom gravy.

Hunting as Providing

I am a hunter from a long patrilineal lineage. Hunting has become more important in my life as a father and husband, because when I bring home healthy meat for my family, I feel as though I'm providing the best I can. As I hunt there are many practices that lend itself to mental and spiritual clarity and well-being.

Fasting is a practice we learn in ceremony and has many applications throughout the year. As a hunter, fasting can enhance the awareness of physical senses. *Smell* and *taste* become much more acute; thus, animals nearby in the air more perceptively pass through my nose and mouth. *Hearing* focuses on the sounds made from both hunter and hunted and discerning the two. *Sight* is heightened, noticing movement, color differences, shapes, and depth. *Touch* and *feeling* is tuned to changes in temperature and direction in the air throughout the day. Looming hunger guides the direction and careful decision-making needed to find and close in on the animal. Being a provider, as with being a husband and father, makes hunting a

deeply meaningful practice in my life, the connection between us to plants and animals, to clean land, water, and air.

Figure 1-5. A Shoshone-Bannock Tribal buffalo hunt in April near Jackson, Wyoming. Our hunters find five nice animals who gave their lives for tribal ceremonies and gatherings.

Hunting Salmon

> *Hunting the salmon is a significant part of our way of life. The name for the salmon, Agai, has been used to define our people as the Agaidika. No one can understate the importance of this resource to the Shoshone and Bannock peoples. We have continued to exercise our right to hunt salmon in the Columbia River Basin since the Treaty was signed. The Shoshone-Bannock Tribes are today co-managers of the anadromous fish resource in the Columbia River Basin and have continued to work towards improving the habitat and supplementation efforts.* (Lionel Boyer, then Chairman of the Shoshone-Bannock Tribes 2000)

"Coming to know" processes (research processes) and the role salmon play as a significant part of our way of life began a few summers later from my first fall hunt in Island Park. We

had taken a road trip to the Yankee Fork of the Salmon River, which originates in the Salmon River Mountains just east of Stanley, Idaho. We were hunting Chinook Salmon (*Oncorhynchus tshawytscha*) in knee-deep water with spear poles about 12-14 feet long. It was a hot July day and we had been walking upstream all day. Salmon were driven almost to extinction in the Yankee Fork by dredge-mining from 1940-1952. There were so few salmon that day, we were searching every part of the stream and the men were using the butt of the spear to flush anything out from under the banks. They were also scoping. A scope is a tube about 3 feet long with clear glass at the end. It works to see into the water like a periscope for a submarine but in reverse.

There used to be so many salmon in the streams, if you tried to walk across they would trip you. My mom, siblings, and I were in some disbelief of these stories they told. How could there be fish so big in these small streams? As the day went on it didn't seem believable there were any fish in the stream at all, much less fish so big they could knock you over. We stopped at a deep hole when my dad, with his spear, looked over my uncle's shoulder as he was scoping. He signaled with his hand and pointed. My dad took the scope and looked, smiled, and gave it back. He handed his spear to my uncle, who gently and carefully entered the spear into the stream and lined my dad up. With a cigarette in his mouth and both hands on his spear, while my uncle, with one hand on the scope and the other on the spear gave a signal to my dad, who then speared! The salmon was on and pulled my dad into the creek headfirst. Again, I was perplexed; my dad had just gotten pulled into the stream by a monster. The story was true! He came out of the water fighting the salmon onto the bank. It was massive! My uncles and dad jumped on it as it flopped and flipped. My dad took out his Old Timer pocket knife and stuck it in the head; they fell silent and paused to acknowledge the salmon dying. The tail fluttered with a couple last slaps on the stream bank. The men were happy again, and so was I.

Traveling from my mother's homelands and back to my father's has shaped a wholeness from each part of my parents. The engulfing sky of the Great Plains expand my thoughts, and the river churning waters carving the mountains along canyon walls speak to me, focusing my thoughts. Neither of these ways of thinking/knowing are exclusive of who I

am nor how I think/know. During the summers when I return with my wife and children to Oglala country, we've spent time learning how to set up a tipi Lakota style with my relatives. Inside the tipi, I've come to know where my ancestors would find concentrated thought, a place to bring expansive thought into focus on wide-open plains. And just as well in Shoshone-Bannock country I've been traveling ridgelines hunting and have looked far across the Snake River Plain expanding my focused experiences up high from down along the river below. Between either my father's country or my mother's I can find the place for my thoughts and understanding to open to possibilities of the sky and focus clearly like water.

Long Spears

I've come to think and interpret the world through my inherited intuition and intellect of my parents: I am a spearfisher from a long lineage of indigenous peoples of Turtle Island. I've thought the act of spearfishing on the Salmon River, at times, arouses feelings of how it was to spear buffalo from horseback on the Great Plains. As I spearfish, there are practices and senses aroused. I stand holding my spear listening to women and children yelling on the banks above, "Coming Up!" and "Going Down!" as they can see the salmon moving up and down the stream. The spearfishers are moving, stationing themselves on large rocks; our positions complement one another strategically. I notice that where I'm standing, a smaller stream enters. We are surrounding the tributary entry into the main stem, and behind me there are huckleberry bushes.

Tributary junctions are special places where two streams come together, and where salmon smell the water and know which direction to go. They return from the Pacific Ocean, over 900 miles in the Upper Salmon River, to find where they were born. Salmon are born in the gravels of the streams high in the Rocky Mountains, then move to the Pacific Ocean to gain 95% of their body mass and return back into freshwater on an amazing journey (in most cases this is terminal). At tributary junctions, Chinook salmon move back and forth, up and down the stream, making them vulnerable to spearfishing. Indigenous knowledge of these places and how to successfully hunt salmon has been passed from generation to generation, bringing with it place names, stories and cultural links, connecting me back to my ancestors.

Long-held family wisdom brings me to this place where my ancestors stood many times before me.

The huckleberry bushes behind me are growing where the seeds were transported in the guts of my ancestors from gathering berries as the harvest seasons are close to one another. We were among other animals dispersing ocean nutrients from eating salmon and seeds from eating huckleberries. Together these are ripe conditions for the successful growth of huckleberry bushes in the future as they are left on the ground from passing through our guts. Thoughts of places long ago enmesh with clarity about where I stand today and draw me to the exact same sites where my ancestors once stood. I imagine my descendants gathering huckleberries and salmon that we will leave for them now, to be realized after we come to pass.

Figure 1-6. Salmon giving their lives so that we may go on from the South Fork of the Salmon River in mid-July, a good return of fish to the basin for the summer.

Looking Forward

In this chapter, I am sharing my stories, honestly, with diverse readers who share experiences on the same landscape embedded in a continuing tragic history. Through boarding schools, urban relocation programs and policies to end our culture, our peoples were in varying degrees displaced physically, mentally, emotionally, and spiritually from the lands that once sustained them. Generations before me, my parents, grandparents, and their generations have been through so much, they still shared, raised my siblings and cousins as best they could. We were categorically, by US standards, in poverty but lived such a rich life connected to water, land, and our foods. I came back to my own deeper experiences with ceremony, culture, and community when I returned to the homelands of my parents from a stint in Iraq (2004-05). Through my own healing processes, I am unpacking normalized concepts of toxic masculinity, internal and external oppression, survivor's guilt, and so on to see empowerment, resistance, and freedom in direct connections to land through my communities. What I see in myself is a reflection of what I see in my communities and my communities sees themselves through me, we are one.

I want to stress the importance of bringing family along. With our families on the land we are setting out to disrupt the cycles of toxic masculinity that plague American society. As part of a matrilineal society we respect women as leaders. They open the seasons, the grounds, the taking of life because they bear life as the nation-builders and have that responsibility, only then are men able to hunt, fish, and gather. The ceremonies and protocols are asking for permission, a consensual engagement that must be renewed, and renewal is ongoing. For instance, for the Shoshone-Bannocks the salmon season begins with a sweatlodge ceremony in the headwaters of the Middle Fork Salmon River in Bear Valley. The sweatlodge is a representation of a woman's womb, and the ceremony is a process of rebirth, an acknowledgment of life bestowed by the life we ingest from the womb of our mothers. For the Oglala Lakota, at the center of the Sundance grounds we stand a cottonwood tree that was taken from a distance away and facilitated by the blessing of young women who prayed

allowing us to cut it down. Before we plant it back into the ground those same young women pray with water, select parts of the buffalo, and chokecherries as a ceremonial offering to the more-than-human sacrifice so that our lives may go on. After the prayers they add them into the hole to feed our tree while the Sundancers take on the next four days without food and water. The complete, complex, consensual commitment through our culture, customs and protocols involve roles through each of our family and relatives towards our children to perpetuate ceremonies honoring water, land and life beings. Our women, children and elders bring other perspectives - when we see the world through their eyes, we become better hunters, gatherers, fishers, and humans. Bring your families and acknowledge your relatives. Through these acts they, us and we are disrupting ideologies of me, mine and I.

I'm talking from an inclusive we, us and ours as in Indigenous waters, lands, plants, animals, and human beings. Although this in most ways excludes a larger part of American society, it also challenges settlers to be better neighbors to Indigenous life: living and non-living entities. To go deeper into colonialism, ideologies, and methodologies. To ask what is decolonization? Does it benefit me to decolonize? To truly sever ties of imperialism as promised in 1776. I can say 'we' need that more than you can know.

I also want to emphasize the importance of keeping up our relationships with ancestral waterways and openness to non-native people in some of our experiences. Each summer, with the help of my white colleagues, their families and ours, we journey with young Native peoples down ancestral rivers. We are attempting to connect pristine river corridors with Indigenous Knowledge in its complexity. It's significant to have young people thinking and knowing these places as did their ancestors and being able to return to places of cultural, ecological, and educational importance. The inclusion of non-Tribal members is important to understand our way of life as truly invested allies through a first-hand experience. Much of our culture has been lost because non-Native folks didn't understand, or didn't want to understand who we are, and how we were living on the lands they wanted. Our removal and displacement was intentional, deliberate and costly. However, trauma goes both ways. For us to come back from that, non-Native folks will need to come to understand us, who we are and

how we are re-initiating living on our homelands. Our time on the river has been priceless and healing in multiple ways and has begun to reduce the distances of cultural divides.

We have discussed how doing (research) as a coming to know process draws on parallels from hunting, gathering and fishing with the land, people, plants and animals. Because we bring non-Native folks, sanctioning research through ceremony as an act of consensual engagement has been challenging and rewarding. One experience in particular during a seven-day trip on the Middle Fork Salmon River provides a glimpse of the possibilities a renewed way of comingling with a landscape using lenses of IK and Western STEM methods can engender profound learning. The setting was at this beautiful cultural site called Veil Falls, a natural cliff amphitheater with a water fall misting over the middle of it. Our friend, a Cherokee Citizen and a snail biologist, had a certain interest in describing a terrestrial species of snail (*Oreohelix*). He had found nothing so far, and this was day 6 of 7. Previous to the trip, Mason had been looking at maps, studying the geology to look for marble outcroppings or other sources of calcium that snails need for their shell building. Once on the trip, day in and day out, he was searching along the river. We selected camps or stops to hike up to marble or limestone deposits and had no luck finding a viable snail presence.

My wife initiated a Chanupa (pipe) ceremony after a bit of a hike up to Veil Falls. The youth, a high school teacher from the Rez, undergrads, grad students were also conducting ceremony, through songs, and dancing with the waterfall. At this point our Native land snail biologist had all but given up on the snail searching and was enjoying the river, the beautiful waterfall overhead and soaking up some sun on a huge rock. Just behind him a youth found a snail shell and asked him, “is this a snail shell?” He grabbed it and looked closely, “Yes! Where did you find it!?” From then on, he was in full snail biologist mode. He had a few kids and adults enact a search protocol (hunting/gathering) for more snails. We found two species; *Oreohelix* was among them. This happened while the ceremony was going on, because of ceremony, and as part of ceremony. Through ceremony similar to those around hunting, gathering and fishing, we were asking for permission to engage with the land in both ancient and contemporary, Indigenous and Western ways of knowing. By honoring our relationship to the land, we were able to open up our minds, bodies, and senses to what was before us, and in

so doing we gained insight into the old as well as contributing to the future care of this place. May the land continue to teach us and show us how to care.

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Sammy L. Matsaw - a PhD candidate in Water Resources and IGERT (Integrative Graduate Education Research & Traineeship) Fellow studying native freshwater mussels. Respectively interweaving Western Science and Thought with Indigenous Thought and Knowledge through symbology to inform both life ways. The idea is to bring Indigenous culture into the current pedagogy, and a pedagogy more agreeable with Indigenous cultures.

875 Perimeter Drive MS 3002
Moscow, Idaho 83844-3002
208.885.2018 (Office)
smatsaw@uidaho.edu

Chapter 2: An Ecological, Cultural and Legal Review of Pacific Lamprey in the Columbia River Basin

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ADAM WICKS-ARSHACK, MATTHEW DUNKLE, SAMMY MATSAW, AND CHRISTOPHER CAUDILL

Abstract

Pacific lamprey (Entosphenus tridentatus) are an anadromous species in an ancient lineage of jawless fishes. The species is native to the North Pacific and it marine-accessible freshwater rivers and streams. Pacific lamprey are understudied relative to other anadromous fishes and has severely declined in abundance throughout the Columbia River Basin. Indigenous people of the Snake and Columbia River basins have long recognized the ecological role and value of lamprey through their spiritual and cultural practices connected to Pacific lamprey. The combined effects of poor passage at dams, historic and continued habitat degradation, and altered marine host conditions have contributed to the observed decline in abundance and distribution. The unique characteristics and management history have placed Pacific lamprey in a legal and cultural grey area and provide a useful foil to Pacific salmon in considering protections for migratory fish. Here we provide a review of legal protections and recovery actions throughout the Columbia River Basin, including an analysis of the Fish and Wildlife Service's 2004 denial of a petition to list Pacific lamprey under the Endangered Species Act. The current patchwork of measures fails to provide integrated protections across the life history of the species. This stems from a complex lifecycle spanning dozens of local, state, tribal, federal, and international jurisdictions as well as a cultural legacy of lamprey being considered "trash fish" by western society and early fisheries managers. However, recent shifts in perceptions about the ecological value of the species and increased co-management of anadromous species within the Columbia River Basin has

elevated the species as a management priority. Continued efforts to conserve and recover Pacific lamprey pose a complex and honorable challenge for fishery managers within the Columbia River Basin.

I. Introduction

Pacific lamprey (*Entosphenus tridentatus*) are a fascinating, understudied, culturally significant anadromous fish species with an eel-like appearance. Native to most marine-accessible freshwater rivers and streams in the North Pacific, Pacific lamprey can be found in Mexico, the United States, Canada,[1] Russia, and Japan.[2] Their life history is characterized by (1) a three-to-seven-year filter-feeding larval phase in freshwater streams, (2) a transition from an eyeless filter-feeding larval form to a juvenile version of their adult form, (3) an understudied ectoparasitic marine phase, and (4) upstream migrations to freshwater winter holding and spawning/rearing streams.[3] Referred to by native peoples in the Columbia River Basin as the ancient ones, older than time immemorial, lamprey have contributed to the characteristics and behavior of both salmon and the salmon eaters.[4] Indigenous peoples of the Columbia River Basin have learned the lamprey's story through observation and celebration honoring the continuation of life.[5] Because of Pacific lamprey's complex life history, downward population trends, and uncharismatic appearance, the current regulatory scheme provides a patchwork of measures that fail to provide substantive protections across the different stages of their life history. The lack of an effective regulatory framework is the result of a single life cycle spanning dozens of local, state, tribal, federal, and international jurisdictions. Coupled with

1. *See* David A. Close et al., *The Ecological and Cultural Importance of a Species at Risk of Extinction, Pacific Lamprey*, 27 FISHERIES 19, 20 (2002).

2. U.S. FISH & WILDLIFE SERV., FACT SHEET PACIFIC LAMPREY (LAMPERTA TRIDENTATA) 2 (2008), https://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/Documents/012808PL-FactSheet.pdf; *see also* Benjamin J. Clemens et al., *Conservation Challenges and Research Needs for Pacific Lamprey in the Columbia River Basin*, 42 FISHERIES 268, 269 (2017).

3. *See* U.S. FISH & WILDLIFE SERV., *supra* note 2, at 1–2.

4. *Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin*, COLUMBIA RIVER INTER-TRIBAL FISH COMM'N 1 (Dec. 19, 2011), http://www.critfc.org/wp-content/uploads/2012/12/lamprey_plan.pdf [hereinafter TRIBAL PACIFIC LAMPREY RESTORATION PLAN] (quoting Elmer Crow Jr., former Vice Chair, Nez Perce Fish and Wildlife Committee: "The lamprey is our elder, without him the circle of life is broken.").

5. *Id.* at 2.

disconnects between western and native value systems, recovery of Pacific lamprey poses a complex and honorable challenge for fishery managers within the Columbia River Basin.[6]

Pacific lamprey possess life history traits beyond anadromous migration that contribute to management challenges. Pacific lamprey are unlike salmon: they are not entirely philopatric, meaning they do not necessarily return to their natal streams and do not share the degree of genetic differentiation that is observed in salmon populations.[7] As we will show in following sections, Pacific lamprey are characterized by a three-to-seven-year filter-feeding, larval phase while residing in fine sediments of freshwater streams followed by a smolt-like transformation, prior to migrating to the marine environment. While in the ocean, lamprey migrate as ectoparasites, attaching to whales, salmon, and other marine organisms to feed on blood and other body fluids.[8] After two to three years of marine growth, Pacific lamprey embark on extended upstream migrations and may reside in freshwater without feeding for a year before spawning in late spring and early summer in similar habitats as Pacific salmonids (salmon and steelhead).[9]

Pacific lamprey face unique threats throughout their life cycle and in different geographic areas, with unimpounded coastal systems facing declines as well. In the Columbia River Basin, Pacific lamprey abundance has severely declined over the last century.[10] While the conservation status varies among both domestic and international jurisdictions, the broadly consistent classification of population status indicates that fisheries and natural resource managers acknowledge Pacific lamprey as imperiled to varying degrees across their entire range.[11] Poor upstream and downstream passage, along with water quality issues and historic commercial

6. Clemens et al., *supra* note 2, at 268–280.
7. See *infra* Section II.A.ii.
8. *See* Adare Evans et al., *Pacific Lamprey*, 27 WILDLIFE EXPRESS 1, 2 (2013).
9. *See id.* at 2.
10. Close et al., *supra* note 1, at 21; Benjamin J. Clemens et al., *supra* note 2, at 269.
11. *See infra* Table 1. While an ideal conservation might require some kind of international cooperation and coordination, this paper focuses mainly on the biophysical, cultural, and legal aspects of Pacific lamprey within the Columbia River Basin. Although there is a domestic coalition of agencies and interested stakeholders in U.S., to date, there is no international effort aimed to address Pacific lamprey's international life history. And while there are international agreements and treaties tailored to Pacific salmon, such as the Pacific Salmon Treaty; there are no international agreements or coordinated research efforts addressing Pacific lamprey's international life history. True conservation of this ancient species may very well necessitate such an international effort.

overharvest,[12] have been implicated in the observed decline in Pacific lamprey run sizes in the Columbia River Basin,[13] but relatively little work has explored population trends in other geographic areas.[14] Additionally, recent research suggests that Pacific lamprey abundance is strongly influenced by ocean conditions similar to many salmonid populations.[15] Recent dam removal actions in the Pacific Northwest have demonstrated Pacific lamprey's ability to recolonize historic habitats, supporting the idea that dam removal can be a successful tool for ecosystem recovery efforts in the Columbia River Basin.[16] Such evidence suggests the importance of coordinated conservation efforts coupled with legal protections that embrace Pacific lamprey's unique life history and importance to Columbia River Basin tribes and first nations.

While Pacific salmon have received substantial regulatory attention and conservation actions exceeding a billion dollars in costs,[17] Pacific lamprey restoration is a relatively new

12. Beyond commercial overharvest, within the Columbia River Basin, Pacific lamprey have long since battled a reputation as a "trash fish." The historic thought of Pacific lamprey being a "trash fish" is evidenced by repeated application of lampricides and other poisons to multiple rivers in Oregon in an attempt to eradicate lamprey. Robin S. Peterson Lewis, *Yurok and Karuk Traditional Ecological Knowledge: Insights into Pacific Lamprey Populations of the Lower Klamath Basin*, *in* Biology, Management, and Conservation of Lampreys in North America 1–39 (2009); *see also* George Plaven, *Lamprey Harvested at Willamette Falls, Distributed to Tribes*, E. OREGONIAN (June 15, 2015), http://www.eastoregonian.com/eo/local-news/20150615/lamprey-harvested-at-willamette-falls-distributed-to-tribes (explaining how and when the Umatilla River was poisoned in 1967 and 1974).

13. *See infra* Figure 5.

14. *See* Peter B. Moyle et al., *Status and Conservation of Lampreys in California*, *in* BIOLOGY, MANAGEMENT, AND CONSERVATION OF LAMPREYS IN NORTH AMERICA 279, 279 (Larry R. Brown et al. eds., 2009); *see also* Michael C. Hayes et al., *Distribution of Pacific Lamprey Entosphenus tridentatus in Watersheds of Puget Sound Based on Smolt Monitoring Data*, 87 NW. SCI. 95 (2013) (providing lamprey conservation statuses and trend information outside of the Columbia River Basin).

15. Joshua G. Murauskas et al., *Relationships Between the Abundance of Pacific Lamprey in the Columbia River and Their Common Hosts in the Marine Environment*, 142 TRANSACTIONS AM. FISHERIES SOC'Y 143, 146 (2013).

16. *See* Michael C. Blumm & Andrew B. Erickson, *Dam Removal in the Pacific Northwest: Lessons for the Nation*, 42 ENVTL. L. 1043, 1050–58 (2012); T. Royal, *Lamprey Returning to a Dam-Free Elwha River*, NW. TREATY TRIBES (Mar. 31, 2016), http://nwtreatytribes.org/lamprey-returning-dam-free-elwha-river/; Press Release, Emily Washines (Yakama Nation) & Amanda Smith (USFWS), Partnership Powers Pacific Lamprey Return Upstream of Former Condit Dam Site, (Mar. 10, 2016), http://www.fws.gov/news/ShowNews.cfm?ID=66F2C9DB-95B1-34EB-938BE2D12E5C86DD (however western brook lamprey, a non-migratory, species were observed both upstream and downstream of Condit Dam).

17. *BPA's Annual Costs for Basin Fish and Wildlife Mitigation Expected to Nudge Above $500 Million*, COLOMBIA BASIN BULL. (July 11, 2014), http://www.cbbulletin.com/431437.aspx.

concept in the Columbia River Basin.[18] Furthermore, unlike many Pacific salmon species which are listed under the federal Endangered Species Act, Pacific lamprey do not receive federal protections.[19] In 2003, as a result of dramatic declines in lamprey populations and an increased understanding of ecological and cultural values of lamprey, several environmental groups petitioned the United States Fish and Wildlife Service (USFWS) to list Pacific lamprey, and three other lamprey species, under the Endangered Species Act.[20] Due to a lack of information and Pacific lamprey's unique anadromous life history, the USFWS determined that listing was not warranted because Pacific lamprey were not a "listable entity" meaning that lamprey within the United States did not constitute a sufficient subset of the overall Pacific lamprey population.[21] The decision served as a catalyst for the tribes along with state and federal agencies to conduct further research to increase our understanding of these species, and to implement novel lamprey restoration measures.

Tribal leadership in Pacific lamprey conservation is borne out of a deep connection between native peoples and this species.[22] Since time, immemorial Pacific lamprey have been prized and honored by indigenous people of the Columbia River Basin.[23] This reverence for Pacific lamprey continues today through the concert of restoring Pacific lamprey habitat on the landscape and continuing celebrations and ceremonies to honor lamprey. Pacific lamprey are

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18. *See* Clemens et al., *supra* note 2.

19. *See* U.S. FISH & WILDLIFE SERV., SPECIES FACT SHEET PACIFIC LAMPREY (LAMPERTRA TRIDENTATE) 3–4, https://www.fws.gov/wafwo/species/Fact%20sheets/Pacific_lamprey_final.pdf (although Pacific lamprey are not listed under the Endangered Species Act, federal agencies do coordinate conservation actions with state and tribal agencies) [hereinafter SPECIES FACT SHEET PACIFIC LAMPREY].

20. KLAMATH-SISKIYOU WILDLANDS CTR. ET AL., PETITION FOR RULES TO LIST: PACIFIC LAMPREY (LAMPETRA TRIDENTATA), RIVER LAMPREY (LAMPETRA AYRESI), WESTERN BROOK LAMPREY (LAMPETRA RICHARDSONI), AND KERN BROOK LAMPREY (LAMPETRA HUBBSI) AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT 3 (Jan. 28, 2003), http://www.biologicaldiversity.org/species/fish/Pacific_lamprey/pdfs/petition.pdf.

21. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,166 (Dec. 27, 2004) (codified at 50 C.F.R. pt. 17). Finding that

> the petition did not attempt to describe or justify a listable entity within the petitioned area, stating only that, 'Pacific lamprey populations could be subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon species. Petitioners believe that delineation of distinct population segments is best left to the discretion of USFWS.'

Id. (citing the 2003 petition list).

22. Close et al., *supra* note 1, at 22.

23. *Id.*

considered tribal trust resources and thus, due to their cultural importance and treaty obligations, the federal government owes the tribes a federal trust responsibility to ensure lamprey's continued existence.[24]

Today in the Columbia River Basin, the Willamette Falls fishery is the primary place of harvest and is limited to a treaty fishery, permit-holding federally recognized tribes, or individuals who obtain a permit from the state of Oregon.[25] However, due to the extirpation of lamprey across a significant portion of their historic range, tribal members throughout the Columbia River Basin are impacted by the drastic decline in lamprey abundance.[26] These impacts are evidenced through diminished harvest opportunity, which limits the extent to which tribes can eat lamprey and use them in culturally significant ceremonies.[27] These losses can only be remedied through lamprey recovery actions which improve habitat, increase the lamprey population and expand their range.[28]

Currently, within the Columbia River basin there are three large-scale Pacific lamprey management and conservation plans: (1) the Columbia River Inter-tribal Fish Commission's (CRITFC) Tribal Pacific Lamprey Restoration Plan,[29] which underscores both the ecological and cultural significance of Pacific lamprey; (2) the Pacific Lamprey Assessment Template for Conservation Measures, set forth by the USFWS in conjunction with other agencies, and

24. *See* Treaty with the Nez Perce, 1855, U.S.-Nez Perce Tribe of Indians, art. 3, June 11, 1855, 12 Stat. 957.
25. *See* OR. ADMIN. R. 635-017-009 (2017).
26. Close et al., *supra* note 1, at 19.
27. *See id.*
28. *Id.* at 24.
29. *See* TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4.

stakeholders;[30] and (3) the United States Army Corps of Engineers' (USACE) 10 Year Passage Improvement Plan.[31]

In recognition of the challenge of Pacific lamprey conservation in the Columbia River Basin, CRITFC and its member tribes (the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Nation) released the Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin.[32] This plan highlights the importance of Pacific lamprey in the cultures of CRITFC member tribes, identifies specific knowledge gaps, and proposes a framework for collaboratively restoring lamprey runs to a level adequate for "ecological health and tribal cultural use" throughout their range by 2050.[33]

The plan highlights six objectives critical to Pacific lamprey conservation: mainstem passage and habitat, tributary passage and habitat, supplementation and augmentation, contaminants and water quality, public outreach and education, and research and monitoring.[34] CRITFC warns that harm to lamprey and their habitat equates to a loss of a critical part of the ecosystems they inhabit, a loss of cultural heritage, and a loss of fishing opportunities, which were guaranteed to its member tribes by the treaties of 1855 from which the tribes retain the right to fish at "usual and accustomed places" on and off reservations.[35] Though this right to fish has historically been viewed as salmon and steelhead-centric, the right to harvest fish includes many species including Pacific lamprey, sturgeon, and other first foods.[36]

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30. *See generally* U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY (ENTOSPHENUS TRIDENTATUS) ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES (2011), http://www.fwspubs.org/doi/suppl/10.3996/112015-JFWM-112/suppl_file/112015-jfwm-112.s3.pdf [hereinafter ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES]. Notably, USFS incorporated many of the goals and initiatives from CRITFC's plan into the Pacific Lamprey Assessment Template for Conservation Measures, which is a product of and one of the guiding documents for their Conservation Initiative, guiding research and recent restoration actions for federal and state agencies. *See id.* at 271–76 app. E.

31. U.S. ARMY CORPS OF ENG'RS NW. DIV., PACIFIC LAMPREY PASSAGE IMPROVEMENTS IMPLEMENTATION PLAN: 2008-2018 (2014) [hereinafter IMPROVEMENTS IMPLEMENTATION PLAN].

32. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4.

33. *Id.* at iv.

34. *Id.* at iv–v.

35. *Id.* at 2.

36. *See* United States v. Washington, 827 F.3d 836, 849 (9th Cir. 2016) ("The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians, in common with all citizens of the

This Article identifies the need for coordinated legal protection and restoration measures to assure the survival of Pacific lamprey. This Article begins in Part II with documenting the Pacific lamprey ecology and decline of the species in the Columbia River Basin.[37] Part III highlights the critical role of survival of the species to the culture of indigenous peoples of the Pacific Northwest.[38] And, Part IV analyzes the current fragmented and inadequate legal landscape for protection of Pacific lamprey in the Columbia River Basin.[39] This Article concludes with recommendations for both legal and physical measures to ensure the continuation of this ancient species.[40]

II. An Ecological Review of Pacific Lamprey

Conservation of highly migratory species with complex life histories presents challenges for policy and management of those species. Species of this type require protection spanning multiple jurisdictions across multiple ecosystems and providing connectivity through migratory corridors to complete life cycles. Effective evaluation of policy and management decisions necessitates an understanding of the life history and ecology of migratory species and their ecosystems. The following section reviews current understandings of the life history and ecological role of Pacific lamprey across life stages and is focused within the Columbia River Basin.

Territory, and of erecting temporary houses for the purposes of curing . . . ") (quoting the 1855 Treaties); *see also* Idaho v. Tinno, 497 P.2d 1386, 94 Idaho 759 (1972) (finding that harvest is not limited to fish but also includes other forms of subsistence hunting and gathering).

37. *See infra* Part II.
38. *See infra* Part III.
39. *See infra* Part IV.
40. *See infra* Part V.

A. Pacific lamprey Life History

i. Adult Lamprey in the Marine Environment

Young adult lamprey migrate to the ocean throughout the year, but most of their migration is observed during spring months.[41] The marine phase of lamprey begins as young adults reach estuaries during downstream migration.[42] During this phase, the skin color of a lamprey changes from dark brown freshwater colors to silvery marine colors and the lamprey begins an ectoparasitic phase where it will attach to the skin of a prey species.[43] Using a combination of sharp tooth-like cusps along the mouth opening and a rasping motion of the toothed tongue,[44] a lamprey will create a wound in the host.[45] From this wound, lamprey feed on body fluids extracted from the host.[46] Lampreys lack a developed stomach and digestion occurs in a simple intestine.[47] Lamprey's high-quality food sources allow rapid growth and energy accrual during a short period of time in the marine environment.[48]

Hosts of Pacific lamprey in the marine environment are predominantly larger-bodied fish with a typical salmon-like body shape and are found in moderate to deep depths.[49] Alexei Orlov found these hosts to include salmonids, cod, pollock, hake, herring, lingcod, mackerel, rockfish, ocean perch, halibut, and flounder.[50] They found that most lamprey wounds were found in specific locations on certain species.[51] For example, most wounds on halibut were on the blind

41. *See* Close et al., *supra* note 1, at 20–21.
42. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 12.
43. *Id.*
44. *See infra* Figure 1.
45. *See* TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 13.
46. Evans et al., *supra* note 8, at 2.
47. PETER B. MOYLE & JOSEPH J. CECH, FISHES: AN INTRODUCTION TO ICHTHYOLOGY 250 (2004).
48. *Id.*
49. Alexei Orlov et al., *Feeding and Prey of Pacific Lamprey in Coastal Waters of the Western North Pacific, in* CHALLENGES FOR DIADROMOUS FISHES IN A DYNAMIC GLOBAL ENVIRONMENT: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM "CHALLENGES FOR DIADROMOUS FISHES IN A DYNAMIC GLOBAL ENVIRONMENT" HELD IN HALIFAX, NOVA SCOTIA, CANADA, JUNE 18-21, 2007, 875, 875–76 (Alex Haro et al. eds., 2009).
50. *Id.* at 875.
51. *Id.* at 876.

side of the body.[52] Similarly, the ventral sections of pollock and flounder were commonly attacked.[53] Pacific lamprey have also been observed feeding on finback, humpback, sei, and sperm whales in the North Pacific.[54] Although the marine stage of Pacific lamprey is not well studied, it is thought that Pacific lamprey spend one to three years in the ocean prior to beginning the spawning migration.[55]

In the marine environment, adult lamprey may be adversely affected by commercial harvest and bycatch of their prey species where fishing pressure is high.[56] Additionally, changes in ocean conditions that limit overall productivity may also limit the growth capacity of Pacific lamprey in the marine phase.[57] For example, the cyclical nature of Pacific lamprey return sizes in the Columbia River Basin are correlated most strongly with commercial landings of top prey species and that broad-scale ocean productivity increased their model precision.[58] Thus, ocean productivity and commercial harvest of prey species together likely affect the abundance of lamprey.

ii. Adult Lamprey in Freshwater

The specific cues inducing lamprey maturation and return to freshwater have yet to be resolved, but likely relate to a combination of individual body condition, photoperiod (length of daily exposure to sunlight), and changes in discharge and temperature of rivers entering the ocean.[59] Adult lampreys are not known to feed after freshwater entry and thus migration and

52. *Id.*

53. *Id.*

54. Gordon C. Pike, *Lamprey Marks on Whales*, 8 J. FISHERIES RES. BOARD CAN. 275, 275 (1951).

55. U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY LONG VERSION FACT SHEET 1 (2016), https://www.fws.gov/pacificlamprey/FactSheets.cfm [hereinafter *Lamprey Overview*].

56. *See generally* Joshua G. Murauskas et al., *Relationships Between the* Abundance *of Pacific Lamprey in the Columbia River and Their Common Hosts in the Marine Environment*, 142 TRANSACTIONS AM. FISHERIES SOC'Y 143, 143–45, 152–54 (2013).

57. *See id.* at 152–54.

58. *Id.* at 153–54.

59. Mary L. Moser et al., *Lamprey Spawning Migration*, *in* LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 215, 218–19 (Margaret F. Docker ed., 2015).

spawning are fueled by fat reserves obtained in the ocean.[60] Pacific lamprey enter the estuary of the Columbia River in winter months and the peak of migration past Bonneville Dam (the first dam encountered during upstream migration) occurs in mid- to late-July.[61] The majority of lamprey migration continues through late September.[62] Early migrants may enter headwater tributaries, though the late season and long-distance migrants often overwinter in main stem rivers.[63] As rivers warm in the spring, a final spawning migration occurs in which lamprey enter inland tributaries.[64]

The mechanisms controlling migration and route selection by adults during upstream migration are poorly understood in lamprey, but appear to differ in fundamental ways from salmonids.[65] It is widely accepted that salmonids use sequential imprinting on olfactory cues, whereby adults select between streams during upstream migration using memories of olfactory cues present in the water.[66] Homing is best demonstrated using marked individuals, which are tracked throughout their lives.[67] Although no known studies have reported the entire life history of marked individual lampreys, genetic evidence and behavioral observations provide strong indirect evidence that homing is absent or much weaker than observed in Pacific salmon.[68] Rather, adult lampreys have been shown to respond and orient to pheromones released by juvenile lamprey during upstream migration.[69] This response is possibly because the presence of juveniles is a reliable signal of suitable spawning and rearing habitat from past cohorts.[70]

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60. *Id.* at 226–29.

61. Laurie A. Weitkamp et al., *Seasonal Abundance, Size, and Host Selection of Western River* (Lampetra ayresii) *and Pacific* (Entosphenus tridentatus) *Lampreys in the Columbia River Estuary*, 113 NAT'L MARINE FISHERIES SERV. FISHERY BULL. 213, 220 (2015).

62. *Id.* at 219–21.

63. *Id.* at 221.

64. *See* Brian J. McIlraith et al., *Seasonal Migration Behaviors and Distribution of Adult Pacific Lampreys in Unimpounded Reaches of the Snake River Basin*, 35 N. AM. J. FISHERIES MGMT. 123, 124 (2015).

65. *See* Lucy Odling-Smee & Victoria A. Braithwaite, *The Role of Learning in Fish Orientation*, 4 FISH & FISHERIES 235, 242 (2003).

66. *Id.* at 242–43.

67. *Id.*

68. Sang-Seon Yun et al. *Identification of Putative Migratory Pheromones from Pacific Lamprey* (Lampetra Tridentata), 68 CANADIAN J. FISHERIES & AQUATIC SCI., 2194, 2194–95, 2199 (2011).

69. *Id.* at 2195; Nicholas S. Johnson et al., *A Synthesized Pheromone Induces Upstream Movement in Female Sea Lamprey and Summons Them into Traps*, 106 PROC. NAT'L ACAD. SCI. U.S. 1021, 1021 (2009).

70. *See* Yun et al. *supra* note 68, at 2195; Johnson et al., *supra* note 69, at 1024–26.

Peak spawning occurs as flows decline and river temperatures increase.[71] In coastal systems, lamprey may spawn as early as March and the peak may be as late as mid-May to mid-July in inland tributaries.[72] Nest site selection appears to be driven by a combination of hydraulic and geomorphic factors with the majority of nests located in transition zones between riffle-to-pool zones, run-to-pool zones, or at the tail-crest of pools. Substrate in and around nests tend to be smaller cobbles with fine sand and gravel inside the nest.[73] Both males and females have been observed participating in nest building;[74] building activity often involves the movement of moderate-sized cobbles with the buccal funnel and finer sediment with caudal fins.[75] When the female is prepared to release eggs in a nest, a male will attach to the female's head or substrate around the nest and wrap around the female's body.[76] Together, they gyrate as eggs and milt are released.[77] Eggs are laid in small bursts in multiple nests and subsequently covered with sand or fine gravel.[78]

During both the migratory and spawning phase, Pacific lamprey provide a resource in freshwater food webs.[79] It has been suggested that migratory lampreys were historically a "prey buffer," meaning they reduced predation on co-migrating salmon because predators selected the slower swimming lamprey with higher per mass caloric value.[80] Currently, Pacific lamprey are still utilized as a food resource by Columbia and Snake River White sturgeon (*Acipenser transmontanus*), marine mammals, riparian scavengers, and tribal peoples.[81] Further research

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71. Benjamin J. Clemens et al., *Do Summer Temperatures Trigger Spring Maturation in Pacific Lamprey*, Entosphenus Tridentatus*?*, 18 ECOLOGY FRESHWATER FISH 418, 418–19 (2009).

72. *See id.* at 419.

73. Abel Forest Brumo, Spawning, Larval Recruitment, and Early Life Survival of Pacific Lampreys in the South Fork Coquille River, Oregon 18–19 (Sept. 22, 2006) (unpublished M.S. thesis, Oregon State University) (on file with Oregon State University Library).

74. *See id.* at 29–30.

75. *Id.* at 18–19.

76. Nicholas S. Johnson et al., *Reproductive Ecology of Lampreys*, *in* LAMPREYS: BIOLOGY, CONSERVATION, AND CONTROL 265, 285 (Margaret F. Docker ed., 2015).

77. *Id.*

78. *See id.*

79. *See* Kevin McCullen, *Low Lamprey Runs in Columbia Worry Biologists, Tribes*, SEATTLE TIMES (Sept. 6, 2010), http://www.seattletimes.com/seattle-news/low-lamprey-runs-in-columbia-worry-biologists-tribes/.

80. *Id.*

81. *See id.*

is needed to elucidate the role of adult Pacific lamprey and associated marine-derived nutrients in stream food webs.

iii. Larval Lamprey

Pacific lamprey are hatched in the gravels and cobbles of tributary streams.[82] They have an extended larval phase characterized by three to eight years of freshwater residence.[83] Young lamprey larvae are eyeless and worm-like.[84] After absorption of the yolk sac, young larvae migrate out of the nest site and colonize stream margins and backwater eddies and burrow into sediment containing organic matter.[85] Larval lamprey filter small drifting leaf litter, diatoms, and other organic matter out of the water column using an oral hood.[86]

Distribution of larvae within a reach, and at the watershed scale is not well understood, but their distribution has been found to be correlated with specific habitat variables, such as water depth, canopy cover, gradient, and current, with evidence of selection for slower pool habitats.[87] Stone and Barndt found similar selection for fine sediments, canopy cover, and water velocity.[88] At a river scale, distribution of larvae is also associated with spawning site distribution[89] as larvae disperse downstream at low to moderate rates every year. Heather Dawson reported anecdotally that age-0 larvae are often found in slow-water-depositional areas at tributary

82. *See* Benjamin J. Clemens et al., *Similarities, Differences, and Unknowns in Biology and Management of Three Parasitic Lampreys of North America*, 35 FISHERIES 580, 582–83 (2010).

83. *Id.* at 582.

84. *See* U.S. FISH & WILDLIFE SERV., PACIFIC LAMPREY (LAMPETRA TRIDENTATA), 1 (2007), https://www.fws.gov/pacific/fisheries/sphabcon/lamprey/pdf/111407%20PL%20Fact%20Sheet%20-%20Short%20Version.pdf; *see infra* Figure 4.

85. Heather A. Dawson et al., *The Ecology of Larval and Metamorphosing Lampreys*, *in* LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 75, 78–84 (Margaret F. Docker ed., 2015).

86. *Id.* at 83.

87. Christian E. Torgersen & David A. Close, *Influence of Habitat Heterogeneity on the Distribution of Larval Pacific Lamprey* (Lampetra tridentata) *at Two Spatial Scales*, 49 FRESHWATER BIOLOGY 614, 623 tbl.2, 625 (2004).

88. Jen Stone & Scott Barndt, *Spatial Distribution and Habitat Use of Pacific Lamprey* (Lampetra tridentata) *Ammocoetes in a Western Washington Stream*, 20 J. FRESHWATER ECOLOGY 171, 171 (2005).

89. Torgersen & Close, *supra* note 87, at 620–22.

confluences along the Columbia River.[90] This suggests that long-distance migration in young-of-the-year larvae is possible (more than 50 river ms), though this may result from unobserved spawning in lower main stem river segments.[91]

Many threats exist to lamprey in the larval phase.[92] For example, the U.S. Fish and Wildlife Service noted at least seven major threats to larval lamprey in the freshwater phase: passage barriers for downstream movement (including irrigation diversions and culverts), dewatering events and changes to flow regimes, poisoning from chemical spills and other environmental toxins, poor water quality (including lethal temperatures), dredging for channel maintenance and mining, stream channelization and floodplain disturbance limiting fine sediment and habitat complexity, and predation by non-native species (e.g. smallmouth bass).[93] Nilsen and colleagues found bioaccumulation of many potentially detrimental chemicals, including flame retardants, pesticides, and heavy metals in the tissues of larval lamprey in the Columbia River Basin.[94]

iv. Migrating Juvenile Lamprey

After a period of three to seven years of filter-feeding, and likely spurred by a number of cues including attainment of sufficient body condition, larvae cease to feed and begin metamorphosing to the parasitic juvenile form.[95] During this period, juveniles begin a process somewhat similar to smolting in Pacific salmon, where changes in internal organs, external coloration, physiology, and the development of large eyes prepares the lampreys for transition to the marine environment.[96] A relatively large change in mouthparts occurs, allowing a switch

90. Dawson et al., *supra* note 85, at 103.

91. *Id.*

92. *See Lamprey Overview*, *supra* note 55, at 4.

93. *Id.* at 4–5.

94. *See generally* Elena B. Nilsen et al., *Reconnaissance of Contaminants in Larval Pacific Lamprey* (Entosphenus tridentatus) *Tissues and Habitats in the Columbia River Basin, Oregon and Washington, USA*, 201 ENVTL. POLLUTION 121 (2015).

95. Richard G. Manzon et al., *Lamprey Metamorphosis*, *in* LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 139, 141–42 (Margaret F. Docker ed., 2015).

96. *Id.* at 142–47; *see infra* Figure 4.

from filter/deposit feeding to ectoparasitism.[97] This change typically begins in spring or summer and continues through the winter until outmigration the following spring.[98]

While migration of juvenile lampreys is poorly understood, downstream migration is generally thought to be timed to coincide with spring flows and other increased discharge events.[99] Changes in flow regimes—the amount and timing of flow—and the creation of reservoirs in the Columbia River Basin have likely contributed to an increased bioenergetic cost of downstream migration in juvenile lamprey. Changes in river conditions that favor invasive warm-water predator species, such as bass, sunfish, and pike, have likely contributed to a mortality bottleneck during the juvenile life phase.[100] Recent studies of smallmouth bass (*Micropterus dolomieu*) stomach content in the reservoirs behind The Dalles, John Day, and McNary Dams found that 2.5% of stomachs sampled contained migrating juvenile lampreys.[101] Juvenile lamprey impingement in screens, designed to safely deter juvenile salmonids, at diversions and hydroelectric facilities are also known sources of mortality.[102] Simulated passage of juvenile lampreys through hydroelectric turbines suggest that lamprey may be somewhat impervious to negative effects of large pressure changes and other injury because they lack a swim bladder; although, direct field observations of passage survival are lacking.[103]

B. Overview of the Conservation Genetics of Pacific Lamprey

97. Manzon et al., *supra* note 95, at 147.

98. *Id.* at 147. (As evidenced by observed rates of captures of juvenile lampreys in smolt traps, which peak in late spring).

99. *FPC Lamprey Data Queries*, FISH PASSAGE CTR. (2014), http://www.fpc.org/smolt/currentsmpsubmitdata_lamprey.html (last visited Jan. 31, 2018) [hereinafter Fish Passage Center].

100. *See generally* Frank J. Rahel & Julian D. Olden, *Assessing the Effects of Climate Change on Aquatic Invasive Species*, 22 CONSERVATION BIOLOGY 521 (2008).

101. ERIC TINUS ET AL., OR. DEP'T FISH & WILDLIFE OCEAN SALMON & COLUMBIA RIVER PROGRAM, 2008-718-00, ABUNDANCE AND DIET OF SMALLMOUTH BASS AT THE DALLES, JOHN DAY, AND MCNARY DAMS, MAY THROUGH AUGUST 2012, at 14 (2013).

102. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 282.

103. Mary L. Moser et al., *Behavior and Potential Threats to Survival of Migrating Lamprey Ammocoetes and Macrophthalmia*, 25 REV. FISH BIOLOGY & FISHERIES 103, 112 (2015).

The Pacific lamprey is an anadromous member of the family *Petromyzontidae*, which encompasses thirty-seven of the forty-one recognized lamprey species globally.[104] Although lampreys have been a common specimen for teaching in biological and medical science for over a century due to the presence of many ancestral features, relatively little research has been conducted on the ecology of lamprey species in their native range compared with other anadromous fishes.[105]

Lamprey ancestors diverged from other vertebrate lineages shortly after vertebrates appeared ~400-500 million years ago, and the oldest known fossil classified as a lamprey has been dated to ~360 million years old.[106] Because lampreys contain cartilaginous vertebrae-like structures, they are thought to be representative of the earliest vertebrates still remaining on the planet.[107] Along with 18 other lamprey species globally, Pacific lamprey express an ectoparasitic adult phase.[108] Of those eighteen, only nine are anadromous and parasitic in the marine environment.[109] Of the nine anadromous species, Pacific lamprey returning to the state of Idaho make some of the longest known migrations of any lamprey species in the world, in some cases exceeding 1,000 km.[110]

Although Pacific lamprey spawn in similar areas as Pacific salmon, they do not show evidence of natal philopatry (the tendency to return to their stream of origin) or genetic structuring as seen with Pacific salmon.[111] In their 2012 study, Spice and colleagues explored the genetic structuring of 965 individuals collected throughout the North American range of

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104. Ian C. Potter et al., *The Taxonomy, Phylogeny, and Distribution of Lampreys, in* LAMPREYS: BIOLOGY, CONSERVATION AND CONTROL 35, 35–37 (Margaret F. Docker ed., 2015).

105. Moser et al., *supra* note 103, at 113.

106. Robert W. Gess et al., *A Lamprey from the Devonian Period of South Africa*, 443 NATURE 981, 981 (2006).

107. MICHAEL J. BENTON, VERTEBRATE PALAEONTOLOGY 3–12 (4th ed. 2015).

108. Potter, *supra* note 104, at 43.

109. *Id.*

110. Moser et al., *supra* note 59, at 218–19.

111. Jon E. Hess, *Insights Gained Through Recent Technological Advancements for Conservation Genetics of Pacific Lamprey (Entosphenus tridentatus), in* JAWLESS FISHES OF THE WORLD 149, 153–159 (Alexei Orlov & Richard Beamish eds., 2016).

Pacific lamprey at twenty different sites.[112] They analyzed nine microsatellite markers (repeated sections of gene sequences often subject to mutations which may be tracked in related populations) of each individual for evidence of population structuring indicative of natal homing (philopatry) or broad mixing among geographic populations (panmixia).[113] The researchers found evidence leading to low population structuring based on a broad geographic region, suggesting some limits to dispersal in the marine phase.[114] They did not find evidence of natal homing to the extent seen in Pacific salmon, suggesting that Pacific lamprey use a combination of other cues to locate viable spawning habitats.[115] This method of spawning site selection has been referred to as the "suitable river strategy,"[116] whereby individuals use a variety of cues to locate available spawning habitats in proximity to where they are located at the onset of maturation. The apparent lack of philopatry has several implications for management of populations. Perhaps most important, unlike many fish species, lamprey populations within rivers are probably strongly ecologically and evolutionarily connected to populations in other rivers.

The motivation of individual lampreys with respect to upstream migration distance remains somewhat unclear. Individual migratory histories, as shown by radio telemetry, have revealed complex and often erratic movements during upstream migration.[117] If we assume lamprey spawning distribution is random and saturates all easily accessed high-quality habitats before spreading into less desirable habitats, then the long upstream movements of some individuals would be difficult to justify. Conversely, if natal philopatry is present, population structuring would be evident in DNA microsatellites. To date, insufficient scientific research has been done

112. Erin K. Spice et al., *Neither Philopatric nor Panmictic: Microsatellite and mtDNA Evidence Suggests Lack of Natal Homing but Limits to Dispersal in Pacific Lamprey*, 21 MOLECULAR ECOLOGY 2916, 2916–2919 (2012).

113. *Id.*; *see also* Binbin Lin et al., *Fragment Length Polymorphism Assessment of Genetic Diversity in Pacific Lamprey*, 28 N. AM. J. FISHERIES MGMT. 1182, 1189–90 (2008).

114. Spice et al., *supra* note 112, at 2925–26.

115. *Id.*

116. John Waldman et al., *Sea Lamprey Petromyzon Marinus: An Exception to the Rule of Homing in Anadromous Fishes*, 4 BIOLOGY LETTERS 659, 660–61 (2008).

117. Mark A. Kirk & Christopher C. Caudill, *Network Analyses Reveal Intra- and Interspecific Differences in Behaviour when Passing a Complex*, 54 J. APPLIED ECOLOGY 836, 842–43 (2016).

on the distinctions of anthropogenic causes or natural patterns and, thus, how to determine causation to the lack of philopatry.

Recent studies in the Columbia River Basin have found that lampreys which migrate further tend to be larger-bodied[118] and have genetic markers linked with larger body size,[119] which indicates that there is stock structure assorting to interior versus coastal streams. However, more data is needed. The body size-migratory distance association may be a result of active selection in the current altered river system, though information on genetic structuring of Columbia River lamprey from the pre-dam period is unavailable. There is, however, potential natural structuring of lampreys based on body size historically in the Columbia River Basin or in undammed rivers because longer migrations may require energetic reserves or swimming capacity only met by larger-bodied individuals.[120]

It is likely that lampreys use a variety of environmental and biological cues to guide migrations. For example, some lampreys use pheromone cues released by successful larvae to guide spawning migrations.[121] Pacific lamprey dispersal may also be driven by discharge, temperature, and other water chemistry cues, which are used to select habitats that may not be the individual lamprey's natal stream but contain suitable habitats for spawning and rearing of offspring.[122] One hypothesis suggests selection of non-natal habitats is adaptive for an ectoparasite, which may be transported long distances in the ocean by its host.[123] There is some confusion here between structuring and panmixia, or random mating patterns among a species resulting in one general population rather than distinct subpopulations because gaps remain in

118. Matthew L. Keefer et al., *Effects of Body Size and River Environment on the Upstream Migration of Adult Pacific Lampreys*, 29 N. AM. J. FISHERIES. MGMT. 1214, 1218–19 (2009).

119. Jon E. Hess et al., *Genes Predict Long Distance Migration and Large Body Size in a Migratory Fish, Pacific Lamprey*, 7 EVOLUTIONARY APPLICATIONS 1192, 1203–05 (2014).

120. Interview with Richard Beamish, Emeritus Scientist, Pacific Biological Station (Apr. 2016).

121. Sang-Seon Yun et al., *Sulfated Bile Acids as Putative Sex Pheromones in Pacific Lamprey*, 143 TRANSACTIONS AM. FISHERIES SOC'Y 1455, 1456–68 (2014); Yun et al., *supra* note 68, at 2199–2202; P. W. Sorensen & T. R. Hoye, *A Critical Review of the Discovery and Application of a Migratory Pheromone in an Invasive Fish, the Sea Lamprey Petromyzon Marinus L.*, 71 J. FISH BIOLOGY 100, 102 (2007).

122. McIlraith et al., *supra* note 64, at 131–32.

123. R. J. Beamish, *Adult Biology of the River Lamprey (Lampetra ayresi) and the Pacific Lamprey (Lampetra tridentata) from the Pacific Coast of Canada*, 37 CANADIAN J. FISHERIES AQUATIC SCI. 1906, 1920–21 (1980) (hosts include Pacific hake, cod, sablefish, flounder, perch, salmonids, and whales).

what is known about lampreys which may impede substantive conservation actions and recovery across their range.

C. Distribution of Pacific Lamprey

The historic distribution of Pacific lamprey includes all ocean-accessible rivers from Baja California in Mexico,[124] to the Aleutian Islands in Alaska, to Kamchatka in Russia, [125] and in the Japanese Archipelago.[126] While Pacific lamprey are still present throughout the majority of the historic range, recent surveys indicate a contraction in their distribution caused by dams and habitat degradation.[127] The freshwater distribution of lampreys is somewhat less clear. It is thought that the historic inland range of Pacific lamprey included at least all spawning reaches accessible to Pacific salmonids and potentially extended further due to the ability of lampreys to ascend vertical waterfalls.[128] In coastal California watersheds, lampreys were found in all watersheds greater than 100 km^2 and were rare or absent in drainages less than 50 km^2, suggesting stream or watershed size limits distribution.[129]

The USFWS, using a diagnostic tool developed by NatureServe, created a distribution map of Pacific lamprey in the contiguous United States.[130] It has predictions of subwatershed-level viability of Pacific lamprey larval populations or adult returns.[131] This designation compared

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124. Gorgonio Ruiz-Campos & Salvador Gonzalez-Guzman, *First Freshwater Record of Pacific Lamprey (Lampetra tridentata) from Baja California, Mexico*, 82 CAL. FISH & GAME 144, 144–45 (1996).

125. CLAUDE B. RENAUD, LAMPREYS OF THE WORLD: AN ANNOTATED AND ILLUSTRATED CATALOGUE OF LAMPREY SPECIES KNOWN TO DATE 5 (FAO Species Catalogue for Fishery Purposes No. 5, 2011).

126. Yuji Yamazaki et al., *Occurrence of Larval Pacific Lamprey (Entosphenus tridentatus) from Japan, Detected by Random Amplified Polymorphic DNA (RAPD) Analysis*, 52 ICHTHYOLOGICAL RES. 297 (2005).

127. Stewart B. Reid & Damon H. Goodman, *Pacific Lamprey in Coastal Drainages of California: Occupancy Patterns and Contraction of the Southern Range*, 145 TRANSACTIONS AM. FISHERIES SOC'Y 703, 709 (2016).

128. *See generally* U. G. Reinhardt et al., *Pacific Lamprey Climbing Behavior,* 86 CANADIAN J. ZOOLOGY 1264 (2008); *see generally* K. E. Frick et al., *Climbing Success of Adult Pacific Lamprey on a Vertical Wetted Wall*, 24 FISHERIES MGMT. & ECOLOGY 230 (2017).

129. Reid & Goodman, *supra* note 127, at 706–707.

130. *See infra* Figure 3.

131. *See generally* L. L. MASTER ET AL., NATURESERVE CONSERVATION STATUS ASSESSMENTS: FACTORS FOR EVALUATING SPECIES AND ECOSYSTEM RISK (Apr. 2012),

historic distribution information, provided by expert opinion and available data, with current monitoring information for presence or absence of adults or juveniles, as well as predictions based on potential threats and limiting factors of population viability.[132] Additionally, the USFWS has delineated ten Regional Management Units (RMU)[133] as an effort to focus conservation efforts to specific watersheds. Notably, the RMUs exhibit some geographic overlap with the species status designations of the NatureServe map.[134] The true historic distribution is likely inaccessible to western science but may be gathered through Traditional Ecological Knowledge (TEK).[135] TEK could be especially powerful with a species like Pacific lamprey because it plays an important role in many indigenous cultures in the region (as discussed in *infra* Part II).[136] Through the interpretation of traditional place names in native languages, TEK has been used to assess historic distribution in California.[137]

D. Passage at Hydroelectric Facilities and Current Distribution

Pacific lamprey have been negatively impacted throughout their range by passage barriers and other anthropogenic changes to river conditions.[138] This is particularly evident in the Columbia River basin, where a complex system of large hydroelectric dams, tens of thousands smaller irrigation diversions, and other barriers have been built in the last century, despite the presence and ecological, cultural, and economic importance of many migratory species in the basin. A variety of fish passage structures have been created to facilitate passage of migratory fish across these barriers but the design criteria have focused on salmonids.[139] For adult

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http://www.natureserve.org/sites/default/files/publications/files/natureserveconservationstatusfactors_apr12.pdf; *see infra* Figure 3.

132. *Id.*

133. *See infra* Figure 2.

134. *See infra* Figure 3.

135. *See generally* Eugene Hunn, *Columbia Plateau Indian Place Names: What Can They Teach Us?*, 6 J. LINGUISTIC ANTHROPOLOGY 3 (1996); *see* David A. Close et al., *supra* note 1, at 19.

136. Close et al., *supra* note 1.

137. *Id.*

138. *See infra* Figure 5.

139. Reinhardt et al., *supra* note 128, at 1264.

salmonids, passage success in modern fishways is now greater than 95%[140] compared to about 50% for adult Pacific lamprey.[141] Many structures designed to facilitate efficient upstream and downstream passage of salmon have been detrimental to lamprey passage.[142] For example, screens used to direct salmon smolts into bypass channels cause impingement of migrating juvenile lampreys.[143] Efforts in the past two decades have begun to address lamprey-specific needs, including construction of lamprey specific passage structures and modification of fishway operations to benefit lamprey without impacting salmon. [144]

The impediments to adult lamprey passage posed by hydroelectric facilities have been implicated as the major limiting factor in the size of returns to inland watersheds.[145] In their 2009 publication, Matthew L. Keefer et al. found that of the roughly 3600 lamprey radio-tagged at Bonneville Dam over the period 2005-2007, roughly half were able to pass one dam, only about 30% were able to pass two dams, about 18% passed three dams, and 1% were able to pass the first dam on the Snake River.[146] Counts of untagged lampreys at dams between 1998 and 2016 follow similar patterns.[147] They also found evidence for size-selective passage at all monitored dams, which suggests larger-bodied individuals are more likely to pass multiple hydroelectric facilities than smaller-bodied individuals.[148]

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140. Matthew L. Keefer et al., *Escapement, Harvest, and Unknown Loss of Radio-Tagged Adult Salmonids in the Columbia River – Snake River Hydrosystem*, 62 CANADIAN J. FISHERIES & AQUATIC SCI. 930, 934 (2005).

141. Mary L. Moser et al., *Passage Efficiency of Adult Pacific Lampreys at Hydropower Dams on the Lower Columbia River, USA*, 131 TRANSACTIONS AM. FISHERIES SOC'Y 956, 960–62 (2002).

142. *See, e.g.*, R.A. MOURSUND ET AL., U.S. ARMY CORPS OF ENG'RS, EFFECTS OF DAM PASSAGE ON JUVENILE PACIFIC LAMPREY (*LAMPETRA TRIDENTATA*) 1.2 (2001).

143. *Id.*

144. M.L. Moser et al., *Development of Pacific Lamprey Fishways at a Hydropower Dam*, 18 FISHERIES MGMT. & ECOLOGY 190, 191 (2011) (describing Lamprey Flume Structures (LFS), Lamprey Passage Structures (LPS), bollard fields and passage orifices in the Portland District dams); *see also* Eric L. Johnson et al., *Movement of Radio-Tagged Adult Pacific Lampreys During a Large-Scale Fishway Velocity Experiment*, 141 TRANSACTIONS AM. FISHERIES SOC'Y 571, 572 (2012).

145. *See* IDAHO DEP'T OF FISH & GAME, THE STATUS OF PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*) IN IDAHO 43–47 (2011).

146. *See* Keefer et al., *supra* note 118, at 1218.

147. *See infra* Figure 5.

148. Keefer et al., *supra* note 118, at 1218; *see also infra* Figure 5.

These findings were summarized, along with other lamprey passage research conducted during the period 2000-2010, in a 2012 report to the U.S. Army Corps of Engineers by Keefer and colleagues.[149] They found that PIT-tagged lamprey passed with greater efficiency than radio tagged lamprey, due to tagging and handling effects.[150] Despite improved performance with PIT-tagged lamprey, only about 50% were able to pass Bonneville Dam, 28% were able to pass The Dalles Dam, 18% were able to pass John Day Dam, and 5% passed McNary Dam.[151] Less than 1% of lamprey passed Ice Harbor and Priest Rapids Dams on the Snake River and Middle Columbia River, respectively.[152] This high attrition, in tagged adult fish moving upstream, corroborates the declining trends in passage observations at count windows inside Columbia River dams.[153] Notably, the proportion of lamprey migrating long distances to interior streams in unimpounded systems remains unknown.

In 2012, Matthew L. et al. summarized the underlying factors that shape the passage success of lamprey in the Columbia River Basin.[154] They found that at multiple scales, from dam-to-dam escapement to individual performance within a fishway, larger-bodied individuals were more successful at navigating the altered river environment.[155] They suggested that larger individuals may be stronger and faster swimmers within fishways than smaller fish, that larger lamprey may have greater energy reserves required for long-distance migrations, and that negative handling effects may be reduced for larger-bodied individuals.[156] They also highlighted the potential that larger-bodied individuals may be from distinct upriver populations, though they note that this would be at odds with the common consensus of fully mixed stock structure in Pacific lamprey.[157] Historic genetic structuring of upriver stocks of Pacific lamprey in the Columbia River basin are unknowable at this point, but assessment of fine-scale genetic structuring in unimpounded large river systems, such as the Fraser River

149. *See generally* MATTHEW L. KEEFER ET AL., U.S. ARMY CORPS OF ENG'RS, REPORT NO. 2012-8, ADULT PACIFIC LAMPREY PASSAGE: DATA SYNTHESIS AND FISHWAY IMPROVEMENT PRIORITIZATION TOOLS (2012).

150. *Id.* at 100–01.

151. *Id.* at 90–91.

152. *See infra* Figure 6.

153. KEEFER ET AL., *supra* note 149, at 90–91.

154. *Id.* at 100–01.

155. *Id.*

156. *Id.*

157. *Id.* at 101.

Basin in British Columbia or the Yukon River in Alaska, using previously applied sampling designs, could guide future restoration efforts.

Fishways and reservoir environments present drastically different river environments than were present during much of the evolution of Pacific lamprey.[158] Matthew L. Keefer et al. in 2012, noted that escapement rates vary across years and may be linked to environmental conditions.[159] Reservoir passage was found to be lowest during periods of very high water temperatures and that this trend increased with further inland reservoirs.[160] Altered conditions in fishways were found to influence passage success.[161] Lamprey passage through dams was observed to be most successful during periods of low discharge and least successful during periods of high discharge.[162] Matthew L. Keefer et al. in 2012, noted that fine-scale conditions in fishways likely influence passage success of lamprey at Columbia River dams because high velocity and turbulent conditions at dam tailraces and forebays are particularly challenging for lamprey migration.[163] These findings suggest lamprey passage may be increasingly threatened by climate induced changes in thermal and hydraulic conditions in the Columbia River basin.

Additionally, other passage bottlenecks have been identified at Columbia River dams.[164] For example, in 2013, Matthew Keefer identified four fishway segments at Bonneville Dam that contributed to 65% of all turnaround events across the years studied.[165] Turnaround events in the upper ladder segments resulted in lamprey which were least likely to attempt to pass the dam again, suggesting a high energetic cost to passage combined with an apparent lack of motivation to return to natal spawning grounds in lamprey.[166] Kirk and others found additional

158. *See generally* DAMS, FISH AND FISHERIES, FAO FISHERIES TECHNICAL PAPER NO. 419. (Gerd Marmulla ed., 2001); *see generally* NAT'L RESEARCH COUNCIL COMM. ON PROT. & MGMT. OF PAC. NW. ANADROMOUS SALMONIDS, UPSTREAM: SALMON AND SOCIETY IN THE PACIFIC NORTHWEST 26 (1996).

159. KEEFER ET AL., *supra* note 149, at 101.

160. *Id.*

161. *Id.*

162. *Id.*

163. *Id.*

164. *E.g.*, Matthew L. Keefer et al., *Fishway Passage Bottleneck Identification and Prioritization: A Case Study of Pacific Lamprey at Bonneville Dam*, CANADIAN J. FISHERIES & AQUATIC SCI. 1551, 1565 (2013).

165. Matthew L. Keefer et al., *Factors Affecting Dam Passage and Upstream Distribution of Adult Pacific Lamprey in the Interior Columbia River Basin*, 22 ECOLOGY FRESHWATER FISH 1, 5 (2013).

166. *See id.* at 7.

evidence that passage bottlenecks are created by a combination of both high turbulence and high-velocity flows.[167] Sharp corners may also impede lamprey in areas of high water velocity.[168]

The poor passage environment within the Columbia River Basin has likely resulted in a contracted upstream distribution for adults.[169] Historic estimates of lamprey returns to the Columbia River generally and to specific subbasins, in particular, are lacking. Despite this, the Idaho Department of Fish and Game has identified restoration goals of greater than 30,000 spawning lamprey per year returning to the Clearwater and Salmon River basins combined.[170] In the last decade, an average of fewer than thirty Pacific lamprey have been observed passing Lower Granite Dam on the Snake River in Washington, the last dam before a fish may reach the Clearwater or Snake River.[171] The CRITFC and its member tribes have also set a goal of restoring harvestable lamprey runs in the inland Columbia River Basin by 2050.[172] Without drastic improvements to lamprey run size and passage rates in the Columbia River basin, the established goal of lamprey restoration set by the State of Idaho and the CRITFC, and its member tribes, will not be possible.

E. Pacific Lamprey Response to Dam Removal

The challenges to comply with the Federal Power Act and the Endangered Species Act have resulted in the removal of hydroelectric facilities across the Pacific Northwest.[173] Pacific lamprey genetics, life history, and recolonization following barrier removal suggest rapid

167. Mark A. Kirk, Migration Behaviors of Adult Pacific Lamprey (*Entosphenus tridentatus*) at Large Hydropower Dams on the Columbia River, at 75, 90–91 (Feb. 2015) (unpublished M.S. thesis, University of Idaho) (on file with the University of Idaho Library).

168. *Id.* at 94.

169. Clemens et al., *supra* note 2, at 269.

170. *See* IDAHO DEP'T OF FISH & GAME, DOCUMENT ID NO. P111657, EVALUATE STATUS OF PACIFIC LAMPREY IN THE CLEARWATER RIVER AND SALMON RIVER DRAINAGES, IDAHO 14 (2009).

171. Fish Passage Center, *supra* note 99.

172. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 6.

173. *See generally* Blumm & Erickson, *supra* note 16.

ability to recolonize historic habitat.[174] Because of their lack of natal philopatry and ability to rapidly colonize newly accessible territory, Pacific lamprey may be a species with high recovery potential when barriers are removed.[175] Recent dam removal actions in the Pacific Northwest, specifically on the White Salmon, and Elwha in Washington, provide relevant case studies for lamprey conservation.[176] In the first two years of recovery of the former reservoir sites of both Elwha and Condit Dams, Pacific lamprey were observed migrating to spawn in upriver sections.[177] Subsequently, larval and juvenile Pacific lamprey have been observed, indicating successful recolonization of historic habitats.[178] Pacific lamprey have also demonstrated the ability to naturally recolonize historic habitats on the Hood River, following the 2010 removal of the Powerdale Dam.[179]

Prior to dam removal on the Elwha River, the Lower Elwha Klallam Tribe had documented and studied lamprey in the lower Elwha. Observations of adult, juvenile, and larvae were limited to sites downstream of the lower dam.[180] Since dam removal in 2012, the Tribe has documented adults migrating to previously blocked habitat.[181] Biologists for the Tribe observed lamprey in their larval stage in 2013 and 2014.[182] Notably, in February of 2016, the Tribe observed a juvenile lamprey making its downstream migration to the ocean.[183] These observations demonstrate successful nest building and larval rearing. The rapid recolonization of Pacific lamprey into previously blocked habitats suggests dam removal as a viable tool for lamprey conservation efforts and demonstrates that the presence of larval pheromones is not a prerequisite for spawning.

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174. Lamprey show little apparent genetic structuring by fine-scale natal philopatry and use alternative cues to determine potential spawning habitat. *See* Spice et al., *supra* note 112, at 2916, 2917 (2012).

175. *See id.*

176. Linda V. Mapes, *More Elwaha Fish Find Way to Dam-free Upper Watershed*, SEATTLE TIMES (Oct. 18, 2016), https://www.seattletimes.com/seattle-news/environment/more-elwha-fish-find-way-to-dam-free-upper-watershed/.

177. *See id.*

178. Royal, *supra* note 16.

179. *Hood River Habitat Program*, DEP'T FISHERIES CONFEDERATED TRIBES WARM SPRINGS, http://wsfish.org/hood-river-habitat/ (last visited Jan. 20, 2018).

180. Royal, *supra* note 16.

181. *Id.*

182. *Id.*

183. *Id.*

Similarly, Pacific lamprey have begun to recolonize habitat following removal of Condit Dam on the White Salmon River.[184] Removal of the Condit Dam was precipitated by the FERC relicensing process.[185] Privately owned and operated by PacifiCorp, Condit Dam first received a 25-year FERC license in 1968.[186] In 1982, the Northwest Power and Conservation Council suggested that relicensing be conditioned on PacifiCorp providing fish passage at Condit Dam for ESA listed salmon and steelhead.[187] Additionally, the Yakama Nation, CRITFC, and environmental organizations advocated that if PacifiCorp did not install fish passage facilities, dam removal would be the reasonable alternative.[188] Pursuant to the National Environmental Policy Act (NEPA), FERC issued a final environmental impact statement (EIS), which conditioned relicensing on the construction fish passage facilities.[189] With a price tag of over $30,000,000 PacifiCorp opted for "the most economically efficient alternative: dam removal."[190]

The Condit Dam was breached and removed in 2011 resulting in the opening of substantial habitat that had been blocked since 1917.[191] Prior to dam removal, biologists of the Yakama Nation and U.S. Fish and Wildlife Service conducted surveys that demonstrated no presence of Pacific lamprey upstream of Condit Dam.[192] In the summer of 2015, as part of the post-dam removal monitoring project, surveys by the U.S. Fish and Wildlife Service observed larval lamprey at three locations upstream of the former dam site.[193] Former reservoir sites may also

184. Tammy Ayer, *Lamprey Found Above Condit Dam Site on White Salmon River*, YAKIMA HERALD (Mar. 12, 2016), http://www.yakimaherald.com/news/local/lamprey-found-above-condit-dam-site-on-white-salmon-river/article_7869617a-e8ea-11e5-a5d2-ef3fc0cee45c.html.

185. *See* Blumm & Erickson, *supra* note 16, at 1061.

186. *Id.* at 1060–61.

187. *Id.* at 1062.

188. *Id.*

189. *Id.* at 1062–63.

190. *Id*. at 1063. Due to excessive buildup of sediment behind the face/forebay, removal of Condit Dam required section 401 certification to ensure the dam removal project complied with the Washington State Water Quality Standards. *See* David H. Becker, *The Challenges of Dam Removal: The History and Lessons of the Condit Dam and Potential Threats from the 2005 Federal Power Act Amendments*, 36 ENVTL. L. 811, 836 (2006).

191. Blumm & Erickson, *supra* note 16, at 1060.

192. Washines & Smith, *supra* note 16 (however, western brook lamprey, a non-migratory species, were observed both upstream and downstream of Condit Dam).

193. *Id.*

contain highly productive larval lamprey habitat in areas of fine sediment, especially when dam removal is paired with floodplain reconnection.[194] Although juvenile lamprey have not yet been observed to demonstrate successful larval rearing, the removal of Condit dam provides a novel case study for natural recolonization of historic habitat in the Columbia River Basin.

Removal of dams in the Pacific Northwest, such as the Glines Canyon and Elwha dams on the Elwha River, and Condit Dam on the White Salmon River have opened miles of spawning habitat that have been blocked from lamprey passage for decades.[195] Recent observations of larval and juvenile lamprey upstream of former dam sites on the Elwha and White Salmon rivers indicate that Pacific lamprey can naturally recolonize historic habitats following dam removal.[196]

i. Conclusion: Unique Life History of Pacific Lamprey Demands Holistic Conservation

Pacific lamprey are a unique and fascinating native component of the ecology of the Pacific Western United States. Though lampreys have existed for millennia, recent anthropogenic disturbances have contributed to the decline in abundance and contraction in the distribution of anadromous Pacific lamprey throughout their historic range. Understanding the specific life-history and stage-specific constraints on Pacific lamprey is critical to evaluating the legal status and conservation of this species. Of these constraints, passage of adult and juvenile lamprey through hydroelectric facilities and highly altered watersheds are likely the strongest limiting factors to lamprey populations that may be directly remedied by managers. Furthermore, the strength of these constraints compounds for the interior Columbia River basins, where lamprey have to pass up to nine major hydroelectric facilities and other barriers resulting in a dramatically limited functional range of this species, and resulting in a missing historic constituent of Columbia River Basin cultures and ecosystems.

194. *See* JEFFREY JOLLEY ET AL., U.S. FISH & WILDLIFE SERV. OCCURRENCE, DETECTION, AND HABITAT USE OF LARVAL LAMPREY IN THE LOWER WHITE SALMON RIVER AND MOUTH: POST-CONDIT DAM REMOVAL: FY 2012 ANNUAL REPORT 15 (Feb. 25, 2013).

195. Washines & Smith, *supra* note 16.

196. *Id.*

III. A Cultural Review of Pacific Lamprey in the Columbia River Basin

> Spiritually, he's [the Pacific lamprey] one of us . . . . How do we let something that's 450 to 500 million years old go extinct? Shame on us - the whole bunch of us . . . . People better realize what they're doing, because we are a big family. We are the circle. That's what life is about. We take care of one another. So, when we have someone [the lamprey] in trouble, that's when the rest of us have to step in. [197]

A. A Cultural Connection with Pacific Lamprey in the Columbia River Basin

For indigenous peoples of the Columbia and Snake River basins, the cultural connection and importance of Pacific lamprey (or "eels") is high, and the impacts of the species' severe decline in the Pacific Northwest cannot be overstated.

i. A Native Worldview, Evident in the Creation Story of Lamprey

Since time immemorial, the sustenance, culture, and way of life of indigenous peoples in the Snake and Columbia River basins has been inextricably intertwined with the fish, animals, and plants, and the waters, land, and air they depend upon. This indigenous worldview encompasses a respect for all things in nature and for Mother Earth herself; an acknowledgement that each life form serves an important role and no life form is more important than any other; a belief that the fish and animals give themselves up to humans for subsistence or for use in daily life; and a responsibility of reciprocity, to respectfully care for these fish and animals, to use them, and honor them.

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197. THE LOST FISH (Freshwaters Illustrated & Columbia River Inter-Tribal Fish Comm'n 2013), http://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/the-pacific-lamprey/lost-fish-film/.

The creation story of eel, told by Jerrid Weaskus of the Nez Perce Tribe in the powerful and provocative film about Pacific lamprey, *The Lost Fish*, captures this worldview:

> Creation story is this; Lamprey was a gambler, okay. He was a gambler. Coyote was the Creator. . . . He's going about his business and he's along the river, there. And [then t]here's Lamprey . . . he's down there, and he's been talking to Beaver and Muskrat. Coyote [comes along and] says, "What's going on?" [Beaver and Muskrat say,] "Lamprey is down there and he's playing stick game, bone game, and he's beating everybody." So, Coyote walks down to the bank and says, "Hey what's going on? . . . [Hey Lamprey] let me play you?" [And Lamprey says,] "Alright." Coyote beats him on the first round, and he's taking his stuff. Then he beats him again. Now Eel is sitting there and he has no possessions, nothing no more to gamble with [and he says,] "One more game, [come'on] Coyote, one more?" Coyote asks, "What you gonna bet with?" [Lamprey,] "I'm gonna bet you my arm, that I'm gonna beat you finally." So, Coyote plays him again, and beats him . . . . [Lamprey says,] "I'm gonna beat you this time Coyote. I'm gonna gamble you my leg." [He loses]. Lamprey is sitting there with no arms, and no legs. Coyote looks at him and says, "You have nothing to gamble with anymore" and he kicks him into the river, "and because your mouth got you into trouble, that's what you're going to suck on the rocks with". . . . He is a fish. He belongs to this river. He's Native to this . . . system . . . . This river needs him. And that's the bottom line.[198]

Weaving morality, justice, traditional ecological knowledge,[199] humor, and entertainment, this story is shaped from a long, ancestral existence connected to a particular landscape. Its

198. *Id.*

199. Prior to European settlement, Native Peoples carefully attended to and upheld laws and policies based on what can be understood as indigenous knowledge of science, contemporarily known as Traditional Ecological Knowledge (TEK). *See generally* FIKRET BERKES, SACRED ECOLOGY (3d ed. Routledge, 2012). Indigenous peoples use an oral tradition in contrast to a written code, and although different, oral traditions are equally as important to the passing of ecological knowledge, values, and norms through the knowledge-practice-belief-complex. Fikret Berkes et al., *Rediscovery of Traditional Ecological Knowledge as Adaptive Management*, 10 ECOLOGICAL APPLICATIONS 1251, 1251–52 (2000). Similarities between Western Science and TEK include integrating observation with conceptual models of the world (paradigms), (implicit) hypotheses, strong recognition

bottom line is that Pacific lamprey are an inseparable part of the river: they need the river and the river needs them to maintain a balanced and sustainable existence.

B. The Cultural Significance and Value of Pacific Lamprey

"The lamprey is our elder, without him the circle of life is broken."[200]

For tribes in the Snake and Columbia River basins, Pacific lamprey are just as important as salmon.[201] However, due to the extirpation and decline in abundance throughout the Columbia River basin, some tribes have a greater opportunity to interact with and honor Pacific lamprey within their cultural practices. Furthermore, upriver and interior tribes, located above migratory blockages such as the Grand Coulee Dam and the Hells Canyon Complex, have not seen Pacific lamprey in their waters since the construction of the respective dams.[202] Therefore, unless actions are taken to restore the Pacific lamprey's range, interior tribes will continue to lose their cultural connection with Pacific lamprey.

Additionally, there are many upriver and interior tribes who have not seen Pacific lamprey in their ancestral waters since the construction of dams without fish passage facilities. For example, Grand Coulee Dam extirpated Pacific lamprey from the Upper Columbia River so that tribes such as the Spokane Tribe of Indians, the Sinixt, Ktunaxa First Nation, and other upriver tribes are losing their cultural connection to them.[203] Likewise, because of low returns into the Salmon River drainage, the Shoshone-Bannock have not seen or harvested lamprey in places where they were once abundant like Salmon, Idaho.[204] The 'townsite' of the northern

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of cause and effect, and (explicit and implicit) predictions for outcomes given a set of conditions. *See id.* Although TEK does not have a formal scientific method and written transmission of ideas, the cultural transmission of ideas has proven responsive to prudent management, conservation and legal decisions. *See generally id.*

200. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 1.

201. *Id*. at iii.

202. PUB. UTIL. DIST. NO. 1 OF CHELAN CTY., FILE E4(2) NO. 67, A STATUS OF PACIFIC LAMPREY IN THE MID-COLUMBIA REGION 3 (Dec. 15, 2000).

203. *See id.*

204. J.E. Booth, *Local Intelligence*, 16 IDAHO RECORDER 3, Aug. 23, 1893.

band of Shoshone known as the *Agai-Dika* or Salmon eaters is now present-day Salmon, Idaho.[205] Additionally, in the Upper Snake River Basin, the Shoshone-Paiute, Burns Paiute, and Fort McDermitt Paiute Shoshone tribes are above the Hells Canyon Complex of dams, which do not have fish passage facilities[206] and thus have been denied the opportunity to honor and celebrate lamprey in their ancestral territories. The losses of cultural connection and indigenous knowledge for upper-river and interior tribes cannot be overstated. And future lamprey restoration efforts should consider translocation programs into historic habitats.

For generations, indigenous peoples of the Snake and Columbia River basins have harvested lamprey for subsistence, medicinal, and religious purposes.[207] Lamprey are among the first foods (along with water, salmon, deer, roots, and berries) that are present at tribal longhouses, ceremonies, and celebrations.[208] These gatherings serve as a reminder of the promise of these foods to take care of the people and for "the people's reciprocal [promise] to respectfully use and take care of the[se] foods."[209] Lamprey and their oil are important in the diets of tribal people.[210] Lamprey have medicinal value to tribal people.[211] "Oil collected from drying lamprey is applied to skin or ailing parts of the body in conjunction with a purifying sweat bath . . . [and] historically [was used] to condition hair and cure earaches."[212] Indigenous knowledge of Pacific lamprey are woven with myths and legends into sacred law that reinforces how humans are "to live with our brothers and sisters of the natural world" and respect them.[213] Pacific lamprey are honored in "songs [and ceremonies] that are specific for different animals, plants, or other beings [that] help people pay respect . . . before and sometimes after their harvest."[214]

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205. LEMHI-SHOSHONE TRIBES, http://www.lemhi-shoshone.com/ (last visited Jan. 14, 2018).

206. DON CHAPMAN, IDAHO POWER CO., FEASIBILITY OF REINTRODUCTION OF ANADROMOUS FISH ABOVE OR WITHIN THE HELLS CANYON COMPLEX: HISTORY OF THE HELLS CANYON COMPLEX 7, 37 (James A. Chandler ed., 2003), https://docs.idahopower.com/pdfs/relicensing/hellscanyon/hellspdfs/techappendices/Aquatic/e31_02_ch02.pdf.

207. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 8.

208. *Id.*

209. *Id.*

210. Close et al., *supra* note 1, at 22.

211. *Id.*

212. *Id.*

213. *Id.*

214. *Id.*

Pacific lamprey migrate to habitats inaccessible to salmon, which is supported by indigenous place names indicating lamprey presence or harvest in areas that are naturally blocked to salmon.[215] In the Nez Perce language, Pacific lamprey are "he su;" in other Sahaptin languages they are "asum" or "ksuyas."[216] The Nez Perce also have place names associated with Pacific lamprey, such as the place "where the eels feed away at" ("hesu nmptipinwes"), which is present-day Council, Idaho.[217] Other place names such as Asotin Creek, a tributary of the Snake River in Washington, are commonly viewed as derivations from "he su."[218] Indigenous place names are an important and applicable use of traditional ecological knowledge that can be used to infer the past expanse of Pacific lamprey's range, and thereby bolster restoration efforts and educate people to the reverence held for lamprey.

To the tribes of the Snake and Columbia River basins, Pacific lamprey are fundamentally important and linked to the ecological health of the basin in a similar manner as salmon and steelhead.[219] From a tribal cultural perspective, it is impossible to place a value, in economic terms, on any animal or plant, whether it be salmon or Pacific lamprey—they are invaluable. Other cultures have not viewed Pacific lamprey, which is not a charismatic species, so kindly. Western culture has widely considered lamprey to be an ugly fish, a trash fish, or even likened to varmints.[220] This has been due in part to an unfortunate association with the invasive Great

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215. *See generally* David A. Close et al., *Traditional Ecological Knowledge of Pacific Lamprey* (Entosphenus tridentatus) *in Northeastern Oregon and Southeastern Washington from Indigenous Peoples of the Confederated Tribes of the Umatilla Indian Reservation*, 38 J. NW. ANTHROPOLOGY 141 (2004).

216. *he su*, NEZ PERCE DICTIONARY 120 (1994); Close et al., *supra* note 1, at 22.

217. *hesu nmptipinwes*, *supra* note 216, at 120.

218. *E.g.*, Phil Dougherty, *Asotin County – Thumbnail History*, HISTORY LINK (Feb. 14, 2006), http://www.historylink.org/File/7643.

219. *Pacific Lamprey*: *A Cultural Resource*, COLUMBIA RIVER INTER-TRIBAL FISH COMM'N, http://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/lamprey/ (last visited Jan. 20, 2018) [hereinafter *Pacific Lamprey*: *A Cultural Resource*].

220. Michael Milstein, *A Desperate Fight to Save an Ugly, Fat Fish*, SEATTLE TIMES (Sept. 22, 2008), http://www.seattletimes.com/seattle-news/a-desperate-fight-to-save-an-ugly-fat-fish/; Cliff Newell, *Trash Fish a Big Key to Sustainability*, PORTLAND TRIB. (Apr. 9, 2008), http://portlandtribune.com/component/content/article?id=65636; TuckRussell, *The Lamprey, Close to Extinction, Could Bring down NW Salmon Too*, CROSSCUT (Mar. 2, 2012), http://crosscut.com/2012/03/the-lamprey-close-extinction-could-bring-down-nw-s/.

Lakes sea lamprey, as well as a limited understanding of the ecological and cultural importance of Pacific lamprey in the Columbia and Snake Basin.[221]

C. Securing Tribal Culture and Way of Life in Treaties with the United States

The United States acknowledged the pre-existing sovereignty of tribes in the Snake and Columbia River Basin by entering into treaties. During the treaty negotiations for the 1855 Treaty with the Nez Perce, the United States, through Governor Isaac Stevens, assured leaders like Chief Looking Glass of the Nez Perce about the continuation of off-Reservation rights as follows:

> I will ask of Looking Glass whether he has been told of our council. Looking Glass knows that in this reservation settlers cannot go, that he can graze his cattle outside of the reservation on lands not claimed by settlers, that he can catch fish at any of the fishing stations, that he can kill game and go to buffalo when he pleases, that he can get roots and berries on any of the lands not occupied by settlers.[222]

The United States Treaty with the Nez Perce and other tribes' treaties reserves to the Tribes the right to take fish at all usual and accustomed places, and to hunt, gather, and pasture on open and unclaimed lands.[223] Indian treaties are, under the U.S. Constitution, part of "the supreme Law of the Land."[224] These Treaty-reserved rights to take fish at all usual and accustomed places, in the words of the United States Supreme Court, were "part of larger rights possessed by the Indians, upon exercise of which there was not a shadow of impediment, and which were not much less necessary to the existence of the Indians than the atmosphere that

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221. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 2.

222. LAWRENCE KIP & BUREAU INDIAN AFFAIRS, THE WALLA WALLA TREATY COUNCIL OF 1855 at 64 (2014).

223. 1855 Treaty with the Nez Perces, Nez Perce-U.S., June 11, 1855, 12 Stat. 957. This language is similar to provisions in other treaties that tribes in the Pacific Northwest negotiated with Governor Stevens.

224. U.S. CONST. art. VI, § 2.

they breathed."[225] These treaty fishing rights include salmon, steelhead, sturgeon, lamprey, and other species.[226]

The United States also has a fiduciary relationship with federally recognized tribes resulting from Treaties, federal statutes, Executive Orders, and court rulings.[227] This federal trust responsibility encompasses protection of treaty fishing rights and other tribal trust resources. For example, the United States has initiated lawsuits on behalf of tribes with Treaty fishing rights, as their trustee, to give meaning to Tribes' Treaty-reserved rights.[228] In the USFWS's 2011 Pacific Lamprey conservation initiative, acknowledged that "Pacific lamprey is a tribal trust species and as such the USFWS recognizes tribal treaty and other rights . . . and strives to conduct its programs and actions in a manner that protects tribal trust resources, including fish and wildlife resources and their associated habitat."[229]

D. Declines in Pacific Lamprey Severely Impact Tribes

> As a Tribe [the Nez Perce], we are witnessing a severe decline in Pacific lamprey throughout Idaho, Washington, and Oregon. The species is in severe decline in both the Snake and upper Columbia Rivers. As a result, tribal members who remain reliant on Pacific lamprey for spiritual, physical, and economic well-being now treat Pacific lamprey as a rare delicacy. This severe decline, and change in tribal members'—including my own—relationship to the Pacific lamprey, has occurred during my

225. United States v. Winans, 198 U.S. 371, 381 (1905). The Treaty with the Eastern Band Shoshone and Bannock, of July 3, 1868, (also referred to as the Fort Bridger Treaty) reserved the right "to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts." Treaty with the Eastern Band Shoshone and Bannock, Jul. 3, 1868, 15 Stat. 673. In *Idaho v. Tinno*, the Idaho Supreme Court affirmed a District Court's construction of that treaty that "hunt" encompasses "fishing". 497 P.2d 1386, 1390, 94 Idaho 759, 763 (1972).

226. Tribal Pacific Lamprey Restoration, *supra* note 4, at 2.

227. *See* United States v. Navajo Nation, 537 U.S. 488, 490 (2003).

228. *See infra* note 241 and accompanying text.

229. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 7.

lifetime. Unfortunately, the decline continues, a fact that is deeply concerning to the Tribe and to me.[230]

From an indigenous perspective, the decline of Pacific lamprey in the Snake and Columbia River basins has severe negative impacts. These negative impacts include, at a minimum, the loss to the ecological circle and tribal way of life; loss of cultural heritage; and loss of fishing opportunities in traditional fishing areas.[231] Tribes are concerned about losing a piece of the ecological circle and losing a fish that they consider to be a sacred elder without which the circle of life is imbalanced.[232] Tribes are concerned about losing part of their cultural heritage because many young tribal members have not had the opportunity to harvest lamprey and prepare them, and important stories and legends associated with these fish are becoming lost.[233] Indigenous people are concerned that the declines in Pacific lamprey mean that they will not be able to harvest Pacific Lamprey in their usual and accustomed fishing places, and are instead being forced to travel long distances to places such as Willamette Falls on the Willamette River to pursue severely limited harvest opportunities on these fish.[234] This is especially troubling because seasonal gathering expeditions for Pacific lamprey have for generations defined harvest locations and guided the movements of people at certain times to various locations throughout the Snake and Columbia River basins.[235]

For indigenous cultures throughout the Columbia Basin, Pacific lamprey is a fundamental staple of spiritual experiences providing connections to the water and the land. If native traditions and spirituality are treated with the same dignity as Western or other religions, then allowing the extirpation or extinction of Pacific lamprey or allowing it to persist but only as a

230. Declaration of Daniel Kane at ¶ 16, Idaho Rivers United v. U.S. Army Corps of Eng'rs (W.D. Wash. Feb. 9, 2016) (No. 2:14-cv-01800-JLR).

231. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 2; Close et al., *supra* note 1, at 19.

232. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 2.

233. *Id.*; Close et al., *supra* note 1, at 19.

234. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 2; Close et al., *supra* note 1, at 19. Recently, tribal treaty fishermen were arrested for fishing for Pacific lamprey at Willamette Falls; although Oregon claimed the treaty did not reserve the right to fish for lamprey at Willamette Falls, the charges were dismissed. Kasia Hall, *Latest Fishing Clash Between Oregon, Native American Tribes is Dispute Dismissed*, OREGONIAN/OREGONLIVE (Aug. 7, 2015), http://s.oregonlive.com/O1FI3tb.

235. Close et al., *supra* note 1.

museum-like curiosity would not be tolerated any more than elimination of any other religion's sacraments or texts. Therefore, from a tribal perspective, it is imperative that restoration goals for Pacific lamprey abundance in the Columbia River basin provide for ecological functioning and sustainable harvest.

E. Tribal Leadership in the Era of Fish and Wildlife Co-Management

In landmark cases where states attempted to restrict Native American Treaty fisheries as in *United States v. Oregon* and *United States v. Washington,* the Courts held that the Treaty-reserved fishing rights secure a "fair and equitable share" of the fish runs, which in turn means "up to 50% of the harvestable surplus as necessary to satisfy a moderate living."[236] Most recently, the Ninth Circuit Court of Appeals in *United States v. Washington* affirmed that Treaty fishing rights impose a duty on the State of Washington to refrain from building or operating culverts under State-maintained roads that hinder fish passage and thereby diminish the number of fish that would otherwise be available for Tribal harvest.[237] The *United States v. Oregon* and *United States v. Washington* Treaty fishing rights cases, which remain under the continuing jurisdiction of the federal courts, also ushered in an era of fish and wildlife co-management among tribes, the United States, and states. Tribes have supplemented their traditional ecological knowledge and stewardship with technical and scientific expertise.[238] Tribes have and are continuing to play significant roles as the United States administers environmental laws, such as the Endangered Species Act (ESA). For example, the listing of salmon in the Pacific Northwest began with the Shoshone-Bannock Tribes' petition to list Snake River sockeye under

236. United States v. Oregon, Civ. No. 68-513-KI (D. Or. 1969); United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974), *aff'd*, 520 F.2d 676 (9th Cir. 1975), *cert. denied*, 423 U.S. 1086 (1976); Washington v. Wash. State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658, 686–687 (1979).

237. United States v. Washington, 827 F.3d 836, 848 (9th Cir. 2016).

238. Jeremy FiveCrows, *Introduction* to ALVIN M. JOSEPHY JR., I AM OF THIS LAND, at xvi (2007) ("Every year we have more and more Nez Perce fish biologists, environmental engineers, and other scientists who are offering their minds as well as their hearts for the protection of the salmon, the water, and, ultimately, the Nez Perce way of life.").

the ESA in April 1990,[239] and the Nez Perce Tribe is actively involved in decades-long litigation over the impact of the operation of the dams that make up the Federal Columbia River Power System (FCRPS) on salmon and steelhead.[240] Over the years of conflict, litigation and hearings, the tribes have united their efforts and leadership through organizations such as the Northwest Indian Fisheries Commission, Upper Columbia United Tribes (UCUT), Columbia River Inter-Tribal Fish Commission (CRITFC),the Upper Snake River Tribes Foundation (USRT), and the Okanagan Nation Alliance and the Canadian Columbia River Intertribal Fisheries Commission (CCRIFC), which comprise the interests of nearly 50 different tribes or tribal groups, and many tribal elders, and council leaders.[241]

F. Conclusion: Advancing Pacific Lamprey Restoration Consistent with an Indigenous Worldview, Conservation Biology, and the Endangered Species Act

Pacific lamprey are a critical part of the ecosystem and are a critical part of the cultural practices, the way of life, and the spiritual and religious practices of the native tribal people of the Snake and Columbia river basins. The impact to indigenous cultures that the severe declines of Pacific lamprey in Idaho, Oregon, Washington and British Columbia, Canada cannot be overstated.

The indigenous peoples of the Columbia River Basin have a generations-long knowledge, history, and experience with stewardship of the lands and water that existed prior to European settlement. Treaties with the United States, in which tribes reserved the right to take fish including Pacific lamprey, mean that Tribes are not only entitled to a right to harvest these fish

239. NAT'L OCEANIC & ATMOSPHERIC ADMIN. (NOAA), NMFS-NWFSC-33, STATUS REVIEW OF SOCKEYE SALMON FROM WASHINGTON AND OREGON (1997), https://www.nwfsc.noaa.gov/assets/25/5589_06172004_120234_sockeye.pdf.

240. Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv., 184 F. Supp. 3d 861 (D. Or. 2016).

241. *See generally*, NW. INDIAN FISHERIES COMMI'N, https://nwifc.org (last visited Oct. 30, 2017); UPPER COLUMBIA UNITED TRIBES, https://ucut.org (last visited Oct. 30, 2017); COLUMBIA RIVER INTER-TRIBAL FISH COMM'N, http://www.critfc.org (last visited Oct. 30, 2017); UPPER SNAKE RIVER TRIBES FOUND., http://www.uppersnakerivertribes.org (last visited Oct. 30, 2017); CANADIAN COLUMBIA INTER-TRIBAL FISHERIES COMM'N, http://ccrifc.org/ (last visited Oct. 30, 2017).

but also are co-managers of Pacific lamprey just like they are with salmon. The United States' trust obligations with respect to Pacific lamprey, both as a Treaty-reserved resource and as a trust resource, mean that the federal government has a significant obligation with respect to Pacific lamprey in the Snake and Columbia River basins. Just as Treaties ensure that harvest is shared, so too is the conservation burden of restoring Pacific lamprey equitably shared as well as the honor and redemption associated with this endeavor.

The worldview described above is remarkably consistent with the fundamental tenets of public land stewardship and conservation biology. It is also remarkably consistent with the intent of the Endangered Species Act, which provides protections for endangered or threatened species and their habitat. Tribes have provided sound stewardship for generations, and have, in the era of co-management, supplemented their traditional ecological knowledge with substantial technical expertise. Tribes also have a long history of leadership, especially with respect to salmon restoration and its intersection with the Endangered Species Act. This is likely to continue to be brought to bear with respect to Pacific lamprey.

IV. A Legal Review of Pacific Lamprey in the Columbia River Basin

The current regulatory scheme fails to provide substantive conservation measures across the complex, anadromous life cycle of Pacific lamprey, which spans multiple jurisdictions and fails to account for native value systems. Notably, across the species range, regulatory authorities have assigned legal conservation statuses demonstrating that Pacific lamprey are imperiled throughout a majority of their range.[242] This consensus warrants a renewed analysis to determine whether listing under the Endangered Species Act may be warranted. While the USFWS denied a petition to list Pacific lamprey and three other lamprey species in 2004, based on the cursory information available, it encouraged the gathering and research of additional information to increase the understanding of Pacific lamprey, which has been occurring.[243] As Pacific lamprey populations continue to decline in the Columbia River basin, substantive legal protections will become imperative to ensure their continued existence.

242. *See infra* Table 1.
243. *See infra* Section IV.B.

While there is a general consensus that lamprey face an increasing threat to their populations throughout their entire range, their legal conservation status varies both on an international and federal level, as well as domestically, from state to state. Furthermore, the anadromous nature of this ancient fish ensures that, in the course of a single life, Pacific lamprey are moving fluidly in and out of different regulations and different scales of protection. This Section begins broadly with an international overview of how lamprey are treated throughout their range. From there, the Section focuses on the United States' federal policy and the different jurisdictions therein; then it turns to different states, and finally focuses on a discussion of Tribal law and its influence on Pacific lamprey within the Columbia River basin.

A. Review of Jurisdictions, Current Legal Status, and State Regulations

As an anadromous species, the life history of the Pacific lamprey ensures it will cross many different jurisdictions, each replete with its own rules, regulations, and value systems. Generally, the USFWS administers the ESA for terrestrial and freshwater species and the National Marine Fisheries Service (NMFS) administers the ESA for marine species.[244] While Pacific lamprey are anadromous, they spend the majority of their life in freshwater and are designated as a freshwater species.[245] Thus for ESA purposes, Pacific lamprey fall under the jurisdiction of the USFWS.[246] Because Pacific lamprey spend a majority of their life in freshwater, the USFWS, rather than the National Marine Fisheries Service (NMFS), has federal jurisdiction and authority to review petitions for listing under the ESA, implement conservation initiatives, and issue rules or policy.[247] The USFWS classifies Pacific lamprey as species of

244. NAT'L OCEANIC & ATMOSPHERIC ADMIN., *Endangered and Threatened Species under NMFS' Jurisdiction*, NOAA.GOV, http://www.nmfs.noaa.gov/pr/species/esa/listed.htm (last updated Aug. 17, 2017).

245. *Pacific Lamprey*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/oregonfwo/articles.cfm?id=149489457 (last visited Jan. 20, 2018).

246. *USFWS History: A Timeline for Fish and Wildlife Conservation*, U.S. FISH & WILDLIFE SERV., https://training.fws.gov/history/USFWS-history.html (last visited Jan. 20, 2018) (The USFWS falls under the authority of the Department of the Interior while NMFS is a regulatory agency within the Department of Commerce).

247. *Listing and Critical Habitat Petition Process*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/endangered/what-we-do/listing-petition-process.html (last updated Jan. 9, 2018).

concern.[248] While in their marine migration, however, Pacific lamprey fall under the jurisdiction of the National Marine Fisheries Service (NMFS).[249] A range-wide analysis is also pertinent in that listing under the ESA may be warranted if a species is threatened or endangered across a significant portion of their range. Additionally, states may classify and, if warranted, list species on state endangered or threatened lists.[250] Finally, as a tribal trust resource, tribes within the Columbia River Basin serve as co-managers with state and federal agencies.

While legal conservation status varies across jurisdictions within Pacific lamprey's range, there is a general consensus that Pacific lamprey face an increasing threat to their existence.[251] In 2001, the State of Idaho classified Pacific lamprey as endangered.[252] In Oregon, Pacific lamprey are designated as a vulnerable and sensitive species, and in Washington, Pacific lamprey are a state-monitored species.[253] California has designated Pacific lamprey to be species of special concern.[254] Although minimal studies have been conducted in Alaska, the Alaska Fish and Game Department designates Pacific lamprey as a species in need of conservation.[255] Federally, the USFWS considers Pacific lamprey to be a species of concern.[256] However, in Canada, the Committee on the Status of Endangered Wildlife (COSEWIC) has nominated Pacific lamprey to be a high priority candidate for endangered species

248. SPECIES FACT SHEET PACIFIC LAMPREY, *supra* note 19.

249. *About Us: Our Mission*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.fisheries.noaa.gov/about-us (last visited Jan. 20, 2018). Although there are few conservation measures NMFS can or does implement to protect Pacific lamprey while at sea individual states have primary jurisdiction over freshwater and coastal fisheries, which include Pacific lamprey. *Id.*

250. Ryan Pellerito, *State Endangered Species Chart*, https://www.animallaw.info/article/state-endangered-species-chart (last vistied Feb. 7, 2018).

251. *See infra* Table 1.

252. *Pacific Lamprey (Lampetra tridentata)*, IDAHO FISH & WILDLIFE INFO. SYS. (2005), https://fishandgame.idaho.gov/ifwis/cwcs/pdf/pacific%20lamprey.pdf.

253. Letter from Kelly Coates, Program Manager, Cow Creek Umpqua Tribe Water and Envtl. Res. to Or. Watershed Enhancement Bd. (Oct. 15, 2014) (on file with Or. Watershed Enhancement Bd.); *Washington State Species of Concern Lists*, WASH. DEP'T FISH & WILDLIFE, http://wdfw.wa.gov/conservation/endangered/list/Fish/ (last visited Jan. 20, 2018).

254. *Fish Species of Special Concern*, CA. DEP'T FISH & WILDLIFE, https://www.wildlife.ca.gov/Conservation/SSC/Fishes (last visited Jan. 20, 2018).

255. U.S. FISH & WILDLIFE SERV., CONSERVATION AGREEMENT FOR PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*) 3 (June 20, 2012); *see also Pacific Lamprey (Lampetra tridentata)*, ALASKA DEP'T FISH & GAME, http://www.adfg.alaska.gov/index.cfm?adfg=pacificlamprey.research (last visited Sept. 11, 2017).

256. SPECIES FACT SHEET PACIFIC LAMPREY, *supra* note 19.

designation.[257] Pacific lamprey are designated as threatened in Mexico[258] and are listed as "data-deficient" on the Red List of Threatened species in Japan.[259] The Ministry of Natural Resources and Environment of the Russian Federation has not published a conservation status nor a management plan.

States within the Columbia River Basin have issued regulations affording Pacific lamprey protections to varying degrees. For example, in Washington State, it is illegal for any person to harvest Pacific lamprey.[260] Likewise under Oregon law, with the exception of Willamette Falls, "it is unlawful for any person to hunt, trap, pursue, kill, take, catch, angle for, or have in possession, either dead or alive, whole or in part, any" Pacific lamprey.[261] However, these state laws do not generally apply to tribal members exercising treaty rights. Idaho, because Pacific lamprey are classified as endangered, prohibits the harvest, take, or have possession of Pacific lamprey.[262]

Willamette Falls on the Willamette River in Oregon is the primary site of lamprey harvesting in the Columbia River basin.[263] Tribes, such as the Nez Perce, Umatilla, Yakama, and Warm Springs harvest lamprey at Willamette Falls pursuant to tribal self-regulation.[264] Furthermore, in light of severe declines in Pacific lamprey abundance throughout the Columbia River Basin, the harvest that does occur at this location is very limited and restricted.[265] And,

257. Committee on the Status of Endangered Wildlife in Canada, *COSEWIC Candidate Wildlife Species*, GOV'T CAN., https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife/candidate-wildlife-species.html#MM002 (last updated July 10, 2017).

258. *Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo*, NORMA 46 (Dec. 30, 2010), http://www.biodiversidad.gob.mx/especies/pdf/NOM_059_SEMARNAT_2010.pdf.

259. *Red List of Threatened Fishes of Japan*, BIODIVERSITY CTR. JAPAN (on file with the Idaho Law Review).

260. WASH. ADMIN. CODE § 220-312-080(4) (2017).

261. OR. ADMIN. R. 635-044-0430(1)(C)(O) (2017).

262. IDAHO ADMIN. CODE r. 13.01.06.300.02 (2017).

263. *Pacific Lamprey: A Cultural Resource*, *supra* note 219.

264. *Id.*

265. *See id.*

as the USFWS acknowledged in its Conservation Assessment, such harvest is not a significant factor in the decline of Pacific lamprey.[266]

The relatively pristine freshwater habitats along the British Columbia coast, Alaska, and parts of Russia provide refuge for Pacific lamprey in their freshwater phases, but climate change and associated ocean conditions may be a limiting factor to achieving historical abundances and distributions. Furthermore, although Canada provides substantial coastal and freshwater habitat, the recent listing of Pacific lamprey as a high priority candidate for listing exemplifies lamprey's potentially imperiled conservation status across a substantial portion of their range.

B. Pacific Lamprey and the Endangered Species Act

The Endangered Species Act (ESA), the Nation's most prominent conservation law, offers substantive protections to species and the ecosystems on which they depend. The ESA's purposes are well-aligned with the multi-jurisdictional challenges that Pacific lamprey face. This section analyzes the intersection of Pacific lamprey with the ESA. Here we discuss the ESA's purposes, its protections, its process for listing species as endangered or threatened, and an analysis of a 2003 petition to list lamprey and the USFWS response to that petition. To receive the protections of the ESA, which focuses efforts and directs resources on recovering species, a future petition will have to present information that can serve as the basis for the USFWS to determine that Pacific lamprey—as a species, as a distinct population segment, or as a species across a significant portion of their range—are endangered or threatened.[267]

i. The Endangered Species Act, the ESA's listing process, and the ESA's protections

266. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 21. Although harvesting is not listed as a significant factor on page 21 of this source, on page 24 the document does indicate that harvesting can threaten to reduce population numbers. *Id.* at 24.

267. *See Endangered Species*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/endangered/what-we-do/listing-petition-process.html. (last updated Apr. 4, 2017).

The ESA's purposes are to "provide a program for the conservation of such endangered species and threatened species," and to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved."[268] The ESA's goal is to recover species found to be threatened or endangered and remove them from the ESA list.[269] Practically, the ESA focuses efforts and directs resources towards recovering such species.[270]

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range,"[271] and defines a threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."[272]

A species that is listed as endangered or threatened receives substantial protections under the ESA. The species "critical habitat"—the habitat needed for its conservation—must be designated, and all federal agencies must, in consultation with the FWS or NMFS,

> insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined . . . to be critical.[273]

Additionally, the ESA and its implementing regulations broadly prohibit the "take" of any species that has been listed as endangered or threatened.[274]

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268. 16 U.S.C. § 1531(b) (2012).

269. *ESA Basics: 40 Years of Conserving Endangered Species*, U.S. FISH & WILDLIFE SERV. 1 (2013), https://www.fws.gov/endangered/esa-library/pdf/ESA_basics.pdf.

270. *See id.*

271. § 1532(6).

272. § 1532(20).

273. § 1536(a)(2).

274. § 1538(a)

The ESA sets forth five factors, and provides that any one or any combination of these, may serve as the basis for listing a species as endangered or threatened: "(A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) *disease* or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence."[275]

The listable entities under the ESA are a species, a subspecies, a distinct population segment (DPS), or a species throughout a significant portion of its range.[276] A DPS, according to a 1996 USFWS and NMFS joint policy, involves consideration of three elements: the "[d]iscreteness of the population segment" relative "to the remainder of the species[,]" "[t]he significance of the population segment" relative "to the species to which it belongs[,]" and "[t]he population segment's conservation status" relative to the ESA's standards for listing.[277] Significantly, the USFWS and NMFS acknowledge the case-by-case and fact-specific nature of applying the DPS policy.[278] It is important to note that the DPS policy emphasizes that application of a DPS to stocks of Pacific salmon set forth in the NMFS 1991 "evolutionarily significant unit" (ESU) policy that relied heavily on genetic distinctions, applies only to those particular species of salmon.[279] Finally, there is widespread acknowledgment that the USFWS and NMFS may list a species throughout "a significant portion of its range," although the

275. § 1533(a)(1)(A–E) (emphasis added); *see also* 50 C.F.R. § 424.11(c) (2017) (ESA's implementing regulations).

276. § 1532(16).

277. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722, 4725 (Feb. 1, 1996).

278. *Id.* ("Because precise circumstances are likely to vary considerably from case to case, it is not possible to describe prospectively all the classes of information that might bear on the biological and ecological importance of a discrete population segment").

279. Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. 58,612 (Nov. 21, 1991) [hereinafter *Applying Definition*] (concluding by confirming that federal agencies "will rely on the biological expertise of the agency and the scientific community in making 'species' determinations under the ESA"; that a species determination must be "supported by scientific evidence"; and that "the lack of direct genetic or any other type of information does not preclude consideration of a population as a 'species' under the ESA if such finding is supported by other information.").

understanding of this latter phrase has been, and continues to be, the subject of a variety of administrative and judicial interpretations.[280]

The ESA provides that listing determinations are to be made "solely on the basis of the best scientific and commercial data available."[281] This means that the USFWS or NMFS cannot deny listing by awaiting the development of the best possible data or by requiring conclusive proof of a particular threat or impact. The ESA's implementation of regulations also emphasizes that listing determinations are to be made "without reference to possible economic or other impacts of such determination."[282]

ii. A 2003 Petition to List Four Lamprey Species and 2004 U.S. Fish and Wildlife Service's Response

In January 2003, eleven environmental groups,[283] led by the Siskiyou Regional Education Project, petitioned the USFWS to list as threatened or endangered and designate critical habitat for four lamprey species (Pacific lamprey, river lamprey, western brook lamprey, and kern brook lamprey) found in California, Oregon, Washington, and Idaho under the ESA.[284] Alternatively, petitioners requested the Secretary of the Department of the Interior list as threatened or endangered and designate critical habitat for one or more distinct population segments of those four species "comprised of one or more major river basins within California, Oregon, Washington, and Idaho."[285] The petition indicated that "[g]enetic and life history data suggest that for federal listing and recovery purposes Pacific lamprey populations could be

280. Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species" and "Threatened Species," 79 Fed. Reg. 37,578 (July 1, 2014) (The policy describes the consequences of listing a species throughout a SPR: "the entire species is listed as endangered or threatened, respectively, and the Act's protections apply to all individuals of the species wherever found." The policy then offers definitions of "significant" and "range.").

281. § 1533(b)(1)(a) (2012).

282. 50 C.F.R. § 424.11(b) (2017).

283. No co-managing tribes or tribal entities participated in the 2003 petition.

284. CTR. FOR BIOLOGICAL DIVERSITY, PETITION TO LIST FOUR LAMPREY SPECIES AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT 1–3 (2003), http://www.biologicaldiversity.org/species/fish/Pacific_lamprey/pdfs/petition.pdf.

285. *Id*.

subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon species" while emphasizing that "delineation of distinct population segments is best left to the discretion of the FWS."[286]

The petitioners claimed listing of these four species was warranted under each of the five factors set forth in Section 4 of the ESA.[287] However, the bulk of the petition focused on two of the listing factors: the "present or threatened destruction, modification or curtailment of its habitat or range" and the "inadequacy of existing regulatory mechanisms."[288] The petition cited population declines, the impact of dams and other artificial barriers on upstream and downstream migration, de-watering of streams, and habitat degradation as among the threats that justified listing.[289] Regarding the three remaining listing factors—other natural or manmade factors affecting continued existence, predation, and the overutilization for commercial or recreational purposes—the petition identified a lack of monitoring data or a lack of information.[290]

In response to the petition, and after a significant delay, in December 2004, the FWS published its ninety-day finding.[291] With respect to Pacific lamprey, the USFWS acknowledged that "[o]ur evaluation of the petition and other information indicates there is a decline in Pacific lamprey historical abundance and distribution throughout California, Oregon, Washington, and Idaho and that threats to the species occur in much of the petitioned range of the species."[292] The FWS then observed that "the petition did not attempt to describe or justify a listable entity within the petitioned area . . . ."[293] The USFWS found that "[n]either the information provided in the petition nor otherwise available in service files presents substantial scientific or commercial information to demonstrate that the petition to list Pacific lamprey located in the

286. *Id*. at 14.
287. *Id.* at 44–53.
288. *Id.*
289. *Id*. at 44–47.
290. CTR. FOR BIOLOGICAL DIVERSITY, *supra* note 284, at 48–51.
291. *See* 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,158 (proposed Dec. 27, 2004).
292. *Id.*
293. *Id*.

lower 48 states may be warranted" and that "[a]ccordingly, we are unable to define a listable entity of the Pacific lamprey."[294] The USFWS concluded that "[s]ince the population of Pacific lamprey cannot be defined as a DPS at this time, [it is] thus ineligible to be considered for listing. . . ."[295] As a result of this conclusion, the FWS did not evaluate Pacific lamprey's status as threatened or endangered under the five ESA listing factors.[296]

While the Secretary's finding did not trigger a formal status review, the USFWS did pledge to continue to work with co-managers to further research and gather information related to lamprey conservation measures.[297] Specifically, the USFWS

> encourage[d] additional information gathering and research to increase our understanding of these species on such topics as . . . : (1) the Pacific . . . lamprey biology and ecology, their current and historical distribution and abundance, and habitat needs during all life stages; (2) the range, status, and trends of these species; (3) specific threats to these species or habitats; (4) techniques for improving identification of lamprey ammocoetes to species; (5) any other information that would aid in determining these species, population status, trends, and structure; and (6) the adequacy of existing regulatory mechanisms to protect or conserve lampreys and their habitat.[298]

As discussed below, this encouragement has led to a substantial body of new information that goes far beyond the cursory information provided in the petition, and in turn, provides a better understanding of Pacific lamprey and their status. In light of this new information, there are several noteworthy observations about the petition and the USFWS's response. First, the petitioners' suggestion that for listing purposes Pacific lamprey "could be subdivided into distinct population segments at spatial scales similar to the ESUs developed for listed salmon

294. *Id.* at 77,166.
295. *Id*. at 77,167.
296. *See id.*
297. 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. at 77,158.
298. *Id*. at 77,167.

species" contains some subtleties that could inadvertently introduce some confusion.[299] As we have seen above, NMFS's 1991 ESU policy for Pacific salmon is predominantly—if not exclusively—focused on genetic distinctions between salmon while the joint USFWS and the NMFS 1996 DPS policy makes it clear that genetic differences are only one of the many bases that may support listing as a DPS.[300] Thus, the petitioners' suggestion is best understood as simply offering an analogy to give a rough sense of scale (for example, considering a DPS at the scale of the Snake River basin). Second, putting aside the nuance that Pacific salmon are a DPS under a specific ESU policy and that Pacific lamprey could be considered a DPS under the 1996 DPS policy, the analogy to Pacific salmon provides a helpful context of listable entities. Third, to the extent the USFWS's response to the petition implies or can be read to suggest that it is the petitioners' burden to identify the specific listable unit, this cannot be squared with the agencies' obligations to administer the ESA and apply that law to the information presented in the petition. In other words, it is appropriate that petitioners would leave the specific delineation of a DPS to the USFWS. Furthermore, it is the petitioners' duty to present compelling science and the USFWS's job to make a determination based on the best available science and commercial data.

That said, future petitioners seeking to have any species listed are well-advised to marshal the best available scientific and commercial data in the way they believe best identifies a listable unit and satisfies one or more of the five factors that will support a listing.

iii. Future pathways for Pacific Lamprey Conservation and Recovery under the ESA

The USFWS's invitation to increase the understanding of Pacific lamprey is the most significant legacy of the agency's 2003 ninety-day finding.[301] As a matter of law and fact, there

299. *Id.* at 77,166.

300. *Compare Applying Definition*, *supra* note 279, *with* Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722, 4725 (Feb. 1, 1996).

301. *See generally* ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30 (The USFWS has overseen the implementation of the Pacific Lamprey Conservation Initiative and a comprehensive agreement among sovereigns, agencies and NGOs known as the Conservation Agreement for Pacific Lamprey).

is nothing in the 2003 finding that prejudices any future petition seeking to list Pacific lamprey.[302] Any future finding by the USFWS will have the benefit of a substantially more comprehensive scientific understanding of Pacific lamprey and their status.

A future petition to list Pacific lamprey under the ESA must present substantial biological and commercial data that would support listing Pacific lamprey as a listable entity (a species, a subspecies, a distinct population segment, or a species at risk throughout a significant portion of its range) based on the five listing factors of the ESA.[303] The USFWS would review the petition and analyze Pacific lamprey at the listable unit of species; the listable unit of a DPS (which is a very case-specific and fact-specific inquiry); and the listable unit of a species throughout a significant portion of its range.[304]

There are multiple options that the USFWS could evaluate for listing, considering what is currently the best available scientific and commercial data with respect to Pacific lamprey.

iv. The Current Regulatory Scheme Fails to Adequately Protect and Conserve Pacific Lamprey Across Life Stages

An examination of the existing regulatory mechanisms reveals, that although they may benefit Pacific lamprey to some degree, they are inadequate to protect and conserve Pacific lamprey across all life stages.

At the state level, harvest regulations are in place to govern harvest by state citizens, and tribal regulations are in place to govern tribal members' limited harvest pursuant to treaty-reserved rights. It is widely acknowledged that harvest has not been, and is not, a significant factor in the current status of Pacific lamprey.[305] At the federal level, the Clean Water Act may provide some protection to Pacific lamprey and its habitat. This protection may be direct or

302. *Id.*
303. *See supra* Section IV.B.i.
304. 16 U.S.C. § 1533(b)(3)(A) (2012).
305. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 174–75.

indirect, either by ensuring the water quality criteria are met or by designating uses set forth in federally-approved water quality standards. The Federal Power Act also requires that private hydropower facilities comply with federally-approved state water quality standards and other facets of state law.[306] Where applicable, the FERC relicensing process imposes further substantive standards under the Federal Power Act (mandatory conditioning authority for USFWS, BIA, etc.).[307]

NEPA requires federal agencies to take a "hard look" at the environmental impact of major federal actions.[308] One would expect that this would ensure that federal agencies have analyzed the effects of their proposed actions on Pacific lamprey. However, NEPA allows an agency to rely on existing data in conducting its analysis; it does not require an agency to do additional monitoring or conduct additional studies or surveys to fully assess baseline conditions.[309]

The limited protection afforded to Pacific lamprey under NEPA is illustrated in a case where Idaho Rivers United and the Nez Perce Tribe, among other plaintiffs, requested a preliminary injunction to halt a proposed dredging project in the Lower Snake River.[310] The plaintiffs sought to enjoin the dredging so as to afford time for updated surveys to occur to demonstrate whether lamprey were present or not.[311] However, the Court held that the Army Corps of Engineers was entitled to rely on its existing data (indicating that no lamprey were observed in the area) despite the significant limitations of the underlying survey and the lack of additional surveys which prevented the plaintiffs from showing the irreparable harm necessary to obtain an injunction.[312] And, NEPA only requires a "full analysis" of the environmental

306. *Federal Power Act*, HYDROPOWER REFORM COAL., http://www.hydroreform.org/policy/fpa (last visited Jan. 20, 2018).

307. *See id.*

308. Kleppe v. Sierra Club, 427 U.S. 390, 410 n.21 (1976) (establishing the hard-look doctrine which states that in a NEPA analysis, the court's sole role is to insure the agency take a hard look at the potential environmental impacts).

309. Nw. Envtl. Advocates v. Nat'l Marine Fisheries, Serv., 460 F.3d 1125, 1139 (9th Cir. 2006).

310. Idaho Rivers United v. U.S. Army Corps of Eng'rs, 156 F. Supp. 3d 1252, 1255 (W.D. Wash. 2015).

311. *Id.* at 1258.

312. *Id.* at 1262.

impacts and alternatives; it does not dictate that an action agency select the most beneficial alternative for Pacific lamprey.[313]

While the Clean Water Act and state regulations do provide some protections and conservation measures, they are limited to reactive measures of specific impacts from hydro-electric projects rather than addressing Pacific lamprey across their life history.

C. Voluntary Agreements and Comprehensive Conservation Plans

For the last decade, stakeholders have engaged in multiple forums addressing Pacific lamprey conservation in the Columbia River Basin. In 2008, several Columbia basin tribes memorialized an agreement with the federal government that provided funds for Tribes to implement some important, albeit limited, conservation and research initiatives for Pacific lamprey.[314] This agreement was part of what was known as the "Columbia Basin Fish Accords" (Accords), which were a set of agreements among the FCRPS action agencies, states, and six Columbia River Basin Tribes.[315] Although these agreements focused on protecting and conserving ESA listed salmonids, Pacific lamprey and other components of the Columbia River Basin ecosystem were also considered.[316] In order to implement the conservation actions in a coordinated manner, the USFWS spearheaded the Pacific Lamprey Conservation Agreement (PLCA).[317] The PLCA built upon the Tribal Pacific Lamprey Restoration Plan put forward by the member tribes of CRITFC.[318] These voluntary agreements serve as the primary vehicle to implement conservation actions within the Columbia River basin.

313. *See* 42 U.S.C. § 4332 (2012).

314. *See* IMPROVEMENTS IMPLEMENTATION PLAN, *supra* note 31, at 1–2 (Dec. 2014 revision).

315. COLUMBIA RIVER BASIN FED. CAUCUS, *Columbia Basin Fish Accords*, SALMONRCOVERY.GOV, https://www.salmonrecovery.gov/Partners/FishAccords.aspx (last visited Jan. 20, 2018).

316. *Id.*

317. *See generally* U.S. FISH & WILDLIFE SERV., CONSERVATION AGREEMENT FOR PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*), *supra* note 255.

318. *See generally* TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4.

i. The Columbia Basin Fish Accords Between the FCRPS Action Agencies and Certain States and Tribes

The 10-year Accords focused on providing substantive commitments for fish and wildlife in exchange for state and tribal support for, and defense of, the 2008 and subsequent FCRPS Biological Opinions during the term of the agreement (that were overturned by the Oregon District Court).[319] The Accords included some beneficial actions for lamprey protection, research funding, and passage enhancement projects.[320] Notably, however, the Accords, which are set to expire in 2018, also included a forbearance provision, which prevents the signatory tribes from petitioning or engaging in a Pacific lamprey ESA listing effort.[321] If subsequent Accords are renegotiated, and they include a similar forbearance provision, non-signatory tribes or environmental organizations will continue to be the only entities capable of initiating or supporting an ESA listing petition for Pacific lamprey.

a. Translocation Programs in the Columbia River Basin

319. *See generally* 2008 Columbia Basin Fish Accords Memorandum of Agreement Between the Three Treaty Tribes and FCRPS Action Agencies, May 2, 2008, http://www.critfc.org/wp-content/uploads/2012/10/moa.pdf [hereinafter Treaty Tribes Accord]; 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Shoshone-Bannock Tribes and FCRPS Action Agencies, Nov. 7, 2008, https://www.salmonrecovery.gov/Files/BiologicalOpinions/ShoBan-AA%20MOA%20FINAL%20PACKAGE.pdf; 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Colville Tribes and FCRPS Action Agencies, May 2, 2008, https://www.salmonrecovery.gov/Files/BiologicalOpinions/Colville-Tribes-Action-Agency-Agreement.pdf. The Nez Perce Tribe and the State of Oregon did not sign an accord, and have continued to actively participate in the FCRPS BiOp litigation. *See* Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv., 184 F. Supp. 3d 861 (D. Or. 2016).

320. Treaty Tribes Accord, *supra* note 319, at 6–9 (providing commitments from Bonneville Power Administration, Army Corps of Engineers, and Bonneville Power administration in the form of financial guarantees, management plans and lamprey passage enhancements throughout the FCRPS).

321. *Id.* at 21. "[T]he Action Agencies' commitments under this Agreement for lamprey actions are adequate for the duration of this Agreement such that the Tribal parties will not petition to list lamprey or support third party efforts to list lamprey as threatened or endangered pursuant to the ESA."

One of the commitments in the Accords provides funding for continuing and expanding Pacific lamprey translocation programs.[322] In recent years, CRITFC members (Yakama, Umatilla, and Nez Perce) have begun a targeted trap and translocation program to move adult lamprey from lower Columbia River dams to historic spawning grounds above these dams.[323] Translocation involves trapping migrating adult lamprey in fishways, transporting these lamprey by truck to holding facilities for overwintering (approximately 6–18 months), and releasing them before or at maturation.[324] This is a critical conservation measure for small populations of lamprey.[325] The Tribes have expressed goals of: (1) increasing larval lamprey numbers in historic systems, which may in turn attract future adult returns through pheromone cues;[326] (2) retaining lamprey-derived ecosystem services in these systems until passage issues can be addressed; and (3) restoring run sizes to harvestable levels across their historic range.[327]

In the Umatilla River basin, where lamprey translocation has occurred since 1999, larval lamprey have increased in density and distribution throughout the upper river system.[328] Adult returns to the Umatilla River basin also increased following establishment of larval lamprey.[329] Adults translocated above Snake River dams continued their migrations and were distributed across the upper basin at the time of spawning.[330] Results from these efforts suggest that habitats for migration, spawning, and larval lamprey still exist above impoundments and that improvements in passage success could dramatically improve lamprey distribution in the Columbia River Basin.

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322. *Id.* at attachment B-8.

323. TRIBAL PACIFIC LAMPREY RESTORATION PLAN, *supra* note 4, at 65.

324. David Ward et al., *Translocating Adult Pacific Lamprey Within the Columbia River Basin: State of the Science*, 37 FISHERIES 351, 352 (2012).

325. Peter S. Maitland et al., *Conservation of Native Lampreys*, *in* LAMPREYS: BIOLOGY, CONSERVATION & CONTROL 375, 410–11 (Margaret Docker ed., 2015); Ward et al., *supra* note 324, at 352.

326. Yun et al. *supra* note 68, at 2195.

327. Ward et al., *supra* note 324, at 352.

328. *See Lamprey on the Rise in Umatilla River; Tribes Embark on Ambitious Artificial Propagation Program*, COLUMBIA BASIN BULL. (Feb. 6, 2015), http://www.cbbulletin.com/433111.aspp.

329. *See id.*

330. McIlraith et al., *supra* note 64, at 132.

b. Passage Enhancements at Federal Dams on the Lower Columbia River

Over the last two decades, several alterations have been made to facilitate passage of Pacific lamprey through complex hydropower facilities.[331] These changes include hydraulic and structural alterations to existing fishways as well as the addition of lamprey-specific passage structures.[332] Through the passage research summarized in section II.D,[333] scientists at CRITFC, Columbia basin Tribes, NOAA, USFWS, University of Idaho, Pacific Northwest National Laboratories, and other institutions identified critical passage bottlenecks at certain facilities.[334] Bottlenecks at some fishway entrances have been addressed through alterations to nighttime attraction flows.[335] A study of that action found that reduced nighttime flows at fishway entrances increased lamprey movements into upstream sections of fishways, but found little evidence for improved overall lamprey passage efficiency.[336] Supported by experimental and observational studies, fish ladders and passage structures designed primarily for Pacific salmon are not as effective for Pacific lamprey passage.[337] While Pacific salmon are great jumpers and can pass hundreds of steps in a fish ladder, Pacific lamprey, on the other hand, are poor swimmers and use their suction capabilities to move along the walls and floors of the passage structure.[338] Enhancements such as slot openings in concrete fishway walls, attraction flows, and lamprey-specific passage structures should be implemented and studied further to increase lamprey passage success rates.

331. *See, e.g.*, M. L. Moser et al., *Development of Pacific Lamprey Fishways at a Hydropower Dam*, 18 FISHERIES MGMT. & ECOLOGY 190 (2011).

332. *Id.* at 191.

333. *Supra* Section II.D.

334. *See generally* Matthew L. Keefer et al., *Fishway Passage Bottleneck Identification and Prioritization: A Case Study of Pacific Lamprey at Bonneville Dam*, 70 CANADIAN J. FISHERIES & AQUATIC SCI. 1551 (2013).

335. Eric L. Johnson et al., *Movement of Radio-Tagged Adult Pacific Lampreys During a Large-Scale Fishway Velocity Experiment*, 141 TRANSACTIONS AM. FISHERIES SOC'Y 571, 577 (2012).

336. *Id.* at 577.

337. Matthew L. Keefer et al., *Testing Adult Pacific Lamprey Performance at Structural Challenges in Fishways*, 30 N. AM. J. FISHERIES MGMT. 376, 382 (2010).

338. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 104.

Identifying bottlenecks has also led to specific structural additions that allow lamprey to bypass problematic sections.[339] These include devices referred to as lamprey flume structures (LFS) or lamprey passage structures (LPS), which have been implemented at lower and mid-Columbia River dams as well as at smaller barriers on tributary rivers.[340] These structures often consist of aluminum ramps leading to boxes which serve as resting pools.[341] Flumes contain minimal flow and lamprey use a suck-and-burst type of movement to ascend them.[342] Moser and others found that of the lamprey that entered these experimental structures, greater than 90% were able to successfully ascend them.[343] Similarly, LPS consist of multiple flumes and rest boxes, which are designed to promote passage success rates.[344] Currently, LPS have been constructed at several federal and privately owned hydropower facilities.[345] Results from these limited-scale projects are encouraging, but significant challenges remain to improve lamprey passage at hydropower facilities.

ii. USFWS Pacific Lamprey Conservation Initiative

In 2011, the USFWS issued an "Assessment and Template for Conservation Measures" for Pacific lamprey.[346] In this document, USFWS developed a range-wide method for assessing the current status and potential trends of Pacific lamprey based on a modification of the NatureServe ranking system.[347] The assessment incorporated Hydrologic Unit Codes (HUC) to analyze specific watersheds.[348] The conservation rank system identifies the specific threat of

339. Moser et al., *supra* note 331, at 191.
340. *Id.*
341. *Id.*
342. *Id.*
343. *Id.* at 195.
344. Steve C. Corbett et al., Adult Pacific Lamprey Passage Structures: Use and Development at Bonneville Dam and John Day Dam South Fishway, 2014 at 1–2 (2015).
345. Emily Anderson & Bao Le, Pub. Util. Dist. No. 1 of Chelan Cty. Pacific Lamprey Upstream Passage Modifications Literature Review and Analysis and Recommendations for Passage Improvements in the Rocky Reach Fishway 1 (2010), http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/34952.pdf; *14-011 Prototype Passage Structure Eases Lampreys' Upstream Journey*, U.S. Army Corps of Eng'rs (Feb. 27, 2014), http://www.nww.usace.army.mil/Media/News-Releases/Article/482640/14-011-prototype-passage-structure-eases-lampreys-upstream-journey/
346. *See generally* ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30.
347. *See generally* Master et al., *supra* note 131; *see infra* Figure 3.
348. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 34–41.

lamprey extirpation at the 4th Field HUC watershed level using a variety of existing population data, trends, and potential threats to the population.[349] Where little data was available, expert opinion was used.[350] This system identified seven possible ranks for Pacific lamprey status: Presumed Extinct, Possibly Extinct, Critically Imperiled, Imperiled, Vulnerable, Apparently Secure, and Secure.[351]

USFWS also identified threat scope, threat severity, population size, and trends for individual watersheds.[352] USFWS concluded that: first, lamprey are highly threatened in all of their inland range and moderately threatened in coastal systems; second, lamprey populations are small in much of the inland range; and lastly, lamprey are rapidly declining throughout much of the range in general and most rapidly in the Upper Columbia River and Snake River basins.[353] Throughout their report, the USFWS identified passage issues, instream flow from diversions, stream and floodplain degradation, and water quality as major limiting factors in lamprey abundance across the range evaluated.[354]

D. Clean Water Act, State Water Quality Standards, and FERC Licensing

Recently, privately owned hydropower facilities have begun implementing Pacific lamprey management plans (PLMPs) pursuant to conditioned approval of their re-licensing and operating permits.[355] The nexus between the Clean Water Act (CWA) and the Federal Power Act is exemplified by FERC's re-licensing requirement that hydropower facilities must receive

349. *Id.* at 93.
350. *Id.*
351. *See infra* Figure 3.
352. ASSESSMENT AND TEMPLATE FOR CONSERVATION MEASURES, *supra* note 30, at 34–41.
353. *Id.* at 46–52.
354. *Id.* at 84, 85, 117, 119.
355. *Pacific Lamprey Management Plan*, DOUGLAS CTY. PUB. UTIL. DIST., http://www.douglaspud.org/wells-project/aquatic-settlement-agreement/pacific-lamprey-management-plan. (last visited Jan. 18, 2018) [hereinafter *Douglas County Management Plan*]. *See also* GRANT CTY. PUB. UTIL. DIST., http://www.grantpud.org/your-pud/media-room/publications/bill-inserts?task=document.viewdoc&id=1313 (last visited Jan. 18, 2018).

compliance certification from the state agency that implements the CWA.[356] In *PUD No. 1 of Jefferson County v. Washington Department of Ecology*,[357] the Supreme Court upheld the state's authority to condition 401 certification on compliance with state water quality standards.[358] Washington State includes aquatic life uses as a designated use for many portions of the state's waters.[359] In an effort to attain state water quality standards and not impair designated uses such as wildlife habitat and aquatic life uses, private dam owners such as PUDs have begun implementing conservation plans, some of which target Pacific lamprey.[360]

The purpose of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[361] In addition to regulating the discharge of pollutants into the waters of the United States, the CWA is a substantive mechanism for aquatic ecosystem conservation. The second express goal of the act is to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife."[362] The CWA is implemented through a cooperative federalism approach that "anticipates a partnership between the States and the Federal Government" to establish state water quality standards.[363]

Section 1313 of the CWA gives states the primary responsibility of establishing water quality standards.[364] A state water quality standard "shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses."[365] Furthermore, the state must take into consideration the "propagation of fish and wildlife."[366] For example, the states of Washington, Oregon, and Idaho include aquatic life,

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356. PUB. UTIL. DIST. NO. 1 OF DOUGLAS CTY, PACIFIC LAMPREY MANAGEMENT PLAN WELLS HYDROELECTRIC PROJECT FERC PROJECT NO. 2149 at 2 (Sept. 2009).

357. 511 U.S. 700 (1994).

358. *Id.* at 722.

359. WASH. ADMIN. CODE § 173-201A-200 (2017) ("It is required that all indigenous fish and nonfish aquatic species be protected in waters of the state.").

360. As evidenced by the implementation of PLMPs at the PUD owned and operated mid-Columbia River dams. *See Douglas County Management Plan*, *supra* note 355.

361. 33 U.S.C. § 1251(a) (2012).

362. § 1251(a)(2).

363. § 1251(b).

364. § 1313(a).

365. § 1313(c)(2)(A).

366. *Id.*

salmon rearing and migration, and cold water fisheries and warm water fisheries among others as designated uses for the Columbia and Snake Rivers.[367] Lamprey conservation efforts under the CWA are typically housed within the designated use of supporting aquatic life and migration.[368]

For example, Washington State includes aquatic life uses as a designated use.[369] Therefore, the projected impacts of a hydroelectric project must be consistent with, and take into account, state water quality standards, including the designated use to provide for fish migration or supporting aquatic life.

i. Pacific Lamprey Management Plans at Private Hydroelectric Facilities

Here, we examine how Pacific lamprey management plans (PLMP) are implemented at two privately owned hydroelectric projects in the mid-Columbia River. Under the Federal Power Act, the Federal Energy Regulatory Commission (FERC) has authority to issue licenses for hydroelectric facilities.[370] Hydroelectric projects cause an impoundment of navigable waters and create a discharge, which constitutes a pollutant under the CWA, thus necessitating compliance with state water quality standards.[371] In *PUD No. 1 v. Washington Department of Ecology*, the Supreme Court upheld the state's authority to condition 401 certification on compliance with state water quality standards.[372] Therefore, because a FERC license is conditioned on receipt of 401 certification, non-federal hydroelectric projects must be consistent with state water quality standards. Furthermore, because 401 certification evaluates the entire project, not just the discharge, states have wide latitude to impose conditions on their approval.[373]

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367. WASH. ADMIN. CODE § 173-201A-602 (2017).
368. *See* PUB. UTIL. DIST. NO. 1 DOUGLAS CTY., PACIFIC LAMPREY MANAGEMENT PLAN 10 (2009).
369. *See* WASH. ADMIN. CODE § 173-201A-200 (2017).
370. FERC, 18 C.F.R. § 5.1 (2017).
371. *See* PUD No. 1 of Jefferson Cty. v. Wash. Dep't of Ecology, 511 U.S. 700, 723 (1994).
372. *Id.*
373. *Id.* at 713.

For purposes of the CWA, the state of Washington divides the river into four sections, which have their own respective designated uses.[374] There are five non-federal, mid-Columbia River dams located within the same reach of the Columbia River as designated by the Department of Ecology and the Water Resource Inventory Area (WRIA).[375] These hydroelectric projects all must maintain, and not result in the degradation of, the following relevant designated uses: salmonid spawning/rearing, primary contact, wildlife habitat, harvesting, and aesthetics.[376] Accordingly, project managers, agencies, and tribes may engage in cooperative agreements to mitigate those threats to designated uses and attainment of state water quality standards.[377]

a. Priest Rapids Hydroelectric Project

The implementation of a Pacific Lamprey Management Plan (PLMP) is an express requirement within the 401 Water Quality Certificate for the Priest Rapids Hydroelectric Project.[378] The initial 2009 PLMP set forth four objectives: (1) to achieve no net impact; (2) provide safe, effective, and timely volitional passage for adult upstream and downstream migration; (3) provide safe effective, and timely volitional passage for juvenile downstream migration; and (4) avoid and mitigate project impacts on rearing habitat.[379] Additionally, the 2009 PLMP recommended installing structural passage enhancements, such as plates along the fishway, ramps, and rounding of edges within the fish ladder.[380] These recommendations were

374. WASH. ADMIN. CODE § 173-201A-602 (2017).

375. *See* WASH. DEP'T ECOLOGY, PUBL'N NO. 06-10-091, WATER QUALITY STANDARDS FOR SURFACE WATERS OF THE STATE OF WASHINGTON (2017).

376. *See* WASH. ADMIN. CODE § 173-201A-602 (2017).

377. *See* Wells Hydroelectric Project, *Aquatic Settlement Agreement* (Oct. 2008), http://www.douglaspud.org/ASA%20Documents/2009_Aquatic_Settlement_Agreement_with_signature_pages_and_MPs.pdf.

378. Letter from State of Wash. Dep't of Ecology to Tim Culbertson, Gen. Manager of Pub. Util. Dist. No. 2 of Grant Cty. (Apr. 3, 2007) (on file with Grant Cty. Pub. Util. Dist.).

379. PUB. UTIL. DIST. NO. 1 DOUGLAS CTY, *supra* note 368. (The PLMP was drafted in consultation with the members of the Priest Rapids Fish Forum, whose members include: Washington Department of Ecology, National Marine Fisheries Service, U.S. Fish & Wildlife Service, Washington Department of Fish & Wildlife, Colville Confederated Tribes, Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Wanapum Indians, the Columbia River Inter-tribal Fish Commission, and the Bureau of Indian Affairs).

380. *Id*. at 11.

actualized in 2010 and Grant PUD continues to monitor their impacts on lamprey passage and possible interactions with salmon passage rates.[381] Furthermore, condition 6.2(5)(6) of the 401 Water Quality Certificate, requires the licensee, in this case, Grant County Public Utilities District (Grant PUD), to file Annual Pacific Lamprey Management Reports.[382]

b. Wells Hydroelectric Project

Similarly, the Public Utility District No. 1 of Douglas County (Douglas PUD) issued a PLMP for the Wells Hydroelectric Project.[383] The PLMP is one of six Aquatic Resource Management Plans within the Aquatic Settlement Agreement.[384] In concert with the Wells Anadromous Fish Agreement and Habitat Conservation Plan, the resource management plans direct implementation of protection, mitigation, and enhancement measures.[385] These plans function as a Water Quality Attainment Plan pursuant to the Wells Hydroelectric Project's 401 Water Quality Certificate.[386] The Wells Hydroelectric Project PLMP puts forth three objectives: (1) identify and address any adverse project-related impacts on passage of adult Pacific Lamprey; (2) identify and address any project-related impacts on downstream passage and survival, and rearing of juvenile Pacific lamprey; and (3) participate in the development of regional Pacific lamprey conservation activities.[387]

In 2013, Douglas PUD conducted the Adult Pacific Lamprey Passage and Enumeration Study, which provided recommendations for fishway modifications.[388] These modifications

381. 2015 GRANT PUB. UTIL. DIST. PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. REP. (2016).

382. Letter from State of Wash. Dep't of Ecology, *supra* note 378, at 71–72; 2015 GRANT PUB. UTIL. DIST. PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. REP. (2016) (the 2015 comprehensive annual report provides a substantial overview of lamprey activities in the Columbia River Basin and the status of activities at the Priest Rapids facility).

383. PUB. UTIL. DIST. NO. 1 DOUGLAS CTY, *supra* note 368.

384. *Id.* at 1.

385. *Id.*

386. *Id.*

387. *Id.*

388. David Robichaud & Chas Kyger, *Adult Lamprey Passage and Enumeration Study, Wells Dam, 2013: The Effects of Head Differential on Entrance Efficiency, and of Picketed Leads on Count Window Enumeration Efficiency*, PUB. UTIL. DIST. NO. 1 DOUGLAS CTY. (Sept. 2014),

included installing enhanced lamprey entrance structures modifying the fish count stations to improve enumeration of lamprey in the fish ladder.[389] Due to construction delays, these modifications have been postponed until the 2016 lamprey passage season.[390]

While these are only two examples of how the CWA and FERC re-licensing process interacts with Pacific lamprey conservation, other hydroelectric facilities within the basin also implement lamprey-specific measures or conservation plans.[391] These efforts might be enhanced through the adoption of an adaptive management strategy to inform future actions. Although the owners and operators of these hydroelectric facilities are taking Pacific lamprey into consideration, there are no substantive requirements to meet specific passage rates under current agreements.

V. Conclusion

Effective conservation of Pacific lamprey requires an understanding of this species' population and genetic structuring, life history patterns, general ecology, and constraints on migration, dispersal, population viability, and importance among the human cultures across its range. Current research has found that Pacific lamprey have a unique life history and one that is very different from other anadromous fish such as salmon and steelhead; for example, the cues employed by lamprey to select spawning habitat probably do not result in strong philopatry—return to stream of origin—as observed in salmon.[392]

Native storytelling, passed on from generation to generation, is analogous to a library of information as a form of knowing the landscape, species interactions, policy, laws, ethics, and values. There is likeness and commonality between European language and thought and indigenous peoples' ways of knowing. At the same time, there are distinct differences. Pacific

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http://www.douglaspud.org/ASWG%20Documents/2014_09_09%20Douglas%20-%202013%20Lamprey%20Passage%20and%20Enumeration%20Study%20Report%20(Final%209-08-14).pdf.

389. *See* 2014 GRANT PUB. UTIL. DIST., PAC. LAMPREY MGMT. PLAN COMPREHENSIVE ANN. RPT. (2015).

390. *Id.* at 63.

391. *See* PUB. UTIL. DIST. NO. 1 CHELAN CTY, PACIFIC LAMPREY COMPREHENSIVE MANAGEMENT PLAN (2004); *see also* IMPROVEMENTS IMPLEMENTATION PLAN, *supra* note 31.

392. *E.g.*, Hess et al, *supra* note 119; Spice et al., *supra* note 112; Lin et al., *supra* note 113.

lamprey have persisted through treaties to settle the land, and the subsequent homogenization of those lands which led to manipulation of waterways, overharvest, and overexploitation of lamprey. Native stories tell us that as humans begin to act with honor and reverence, the land and Pacific lamprey will respond positively. Unfortunately, range-wide declines in Pacific lamprey abundance and distribution reveal that Pacific lamprey are telling us that we are not yet there.

Due to the complexity of Pacific lamprey life history and their extensive range, conservation statuses vary across jurisdictions. Notably, like salmon, Pacific lamprey are a tribal trust resource and thus the federal government has a heightened responsibility to ensure the continued existence of the species.[393] Although the species is listed as endangered by the state of Idaho and similarly identified by other states and is considered a "species of concern" by the USFWS, conservation actions predominantly stem from voluntary agreements and conservation plans.[394] While there are some positive activities happening with regard to lamprey, including some limited funding committed through the accords, it's a drop in the bucket compared to what lamprey need. Since 2008, substantial advancements in the understanding of lamprey have contributed to successful and novel restoration measures such as artificial propagation, targeted translocations from lower Columbia River dams to historic spawning grounds, and the addition of lamprey-specific passage structures at impoundments.[395] Pacific lamprey were not listed under the Endangered Species Act in 2004 because at the time the best available science was insufficient to support the identification of a "listable unit" of Pacific lamprey.[396] Since then, advancements in understanding Pacific lamprey ecology and causes of population declines support a renewed look at listing lamprey under the Endangered Species Act. These advancements also support an examination of potential federal obligations for explicit protection of the species under tribal trust responsibilities.

393. *Id.*

394. *Id.*

395. *Id.*

396. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition to List Three Species of Lampreys as Threatened or Endangered, 69 Fed. Reg. 77,158, 77,166 (Dec. 27, 2004) (codified at 50 C.F.R. pt. 17).

Tables and Figures

Figure 2-1. Buccal opening of juvenile Pacific lamprey at the onset of exogenous feeding (Courtesy of USFWS, public domain)

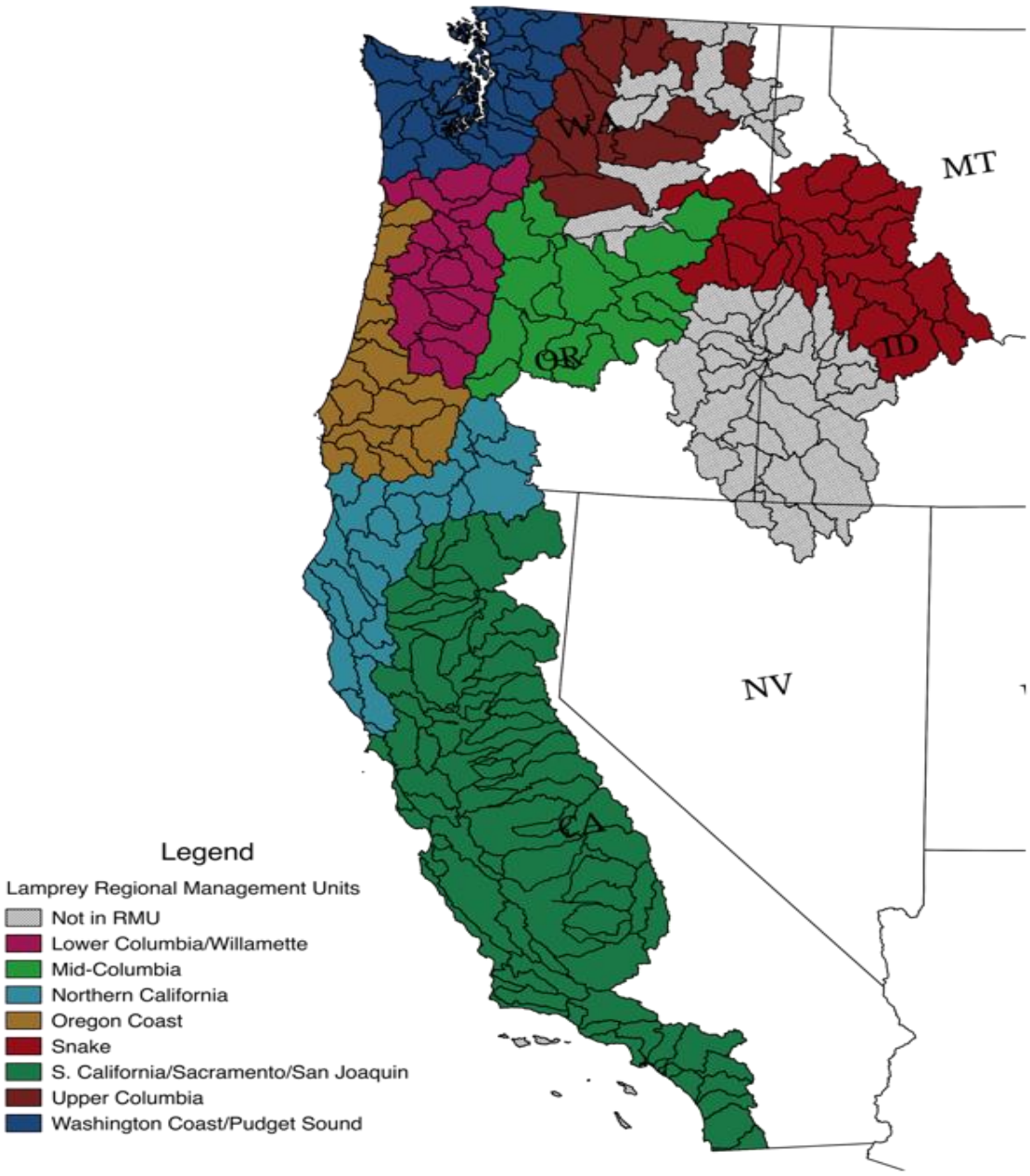

Figure 2-2. USFWS Regional Management Units

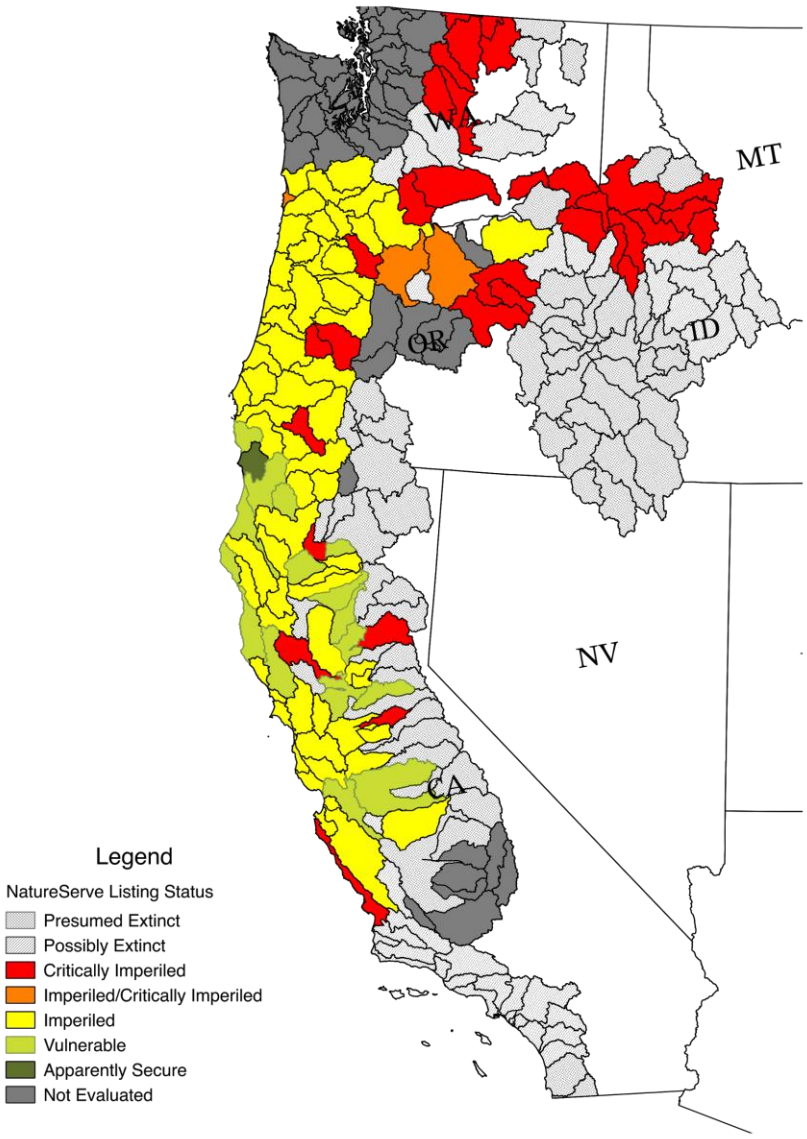

Figure 2-3.Pacific lamprey NatureServe listing status

Figure 2-4. Pacific lamprey (top) and recently transformed juveniles (below) (Courtesy of USFWS, public domain).

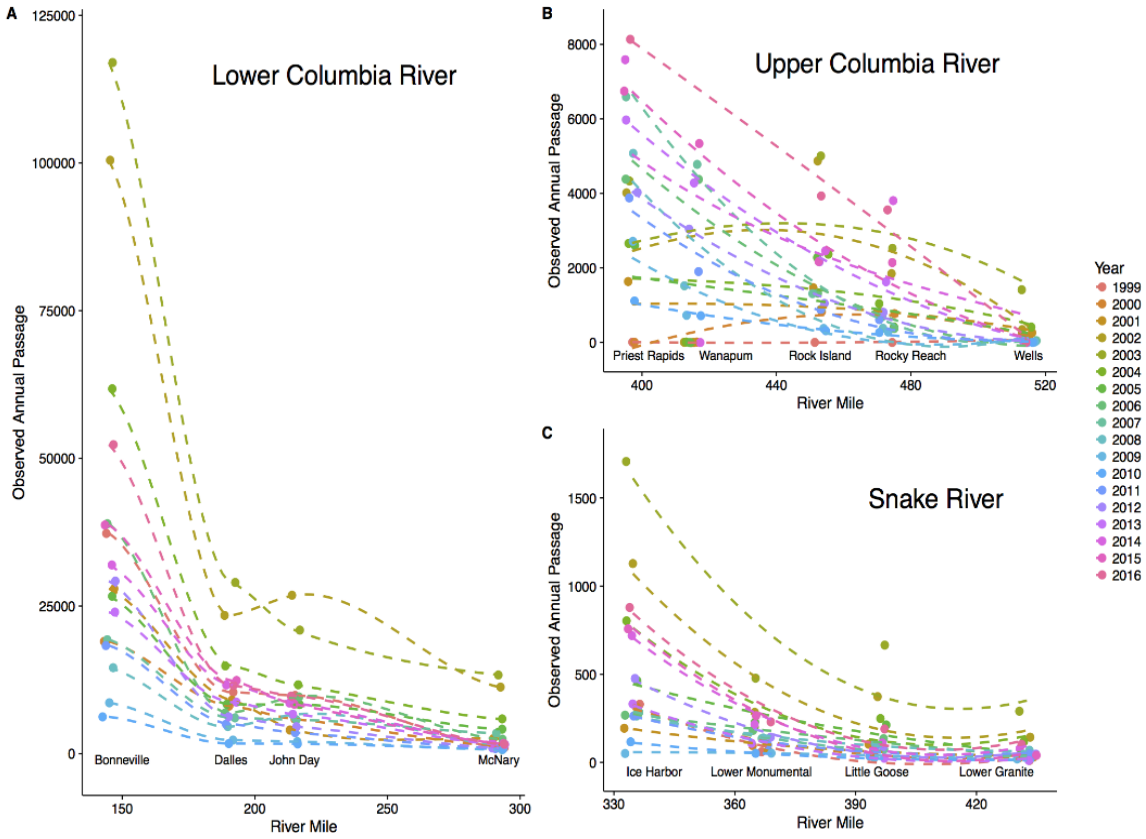

Figure 2-5. Modern annual total observations of Pacific lamprey passage at four lower Columbia River (A) dams, five dams in the upper Columbia River (B), and four dams on the lower Snake River (C) during the period 1999-2016 (points) with loess smoothing functions representing yearly upstream attrition due to spawning tributary entry, poor passage, or mortality (lines). Note that some years show more observations at upstream dams than downstream dams, suggesting limited capacity to effectively monitor lamprey passage through the Columbia River hydrosystem.

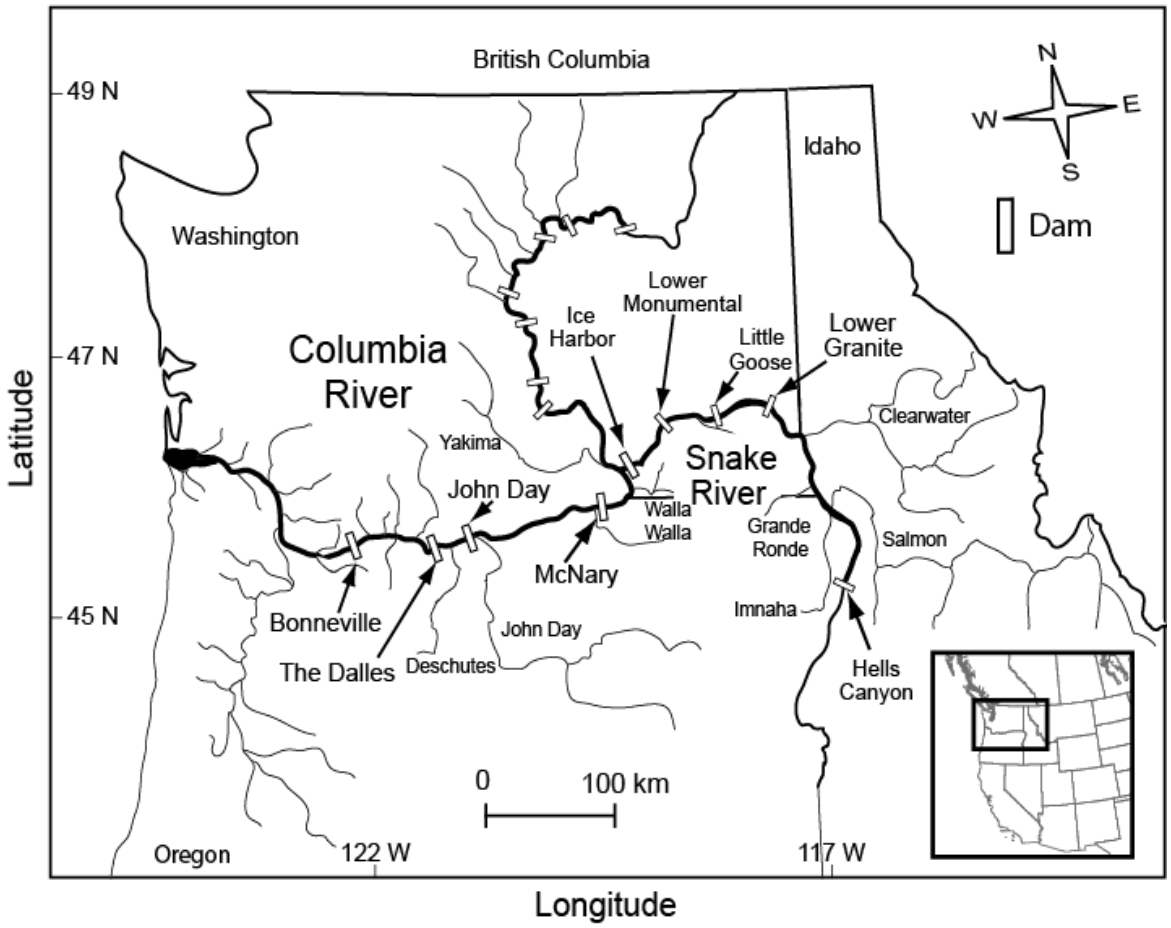

Figure 2-6. Map of Columbia River basin dams in the United States.

Country / Regulatory Entity	Conservation Status	Mechanisms for conservation actions
International		
IUCN (2013)	Unassessed	n/a
NatureServe (2013)	G4 - Apparently Secure / Moderately Vulnerable	Diagnostic tools, International Extinction Risk estimates (multi-jurisdictional)
USA		
Fish and Wildlife Service	Species of Concern	Pacific Lamprey Conservation Iniative, Endangered Species Act
Bureau of Land Management	Type 2 (rangewide/Globally imperiled)	Resource Management Plans,NEPA (Biological assessment/Environmental Impact Statement)
Forest Service	Sensitive species regions 1 &4	Resource Management Plans,NEPA, habitat restoration
Columbia River Inter-Tribal Fisheries Commission	Tribal Trust Resource	Tribal Pacific Lamprey Restoration Plan, research program and Treaty Rights
Nez Perce Tribe	Tribal trust species/resource	Treaty of 1855
Alaska Dept. of fish and Game	Species in need of conservation	None - Recommends more research to occur.
Idaho Dept. of Fish and Game	Endangered	Research, tributary passage, habitat mitigation
California Dept. of Fish and Wildlife	Species of Special concern	Harvest limit of 5 Pacific Lamprey per day
Oregon Dept. Fish and Wildlife	Sensitive -Vulnerable	Fish passage, Native fish recovery, harvest restrictions
Washington Dept. of Fish and Wildlife	State monitored (lowest level)	Species of Concern List, research, habitat restoration programs, tributary passage
Canada		
Committee on the Status of Endangered Wildlife in Canada (COSEWICK)	*High Priority Candidate Endangered Species designation (2016)*	*Species at Risk Act* (SARA)
Mexico		
Secretariat of Environment and Natural Resources (SEMARNAT)	*Threatened (2010)*	*Norma Oficial Mexicana (NOM)*
Russia		
Ministry of Natural Resources and Environment of the Russian Federation	*n/a*	Red Data Book of the Russian Federation (RDBRF)
Japan		
Ministry of the Environment	*Red List of Threatened Species:* data deficient *(Japan Integrated biodiveristy system)*	Act on Conservation of Endangered Species

Table 2-1.—Range-wide legal conservation statuses, mechanisms for conservation actions.

Chapter 3: Cultural Linguistics and Treaty Language: A Modernized Approach to Interpreting Treaty Language to Capture the Tribe's Understanding

Matsaw, S., Hedden-Nicely, D., & Cosens, B. (2020). Cultural Linguistics and Treaty Language: A Modernized Approach to Interpreting Treaty Language to Capture the Tribes Understanding. Environmental Law, 50(2), p 415-446. doi:10.2307/26939864

By

Sammy Matsaw[*], Dylan Hedden-Nicely[§], Barbara Cosens[±]

The authors acknowledge that the region surrounding the University of Idaho in Moscow, Idaho is the traditional homeland of the Nez Perce and Coeur d'Alene peoples and that the University sits upon land that was reserved by the Nez Perce Tribe in its Treaty with the United States in 1855. Honor the treaties.

Language is a reflection of a thought world. A worldview that has been shaped by place to describe one's identity in space and time does not equate to species relatedness as a default to know one another. In the legal system of the United States there is acknowledgement of treaties in colonized lands that there are rights granted from the tribes and not to them, and those rights are land-based. Yet the Indigenous voice is dead before arrival, before it enters the room of science, justice, academe or otherwise. The exclusion of Indigenous peoples at the table of knowledge and the power to make decisions within their homelands has proven a detriment to the land, waterways, flora and fauna, and human-beings. Nowhere would tribal peoples have agreed to our own destruction, it is and has been a forced hand. This article explores

[*] Father, husband and extended family member of the Shoshone-Bannock and Oglala Lakota peoples, Ph.D. Candidate, University of Idaho, Water Resources Interdisciplinary Graduate Education and Research Traineeship (IGERT) Program. The first-person voice in this article is that of Sammy Matsaw.

[§] Director Native American Law Program and Associate Professor, University of Idaho College of Law, Affiliate Water Resources Graduate Program, citizen of the Cherokee Nation of Oklahoma.

[±] University Distinguished Professor, University of Idaho College of Law, Affiliate Water Resources Graduate Program, co-PI on Water Resources IGERT Adaptation to change in water resources: science to inform decision-making across disciplines, cultures and scales

the changing interpretation of the US Supreme Court canon to construe treaties with Native American tribes as the tribe would have understood them why mere translation of Native language to English fails to capture a Native understanding. The juxtaposition of western legal analysis and the powerful voice of a Native scientist illustrates how difficult and yet how necessary it will be to bridge that divide if this powerful western nation is to fulfill its sacred promises to Native people. As a contribution to the volume on the sixtieth anniversary of US v Oregon, this article looks to the future of federal jurisprudence on the interpretation of treaties with American Indians and envisions one in which reconciliation through an understanding of different worldviews is possible.

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I. Introduction

A. The Indigenous World View

We are connected to all things. Being connected to all things runs amiss in a Euro-context. The idea goes against the discrete perspective of foundational thinking in the Western European (Western) worldview. From Descartes to Bacon to Hume to academic philosophers teaching droves of students everyday across colonized lands the world is lived in opposites, discrete, and deduced. As a consequence, the Indigenous voice is dead before arrival, before it enters the room of science, justice, academe or otherwise. It is easier to say we are disconnected from all things, that is truthful, fact and a sad statement. ‘All my relations’ is taken as a chaotic statement. The teachings are deeper than the chaos that is implied, and

would take a lifetime to live, to understand. One cannot generate tribal intent without living this way of life no matter how many pixels of categories make up the mosaic.

Language is a reflection of a thought world. A worldview that has been shaped by place to describe one's identity in space and time does not equate to species relatedness as a default to know one another. The danger of this assumption defies how different and special cultures are to one another and the distinctness of one's own culture within and across species. Also, how special a particular place in the world is that has shaped culture and language for many species in those lands. When one travels to another place there is intrigue into the new lands, culture and foods. To enter into another's thought world is exciting. Being on travel can give us pause to our homelands, to how special our place is, our language and culture.

Colonialism has been a strange traveling 'adventure' and permanent occupation. Some of the strangeness comes from the assumptions made by Euro-colonists onto Indigenous lands. One assumption, in particular, is that Indigenous peoples are a former primitive state of European man and therefore have no new knowledge to contribute. A process of dehumanization follows this assumption justifying massive undertakings such as Manifest Destiny bringing civilization to savages. The idea of travel has lost its intrigue, excitement, and adventure, thus the forced near extinction of a whole thought world, many thought worlds over the past few centuries. Quite the incentive gained in billions of acres of land, water rights into perpetuity growing bountiful amounts of food through various forms of energy in fossil fuels, hydro, wind and solar. Although there are far too many maladaptive traits accepted as the norm of colonized societies to name here and far beyond the scope of this paper. However, there is acknowledgement of treaties in colonized lands that there are rights granted from the tribes and not to them, and those rights are land-based. Nowhere would tribal peoples have agreed to our own destruction, it is and has been a forced hand.

There is a loss of cultural and ecological diversity that is laden with hubris assumptions and contradictions justifying the protection and continuation of the status quo. There are parallels between the loss of ecological processes and those processes of coupled

human cultures of Indigenous communities and their respective identities to land. Matrilineal societies give rise to an ethic of the environment that disrupts a patriarchal economic system beholden to racism, misogyny, and many other fears; xenophobia. In order to continue to plunder the land embodied as a woman, then it would logically follow the peoples whose cultures pay homage to her were to be wiped from the land. The societal move of the Christian state was Manifest Destiny while on the other hand, justifying the secular West's progress, scientists whether Lamarckian or later Darwinian believers still had underlying assumptions (a mostly obsolete theory of Social Darwinism). The exclusion of Indigenous peoples at the table of knowledge and the power to make decisions within their homelands has proven a detriment to the land, waterways, flora and fauna, and human-beings. Therefore, Indigenous peoples are not part of the over-arching responsibility of the Anthropocene, and climate change, we cannot be inclusive to human-caused issues we were never party to. The exclusion of our voice, knowledge and call to honor the treaties as supreme law of the land has gone unheard, unacknowledged and forgotten. For example, a noble commentary in Nature Climate Change by Mantyka-Pringle et al.[397] made a call to "Honouring Indigenous Treaty Rights for Climate Justice" to acknowledge the laws protecting Indigenous lands from over-exploitation. The article calls to protect the environment through the constitution of the countries where treaties and governments have a responsibility to protect the land in the interest of both parties. Another article by Armitage et al.[398] studied co-management through the co-production of knowledge and found that the struggle lies amid power inequities and barriers to success from roles of power imbalance. Although these two recent examples do not bring to light the underlying assumption explicitly therein lies a subvert influence in the relationship between European settlers and Indigenous peoples of Turtle Island (North America). Additionally, because of this assumption as a subvert influence treaties have been repeatedly broken, sovereignty has been continually diminished, Indigenous rights are being eroded daily, and languages are being lost.

[397] C. S. Mantyka-Pringle, C. N. Westman, A. P. Kythreotis and D. W. Schindler, Commentary, *Honouring indigenous treaty rights for climate justice*, 5 NATURE CLIMATE CHANGE 798–801 (August 3, 2015).

[398] Derek R Armitage, Fikret Berkes, Aaron Dale, *Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic*, 21(3) GLOBAL ENVIRONMENTAL CHANGE 995-1004 (July 2011).

B. Colonizing Language

Nowhere is the loss of Native language and meaning more apparent than when courts must interpret the legal rights reserved by American Indian tribes. For the first half of the United States' existence, and Great Britain before, the preferred method of colonizing North America was through government-to-government agreements: treaties and Congressionally ratified agreements. At their core, the bargain struck in those agreements was simple; the United States wanted Indian land and Indian people wanted to preserve their way of life. Nonetheless, courts have struggled to give meaning to these agreements. Negotiators spoke different languages, and because these agreements were always drafted in the language of the colonizer, it is far from clear that actual treaty terms matched tribal intent.[399] The stark difference in world view between colonizing and Indigenous people and the privileging of the English language combined to distort meaning in the English translation. . Invariably federal negotiators, were—at best—recording what they thought the Indians were trying to tell them, most likely what they thought was best for the Indians, and—at worst—drafting the terms to the detriment of the tribes.

In an effort to acknowledge these inequities, the United States Supreme Court has a history, beginning with its first Chief Justice—John Marshall—of articulating rules ("canons") of interpretation of treaty language and of employing those rules for the benefit of Tribes. Today, the Indian canons of construction are black letter law, requiring that

> treaties, agreements, statutes, and executive orders be liberally construed in favor of the Indians and that all ambiguities are to be resolved in their favor. In addition, treaties and agreements are to be construed as the Indians would have understood them, and tribal property rights and

[399] ALVIN M. JOSEPHY, THE NEZ PERCE INDIANS AND THE OPENING OF THE NORTHWEST 318 (Mariner Books, 1965) (Descriptions of the 1855 treaty negotiations at the Council of Walla Walla indicate that negotiations were done in trade language and often had to be interpreted through several translators to come close to the language of a particular Native language group represented at the Council.)

> sovereignty are preserved unless Congress's intent to the contrary is clear and unambiguous.[400]

The Court has rarely deviated from these rules, most often during periods where the Court had justices taking a broad and protective view of states' rights in the United States system of federalism. Most notable of late is the Rehnquist-Roberts Courts, both of which have adopted a "new subjectivism in Indian law" whereby the Court "began to depart from [its] traditional standard, abandoning entrenched principles of Indian law in favor of an approach that bends tribal sovereignty to fit the Court's perceptions of non-Indian interests."[401] While some viewed the direction of the Rehnquist -Roberts Courts away from tribal sovereignty and toward state jurisdiction as a sign of things to come, recent rulings—most notably *Herrera v. Wyoming*—suggests a renewed understanding on the Court of the basis and importance of the canons of construction and the need for federal mediation of state interference with tribal sovereignty.

However, the Supreme Court's directive that treaties are to be "construed as the Indians would have understood them," simply begs the questions of how tribal people understood—and understand—their treaties. Judges today invariably share the same biases and cultural misunderstandings of the federal negotiators of yesteryear. The purpose of this work is to begin bridging that gap so that courts may finally be able to give meaning to the Supreme Court's canon of construction. To begin that dialogue, this article explores the canon of construction requiring that treaty language be interpreted as the relevant tribe would have understood it. Part II traces the judicial source and reasoning for the canon, then discuss the sources of evidence courts have relied on in the decisions on tribal hunting and fishing rights in the Pacific Northwest. Part III analyzes the role of culture in the meaning of language and its manifestation in the relation between traditional knowledge ("TK") and Native language referencing place and the use of natural resources to shed light on what it means to interpret treaty language as the tribe would have understood it. Part IV concludes with thoughts on how courts may incorporate this more complex understanding of the

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[400] FELIX COHEN, COHEN'S HANDBOOK OF FEDERAL INDIAN LAW 2.02 (2012)

[401] David H. Getches, *Conquering the Cultural Frontier: The New Subjectivism of the Supreme Court in Indian Law*, 84 CAL. L. REV. 1573, 1574 (1996)

meaning of Indigenous language in its interpretation of treaties as the tribes would have understood them. Throughout we juxtapose the first person narrative of our lead author, Native scientist Sammy Matsaw with the western legal analysis of his co-authors as a stark reminder of the divide between the two world views.

II. The history, justifications, and evolution of the canons of construction

The first Chief Justice of the United States Supreme Court, John Marshall, authored three opinions that would become known as the foundations of United States Federal Indian Law and are referred to as "the Marshall trilogy."[402] The first – Johnson v M'Intosh[403] -- although primarily known (and criticized) for the "Discovery Doctrine" justifying acquisition of land through conquest, is of importance to the issues surrounding treaties in its conclusion that only the federal government (as opposed to private citizens) may acquire land from an Indian tribe.[404] The second -- Cherokee Nation v. Georgia[405] -- although a case that was dismissed for lack of jurisdiction, would become known for its articulation in dicta of the trustee relationship between the federal government and Indian tribes stating: [Indian tribes] may, more correctly, perhaps, be denominated domestic dependent nations. . . . Their relation to the United States resembles that of a ward to his guardian."[406] The third -- Worcester v. Georgia[407] -- is the source of the concept that treaty language must be interpreted as the Tribe would have understood it. The majority opinion does not articulate the canon, but applies the concept in finding that the Cherokee Nation retained its sovereignty visa vie Georgia and that the laws of Georgia do not apply. In writing for the majority, Justice Marshall states that:

> Not well acquainted with the exact meaning of words, nor supposing it to be material whether they were called the subjects, or the children of their father in Europe; lavish in professions of

[402] Cohen supra n. 4 at

[403] Johnson v M'Intosh, 21 U.S. (8 Wheat.) 543 (1823)

[404] Johnson v M'Intosh, 21 U.S. (8 Wheat.) at 592 "The absolute ultimate title has been considered as acquired by discovery, subject only to the Indian title of occupancy, which title the discoverers possessed the exclusive right of acquiring."

[405] Cherokee Nation v. Georgia, 30 U.S. 1 (1831)

[406] Cherokee Nation v. Georgia, 30 U.S. at 13.

[407] Worcester v. Georgia, 31 U.S. 515 (1832)

> duty and affection, in return for the rich presents they received; so long as their actual independence was untouched, and their right to self government acknowledged, they were willing to profess dependence on the power which furnished supplies of which they were in absolute need, and restrained dangerous intruders from entering their country: and this was probably the sense in which the term was understood by them.[408]

It is in the concurrence by Justice McLean that the actual canon is found:

> The language used in treaties with the Indians should never be construed to their prejudice. If words be made use of which are susceptible of a more extended meaning than their plain import, as connected with the tenor of the treaty, they should be considered as used only in the latter sense. . . . How the words of the treaty were understood by this unlettered people, rather than their critical meaning, should form the rule of construction.[409]

Over time, the manner in which the Court applies this canon of construction gave rise to a variety of justifications for its use. The practice in international law of interpreting ambiguity against the party whose language the agreement is drafted in, provides a legal basis for the canon,[410] as well as providing an explanation for why tribal intent is not considered if the court deems the language unambiguous.[411] However, cases indicate a more normative basis for the canons of construction that are unique to the relationship between the United States and Indian tribes.

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[408] Worcester v. Georgia, 31 U.S. at 546-547.

[409] Worcester v. Georgia, 31 U.S. concurrence of Justice McLean at 582.

[410] Richard B. Collins, *Indian Consent to American Government*, 31 Ariz. L. Rev. 365, 379 (1989) ("Treaty interpretation in international law seeks to give effect to the parties' intent. When the treaty memorial is in the language of one party, at best imperfectly understood by the other, it is well established that the other party's understanding should define the scope of interpretation.")

[411] Philip P. Frickey, *Congressional Intent, Practical Reasoning, and the Dynamic Nature of Federal Indian Law*, 78 Calif. L. Rev. 1137, 1141 (1990).

First, while relying on the differences between English (the written language of the treaties) and the various tribal languages, courts have gone to great lengths to describe the multiple steps in translation to get from English to the language of a particular band of Indians,[412] and the frequent use of "trade" language for translation[413] – a language best suited to cost negotiation as opposed to homeland designation and reservation of rights. This practice stands in stark contrast to the recording of the Treaty of Waitangi between the British and the Maori people of New Zealand in both English and Maori language,[414] and recognizes the greater disadvantage to people without a written language and without translators familiar with the variety of native languages represented in negotiations.

Second, the United States Supreme Court has gone beyond the recognition of a mere language barrier to refer to the "superior power" of the federal government in negotiation with an "unlettered people."[415] Thus, while the canon may appear to be about translation issues, these references suggest the Court considers it further evidence of unequal bargaining power.[416] Scholars have considered this basis as an aspect of the trust doctrine in recognizing the need to protect tribes from the overreach of state government and settlers.[417]

Third, and possibly most importantly, the United States Supreme Court has indicated that the canon is necessary if we are to assume good faith on the part of the federal negotiator (and by implication, allow the Court to uphold the validity of the treaties).[418] The strongest

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[412] US v Washington, 384 F.Supp. 312, 356 (US Dist Ct WD WA 1974) [Boldt Decision]

[413] Boldt Decision, 384 F.Supp. at 356.

[414] The Treaty of Waitangi (1840). Treaty text in both languages can be found at https://www.waitangitribunal.govt.nz/treaty-of-waitangi/

[415] See e.g. language quoted from Worcester v. Georgia, 31 U.S. concurrence of Justice McLean, note 13 at 582, U.S. v. Winans, 198 U.S. 371 at 380 (1905) quoting Choctaw Nation v. United States, 119 U.S. 1, 30 (1886).

[416] Jill De La Hunt, *The Canons of Indian Treaty and Statutory Construction: A Proposal for Codification*, 17 U. Mich. J.L. Reform 681 at 681 (1984)

[417] Jill De La Hunt, *The Canons of Indian Treaty and Statutory Construction: A Proposal for Codification*, 17 U. Mich. J.L. Reform 681 at 681 and 689 (1984); Philip P. Frickey, *Congressional Intent, Practical Reasoning, and the Dynamic Nature of Federal Indian Law*, 78 Calif. L. Rev. 1137, at 1177 (1990). David M. Blurton, *Canons of Construction, Stare Decisis and Dependent Indian Communities: A Test of Judicial Integrity*, 16 Alaska L. Rev. 37 at 44 (1999). The trust doctrine as justification for the canons of construction is considered particularly relevant in their extension to statutes. This article will not address that extension which does not include the canon to interpret as the Indians would have understood the language. Blurton at 43.

[418] Jill De La Hunt, *The Canons of Indian Treaty and Statutory Construction: A Proposal for Codification*, 17 U. Mich. J.L. Reform 681, at 689 (1984); Philip P. Frickey, *Congressional Intent, Practical Reasoning, and the Dynamic Nature of Federal Indian Law*, 78 Calif. L. Rev. 1137, at 1177 (1990).

statement of this occurs in Winters v United States in which Justice McKenna writing for the majority states:

> The Indians had command of the lands and the waters--command of all their beneficial use, whether kept for hunting, "and grazing roving herds of stock," or turned to agriculture and the arts of civilization. Did they give up all this? Did they reduce the area of their occupation and give up the waters which made it valuable or adequate? . . . If it were possible to believe affirmative answers, we might also believe that *the Indians were awed by the power of the Government or deceived by its negotiators. Neither view is possible.* The Government is asserting the rights of the Indians. But extremes need not be taken into account. By a rule of interpretation of agreements and treaties with the Indians, ambiguities occurring will be resolved from the standpoint of the Indians.[419]

Scholars relate this basis to the discomfort of the Court with the absence of consent on the part of Indian tribes to the assertion of the plenary power of Congress over their rights.[420] Professor Frickey notes the inconsistency of plenary power with the concept of democracy stating:

> Even minimal reflection upon the tension between colonization and American constitutionalism should uncover the foundational

[419] Winters v United States, 207 U.S. 564 at 576 (1908) (emphasis added).

[420] Richard B. Collins, *Indian Consent to American Government*, 31 Ariz. L. Rev. 365 at 379 (1989); Philip P. Frickey, *Congressional Intent, Practical Reasoning, and the Dynamic Nature of Federal Indian Law*, 78 Calif. L. Rev. 1137 at 1141 (1990) (noting that: "The extent to which the canons actually soften the impact of the doctrine is subject to debate."); Philip P. Frickey (1993) *Marshalling Past and Present: Colonialism, Constitutionalism, and Interpretation in Federal Indian Law*, 107(2) Harvard Law Review 381 at 383; Scott C. Hall, *The Indian Law Canons of Construction v. The Chevron Doctrine: Congressional Intent and the Unambiguous Answer to the Ambiguous Problem*, 37 Conn. L. Rev. 495 at 516 (2004) (noting that: "While Justice Marshall accepted the discovery of America as a "conquest" that gave legal rights to the colonizers, Marshall invoked the Indian law canons to safeguard against inadvertent loss of Indian sovereignty. Marshall thus tempered U.S. power with responsibility, creating a kind of 'conqueror with a conscience'" (citation omitted).

> place federal Indian law occupies in public law. A country that prides itself on following the rule of law, the justifications for colonization uttered by those European explorers and recognized by the Supreme Court itself - to impose Christianity upon the heathen, to make more productive use of natural resources, and so on" - do not go down easily in the late-twentieth century.[421]

This appeal to higher principles should not mask the fact that the Court, lower federal courts, and state courts have been uneven in their application of the canons of construction for Indian treaties. While some of the variation has been explained by the substance of the specific litigation with courts more likely to rely on the canons in reference to traditional practices such as hunting and fishing, but to avoid them in jurisdictional battles that would limit state sovereignty[422] or the civil rights of non-Indians within the boundaries of a reservation.[423] But these lines do not always explain the variation. Sadly, some of the variation appears related to the political views of the authoring justice on the role of federalism.

One stark example of this is the Court's jurisprudence during the allotment-assimilation era from the 1880s through the early twentieth century. Following the assimilationist policies of the federal executive and legislative branches, the Supreme Court oscillated between opinions recognizing and abrogating tribal sovereignty during this period.[424] Often leading the assimilationist effort of the Court during this era was Justice Edward White,[425] who has the dubious distinction of having written the majority opinion in

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[421] Philip P. Frickey (1993) *Marshalling Past and Present: Colonialism, Constitutionalism, and Interpretation in Federal Indian Law*, 107(2) Harvard Law Review 381 at 383.

[422] Samuel E. Ennis, *Implicit Divestiture and the Supreme Court's (Re)Construction of the Indian Canons*, 35 Vt. L. Rev. 623 at 653 (2011).

[423] Philip P. Frickey, *Congressional Intent, Practical Reasoning, and the Dynamic Nature of Federal Indian Law*, 78 Calif. L. Rev. 1137 at 1200 (1990)

[424] *Compare*, United States v. Winans, 198 U.S. 371 (1905) *with* Lone Wolf v. Hitchcock, 187 U.S. 553 (1903).

[425] Prior to service on the United States Supreme Court, Justice Edward White had fought for the Confederacy. The Supreme Court Historical Society, History of the Court: Edward Douglass White, 1910-1921, URL: http://supremecourthistory.org/timeline_edwhite.html. He and his father (a plantation owner and Governor of Louisiana) believed strongly in state's rights. The Editors of Encyclopedia Britannica (updated 2019), Edward Douglass White, URL: https://www.britannica.com/biography/Edward-Douglass-White; Steven E. Silvern,

both *Ward v. Race Horse*,[426] as well as *Lone Wolf v. Hitchcock*.[427] These opinions are infamous for turning their back on the principles laid out in the Marshall Trilogy and instead basing their holdings on the assimilationist and colonialist rhetoric that prevailed in that day. For example, Justice White based his holding in *Lone Wolf* that Congress may unilaterally abrogate treaties it had entered into with American Indian Tribes on his view that "[t]hey are communities *dependent* on the United States. Dependent largely for their daily food. Dependent for their political rights."[428]

Previously, in 1896, Justice White found that Congress had extinguished the off-reservation hunting rights of the Shoshone-Bannock Tribes on the entry of Wyoming to the Union.[429] Many western states were admitted to the Union through Congressional acts that expressly disclaimed any right of the fledgling state to control Indian lands or affairs.[430] However, the Wyoming Organic Act did not contain any language related to Indian tribes.[431] That silence created an ambiguity in the mind of Justice White, who was tasked with determining whether Congress intended the rights guaranteed to the Shoshone-Bannock by treaty in 1868 survived Wyoming statehood just twelve years later in 1890. Ignoring the canons that should have controlled, Justice White instead found that survival of those hunting rights

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Scales of justice: law, American Indian treaty rights and the political construction of scale, 18 Political Geography 639 at 648 (1999) (noting in reference to Race Horse, infra note 30: "Both federal and state courts gave legal legitimacy to these scalar perceptions and interpretations of the prominence of state rights, the elimination of Indian political autonomy and the termination of Indian treaty rights.).

[426] 163 U.S. 504 at 509 (1896)

[427] *Lone Wolf*, 187 U.S. at 553. Justice White also joined the majority opinion in Plessy v Ferguson, a landmark case challenging and upholding a Louisiana law compelling segregation on railway cars. Plessy v Ferguson, 163 U.S. 537 (1896). Not until 1954 was this reasoning and Plessy resoundingly rejected in Brown v Board of Education, holding that: "in the field of public education the doctrine of 'separate but equal' has no place. Separate educational facilities are inherently unequal." Brown v Board of Education, 347 U.S. 483 at 495 (1954).

[428] *Id.* at 567 (emphasis in original).

[429] Ward v. Race Horse, 163 U.S. 504 at 509 (1896)

[430] *See generally*, David E. Wilkins, *Tribal-State Affairs: American States as 'Disclaiming' Sovereigns*, 28:4 PUBLIUS: THE JOURNAL OF FEDERALISM 55(1998)

[431] *Id.* at 68. Professor David Wilkins suggests that Congress did not include a disclaimer because Wyoming's "territorial governments launched statehood and proposed constitutions that were largely in compliance with federal policies," including a disclaimer in the Wyoming Constitution that mirrors those found in the enabling acts of other states. *Id.*

> would . . . render necessary the assumption that congress [sic], while preparing the way, by the treaty, for new settlements and new states, yet created a provision, not only detrimental to their future well-being, but also irreconcilably in conflict with the powers of the states already existing.[432]

In so doing, Justice White not only ignored the rule that ambiguities are to be resolved in favor of tribal rights but found that those rights could be *implicitly* abrogated in favor of the rights of newly created states.

The Supreme Court's brief but damaging turn away from the entire body of Indian law—including the canons—ended shortly after the Court's decision in *Lone Wolf*. This is not necessarily because the Court had a change of heart but because it largely stopped taking Indian law cases.[433] By this time, tribal sovereignty had reached its nadir while federal control over Indian affairs, tribes, and people had reached its zenith. This was the era where Indian agents were described as "reservation Czars"[434] and the President would appoint individual tribal members as "chief for a day," just long enough to sign whatever legal documents were put in front of them.[435]

Things began to slowly change by the 1920s. First came the Meriam Report, which precipitated the Indian Reorganization Act.[436] Then, after World War II, wherein American Indians served at higher per-capita rates than any other group,[437] Indian Country was

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[432] Ward v. Race Horse, 163 U.S. 504 at 509 (1896)

[433] The Court decided approximately twelve cases involving Indian tribes between 1903 and 1958. See, Ex parte Joins, 191 U.S. 93 (1903); Winters v. United States, 207 U.S. 564 (1908); United States v. Sandoval, 231 U.S. 28 (1913); United States v. Nice, 241 U.S. 591 (1916); United States v. Ramsey (1926), 271 U.S. 467 (1926); Carpenter v. Shaw, 280 U.S. 363 (1930); United States v. Creek Nation, 295 U.S. 103 (1935); United States v. Shoshone Tribe of Indians, 304 U.S. 111 (1938); Tulee v. Washington, 315 U.S. 681 (1942); Seminole Nation v. United States, 316 U.S. 286 (1942); Oklahoma Tax Commission v. United States, 319 U.S. 598 (1943); Arenas v. United States, 322 U.S. 419 (1944).

[434] DAVID H. GETCHES, et al., CASES AND MATERIALS ON FEDERAL INDIAN LAW 221 (7th ed. 2017)

[435] ROBERT J. CONLEY, CHEROKEE THOUGHTS: HONEST & UNCENSORED 43 (2008).

[436] LEWIS MERIAM, THE PROBLEM OF INDIAN ADMINISTRATION (1928); 25 U.S.C. § 5101, *et sec.*

[437] THOMAS D. MORGAN, NATIVE AMERICANS IN WORLD WAR II 22 (1995)

galvanized by the coming of the federal termination policy.[438] The result was a concerted effort by tribal people to have their rights and sovereignty reaffirmed by the United States Supreme Court.[439]

That effort culminated with the Supreme Court returning to its roots in 1959 with its unanimous decision in *Williams v. Lee*.[440] There, in a case about whether a state court may assume jurisdiction over an on-reservation contract dispute between an Indian and a non-Indian, the Court reaffirmed *Worcester v. Georgia*, calling it "one of [Chief Justice John Marshall's] most courageous and eloquent decisions."[441] Although the Court acknowledged that "[o]ver the years this Court has modified these principles in cases where essential tribal relations were not involved and where the rights of Indians would not be jeopardized, but the basic policy of Worcester has remained."[442] And with that, the Court ushered in what has been referred to as the "modern era" of federal Indian law,[443] by returning to first principles and reaffirming tribal sovereignty; "the broad principles of [*Worcester v. Georgia*] came to be accepted as law."[444]

The modern era came to an abrupt end with the appointment of William Rehnquist to replace Warren Earl Burger as Chief Justice of the Supreme Court. Dean David Getches marks this point as the adoption by the Court of a "new subjectivism in Indian law" whereby the Court "began to depart from [its] traditional standard, abandoning entrenched principles of Indian law in favor of an approach that bends tribal sovereignty to fit the Court's perceptions of non-Indian interests."[445] The cornerstone of Justice Rehnquist's "subjectivist" approach

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[438] *See*, DAVID H. GETCHES, et al., *supra* note 5, at 247

[439] *See generally*, CHARLES F. WILKINSON, BLOOD STRUGGLE: THE RISE OF MODERN INDIAN NATIONS 57-112 (2005). *See also*, VINE DELORIA JR., CUSTER DIED FOR YOUR SINS 54-77 (1988)

[440] Williams v. Lee, 358 U.S. 217 (1959).

[441] *Id.* at 219.

[442] *Id.*

[443] *See*, CHARLES F. WILKINSON, AMERICAN INDIANS, TIME, AND THE LAW 1 (1987). *See also*, Getches, *supra* note, at 1574, n. 3 .

[444] Williams v. Lee, 358 U.S. 217, 219 (1959).

[445] Getches, *supra* note, at 1574

was to "[r]etreat from the established canons of construction," by simply "dismiss[ing] the canons by declaring that no true ambiguity exists."[446]

The Court's recent decision in *Herrera v. Wyoming* however, provides a glimmer of hope.[447] Clayvin Herrera is a member of the Crow Tribe, a nation that has long inhabited the central portion of what is today called Montana and Wyoming.[448] Among other treaties, the Crows entered into the 1868 Treaty of Fort Laramie, wherein it ceded over 30 million acres to the United States and promised it would make "no permanent settlement" outside of the Crow Reservation.[449] No payment was made for this land by the United States. Instead, the United States agreed to provide a few buildings, clothing, and implements and other goods necessary for agriculture.[450] Additionally, the United States agreed that

> The Indians . . . shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and as long as peace subsists among whites and Indians on the borders of the hunting districts.[451]

This promise would not last thirty years before it was partially abrogated by the United States Supreme Court in *Ward v. Race Horse*.[452] There, the Court was interpreting the 1868 Treaty of Fort Bridger between the United States and the Shoshone-Bannock Tribes, which contained language identical to Article IV of the 1868 Treaty of Fort Laramie. In a decision that was entirely contrary to traditional principles of federal Indian law, it concluded that Congress had implicitly abrogated Article IV by admitting the State of Wyoming into the Union "on equal terms with the other states . . . ."[453] The Court's reasoning was two-fold. First, it found that because Article IV contained conditions whereby the treaty right would be

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[446] *Id.* at 1620-22. *See also*, Ralph W. Johnson & Berrie Martinis, *Chief Justice Rehnquist and the Indian Cases* 16 PUB. LAND L. REV. 1, 18 (1995) (noting that under Rehnquist the Court often "interpreted what seems an ambiguous statute against Indian interests.").

[447] Herrera v. Wyoming, 139 S.Ct. 1686, 1686 (2019)

[448] *Id.* at 1692

[449] *Id.* ; Art. II, 15 Stat. 650.

[450] *Id.* at 1692-93

[451] *Id.* at 1693 (quoting Art. IV, 15 Stat. 650).

[452] Ward v. Race Horse, 163 U.S. 504 (1896)

[453] *Id.* at 514

reduced or lost, the right was not permanent but "essentially perishable" and "temporary and precarious."[454] Second, the Court applied the equal footing doctrine and reasoned that if the treaty right of the Shoshone-Bannocks continued after statehood, "Wyoming, then, will have been admitted into the Union, not as an equal member, but as one short of a legislative power vested in all the other states of the Union . . . ."[455] The Supreme Court's reasoning in *Race Horse* abrogating the Shoshone-Bannock's off-reservation hunting right in Wyoming was subsequently extended to the Crow Tribe's off-reservation hunting rights by the Tenth Circuit in the 1995 case *Crow Tribe v. Repsis*.[456]

The Supreme Court's 1999 decision in *Minnesota v. Mille Lacs Band of Chippewa Indians*, however, breathed new life into the Crow Tribe's off-reservation hunting rights.[457] At issue there was whether a number of bands of Chippewa continued to have usufructuary rights in lands ceded by the Tribe in 1837.[458] The State of Minnesota argued that "the Indians lost these rights through an Executive Order in 1850, an 1855 Treaty, and the admission of Minnesota into the Union in 1858."[459] In a decision remarkable for its deviation from the Rehnquist Court's typical "subjectivist approach" to Indian law cases,[460] Justice O'Connor found that none of these events abrogated the Tribe's usufructuary rights.

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[454] *Id.* at 515

[455] *Id.* at 514

[456] Crow Tribe of Indians v. Repsis, 73 F.3d 982 (1995)

[457] Minnesota v. Mille Lacs Band of Chippewa Indians, 526 U.S. 172 (1999)

[458] *Id.* at 176

[459] *Id.*

[460] The decision is noteworthy in particular for its treatment of the 1855 Treaty. That treaty included a sweeping cession:

> The Mississippi, Pillager, and Lake Winnibigoshish bands of Chippewa Indians hereby cede, sell, and convey to the United States all their right, title, and interest in, and to, the lands now owned and claimed by them, in the Territory of Minnesota, and included within the following boundaries, viz: [describing territorial boundaries]. And the said Indians do further fully and entirely relinquish and convey to the United States, any and all right, title, and interest, of whatsoever nature the same may be, which they may now have in, and to any other lands in the Territory of Minnesota or elsewhere.

See, id. at 184 That cession included the lands where the Tribe's usufructuary rights had been reserved in 1837. The State of Minnesota argued that this was unambiguous language of cession. The Court, however, found that

> [t]his sentence, however, does not mention the 1837 Treaty, and it does not mention hunting, fishing, and gathering rights. The entire 1855 Treaty, in

Important for our purposes, *Mille Lacs* systematically deconstructed the twin-pillars of the *Race Horse* decision.[461] First, the Court dismissed the notion that treaty rights can be "temporary and precarious," finding that such an approach is "too broad to be useful."[462] Second, the Court "entirely rejected the 'equal footing' reasoning applied in *Race Horse*."[463] *Race Horse*'s equal footing analysis was premised on the notion that tribal usufructuary rights cannot be reconciled with state sovereignty and therefore, newly admitted states should not be burdened with treaty rights that do not exist in the original states.[464] The *Mille Lacs* Court found this to be a "false premise."[465] Pointing to a bevy of cases decided subsequent to *Race Horse*,[466] the Court concluded

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> fact, is devoid of any language expressly mentioning—much less abrogating—usufructuary rights.

Id. at 195. As a backstop to this, the Court went on to note

> to determine whether this language abrogates Chippewa Treaty rights, we look beyond the written words to the larger context that frames the Treaty, including "the history of the treaty, the negotiations, and the practical construction adopted by the parties."

Id. at 196 (quoting Choctaw Nation v. United States, 318 U.S. 423 (1943)). The Court then analyzed the language of the Act authorizing the 1855 Treaty negotiations, the negotiation instructions, and the negotiation transcript to determine whether either the United States or the Tribe understood the Treaty to include a cession of off-reservation usufructuary rights. *See, id.* at 197-99 Ultimately, the Court concluded

> the historical record provides no support for the theory that the second sentence of Article 1 was designed to abrogate the usufructuary privileges guaranteed under the 1837 Treaty, but it does support the theory that the Treaty, and Article 1 in particular, was designed to transfer Chippewa land to the United States. At the very least, the historical record refutes the State's assertion that the 1855 Treaty "unambiguously" abrogated the 1837 hunting, fishing, and gathering privileges. Given this plausible ambiguity, we cannot agree with the State that the 1855 Treaty abrogated Chippewa usufructuary rights. *Id.* at 200

[461] *See*, *id.* at 203-08
[462] *Id.* at 206
[463] Herrera v. Wyoming, 139 S.Ct. at 1693
[464] *See*, Ward v. Race Horce, 163 U.S. at 514
[465] *Mille Lacs*, 526 U.S. at 204
[466] Washington v. Washington State Commercial Passenger Fishing Vessel Assn., 443 U.S. 658 (1979); Antoine v. Washington, 420 U.S. 194 (1975); Missouri v. Holland, 252 U.S. 416 (1920); Kleppe v. New Mexico, 426 U.S. 529 (1976); United States v. Winans, 198 U.S., at 382–384; United States v. Forty–Three Gallons of Whiskey, 93 U.S. 188 (1876); Menominee Tribe of Indians v. United States, 391 U.S. 404 (1968)

> an Indian tribe's treaty rights to hunt, fish, and gather on state land are not irreconcilable with a State's sovereignty over the natural resources of the State. Rather, Indian treaty rights can coexist with state management of natural resources. Although States have important interests in regulating wildlife and natural resources within their borders, this authority is shared with the Federal Government when the Federal Government exercises one of its enumerated constitutional powers, such as treaty making.[467]

Rather than adopt the misguided analysis from *Race Horse*, the Court refocused on the proper analysis based upon foundation principles.[468] It

> drew on numerous decisions issued since *Race Horse* to explain that Congress "must clearly express" any intent to abrogate Indian treaty rights. The Court found no such "'clear evidence'" in the Act admitting Minnesota to the Union, which was "silent" with regard to Indian treaty rights."[469]

That is how things stood until Clavin Herrera followed a herd of elk across the boundary of the Crow Reservation into Wyoming's Big Horn National Forest.[470] He was charged by the State of Wyoming with taking elk out-of-season and without a state license.[471] Herrera attempted to base his defense at trial on Article IV of the 1868 Treaty of Fort Laramie.[472] However, the trial court prohibited him from making a treaty-based defense and he was convicted.[473] Herrera raised the same defense on appeal, but the Wyoming state

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[467] *Mille Lacs*, 526 U.S. at 204

[468] *Id.* at 202

[469] Herrera v. Wyoming, 139 S.Ct. at 1696 (discussing *Mille Lacs*, 526 U.S. at 202-03) (citing United States v. Dion, 476 U.S. 734, 738-40 (1986); *Passenger Fishing Vessel*, 443 U.S. at 690; *Menominee*, 391 U.S. at 413)

[470] Herrera v. Wyoming, 139 S.Ct. at 1695 (discussing *Mille Lacs*, 526 U.S. at 204).

[471] Herrera v. Wyoming, 139 S.Ct. at 1693

[472] *Id.*

[473] *Id.*

appellate court found that *Mille Lacs* had not entirely repudiated *Race Horse* and that Mr. Herrera was precluded from raising a treaty-based defense after the Crow lost the same argument in *Repsis*.[474]

The Supreme Court made short work of these arguments.[475] First, after reaffirming the analysis from *Mille Lacs*, the Court clarified that

> [w]e thus formalize what is evident in *Mille Lacs* itself. While *Race Horse* "was not expressly overruled" in *Mille Lacs* "it must be regarded as retaining no vitality" after that decision. To avoid any future confusion, we make clear today that *Race Horse* is repudiated to the extent it held that treaty rights can be impliedly extinguished at statehood.[476]

The Court's repudiation of *Race Horse* fed directly into whether Mr. Herrera was precluded from making his treaty-based defense. The Court began by acknowledging that "[u]nder the doctrine of issue preclusion 'a prior judgment . . . foreclose[es] successive litigation of an issue of fact or law actually litigated and resolved in a [previous case] . . . .'"[477] However, an important exception exists where "there has been an intervening 'change in [the] applicable legal context.'"[478] Looking to its treatment of *Race Horse*, the Court concluded that "this is not a marginal case. At a minimum, a repudiated decision does not retain preclusive force."[479] As a result, the Court moved on to the merits of Mr. Herrera's treaty-based defense.

On the merits, the Court refocused the inquiry onto foundation principles:

> [i]f Congress seeks to abrogate treaty rights, "it must clearly express its intent to do so." There must be "clear evidence that

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[474] *Id.*
[475] *Id.* at 1694
[476] *Id.* at 1697 (quoting Limbach v. Hooven & Allison Co., 466 U.S. 353, 361 (1984)).
[477] *Id.* (quoting New Hampshire v. Maine, 532 U.S. 742, 748-749 (2001)).
[478] *Id.* (quoting Bobby v. Bies, 556 U.S., 825, 834 (2009)).
[479] *Id.* at 1698

> Congress actually considered the conflict between its intended action on the one hand and Indian treaty rights on the other, and chose to resolve that conflict by abrogating the treaty."[480]

The Court looked to three places to determine whether the requisite "clear evidence" might exist in this case. First, it looked to the language of the Wyoming Statehood Act; second to the 1868 Treaty of Fort Laramie; and finally to the historical record.[481]

Looking to the Wyoming Statehood Act, the Court reiterated the foundational rule that the presumption is that treaty rights remain unless expressly abrogated. Looking to this rule, the Court found the Statehood Act "'makes no mention of Indian treaty rights' and 'provides no clue that Congress considered the reserved rights of the [Crow Tribe] and decided to abrogate those rights when it passed the Act.'"[482] As a result, unlike *Race Horse*, where the court presumed the termination of the Shoshone-Bannock's treaty rights at Wyoming statehood, the Court here found "[t]here simply is no evidence that Congress intended to abrogate the 1868 Treaty right through the Wyoming Statehood Act, much less the 'clear evidence' this Court's precedent requires."[483]

The Court next considered whether the 1868 Treaty of Fort Laramie expressed an intent for the Crow Tribe's off-reservation hunting rights to expire upon Wyoming's statehood. Recall that the Court in *Race Horse* described the identical language found in the 1868 Fort Bridger Treaty to be "essentially perishable" and "temporary and precarious."[484] That reasoning was repudiated by the Court in both *Mille Lacs* and *Herrera*. Instead, the Court returned once again to foundation principles, this time to reiterate that treaties must be interpreted consistent with the canons of construction:

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[480] *Id.* (quoting *Mille Lacs*, 526 U.S. at 202; *Dion*, 476 U.S. at 740)
[481] *See*, Herrera v. Wyoming, 139 S.Ct. at 1698-1700.
[482] *Id.* at 1698(quoting *Mille Lacs*, 526 U.S. at 203)
[483] Herrera v. Wyoming, 139 S.Ct. at 1698 (quoting *Mille Lacs*, 526 U.S. at 203)
[484] Ward v. Race Horce, 163 U.S. at 515

> A treaty is "essentially a contract between sovereign nations." Indian treaties "must be interpreted in light of the parties' intentions, with any ambiguities resolved in favor of the Indians," and the words of the treaty must be construed "in the sense in which they would naturally be understood by the Indians[.]"[485]

The Court found that the Treaty itself listed out the conditions upon which the Treaty hunting right would be terminated and found that "Wyoming's statehood does not appear on this list."[486] The Court likewise applied the canons to its analysis of the historical record. After sifting through the record as presented by both parties, the Court concluded "the historical record is by no means clear."[487] The Court then properly resolved this ambiguity in favor of the Tribe.[488] Ultimately, the Court found

> [a]pplying *Mille Lacs*, this is not a hard case. The Wyoming Statehood Act did not abrogate the Crow Tribe's hunting right, nor did the 1868 Treaty expire on its own accord at that time. The treaty itself defines the circumstances in which the right will expire. Statehood is not one of them.[489]

A second question addressed by the Court was whether Crow tribal members had lost their right to hunt within the Bighorn National Forest, the location where Mr. Herrera had been hunting.[490] Recall that the treaty right reserved by the Crow Tribe in 1868 was the right to "hunt on the unoccupied lands of the United States . . . ."[491] Wyoming argued that lands reserved by the United States as national forests were categorically "occupied" as that term was contemplated in the treaty.[492] In addressing this question, the Court once again relied upon the canons of construction, holding that "[t]reaty analysis begins with the text, and treaty

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[485] Herrera v. Wyoming, 139 S.Ct. at 1699
[486] *Id.*
[487] *Id.* at 1700
[488] *Id.*
[489] *Id.*
[490] *Id.* at 1700-01
[491] *Id.* at 1693 (quoting Art. IV, 15 Stat. 650).
[492] *Id.* at 1701

terms are construed as 'they would naturally be understood by the Indians.'"[493] The Court construed the treaty by examining its text and the circumstances surrounding the treaty's creation and ultimately concluded that "the Crow Tribe would have understood the word 'unoccupied' to denote an area free of residence or settlement by non-Indians."[494] As a result, the Court found

> Considering the terms of the 1868 Treaty as they would have been understood by the Crow Tribe, we conclude that the creation of Bighorn National Forest did not remove the forest lands, in their entirety, from the scope of the treaty.[495]

The Court was careful to note two limitations on its holding, however. First, it noted that "not all areas within [national] forest[s] are unoccupied. On remand, the State may argue that the specific site where Herrera hunted elk was used in such a way that it was 'occupied' within the meaning of the 1868 Treaty.[496] Second, the Court noted that "[o]n remand, the State may press its arguments as to why the application of state conservation regulations to Crow Tribe members exercising the 1868 Treaty right is necessary for conservation."[497]

The Court's turn back to the canons of construction in *Herrera* is significant. However, as the late Professor Philip Frickey has observed

> Canons are mere formulations. Standing alone, a canon cannot be expected to control judicial outcome, particularly in a context removed from the one that gave birth to the canon.[498]

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[493] *Id.* (quoting *Passenger Fishing Vessel*, 443 U.S. at 676).
[494] *See*, Herrera v. Wyoming, 139 S.Ct. at 1701-03
[495] *Id.* at 1703
[496] *Id.* (citing State v. Cutler, 109 Idaho 448 (1985)).
[497] Herrera v. Wyoming, 139 S.Ct. at 1703.
[498] Philip P. Frickey, *Marshalling Past and Present: Colonialism, Constitutionalism, and Interpretation in Federal Indian Law*, 107(2) HARVARD L. REV. 381(1993)

In other words, reaffirming these canons simply begs the question: how do we know how a tribe would have interpreted their treaty?

III. Linguistics and the relation between traditional ecological knowledge and Native language referring to place

A. Cultural Linguistics and Legal Evidence for the Meaning of Language

The ultimate goal for treaty interpretation is to understand the intent of both the United States and the tribe in negotiating and executing the treaty.[499] That understanding is typically developed through examination of three separate but intertwined sources of information: the document itself, the circumstances surrounding the development of the document, and the history of the tribe that is party to the treaty.[500] The evidence brought to bear toward each of these sources of information is filtered through the canons. The treaty, circumstances, and history of the tribe is to be viewed "in the sense in which they would naturally be understood by the Indians," with "any ambiguities resolved in favor of the Indians."[501]

Courts rely on expert testimony from linguists to determine how a tribe would have understood the terms of their treaty. The 1972 Idaho Supreme Court case *State v. Tinno* provides a textbook example of how linguistics has been used to interpret treaties.[502] The

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[499] *Passenger Fishing Vessel*, 443 U.S. at 675

[500] *See*, *Winans*, 198 U.S. at 380-81; Winters v. United States, 207 U.S. 564, 575-77 (1908); Arizona v. California, 373 U.S. 546, 598-600 (1963); *Menominee*, 391 U.S. at 406; *Antoine*, 420 U.S. at 197-200; *Passenger Fishing Vessel*, 443 U.S. at 664-670; *Mille Lacs*, 526 U.S. at 196; Idaho v. United States, 533 U.S. 262, 265-73 (2001); Washington State Dept. of Licensing v. Cougar Den, Inc., 139 S.Ct. 1000, 1011-13 (2018); Herrera v. Wyoming, 139 S.Ct. at 1698-1700. *See also*, Kimball v. Callahan, 493 F.2d 564, 566 (9th Cir. 1974); Colville Confederated Tribes v. Walton, 647 F.2d 42, 47 (9th Cir. 1981) ("[t]o identify the purposes for which the Colville Reservation was created, we consider the document and circumstances surrounding its creation, and the history of the Indians for whom it was created."); United States v. Adair 723 F.2d 1394 (9th Cir. 1984) (noting that water rights case "depends on an analysis of the intent of the parties to the . . . [t]reaty, as reflected in its text and surrounding circumstances."); United States v. Washington, 853 F.3d 946, 963 (9th Cir. 2018); United States v. Washington, 384 F.Supp 312 (W.D. Wash. 1974); Klamath & Modoc Tribes v. Maison, 139 F.Supp. 634, 636 (D. Oregon 1956); *U.S. v. Washington*, 384 F.Supp at 350-50 (including analysis on "Pretreaty Role of Fishing Among Northwest Indians," "Treaty Background," "Negotiation and Execution of the Treaties," and "Post-Treaty Indian Fishing.").

[501] Herrera v. Wyoming, 139 S.Ct. at 1699 (quoting *Passenger Fishing Vessel*, 443 U.S. at 676; *Mille Lacs*, 526 U.S. at 206).

[502] State v. Tinno, 497 P.2d 1386 (Idaho 1972)

Court there was considering the meaning of Article 4 of the Treaty of Fort Bridger with the Shoshone-Bannock Tribes.[503] Again, that treaty included the promise that the Tribes "shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts."[504] The question posed was whether "to hunt" includes fishing.[505] The court turned to the "expert testimony of Dr. Sven S. Liljeblad, a professor of anthropology and linguistics at Idaho State University, relating to the term 'to hunt' as the term was generically used in the languages of the signatory Indians."[506] The expert testified that neither tribe separated hunting and fishing in language. Instead, the Shoshone verb, tygi, and the Bannock verb, hoawai, both refer to the process of obtaining wild food, whether fish, game, or plants.[507] The court also had before it notes taken by a United States General participating in the negotiations indicating that both hunting and fishing were discussed.[508] Using this evidence, the court concluded that the words "to hunt" in the treaty include a fishing right.[509]

A similar approach was taken the United States Supreme Court during the 2019 term in *Cougar Den*.[510] The Court there sought to discern how the Yakama Nation would have understood the term "in common with," as it related to the Nation's treaty right to travel.[511] Using linguistics, the Justice Gorsuch found that "[i]n the Yakama language, the term 'in common with' . . . suggest[ed] public use or general use without restriction.'"[512] Based on this, the Justice concluded "the evidence suggests that the Yakama's understood the right-to-travel provision to provide them 'with the right to travel . . . without being subject to any licensing and permitting fees related to the exercise of that right . . . ."[513]

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[503] *Id.*
[504] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1389 (1972)
[505] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1389 (1972)
[506] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1389 (1972)
[507] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1389 (1972)
[508] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1389 (1972)
[509] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1390 (1972)
[510] Washington State Dept. of Licensing v. Cougar Den, Inc., 139 S.Ct. at 1017 (Gorsuch, J., concurring)
[511] *Id.* (Gorsuch, J., concurring)
[512] *Id.* (Gorsuch, J., concurring) (quoting Yakama Indian Nation v. Flores, 955 F.Supp. 1229 (E.D. Wash. 1997)).
[513] *Id.* (Gorsuch, J., concurring)

Notwithstanding these strong signals, courts have been spotty at best in developing a rigorous methodology for discerning historical tribal understanding of the terms of treaties. However, as more people with Indigenous heritage have entered the academe, scholarship is moving closer to an understanding of native language. This section will focus on the meaning of native words through the lens of cultural linguistics. The part following this section will turn to traditional ecological knowledge to inform language reserving rights to use and occupy land and natural resources. While the goal is to understand the meaning of treaty language at the time it was written, that understanding must evolve as new approaches to unpacking their meaning are developed.

One of many ways to honor the original intent of tribal people in coming to these treaties is to better understand the words through their eyes. Cultural linguistics provides us with that opportunity.

B. Ethno- and Cultural Linguistics

Cultural (and ethno-) linguistics explores how the interaction among a group of people reflects their conceptualization of the world around them.[514] Scholars of cultural linguistics refer to language as the "collective memory bank" of a people,[515] reflecting "the cultural knowledge that emerges from the interactions between members of a cultural group across time and space."[516] Cultural linguistics looks at the emergent aspects of language including: how language is used to form mental models of what is observed in time and space in the world around us as well as our own practices as a community of people and reflects the shared assumptions about the meaning of language;[517] how language is used to reflect classification

[514] Farzad Sharifian (2017) *Cultural Linguistics*, 38 ETHNOLINGUISTIC 34, DOI: 10.17951/et.2016.28.31; Gary B. Palmer (1996) Toward a Theory of Cultural Linguistics. Austin, TX: University of Texas Press at 34.

[515] Sharifian (2017) note at 38 (quoting Ngugi.w Thiong'o, (1986) Decolonising the Mind: The Politics of Language in African Literature. London: Heinemann.)

[516] Sharifian (2017) note 118 at 38.

[517] Sharifian (2017) note 118 referred to as "cultural schema" at 40-43.

of concepts reflecting the broader meaning associated with a single word;[518] and how metaphors may reflect cultural understanding of ourselves and our place in space and time.[519]

The authors do not claim expertise in cultural linguistics. Instead, we refer to it as an example of the increasing understanding of the depth of meaning in language. It represents a field of western science struggling to translate meaning from the language of other cultures and may be useful in helping western judicial systems unpack that meaning. While federal courts have long allowed oral history, anthropology, and Native mythology to inform translation of Native language in court proceedings,[520] the fact that English language mental models do not provide a cultural basis to understand this information as the Tribe would, hinders the use of this information in judicial proceedings.[521] This notion of having to look beyond the so called "plain meaning" of translated language is captured in the following statement by Sharifian about the problems of intercultural communication:

> In recent years several studies have shown that in certain contexts, intercultural communication, and in particular miscommunication, reflect differences in the ways in which various groups of speakers conceptualise their experiences. In doing so they draw on their own cultural schemas, categories, and metaphors. Wolf and Polzenhagen (2009) observe that "cross-cultural variation at the conceptual level calls for a strongly meaning-oriented and interpretive approach to the study of intercultural communication" and that is what Cultural Linguistics has to offer.[522]

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[518] Sharifian (2017) note 118 referred to as "cultural categories" at 43-45. In reference to the noun classification system of an aboriginal people in Australia, Sharifian states "This system of noun classification is entrenched in Murrinh-patha cultural categorisation, which in turn is based on the Murrinh-patha world-view. For instance, as Walsh argues, the fact that fresh water, fire, and language are classified separately indicates that each holds a prominent place in the culture of the Murrinh-patha.

[519] Sharifian (2017) note 118 referred to as "cultural metaphors" at 45-46.

[520] *See e.g.* Boldt, State v Tinno

[521] *See e.g.* reversal of Navajo Nation v. United States Forest Service, 479 F.3d 1024 (9th Cir. 2007), reversed after rehearing en banc, 535 F.3d 1058 (9th Cir. 2008)

[522] Sharifian (2017) note 118 at 49. Sharifian goes on to note that in the context of international negotiations: "they are very likely to need to convey cultural conceptualisation found in one language by means of cultural conceptualisations found in another. In other words, the process of translation or cross-cultural rendering of cultural conceptualisations can be difficult since languages encode the culturally differentiated and hence historically entrenched ways in which speakers have conceptualised their world in the past and continue to do so in the present. As a result, finding sets of words that successfully capture equivalent cultural conceptualisations in another language can become complicated, depending on the degree to which the two cultures have been in contact and, as a result,

Similarly, western science is beginning to acknowledge the value of traditional ecological knowledge in providing a holistic approach to understanding complex systems.[523]

> *Vignette by Sammy Matsaw:* I was sitting in on a meeting as a program manager for the Shoshone-Bannock Tribes' Fish and Wildlife department. One of our elders and director was talking about our treaty rights and the differences between treaties of the lower [Columbia] river tribes i.e. Confederated Tribes of the Umatilla, Yakima, Nez Perce, and Warm Springs. Their treaty language says, 'to fish in common with settlers' while ours' says 'to hunt'. During the Tinno case Sven[524] said our language for 'to hunt' meant to gather wild foods. Of course, they're going to listen to a white guy who is an expert in our language over our own people? It was good either way because they understood our language doesn't translate to English and we say to gather wild foods as in hunting, fishing, trapping, and gathering our foods. But the old ones said it meant more than that, it meant to gather your things up, go out on the land, camp, and gather wild foods.
>
> To me when the more I talked with my own generation about the ideas in tygi or hoawai, the Shoshone or Bannock word for 'to hunt', respectively, it seems there was so much more to our language. Language for Shoshone and Bannock peoples, and Indigenous peoples of North America, are made up of mostly verbs whereas English and Latin based languages are made up of nouns. For example, in English one would call a writing utensil a pen, a pencil, a marker and so on whereas with Shoshone-Bannocks we say gimme the thing to write with. When we talk about tygi/hoawai it seems there must be learning and teaching in there as well. Teaching and learning about the seasonal round, the dances, the songs, the stories, where to go, where to set

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have similar although perhaps not identical cultural conceptualizations (see Avruch and Wang 2005). Sharifian (2017) note 118 at 53.

[523] *See e.g.,* Deborah McGregor (2003) *Coming Full Circle: Indigenous Knowledge, Environment, and Our Future*, 28 (3/4) AMERICAN INDIAN QUARTERLY 385-410, SPECIAL ISSUE: THE RECOVERY OF INDIGENOUS KNOWLEDGE

[524] Dr. Sven S. Liljeblad (1899-2000), was a professor of anthropology and linguistics at Idaho State University who gave expert testimony of signatory tribes during *Tinno,* 497 Idaho P.2d

> up camp, what's there, what's in season, and so on. Tygi and hoawai moved within and among the ceremonies of Shoshone and Bannock ways of living in our sacred homelands and waterways. I can imagine our ancestors deliberating the language of the treaties over the years. I say treaties and years plural because the Fort Bridger Treaty of 1868 was among dozens previously negotiated treaties over decades of settlers trying to come to an agreement with the local Tribes. How they must've thought someday we can teach them about how to live within our homelands through our ceremonies, teachings and way of life, naïve? Maybe, maybe not?

The observations present in the vignette above highlight the many gaps in understanding that exist between Native and Eurocentric worldviews. The first step toward filling these gaps—and thereby finally honoring tribal intent when construing treaties—is to understand how tribal people think differently than those from non-Indian communities. Those differences are manifold but we highlight three here: (1) philosophical differences in time and space; (2) miscommunications caused by direct translations; and (3) misunderstandings developed by tribal use of verb-based thought worlds.

1. Philosophical differences of time and space

Benjamin Whorf an anthropologist and linguist proposed a theory of linguistic relativity through his studies of Mayan and Hopi languages. He states,

> I find it gratuitous to assume that a Hopi who knows only the Hopi language and the cultural ideas of his own society has the same notions, often supposed to be intuitions, of time and space that we have, and that are generally assumed to be universal. In particular, he has no general notion or intuition of TIME as a smooth flowing continuum in which everything in the universe proceeds at an equal rate, out of a future, through a present, into a past; or, in which, to reverse the picture, the observer

> is being carried in the stream of duration continuously away from a past and into a future.[525]

From this Whorf goes onto to distinguish the thoughts and ideas of Hopi peoples' metaphysics can come to similar views of the universe upon very different thought worlds. Subbiondo who has found Whorf's writings and studied them in the context of critiquing Western science quotes Whorf:

> Whorf argued that paying attention to how other physical phenomena are described in the study of linguistics could make valuable contributions to science by pointing out the ways in which certain assumptions about reality are implicit in the structure of language itself, and how language guides the attention of speakers towards certain phenomena in the world which risk becoming overemphasized while leaving other phenomena at risk of being overlooked.[526]

Certain assumptions usually remain implicit in the language of English speaking Euro-descended peoples so as not to challenge the power and privilege given to them through Indigenous peoples, their lands and thereby signing treaties.[527] There is a bias in the implicit structure of English speaking peoples shaping certain assumptions. In most cases these certain types of assumptions are believed to be universal such that the implicit idea of a scientist is usually a white male, in a white lab coat. The implicit reality is that he is also believed to be cis-hetero male with a wife and nuclear family, Christian, Anglo, patriot, middle-class, etc. The uniformity is a part of the goal of scientific research in order to find universally applied solutions, a monoculture of science and its application. There is an interplay where science effects society and vice-versa in unforeseen ways such that the implicit become ubiquitous. The dangers of an unquestioned implicit-cy. How much of certain assumptions are shaped by language and how much is shaped by methodology? Because if colonialism is a culture of

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[525] Whorf, B. L. (1950) *An American Indian Model of the Universe,* 16 INTERNATIONAL JOURNAL OF AMERICAN LINGUISTICS 67-72.

[526] Subbiondo, J. L. (2005) *Benjamin Lee Whorf's Theory of Language, Culture, and Consciousness: A Critique of Western Science,* 25 (2) LANGUAGE & COMMUNICATION: 149–59 https://doi.org/10.1016/j.langcom.2005.02.001

[527] Bell, David A. (2015) *Columbia River Treaty Renewal and Sovereign Tribal Authority under the Stevens Treaty Right-to-Fish Clause* 36 PUBLIC LAND & RESOURCES LAW REVIEW 269–98.

colonizing Indigenous lands and asserting a supremacy through one spoken language, does that make Western frameworks the best i.e. Western Science. Without any research of these certain assumptions in language, or analysis how would we ever know?

2. Direct translation often fails to grasp meaning

We do know that Indigenous languages are usually bounded by a particular place. They are also verb-based because there was/is more interest in processes and relationships (past tense is from the extinction/endangerment of Indigenous languages happening today). The idea, feeling, and conversation is not about an object per se rather the processes of energy around a particular set of objects. For instance:

> Lakota is really specific in terms of the describing of different processes. For instance, -ȟléčA which means the idea to tear. If you tear something with your fingers its, yuȟléčA. If you tear something with your teeth, yaȟléčA. If you tear something with pressure, paȟléčA. If you tear something with your foot, naȟléčA. If the wind blows and tears something its, woȟléčA. And it goes on, there's more than this. But I'm just trying to emphasize the fact that the Lakȟóta language offers a different perspective, a different angle on the world we live in.[528]

We can learn that Lakota language as Indigenous peoples revealing another frame of thought interested in processes and relationships over cause and effect and categories as in the English and other European languages. In the Lakota language there is more interest in the processes of energy than there is in the object per se. If we were to apply this to a network, or food web analysis we would see more interest in the flow through nodes, not necessarily the nodes themselves. Thus, it follows that we see ourselves as part of nature rather than a part from nature as in English speaking thinkers. English thinking speakers see categories and therefore use a language as discrete separation from nature.

[528] Kevin Locke, Educator –Huŋkpapȟa Lakȟóta—in Rising Voices / Hóthaŋiŋpi - Revitalizing the Lakota Language (Dana Claxton, Alayna Eagle Shield, Milt Lee and Yvonne Russo eds. 2015)

3. Verb-based thought worlds

The fixation on objects and seeing nature as objects creates a divisiveness such as human-nature division or conflict. Where civilization takes natural resources converting nature for the needs of humans in the view of nature providing ecosystem services. Rather nature for the Indigenous is viewed as one in the same:

> ". . . all of nature is in us, all of us is in nature."[529](Lame Deer & Erdoes, 1973)

From this quote we were once more interested in the *is*, the *being-ness* of life our connection and fluidity between us and us between all of creation. In a contemporary English lens of the world we are preoccupied with the *it*, the *object* of life. The being-ness of life is where we want to get back to, our languages and our way of thought. If the being-ness of life is of interest and leads how we form ideas about science then we have much to re-claim, to call our own. We have maintained a hunting-gathering-fishing tie to the land that still informs our science thinking and science-ing. Such that:

> They saw themselves as existing in a web of highly interrelated and interdependent "substances": air, water, other beings, and land. They maintained their life force by ingesting the life force of other beings. No less respect was due a wild onion than a deer. "Eat it," my father would say to us, "we took its life that we might continue our own." Eating was a holy sacrament; a thanksgiving to the creatures that provided us life.[530]

The teachings Viola is sharing in the quote above sheds light on the idea of a matrices of thought underlying implicitly in the words from her father. We would go a bit farther as to say that not all ideas need be said, as we understand one another's actions and it is those actions

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[529] Lame Deer, John F., and Richard Erdoes (1973) *Lame Deer, Seeker of Visions*. Simon and Schuster.
[530] Cordova, Viola Faye (2001) *Time, Culture, and Self*, 1(1) THE AMERICAN PHILOSOPHICAL ASSOCIATION .

that represent an unspoken truth of who we are. Language is vital and necessary, but is not the end all, be all of reconnecting our thought patterns with our reality and world.

C. Traditional Ecological Knowledge shapes mental models of nature

There are very few fluent speakers of Indigenous languages. Not to say the impacts of the language do not remain, they do. Part of the implicit nature of language is its spirit, and without being fluent in one's language the spirit of the language lives on. The language is from the land and when we go back out onto our homelands the language is there. Similar to niche concept theory, a species will match to their behavioral characteristics and genetic traits to their surrounding environment, so do humans with language. Language, as a behavioral characteristic, is a response of the lands we live within. Forcing a foreign language onto Indigenous lands is similar to building fences, roads, and dams, plowing crops, extraction mining and so on. The call from Indigenous peoples has been what we do to our lands, we do to ourselves, an agentic relationship. There are few fluent speakers of Indigenous languages just as there are few places untouched by colonialism. We are all living in a recent story of how our lands are being destroyed much like our stories of the past, Indigenous peoples have experienced something similar before.

Indigenous storytelling of climate change are theoretical anchors. As an explanation of phenomena these stories are held as "theories" that indigenous communities adapt, are regenerative, and take on the responsibilities before us and how we live in our homelands[531]. In contrast to colonialism defined as a policy or practice of acquiring full or partial political control over another country, occupying it with settlers and exploiting it economically[532], it being our homelands there is a lack of theoretical anchors similar to Indigenous peoples. Theoretical anchors are grounded in the sacredness of place that, ""Theory" isn't just an intellectual pursuit – it is woven within kinetics, spiritual presence and emotion, it is

[531] *See* Simpson, Leanne Betasamosake (2014) *Land as pedagogy: Nishnaabeg intelligence and rebellious transformation,* DECOLONIZATION: INDIGENEITY, EDUCATION & SOCIETY 3.3 (2014).

[532] Retrieved from Oxford University Press. Lexico.com. (2019) https://www.lexico.com/en/definition/colonialism

contextual and relational. It is intimate and personal, with individuals themselves holding the responsibilities for finding and generating meaning within their own lives." Settlers with a colonial mindset act in funny ways, such that as a product of Western European paradigms there is a denial of climate change because scientific theory is only for academics whereas for Indigenous "theory" it is for everyone[533]. Being anchored to homelands forbids a denial of homeland destruction.

Indigenous Knowledge cannot be defined and shouldn't be. Henderson and Battiste offer a conceptualization as such:

> Perhaps the closest one can get to describing unity in Indigenous knowledge is that knowledge is the expression of the vibrant relationships between people, their ecosystems, and other living beings and spirits that share their lands.... All aspects of knowledge are interrelated and cannot be separated from the traditional territories of the people concerned. ... To the Indigenous ways of knowing, the self exists within a world that is subject to flux. The purpose of these ways of knowing is to reunify the world or at least to reconcile the world to itself. Indigenous knowledge is the way of living within contexts of flux, paradox, and tension, respecting the pull of dualism and reconciling opposing forces.... Developing these ways of knowing leads to freedom of consciousness and to solidarity with the natural world.'

Traditional Ecological Knowledge is understood from a perspective from the Eurocentric lens extracting from Indigenous Knowledge what it perceives as Science knowing from Indigenous peoples. From Indigenous scholars such as Deborah McGregor she states the following:

> a body of knowledge built up by a group of people through generations of living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that

[533] Simpson (2014) note 135 at 7

> governs resource use. The quantity and quality of traditional environmental knowledge varies among community members, depending upon gender, age, social status, intellectual capability, and profession (hunter, spiritual leader, healer, etc.). With its roots firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present.

TEK *is* a relationship with land and Creation, not just *about* a relationship with land and Creation. Gregory Cajete states:

> Native people traditionally lived a kind of communal environmental ethics that stemmed from the broadest sense of kinship with all life. The underlying aim of the science of ecology, therefore, the understanding of the web of relationships with the "household" of Nature, is not modern science's sole property. Understanding the relationship scientifically is not enough—living and nurturing these relationships is the key. This is the ecology of the Native community.

There is a distinction is/about being similar to the of/from the land, as relationships with ecosystems are viewed differently shaping different worldviews (more below from Megan Bang). Reconciling these differences in the present

Evidence of TEK can been seen in many Indigenous cultures by their relationships with their homelands. For instance, a seasonal round as depicted by Shoshone language instructor Druscilla Gould at Idaho State University shows how the people move about the land through the seasons by solstices, and equinoxes, moon phases. As those times come, they sing songs and dance to welcome in the season. Each season is marked by moon phases informing when to hunt, gather, and fish for certain species of plants and animals. All of this is done in randomly to take what you need and no more from one population, not to wipe a whole population out. Moving about the land was important to be in a respectful giving and taking relationship with life-sustaining living and non-living entities. Thus, it also follows why we speak in verbs because it is the moving across the land driving the basis of our cultures such

as values, customs, protocols, ethics, and traditions. The noun is secondary to the action-based culture, to move place to place, and give our songs, and dances, and tobacco was in relationship with taking of life we are primarily interested in verbs, the doing. Tygi and hoawai are seminal to our way of living, still is, always will be.

Storytelling is a matrix of human experiences over time. The pattern system or matrices of thought to which the language speaks of and represents is a tool to make that representation more fluid. When the language is absent it has been shown the pattern system remains and is reflected in recent research by Bang et al.[534]. They showed a precociousness to ecological orientation in Menominee children, although they don't disclose a fluency of language the study was designed using the English language, and Western tools of science. And still the culturally-based epistemological orientations of the Menominee people's implicit nature and spirit of language had shown through. Fluency of Indigenous languages is important to preserving different ways of knowing and knowledge and would behoove the scientific enterprise to co-lead this effort with the peoples of whose lands they are occupying. We call on scientist's to be true to their fundamental interest in seeking knowledge by embracing Indigenous languages and thinkers shaping culturally-based epistemological orientations who can bring new knowledge from Indigenous cultures.

Let's review some of the recent research that reveals the distinct relationship Indigenous peoples have with land, and nature. For example, in Bang et al.'s Cultural Models and Mental Models of Nature[535], there are significant differences of how cultural groups such as Indigenous and non-Indigenous peoples see themselves on the land as a part of nature and apart from nature, they foreground and background this relationship with nature, respectively. This is important because as they explain, "the cultural framework theories provide individuals with skeletal principles for meaning making, including beliefs about what sorts of things are relevant, worthy of attention and in need of explanation". Specifically, in hunting experiences there are differences that provide perspectives of human relationship with nature, plants and animals, and the land. In the Euro-American sense hunters follow a set of protocols

[534] Bang, Megan, Douglas L. Medin, and Scott Atran (2007) *Cultural Mosaics and Mental Models of Nature*, 104 (35) PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES: 13868–13874.
[535] *Id.*

such as but not limited to a uniform, an ethic, and share stories of hunting experiences. The Euro-American experience is categorical whereas in the foregrounding of, "*all of nature is in us, all of us is in nature*"[536] our experiences are about not necessarily focused on person, place or thing rather more nuanced interests in non-categorical processes. As in Cordova's quote of her father's teachings that a life force transfers through eating and ingesting traditional foods thereby eating is a taking of daily sacrament so that life goes on. From the English perspective our teachings are complicated because they go against the ideas of separation. In a highly interrelated connection of life forces we are experiencing both science and spirituality at the same time, we do no separate those two ideas in the transfer of life to life through eating. For us it is a complicated to practice a science way of thinking in one box, eat in another, and pray in another.

IV. To Interpret American Indian Treaties as the Tribes Would Have Understood Them

Indigenous peoples of Turtle Island tell stories about the roles of plants and animals for their survivance (coined by G. Vizenor[537] upon highly modified landscapes to riverscapes from continued settlement[538]. These stories are 'contracts' between Indigenous peoples and life forms, and the environment (water, land, and sky) they rely upon[539]. Within the agreements human beings are to take care of them as they sacrificed themselves to take care of Indigenous peoples. Because of the 'contractual' relationship Indigenous peoples *remember to remember* at intervals within the seasons to pay homage to life forms and the environment[540]. The seasonal ceremony can begin in spring paying homage to *Traditional Foods* also known as *First Foods* in the Pacific Northwest through varying customs and traditions, usually dependent on the bounded space of each tribe[541]. The ceremonies continue

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[536] *Id. At 230*

[537] Grande, Sandy. RED PEDAGOGY: NATIVE AMERICAN SOCIAL AND POLITICAL THOUGHT. (Rowman & Littlefield, 2015).

[538] *See* Paul Goble books for children such as "The legend of the White Buffalo Woman" 2002; "The great race" 1991; "All our relatives: Traditional Native American thoughts about nature" 2005.

[539] Monroe, Jeremy. *The Lost Fish: The struggle to save Pacific Lamprey*. www.critfc.org. Freshwaters Illustrated Organization. 2013. https://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/lamprey/lost-fish-film/

[540] Kimmerer, Robin. *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Milkweed Editions, 2013.

[541] Cordova, Viola Faye. *How it is: the native American philosophy of VF Cordova*. University of Arizona Press, 2007.

throughout the year through a seasonal round: central to moon and sun phases i.e. months, equinox, and solstice, while acknowledging the plants and animals, and the environmental phase of the harvest time through song and dance. However, driven mainly by a highly modified landscape, climate change, and a mass extinction event primarily because of colonization, and its derivatives i.e. industrialization, capitalism, etc., have continued to endanger and threaten Indigenous culture, identity, language, and sovereignty[542]. The time is now to re-evaluate treaties as the tribes would have understood them, on their terms, without Euro-what-have-you intervention.

The hunting and fishing rights in the Treaty of Fort Bridger with the Shoshone-Bannock Tribes of the Fort Hall Reservation has been interpreted in two strikingly different cases discussed above. In the 1896 United States Supreme Court case of *Race Horse,*[543] the Court gave no meaning to the understanding of Tribes, interpreting their rights as "temporary and precarious"[544] and thus easily abrogated by the admission of a state to the union.[545] In the Idaho Supreme Court case of *State v. Tinno,*[546] the court admitted expert testimony on linguistics and concluded that because the tribes did not separate hunting and fishing in language using the Shoshone verb tygi and the Bannock verb hoawai in reference to obtaining wild food, the words "to hunt" in the treaty include a fishing right.[547] *Tinno* illustrates the understanding of language that must be entered in cases interpreting treaty language.

Tygi/Hoawai as a set of processes can be thought of as, but not limited to, part of a living and nurturing of relationships with land and Creation through a seasonal round as a continual experimental design honoring time (i.e. moon phases, equinox, and solstice) and space (i.e. usual and accustomed use areas bounded by the four directions) by a set of protocols, customs and traditions expressed in song, dance, paintings, pictographs, and language with a beingness of gathering wild foods to care for our families, communities and ecosystems we moved in and out of, on water and land, regenerating and adapting Shoshone-

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[542] Cajete, Gregory. *Native science: Natural laws of interdependence*. Clear Light Pub, 2000.
[543] Ward v. Race Horse, 163 U.S. 504 (1896)
[544] *Id.* at 515
[545] *Id.* at 509.
[546] State v. Tinno, 94 Idaho 759, 497 P.2d 1386 (1972)
[547] State v. Tinno, 94 Idaho 759, 497 P.2d 1386, 1390 (1972)

Bannock knowledge since time immemorial. Accordingly, when we give weight to the verb-thought world the definition of 'to hunt' in the English language, a noun-thought world, it is quite limiting to the ideas-feelings-spiritual sense of the Shoshone-Bannock treaty signatories and how they would have understood tygi/hoawai. Tygi and hoawai have much more meaning than the English translation 'to hunt'. As further described by Sven, the Shoshone-Bannock ancestors would have understood to hunt as to gather wild foods, to include fishing. The idea to gather wild foods does not stop there.

Culture should not be understood as individual traits, but rather as the constellation of ways in which people think, act, and make sense of the world[548]. Only by acknowledging the deep cultural and ethnic roots of language through the evidence admitted in court cases interpreting treaties with American Indian tribes may the courts of the colonizer begin to reconcile the conflicting world views and begin to address the sacred responsibility to the Indigenous peoples of America.

[548] *Id.*

Chapter 4: Native Freshwater Mussels and Chinook Salmon from a Benthic Perspective: An Experiment Informed by a Story of Eating Mussels, and Salmon from Shoshone-Bannock Memories

Abstract

Honor, the fifth H. The seasonal and ecological rhythm of gathering and hunting is the act of ceremonial and traditional cultural practices ensuring a vibrant and sustainable tribal culture through intergenerational teachings. Freshwater mussels are filter-feeding organisms that contribute to nutrient cycling in aquatic ecosystems. In the Pacific Northwest there is less known scientifically about the role of freshwater mussels in freshwater ecosystems supporting ESA-listed salmon and steelhead spawning and rearing. Mussels filter feed nutrients from the water column and transfer nutrients to the substrate through faeces and pseudofaeces, which may then increase production of algae and invertebrates. Therefore, I chose to select elements from the bottom of the stream up looking at nutrient recycling and basic freshwater mussel ecology within the usual and accustomed areas of Shoshone-Bannocks in Bear Valley Creek of the Middle Fork Salmon River, Idaho. My research questions are in two parts: 1) Do living native freshwater mussels effect the benthic community, and does that differ by shells (shams) and sediment alone; 2) How do mussels influence the response of freshwater communities to salmon carcass inputs? The research is designed to evaluate key elements of freshwater mussel ecology through nutrient recycling conducted in salmon bearing streams that could prove to reveal a unique relationship between mussels and salmon. I collected data to measure mussel contributions at each trophic level in this relationship. I specifically focused on freshwater mussels contribution from the bottom-up using a field experiment to quantify: 1) Materials filtered from the water column and then released as pseudofaeces and faeces into the substrate before and after spawning events by salmon; 2) Periphyton biomass pre- and post-spawning; 3) Invertebrate abundance and assemblage composition pre- and post-spawning. I found algal biomass increased and invertebrate abundance generally decreased after spawning, suggesting the effects of bioturbation during spawning, carcass nutrient inputs and/or background seasonal effects on stream benthic communities. I did not observe

significant treatment effects of live mussels, perhaps because of methodological or experimental artifacts, insufficient statistical power, or a lack of ecological effect. Nonetheless, the approach applied here holds promise for future investigation of the interactions among freshwater mussels, salmon and other stream biota.

Introduction

> *"One of the things that I would like to say is that the All-H paper [describing the four "H's" of salmon decline: Harvest, Hydro, Habitat, and Hatcheries], if there was some way that we could put the spirituality of the tribes with the salmon and the natural resources as an H, we may be able to understand what we are talking about . . . we could consider as one of the H's, as Mr. Penney stated, Honor. Honor those agreements, those treaties. The spirituality connection that we have with all of these resources, and specifically with the salmon, is that is important to us, . . . That hasn't been considered. That's what I'm getting to. That's why I'm saying the natural rivers should be there. That's what the fish need. That's what the country needs. That's what the economy needs. It has to be natural."* (Lionel Boyer, Shoshone-Bannock Tribal Chairman, Columbia River Power System, 2000)

The seasonal and ecological rhythm of gathering and hunting is the act of ceremonial and traditional cultural practices ensuring a vibrant and sustainable tribal culture through intergenerational teachings (Matsaw, 2020). Indigenous peoples along the Columbia River gather, and eat, freshwater mussels (Bivalvia: Unionoidea), then use the shells as beads and tools (Reservation, 2015) as they did historically (e.g., based on archeology sites, Lyman, 1984; Osborne, 1951). In the Salmon River Basin, higher up in the Columbia River watershed, freshwater mussels are also a traditional First Food and an important part of the seasonal lifestyle of Shoshone-Bannock way of life guaranteed as treaty resource (Matsaw et al., 2020). Shoshone-Bannocks, who maintain lifestyles closely adapted to the rhythm of the natural river environment, find freshwater mussels as a source of energy and part of their cultural identity. The ancestors of Shoshone-Bannock peoples were honoring mussels well over 10,000 years ago as shown by shells excavated from midden piles at rock-shelters along

the Salmon River (Swanson & Sneed, 1966). The cultural connection to freshwater mussels is still important (Box et al., 2006) and could be more important than ever (Noble et al., 2016) given the circumstances of a changing climate and continued destruction of natural landscapes.

Freshwater mussels are filter-feeding organisms that contribute to nutrient cycling in aquatic ecosystems (Strayer, 2008). Because of filter feeding, they are also part of a larger food web and nutrient recycling process. While many of the studies conducted thus far have occurred within the southeast of the continental U.S., the freshwater global hotspot of mussel species richness (Haag, 2012), there is still a lack of overall understanding of their biology (Ferreira-Rodríguez et al., 2019; Vaughn et al., 2008) and foodweb effects, especially in the western U.S. These filter feeding species contribute to beneficial water quality, provide forage for fish as well as other wildlife species, and act as valuable indicators for the robustness of aquatic ecosystems. Some species of freshwater mussels (i.e. *Margaritifera falcata,* Western pearlshell) may live for a century or more and thus have the ability to outlive most other animal species and have a longevity dependent on environmental stability at scales differing from other aquatic species.

In the Pacific Northwest there is less known scientifically about the role of freshwater mussels in freshwater ecosystems supporting ESA-listed salmon and steelhead spawning and rearing. Populations of salmon and steelhead are co-evolved with freshwater mussels in a host-parasitic relationship (Karna & Millemann, 1978). Mussels could play a significant role through nutrient recycling, particularly in oligotrophic streams, by both increasing nutrient availability and by retaining seasonal pulses of nutrients and releasing those nutrients over longer periods of time. As anadromous fish runs return to their natal streams, spawn, and die, their high-quality carcasses are an important nutrient subsidy driving productivity and trophic foodweb dynamics (Kohler et al., 2013). Nutrient capture and recycling by filter feeding organisms, like mussels, may buffering export of salmon-derived nutrients needed by density

dependent organisms, and potentially could decrease extinction risk of co-evolved salmon populations (Armstrong et al., 2016).

Mussels filter feed nutrients from the water column and transfer nutrients to the substrate (Howard & Cuffey, 2006; Spooner & Vaughn, 2006; Vaughn et al., 2004; Vaughn & Spooner, 2006, 2006) through faeces and pseudofaeces, which may then increase production of algae and invertebrates. Increases in periphyton growth has been shown to increase the abundance and diversity of invertebrates in stream ecosystems (Howard & Cuffey, 2006; Vaughn et al., 2007). Here in the PNW, nutrient recycling timing could co-occur with capture of nutrients of salmon from adults during and after spawning. Pathways whereby nutrients from carcasses delivered in the fall that could affect salmonid fry emerging in the spring include: mussel growth and capture of nutrients in fall and release of nutrients by spring/summer respiration; increased transfer of nutrients into CPOM and FPOM storage pools in benthos that are resuspended with spring flows and/or remineralized in spring with increased temperatures; respiration and remineralization of faeces and pseudofaeces through hyporheic processes and transport, release of nutrients and biomass during mussel spawning in late spring-early summer (Allard et al. 2017), and mortality and decomposition during spring run-off of mussel production subsidized by salmon.

Therefore, I chose to investigate elements from the bottom of the stream up looking at nutrient recycling and basic freshwater mussel ecology within the usual and accustomed areas of Shoshone-Bannocks in Bear Valley Creek of the Middle Fork Salmon River, Idaho. My research questions are in two parts: 1) Do living native freshwater mussels effect the benthic community, and does that differ by shells (shams) and sediment alone; 2) How do mussels influence the response of freshwater communities to salmon carcass inputs? The research is designed to evaluate key elements of freshwater mussel ecology through nutrient recycling in salmon bearing streams that could prove to reveal a unique relationship between mussels and salmon. I collected data to measure mussel contributions at each trophic level in this relationship. I specifically focused on freshwater mussel contribution using a field experiment to quantify: 1) Materials filtered from the water column and then released as pseudofaeces

and faeces into the substrate before and after spawning events by salmon; 2) Periphyton biomass pre- and post-spawning; 3) Invertebrate abundance and assemblage composition pre- and post-spawning.

Methods

Study Area

I chose a watershed where a wild chinook population returns to each year that is managed with a video picket weir, creel, carcass and redd surveys by the Shoshone-Bannock Tribes in the headwaters of the Middle Fork Salmon River at Bear Valley Creek, Idaho, USA (11N 630144 4919064 [lat 44°24' 47.4264"N, long 115°21'55.2708"W], Figure 1). The area is largely unimpacted by human-caused disturbances in a wide valley that is boggy, contains fields of camas, wildflowers, and grasses then constrains, mixing with a large hot spring, and finally combines with Marsh Creek to become the Middle Fork Salmon River mainstem. The valley is a wintering ground for large elk populations along with deer, moose, antelope, sandhill cranes, eagles, wolves, black bears, salmon, etc. Most annual precipitation for the area arrives as a snowpack and the hydrograph is snowmelt dominated with peak flow around early to mid-June during the spring freshet. The study year (2018) had discharge levels which were approximately twice the 20-year average (Figure 2).

Just before Bear Valley Creek flows under USFS road 579 it mixes with Elk Creek at the confluence then flowing by Bear Valley campground on the river right. The specific site I selected is downstream from Bear Valley campground about 400-500 m, where it is mostly straight, and similar width across the channel, relatively free of mussels, and salmon spawn just upstream based on past redd surveys. Additionally, I chose this site because it is amongst a longer set of data collected from Traditional Ecological Knowledge of Shoshone-Bannocks and thereby was an opportunity to connect TEK and experimental approaches (or way of knowing).

Study Design

I was interested in the effects of live mussels and sham mussels on the benthic community and related nutrient pathways among them before and after spawning events. My design consisted a 3 x 2 factorial randomized block design with three mussel treatments (live mussels, sham mussels and no mussel presence) and two time treatments (before salmon spawning event and after spawning event with carcasses in the stream). This design allowed me to examine the effects of live mussels to sham, and no mussels when there are no carcasses in the stream and later in the season when salmon have died, and carcasses are in the stream. The experiment was placed in the stream July 28-29.

The experiment was carried out using 60 enclosures (30 cm x 30 cm x 30 cm) framed with 1 x 2 in lumber and then covered in poultry netting leaving the top open. We dug 60 enclosures to 15 cm depth in two treatment blocks (before and after spawning) of 30 each with the first (September 5-6) removal downstream of the later (October 6-7) season treatment. In each of the blocks the enclosures were randomly assigned live mussels, shams or nothing, then arranged in five rows spaced 2.5 m apart and staggered with six enclosures at 2.5 m from one another. We collected 100 mussels from a nearby bed downstream that varied in size but were larger along the secondary axis than poultry netting mesh size (2.5 cm), scrubbed them with a plastic brush and placed five each in the live mussel enclosures. Sham mussels were previously gathered as postmortem shells along the shore or in the stream, then assembled using an aquarium grade silicon and filled with sand; shams also varied in size and were larger than poultry netting mesh; the sham mussels collected dry from shore may have thus differed in initial algal community and biofilm. Four replicate submerged rocks were cleaned and placed within each mesh cage with equally spacing and were used to estimate biomass of primary producers.

Sample collection

When we returned to sample the pre- and post-spawn intervals, we worked from the most downstream to the most upstream row of enclosures. Prior to sampling enclosures, we took three Surber samples (0.09 m^2, 250 µm mesh size) within the experimental area and downstream from the immediate experimental area to a depth of approximately 10 cm. We

then sampled each enclosure as follows. We removed each of the four primary production rocks into a 12-quart rectangular plastic container scrubbed them with 150 ml of stream water then labeled, bagged the sample, and stored samples on ice. The outline of each rock was traced on write-in-the-rain paper and labeled. The same method was used to scrub either five live mussels or five shams per enclosure and we also traced sizes of the sample of live mussels and shams. The enclosure was then rapidly removed from the benthos and transferred to a 32-gallon plastic container to collect benthic macroinvertebrates. Larger rocks were hand cleaned and removed, and the remainder of substrate was elutriated three times and filtered across 250 µm mesh. Samples were stored in 70% ethanol until analysis.

In the lab, each of the samples were processed to quantify chlorophyll *a* (Hauer & Lamberti, 2017), ash-free dry mass (Clesceri et al., 1989), and invertebrates were sorted and identified to family in most cases (Merritt et al., 2008). A 50 mL subsample of the live mussels, sham, and rock scrubs were filtered and analyzed for chlorophyll *a* following the ethanol extraction method. Another 50 mL subset of the scrub was filtered for ash-free dry mass analysis. Invertebrates in the sample or in subsamples were enumerated and no less than 500 invertebrates per sample identified to the level of family for most groups. Autotrophic index is a measure of the biofilm composed of algal and was calculated as total biofilm mass/chlorophyll *a* (dry mass basis); lower values indicate higher algal composition.

Data Analysis

A two-way randomized block ANCOVA (Analysis of covariance) was performed to examine the effects of treatment (mussels, shams and sediment) on each response variable (chlorophyll a, organic matter, autotrophic index, invertebrate abundance) between intervals (pre and post salmon spawning) while statistically controlling for water depth of each enclosure as a continuous covariate using the model:

$$y_{ij} = \mu + \tau_i + I_i + B\left(x_{ij} - \bar{x}\right) + Bk\,\epsilon_{ijk}$$

Where:

$$Response_{ij} = grand\ mean + treatment_i + interval_j + B\ (depth_{ij} - depth\ global\ mean) + block + error_{ij}$$

Post-hoc testing was performed among treatment and interval combinations when treatment effects were detected using Tukey HSD. Statistical analyses were performed in R version 1.2.5033 (R core team, 2019).

For each response variable, I expected: 1) that mussel treatments would differ from shams and from no-shell, sediment only controls; and 2) that differences would increase after spawning if mussels were measurably transferring salmon carcass material into the foodweb. I expected salmon carcasses could also generate pre- vs. post-spawning differences, though the effects of salmon spawning could not be separated from other seasonal effects because no-salmon controls were not available.

Results

Chlorophyll *a* differed between mussel treatments ($F_{2,45}$ =19.083, P <0.0001), pre- and post-spawn periods ($F_{1,45}$ = 14.934, P = 0.0004) and across depths ($F_{1,45}$ = 27.368, P <0.0001) (Figure 4-3). There was also evidence of a treatment x interval effect ($F_{2,45}$ = 5.250, P = 0.00893). Notably, chlorophyll *a* mass was higher in the no-shell sediment controls than in either the live mussel or sham mussel control treatments (Tukey's P < 0.0001), but live and sham mussels did not differ in algal biomass (P = 0.991), indicating no evidence live mussels increased algal biomass during the experiment and potentially revealing a decline algal biomass caused by the experimental placement of live mussels or mussel shams. The differences among treatments and interval suggested that algal biomass increased between pre- and post-spawn periods.

Organic mass (afdw) revealed similar patterns (Figure 4-3): organic mass increased significantly during the experiment ($F_{1,45}$ = 26.974, P< 0.0001) and the significant treatment effect ($F_{2,45}$=0.00198) was caused by differences between sham vs. sediment (Tukey's HSD P = 0.00857) and live mussels vs. sediment (P = 0.00382), but not sham mussel vs. live mussel

(P = 0.954). There was a significant block effect ($F_{8,45}$= 3.198, P = 0.00586), but no significant interaction or depth effect (P > 0.0758).

Autotrophic index differed between treatments ($F_{2,45}$ = 8.357, P = 0.0008) after accounting for significant block (P = 0.00175) and depth effects (P < 0.0001; all other P> 0.252). Pairwise comparison of treatments revealed a significant difference between sham mussels and sediment treatments (Tukey's HSD P = 0.000546) and weak evidence that live mussels had significantly lower autotrophic index than sham mussels overall (Figure 4-3a; P = 0.0531), though this difference was largely associated with the pre-spawning period and should also be interpreted with caution as the P-value is uncorrected for multiple response variables.

Comparison of mean benthic macroinvertebrate numbers across treatments revealed no treatment or treatment by interval interaction effects (all mussel treatment *P* > 0.186, Figure 4-4). Significant differences between pre- and post-salmon sampling periods revealed declines total abundance ($F_{1,45}$ = 7.955 P = 0.007), Trichoptera ($F_{1,45}$ = 4.99, P = 0.031), Chironomidae ($F_{1,45}$=7.147, P = 0.0104), first instar Tipulidae ($F_{1,45}$ = 13.435, P = 0.00565) and the density of Other taxa ($F_{1,45}$ = 33.003, P = <0.0001) in the post spawn period. There was evidence that the density of Plecoptera decreased with depth ($F_{1,45}$ = 6.821; P = 0.0122). There was a significant block effect for Chironomidae ($F_{1,45}$=2.182, P = 0.0470) and Other taxa ($F_{1,45}$ = 3.349, P = 0.00432).

Discussion

I used a field experiment to test for evidence that living native freshwater mussels influenced periphyton and invertebrate organisms associated with mussels in oligotrophic streams before and after a salmon spawning event. The effects of treatments in enclosures with live mussels compared to shams seemed to be influenced by shells as much as live mussels because of some unknown effect of the shells themselves. The consequence of a filter-feeding organism's ability to contribute faeces and pseudofaeces did not outweigh the presence of the shell alone in sham level of treatments in contrast to studies performed outside the Pacific Northwest (Spooner & Vaughn, 2006; Vaughn et al., 2007, 2008; Vaughn &

Spooner, 2006). The strongest effect observed was a seasonal difference between the pre- and post-spawn periods on algae, organic matter and most benthic invertebrates.

Organic matter and chlorophyll were higher in no-shell (sediment only) controls compared to live mussel and sham controls. This pattern reveals the importance of having multiple types of control in field experiments and suggests the shells directly or indirectly affected algal biofilms and organic matter. These results suggest invertebrates were inhabiting enclosures with live (and sham) mussels and consuming chlorophyll a producing organisms and organic matter associated with faeces and pseudofaeces. However, the abundances of invertebrates did not differ among treatments, perhaps because invertebrates were analyzed at the family or higher taxonomic level, obscuring treatment difference in key taxa. If live mussels are attracting invertebrates because of these subsidies then, perhaps, the shells themselves are what invertebrates are cuing into and inhabiting near or on shells of living or dead mussels, which could explain higher algae and organic matter in the sham controls. A cuing behavior that could favor movement to stable hotspots in oligotrophic streams disrupted by salmon performing redd digging every year.

Salmon during spawning are known to be streambed engineers through building redds (using their tails to dig into the stream bottom), a process of bioturbation (Montgomery et al., 1996; Moore, 2006). Although, salmon dying in streams contributes a higher contribution of nutrients derived from the marine environment, the act of digging redds may have masked some of the direct effects of freshwater mussels. Notably, the increase in algae but decline in most invertebrate groups between pre- and post-spawn periods was consistent with nutrients stimulating primary production and bioturbation simultaneously reducing the local abundance of invertebrates. While not detected, the potential for mussels to affect carcass material dynamics is substantial. Filtering about 0.5-1 liter of water per minute for 61-mm individuals (Alimov, 1969; Kryger & Riisgård, 1988; McIvor, 2004; Pusch et al., 2001; in Vaughn et al., 2008) combined with lower water levels into the late summer during a spawning event could make filtering all of the decaying salmon particles in the water column quite imaginable (Vaughn et al., 2004). Mussel beds with densities approximately five metric tons equating to thousands of mussels per bed filtering the whole stream as it passes over is not beyond an

actual realization (Vaughn & Spooner, 2006). However, changing intensities, through redd digging, of the abiotic and biotic properties in the pre and post spawning events create a level of complexity effecting the measurements taken in enclosures during the timeframes chosen that were difficult to discern.

Mussels as individuals, in clusters, and beds are inhabiting stream niches as stable biogeochemical hotspots in a highly physically disrupted environment (Atkinson & Vaughn, 2015). The settling of invertebrates into enclosures may have happened during the pre-spawn time period where most of the bioturbation of redd building occurs in Bear Valley. The post-spawn time period there would be less bioturbation as salmon are dying and/or senescing, having spent all to most of their energy digging and spawning. If this is true, in the post-spawn period we would expect to see periphyton increases as compared to the pre-spawn period that is much more apparent in the sediment only enclosures.

Past studies have found increased chlorophyll a, organic matter, N:P ratios, invertebrate diversity and abundance in their results following similar native freshwater experiments. At this time there have been no experiments of this nature in salmon-bearing streams with freshwater mussels. Besides a study that showed the increased relationship between lamprey and mussels where they found increases in measures when both species are present (Limm & Power, 2011) there is little to no research on mussel ecology in the western U.S.

Despite identifying clear results as described outside the western U.S. there are many elements of this study that have brought to light the importance for future research. The complexity of salmon-bearing streams with freshwater mussels needs careful attention at the level of study design elements. Elements such as using enclosures may not be suitable as bioturbation from salmon increases trapped matter on the forefront of the cages. The effect of the cages may have created a level of variability we tried to discern through accounting for depth. Another element would be to have a control in a nearby, non-salmon bearing stream to account for the differences in the effects of bioturbation and nutrient inputs. One element that

could have had a significant effect on the results could have been a lower return of salmon and higher than average flows (Figure 4-2). Finally, mesocosm or laboratory experiments could be used to more directly measure the capture and processing of salmon carcass material by freshwater mussels.

Conclusion

With a changing climate and conditions, not only are flows lowering on average but so have the return of salmon into the basin over the last century. As mentioned, Bear Valley Creek borders the largest designated wilderness of continuous habitat in the lower 48 states. The Middle Fork Salmon is free-flowing; however, salmon see eight Federal Columbia River Power System hydroelectric dams on their travel to the ocean and subsequent return to spawn in the very streams they reared in. Part of their rearing could be inhibited by the extreme change in snowpack lowering spring freshet and sustained low water later in the year effecting the overall interactions and connection in their larger rearing ecosystem through related animals such as freshwater mussels. My ancestors, salmon and mussels may not recognize our homelands in this changed climate however it is imperative we adhere to their teachings from nature and not a part from nature (Bang et al., 2007). Native freshwater mussels may not be able to sustain themselves unless changes are made in the larger scope of the Columbia River basin and climate the earth over (Blevins et al., 2017).

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Figures

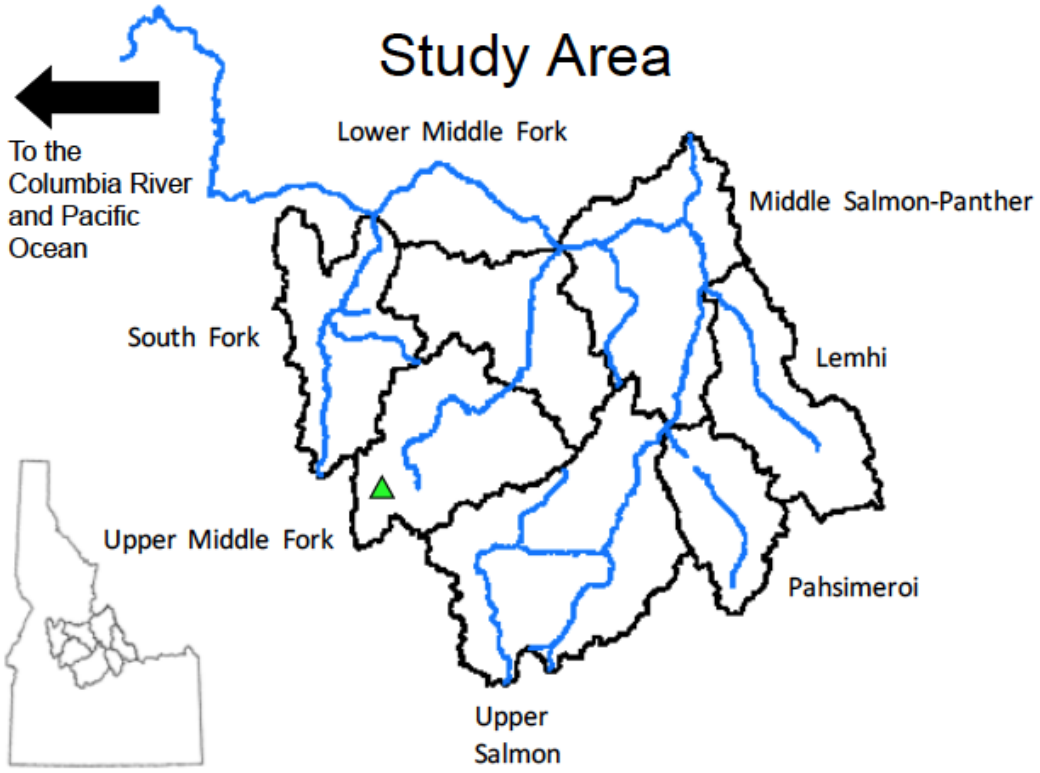


Figure 4-1. Sub-basins of the Salmon River, inset on bottom left, as located in central Idaho, and Bear Valley Creek study site is marked by the triangle in the Upper Middle Fork SR drainage.

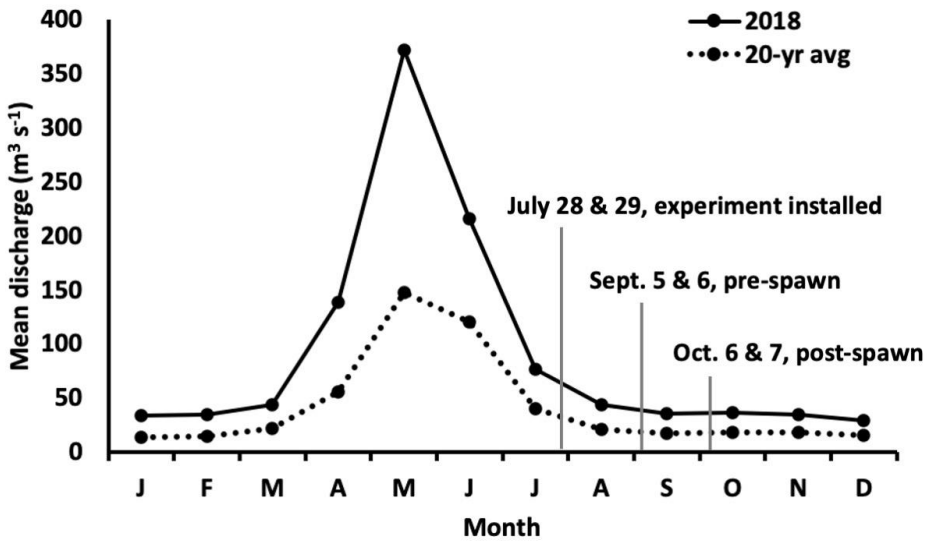


Figure 4-2. Mean monthly discharge in cubic meters per second (m^3 s^{-1}) for 2018, and 20-year average (from USGS gage site data at Middle Fork Salmon River at Middle Fork Lodge near Yellow Pine) downstream from the study site in the mainstem.

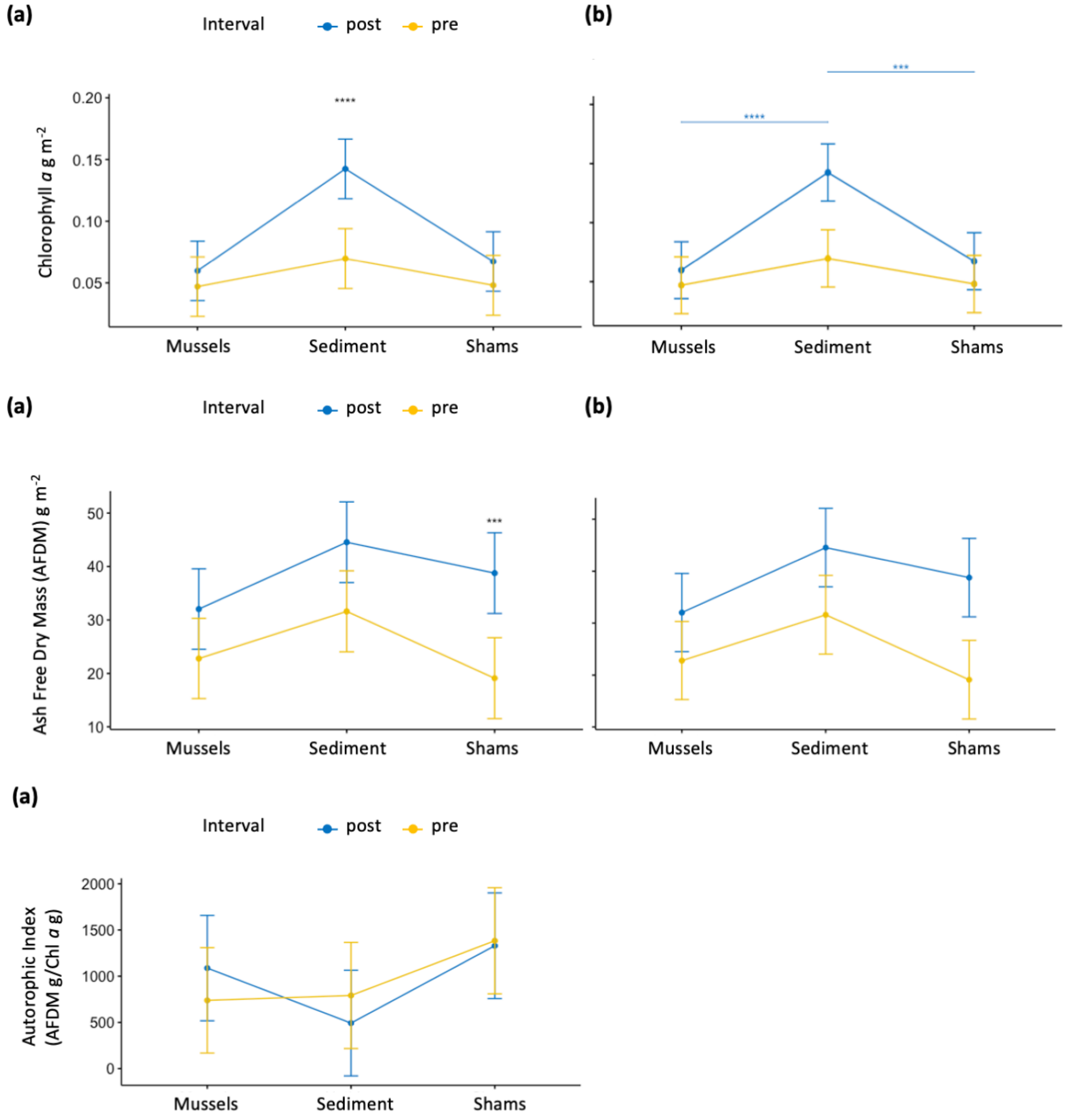
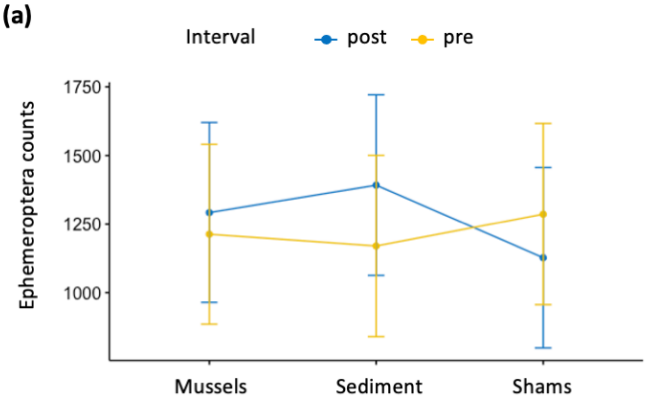
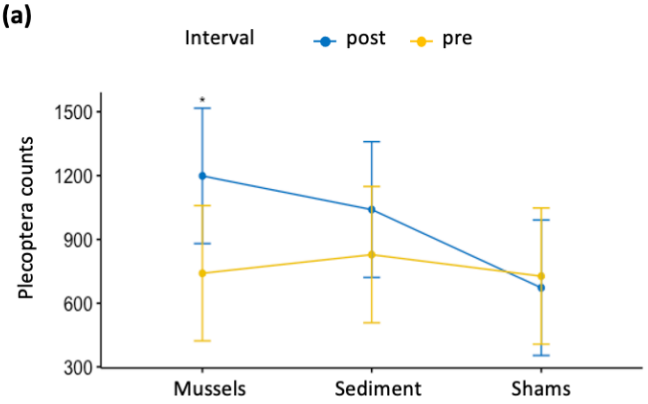


Figure 4-3. Pair-wise comparisons of treatments (Mussels, Sediment, & Shams) by measures of the response variables as benthos production (Chlorophyll a, Ash-Free Dry Mass, and Autrophic Index) and p adjusted with a Bonferroni correction across intervals (post-spawning & pre-spawning) with adjusted means (emmean). Comparisons are between: (a) interval group at each treatment; (b) treatment group at each interval.

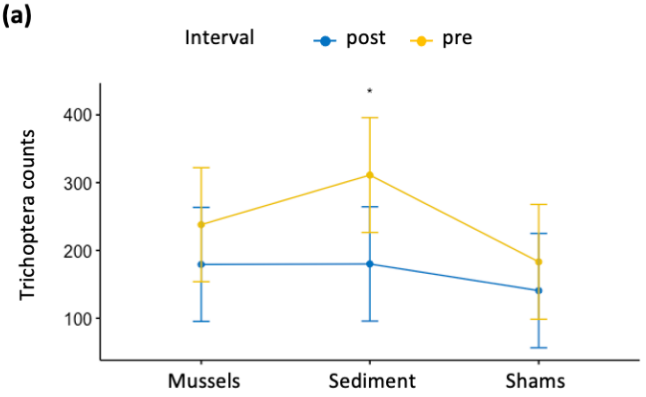
(a)


Interval
post
pre
Ephemeroptera counts
1750
1500
1250
1000
Mussels
Sediment
Shams

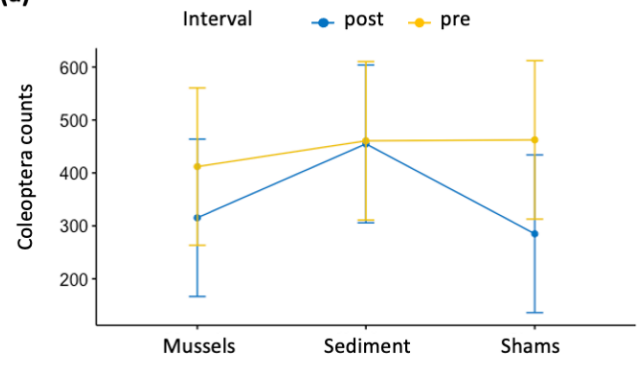
(a)


Interval
post
pre
Plecoptera counts
*
1500
1200
900
600
300
Mussels
Sediment
Shams

(a)


Interval
post
pre
Trichoptera counts
*
400
300
200
100
Mussels
Sediment
Shams

(a)


Interval
post
pre
Coleoptera counts
600
500
400
300
200
Mussels
Sediment
Shams

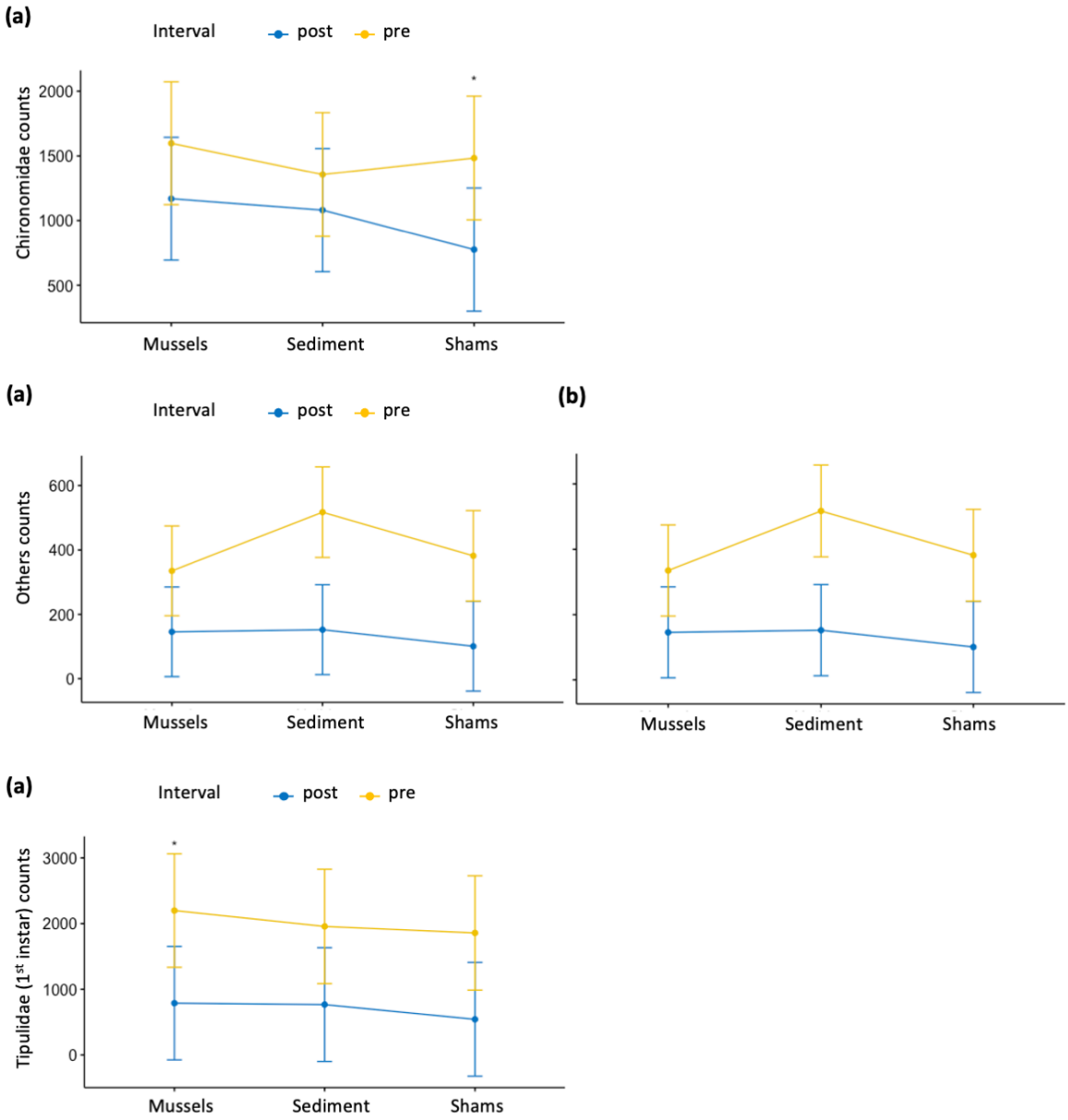


Figure 4-4. Pair-wise comparisons of treatments (Mussels, Sediment, & Shams) by measures of the response variables as invertebrate counts (Ephemenoptera, Plecoptera, Trichoptera, Coleoptera, Chironomidae, Others, and Tipulidae~1st instar) and p adjusted with a Bonferroni correction across intervals (post-spawning & pre-spawning) with adjusted means (emmean). Comparisons are between: (a) interval group at each treatment; (b) treatment group at each interval.

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