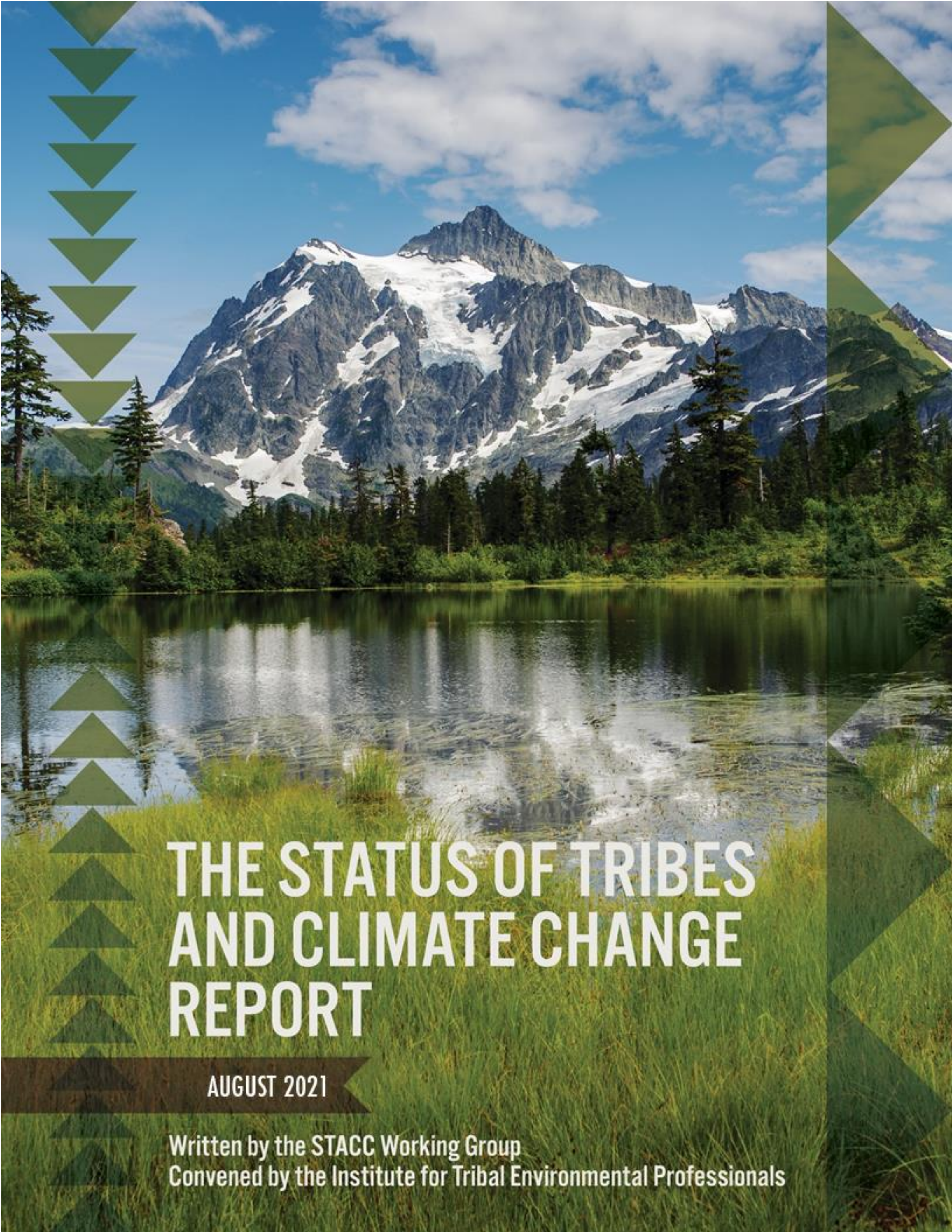

THE STATUS OF TRIBES AND CLIMATE CHANGE REPORT

AUGUST 2021

Written by the STACC Working Group
Convened by the Institute for Tribal Environmental Professionals

Cover photo: Mt. Shuksan, Washington

We acknowledge all Indigenous peoples across Turtle Island who have inhabited the lands, currently known as the United States of America, since time immemorial. We honor their past, present, and future knowledges, cultures, and lifeways for tending and preserving Mother Earth. We extend gratitude to and honor all our human and nonhuman relatives and the land, plants, waters, and air. We honor and recognize all voices of our Sisters, Brothers, Leadership, Elders, and Youth fighting for the next Seven Generations.

Produced by

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One of the aspects of this Report that makes it not only unique but also raw and personal is the inclusion of the voices of Tribes and Tribal people who are on the front lines in experiencing and responding to climate change. ITEP sincerely appreciates all the narrative contributors: Alexandria Warneke, Amber Pairis, Amy Boetcher, Anahma Shannon, April Taylor, Belén Rodriguez, Bob Blake, Carol Kriebs, Chantel Comardelle, Chaylum Hogue, Christian Nelson, Colleen Sanders, Collin Spriggs, Connor Magee, Coral Avery, Craig Kreman, Cynthia Naha, Daniel Mosley, Dara Marks-Marino, Darren McCrea, Debbie Dotson, Doug Crow Ghost, Elizabeth Azzuz, Fletcher Wilkinson, Frederick Olsen, Jr., James C. Collard, Jane Breckinridge, Jennifer Hill, Jessica Mauck, John Doyle, Kari Hedin, Kari Lanphier, Ken Lomayestewa, Krishna Woerheide, Margie Connolly, Mari Eggers, Opik Ahkinga, Page Hingst, Paula Ezcurra, Philomena Keyes, Sara Bliss, Scott Clow, Teara Farrow Ferman, Teresa Romero, Virginia LeClere, and Wenix Red Elk. Thanks also goes to Ann Marie Chischilly for writing the narrative introductions.

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The peer review process for the STACC Report involved four layers: 1) an internal peer review, made up of the Report authors, ITEP staff members, and others, 2) a federal agency review, made up of representatives from the BIA, 3) a single blind external peer review, made up of three highly qualified scholars, and 4) a final author and Steering Committee review. While this process was likely more robust than typical reports, we collectively recognized the need for the review process to not only be thorough, but also to capture inclusive and diverse thoughts and opinions. ITEP would like to acknowledge the work of all the internal peer reviewers: Adelheid Herrmann, Alexandria Warneke, Andy Bessler, Charlie Schlinger, Chas Jones, Colleen Cooley, Coral Avery, Dara Marks-Marino, Eva Burk, Haley Mullen, Jamie Donatuto, Joy Wiecks, Karen Cozzetto, Kathy Lynn, Kelsey Morales, Lynda Zambrano, Malinda Chase, Mansel Nelson, Mark Junker, Nikki Cooley, Sara Smith, Shannon McNeeley, Shasta Gaughen, and Stefan Tangen; as well as the federal agency reviewers from BIA: Rachael Novak, Alyssa Samoy, Crystal Keys, Harold Peterson, and Michael Benedict. While the external peer reviewers will remain anonymous to protect the integrity of the peer review process, we sincerely appreciate the time and effort they put into making this a more robust report. Thanks also goes to Risa Jacobson for her transcription and copy-editing expertise.

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It is impossible to attribute proper credit to all the conversations held, research conducted, webinars and conferences attended, and more that led to the thoughts, insights, and information included in this Report. Additionally, the groundwork laid by the authors of the National Climate Assessment, and their efforts to include Indigenous peoples in their publications, has contributed immensely to the breadth and depth of awareness in the U.S. of the impacts from climate change to Tribes.

Lastly, ITEP would like to thank the BIA TCRP for its continued support of Tribes, Tribal communities, and ITEP’s Tribes and Climate Change Program. Without the funding and support provided by the BIA’s TCRP, Tribal capacity in responding to climate change would be a fraction of what it is today.

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EXECUTIVE SUMMARY

The climate is changing. Global air temperatures are rising, as are sea levels throughout most of the U.S. Heavy rainfall is increasing in intensity and frequency. Atlantic hurricane intensity is on the rise, and the number of large forest fires in the western U.S. and Alaska is increasing and is exacerbated by drought and heat. In Alaska and the Arctic, sea ice is declining, permafrost is thawing, and warming is more than twice the global average (Walsh et al., 2014; Hayhoe et al., 2018; USGCRP, 2017).

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Given close relationships with the natural world stemming from deep spiritual and cultural connections and subsistence lifeways, Indigenous peoples are on the frontlines of those experiencing and adapting to climate change. Indigenous peoples possess incredible resiliency and innovation, borne from Indigenous knowledges, worldviews, and countless generations of connection to place (Ford et al., 2020). At the same time, climate change impacts for many Tribal communities are already severe (such as shifts in/loss of key cultural species and land loss due to erosion, flooding, and permafrost thaw), and the challenges they face responding to impacts are daunting (such as lack of funding and technical resources and legacies from colonialism and discrimination). The time to act is now, and the way to act is together: in community, taking care of one another and all our relations.

What Is the Status of Tribes and Climate Change (STACC) Report?

The *Status of Tribes and Climate Change (STACC) Report* seeks to uplift and honor the voices of Indigenous peoples across the U.S. to increase understanding of Tribal lifeways, cultures, and worldviews; the climate change impacts Tribes are experiencing; the solutions they are implementing; and ways that all of us can support Tribes in adapting to our changing world. Given this, the STACC Report was written for diverse audiences, including Tribal managers, leaders, and community members; the authors of future National Climate Assessments; federal and state agencies and decision-makers; and nongovernmental organizations. Over 90 authors representing diverse entities and perspectives contributed to this report, including the authors of 34 personal narratives and author teams who wrote topic reviews using elements from their own experiences and knowledge as well as information from the most current peer-reviewed literature. The development of the STACC Report was coordinated by the Institute for Tribal Environmental Professionals (ITEP), which was established in 1992 at Northern Arizona University with a cooperative agreement with the Bureau of Indian Affairs' Tribal Climate Resilience Program. ITEP is honored to have worked with these authors, who together, along with the Steering Committee, form the STACC Working Group.

Why This Report Was Created

The Indigenous peoples of North America have seen many hardships, including legacies of colonialism, forced assimilation, intergenerational trauma, upheaval and repression of Native economic systems, and the loss of ancestral lands, languages, natural resources, and traditions. Due to colonialization and subsequent land dispossession, social exclusion, and discrimination, researchers have identified Indigenous peoples globally and in the U.S. as populations “at-risk” to environmental change (Ford et al., 2020; Nakashima et al., 2018). Tribes have, however, continually proven to be resilient and innovative, which is evident in their creating adaptation and mitigation plans and continuing to rely on traditional knowledges to inform actions and strategies. This resiliency and adaptation dates back thousands of years and holds true in today’s changing climate.

As numerous Indigenous persons would attest to, the close relationship that Tribes have with their lands, waters, resources, and heritage includes a responsibility to one another, to all relations, and to the past and future generations of human and nonhuman relatives alike. It embodies the need to care for and respect the needs of all things and recognizes the responsibility to honor the wisdom of their ancestors and carefully consider the consequences of their decisions and actions for future generations. This may lead Tribal members to ask: what does it mean to be a good ancestor?

Due in part to these worldviews that are tightly interwoven with many compounding dimensions, Tribal experiences with climate change can make Indigenous peoples particularly vulnerable to cascading and disproportionate impacts, while their responses simultaneously support Tribal resilience to those impacts and are discussed throughout the STACC Report.

While Tribes cannot be thought of as one monolithic group, diverse Indigenous persons are in dialogue about synergies that exist among their worldviews. Numerous Indigenous persons have articulated that their worldviews understand all things as an interconnected whole, as shown in Figure 1, the *Indigenous Holistic Worldview Illustration*. There is inherent difficulty in writing a report that includes sectoral chapters about impacts experienced by Indigenous peoples that also reflects the interconnected nature of those experiences. However, as Figure 1 shows, each topic is interwoven with the others and all the systems of the world. (See *Introduction* for further discussion of Figure 1.)

Although Indigenous peoples have been involved in various scientific reports related to climate change (see Ch. 1), a gap exists in the published literature of a holistic, in-depth review of the unique experiences of and threats to Tribes, in particular with first-hand experiences described. The STACC Report aims to fill this gap as well as provide recommendations for decision-makers and others supporting Tribal efforts.

Understanding Tribal Sovereignty

In order to effectively support Tribes in their efforts to address climate change, it is vital to understand Tribal sovereignty, self-determination, the federal trust responsibility, and consultation requirements within the government-to-government relationship. Tribal sovereignty is the inherent right of American Indians and Alaska Natives to govern themselves, and any decisions that could impact their property or citizens must be made with their participation and consent (NCSL, 2013; USDOI Frequently Asked Questions, n.d.). Similar to states, Tribes "possess the right to form their own governments; to make and enforce laws, both civil and criminal; to tax; to establish and determine membership (i.e., tribal citizenship); [and] to license and regulate activities within their jurisdiction…" (USDOI Frequently Asked Questions, n.d.). The Indian Self-Determination and Education Assistance Act of 1975 articulates a

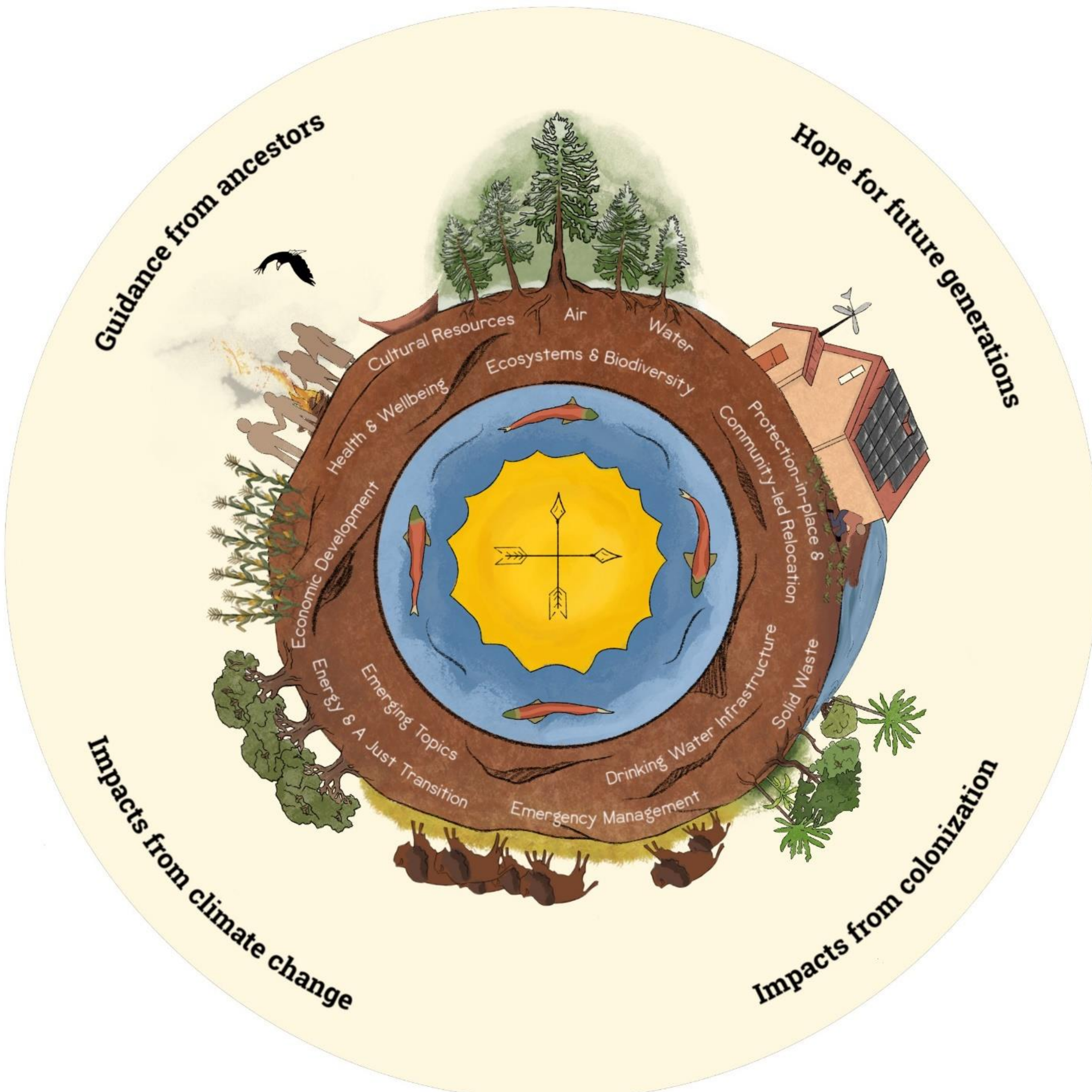

Figure 1. The Indigenous Holistic Worldview Illustration visually depicts the interconnected way in which many Indigenous peoples experience the world and includes factors that influence the natural world. The various topics that the STACC Report addresses are included in the roots to demonstrate that while the Report is divided into independent chapters, the topics are, in reality, part of an interdependent whole. This illustration's shape resembles a turtle in reference to Turtle Island, as some of the creation stories of Indigenous peoples of North America include a turtle, which can be thought of as either the continent of North America or as the entire Earth, depending on the storyteller. Illustration design: Coral Avery and Molly Tankersley

pathway for Tribal control, responsibility, and autonomy over programs and services usually administered by the Bureau of Indian Affairs (USDOI Self-Determination, n.d.; USDOI Frequently Asked Questions, n.d). The federal trust responsibility addresses the reality that Tribal nations ceded their homelands in exchange for the guarantee of protection of their rights to self-government and lands and to provide for federal assistance (NCAI Tribal Governance, n.d.). The government-to-government (or nation-to-nation) relationship is a fundamental principle of the federal trust responsibility (NCAI State/Tribal Relations, n.d.), and government-to-government consultation must occur from the beginning stages of all decision-making that could potentially impact Tribes.

Executive Order 13175, which was established in 2000, "reaffirms the Federal government's commitment to tribal sovereignty, self-determination, and self-government. Its purpose is to ensure that all Executive departments and agencies consult with Indian tribes and respect tribal sovereignty as they develop policy on issues that impact Indian communities" (DOE, 2000). This executive order was reaffirmed by the Biden administration on January 26, 2021. Sovereignty is an inherent right of Tribes, and the onus is on the federal government to ensure that right and government-to-government consultation are upheld. It is important to note that not all Indigenous groups/peoples have federal recognition, which limits their access to federal resources and impacts their ability to address climate change.

Chapter Number	Chapter Title
Chapter 1	History of Indigenous Peoples in National Climate Assessments
Chapter 2	Worldviews, Knowledges, & Social Impacts
Chapter 3	Actionable Science & Collaborative Climate Planning
Chapter 4	Ecosystems & Biodiversity
Chapter 4.1	Air
Chapter 4.2	Water
Chapter 4.2.1	Drinking Water Infrastructure
Chapter 5	Health & Wellbeing
Chapter 6	Economic Development: Renewables, Sustainable Economies, & Carbon Offsets
Chapter 7	Energy & a Just Transition
Chapter 8	Cultural Resources
Chapter 9	Emergency Management
Chapter 10	Protection-in-Place & Community-Led Relocation
Chapter 11	Solid Waste
Chapter 12	Emerging Topics

Table 1. Chapter numbers and titles for easy reference and an overview of the Report layout.

Interwoven Key Messages & Recommendations

The full list of Key Messages & Recommendations can be found within each chapter and in the Conclusion. Much like the interwoven nature of all the topics addressed in this report, the key messages and recommendations are interdependent and can be distilled into two themes: ***Respect and uphold Tribal sovereignty and self-determination*** and ***Integrate holistic responses in line with Tribal values***.

Key Message & Recommendation: Respect and Uphold Tribal Sovereignty and Self-Determination

Tribal sovereignty and self-determination help to counteract historical trauma, disproportionate climate change impacts, and vulnerability and are strong themes in the Recommendations across all chapters. The remedial dynamic of recognizing and respecting the pre-existing right of self-determination of Tribes should be acknowledged. Each chapter identifies key ways to promote Tribal sovereignty, including, but not limited to, the following actions and examples:

Engage Tribes early and often in decision-making processes (Chs. 3 and 10). Many federal programs and policies affecting Tribes have been designed without meaningful Tribal participation. Tribes should be central to such decision-making. Engaging Tribes early and often helps to ensure that programs developed are accessible to Tribal communities and that Tribal concerns, values, and priorities are included in decisions such as those about land or water management, the development of regulations, choices about what science questions to pursue, and more. One best "early and often" engagement practice is to establish Tribal partnerships before developing project proposals. Building relationships with Tribal leaders, managers, and community members is key to ensuring respectful dialogue and that intentions are trustworthy.

Increase co-management of natural resources. Co-management of natural resources involves cross-jurisdictional, cooperative, participatory collaboration in decision-making, planning, and enforcement (Ch. 3), and contributes to strengthening of food security and the realization of food sovereignty (Ch. 5). As the Kootenai Tribe of Idaho describes in their narrative in Ch. 4.1, their state-Tribal partnership improved monitoring capabilities during the 2020 wildfire smoke season.

Respect, include, and protect Indigenous and traditional knowledges in climate change actions. Such knowledges are a fundamental and interwoven part of Indigenous cultures and are important for understanding and responding to changes that are occurring. For instance, during climatic and other disruptions such as wildfires, extreme weather, and the COVID-19 pandemic, when access to commercial foods may be cut off, traditional hunting, fishing, and gathering methods form a source of local resilience. In addition to the information in Chs. 2, 3, 4, 5, and 12, a resource for better understanding this concept is the *Guidelines for Considering Traditional Knowledges in Climate Change Initiatives*.[1] As described in the Guidelines, Tribes must be able to choose to share or not share traditional knowledges with others.

Provide adequate funding for climate change adaptation (Chs. 4–12 and Appendix A). Inadequate funding remains one of the greatest barriers for Tribes to plan for and adapt to climate change, as well as to mitigate climate change through greenhouse gas reductions and developing a zero-carbon economy (Chs. 4.2.1, 6, 7, and 12). For example, across the U.S., Tribal communities are experiencing land loss due to erosion, flooding, and permafrost thaw (Chs. 4 and 10). Nationwide, at least $6.2 billion is needed over the next 50 years to protect, replace, and move existing Tribal infrastructure. This amount includes at least $175 million needed annually nationwide over the next ten years (Ch. 10).

[1] Guidelines for Considering Traditional Knowledges in Climate Change Initiatives: https://climatetkw.wordpress.com/about/

Increase coordination among federal programs so that financial and technical resources are more easily accessed by Tribes and are used more efficiently. When accessing climate change adaptation resources, Tribes may face hurdles navigating a federal system in which funding and technical expertise are dispersed across multiple departments and programs, each with differing and sometimes complicated processes for accessing resources (Ch. 4.2.1, 9, and 10). For example, programs that provide funding to construct public drinking water systems are located within seven different federal agencies, and there is no lead federal agency or program to help communities facing relocation (Ch. 4.2.1 and 10).

Build and retain capacity within Tribes to manage and adapt their resources and infrastructure to climate change through passing down of knowledge between elders and youth, workforce development, professional training to increase technical and managerial expertise, and the equitable and ethical use of Indigenous knowledges and Western science (see Chs. 3, 4.2.1, 5, 7, and 12). Tribal Colleges and Universities, for example, are important institutions for students to transition from education to their careers as professionals; on-the-job training programs allow for the application of emerging technologies such as those in energy generation; and hiring community members first ensures the local community will benefit. Workforce development can transcend inequity issues, contribute to strong economies, and help maintain cultural integrity. Federal responses should integrate support for these local capacity-building and retention efforts.

Provide Tribally-focused data, resources, and actionable science to support Tribal decision-making (Chs. 3 and 6 and Appendix B). Climate change occurs globally but is experienced locally in a variety of ways. Climate change data that is more local and integrated with local observations and knowledge can be more relevant for planning and actions. The University of Washington's *Tribal Climate Tool*,[2] for instance, provides Pacific Northwest Tribes with reservation-specific climate change data. Actionable science helps people make better decisions about things they care about and should start off with the question, "What does this community value?" This is aided by engaging Tribes early and often (see above).

Support the planning and implementation of Tribally-led solutions to Tribally-identified needs (Chs. 4.1 and 12 and Appendix A). Due to colonization, Tribes have had decisions about their futures imposed on them from outside entities. A key element of Tribal sovereignty involves Tribes identifying their own needs and priorities and leading their own responses and actions. The Climate Science Alliance's Tribal Working Group is one example of successfully building, supporting, and accelerating Tribal resilience in a Tribally-led environment in which the planning and implementation aspects are fully supported (narrative, Ch. 12). Another example is described by the Nottawaseppi Huron Band of the Potawatomi in Ch. 4.1: they had concerns about air pollution from area sources, which led to them directing their resources to strategically install PurpleAir monitors and develop an Environmental Dashboard to help protect the health of their Tribal members.

Key Message & Recommendation: Integrate Holistic Responses in Line with Tribal Values

As described above, Tribal worldviews, experiences, and responses embody interconnectedness. Cascading impacts from, and holistic and interconnected responses to, climate change are addressed throughout the STACC Report and include actionable steps such as:

When developing climate change solutions, recognize the interconnectedness of systems and consider strategies that achieve multiple objectives (see Chs. 4.2 and 5). Ocean acidification and harmful algae events negatively affect Indigenous food systems and security, human health, and local economies. Solutions like clam gardens—essentially, rock walls in bays or inlets that increase shellfish productivity—are an integrated response to multiple climate change impacts (e.g., rising tides, food security, and ocean acidification) and draw upon traditional knowledges. Exerting economic sovereignty through sustainable enterprise development is another strategy Tribes use to address system interconnectedness and achieve multiple objectives (see Ch. 6). Additionally, rising air temperatures and increasing drought may stress native vegetation, leaving plants more vulnerable to insect outbreaks and providing greater opportunities for invasive plants to become established. Large-scale, uncharacteristically high-severity wildfires that could contribute to ecosystem conversion may continue to increase. Cultural burning is a stewardship practice that can enhance ecosystem resilience to climate change and achieve multiple objectives by promoting drought-tolerant and fire-adapted vegetation species; inhibiting insect pests that affect foods such as nuts, seeds, and berries; mitigating large-scale detrimental fires; and promoting the growth of basket-weaving materials and medicinal and food species. By working with the fire regimes of native and nonnative vegetation, cultural burning can also inhibit the establishment of invasive plants. Momentum is gaining for the use of this multifaceted strategy as recognition of the benefits of cultural burning spreads beyond Tribal communities, scientific understanding of the role that fire plays in ecosystems builds, and legal policies that limit cultural burns shift (Chs. 4, 4.1, 5, 8, and 12.)

Increase partnerships across jurisdictional boundaries and at different scales and integrate climate change considerations into ongoing planning and implementation processes (Chs. 3, 4.2, 6, 9, and 12). Climate change impacts are often interconnected and complex, sometimes crossing jurisdictional lines. Integrating climate change into ongoing planning and implementation, along with collaborative responses at larger geographic scales, has the potential to be more cost-efficient, more inclusive with respect to decision-making, and less time-consuming and to lead to actions that are more sustainable in the long term. Ch. 12 describes how Tribes are participating in a variety of cross-boundary, collaborative projects, including the Rio Grande Water Fund hosted by The Nature Conservancy. The Fund supports large-scale forest restoration by a variety of entities in the aftermath of an extensive wildfire to ensure a clean water supply for the region's people and wildlife, both now and in the future. Examples of plans in which climate change can be considered as one factor among many include: FEMA Tribal Hazard Mitigation Plans; EPA Tribal Environmental Plans; Land/Resource Management Plans; Community Comprehensive Plans; and BIA forest, wildland fire, irrigation, fish and wildlife, agricultural, and integrated resource management plans.

Implement climate adaptation strategies that are proactive versus solely reactive (Chs. 4.2, 4.2.1, and 11). In contrast to reactive responses, proactive strategies anticipate future scenarios and plan for problems that may occur before they take place, helping to minimize harm. Climate-resilient drinking water systems, for example, provide reliable service with limited disruptions and/or harm in the face of changing environmental conditions and extreme climate events. If disruptions occur, systems can recover quickly. Infrastructure deficiencies provide opportunities to install new infrastructure in climate-resilient ways that can help decrease emergencies. System upgrades provide occasions to improve the climate resiliency of existing infrastructure.

Connect solutions to Tribal values and priorities, and recognize the tangible and intangible significance of climate change impacts. Tribes may have different views than their non-Tribal counterparts with respect to what they value and prioritize, and not all resources have tangible value or risk of loss (Ch. 8). Ch. 5 describes how the Swinomish Indian Tribal Community, for instance, developed Indigenous Health Indicators (IHIs) that contrast somewhat with a more western view of health. The indicators include community connection, cultural use, education, natural resource security, self-determination, and resilience. The Swinomish Tribal government used these IHIs to prioritize and make decisions about how to use limited time and resources to address sea level rise and storm surge impacts to key first foods habitats.

Support Tribes' just transitions away from fossil fuels. Tribal self-determination means that decisions made by individual Tribes will vary, but a just transition away from fossil fuels and towards renewable energy will ensure that regenerative and sustainable economies are a part of the restoration of Indigenous peoples' lifeways (Chs. 6 and 7). Some Tribal economies are dependent on fossil fuels, which is an unsustainable economic model, and the burning of fossil fuels is ultimately driving climate change. The Hopi Tribe's economy has depended on coal for 50 years, and the closure of the area's coal mine was a devastating loss. The Tribe is working towards transitioning to renewable energy development to improve the health of the community while also creating new revenue and jobs (narrative, Ch. 7).

The 2021 STACC Report is the first of its kind. Future STACC Reports will seek to identify new topics and developments important to Tribes and current topics that this edition did not cover. The authors of future Reports will also continue to strive to integrate topics holistically.

Building on the successes of Tribes and individuals who have dedicated their lives to elevating Indigenous peoples' concerns and implementing the changes imperative to improving their lives, the 2021 STACC Report demonstrates the unique climate change impacts experienced by Tribes and the many ways they are responding. Gaining an understanding of Tribal worldviews, traditional knowledges, and the increased impacts that many Tribal communities face may lead to improved responses to climate change in the U.S. and greater environmental and social justice for the original peoples of this land. When we recognize we are not separate from our natural environment and value justice, equity, and respect for all our relations, we may collectively achieve a society in which all can thrive.

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NOTES ON TERMINOLOGY

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Status of Tribes and Climate Change Working Group (STACCWG)

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Whyte, K., & STACCWG. (2021). Terminology. In *Status of Tribes and Climate Change Report* [Marks-Marino, D. (ed.)]. Institute for Tribal Environmental Professionals, pp. 15–17.

The terminology employed throughout the *Status of Tribes and Climate Change Report* reflects an effort to emphasize the importance of the meanings of Indigenous concepts, worldviews, knowledge, and languages. In some cases, there are straightforward words that can be used whose meanings correspond appropriately with Indigenous meanings. In other cases, readers have to exercise a respectful interpretation that there may be few if any appropriate English language words that correspond appropriately with Indigenous meanings. Some of the authors of the Indigenous peoples sections and chapter of the NCA4 developed a document titled *Indigenous Peoples Terminology for the Fourth National Climate Assessment*,[2] where they thoughtfully laid out definitions of terms. While, for the most part, the terminology used in this Report is in alignment with the definitions in the NCA4 terminology document, there are a few slight differences. Readers of the Report should expect to see diverse choices made about terminology. The rule used in the Report is to use terminology consistent with the best expression of information about Indigenous understanding, experience, and goals with respect to climate change. The authors collaborated with one another to determine what choices would be made about terminology. While the following list is not exhaustive, key terminology and stylistic choices are as follows:

Indigenous peoples: The term “Indigenous peoples” is used to be inclusive of self-determining societies whose political and cultural foundations pre-exist the formation of the United States, regardless of their recognition status by the United States government. “Indigenous peoples” includes the 574 federally recognized Tribes as of 2020, Native Hawaiians, state-recognized Tribes, and unrecognized Tribes and peoples. More specific terms will be used where the particular government, legal, cultural, or diplomatic situation is being referenced. Indigenous peoples’ self-determination can be best respected by using terminology that acknowledges Indigenous governance systems. Indigenous peoples are not stakeholders, but self-governing and sovereign societies. The authors of the Report must rely on general words like “culture” or “knowledge” to stand in for complex, place-based institutions and scientific traditions, which can fail to convey the diversity of Indigenous peoples’ lifeways and social structures. In some parts of the Report, the authors are deliberate to use words such as “some” or “diverse” to convey differences across Indigenous peoples.

Terms such as Tribe, Tribal, Tribal peoples, Tribal communities, and Indigenous peoples are all used throughout the Report, as appropriate to the context. The term “Alaska Natives” is a formal, legal, and functional term used specifically to refer to the Indigenous peoples of Alaska.

[2] Indigenous Peoples Terminology for the Fourth National Climate Assessment: http://www7.nau.edu/itep/main/tcc/docs/resources/Indigenous Peoples Terminology for NCA4_final.pdf

Capitalization choices: Consistent with some academic and international conventions, there will be capitalization of the words "Indigenous" and "Tribe/Tribal." It is important to be aware that there is no universal or widely accepted rule about capitalization. Different authoritative sources on grammar and style—whether from professional societies, style guides, political agencies, or international organizations—offer different and incongruent guidance. The decisions about capitalization in this Report reflect the will of the authors and steering committee who sought to focus on being respectful of Indigenous self-determination and being vigilant about past and continuing textual assumptions that can marginalize Indigenous peoples' presence.

In this Report, the terms "Indigenous" and "Tribe/Tribal" are being used to denote specific meanings of Indigeneity tied to government, culture, and diplomacy. For this reason, the Report is conveying to the reader meanings that actually do fulfill a certain conventional wisdom about when to capitalize. There may be some isolated instances in the Report when capitalization may not be respectful or conventional, which the Report's lead authors took responsibility in evaluating. In cases of the terms "Indigenous peoples" and "Tribal nations," the rule followed in the Report is not to capitalize "peoples" or "nations," unless a particular usage is conventional in some context. One example of an exception is the use of the term "First Nations" in Canada, which almost always capitalizes "Nations."

Terminology related to ecosystems and climate change: Indigenous peoples' knowledge systems have developed different concepts for understanding ecosystems, biodiversity, and climate change. Yet given the dominance of the English language, Indigenous persons have had to find ways to communicate collaboratively in English with non-Indigenous persons. Indigenous leaders, knowledge keepers, and scholars have expressed concern that some English-language concepts do not give sufficient awareness or respect to how Indigenous peoples understand relationships with the environment, especially when considering Indigenous conceptions of cosmology, kinship, and responsibility. Terms or phrases like "ecosystem services," "biota," or "invasive species" are important examples. These terms or phrases can connote instrumental, physical, and transactional relationships with species and aspects of the environment, but exclude relationships that carry important connotations regarding obligations and responsibilities for caretaking and kinship that are fundamental within many Indigenous peoples' cosmologies, worldviews, and cultures. The authors took seriously the problem of navigating the dominance of the English language and how such dominance affects Indigenous expression.

The Report does, in places, use more Indigenous-inspired conventions in English, where appropriate. For example, instead of "ecosystem services," some parts of the Report discuss responsibilities connecting diverse species in mutually beneficial relationships. Instead of using scientific names for individual species, some authors may use common names for ease of understanding by Indigenous peoples. At the same time, some of these English-language terms are best preserved to protect the scientific integrity of the terminology within particular literature. In other cases, Indigenous peoples have used these terms to enhance communication within multicultural exchanges of information. In some parts of the Report, "knowledge" is pluralized as "knowledges" to reflect the diversity of knowledge within Indigenous peoples and across them.

Certain Indigenous individuals and cultures refer to living entities as beings, and their use of this term may apply to or encompass humans, plants, animals, or even microorganisms. Additional context may be provided as far as, for example, whether beings are welcomed or unwelcomed (e.g., pathogens) or whether they have long been present in Indigenous communities or areas or whether they are newly arrived (invasive).

Some Suggested Reading with Connections to Choices on Terminology

Bird, M. Y. (1999). What We Want to Be Called: Indigenous Peoples' Perspectives on Racial and Ethnic Identity Labels. American Indian Quarterly, 23(2), 1–21. https://doi.org/10.2307/1185964

IJIHDefiningIndigenousPeoplesWithinCanada.pdf. (n.d.). Retrieved November 15, 2020, from https://journals-uvic-ca.proxy.lib.umich.edu/journalinfo/ijih/IJIHDefiningIndigenousPeoplesWithinCanada.pdf

CTKW (Climate and Traditional Knowledges Workgroup) (2016). The Ethics of Traditional Knowledge Exchange in Climate Change Initiatives. Earthzine. http://earthzine.org/2015/07/31/the-ethics-of-traditional-knowledge-exchange-in-climate-change-initiatives/. Retrieved December 1, 2020.

Johnson, J. T., Cant, G., Howitt, R., & Peters, E. (2007). Creating Anti-colonial Geographies: Embracing Indigenous Peoples' Knowledges and Rights. Geographical Research, 45(2), 117–120. https://doi.org/10.1111/j.1745-5871.2007.00441.x

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ACRONYMS USED IN THIS REPORT

ACS	U.S. Census Bureau's American Community Survey
AF	Acre Feet
AI/AN	American Indians and Alaska Natives
AIHEC	American Indian Higher Education Consortium
ANCSA	Alaska Native Claims Settlement Act
ANTHC	Alaska Native Tribal Health Consortium
AOS	Arctic Observing Summit
AP	Adaptation Plan
APHIS	Animal and Plant Health Inspection Service
AQP	Air Quality Program
ASPIRE	Advancing Science Partnerships for Indoor Reductions of Smoke Exposures
ATNI	Affiliated Tribes of Northwest Indians
BGA	Blue-Green Algae
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practices
BOD	Biological Oxygen Demand
BRFO	Blue River Foundation of Oklahoma
CAA	Clean Air Act
CAKE	Climate Adaptation Knowledge Exchange
CASC	Climate Adaptation Science Center
CCHRC	Cold Climate Housing Research Center
CDC	Centers for Disease Control and Prevention
CFLRP	Collaborative Forest Landscape Restoration Program
cfs	Cubic Feet per Second
CJRF	Climate Justice Resilience Fund
CNRA	Chickasaw National Recreation Area
CPN	Citizen Potawatomi Nation
CRCCS	Cultural Resources Climate Change Strategy
CRS	Congressional Research Service
CRWU	Creating Resilient Water Utilities
CSA	Climate Science Alliance
CSKT	Confederated Salish and Kootenai Tribes
CSZ	Cascadia Subduction Zone
CTKW	Climate and Traditional Knowledges Workgroup
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DOE	Department of Energy
DOI	Department of Interior
EAB	Emerald Ash Borer
ECHO	Enforcement Compliance History Online
EEOP	Environmental Education Outreach Program
EI	Emissions Inventory
EPA	Environmental Protection Agency

ESFs	Emergency Support Functions
FARR	Federal Air Rules for Reservations
FEMA	Federal Emergency Management Agency
FHORT	Framework of Historical Oppression, Resilience and Transcendence
FRP	Fire Radiative Power
FWS	Fish and Wildlife Service
GAO	Government Accountability Office
GAP	General Assistance Fund
GCRA	Global Change Research Act
GIS	Geographic Information System
GLIFWC	Great Lakes Indian Fish & Wildlife Commission
GSHP	Ground Source Heat Pump
HAB	Harmful Algal Bloom
HAE	Harmful Algae Event
HEARTH	Helping Expedite and Advance Responsible Tribal Home Ownership
HITS	Home Inventory Tracking System
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HNR	Hanford Nuclear Reservation
HRL	Health Reference Level
HUD	Housing and Urban Development
HWB	Health and Wellbeing
IDEQ	Idaho Department of Environmental Quality
IDJC	Isle de Jean Charles
IEN	Indigenous Environmental Network
IGAP	Indian General Assistance Program
IGSM-CAM	Integrated Global System Model–Community Atmosphere Model
IHIs	Indigenous Health Indicators
IHS	Indian Health Services
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
IPCCWG	Indigenous Peoples Climate Change Working Group
IRMP	Integrated Resource Management Plan
ITEDSA	Indian Tribal Energy Development and Self-Determination Act
ITEP	Institute for Tribal Environmental Professionals
ITF	Infrastructure Task Force
KSM	Kerr Sulphurets Mitchell
LAWA	Lake of the Arbuckles Watershed Association
LPNF	Los Padres National Forest
MACS	Multiagency Coordination Groups
MCL	Maximum Contaminant Level
MTE	Menominee Tribal Enterprises
MW	Megawatts
NAFSI	Native Agriculture and Food Systems Scholarships
NASA	National Aeronautics and Space Administration

NAU	Northern Arizona University
NCA	National Climate Assessment
NCAI	National Congress of American Indians
NFIP	National Flood Insurance Program
NGO	Nongovernmental Agency
NHBP	Nottawaseppi Huron Band of the Potawatomi
NIACS	Northern Institute of Applied Climate Science
NICC	National Indian Carbon Coalition
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NPNH II	Native Peoples-Native Homelands second workshop
NPS	National Park Service
NREL	National Renewable Energy Laboratory
NRF	National Response Framework
NTAA	National Tribal Air Association
NTEMC	National Tribal Emergency Management Council
NYCALC	Native Youth Community Adaptation and Leadership Congress
O&M	Operations and Maintenance
ODEQ	Oklahoma Department of Environmental Quality
PAH	Polycyclic Aromatic Hydrocarbons
PBPN	Prairie Band Potawatomi Nation
PM	Particulate Matter
PNSN	Pacific Northwest Seismic Network
PNW	Pacific Northwest
PSP	Paralytic Shellfish Poisoning
PTSD	Post-traumatic Stress Disorder
PV	Photovoltaic
PWS	Public Water System or Public Drinking Water System
RCPs	Representative Concentration Pathways
RPS	Renewable Portfolio Standard
RTC	Reservation Tribal Council
SAFER	Safe and Affordable Funding for Equity and Resilience
SAITC	Southeast Alaska Indigenous Transboundary Commission
SDS	Sanitation Deficiency System
SDWA	Safe Drinking Water Act
SEATOR	Southeast Alaska Tribal Ocean Research
SMBMI	San Manuel Band of Mission Indians
SMM	Sustainable Materials Management
STACC	Status of Tribes and Climate Change
STACCWG	Status of Tribes and Climate Change Working Group
STA-ERL	Sitka Tribe of Alaska Environmental Research Lab
STAR	Status of Tribal Air Report
STEAM	Science, Technology, Engineering, Art, and Math
STEM	Science, Technology, Engineering, and Math
SYCEO	Santa Ynez Band of Chumash Indians Environmental Office

TAM	Tribal Adaptation Menu
TAP	Tribal Alliance for Pollinators
TAR	Tribal Authority Rule
TCRP	Tribal Climate Resilience Program
TCUs	Tribal Colleges and Universities
TDS	Total Dissolved Solids
TEAM	Tribal Environmental Action for Monarchs
TEISS	Tribal Emissions Inventory Software Solution
TERA	Tribal Energy Resource Agreements
TNC	The Nature Conservancy
TWG	Tribal Working Group
UCAR	University Corporation for Atmospheric Research
UCMR	Unregulated Contaminant Monitoring Rule
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGCRP	U.S. Global Change Research Program
USGS	United States Geological Survey
VA	Vulnerability Assessment
VW	Volkswagen
WCS	Wildlife Conservation Society
WQI	Water Quality Index
WQMP	Water Quality Monitoring Program

INTRODUCTION

> ***Chapter Lead***
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>
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The *Status of Tribes and Climate Change (STACC) Report* seeks to uplift and honor the voices of Indigenous peoples across the U.S. to increase understanding of Tribal lifeways, cultures, and worldviews; the climate change impacts Tribes are experiencing; the solutions they are implementing; and ways that all of us can support Tribes in adapting to our changing world. The Indigenous peoples of North America have seen many hardships, including legacies of colonialism, forced assimilation, intergenerational trauma, upheaval and repression of Native economic systems, and the loss of ancestral lands, languages, natural resources, and traditions but have continually proven to be resilient and innovative in finding solutions. This resiliency dates back thousands of years to time immemorial and holds true in today's changing climate. Furthermore, as this Report and the narratives herein demonstrate, Tribes are often at the leading edge in adapting to climate change; implementing locally based, scientifically supported actions to mitigate climate change; and creating the necessary systemic shifts to reconnect people with both environment and community. Despite this resiliency, climate change impacts for many Tribal communities are already severe, the challenges they face responding to impacts are daunting, and the need to take action is urgent.

Tribal ability to respond to climate change is influenced by capacity and the degree to which they can exercise their sovereignty, which is in turn influenced by external policies. The Doctrine of Discovery is one such external policy and was utilized from the mid-1400s through the mid-1900s to influence and justify the dispossession of Indigenous lands. Ideas that led to the Doctrine of Discovery predate the colonization of the Americas, with foundational elements dating back as early as the 1100s (Upstander Project, n.d.). Federal Indian policy has shifted over time, in large part due to the ongoing efforts of Tribal communities who have continually engaged in activism, political participation, and resistance movements. Previous eras of federal Indian policy include Relocation (1828–1887),[3] Allotment and Assimilation (1887–1934), Indian Reorganization (1934–1953), Termination (1953–1968), and Self-Determination (1968–present) (Pevar, 2012). Most recently, federal Indian policy has coupled Self-Determination with Self-Governance, which "returns decision-making authority and management responsibilities to Tribes" (as quoted in Wilkins & Kiiwetinepinesiik Stark, 2011). This is implemented across several federal agencies through self-determination contracts and compacts with Tribes to manage, develop, and take ownership of their programs, functions, services, and activities, including many environmental and health programs.

[3] The Treaty-Making Era (~1778–1871) and the Removal Era (~1820–1850) overlap with the Relocation Era; the Removal Era is very similar to the Relocation Era.

On January 26, 2021, President Biden released a [Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships](https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/26/memorandum-on-tribal-consultation-and-strengthening-nation-to-nation-relationships/),[4] reaffirming the critical importance of Executive Order 13175, which charges all federal agencies to engage in "regular, meaningful, and robust consultation with Tribal officials," in all matters with Tribal implications. The memorandum opens with the following paragraph:

> *American Indian and Alaska Native Tribal Nations are sovereign governments recognized under the Constitution of the United States, treaties, statutes, Executive Orders, and court decisions. It is a priority of my Administration to make respect for Tribal sovereignty and self-governance, commitment to fulfilling Federal trust and treaty responsibilities to Tribal Nations, and regular, meaningful, and robust consultation with Tribal Nations cornerstones of Federal Indian policy. The United States has made solemn promises to Tribal Nations for more than two centuries. Honoring those commitments is particularly vital now, as our Nation faces crises related to health, the economy, racial justice, and climate change—all of which disproportionately harm Native Americans. History demonstrates that we best serve Native American people when Tribal governments are empowered to lead their communities, and when Federal officials speak with and listen to Tribal leaders in formulating Federal policy that affects Tribal Nations.*

Understanding Tribal Sovereignty

In order to effectively support Tribes in their efforts to address climate change, it is vital to understand both Tribal sovereignty, self-determination, the federal trust responsibility, and consultation requirements within the government-to-government relationship. Tribal sovereignty is the inherent right of American Indians and Alaska Natives to govern themselves, and any decisions that could impact their property or citizens must be made with their participation and consent (NCSL, 2013; USDOI Frequently Asked Questions, n.d.). Similar to states, Tribes "possess the right to form their own governments; to make and enforce laws, both civil and criminal; to tax; to establish and determine membership (i.e., tribal citizenship); [and] to license and regulate activities within their jurisdiction…" (USDOI Frequently Asked Questions, n.d.). The Indian Self-Determination and Education Assistance Act of 1975 articulates a pathway for Tribal control, responsibility, and autonomy over programs and services usually administered by the Bureau of Indian Affairs (USDOI Self-Determination, n.d.; USDOI Frequently Asked Questions, n.d). The federal trust responsibility addresses the reality that Tribal nations ceded their homelands in exchange for the guarantee of protection of their rights to self-government and lands and of provision for federal assistance (NCAI Tribal Governance, n.d.). The government-to-government (or nation-to-nation) relationship is a fundamental principle of the federal trust responsibility (NCAI State/Tribal Relations, n.d.), and government-to-government consultation must occur from the beginning stages of all decision-making that could potentially impact Tribes.

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[4] Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships, January 21, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/26/memorandum-on-tribal-consultation-and-strengthening-nation-to-nation-relationships/

Elevating Tribal Voices

The STACC Report includes 34 narrative submissions directly from Tribes, which are identified in the Report by using green font. These narratives include diverse voices that speak of the innovative, active, collaborative projects addressing the serious challenges that Tribes face, their searches for solutions, their use of both traditional knowledges and Western science, and much more. Impacts from climate change and Tribal responses to climate change are as diverse as are the Tribes across the U.S. As the narratives in this Report demonstrate, many Tribes are on the cutting edge of climate change adaptation and mitigation, while others struggle with limited capacity to respond to the major changes they are experiencing. Tribes have shown time and again that their traditional lifeways, worldviews, knowledges, and wisdom provide guidance for the systemic shift that is necessary to create a sustainable, reciprocal relationship with the environment.

The design of the STACC Report reflects the intention to uplift and honor Indigenous voices. *Section 1: Briefing on Climate Change in the Tribal Context* gives an overview for the reader to deepen their understanding of how Tribal lifeways and cultures influence their potential responses to climate change and how their lifeways and cultures are dependent upon clean air and water, healthy soils, and the ability to exercise their inherent sovereignty. *Section 2: Impacts & Solutions by Topic* is structured to highlight the Tribal narratives by including them in the beginning of each chapter, followed by reviews of each topic by the diverse writing teams. The *Conclusion, Key Messages, and Recommendations* includes a full listing of the key messages and recommendations generated by the authors of each chapter. *Appendix A: Funding* highlights key resources to assist Tribes in developing funding strategies for Tribal climate change projects, and *Appendix B: Resources* provides descriptions and links to resources of all types mentioned throughout the STACC Report.

The topic reviews in Sections 1 and 2 were written by teams of authors representing a wide array of backgrounds and expertise who include elements from their own experiences and knowledge as well as information from the most current peer-reviewed literature. These teams provide diverse expertise, writing styles, and perspectives on the key points to address in Tribal responses to climate change.

The STACC Report seeks to create dialogue across diverse cultures, heritages, and worldviews. Many Indigenous perspectives worldwide describe the environment, climate change, and the various impacts and solutions as an interconnected whole, demonstrating some of the uniqueness of how Indigenous peoples understand the world. (See *Chapter 2: Worldviews, Knowledges, & Social Impacts*.) The Indigenous Holistic Worldview Illustration (Figure 1) was developed for this Report to visually depict the interconnected way in which many Indigenous peoples experience the world. For most Indigenous communities, there is no separation between earth, sky, water, humans, animals, plants, and other elements. All are interconnected relations, and the experiences of one inevitably affect the others. Other factors also influence these interconnected systems, such as the legacy of colonialism, guidance from ancestors, choices today that will affect future generations, and climate change.

The 2021 STACC Report also seeks to inform the work of the U.S. National Climate Assessment (NCA). As described in the next chapter, the NCA has included Indigenous peoples in the last several iterations, most heavily in *Chapter 15: Tribes and Indigenous Peoples* in NCA4 (2018), but the need for a deeper dive into the experiences and circumstances of Tribal peoples required a novel approach. Hence, the STACC Report was created. While the 2021 STACC Report addresses a wide variety of topics, it is by no means exhaustive of all the impacts felt by Tribes, solutions implemented by Tribes, or factors that impact Tribes, as related to climate change. Future editions of the STACC Report will attempt to fill the gaps left by the 2021 edition, as well as provide updates that occur between now and the next publication.

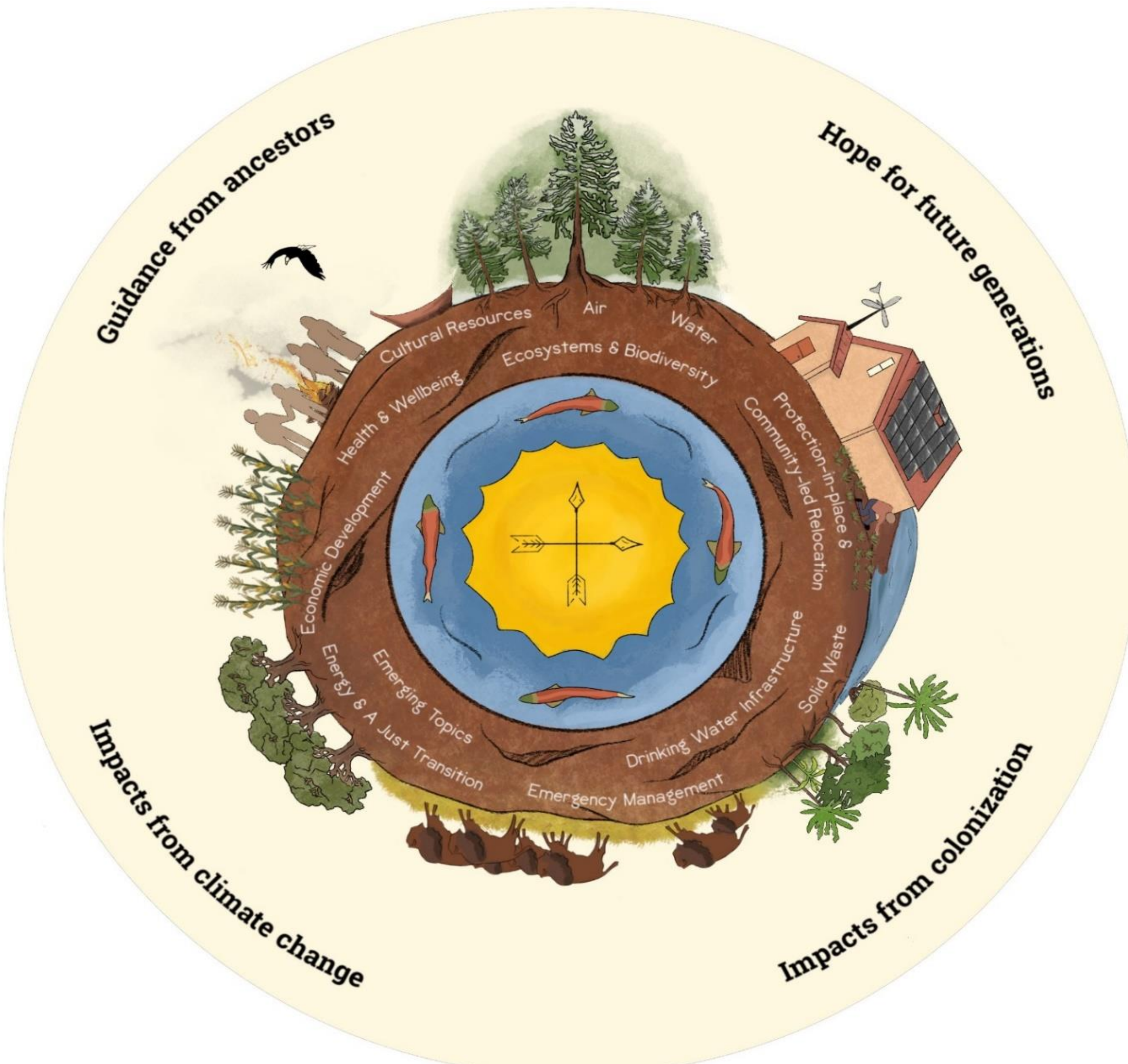

Figure 1. The Indigenous Holistic Worldview Illustration visually depicts the interconnected way in which many Indigenous peoples experience the world and includes factors that influence the natural world. The various topics that the STACC Report addresses are included in the roots to demonstrate that while the Report is divided into independent chapters, the topics are, in reality, part of an interdependent whole. The Illustration shape resembles a turtle in reference to Turtle Island, as some of the creation stories of Indigenous peoples of North America include a turtle, which can be thought of as either the continent of North America or as the entire Earth, depending on the storyteller. Illustration design: Coral Avery and Molly Tankersley

Introduction References

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Pevar, S. L. (2012). *The rights of Indians and tribes*. Oxford University Press.

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SECTION 1: BRIEFING ON CLIMATE CHANGE IN THE TRIBAL CONTEXT

Chapter 1: History of Indigenous Peoples in National Climate Assessments

History of Indigenous Peoples in NCAs
Key Message
Indigenous peoples have been substantively involved in national and international climate assessments for decades, and this involvement has grown, including more Indigenous engagement and authorship on the third and fourth National Climate Assessments. There is still much work to be done to engage and include Indigenous perspectives, knowledge, and expertise in climate assessments.

Recommendation
Future reforms to make NCAs more inclusive should acknowledge, learn from, and build on Indigenous peoples' involvement throughout the history of the U.S. Global Change Research Program.

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Indigenous peoples globally have worked to advance their equitable participation in high-stakes scientific reports. In New Zealand, a Māori Working Group on climate change formed following the establishment of the New Zealand Climate Change Programme in 1988 and a workshop that same year entitled "Climate Change: The New Zealand Response" (Tunks, 1997). The Arctic Council called for the creation of the Arctic Climate Impact Assessment, which issued a 2004 report entitled "Impacts of a Warming Arctic." At the time, and currently, the Council consists of eight arctic states, six Indigenous permanent participants, and various official observers. The Indigenous permanent participants include the Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, and Saami Council (Arctic Climate Impact Assessment, 2004). Diverse scientific reports, more locally and globally, have their own histories of engagement with and involvement of Indigenous peoples (see, for example: Goode et al., 2018; IPCC, 2019).

In the U.S., diverse Indigenous peoples and Indigenous educational institutions, such as Tribal colleges and universities, have long been involved with scientific research and assessment performed by federal and state agencies, universities, and nonprofit organizations. We will discuss the many ways that, since at least the mid-1990s, Indigenous persons have been substantively involved with the U.S. Global Change Research Program (USGCRP), a program mandated by Congress in the Global Change Research Act (GCRA). The GCRA of 1990 seeks to advance “a comprehensive and integrated United States research program, which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.”

One of the first engagements was the Native Peoples-Native Homelands Workshop (Albuquerque, NM, 1998), which was organized by NASA and the Intertribal Council on Utility Policy. The workshop included over 100 participants representing Tribal leadership, Tribal organizations, Indigenous knowledge-keeping traditions, U.S. government, and climate science. The final report from that workshop, titled *Circles of Wisdom*, was published in 2002 (Maynard, 2002). The report references the Indigenous-focused chapter in the first NCA (NCA1) (National Assessment Synthesis Team, 2000). It states, “Following this workshop, the discussion results from the Wisdom Circles (Breakout Groups) were synthesized and augmented based upon comments from a number of workshop participants and other reviewers into what is now Chapter 12 of the U.S. National Assessment” (Maynard, 2002, Editor’s Notes). The chapter is titled, “Potential Consequences of Climate Variability and Change for Native Peoples and Homelands” (Houser et al., 2000).

The chapter highlighted the importance of Indigenous knowledge systems and that Indigenous peoples have a history of relating to human-caused climate change through land-use changes imposed on them by the actions of U.S. citizens and policy-makers. Key issues included tourism and community development, human health and extreme events, rights to water and other natural resources, subsistence economies and other natural resources, and cultural sites, wildlife, and natural resources (p. 351). The chapter advocates for more research relating to Indigenous peoples and climate change while raising ethical concerns about previous abuses by researchers. NCA1 also included an Overview Report that was intended to be more widely accessible to the public. Limited material from Chapter 12 was included within a regional section in the NCA1 Overview Report. A 1999 Special Issue on Indigenous peoples and climate change in the academic journal *Native Americas* references the Native Peoples-Native Homelands workshop and the GCRA (Barriero, 1999).

In NCA2 (Karl et al., 2009), there are references in a section on “society” to the description of “unique vulnerabilities” of Native Americans, including “limited relocation options,” specific mentions of Alaska, reduction of availability of traditional food sources, problems of Indigenous peoples being subject to flooding and erosion, and how Native cultures in the Southwest are vulnerable to climate change impacts on water availability and quality. In references to regional climate change impacts in the Great Plains, Southwest, and Alaska, some Tribal issues are referenced. There is no Tribal chapter, nor are Indigenous peoples referenced in the recommendations. It is unclear how Indigenous authors or topical experts may have contributed. At the same time, during this broad period, Indigenous peoples continued to organize efforts to address climate change. The Indigenous Peoples Climate Change Working Group (IPCCWG) was established at Haskell Indian Nations University (2006) (Shepherd, 2016). Members of the IPCCWG have contributed to NCA and other climate assessments. Grossman documented reports and conferences on Indigenous peoples and climate change during the years 2006 and 2007 (Grossman, 2008, 2009), such as the Northwest Indian Applied Research Institute's report titled *Climate Change and Pacific Rim Indigenous Nations* (2006).

A second Native Peoples-Native Homelands (NPNH II) workshop was held in 2009 on the homelands of the Shakopee Mdewakanton Sioux Community at the Mystic Lake Casino Hotel in Minnesota (Maynard, 2014). Close to 400 Tribal leaders, elders, scholars, and students convened to share Indigenous perspectives and solutions. The Mystic Lake Declaration (2009) was written there and was intended as input into the 15th Conference of Parties of the United Nations Framework Convention on Climate Change. The declaration tied climate change adaptation issues to human rights, the sacredness of human relationships to the land, Indigenous knowledge traditions, and concerns about certain solutions to lowering carbon footprint, among other topics.

Over 20 people served on a technical team for Indigenous peoples' involvement in NCA3 (Melillo et al., 2014), which would lead to a Tribal chapter (Bennett et al., 2014). Technical input was provided, in part, through regional workshops that produced reports (Coastal Louisiana Tribes, 2012; Riley, 2011; Souza and Tanimoto, 2012). There were also Indigenous regional reports and media created outside of these workshops (Blanchard, 2013; Redsteer et al., 2013; Ojima et al., 2015). An author team was developed that synthesized the information provided by the technical team, resulting in the *NCA3 Chapter 12, Indigenous Peoples, Lands, and Resources* (Bennett et al., 2014).

The efforts leading to NCA3 coincided with increasing Indigenous leadership in climate change nationally, as well as federal funding and support for Indigenous climate initiatives. For example, the National Center for Atmospheric Research, managed by the University Corporation for Atmospheric Research (UCAR), began hosting the Rising Voices Center for Indigenous and Earth Sciences, which is jointly funded by the National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management. Rising Voices seeks to bridge diverse worldviews on climate change, with an emphasis on Indigenous knowledges. The Indigenous Peoples Climate Change Working Group continued to hold student-oriented events engaged with scientific and other climate change issues (Shepherd, 2016). A U.S. Forest Service technical report on climate change impacts on Indigenous peoples was published as an interim synthesis between NCA3 and NCA4 (Norton-Smith et al., 2016). The U.S. Geological Survey's Climate Science Centers (now Climate Adaptation Science Centers) established some Indigenous consortium and partners members, such as the Chickasaw and Choctaw nations and the College of Menominee Nation. The Bureau of Indian Affairs (BIA) initiated funding support specifically for Tribal climate resilience in 2011 and focused its support on Tribal adaptation planning, training, data development, and leadership engagement. The Department of Interior's Advisory Committee on Climate Change and Natural Resource Science included members representing Indigenous peoples and Indigenous issues. In 2014, the committee published a report with a primer, *Climate Change and Indigenous Peoples: A Primer*, and a guide, *Traditional Knowledge Guidelines* (Morishima, 2014; Climate and Traditional Knowledges Workgroup, 2014). By 2014, Congress appropriated $10 million and supported the BIA's Tribal Climate Resilience Program at that level until 2020, when it further increased its support. A special issue of the peer-reviewed journal *Climatic Change* focused on issues related to Indigenous peoples and climate change in the U.S. context, with over 50 authors contributing, the majority of authors being Indigenous (Maldonado et al., 2013). In 2016, USGCRP produced a synthesis report on climate change and health (USGCRP, 2016). There is a subsection of Chapter 9 on Indigenous peoples. The subsection covers diverse health issues tied to food and nutrition, cultural and family integrity, traditional practices, and mental health. In 2016, NOAA established a 15-member Advisory Committee for the Sustained National Climate Assessment, which included two specialists in Indigenous climate change as part of the membership (National Oceanic and Atmospheric Administration, 2016).

NCA4 (USGCRP, 2018) was the first time there was a concerted effort to ensure Indigenous authors and sections were spread throughout the report on each of the regional chapters. The team of approximately 50 authors also conducted an assessment of Indigenous-related terms throughout the entire NCA4 draft to develop a set of consistent terms as a reference for all of the NCA4 authors. The *Tribes and Indigenous Peoples* chapter features an interactive map of Tribal climate change initiatives, primarily supported through federal funding sources, organized by the BIA, which at the time of publication had 800 initiatives (Bureau of Indian Affairs website, 2021; Jantarasami et al., 2018). Currently the map has well over 1,000 entries of Tribal resilience actions. Similar to NCA3, there was considerable effort to get input and engage Indigenous peoples and Tribal experts throughout the U.S. and its territories through regional workshops, engagement at major conferences, webinars, focus groups, mini-grants for community meetings, and publicizing of the opportunities for public review throughout Tribal distribution networks.

Over time, Indigenous peoples have engaged in diverse ways in NCA. In the case of certain aspects of NCA, Indigenous engagement has increased, such as through the continuation of a dedicated chapter to Indigenous climate change issues in each NCA. This has led to a wider array of credible sources of information being included in the program's reports. The special report on how to build a sustained assessment (Buizer et al., 2013:27) stated, "The NCA should ensure adequate support for Tribal engagement in future assessments and include Tribal engagement as a metric of success for ongoing efforts."

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Chapter 2: Worldviews, Knowledges, & Social Impacts

Worldviews, Knowledges, & Social Impacts
Key Messages

- Indigenous peoples have their own systems of governance that have norms of behavior for land use and land care.
- A growing dialogue among some Indigenous peoples articulates Indigenous knowledge systems through an understanding that all things are interconnected.
- Legacies left by colonialism in economic, social, environmental, and educational systems have altered lifeways, traditions, practices, customs, and values of Indigenous peoples, influencing their understanding of how climate change affects their daily lives and opportunities for adaptation.

Recommendation
Climate change policy and climate science fields should respect Indigenous self-determination in governance and knowledge exchange. Indigenous peoples should be consulted meaningfully from the earliest stages of policy and research development. Legal, policy, ethical, and cultural best practices and requirements should be followed to make consultation meaningful.

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Indigenous Worldviews, Sovereignty, and Climate Change
This section seeks to provide some of the general context on Indigenous peoples' worldviews and sovereignty and intends to be useful for contextualizing the issues, knowledge, experiences, and recommendations to which this report bears witness.

Indigenous peoples have their own social and cultural norms of behavior and action governing interactions between people and the land, water, air, plants, and animals that all share environments together. These norms include systems of governance regarding protection and transfer of knowledge that have been developed over countless generations and are commonly expressed through language, practices, ceremonies, traditions, educational programs, mentorship bonds, and kinship networks (e.g., clans, lodges) (see, for particular examples, Trosper, 2009; Menzies, 2006; Kimmerer, 2013). Today, Indigenous peoples also commonly employ methods adopted from other cultures to formalize and record their expectations for normative behavior and action by enacting written laws, policies, codes, regulations, rights, rules, resolutions, procedures, and protocols as self-determining sovereign governments (see, for particular examples, Chief et al., 2016; Royster et al., 2002). As political sovereigns, Indigenous peoples engage in diplomatic relations with local, regional, state, national, and international governments through multilateral laws and policies, including treaties, statutes, and agreements that set forth rights, requirements, obligations, duties, and responsibilities.

There are, of course, many dimensions of Indigenous peoples' worldviews, and we recognize here the semantic inadequacies of the very term "worldviews." Although Indigenous peoples are diverse internally and across peoples in terms of their worldviews, religions, and practices, there is an overlapping dialogue among many Indigenous people about how Indigenous cultures, histories, social institutions, and knowledge systems provide critical context, knowledge, and practical wisdom regarding adaptation and mitigation in relation to anthropogenic climate change. The authors of this chapter seek to convey some key points regarding this overlapping dialogue and provide a snapshot of some of the relevant literature.

In the U.S., the "government-to-government relationship" is a term used to describe some Indigenous relations with the U.S. federal government and to set forth expectations of how Tribes must relate to other units of government (whether those expectations are satisfied in practice). Due to long histories of legal relationships evolving between federally recognized Tribes and the U.S., the exercise of Indigenous sovereignty is tethered to U.S. sovereignty, which is sometimes referenced by the term, "nations within a nation."

Indigenous peoples' diverse worldviews and systems of governance affect how they approach climate change adaptation and mitigation, informing how they address impacts on their cultures, economies, multilateral governance relationships, and stewardship responsibilities toward the environment and future generations. As contemporary political sovereigns, Indigenous peoples recognize that self-determination and intergovernmental relations are cornerstones of solutions for addressing global issues of climate change as well as opportunities for adaptation and mitigation. Yet, as nations within a nation, their sovereignty is both protected and limited, operating within the bounds of treaties, acts of Congress, executive orders, administrative agreements, and court decisions. For federally unrecognized Tribes, Native Hawaiians, and other Indigenous peoples, their externally acknowledged sovereignty is more limited than federally recognized Tribes.

Addressing climate change is connected with the issue of how people come to know climate change (Callison, 2014). Indigenous peoples have diverse cultures, histories, social institutions, and knowledge systems that are highly relevant to understanding environmental change, whether changes are seasonal, intermittent, or long-term. Ancient stories kept by Indigenous peoples tell of social and environmental disruptions and convey lessons learned from the observations, experiences, and responses of their ancestors (Therrell & Trotter, 2011). Many Indigenous families, communities, and governments practice or are guided by traditions of living that pay close attention to the dynamics of seasonal and climatic change (Child, 2012; Hatfield et al., 2018). The languages of Indigenous peoples often incorporate specific terms to reference or describe local places, events, or times of importance, such as timing of flowering, migrations, fruiting, wildlife movements, plant life cycles, or availability of water. Indigenous linguistic scholarship has demonstrated important relationships between how language connects to knowledge and a sense of responsibility for protecting the environment (see Noodin, 2017, and Oh et al., 2021, for example). Indigenous knowledge is often articulated through concepts and practices that express interconnections across spatial, physical, spiritual, cultural, political, and temporal dimensions.

Stories and lifeways frame and draw on time-tested knowledge systems. Indigenous peoples have depended on such knowledge systems for surviving and maintaining continuity in complex, uncertain environments to sustain food, medicine, and materials and develop methods to successfully negotiate shortages and crises. Such histories, memories, and experiences can motivate recognition of the need to honor the wisdom and decisions of ancestors and the profound responsibility to carefully consider the consequences of decisions and actions for future generations. Indigenous knowledge systems are sometimes articulated as place-based, yet they are far from static or limited in their geographic usage. Scholarship has covered how Tribes have used their knowledge systems to rebuild their societies after forcible relocation to territories hundreds and sometimes thousands of miles away from their homelands (see Carroll, 2015).

Indigenous peoples sometimes rely upon English language terms and expressions such as “cosmology” or “all our relations” to try to convey the importance of recognizing and respecting the interconnections on which their worldviews and knowledge systems are based. It is critical to understand that the worldviews of Indigenous peoples deeply tie the past to the present and the present to the future. Societal continuity of Indigenous peoples means that Indigenous persons seek to acknowledge explicitly that their decisions and actions of today are influenced by the experiences of their ancestors. Their past is colored by a long, painful history of social and economic disruption from broken treaties, land-theft, assimilative education, territorial trespass, cultural erasure, and the denial of their rights to self-determination (Hartmann & Gone, 2016).

Many U.S. laws, policies, and practices subsequent to the signing of treaties have led to the loss of access and inherent rights to the lands, water, and plant and animal species. This loss of access and inherent rights is a major factor creating challenges for Indigenous peoples to adapt to and mitigate climate change, to which some of the material in this report bears witness. As a matter of general context, the U.S. allotment policy of the 1880s, for example, dispossessed Indigenous peoples of 90 million acres of land. The effects of colonialism on economic, social, environmental, and educational systems have altered, disparaged, and disregarded lifeways, traditions, practices, customs, and values of Indigenous peoples, creating generational and intergenerational trauma (Walters et al., 2011). The long-lasting effects of such deeply rooted historical trauma may not be perceived outside of Tribal communities, but are leading concerns within these communities (Evans-Campbell, 2008).

Indigenous peoples have, at the same time, worked ingeniously to create legal and policy avenues to recover and protect their lands and self-government. Many such avenues are crucial to addressing climate change. The expansion of Tribal lands through bringing fee land into trust (a repudiation of the General Allotment Act) and legislation like the Indian Self-Determination and Education Assistance Act of 1975, as amended (25 U.S.C. 450 et seq.), and the Tribal Self-Governance Act of 1994 (25 U.S.C. 458aa et seq.) involves Tribes taking on programs and services the federal government had administered in the past. Court decisions have led to partial victories for Tribes, such as the Boldt Decision that affirmed treaty rights to the fishery in Washington state. State- and un-recognized Tribes, working without affirmation of their self-government, have strategically used incorporation as 501(c)(3) nonprofits as a way to build capacities to provide services for their members. They have used private conservation tools as well to protect their lands (see Middleton, 2011). Native Hawaiians have organized through institutions such as the Office of Hawaiian Affairs (OHA), a self-governing corporate body established in the 1978 state constitution of Hawaii (OHA, 2021). Inter-Indigenous organizations, such as the Inter-Tribal Timber Council (ITC), have developed strategies for sustainable economies (ITC, 2013).

Ethics of Multicultural Knowledge Exchange

This section discusses one of the most prominent issues in Indigenous peoples' engagement with major climate science institutions: the exchange of knowledge about climate change. There are ethical issues that must be understood when people seek to braid diverse knowledge systems together. The Climate and Traditional Knowledges Workgroup developed a set of proposed guidelines for Indigenous peoples, scientists, and government professionals when working with Indigenous knowledge and content with strong cultural and economic values for Indigenous peoples. This section directly reflects some of the information from the guidelines, used with permission from the authors of the Workgroup.

Indigenous peoples do not generally view knowledge or science as simply information. Rather than a form of bare information, knowledge is deeply and inextricably linked to Indigenous origins, ancestors, lands, and traditions (Forbes, 2001; Greenwood & Lindsay, 2019). In some communities, knowledge often comes with obligations and restrictions for its use (Climate and Traditional Knowledges Workgroup, 2014). Indigenous knowledge systems are connected to Indigenous self-determination as peoples. Based on these reasons, there are ethical issues that can arise when non-Indigenous individuals and institutions seek to exchange information about worldviews and knowledge tied to climate change.

These guidelines created by the Workgroup are intended to cover, in particular, traditional knowledge in relation to climate change within the context of potential risks to Indigenous peoples in the U.S. for sharing traditional knowledge in federal and other non-Indigenous climate change initiatives. Traditional knowledge refers to some dimensions of larger Indigenous knowledge systems described in the previous section, but there are some challenges with delineating traditional knowledge by definition. Both the words "traditional" and "knowledge" carry much baggage in English and can inappropriately objectify, essentialize, or interject foreign understandings and assumptions. "Traditional" tends to characterize what is being referred to as "old" in time, passed in a material way "from generation to generation." While this is a common way that traditional knowledge is transmitted and characterized by Indigenous persons, Indigenous knowledge keepers may also receive knowledge through spiritual means, ceremonies, and direct communication with other-than-human beings, persons, and entities (ANSC, n.d.; Simpson, 2000). What makes such knowledge traditional is not its age in the Western time system, but its spiritual origins and relational validity—the way it fits into the First Instructions or ancestral teachings of the Tribes (Marsden, 2004).

The guidelines focus on two formative ethical principles: "Cause No Harm" and "Free, Prior, and Informed Consent." Broadly, these principles establish a foundation for equitable and meaningful relationships. "Consent" recognizes that each Tribal community has its own governance norms and expectations that guide and structure how different facets of traditional knowledge are treated by Indigenous and other entities, and more broadly regulates interactions. The "Cause No Harm" principle involves the identification and avoidance of risks that could lead to loss or harmful misappropriation of traditional knowledge (CTKW, 2016).

Traditional knowledge has been shared most successfully where Indigenous protocols are respected and followed. However, much work remains to ensure that there are appropriate legal, policy, and ethical protections wherever traditional knowledge is shared outside of Indigenous territories and governance systems (Norgaard, 2014). Non-Indigenous persons must understand that sharing traditional knowledge may carry risks for Tribes, as there are many potential conflicts of worldviews and laws and few safeguards for their protection. Used in compliance with these protocols, traditional knowledge is often essential in providing solutions to climate change impacts (CTKW, 2016).

The account of traditional knowledge just offered here is generalized and does not express the beliefs of any particular Indigenous peoples. Each Indigenous peoples should be consulted for their views on what traditional knowledge means to them. The account in this section is meant to illustrate some of the fundamental challenges of working with traditional knowledge. Indigenous peoples and persons in practice live in multiple worlds, and the phrase "traditional knowledge" is used in multiple senses both within particular Indigenous peoples and when working with non-Indigenous persons, institutions, and agencies. Some ways that Indigenous peoples use and share their knowledge are more like a kind of practical information, and Indigenous knowledge holders often share the informational aspects of their knowledge while keeping the spiritual aspects to themselves (SAMHSA, 2009).

Case Study: The State of Wisconsin's Respectful Integration of Traditional Knowledges
The Wisconsin Governor set up the Governor's Task Force on Climate Change in 2019, including the Bad River Band of the Lake Superior Tribe of Chippewa Indians and staff members from the Great Lakes Indian Fish & Wildlife Commission (GLIFWC). The Task Force was open to working with Tribes and bringing in Indigenous knowledges they were willing to share in order to inform the science and generate policy recommendations for the state of Wisconsin. The GLIFWC spokesperson brought in traditional knowledges from Ojibwe rice chiefs who monitor and interpret the health of manoomin, or wild rice, that is a sacred and culturally important food. One observation from traditional knowledge, not generally appreciated by scientists, was that there had once been seven bodies of water in the Sokaogon Ojibwe reservation that had now merged into a single body of water due to increased runoff. The rice harvest has decreased dramatically, to 5% of prior levels. A rice chief with Sokaogon Ojibwe believes this is due to brown spot disease and rice worm infestations associated with higher runoff from extreme weather events and increased humidity associated with climate change (Vaisvilas, 2021). These observations brought the Task Force to recommend creating a permanent Manoomin (Wild Rice) Stewardship Council to work directly with rice chiefs from Tribes that voluntarily choose to work with the Council to provide traditional knowledge expertise to the state of Wisconsin. The state is establishing a permanent institution that will allow for the voluntary submission of information drawn from traditional knowledge that will provide a venue for manoomin rice chiefs to discuss their observations and assessments and make decisions about what to share with the state. The Council can hopefully provide a test bed and a way to spread the institutionalized use of traditional knowledges in a way that is controlled by the knowledge keepers.

Social Impacts on Indigenous Peoples from Climate Change

Climate change has multiple and interconnected impacts on Indigenous governance systems. Impacts-based language in risk and vulnerability assessments can take the form of victimhood where Tribes are viewed as passively and adversely affected by climate drivers beyond their control (Cameron, 2012; Haalboom & Natcher, 2012; Callison, 2014; Whyte, 2016, 2013). Indigenous peoples are active, self-determining societies, and they are working to heal and negotiate historical traumas, rebuilding their identities and strengthening resilience to climate change impacts. This section must be read with great care, given its coverage of the social layers that are connected to climate change.

Indigenous peoples have diverse histories. For many Indigenous peoples, the influence of historical traumas is a prominent dimension of their recent histories. It is necessary to understand these traumas in some depth to appreciate ongoing challenges to addressing climate change (Billiot et al., 2020). Historical trauma interacts with other often-linked social determinants of vulnerability such as low income, socio-economic status, lack of savings, lack of information, inadequate housing, chronic diseases, disabilities, minority status, and linguistic vulnerability (see review in the context of COVID-19, Hathaway, 2020). Further social vulnerabilities arise as a consequence of AI/AN resource- and place-based lifeways (Ford, 2012).

These impacts must be understood under different frameworks. Indigenous researchers have assessed Indigenous responses to climate change impacts through the following and other frameworks necessary to understand them from an Indigenous lens. These frameworks are not exclusive, and the authors who worked on this section emphasize that the categories are provisional.

- An *Indigenous decolonization framework* can focus on the capacity to respond within Indigenous concepts, methodologies, processes, understandings, assessment criteria, and indicators that are understood by them and compatible with their cultures (Armstrong, 1998; Simpson, 2017; Dhillon, 2018; Yazzie & Riesling Baldy, 2018).

- An *Indigenous agency framework* can emphasize the governance and decision-making dimension of Tribes as agents that actively shape their own destiny through full autonomy and self-determination (Abate & Kronk, 2013; Maldonado et al., 2013; Carroll, 2015; Chief et al., 2016; McNeeley, 2017; Donatuto et al., 2020).

- An *Indigenous survivance/continuance framework* can focus on the goals of responses that are more than targeted toward cultural survival or subsistence, as is sometimes presented. Indigenous responses to challenges are strongly based on their values, creativity, and ingenuity. It is not enough just to solve a problem, but to solve it in a way that is consistent with such values as ancestral teachings, moral responsibilities, relational accountability to community and the natural world, trust, reciprocity, and consent (Vizenor, 1999; Goeman, 2009; Wildcat, 2009; Ortiz, 2011; Maracle, 2015; Whyte, 2019). Because of their unique origins, place-based histories, collective identities, and deeply spiritual beliefs, climate solutions often involve negotiations within their Tribes and with more-than-human beings (GLIFWC, 2019).

Indigenous responses to climate change therefore attempt to solve the problem while ensuring that it moves the collective whole of Indigenous ways of being, knowing, and doing in ways that are active, engaged, resilient, and sustainable. They work to renew and continue the culture as a whole rather than focus narrowly on technical solutions implemented by experts. Their responses usually involve the whole-of-community and achieve this through their own worldviews (Maldonado et al., 2013; Whyte, 2017). The *Dibaginjigaadeg Anishinaabe Ezhitwaad—A Tribal Adaptation Menu* illustrates the use of these kinds of frameworks (GLIFWC, 2019). Anishinaabe peoples of the Great Lakes region assess adaptation opportunities through multiple perspectives. They assess climate responses using some common non-Tribal frameworks (e.g., reduce biological and anthropogenic stressors, promote landscape connectivity). They also assess impacts and responses in a cultural framework (e.g., actions to help more-than-human beings to adapt, maintain reciprocity and balance, and frame actions in the context of cultural calendars). *A Tribal Adaptation Menu* exemplifies diverse dimensions of decolonization, agency, and survivance/continuance.

One reason why decolonization, agency, and survivance/continuance frameworks are critical is that Indigenous lifeways, wellness, and political sovereignty are vulnerable to climate change. Many traditional activities occur outdoors on the land. The elements of the natural world that they depend upon are affected by climate impacts (Houser et al., 2001; Maldonado et al., 2013; McNeeley, 2017; Jantarasami et al., 2018; Donatuto, 2020). Their ways of life are fundamentally relational—they do not just utilize the environment, they inhabit it and maintain spiritual and mutual relationships with multiple tangible and intangible beings that may also be affected by climate change and nonclimate stressors (Hatfield et al., 2018; Thomas et al., 2019).

Tribal vulnerability varies and is affected by interacting and complex historical, political, and social factors, such as differential access to resources, poverty, and different ways of accessing and transmitting knowledge (Thomas et al., 2019). The existing historical context of trauma, discrimination and neglect, and high connectedness to and dependence on the landscape and seasonal timing increases exposure among many interrelated facets of Tribal culture that can cause cascading impacts on multiple dimensions (Clarke et. al., 2018; Lawrence et al., 2020). Extreme climatic events such as floods or extreme heat events, in addition to impacts from longer-term climate changes, can harm health and make activities risky, dangerous, or impossible, e.g., outdoor work and traditional activities under extreme heat events, harvesting of driftwood during breakup of river ice, or hunting over thinning sea ice (Hansen et al., 2013; Jones et al., 2015; Sharma et al., 2020). These multiple and sometimes cascading impacts can interrupt the transmission of traditional knowledge and norms and lead to the loss of trust in traditional institutions and external partnerships and cooperation (Billiot et al., 2019; McKinley et al., 2019; Lyver et al., 2019; TPEHTT, 2019).

Impacts associated with climate change affect Indigenous peoples' infrastructure, energy systems, and businesses. Economic disparity is a major factor that increases the impact of climate change on wellbeing. Access to economic resources, resilient infrastructure, and diverse economic opportunities allows Indigenous peoples and their communities to be proactive in addressing their priority issues. A thriving economy offers flexibility and adds to the capacity for addressing challenges. It allows for Tribes to maintain and attend to their aging infrastructure. It allows them to relocate community resources that are threatened by flooding, sea-level rise, or coastal storm surges. It allows Tribes to hire staff to research the loss of habitat for subsistence species and to design and implement habitat restoration projects to improve access to culturally important fish and wildlife. Funding allows Indigenous peoples to develop forest management plans so that their forests are less prone to drought-induced disease, pest infestation, and subsequent wildfires. Thriving economies also allow Tribes to protect and care for the most vulnerable individuals and families in their communities and to monitor overall physical and mental wellbeing (NCAI, 2017; NCAI, 2019; ATNI, 2020).

In addition to reducing economic disparities, measures are needed to address the historical traumas that Indigenous peoples face and revitalize Tribal institutions, languages, and traditional knowledge systems. Activities that work to restore relations with the land, waters, and living world are necessary to restore balance in social systems (Maldonado, 2018; McGinnis et al., 2019; Donatuto et al., 2020). For Indigenous peoples, adaptation and mitigation measures must be holistic. They must be approached in an interconnected way that is aligned with the values and knowledge of the communities. Adaptation and mitigation are not just about “solving” a single physical problem such as flooding or establishing solar power. Rather, they are about empowering the community to restore, revitalize, and strengthen their cultures, social wellbeing, and political sovereignty. For many Indigenous peoples, it is about achieving good relationships of interdependence with the diverse nonhumans that share the environment.

Figure 1. Word Cloud using words from the CRCCS.

Figure 2. Word Cloud using words from the TAM.

Words and concepts matter, and they influence how climate issues are characterized, problematized, prioritized, and acted upon. The spiritual, place-based, and traditional words of Indigenous peoples are value-laden (Donatuto et al., 2020). One recent project compared the language of two reports, the Cultural Resources Climate Change Strategy (CRCCS), written by the National Parks Service in 2016, and the Tribal Adaptation Menu (TAM), written by Tribal and non-Tribal partners, that reflected Anishinaabeg worldviews and translated Ojibwe and Menominee words (Oh et al., 2021). Word clouds from the two documents revealed differences in worldviews and values in approaching cultural issues in adaptation. While there is overlap in the language of the documents (e.g., climate, cultural, change), there are important differences. The CRCCS emphasizes the standard nomenclature of natural and cultural resource management, while the TAM language emphasizes relationships through language focused on other-than-human beings, adaptation, and community. See Oh et al. (2021) for a more detailed discussion of findings. Graphic source: Oh et al., 2021. Figure numbers are from original source.

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Chapter 3: Actionable Science & Collaborative Climate Planning

Actionable Science & Collaborative Climate Planning

Key Messages

- Tribes are investing efforts in adaptation planning and projects to keep their communities, ecosystems, and people healthy. In doing so, they are implementing the most cutting-edge work on climate. Tribal nations are actively creating climate-vulnerability assessments, adaptation plans, and hazard-mitigation plans. Protecting traditional knowledges is an important part of these processes.
- Locally relevant and regionally specific information is needed to understand local climate impacts and develop solutions that incorporate local, traditional, and Western knowledge for holistic solutions.
- Actionable science co-produced in partnership with Indigenous peoples can support Tribal resource management decision-making.

Recommendation

Support Tribal sovereignty and self-determination through Tribally-led climate adaptation planning to allow Tribes to prepare for climate uncertainty and associated risks. Management decision-making should involve consultation with Tribes early and often, co-production of actionable science, and the incorporation of local knowledge.

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Introduction

The global rate of climate change is continuing at a rapid pace, and future climate projections demonstrate the increasing severity of climate impacts without immediate and intentional mitigation efforts (Xu et al., 2018). In general, these impacts will negatively affect human and nonhuman populations across the globe, some more than others. Indigenous peoples and their livelihoods, in particular, are affected by climate impacts (CCTHITA, 2019; Chisolm Hatfield et al., 2021; Jantarasami et al., 2018; St. Regis Mohawk Tribe, 2013; USRT, 2017). As a result, organizations and entities across the

U.S. are taking collective action to reduce greenhouse gas emissions in order to reduce these impacts (Steen-Adams et al., 2020). Still, the uncertainty in future greenhouse gas emissions is substantial. As such, different representative concentration pathways (RCPs) are used to model possible future emissions scenarios (Figure 1; adapted from Vose et al., 2017). RCPs capture the effects of different potential emissions levels and delineate the current and future impacts of climate risks on the economy and infrastructure, the natural environment and ecosystem services, and human health and wellbeing. Appropriate mitigation and adaptation strategies are needed to reduce these risks posed by climate change.

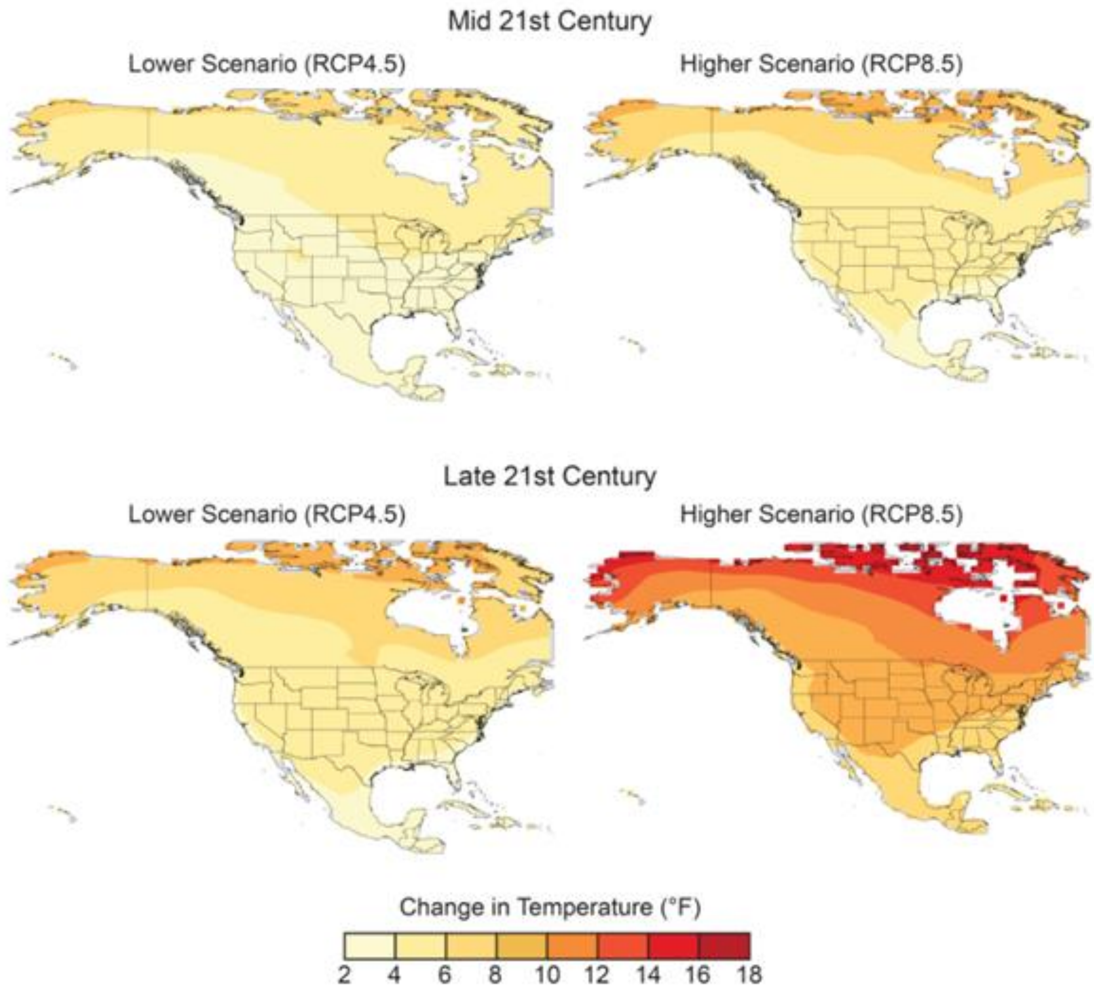


Figure 1. Annual average temperatures across North America are projected to increase over this century, with greater changes at higher latitudes and under higher CO_2 emissions scenarios (RCP8.5; right). This figure shows projected differences in annual average temperatures for mid-century (2036–2065; top) and end of century (2071–2100; bottom) relative to the near present (1976–2005) (Vose et al., 2017).

Mitigation strategies that involve market forces and technological changes have already successfully contributed to the decline of greenhouse gas emissions (Fahey et al., 2017). Meanwhile, adaptation strategies require a consistent reassessment of climate risks and can be conceptualized through the following stages: awareness, assessment, planning, implementation, and monitoring and evaluation (Figure 2). Building climate resilience for the benefit of all, but especially Indigenous peoples and other marginalized communities, requires coordinated efforts between different entities and implementation of various mitigation and adaptation strategies. These efforts have started to be implemented using a combination of strategies.

Figure 2. Successful adaptation requires a continuing risk-management process. With this general approach, individuals and organizations become aware of and assess risks and vulnerabilities from climate and other drivers of change, plan, take actions to reduce those risks, and learn over time. The gray arcs indicate the status of implementing this process with the status reported by the Third National Climate Assessment in 2014; darker color indicates more activity (Lempert, 2018). In 2021, there are more Tribal projects that have been implemented and some projects that are starting to be monitored and evaluated.

Actionable Science Based upon Regional and Locally Derived Information

The impacts of climate change that have long been predicted are being observed on local, regional, and global scales. While global climate models provide a valuable starting point for addressing these impacts broadly, downscaling these models to individual regions is important for making the data accessible, useful, and actionable. It is even more important to couple that information with local and traditional knowledge (see sidebar titled *Protecting Traditional Knowledges in Locally Derived Studies*) so that the information can be considered in a local context. Observations and knowledge of place are key to understanding short- and long-term impacts and to supporting decision-making in the face of uncertainty. The cultural, social, economic, historic, and geographic context of each region's Tribal communities is as unique and intricate as the natural ecosystems themselves. Impacts felt in one community or system might differ from the next, and knowledge provided by downscaled models coupled with a knowledge of the land over time provides a pathway for resilience and transformation into the future. Native American Tribal communities have always adapted, while remaining steadfast stewards of the land with a deep knowledge of place.

Protecting Traditional Knowledges in Locally Derived Studies

It is important that the traditional knowledges of Indigenous peoples be protected, as recognized in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP; UN General Assembly, 2007; Steen-Adams et al., 2020). There are protocols that have been developed to provide guidelines and considerations (Sloan & Hostler, 2014; CTKW, 2014) for collaborative research projects. This is particularly important when using federal funding from the U.S. government, which can sometimes require that any data gathered for a project be shared and made publicly available upon conclusion of the project.

Within the Western science paradigm for climate adaptation planning, there is a strong desire for more fine-scaled/local downscaling as an approach for creating solutions and taking actions. As data are refined to finer scales, we run the risk that errors will be magnified and may give potential users the impression that they are "correct" because the finer scale data more closely resemble the scale of information observed on the ground. However, the observational vs. modeled data could differ greatly. Multiple downscaled scenarios can be useful in that they can provide a range of possibilities but can be stronger if based upon local knowledge and regionally specific data. This type of modeling is important for allowing Tribes to be adaptable and strive for management practices that are resilient across multiple scenarios.

To that end, bringing together finer scale climate information, local data, and traditional knowledge can help provide a better understanding of possible scenarios of local impacts, providing opportunities to focus on solutions that are specific to location. This is especially important for climate adaptation and mitigation planning, because it can bridge the gap between global and local effects (Cooney, 2012), while allowing for opportunities to incorporate real-time and local knowledge and data. Pairing downscaled climate models with regionally specific information and the observations from those closely tied to place opens pathways for targeted regional or local solutions that are informed by local input. Coupling climate models and information with local inputs helps to make data accessible, useful, and relevant, while also providing an opportunity to Indigenize a process that has been long dominated by Western science, making space for Tribal and Western science to be equally valued and brought together to produce actionable science, when appropriate. For an illustration of this approach that builds on the application of downscaled models, please refer to the narrative below titled *Bringing Together Climate Data and Local Knowledge to Regional Downscaled Data to Advance Tribal Adaptation Planning.*

Actionable science in partnership with Indigenous peoples involves collaboratively using data (including traditional knowledges and Western approaches to information gathering), analyses, projections, or tools with the intention or goal of supporting decision-making in resource management that Tribes can use (Vogel et al., 2016). As a result, actionable science can be perceived as more holistic than current goal-oriented management approaches. There is not a single manner for developing actionable science, but Tribes should be consulted early and often when these types of efforts are being considered.

Climate Change Planning

Adaptation planning is one type of actionable science that is improved through the use of locally relevant information derived from traditional knowledge. There are opportunities to transform how adaptation planning is approached and incorporated into existing Tribal planning efforts and documents. Certain environmental areas, such as “natural resources” and “wildlife” that are often represented in Tribal agencies and programs, have opportunities to incorporate adaptation planning into their existing work. In doing so, they can start to address challenges shared across Tribal programs to minimize impacts to Tribal resources and respect existing capacities. In this manner, adaptation planning can be included in departmental planning processes across a Tribal government. Given current and future projected climate impacts, adaptation planning is often considered to be an active and ongoing process that will need to occur simultaneously with implementation (Nelson & Andrew, 2020).

Tribal nations are among the most active entities in creating climate vulnerability assessments (VAs) and adaptation plans (APs) (see databases created by Institute for Tribal Environmental Professionals[5] (ITEP), the University of Oregon’s Tribal Climate Change Project[6] (TCCP), and the Climate Adaptation Knowledge Exchange (CAKE) Network[7]). A number of Tribes are also considering climate change as they develop hazard mitigation plans (HMPs), while others have been included in state- or county-wide HMPs. Availability of this information for knowledge exchange and resource management is important for allowing Tribes to build from the knowledge, expertise, and experiences of other Tribal nations. The above-mentioned catalogs of Tribal VAs and APs are incomplete, as not all Tribes make their plans available to the public. There is not a single repository for HMPs; however, the Federal Emergency Management Agency (FEMA) keeps records of which entities have finished FEMA-approved HMPs and which have been funded to do so.

In regard to the VAs and APs, Tribal nations have taken a wide range of approaches to develop these types of documents. Some make extensive use of habitat-suitability models, climate-modeling outputs, geographic information systems, remote sensing, and other technical Western science-based quantitative data to develop various vulnerability scenarios (USRT, 2017; CCTHITA, 2019; St. Regis Mohawk Tribe, 2013). Other Tribal efforts incorporate traditional knowledges, input from traditional knowledge keepers, perspectives from local subject-matter experts, feedback from their most valued subsistence hunters and gatherers, community meetings, youth involvement, and other types of locally derived, place-based data to inform their VAs and APs.

[5] Institute for Tribal Environmental Professionals: http://www7.nau.edu/itep/main/tcc/Mindmap/TribalAdaptationPlans

[6] University of Oregon’s Tribal Climate Change Project: https://tribalclimate.uoregon.edu/

[7] Climate Adaptation Knowledge Exchange (CAKE) Network: https://www.cakex.org/resources/type/document

HMPs are often based upon templates created by FEMA and tend to result in a similar format (CTUIR, 2016; Lac du Flambeau Tribe, 2019; Penobscot County, 2016). This approach is useful in some ways: templates can help Tribes overcome limited capacity by providing the foundational legwork of the planning process so that Tribal staff can actually perform the HMP, VA, or AP analyses. The templates help them frame their analyses at a high level, rather than focusing on the minutiae of how to initiate the effort. HMP templates are also useful for allowing users that are familiar with the document structure to quickly identify the information that they are seeking. The potential downside is that documents created with templates could be considered to be a colonial construct that lacks the holistic approaches that are commonly encountered in Tribal planning efforts, such as vulnerability assessments and adaptation planning.

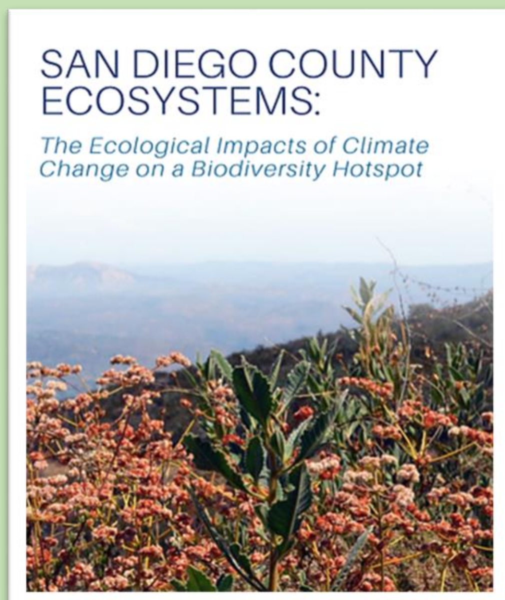
Overcoming Limited Capacity through Partnership

Tribes are often understaffed and overworked, with a limited amount of time and resources to focus solely on climate change. Partnerships that value different ways of knowing provide a robust pathway for remaining resilient in the face of ongoing challenges, managing in the face of uncertainty, and bringing knowledge and wisdom acquired through generations of practices and beliefs (Jantarasami et al., 2018; National Congress of American Indians, 2019). Integrating climate change into already ongoing planning and implementation efforts can be more efficient, less time-consuming, and more cost-effective and lead to actions that are more sustainable in the long term. Examples of plans in which climate change can be considered include FEMA Tribal HMPs and EPA Tribal environmental, community comprehensive, and land/resource management plans (Dalton et al., 2018; Pletnikoff et al., 2017). The BIA also produces a variety of plans that could include climate change considerations. Such plans include forest management, wildland fire management, irrigation projects, fish and wildlife, agricultural resources, and integrated resource management plans (IRMPs). There is also the opportunity to utilize BIA IRMPs, a comprehensive management planning program for Tribes that incorporates multiple aspects of planning with various federal agencies. This planning process allows Tribes to create a single cross-cutting plan that relates to many Tribal departments and federal agencies instead of working on a separate plan for each issue. Climate change considerations could be included within the IRMP. The inclusion of climate change and utilizing partnerships into any and all of these planning efforts help Tribes to advance their planning needs.

It can be challenging for Tribes to find the capacity to perform climate planning with existing staff and resources, but there are opportunities and resources available to assist. Collaborations and partnerships with outside entities can lead to the co-production of relevant and important information. Strong relationships and trust are necessary to form the basis for relationships between Tribal nations, governments, staff, or intertribal organizations and other existing networks. Some of those Tribally focused networks and boundary organizations include intertribal consortia, ITEP, the Tribal Climate Change Network (University of Oregon), and the regional DOI Climate Adaptation Science Centers, among others. However, in developing actionable science projects, it should be recognized that the objectives for different partners may vary. Publication in a high-caliber research journal may not be a high priority for Tribal nations, whereas habitat suitability projections and resource management plans under a warming climate could be important to the management actions of a Tribe. Partnerships should be established in advance of potential projects so that each organization can come to the table and have significant input on defining the project objective(s) and pertinent project details. In many cases, non-Tribal groups are interested in collaborating or partnering with Tribes. It is important that these groups solicit partnership from Tribes as early in the process as possible. Best practices include establishing these collaborations before acquisition of funding or developing a project proposal. For additional guidelines for working in collaboration and partnership with Tribal nations, see the guidance developed by the USFS (Steen-Adams et al., in press).

Conclusions

It is important that Tribal nations can support their priorities in ways that honor their sovereignty and rights to self-determination. Tribally-led climate planning that is informed by locally relevant data (including downscaled modeling data and traditional knowledge) allows Tribes to better prepare for uncertainty imposed by climate factors and their associated risks. Collaborative partnerships can be a tool for Tribes to overcome issues of capacity, but also to provide technical expertise, if needed. Those partnerships can also help to relate local knowledge to climate data to better inform actionable science and management resource decisions.



The Summary Magazine of "San Diego County Ecosystems: Ecological Impacts of Climate Change on a Biodiversity Hotspot" for use by natural resource practitioners and managers.

Bringing Together Climate Data and Local Knowledge to Regional Downscaled Data to Advance Tribal Adaptation Planning

Climate change is a global phenomenon whose impacts are felt locally. As such, in order to advance adaptation actions, it is essential to take an inherently local approach. Advancing regionally specific downscaled modeling is critical for providing the detailed information necessary for climate change adaptation planning and implementation but is more effective when coupled with local and traditional knowledge. In 2018, the Climate Science Alliance (CSA) convened a distinguished, bi-national team of ecologists, climatologists, and Tribal leads to formulate a scientific assessment entitled, *San Diego County Ecosystems: The Ecological Impacts of Climate Change on a Biodiversity Hotspot* (Jennings et al., 2018). This assessment was the first of its kind to provide regionally specific climate hazard information for natural communities in the south coast of southern California. This document was published as a technical report for the State of California's *Fourth Climate Change Assessment* (Jennings et al., 2018); however, from the onset of this endeavor, all participants made an intentional effort to consider how the results of this technical report would play out across different jurisdictional boundaries and audiences that included natural resource management, decision-makers, the public, and youth. The results of the assessment were synthesized into specific resources that were created for Tribal and non-Tribal audiences:

- A summary magazine was created for natural resource practitioners and managers
- A summit was held for assessment authors to interact and discuss findings with decision-makers and planners
- Data from the assessment was integrated into a hands-on 6–12th grade science education curriculum for youth
- A public campaign was created titled, “San Diego Wildlife, Climate Change, and You!” with a web page and pocket guide targeted specifically for the public to learn more about the findings of the assessment and the 10 things they could do to help

This approach integrated regionally downscaled modeling with regional data on local species and ecosystems coupled with local knowledge to inform and identify impacts, strategies, and opportunities for advancing climate adaptation actions across boundaries and within communities. In addition, this approach is being replicated by the CSA to support planning efforts for Tribal nations within San Diego County such as the La Jolla Band of Luiseño Indians Climate Adaptation Plan (2019) and the Manzanita Band of Kumeyaay Indians Tribal Resilience Strategy (2020). The CSA is bringing together Tribal and non-Tribal experts in a process that equally values all ways of knowing in the creation of strategies and solutions. These plans are living documents for the Tribes that provide strategies and actions the Tribes have created by building off the information co-created with Western researchers and managers. These efforts take a holistic approach and integrate a variety of sectors, including natural resources, infrastructure and economy, health and wellness, and community and culture, that can evolve through successive updates, be expanded as needed, and serve different purposes over time as deemed appropriate by their respective Tribes. This flexibility and ability to adapt to a range of future scenarios provides space to be resilient in the face of uncertainty.

“San Diego Wildlife, Climate Change, and You!” Pocket Guides were distributed to local libraries targeted specifically for the public to learn more about the findings of the regional assessment and the 10 things they could do to help.

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SECTION 2: IMPACTS & SOLUTIONS BY TOPIC

Chapter 4: Ecosystems & Biodiversity

The narratives in this chapter illustrate the way Tribes live and protect their ecosystems and biodiversity through self-determination as practitioners of biodiversity conservation and ecological protection. The Fond du Lac Band of Lake Superior Chippewa in Minnesota has taken an integrated ecosystem management approach by incorporating Indigenous Knowledge to protect their black ash trees, forests, wild rice lakes, and groundwater. In the video narrative that is linked and transcribed, the Yurok Tribe in California speaks to using their traditional knowledge to develop a Comprehensive Burn Plan to develop a healthier landscape for their communities and wildlife. Then, in the next video narrative that is linked and transcribed, a member of the Colville Confederated Tribes of Washington State gives a description of how the forests on his reservation are dying due to climate change impacts. Lastly, the Tribal Environmental Action for Monarchs and Tribal Alliance for Pollinators describe their partnerships that serve the central U.S. Tribes that restored their Tribal lands to save the threatened monarch butterfly. A researched overview of Ecosystems & Biodiversity as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Climate Change and Invasive Species on the Fond du Lac Band's Lands

Written by: Christian Nelson from the Fond du Lac Band of Lake Superior Chippewa

The Fond du Lac Band of Lake Superior Chippewa's community members have a close relationship with baapaagimaak (literal translation "snowshoe making tree"), also known as black ash. It is used for many ceremonial purposes, and baapaagimaak's unique biology lends itself to making snowshoes and woven baskets. Many plant foods and medicines can be gathered from baapaagimaak stands. There are also unique macroinvertebrate assemblages and other animals that rely on these ecosystems and contribute to their functions. Many of Fond du Lac's baapaagimaak stands occur within the watershed that feeds and drains the manoomin (wild rice) lakes. With manoomin being a crucial component of Anishinaabe culture and subsistence lifestyle, it is imperative to consider the hydrological effects of baapaagimaak loss on the entire watershed. Fond du Lac has taken an integrated ecosystem management approach as well as incorporated Indigenous knowledge into planning for the loss of baapaagimaak in these unique ecosystems. It is crucial to look at more than the monetary value of baapaagimaak itself when planning for the effects of the inevitable infestation of emerald ash borer (EAB), which is currently decimating ash trees just 15 miles away in and around the Duluth, Minnesota, area.

Fond du Lac's forests have over two square miles of baapaagimaak stands. The rapid loss of ash transpiration—where ash trees uptake ground water and release the water through their leaves—may alter water tables and surface runoff, potentially stressing a watershed already greatly affected by the judicial ditching that occurred in the early 1900s. Judicial ditching is the excavation of new water channels, or straightening and deepening of existing channels, that was done across northern Minnesota to drain wetland areas, including forested wetlands, in an attempt to make more land available for farming. This channelization has made wild rice lakes prone to rapid water level fluctuations following spring snow melt or summer rainstorms as water, cut off from natural flood plains and wetlands, rapidly drains from the landscape and is channeled into lakes. Manoomin is very sensitive to water level fluctuations, and EAB will likely exacerbate this problem by killing ash trees that naturally lower water tables and therefore reduce and slow surface runoff. Hard-to-access locations and small stand sizes present a logistical and practical barrier for any possible large-scale preemptive or post-EAB infestation treatments.

Fond du Lac's Forestry and Wetlands Programs have collaborated on a research project since 2015 to assess the viability of planting non-ash trees in baapaagimaak stands with the goal of ultimately maintaining the hydrology of these systems in the event of EAB-induced mortality (i.e., keeping forested wetlands forested). The early and ongoing results of this project and similar projects in the area are helping guide current and future tree-planting projects. Other management strategies include methods to slow the spread of emerald ash borer, preserve ecosystem function and conditions, and preserve baapaagimaak for cultural use. Fond du Lac supports existing state regulations of ash and other hardwood movement and storage. Monitoring efforts are also carried out by our Invasive Species Program in collaboration with the USDA's APHIS division. With no effective remedy for EAB, prevention and adaptation are essential to maintaining the health of these forested wetlands and the ecosystems and watersheds they impact.

Power to the People: Fire as Land Management[8]

Written by: Elizabeth Azuz from the Yurok Tribe, Cultural Fire Management Council

Transcript:

Speaker 1 (00:04):
All the Natives burnt their lands back in the day. When our burns started to get taken away from us, it was way before I was born.

Speaker 2 (00:15):
About a hundred years ago, they made a law that outlawed burns.

Speaker 1 (00:22):
When they told us, if we catch you out there lighting fires, we're going to put you in the penitentiary. And so it kind of scared us a little bit.

Speaker 2 (00:32):
It's resulted in just massive brush, thick impenetrable brush. If a wildfire ever comes, we won't have any defense against it.

Speaker 1 (00:46):
Everything is just getting choked off and our wildlife ain't got nowhere to go. I always felt the land kind of crying out, you know, help me. I'm...I'm suffocating.

Speaker 3 (00:59):
Fire helped us to keep our land, to keep it clean and healthy. Therefore, people can be healthy. It's time for us to make a change, create that connection, the bond with the land.

Speaker 2 (01:18):
Our local organizer went around and talked to hundreds of people in the community. And the people said, we need to put fire back on the land.

Speaker 4 (01:29):
A project of this magnitude requires the coordination working with private land owners and other Indian people in the Yurok Tribal government and of a lot of federal and state agencies that are all part of managing the land and landscape here. I told my mom what we were doing in this project. And she said, son, I think this is the hardest thing you've ever tried to do. She said, we as Indian people, we don't even like to talk to each other. Now you want us to talk to other people? So I said, yes, mom, I do want us to talk to other people because I think that's how we get stronger.

Council Meeting Speaker 1 (02:02):
I'm so happy to see so many people here tonight from up and down the river, people from Hoopa, people from Weitchpec, people from Morek Won, people from down, all the way down to Pecwan.

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[8] Power to the People: Fire as Land Management.
https://www.youtube.com/watch?v=q9c1KBgzU00&feature=youtu.be

Council Meeting Speaker 2 (02:15):
Over the last nine months we've had conversations with almost 100 people, from Johnsons to Weitchpec, and through this work, many concerns have been surfaced.

Council Meeting Speaker 3 (02:24):
Our main issue with burning is pretty much its liability. It's who's responsible if, if our fires get away.

Speaker 2 (02:30):
Educating the community is really important because fear of fire has been ingrained in us for a hundred years. And so people need to understand that it can be done in a controlled, safe manner.

Council Meeting Speaker 4 (02:47):
I hope we will unify as a community to use fire to fight fire in the way our local Indigenous cultures did since time immemorial.

Council Meeting Speaker 5 (02:55):
Sovereignty has been one of the things that I've preached for many years. If you don't use it, you lose it. We're not firebugs, it's our history. It's our past. It's how we've lived. Okay. Thanks. (Applause)

Council Meeting Speaker 6 (03:12):
We're asking that the Yurok Tribal Council exercise its authority as the governing body of a federally recognized sovereign nation to support the creation and implementation of a comprehensive community burn plan.

Council Meeting Speaker 7 (03:24):
Does the Yurok Tribe support the work of and will they partner with the Klamath River local organizing committee on building a comprehensive community burn plan?

Council Meeting Speaker 8 (03:35):
Yes, so says the Council. (Applause)

Speaker 2 (03:49):
We had to get a permit from Cal Fire. They came up and they helped us with our first burn that we did. They brought a couple of fire engines and then they brought a 20-man crew from Alder Camp. And then also the Yurok Wildland Fire, they helped put the fire on the ground and we burned seven acres our first time.

Speaker 5 (04:11):
We're so blessed right now, today is just awesome.

Speaker 2 (04:13):
They're professionals, they're professionals. They know what they're doing and they're training our people.

Speaker 6 (04:21):
Just a perfect burn. Two units split up, both sides of the river, on fire, prescribed burn. It's the thing. People from all walks of life, from all over the world, coming together, like minds, like spirits, it's flawless, it's flawless.

Speaker 1 (04:43):
All this stuff ties to our, our food security. In my heart that's what I'm pushing for is for our people to be able to stand on their own two feet and have their food security.

Speaker 2 (04:59):
So our goal is to, to take care of our whole ancestral territory. We need to have big burns. We need landscape burns. As Native people, our whole identity is connected to the land. It gives us hope that we can be healthy again.

Speaker 1 (05:22):
Our creator, you know, he gave us this land to take care of. Dominion is a responsibility to act in the best interest of the land so that the land will always provide for all people. Together we...we will restore it.

Observed Evidence of Changing Forests: A Testimonial[9]

Written by: Darren McCrea from the Colville Tribes

Transcript:

Darren McCrea (00:00):
My name's Darren McCrea. I'm a member of the Colville Confederated Tribes. You're gonna see me do a little shaking, you'll hear a tremor in my voice. I have Lewy body dementia. When I was 15 years old, I was in a Native youth program and I job shadowed a guy on the Spokane Rez named Neil Abrahamson. He taught me how to set up logging units. I also planted trees and did some tree thinning for the Spokane Tribe. A little later on I bumped knots and cut logs for another company. I worked at a post and pole plant on the Colville Indian Reservation in Inchelium. And I worked at a little plywood mill, a little south of the Canadian border here in Washington state in a town called Kettle Falls. The day before I presented at the Affiliated Tribes of Northwest Indians Conference on Global Warming at the Northern Quest Casino, I noticed the insects disappeared from around all the lights and are still not here.

Darren McCrea (01:11):
There is an article in the May 2020 issue of *National Geographic* that says we've lost 70% of our insects from 1990 to 2016. *The Spokesman Review* put me on the front page of their paper about them. Let's see. This is, would be back at the beginning of September and August, talking about the disappearance, of the insects. But what I presented at the ATNI conference was that I noticed all the trees dying. I discovered five signs that's wrong with the pine needles. The first one is they're supposed to be forest grey-green. They're a long ways from forest green. They're a dull green. And the reason they're so dull is because the cuticle has disappeared. That's the waxy substance that you find on leaves and needles that hold in moisture reflects the sunlight. Pine needles are supposed to come on in different parts of the branch.

[9] Observed Evidence of Changing Forests: A Testimonial. https://youtu.be/BOobI8-Sehw

Not anymore. Now they come on in a circumference around the end of the branch, like a chimney brush was what came to mind when I first noticed this in 2014. Last two signs I want to share: I can go out and I can take a pine needle. I can take say eight of them. I can put them into a bunch and I can start pulling those pine needles apart in, say, quarter-inch pieces from one end to the other. I can go and I can rake up a pile of needles with my hands. And it doesn't take a very big area because of the amount of pine needles. I can take that pile of pine needles, put it between my hands and scrunch it and turn it to powder. Either that, or I can bunch up a bunch of them and, and pull them apart.

Darren McCrea (03:35):
So what's wrong with those last two examples? Indian Country has been weaving with pine needles forever. One needle at a time. If I can pull eight apart, a person wouldn't be able to weave with just one. You can go out and you could feel a leaf, say a maple leaf, and you can feel how much thinner they have become. Pine branches are supposed to go straight out and lean down. Not anymore. All the branches are trying to become a leaders, reaching for the light. The trees are dying so fast they don't have time to shed their branches. They're dying from the ground up. The trees are dry and brittle, but they look like they're flourishing.

Darren McCrea (04:38):
It doesn't matter what species; I will be showing you examples of me breaking saplings, but you should almost be able to tie them in a knot. Pre-industrial revolution CO_2 sat at 280 parts per million. Today, it sits at 417. That's an increase of about 50%. The elevated levels of CO_2 are forcing our vegetation to grow at an accelerated rate. Everything has a tipping point. They're being forced to grow in an accelerated rate and they don't have enough nutrients and water to sustain themselves using that type of energy to grow that way. So thanks for listening to what I got to say. This is what I'm talking about. These trees are dying so fast. They don't have time to shed their bottom branches, but you can still, you can see that they're still flourishing and you can see the tops of those where every one of those branches are reaching for the sun. Again, you can see how many of these branches are dead. So with that, we're going to see a lot of dead pine needles. And this right here is what I'm talking about. Look, look at the mat of needles, how thick this is. Now this is just a little tiny area right here.

Darren McCrea (06:33):
And if you would, come over, take a look at this as well here while I'm ripping, while I'm pulling these pine needles away from this, take a look at these seedlings. We are, we are, where are we at guys? What's the date today? I guess 2nd of October isn't it, 2020. Pine seeds will germinate during the winter and they'll come up in the spring when the ground is soft and they're able to establish a root system. Look at these and you can see there's two years right there. You can see the year before. And then this is the next year. Notice that there's just a taproot there, there aren't any roots going off to the side. It shows two years of growth. Indian Country wouldn't have made mats and bowls out of these needles if they're going to be this brittle. These trees are growing at an accelerated rate. These trees are dry and brittle, but they look like they're flourishing. It doesn't matter what species: a maple tree or a pine tree, hardwood, softwood, deciduous trees, conifers. Best to you guys.

Left picture: Two years of growth. Note there are no lateral roots, the needles are losing their tint, and they seem to be stunted. Second picture from left: Four seedlings harvested in 2019; note there are no lateral roots. Third picture from left: Three seedlings harvested in 2020. Right picture: three years of growth, with a lighter for size comparison.

Tribal Environmental Action for Monarchs and the Tribal Alliance for Pollinators

Written by: Jane Breckinridge from the Muscogee Nation and Collin Spriggs from the Cherokee Nation – Tribal Alliance for Pollinators

Tribal Environmental Action for Monarchs (TEAM) was launched in 2015 as a partnership between the University of Kansas Monarch Watch, the Euchee Butterfly Farm, and seven Tribal nations in Oklahoma: Chickasaw Nation, Seminole Nation, Citizen Potawatomi Nation, Muscogee (Creek) Nation, Osage Nation, Miami Nation, and Eastern Shawnee Tribe of Oklahoma. TEAM united the seven Tribes to help save the threatened monarch butterfly by training Tribal staff in all aspects of habitat restoration and native plant production. To date, TEAM has restored over 60,000 milkweeds and 50,000 native wildflowers to Tribal lands in Oklahoma.

The TEAM project has been so successful that it spawned a new organization, the Tribal Alliance for Pollinators (TAP), in 2017 to keep up with the demand. TAP is a new Native-led nonprofit organization that unites traditional ecological knowledge with cutting-edge technical resources to create an innovative model for conservation and restoration of Tribal lands. TAP provides training and technical support for Tribes throughout North America that want to conserve and restore grassland ecosystems to help threatened pollinators and to preserve the native plants that serve as the foundation for Indigenous cultural, medicinal, and culinary traditions. TAP also has a regional seed bank of native plants that is available for Tribes to use at no cost. TAP is the only Native American group in the country working on monarch and pollinator habitat restoration. It is leveraging the infrastructure and best

Rhonda Sellers, Ecological Resource Coordinator for the Chickasaw Nation Cultural Center, demonstrates how to stratify native plant seeds to Ryan Herrod of the Wetumka Indian Community during a TAP training workshop.

management practices created by the TEAM project to create a conservation model that is transferable across Tribal communities in different geographic areas.

A hallmark of this project has been its ability to engage with, support, and connect entities not typically included in other monarch conservation outreach programming. These entities include Tribal nations, but also include other groups that are not directly a part of Tribal governmental structures, such as Native American cultural, environmental, and agricultural groups. Past examples of direct technology transfer to these cohorts have included native plant horticultural training to the Yuchi Language Project, interactive education/conservation outreach tables at multiple powwows, pollinator plant seed cleaning demonstrations for Seminole Nation Winery grape farmers, and TAP recruitment at the Native Corn/Honoring America's First Farmers conference in Nebraska. Without TAP, communities such as these would not have access to conservation information produced by Native people and tailored for their needs or, most likely, any monarch conservation outreach at all.

Yuchi Language Project students transplanting milkweed as a hands-on training exercise to boost their language skills.

Historically, intertribal collaborations on habitat restoration efforts have been virtually nonexistent. The TEAM project was groundbreaking in establishing a new precedent of cooperation and assistance, and TAP is building on and expanding those relationships. Participating Tribes have consistently volunteered to provide technical support and share resources with each other, and close relationships have developed. New Tribes have been warmly welcomed into the coalition and generously supported in every way. These collaborations are unique and have the potential to have a profound impact on future Tribal monarch conservation.

No other nongovernmental or community organization currently exists to provide support or technical resources for monarch/pollinator habitat restoration on Tribal land. Tribal nations are unique communities that need specialized outreach and education efforts, and for historical and cultural reasons these efforts are unlikely to succeed unless designed by and for Native people. The potential resources that the Tribes can bring to habitat restoration efforts are enormous. In Oklahoma, over one million acres are currently under Tribal jurisdiction, and the Tribes are aggressively purchasing property to increase their land base. Native people have cultural values which revere nature, making them ideal candidates for conservation programs. In every possible way, this is a demographic that should be viewed as an important potential partner in the fight to save the monarch butterfly migration, which has cascading benefits to ecosystems that are being impacted by climate change.

TAP also provides a nexus for state, national, and international groups to exchange monarch conservation ideas and information with Tribal entities. Organizations that have enlisted our assistance in connecting with Native monarch conservation efforts include CEC, NatureServe, and the Oklahoma Monarch and Pollinator Coalition.

Blane Stacy of the Oklahoma Conservation Commission leads a field training session on controlling non-native invasive species at a TAP workshop on habitat restoration.

Partnerships with Tribal colleges create additional avenues for transferability and long-term impact through the creation of educational programming that will continue to be used as curricula beyond the duration of the grant project funding. We have seen firsthand that when students at Tribal colleges, many of whom are adult scholars, participate in monarch conservation through TAP, they take that knowledge back to their home communities in other parts of the state, empowering them to become community educators and policy influencers. TAP currently has a multidepartmental partnership with the College of the Muscogee Nation in Oklahoma and has received partnership requests from the Fond du Lac Tribal and Community College in Minnesota and the Pawnee Nation Tribal College in Oklahoma. We are actively seeking to develop these programs further as we receive additional funding.

TAP also partners with Langston University, Oklahoma's only Historically Black University, in their agricultural outreach to rural Oklahomans about the importance of supporting pollinators. These efforts include all rural Oklahomans, with an emphasis on educating African American and Native American youth using butterflies as a hands-on science engagement tool to promote conservation of monarchs and pollinators.

Tribal partners and participants for TAP currently include the following nations: Chickasaw, Seminole, Citizen Potawatomi, Muscogee Creek, Osage, Miami, Eastern Shawnee, Choctaw, Sac and Fox of Missouri in Kansas and Nebraska, Sac and Fox Nation of Oklahoma, United Keetoowah Band of Cherokee Indians in Oklahoma, Pawnee Nation, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Ponca Nation, Tonkawa Tribe, Shawnee Tribe, Karuk Tribe, Iowa Tribe of Oklahoma, Cherokee Nation, Delaware Nation, Modoc Nation, Quapaw Nation, Kickapoo, Nottawaseppi Huron Band of Potawatomi, Iowa of Kansas and Nebraska, Yuchi, Seneca-Cayuga, and Fond du Lac Band of Lake Superior Chippewa.

For more information on how Tribal Alliance for Pollinators can assist you with restoring habitat on Tribal land to benefit monarch butterflies and other pollinators, please go to www.tribalallianceforpollinators.com or contact Collin Spriggs at collin@tribesformonarchs.org.

Ecosystems & Biodiversity
Key Message
Indigenous peoples' worldviews are often explicit in their centering of relationality, responsibility, and reciprocity as critical concepts. These concepts may inform Indigenous responses to climate change impacts. Examples of these impacts include increases in destructive wildfires and invasive species and decreases in ice cover due to warming temperatures. Indigenous actions to address climate change are vast, but some specifics include cultural burning, protection of keystone species, and observation and evaluation of invasive species before deciding how to respond.

Recommendation
Indigenous peoples' self-determination as practitioners of biodiversity conservation and ecological protection should be respected and reinforced. This can be accomplished through collaboration across jurisdictions; consultation and consent in the first stages of land and water planning, research, and management processes; increasing support mechanisms for the exercise of Tribal sovereignty; and the removal of barriers to Indigenous peoples' rights to implementing land management practices. Special measures need to be taken to provide access to and management of off-reservation areas to promote the retention of culturally valued species to the maximum extent possible. This helps to ensure the promotion and maintenance of Indigenous economies, traditional knowledge systems, livelihoods, meanings, and identities. Where retention is not feasible, measures are needed to support Tribes in making new relationships with newly arriving living beings.

Climate Change, Ecosystems, and Biodiversity: A Broad Perspective
Indigenous peoples often describe their experiences with and knowledge of climate change in terms of the responsibilities they have to support the wellbeing of human and other-than-human entities now and for generations to come. Responsibilities do not refer to actions that take place in isolation. Indigenous concepts of responsibility are socio-ecological systems approaches to understanding and responding to climate change. By systems, it is meant that the causes and effects of climate change are viewed as functions of interconnected, cross-scale relationships. Indigenous experience and knowledge of climate change move beyond narrow descriptions of climate change impacts, such as changing water temperatures in rivers. Indigenous peoples often recognize that such a change is exacerbated by breakdowns in responsibility between human groups to the environment. Euro-American colonial and settler industrialization and overdevelopment of river systems, for example, can be related to detrimental impacts to water quality, such as rising temperatures, although Indigenous peoples did not consent to this hydrologic system modification. Warming can negatively affect fish populations and hence humans' ability to take care of fish and other cold water adapted aquatic species. The less humans can carry out their responsibilities to fish, the less fish can support humans and other species. As this mutual responsibility changes, so too do human ceremonies and social activities, as subsistence harvesting lessens. This leads to changes in cultural and family lifeways. At the same time, the threat of warming waters caused by riverine water impoundments (e.g., dams) can mobilize political action locally and more broadly and motivate Indigenous knowledge keepers to engage with scientists.

Indigenous systems approaches, then, often involve grassroots, bottom-up activities as responses to climate change. Systems-level action can start with families, clans, or lodges and ripple out through different parts of society. This is different from other systems approaches that start with attempts to view an entire system from a higher scale (e.g., regional, state/provincial, national, global) and issue analyses and recommendations from that vantage point.

Holistic Approaches to Ecosystems and Biodiversity

Indigenous peoples approach climate change through socio-ecological cross-systems concepts, often using terms like “land” to stand in for complex systems of responsibilities like those just described. In English, some Indigenous peoples use concepts like “cosmovision,” “kincentricity,” or “our relations in nature,” among others, to denote systems that are moral, social, cultural, and environmental. Indigenous peoples also use their own words integrated within English language discourse. Margaret Noodin (2017) discusses the concept of ganewendamaw, which denotes complex caretaking and responsibility in the Anishinaabe language. Jeanette Armstrong (1998) discusses the concept of naw’qinwixw, which denotes long-term sustainability in terms of people’s interaction with each other, the environment, and their passing on of knowledge and ecological literacy, in the Okanagan language.

For at least some of these Indigenous peoples, scholars and knowledge-holders have expressed different understandings of other-than-human entities as self-determining agents who can engage in responsible and reciprocal relationships with humans (Larsen & Johnson, 2017). The behavior of these beings, persons, relatives, relations, ancestors, or other entities is taken very seriously by some Indigenous persons as a source of teachings, knowledge, and moral protocols supporting coexistence (Reo & Whyte, 2012). In certain contexts, Indigenous peoples’ relationships with nonhumans are taken to express their sovereignty relating to the land, water, and air given the importance of relationships of interdependence with other-than-human entities (Quintana, 2020).

Some Indigenous persons have been involved in engagements with scientists on analogous concepts used in fields like ecology, climate science, ecosystem services, or sustainable resource management. For example, the concept of an ecosystem is often understood as a systematic organization, or a group of interconnected elements, formed by the interaction of a community of organisms, including humans, with their environment. The concept of biodiversity typically involves every living thing among ecosystems, including plants, bacteria, animals, and humans. These concepts highlight interconnectedness. Indigenous peoples have pushed these concepts to consider the integration of humans within environmental systems and ecological processes, highlighting how moral relationships like responsibilities (vs. rights) are important ways to learn about, plan for, and respond to current and future climate or socio-ecological disruptions.

Reciprocity, as a quality of responsibility, is one example. In the literature, reciprocity is often used by Indigenous people as a way of understanding the mutuality of relationships of interconnectedness. Reciprocity can be placed in dialogue with how ecologists view ecosystems. Indigenous peoples understand reciprocity as involving multiple relationships, often crossing generations, and as sustaining numerous species (including humans), which is comparable to the understanding of biodiversity and resilience. Yet often, where sciences of ecosystems and biodiversity exclude or limit connections to human societies, Indigenous peoples are among those (including many in different scientific fields) emphasizing that cultural, social, familiar, and political systems are integral aspects of environmental systems. Ronald Trosper, for example, has studied how potlatch (giveaway) ceremonies for Salish peoples were part of complex systems of reciprocity in which Indigenous peoples coordinated the stewardship of entire regional ecosystems. Reciprocity was systematically entwined with moral responsibilities, methods of evaluating the success of knowledge keepers and stewards of species like salmon, and conflict mediation and mutual aid protocols to appeal to in times of disruption or hardship (Trosper, 2002).

Case Study: Beaver and Coho Salmon
One example of the value Indigenous peoples place on relationships and interconnected systems involves beaver and Coho salmon habitats. Beavers once populated many drainages and were critical to the habitat quality and populations of Coho salmon across the Pacific West in many coastal riverine systems. Fur trapping and industrial riverine development for hydrologic modifications (e.g., water resource impoundments and dams) actively removed beavers from many river systems. Beavers, as significant natural geo-hydro engineers, promoted and maintained aquatic habitat features, such as ponds and backwater habitats in fluvial river valleys that directly increased the suitability of habitat for Coho salmon. Coho salmon, as an anadromous fish, spawn in freshwater creek and river systems; the juveniles spend one year in the fresh water systems before migrating downstream to the ocean.

Beavers and Coho salmon are highly valued aquatic species by Tribes economically, culturally (e.g., ceremony), politically (e.g., treaty rights), and health-wise (e.g., nutritious diet). Efforts by Tribes for riverine restoration coupled with beaver and Coho salmon conservation are understood to be critical components of a healthy aquatic system's functionality, water quality, and water quantity and as mitigation measures to alleviate the effects of climatic-induced drought and changes in precipitation regimes (Dittbrenner et al., 2018; DeVries et al., 2012). These efforts involved political mobilization by leaders, actions by family members, harvesters, and knowledge keepers, studies and regulatory activities by Tribal and intertribal staff, and partnerships with other actors in the region (Ebbin, 2012). These grassroots efforts start with people taking personal responsibility locally and coordinating with others in ways that provide the basis for scaling up.

For some Indigenous peoples, ecosystem conservation protects key species for biodiversity while also conserving key sources of community medicine, food, and cultural activities, all of which are tied to maintaining and increasing the use of language, family activities, ceremony, and other broader societal groups such as clans, lodges, and houses. Indigenous notions of conservation are generally associated with sustainable resource use that fosters biodiversity by focusing on indicator or cultural keystone species that represent ecosystem integrity. Founded upon acknowledging that species have the right to survive, thrive, and reproduce, these Indigenous conservation tenets often include sacred areas (as protection area surrogates), rituals, practices that mitigate or reduce harvest of species at vulnerable times of their life cycles (e.g., mating or breeding), and retaining plant and animal propagules that sustain populations. This sustainable resource-use also consciously influences ecological processes (e.g., cultural burning, discussed below) that conserve the socio-ecological system as a form of mutualism (Garibaldi & Turner, 2004). Conservation of the land supports culture and creates a sense of community and connectedness that ultimately protects the health and wellness of the people and the environment. A respect for the aforementioned concepts and practices is crucial in some Tribal and non-Tribal relationships for environmental problem solving (Reo et al., 2017).

COVID-19 as a Systems Issue
The COVID-19 pandemic is another systems issue that can be understood similarly to ecosystems and biodiversity. Some Indigenous peoples face severe threats from the pandemic due to pre-existing

inequalities caused by Euro-American colonial invasion and settlement, related to access to water, economic opportunities, and food resources, among others. Risks are also tied to the meaningfulness and significance of cultural activities (e.g., rituals and ceremonies) that may have to be halted or modified from traditional practices due to social distancing. The pandemic affects systems spanning numerous relationships connecting humans and the environment. In particular, when intra- and inter-family ceremonial or subsistence activities that promote and foster broader socio-ecological resistance or resilience are prevented or greatly reduced, adaptive capacity to respond to climatic disruptions or recovery following climate-induced disturbances such as storm surges and flooding, wildfires, heatwaves, and extreme cold weather events may also be reduced.

As one of the greatest contemporary issues globally, climate change and its associated extreme weather and environmental hazard events present significant challenges for Tribal communities. These events bring on new stressors that can compound the impacts of the historical legacy and persistent socio-economic problems that many Tribes face (Bennett et al., 2017). In light of the COVID-19 pandemic, these climatic stressors and their systemic consequences are exacerbated by physical isolation and digital disconnection, leaving the most vulnerable in our communities at an even greater risk.

Introduced invasive diseases such as flu, smallpox, and others have decimated Indigenous populations (Pfeiffer & Voeks, 2008). COVID-19 could be considered the latest example of such an introduced species. (Other introduced invasive species are discussed in depth below.)

The already existing digital divide leaves some communities lacking access to resources and information that are commonly available to most of the U.S. Moreover, people without adequate cell phone coverage or reliable high-speed internet are not able to access time-sensitive information on how the virus is spreading, updates on where to access healthcare professionals or supplies, or access to each other to check in on family and friends. For this or future pandemics that require the need for quarantine and self-isolation, this divide can feel insurmountable. The inability to connect with others can take a physical and emotional toll, and the longer in-person contact is limited, the more individuals lose the ability to create or maintain a sense of community. Further isolation and lack of cohesion will also impact efforts to support or advance discourse on climate change or the implementation of climate adaptation activities.

Indigenous Fire Stewardship as a Systems Approach

Indigenous fire stewardship has been used by Indigenous peoples since time immemorial as an approach to managing landscapes. It is a contemporary term used to define the traditional practice of applying fire to enhance the resources integral to one's livelihood and culture and includes burning (or prevention of burning) for ecosystem health (Marks-Block et al., 2019). Indigenous peoples have a long history of managing the landscape through their use of burning (Boutsalis, 2020; Marks-Block et al., 2019; Marks-Block, 2020). The use of cultural burning mitigates the spread and threat of catastrophic wildfire and helps create resilient landscapes while promoting the growth of culturally significant plants used as food sources or as source material for activities such as basket-making. Burning can be understood as a strategy for addressing climate change, as drier grasslands and forests and changes in snowpack and snowmelt are connected to less vigorous plants, increases in invasive species, insect outbreaks, and stand-replacing fire events. Generations of fire suppression and the forced removal of Tribal fire use has left the landscape overburdened with fuel and out of balance in the composition of species.

In the western U.S., Indigenous fire stewardship was a common practice until the U.S. government outlawed the practice under the threat of punishment by death after colonization (Cagle & Hootnick, 2019). The proper timing, approach, and strategies for burning practices are held in the collective traditional knowledge of Indigenous peoples. In the Pacific Northwest, the United States Forest Service (USFS) has been experimenting with the use of cultural burning approaches in collaboration with the Yurok and Karuk Tribes. In a manner, they are exploring the concepts of co-management between the USFS and the Tribal governments. Lake and Christiansen (2019) discuss the concepts of Indigenous land stewardship using fire as a land management tool. In their chapter summary, they state, “Frequent and diversified Indigenous burning coupled with natural ignitions reduced fuel loading, which often lowered the intensity and resultant severity of subsequent fires. As such, lower fuel load continuity, increased proportion of fire-adapted vegetation, and heterogeneous habitats (mosaics) greatly reduced the threat of and impacts of non-desired wildfires.”

An example of the interconnectedness of Indigenous stewardship, biodiversity, and ecosystems is the coupling of socio-ecological and cultural fire regimes. Indigenous fire stewardship exercised by cultural practitioners includes but is not limited to the diversification of natural ignitions (e.g., lightning) that often increases the frequency of fires, differing seasons or timing of burns within seasons (linked to phenology), specificity, and spiritual-ritual obligations of having fires that increase resilience, diversity, productivity, and functionality of fire-dependent plants, fungi, and animals that are highly valued Tribal resources. From Indigenous perspectives, the use of fire across different ecosystems among varied habitats in response to climate and socio-ecological processes is and can be human services for ecosystems and associated species (considered as relations). This stewardship approach can increase and promote species diversity, resistance or resilience among habitats and between species (reduced fuel loads and vegetation continuity, fostering drought-tolerant fire-adapted species), and socio-ecological systems. This can help moderate or buffer against extreme events that expand the range of variation (e.g., natural fires or lightning being sporadic results in more intensive fires, compared to an intentionally culturally burned area that moderates the intensity and severity of future fires), climate-induced disruptions (e.g., intentional burning to foster diverse vegetation mosaics reduces pest outbreaks and the vulnerability of other factors such as drought stress by having less water competition among trees that are drought-tolerant and fire-adapted), and Euro-American colonial modification of ecological processes (Lake & Christianson, 2019; Lake et al., 2017; Norgaard & Tripp, 2019; Lake, 2021).

Impacts on Ecosystems & Biodiversity Experienced by Tribes

The following sections describe some of the general and specific impacts to ecosystems that many Tribes are experiencing.

General Ecosystem and Biodiversity Impacts

Climate change is inducing species, habitat, and ecosystem range shifts that are slowly leading to the loss of valued resources and is making these resources less reliable (Bond et al., 2019; McNeeley et al., 2020; Weiskopf et al., 2020). These range shifts are moving culturally important resources outside of the territories and areas where Indigenous peoples can access them. Climate change can also cause phenological shifts that make resources less available or available at times outside of a legal harvest window or can disrupt ecological interactions, resulting in ecological reorganization and changes in species composition. This can lead to "biocultural hysteresis" due to interacting biological, ecological, legal, social, and other historical constraints, resulting in disruption of Indigenous human-nature-social relationships and limiting capacities to adapt (Billiot et al., 2019; McKinley et al., 2019; Lyver et al., 2019).

Increasing Temperatures

While ecosystems on Tribal lands throughout the U.S. are experiencing impacts from climate change, one example is in the upper Midwest (northern Minnesota, Wisconsin, and Michigan), where climate changes threaten many beings on which Ojibwe Tribes residing in the region rely for spiritual, ceremonial, medicinal, subsistence, and economic needs. Many Ojibwe Tribes retained treaty rights to hunt, fish, and gather off-reservation in the upper Midwest Ceded Territories, and these treaty rights are directly threatened by climate change and its effects on culturally important beings. Increased air and water temperatures will stress northern animal beings such as wood turtle, moose, American marten, snowshoe hare, fisher, sharp tailed grouse, common loon, and tullibee, as well as many northern and boreal plant beings such as wild rice, paper birch, sugar maple, northern white cedar, and Labrador tea (Handler et al., 2012; Panci et al., 2018), many of which are found at the southern end of their ranges in the Ceded Territories. This may lead to reduction or possible elimination of accessible ranges or occurrences (Tribal Adaptation Menu Team, 2019), such as the modeled northward shift of suitable habitat for sugar maple (Iverson et al., 2008).

The Great Lakes, a resource vital to many beings in the upper Midwest, including human inhabitants in the region, are also experiencing warming, which could threaten the habitat and existence of many, make the lakes more prone to algal blooms, and create more suitable habitat for invasive species. Fish in the Great Lakes are under particular threat, as climate change, pollution, and invasive species are imperiling the entire food web of the Great Lakes, including native lake trout (Folger, 2020; Treat et al., 2020). Tribes in the region, as well as intertribal agencies, have begun adaptation planning processes together with other efforts to record valuable Tribal knowledge from elders and harvesters. (See the Midwest Region of the Tribal Climate Change Assessments and Adaptation Plans document for links to eight completed plans from the region.)

Where the ranges of species, habitats, and ecosystems are shifting, special measures need to be taken to provide access to and management of off-reservation areas to promote the retention of culturally valued species to the maximum extent possible. This helps to ensure the promotion and maintenance of Indigenous economies, traditional knowledge systems, livelihoods, meanings, and identities. Where retention is not feasible, measures are needed to support Tribes in making new relationships with newly arriving living beings. Collaborative efforts and initiatives between cross-jurisdictional stakeholder groups and Indigenous peoples are also needed.

Wildfire

According to the Congressional Research Service (CRS, 2020), the number of acres burned annually by wildfire has drastically increased as a result of anthropogenic climate change. The record-breaking wildfire seasons of 2019 and 2020 had such extreme impacts that public utility companies have begun to shut off power to millions of people in metropolitan urban and rural outlying areas as a preventative approach to wildfire inception during extreme wind and storm events (County of Santa Clara Emergency Management, 2020). This pattern is only expected to worsen, as climate change will continue to increase the number of extreme fire days by 2100 (Goss et al., 2020). As of October 2020, California was on track for another record wildfire season, with over four million acres burned (Freedman, 2020). In 2012, the California Public Utilities Commission ruled that energy companies can turn off power during high wind events to avoid wildfire. This often leaves rural communities, and many rural Tribes, without power during high wind events that can last for days. This has a great impact on communities who do not have backup generators or other options to maintain critical infrastructure and care for elders and others who are at increased risk. Renewable energy development, microgrids, transmission infrastructure, and other associated infrastructure in rural areas could help reduce these risks to Tribal communities (see *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets*, and *Chapter 7: Energy & a Just Transition* for more on energy development).

While climate change is directly exacerbating extreme fire behavior, a history of fire suppression and loss of Tribal sovereignty over land management practices has removed fire from its ecological role on the landscape (Norgaard, 2014). Historical fire regimes throughout the southwestern U.S. (with presumed mean fire return intervals of 5 to 10 years, according to the LANDFIRE database) were disrupted through Euro-American colonial settlement of the West, arrival of the railroad, and a national policy of fire suppression. In Alaska, wildfires are becoming more frequent and severe as a result of climate change (Woo et al., 2020).

As a result of high-severity and catastrophic wildfires, communities like that of Santa Clara Pueblo, located on the eastern flank of the Jemez National Forest in New Mexico, have experienced severe post-fire runoff and costly damages to infrastructure ($200 million dollars) and are facing the question of what happens after the fire. Following the Las Conchas fire of 2011, landscapes that were once dominated by Ponderosa pine and Douglas fir are coming back not as forests, but as shrubland. Ecological disturbances like wildfire are increasing ecological transformation throughout the Southwest and threaten already declining snowpack-water resources (Keyser et al., 2020).

At present, the Tulalip Tribes and the Swinomish Indian Tribal Community are partners on a project that is studying forest fires on the west side of the crest of the Cascade Mountains in Oregon and Washington (Harvey et al., in progress). These fires tend to occur in areas that have a heavy fuel load, but are also wetter and less likely to burn. However, under the right conditions (extremely hot, dry winds from the east during droughts), the researchers have documented extensive and intense wildfires that are difficult to contain. They are exploring the climatic drivers of these wildfires and seeking a better understanding of how these forests respond to burning. For Tribes, a warming climate and its relationship to fire is a critical resource management concern, especially regarding natural resource planning in the wildland–urban interface. These research results will inform USFS Forest Plan revisions and National Park Service (NPS) post-fire planning under a warming climate and guide pre- and post-fire adaptive management by the NPS, USFS, Bureau of Land Management, and several federally recognized Tribes in the northwestern U.S.

Invasive Species

The concept of invasive species is important within Indigenous understandings of ecosystems and biodiversity. Often “invasive species” is a term used to indicate how the introduction, establishment, and migration of a species that was initially not Indigenous or native (i.e., exotic) disrupts the integrity of an ecosystem and its biodiversity. “Invasive” or “exotic” connotes a foreignness and a lack of belonging. Indigenous peoples, while concerned about invasive species, have in some cases taken a different approach.

Indigenous peoples have multiple beliefs and traditions concerning so-called invasives which may be held simultaneously within a community. Some conceptualize species as "nations" having their own sovereignty, and species new to an area are not treated as invaders but rather as approaching nations that are addressed through protocols with a foundation in respect for all life (Reo & Ogden, 2018). They are also viewed as relatives (e.g., "all my relations"), what has been called "kincentricity" (Martinez, 2018; Salmon, 2000). Rightful and respectful relationships with other-than-human beings and the natural world are central to Indigenous societies. This creates an "original compact" between humans and living beings, violations of which can cause plants and animals to refuse to give their lives for human sustenance (Martinez, 2018).

Indigenous peoples often wait for a time after a new relative arrives to understand what they are offering to provide and in return the mix of responsibilities for them and how best to relate to or address the new member to the socio-ecological system (Reo & Ogden, 2018). This approach then mobilizes multiple ways of evaluating a newly arrived potential relative, including cultural knowledge, rather than immediately engaging in the eradication of the invasive or exotic species. At the same time, Indigenous peoples make decisions about their conservation and climate change priorities based on the degree of relatedness. Although all species are related, they may have different degrees of relatedness. Some species may be prioritized over others because of the particular relationships, services, or functions they provide with respect to other relations they have with Indigenous peoples, given ramifications beyond their ecological function (Pfeiffer & Voecks, 2008). Some are recognized as disrespectful relatives that are outcompeting, modifying, or degrading the suitability of biocultural systems and their relationships with close relatives, and these harmful effects are also evaluated and assessed (Bond et al., 2019).

Some scientists have voiced concern that taking cultural concerns into account, such as through incorporating the concept of “cultural keystone species,” fails to acknowledge the ecological, environmental, biodiversity, and economic harms associated with invasive species and claim that there is insufficient evidence that it is effective (Garibaldi & Turner, 2004; Nuñez & Simberloff, 2005). This criticism itself fails to recognize that Indigenous peoples often follow the same policy prescriptions of scientists to evaluate invasive species on a case-by-case basis, using multiple criteria to decide whether to eradicate, control, or accommodate invasive species (see Long et al., 2018, for many examples of culturally appropriate invasive species management).

Impacts of invasive species on Indigenous peoples and relations

Human travel, trade, colonial environmental management policies, and climate change are contributing to the spread of invasive species both within the U.S. and worldwide, with invasive species being one of the leading drivers of biodiversity loss (Lipton et al., 2018; Norgaard, 2007; APHIS, 2020). From a Western science and management perspective, such species are often defined as organisms, nonnative to a particular ecosystem, that cause or are likely to cause economic or environmental harm or harm to human health (ISAC, 2006; Lipton et al., 2018). Invasive species can include animals, plants, or pathogens.

For Indigenous peoples, another type of harm that can occur is cultural. This can be evaluated in terms of relationships and responsibilities as discussed above. Invasive species can affect the quantity, health, and quality of culturally important resources and relatives, in some cases upsetting ecosystem balance (Pfeiffer & Voeks, 2008). For instance, in the southwestern U.S. tamarisks are replacing culturally significant willows and cottonwoods. In the Pacific Northwest, escaped farm Atlantic salmon are competing with and transferring diseases to the native, wild salmon, threatening spiritual and cultural practices and identities. Another example is when an exotic, nonindigenous aquatic invertebrate (e.g., mussel or snail) is introduced to a river or lake ecosystem, it begins to displace other native aquatic species, changes the water quality, and may be more adaptable given industrial modification of the river's hydrologic network (Petsch et al., 2020; Kernan, 2015).

Dibaginjigaadeg Anishinaabe Ezhitwaad: A Tribal Climate Adaptation Menu

There is no way to translate "invasive species" into Anishinaabemowin, and the term itself is considered disrespectful. The *Dibaginjigaadeg Anishinaabe Ezhitwaad: A Tribal Climate Adaptation Menu* author team was given the phrase "bakaan ingoji gaa-ondaadag" by an Ojibwe elder and language speaker to refer to these beings (TAM Team 2019). Loosely translating in English to "non-local beings," the phrase reflects the Anishinaabe belief that all beings deserve respect and that all were given original instructions by the Creator. Beings that have found themselves outside their original community are still acting according to their instructions, but their actions may not be balanced by the other beings in their new communities, in some cases causing disruption to the normal function and health of an ecosystem. The Menu recognizes this conflict and suggests that climate adaptation may require respectful actions to minimize or prevent the establishment of bakaan ingoji gaa-ondaadag if they pose a threat to the health of the local environment. Culturally appropriate approaches and tactics include not only physical and biological control, but also respectful observation, seeking traditional and cultural knowledge from areas where beings may be native and the creation of new reciprocal relationships through ceremony and harvest.

In the western U.S., American colonial settler fire suppression policies combined with a decline in Indigenous land tenure have disrupted socio-ecological fire regimes (including Indigenous fire stewardship). This has contributed to the expansion of some conifers and hardwoods, as well as other vegetation invading formerly burned habitats that hosted many fire-dependent plant and animal species on which Indigenous peoples rely (Huntsinger & McCaffrey, 1995; Keeley et al., 2010). Subsequently, ecosystem services and functions have been degraded, leading to increased vulnerability to drought, increased prevalence of insects and diseases, and an increase in the risk of severe wildfire that is exacerbated by climate-induced drought (Knapp et al., 2013; Heyerdahl et al., 2006).

Invasive species can also affect the accessibility of resources. In California, invasive plants with spines and thorns such as starthistle and stinging nettle can inhibit weavers from gathering basketry plants (Pfeiffer & Ortiz, 2007).

In addition to these more direct effects, management responses to invasives can also affect Tribal peoples. One of the major factors in the establishment of the California Indian Basketweavers Association was opposition to herbicide use to control invasive plants. Concerns include impacts on the quality of basketry materials (e.g., stunted growth, plant physical deformities), potential health impacts to weavers, plants, wildlife, and aquatic species resulting from chronic exposure to herbicides or their residues, and desecration of sacred sites by spraying poisons on the sites (Norgaard, 2007; Pfeiffer & Ortiz, 2007). All of the impacts discussed above can lead to cultural erosion in which stories, language, management practices, intergenerational connections, and relationships with and reverence for species and places are diminished or lost and not passed on to younger generations (Pfeiffer & Voeks, 2008).

Responses to invasive species and climate change

The Indigenous focus on relationships and responsibilities increases ways to respond to invasive species when compared to Western methodologies. For instance, while some species may be considered culturally impoverishing, leading to cultural erosion as described above, other invasives might become used in culturally enriching or facilitating ways and become included in or help to retain cultural practices. Examples include wild horses becoming incorporated into the traditions of Tribes in the western U.S. or invasive plants becoming a part of Indigenous pharmacopeias. In some cases, integration of an invasive species into cultural practices and harmful impacts may occur simultaneously. Feral pigs introduced into Hawaii from Polynesia have become a part of Indigenous Hawaiian cultural rituals, yet at the same time the pigs contribute to the destruction of native ecosystems and the food and medicinal plants found therein (Pfeiffer & Voeks, 2008).

In California, basketweavers advocate for the management of invasive plant species from a more relational perspective, including protecting native plant competitors of invasive species, using traditional cultural burning to promote ecosystem balance, protecting gathering sites from invasion, and restoring native plants. They oppose chemical treatments that could harm basketweavers and other relatives within the ecosystems that they steward (Norgaard, 2007; Pfeiffer & Ortiz, 2007). In other instances, invasive plants that are native pollinator host surrogates are valued and understood to have a service or function while the habitat is being actively restored. In such a case, the Tribal philosophy of "feeding your relations" is embraced and exercised by not eradicating all nonnative flowering plants, but instead fostering a transition to native host plants for pollinators (Long et al., 2020).

As the climate continues to change, species will continue to shift in response, with different species within ecosystems moving at different rates. Species may disappear from some regions and move to others or may become extinct. New species interactions and ecological communities may develop with no prior precedent, further challenging and complicating Western conceptualizations of what it means to be invasive (Lipton et al., 2018). Indigenous approaches to newcomers that focus on relationships, understanding, and responsibilities can inspire a broader array of paths forward and may be particularly relevant as we choose how best to respect and respond to all our relations in a transforming and uncertain world.

Thawing Permafrost, Glacial Retreat, and Loss of Sea Ice

Degradation of Alaska's permafrost began as early as the mid-1700s due to relatively naturally occurring warm climatic cycles, but that has accelerated substantially due to climate change in the 1900s and 2000s (Jorgenson et al., 2001). This degradation has led to loss of ecosystem services, conversion of dominant terrestrial landscapes to aquatic or wetland-type classifications, and the alteration of subsurface hydrology (Jorgenson et al., 2001).

Glacial retreat, which occurs whenever melting of a glacier exceeds the rate of snow accumulation that would form new glacial ice, and rising sea levels are altering the shoreline of places like southeast Alaska. When glaciers retreat, land that was previously ice covered becomes exposed, while rising sea levels can lead to inundation of shorelines. Overall, Alaskan glaciers show the highest global rate of acceleration of mass change (Li et al., 2021), and southeast Alaska is particularly vulnerable because of the combined factors of glacial retreat and sea level rise. Additionally, the isostatic rebound (which is the rising of land masses once the weight of an ice sheet is removed) in southeast Alaska has the highest measured rate in the world: the community of Yakutat has a measured isostatic rebound rate of one inch per year (McDaniel et al., 2019). This shoreline alteration impacts both the coastal habitats and the availability of food resources, particularly for Alaska Natives who typically have a more subsistence-based diet than other communities (see *Chapter 5: Health & Wellbeing*). The projected change over the next 100 years in shoreline elevation in southeast Alaska ranges from almost six feet of new land emergence due to glacial retreat to a loss of 0.65 feet of land due to rising sea levels (McDaniel et al., 2019). Where land is emerging, the length of estuaries (specifically, eelgrass and clam habitats) is projected to decrease by up to 30%, while estuaries in areas of land submergence may lengthen by up to 3% (*Id.*). Both scenarios will greatly impact the traditional foods of the Indigenous peoples in southeast Alaska.

Melting sea ice impacts species that are dependent on the ice for their hunting, which has cascading effects on Alaska Natives who in turn depend on those species for sustenance (Marks-Marino, 2019). The loss of sea ice in the Arctic is impacting marine mammals (e.g., walrus and seals) that are unable to haul themselves out of the water and onto the ice, which is relatively protected from predators. Walruses show a general preference for sea ice to molt, mate, nurse, and rest (Joling, 2018). As an alternative, these mammals are gathering on lands connected to the mainland or islands, which are occupied by humans and other predators. These areas offer much less protection, greater exposure, and more risk for these animals.

Inupiaq and Yup'ik hunters have observed and described significant changes, such as to the timing of sea ice formation and weather patterns that have, in turn, changed the timing of marine mammal migrations, their distribution, and their behaviors, as well as the efficacy of the hunting methods they have used for generations (Huntington et al., 2016).

Alaska Natives typically use snowmobiles and four-wheelers as primary sources of transportation in the winter to cross both land and bodies of frozen water; in recent years, people have died by falling through rivers that had been dependably frozen in the past (Marks-Marino, 2019), making wintertime travel and hunting simultaneously more dangerous and less accessible (Huntington et al., 2016; Sharma et al., 2020).

Air and Water

Air and water are two topical areas in which Indigenous peoples have devoted their energies toward environmental protection and climate change adaptation and mitigation. While air and water are inextricably connected to the broader topic of ecosystems, the structure of many natural resource agencies like the U.S. Environmental Protection Agency delineates air, water, and land into their own, siloed programs (Office of Air and Radiation, Office of Water, and Office of Land and Emergency Management). Although this is counter to the interconnected way in which the world truly functions, this report will take an additional, deeper look into the impacts to and responses by Tribes regarding both air and water in the following chapters.

Conclusions

As discussed previously, Indigenous peoples address these issues systemically, relying on diverse scientific (Indigenous and Western knowledge) approaches, and leveraging political, cultural, and social connections to their ancestral lands that can benefit Indigenous communities and society. Indigenous teachings, often with creation stories of norms and responsibilities to family and community, relate interconnectedness and dependency. Such teachings are potent reminders of culturally rooted ethics, responsibility, and reflection on the appropriateness of human actions and implications for the environment. These approaches are applicable to climatic disruptions that result in degradation or damage to valued species used for resources, to localized observations of climatic-induced changes to species distributions, or to seasonal or annual movements in relation to ecological factors, be they extreme heat or cold, intensified weather, drought, or disturbances such as wildfires.

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Chapter 4.1: Air

The narratives in this chapter from the Kootenai Tribe of Idaho and the Nottawaseppi Huron Band of the Potawatomi of Michigan speak to the challenges and solutions Tribes are encountering in maintaining air quality programs and protecting the health of their Tribal members. Both Tribes lack adequate funding for staff, support, and equipment. Without air quality programs, the communities they serve suffer health related consequences. The Kootenai Tribe provides an example of how states and Tribes can work together, and the Nottawaseppi Huron Band describes how they actively sought solutions to implementing a complete network of air monitoring. A researched overview of Air as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Kootenai Tribe of Idaho Air Monitoring Equipment

Written by: Carol Kriebs, Environmental Director – Kootenai Tribe of Idaho

I have been working with the Kootenai Tribe of Idaho since July 9, 2018, and inherited an air station with equipment that was 20-plus years old. There were many things that needed to be replaced, and priorities had to be set on how to begin. The first year the deck was replaced; the wood construction had made it unsafe for people to walk on due to rotten wood under your feet. I was able to move some funding around and replace it with a corrugated metal platform. This allows snow to pass through the platform and gives staff a slip-resistant surface, as well as longevity for many decades.

In 2019, our sensors and equipment began to fail. Due to COVID-19, we had travel funding that wasn't spent, so with permission I was able to move those funds to buy a new data logger and wind and temperature sensors. The data logger was so old that this model wasn't even being serviced anymore. Thinking I was in good shape, the unthinkable happened. My nephelometer ($PM_{2.5}$ monitor) motherboard went out. That took my site offline for months just prior to smoke season (a really bad time to lose a major piece of equipment). This time there was no available funding for replacements, but conversations with the Idaho Department of Environmental Quality (IDEQ) led to them sending us four old nephelometers that they had replaced. We found one of the four that was still working. I did some research and found out these units are being phased out. IDEQ has also loaned me an E-Sampler so we can co-locate, since no one was sure how long the nephelometer would last, giving us time to find funding to replace our nephelometer.

Equipment failure is happening all across Indian Country, and additional funds are greatly needed to be able to, at a minimum, keep equipment running and in most cases to upgrade. The National Tribal Air Association has reported this need for many years in the *Status of Tribal Air Report* to EPA leadership, and still grant funds being allocated to Tribal programs continue to decrease. It is my hope that this article will shed new light on this issue and help others to build partnerships with their states, for without the State of Idaho's help the Kootenai Tribe wouldn't have been able to monitor through the smoke season.

Kelby Sullins from the Idaho Department of Environmental Quality setting up the portable air monitoring station.

Nottawaseppi Huron Band of the Potawatomi's Particulate Matter Monitoring Program

Written by: Amy Boetcher, Environmental Specialist – Nottawaseppi Huron Band of the Potawatomi

Non-Tribal land located about 9 miles from Pine Creek Reservation in Calhoun County, Michigan, showing industrial farms (circled in orange) and oil/gas wells (circled in yellow). There were zero oil/gas wells here in 2013.

BACKGROUND

The Nottawaseppi Huron Band of the Potawatomi (NHBP) air program serves approximately 1,600 Tribal members and is located on the Pine Creek Reservation in southwest Michigan. We do not receive any air-specific funding. We run eligible components of our program with EPA GAP funds and the rest with Tribal general funds.

NHBP is concerned about pollution from area sources, particularly activities relating to land use on and near local farm operations. With few exceptions, Tribal members live in counties with at least 40% (and as much as 80%) of land use in crops and/or are within about 20 miles of industrial farm operations (the Reservation is within five miles of three industrial farms). The Pine Creek Reservation lies within the St. Joseph River Watershed, of which about 70% is used for crop and animal production. On area farms, particulate matter (PM) is a potential concern, coming from windblown dust, pesticides, herbicides, and manure use. Another potential source of PM in the area is active oil and gas wells. There are currently 15,500 active oil and gas wells in the state of Michigan, and they are becoming more numerous in agricultural lands near the Reservation. As the number of active oil and gas well sites increases, we would like to be able to monitor the potential impacts on our air.

IMPORTANCE OF THE PROJECT

Street view of a rural oil and gas operation in Calhoun County, Michigan.

We are concerned about PM because it impacts the health of our community, and climate change may have additive impacts. Michigan Department of Health & Human Services/Great Lakes Integrated Sciences and Assessments reports that one of the top five climate-related health concerns in Michigan is respiratory diseases. According to Johns Hopkins Bloomberg School of Public Health, adverse health impacts linked to PM include development/exacerbation of chronic lung issues, heart attacks, and hospital admissions and ER visits for heart and lung disease, among others. In addition, PM is known to cause more risks for elders, children, and people with heart and/or lung disease. We have a disproportionate number of community members that are considered to be more sensitive to PM. We know that Michigan has already experienced a 2°F increase in average annual temperature. We do not know what intersectional impacts climate change might have on PM pollution and Tribal member health.

PREVIOUS STEPS

In our first year focusing on ambient air (2018), we identified our generic concerns. They include: 1) Tribal member health, and 2) area sources of PM from agriculture. We started exploring how to perform an emissions inventory (EI) to create a formal plan of action. We utilized free online trainings, guidance documents, and the Tribal Emissions Inventory Software Solution (TEISS) to get oriented, particularly the Inventory Preparation Plan wizard. We also read about the $249 PurpleAir monitor, known for its robust use in California to detect PM from wildfires. We are interested in the monitor's potential to get Tribal citizens involved in our efforts and to serve as a health screening tool. Studies from reputable air quality control agencies indicate high levels of correlation between PurpleAir sensors and expensive, commercial-grade sensors used by EPA.

One challenge we face in understanding local PM conditions is a lack of local monitors. Of the 68 PM monitors currently operated by the state of Michigan and PurpleAir, about 80% are in its southeastern counties. PM can vary from neighborhood to neighborhood, so local screenings are important.

CURRENT AND FUTURE STEPS

PurpleAir Monitoring Network and the NHBP Environmental Dashboard

We are currently operating one PurpleAir monitor to screen for potentially unhealthy air days. With help from our membership, we have placed our first off-Reservation monitor in northern Michigan. We have an additional five PurpleAir monitors to strategically expand our screening to areas where Tribal members are living (throughout Michigan). We plan to display data from our Tribal PurpleAir monitoring network on an NHBP Environmental Dashboard. The Dashboard is a website for Tribal membership that displays local environmental conditions and highlights Environmental Department program areas. It includes local, live weather, PM, and water quality readings. It also has an interactive map of Tribal parcels, and local radon and environmental assessment actions. The PM screenings from our local PurpleAir monitor (housed at the government campus) are used to apply an existing EPA Air Quality Index to our dashboard. Once we complete our EI, we will have a better idea of how to best monitor pollutants of interest, and how to incorporate them into the index.

Pine Creek Reservation Tribal homes pictured just east of an active ag field. We are curious what the prevailing winds blow onto the Reservation.

GOALS FOR DATA

In 2020/1, we plan to expand our screening of neighborhood-scale PM levels by placing PurpleAir monitors in other counties with an NHBP presence. Our long-term goal is to be able to impact policy relating to sources/impacts of particulate pollution that will help improve and/or protect our community's air in an ever-changing climate.

Air

Key Messages

- The federal government must uphold Tribal sovereignty, authority, and co-management rights for air quality management. Impediments to exercising sovereignty could be removed. For example, Tribes should be allowed to perform traditional fire-prevention activities on their lands, such as cultural burning of the landscape to prevent wildland fires.
- Tribes experience disproportionate impacts from poor air quality, including smoke/fine particulates, heat, and humidity, all of which can be connected to climate change. These factors are believed to impact rates of mortality and morbidity from COVID-19.

Recommendation

Fully engage Tribes as co-regulators in the very first stages of air quality regulatory planning, development, implementation, and enforcement. Adequate funding of air quality programs for staffing, monitoring, and emergency response to air quality issues supports Tribal sovereignty, as does addressing underlying causes of environmental, social, and health inequalities and injustices with the full participation of Tribal peoples.

Spiritual Foundations of Tribal Air-Related Climate Actions

Indigenous peoples inhabit a living universe, in which proper and respectful relationships lie at the core of their Creation stories, identity, cultural integrity and meaning, and dignity as peoples.[10] The wind and air are often conceived of as living spiritual forces and inhabited by deities such as Father Sky (Forbes, 2001). All Tribal communities have spiritual protocols, ceremonies, beliefs, and practices related to the air, wind, smoke, and sky and cultural responsibilities to respect and maintain balance among these spiritual forces and beings. Tribal climate actions are not only about objects and physical processes, but relate to maintaining healthy spiritual and environmental balance and relationships (Kimmerer, 2015; Krakoff, 2008; LaDuke, 2016).

Tribal Sovereignty and Air Programs

Tribal sovereignty refers to the rights of American Indians and Alaska Natives to self-governance, as recognized in the U.S. Constitution. This concept recognizes that these sovereign states existed long before the arrival of Europeans and recognizes the inherent right of Tribal nations to regulate their internal affairs. Tribal air programs were born out of Tribal sovereignty rights and are connected to federal policy initiatives. The 1984 EPA Indian Policy recognized the unique sovereign status of Tribes. The Clean Air Act (CAA) Amendments §301(d) of 1990 established a Tribal role in implementing the CAA. The Tribal Authority Rule (TAR) in 1998 recognized the right of Tribes to assert their authority within the exterior boundaries of their reservations. The TAR also established Treatment as a State status for Tribes that allows them to implement and manage certain environmental programs in Indian Country as a state

[10] Every Tribe is sovereign and has their own beliefs and the authority to articulate those beliefs. The references on spiritual issues are only provided as preliminary and general orientation and are not intended to voice the beliefs of any particular Indigenous peoples, who should be consulted directly on these issues.

and receive long-term funding. An example of Tribes asserting air quality authority is the EPA Region 10 incorporation of the Federal Air Rules for Reservations (FARR). These rules were designed to protect air quality on the 39 reservations in the region in the absence of Tribal-specific regulations. In 2011 the EPA promulgated the Federal Indian Country Minor New Source Review Rule, which created a mechanism for permitting of minor sources on reservations. Prior to this action, there was no mechanism for any permitting authority to issue these permits, allowing sources to operate unchecked. This permitting authority was an important step toward recognizing Tribal sovereignty. Presidential Executive Order 13175 of 2000 requires federal agencies to engage in "Consultation and Coordination with Indian Tribal Governments," further acknowledging the importance of Tribal contributions to air quality management.

As of 2020 there are 121 Tribes with either §103 (project) or §105 (program) air quality funding.[11] Many Tribes conduct air quality activities through Indian General Assistance Program[12] (IGAP) work plans and funding. Tribes use §103, §105, and IGAP funding for multiple purposes, from conducting indoor air quality assessments and completing emissions inventories to carrying out air quality monitoring in order to protect the health of their Tribal members and their environments, all of which can also be connected to climate change.

The National Tribal Air Association's (NTAA) 2020 *Status of Tribal Air Report* (STAR) outlines how Tribal funding has remained stagnant, even as Tribes are being asked to do more in the field of air quality. As described in the STAR, the original Tribal funding amount of $11 million (1996) would translate to $31 million if it kept pace with increasing health care costs, or $18.1 million if it kept pace with the rate of inflation (NTAA, 2020).

Air Impacts and Tribal Vulnerability

The U.S. Department of Health and Human Services Office of Minority Health (2018) has shown that American Indians and Alaska Natives (AI/AN) have higher rates of disease and lower life expectancy than Caucasians, often from diseases that can be connected to high levels of fine particulate matter ($PM_{2.5}$) (such as heart disease, cancer, diabetes, and stroke [Bowe et al., 2019]) as well as to lower incomes and geographic isolation. (See narrative titled *Nottawaseppi Huron Band of the Potawatomi's Particulate Matter Monitoring Program* in this chapter for an example of particulate matter emissions and the impacts to human health.) An NTAA white paper[13] states:

> *Studies have also been conducted specifically regarding asthma and AI/AN children. We know that AI/AN children have greater incidence of asthma (approximately 13% compared with 8.6% of children of non-AI/AN descent) [Brim et al., 2008]. Health*

[11] The National Tribal Air Association's Status of Tribal Air Report https://www.ntaatribalair.org/status-of-tribal-air-report/

[12] Indian General Assistance Program https://www.epa.gov/tribal/indian-environmental-general-assistance-program-gap

[13] NTAA's White Paper Detailing the Science and Connections Between Air Pollution, Tribes, and Public Health https://secureservercdn.net/198.71.233.47/7vv.611.myftpupload.com/wp-content/uploads/2020/05/NTAAs-2020-White-Paper-Detailing-the-Science-and-Connections-Between-Air-Pollution-Tribes-and-Public-Health.pdf

disparities such as poverty and inadequate access to respiratory care impact AI/AN children with asthma that live on reservations, and environmental challenges such as both indoor and outdoor air pollution compound the problem [Lowe et al., 2018]. More AI/AN people use biomass for heating and cooking than do non-AI/AN people (in fact, 89% of families on the Navajo Nation reservation do), elevating the levels of both PM2.5 and PM10 in their homes, and contributing to the increased incidence of asthma severity and morbidity [Garcia et al., 2019].

While there are many contributing factors to these disproportionate health impacts, ensuring that activities such as those listed in the Nottawaseppi Huron Band of the Potawatomi's narrative (e.g., agricultural development leading to increased windblown dust, pesticides, and herbicides as well as oil and gas wells) are located a safe distance from Tribal lands and that Tribes have robust air quality monitoring programs could reduce the prevalence of air pollution related diseases.

The COVID-19 pandemic has disproportionately impacted Tribal communities. "Historical trauma and persisting racial inequity have contributed to disparities in health and socioeconomic factors between AI/AN and white populations that have adversely affected AI/AN communities; these factors likely contribute to the observed elevated incidence of COVID-19 among the AI/AN population" (Hatcher et al., 2020, as cited in Sequist, 2020). An increase in COVID-19 contagion and mortality has been correlated with both long- and short-term exposure to air pollution (Comunian et al., 2020; Wu et al., 2020). Climate change is exacerbating and amplifying these existing vulnerabilities and other social determinants of health, which include economic and social conditions—such as income, education levels, discrimination, and health care access and quality—that influence a wide range of health outcomes. Given the disparities in health outcomes for Tribal communities and the emerging connections between air quality and COVID-19 risks, more research, improved air quality, and a focus on addressing social, environmental, and health justice issues must be undertaken (Centers for Disease Control and Pollution, 2020; Raine et al., 2020).

Wildland Fires and Air Quality Impacts

Climate change is contributing to an increased risk in catastrophic wildfires due to rising temperatures, decreasing snowpacks, and extended droughts, in part by increasing the amount of dried vegetation available to provide fuel. As shown in Figure 3, the number of acres burned in wildfires has a clearly increasing trend per year since 1983, which plays an important role in the impacts to air quality. According to the EPA, wildfires were responsible for 40% of the total PM emitted (EPA, 2019) in the U.S. as of 2018. Very high $PM_{2.5}$ concentrations have been shown to increase respiratory and cardiac illnesses, particularly in sensitive populations (Edwin & Mölders, 2018). Polycyclic aromatic hydrocarbons (PAHs) are naturally occurring chemicals in fossil fuels such as coal, oil, and gasoline and are also produced when fossil fuels or wood, garbage, or tobacco are burned. "Events such as wildfires greatly increase the amount of PAHs containing $PM_{2.5}$ entering and transporting throughout the atmosphere" (Kramer et al., 2020, from Navarro et al., 2016, ns).

This increase in $PM_{2.5}$ and other air pollutants—caused by wildfires that are increasing in acreage and duration from climate change—leads to an increase in indirect mortality. A recent study on the consequences of a spike in $PM_{2.5}$ exposure by just 1 microgram per cubic meter ($\mu g/m^3$) for just one day led to "0.69 additional deaths per million elderly individuals over the three-day window that spans the day of the increase and the following two days" (Deryugina et al., 2016). While this data is for elderly people at large, as stated above, Tribal peoples experience increased deleterious health impacts for a wide variety of reasons. Concerningly, analysis suggests that in interior Alaska, levels of $PM_{2.5}$ caused by wildfires in the month of July will increase by an average of at least 15–20 $\mu g/m^3$ by the year 2047 due to climate change (Woo et al., 2020).

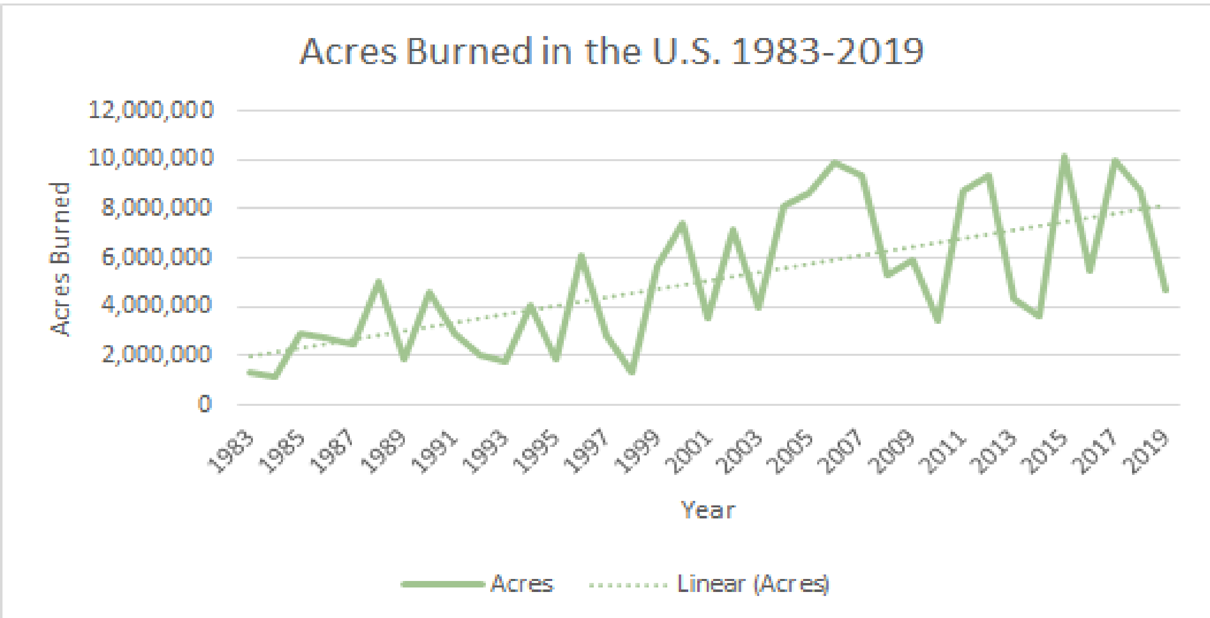

Figure 3. Acres Burned in the U.S. 1983-2019. Data source: National Interagency Fire Center.

In 2020, like in many recent years, wildfires particularly impacted the western regions of the U.S. While air quality impacts from these wildfires have been detected as far away as the east coast of the U.S., those closer to the fires generally experience greater air quality impacts. Alaska and the western U.S. have very high numbers of Tribal communities (231 Tribes in Alaska and a combined total of 215 Tribes in the 11 western states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; these 446 Tribes represent nearly 78% of the total number of federally recognized Tribes in the U.S.), many of whom have experienced direct impacts to their air quality from wildfires in recent years:

- Among the 11 western states, all 215 Tribes experienced episodes of "thick density" smoke (21–32 $\mu g/m^3$) between September 1, 2019, and September 30, 2020, affecting 149,608 square miles, or 95,749,120 acres, of Tribal land. For point of reference, this is nearly the size of the entire state of California, which is 105,000,000 acres. (J. Payne, personal communication, November 18, 2020.)

- The Hoopa Valley Tribe in California declared a state of emergency due to smoke impacts in September 2020 following the Red Salmon Complex Fire; then, during the first week of October, their air quality index (AQI) registered in the 400s to 500s with spikes up to 1,500 µg/m^3 for $PM_{2.5}$ for 10 days straight (for reference, an AQI of 250 µg/m^3 or above is considered "hazardous"). (B. McCaughey, personal communication, October 14, 2020.)
- The Yurok Tribe in California has had episodes of unhealthy air quality from smoke impacts for 15 of the last 21 years, but the summer and fall of 2020 had the worst air quality impacts since 2008. They measured AQIs in the 300s to 400s for several weeks in a row, and the first week of October remained in the 400s to 500s with spikes up to 600. (J. Hostler, personal communication, October 13, 2020.)
- The Confederated Tribes of the Colville Reservation in Washington lost 78 homes and 60 other buildings in the Cold Springs Fire, plus 14 homes and other structures in the Inchelium Fire Complex. There were 13 days in September that the AQI was in the unhealthy, very unhealthy, or hazardous ranges due to the Cold Springs Fire. (K. Ray, personal communication, October 8, 2020.)

Cultural or Indigenous burning is a traditional practice that has been utilized by Indigenous peoples for millennia in order to enhance the health of the land and its people (Boutsalis, 2020; Marks-Block, 2020). Continuing the practice of cultural burning of the landscape is one way Tribes are not only exerting their sovereignty, but also leading the way in reducing the frequency, size, and intensity of wildfires and therefore lessening the risk of diminished air quality. Decreased precipitation and changing precipitation patterns have led, in many cases, to an excess of underbrush and nonnative species that need to be cleared in order to prevent eventual uncontrolled burning. Regular cycles of burning that take place under favorable weather conditions and with careful supervision can prevent catastrophic burning under adverse circumstances.

This reduction in risk, however, is just one benefit among many that exemplifies the interconnected relationship with the Earth that is integral to Tribal cultures. (See *Chapter 4: Ecosystems & Biodiversity*.) In addition to clearing undergrowth, dead leaves, tree limbs, and other debris, Tribes may engage in cultural burning to stimulate the growth of desirable, native vegetation and reduce the spread of invasive species and pests, which are becoming more prevalent due to warmer conditions resulting from climate change. For example, burning blueberry fields helps control pests such as mummy berry, flea beetles, and spanworm (Fater, 2020). Some seeds, such as those from certain pine species, cannot be released from their cones without fire (*National Geographic*, n.d.). Burning also returns nutrients to the soil and allows additional sunlight to penetrate forests, supporting new growth (*Id*.). Soils can be impacted by climate change through changes in temperature and moisture patterns and by erosion caused by frequent high-intensity precipitation events (Hamidov et al., 2018). Habitat improvements resulting from controlled burns also have been shown to positively impact fish and wildlife populations, and regenerated vegetation can provide food for moose and grouse (Woodford, 2003). Increased populations of small mammals provide food for raptors (*Id.*). Wildfire smoke appears to have a cooling effect on water temperatures by blocking solar radiation, benefitting cold-water species such as salmon (David et al., 2018).

While cultural burning activities have been practiced throughout time by some Tribes, others have been unable to do this due to restrictions imposed by local, state, or federal authorities. However, there is now additional momentum and legal authority for continuing these practices, along with scientific evidence to support the important role that fire plays on the land. Members of the Yurok, Karuk, and Hoopa Tribes in California have reached out to other Tribes, nonprofits, and land management agencies to form training and support networks for local burns (Buono, 2020). (See also *Chapter 4: Ecosystems & Biodiversity*.)

Although it is not one of the more frequent observations, changes in wind strength and direction have been observed by Indigenous communities, particularly by people in the tropical Pacific and Arctic regions (Savo et al., 2016). Extreme wind events such as Santa Ana or Diablo winds are exacerbating wildfires by driving them or by leading to the failure of electrical infrastructure, which can ignite extreme fire events and contribute to drying conditions, thereby heightening drought impacts. These dry winds have been documented to drive fire and smoke across large landscapes, knock down power lines (causing mass blackouts), spark wildfires in backcountry settings, and heighten the danger of fire ignition. Urbanization, particularly in southern California, puts not only the endangered chaparral landscape at risk, but nearby communities as well. The 2020 August Complex Fire in northern California was the largest complex fire in the state since record-keeping began, according to data from CAL FIRE, while the Creek Fire in September 2020 was the largest single fire (ABC7 News, 2020).

Tribes in the northwest U.S. experienced an anomalous wind shift (both direction and speed) that led to the expansion of the Labor Day fires of 2020 (J. Hostler, personal communication, October 13, 2020). This shift in wind dynamics has cascading effects on ecosystems, such as pollination, smoke dispersion, animal behavior, environmental cues for hunter navigation, tidal surges, sea ice conditions, and precipitation delivery. Indigenous communities living subsistence lifestyles not only tend to be more aware of these dynamics, but their lifestyles are also more dependent on understanding these shifts and changes in order to make adaptive responses. Additionally, changes in wind will have an impact on Tribal (or anyone's) plans for wind energy development. (See also *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets* for discussion of wind energy potential on Tribal lands.)

Extreme Heat and Humidity

With climate change comes increased heat in most locations. In the U.S., the past five years have been the hottest years on record, and the year 2019 completed the hottest decade on record (Climate Central, 2020). Many Tribal people work outdoors in settings where they are raising food or tending animals related to food production. This could include farming, raising sheep or cattle, gardening, fishing, or gathering food products. Rising temperatures and humidity can put these people at risk of heat stroke or other heat related health problems, particularly in southern areas of the country.

In places like the Four Corners Region of the Southwest, trends indicate the largest increases in temperature are occurring in the winter minimum temperatures, summer minimum temperatures, and summer maximum temperatures (Meadow, 2018; Ute Mountain Ute Tribe, 2020). Extreme heat and higher nighttime temperatures have big impacts on Tribal members. The Ute Mountain Ute Tribe (2020) interviewed elders about their observations on changing climatic conditions. These interviews indicated that extreme heat has negative impacts on their health (due to heat stress and lack of reliable access to air conditioning) and leads to higher electric bills in the summer (for those with access to air conditioning). In some cases, elders have decreased participation in traditional and cultural activities, due to extreme heat.

Higher temperatures lead to increased ozone formation due to accelerated chemical reactions in the atmosphere. According to the EPA, high ozone levels can adversely impact sensitive grasses, forbs, shrubs, and trees, which are important to the cultural practices and lifeways of AI/AN people, who use those plants for economic benefit, personal subsistence, food sovereignty, medicines, and other traditional practices. More than 30 ozone-sensitive plants used by Tribes have been identified by the EPA (EPA, 2014).

Extreme heat and drought both lead to more frequent and more intense wildfire events, which can emit thousands of tons of pollutants (Peterson et al., 2013). In addition to these increased levels of pollutants, higher air temperatures can lead to weather conditions that cause stagnation, trapping these pollutants in the lower atmosphere where people live and breathe. Drought events associated with high temperatures can keep the air dirty, as falling precipitation tends to cleanse the air of these pollutants. The combination of heat stress and increased drought can also lead to crop failure (Ute Mountain Ute Tribe, 2020).

Rising CO_2 levels contribute to increased growth and pollen levels in plants such as ragweed that cause human allergies and asthma attacks. Increased temperatures can lead to longer growing seasons, which extends the length of time that people are exposed to allergens. Further, allergens can interact with air pollutants in ways that amplify their individual impacts (National Wildlife Federation, 2010).

Warmer winter minimum temperatures in the Midwest will allow for increased survival of pests or pathogens. For example, the nonnative emerald ash borer (EAB) has decimated ash populations throughout its range and has been expanding its range as winter temperatures are less frequently reaching levels that would keep EAB populations in check (Poland & McCullough, 2006). (See narrative titled *Climate Change and Invasive Species on the Fond du Lac Band's Lands* in *Chapter 4: Ecosystems & Biodiversity*.) The longer growing season will also give EAB and other invasive (nonlocal) beings time and habitat in which to expand their ranges. White-tailed deer will be able to expand their ranges and population, which can have major effects on plants browsed by deer or on other beings such as moose, which can be impacted by diseases spread by deer (Weiskopf et al., 2019). Decreased ice cover on lakes will affect the timing of spawning for walleye and other fish, as well as make northern lakes more vulnerable to invasive species, algal blooms, etc.

Higher levels of relative humidity have been shown to lead to increased formation of secondary particulates, especially sulfate and nitrates. This can have a marked impact on visibility, particularly in the winter (Liu et al., 2018). High humidity can lead to formation of secondary particles of larger than usual size, which can then trap pollutants near the ground along with excess water vapor, causing a self-amplification mechanism (Tie et al., 2017).

Many individuals, especially older people, experience health impacts during extreme heat events. Heat can place increased stress on individuals with cardiovascular disease, diabetes, obesity, or respiratory disease, leading to increased rates of heat illness or potentially death (Kenny et al., 2010). High levels of humidity can act in conjunction with higher temperatures in putting additional stress on human bodies by impeding the body's ability to cool itself. High humidity can also be dangerous because bacteria and viruses thrive in humid conditions. The lower socio-economic status of many Tribal Nations has led to a disproportionate number of Tribal people living in substandard housing that lacks proper insulation or cooling systems to allow for cooling spaces on the hottest and most humid days. It is unclear what impact humidity has on the coronavirus and its epidemiology, which is a topic in need of further study.

Indoor Air Quality

During wildfire and prescribed fire smoke events, the protocol to protect health is often to shelter in place. However, indoor environments can also expose people to high levels of smoke, particularly if they do not have air conditioning and rely on open windows to cool their indoor spaces, as many Tribal people in the West do. Additionally, commercial air filters can be cost-prohibitive. Many Tribes are actively addressing these dual concerns through Smoke Ready Communities and do-it-yourself indoor air filter box fans.[14] The Air Quality Program (AQP) of the Confederated Tribes of the Colville Reservation has been a leader in developing Smoke Ready Communities[15] information, providing webinars, printed information, and other forms of outreach and education, in addition to their air quality monitoring. Colville's AQP is funded by an EPA §105 Clean Air Act grant and is governed under EPA's FARR. This structure and financial support allow the Colville Tribe to invest deeply in building their AQP and protecting the health of their Tribal and community members.

Increasing temperatures and rising humidity levels both contribute to increases in mold and fungi growth inside of homes and buildings. Mold can lead to health impacts such as coughing or wheezing, asthma attacks, nasal congestions, and shortness of breath (Centers for Disease Control and Prevention, 2020). High indoor humidity can also lead to higher levels of airborne chemical contaminants due to off-gassing from carpet or household wood products. This can lead to skin, eye, and throat irritation (Arundel, 1986). Indoor air pollution is an environmental justice issue, as exemplified by the flooding event in the summer of 2012 on the Fond du Lac Band of Lake Superior Chippewa's Reservation, which caused extensive mold damage to several homes. Workers removed wet carpeting from over 60 homes following this incident; inadequate response from state and federal agencies in the aftermath of this flood showed the Band that they must be self-sufficient in taking care of Band members' needs, as these other agencies were overwhelmed and unable to respond on the Reservation.

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[14] Colville Tribe's DIY Box Fan Filters https://www.cct-enr.com/box-fan-filter

[15] Colville Tribe's Smoke Ready Community Resources https://www.cct-enr.com/smoke-ready-community

Many Tribes across the nation have taken steps to address indoor air quality, such as conducting radon testing and mitigation activities, educating Tribal members on mold prevention and removal, and exchanging old, poorly operating woodstoves with updated, cleaner versions. The organization Trees, Water & People[16] works with rural communities to replace open-fire cooking methods with clean cook stoves, greatly improving indoor air quality and reducing the amount of firewood needed for cooking.

Air Monitoring

As of 2020, a total of 88 Tribes operate air monitors that are funded through EPA (NTAA, 2020), representing just 15% of the federally recognized Tribes in the country. Many of those air monitors are more than 10 years old and are reaching or have exceeded their lifespans. (See narrative titled *Kootenai Tribe of Idaho Air Monitoring Equipment*.) Without properly functioning air monitors, Tribes' ability to protect their members' health from wildfire smoke impacts and other air quality pollutants is truncated. Additional challenges experienced by some Tribes, particularly those located in remote areas of Alaska, include the difficulty of maintaining air quality monitoring networks when access to the area is limited to travel by boat or small aircraft. This adds to the costs and widens the data gaps (Edwin & Mölders, 2018). Alaskan Tribes and Villages not only have a limited network of air quality monitors, but the $PM_{2.5}$ monitors that are in place measure the total mass of $PM_{2.5}$ without differentiating between $PM_{2.5}$ from wildfire smoke, road dust, vehicles, etc. (Woo et al., 2020). On top of wildfire smoke impacts, dust is also an increasing concern for many Tribal communities both within the Alaskan interior and in places such as the desert Southwest, where dust impacts are increasing due to drought conditions that are exacerbated by climate change. In the Southwest, fine and coarse dust are projected to increase significantly (57% and 38%, respectively) (Achakulwisut et al., 2019). These increases are predicted to lead to increases in climate-attributable cardiovascular diseases and mortality, asthma-related hospital visits, and other forms of dust-related morbidity and mortality, coupled with economic impacts. Most studies focus on the human dimensions of dust, smoke, and other particulates, and there is little research on climate-attributable effects on wildlife upon which Tribes depend. Without robust and accurate data, it is difficult for Tribes to begin to address these problems.

In order to expand the network of air monitoring with low-cost monitors, some Tribal communities—including many in Alaska—are turning to PurpleAir sensors (see narrative titled *Nottawaseppi Huron Band of the Potawatomi's Particulate Matter Monitoring Program*), which can be easily installed for about $200 anywhere that has electricity and a wi-fi connection (Ellis, 2019).

Some Tribal environmental programs choose to monitor air quality and run air programs despite not having any dedicated funding, such as through CAA §103 or §105 grants. The Hoopa Valley Tribe, for example, does not have CAA §103 funding. Nonetheless, they operate two $PM_{2.5}$ monitors and are partnering in a project called the ASPIRE[17] (Advancing Science Partnerships for Indoor Reductions of Smoke Exposures) study to study the impacts of wildfire smoke on indoor air quality and mitigate

[16] Trees, Water & People: https://treeswaterpeople.org/

[17] ASPIRE https://www.epa.gov/air-research/wildfire-study-advance-science-partnerships-indoor-reductions-smoke-exposures

exposure to community members. Tribes in California also have excellent working relationships with the California Air Resources Board, which often provides support during wildfires. Although beneficial to both parties, cooperative projects like this are too few in number and should be widely expanded.

Recommendations

Tribal Engagement and Regulatory Authority

Tribal sovereignty and the role of Tribes as regulatory authorities should be acknowledged by federal, state, and local entities to a greater extent. This would lead to increased Tribal involvement in key issues regarding climate change. Specifically, Tribes should be involved as co-regulators in the very first stages of regulatory planning and development and in the implementation and enforcement of regulations. Policy revisions should encompass environmental justice, equity, diversity, and inclusion, as well as access to data and training.

Funding

Adequate funding is needed for multiple reasons. It is required for staffing, monitoring, and emergency response to air quality issues related to climate change, especially the increasing frequency and extent of wildfires. Tribes also need to be able to keep experienced staff in place because of the value of institutional knowledge. Increased funding allows Tribes to effectively participate in multijurisdictional organizations, work collaboratively on key issues, and truly be a part of air quality policy and implementation. It also allows Tribes to replace outdated and failing monitors.

Tribal Sovereignty; Systemic, Transboundary, and Justice Issues; and the Social Determinants of Health and Vulnerability

The air quality issues associated with climate change highlight the need for regulatory agencies to respect Tribal sovereignty, as these are interrelated problems that are systemic and transboundary in nature and cannot be solved by any one party, but only through respectful interactions and relationships. Solutions that are effective, ethical, and compliant with treaty and other obligations must address underlying causes of environmental, social, and health inequalities and injustices. AI/ANs' actions alone are not sufficient. Many social determinants of health, vulnerability, and environmental justice issues arise outside of their lands and cannot be addressed without their full and effective participation and accommodation in all climate-related decisions that affect their rights, air quality, and health.

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Chapter 4.2: Water

Water-related impacts from climate change are of particular concern to Tribes. The first two narratives explain how two Alaskan partnerships, the Southeast Alaska Indigenous Transboundary Commission (SAITC) and the Southeast Alaska Tribal Ocean Research (SEATOR), each composed of 15 U.S. Alaskan Tribes, collectively work together to face climate change issues. The SAITC fights with upstream Canadian mining companies that pollute their waterways by leakage from mining storage facilities that are weakened by climate change. The SEATOR tests subsistence shellfish samples for PSP toxins, which could be lethal to Tribes. Due to the changing climate, the Tribes cannot rely on traditional knowledge and observations to determine if the shellfish are safe to eat. In the lower 48 states, narratives from the Pyramid Lake Paiute Tribe of Nevada, Chickasaw Nation of Oklahoma, Fond du Lac Band of Lake Superior Chippewa, Crow Tribe of Montana, and the Eastern Shawnee Tribe of Oklahoma describe documented evidence of climate change. These Tribes have experienced severe water temperature changes, variance in precipitation frequency and amounts, and an increase in severe weather events. All these changes have had a direct effect on the Tribes' beneficial uses and subsistence lifestyles. A researched overview of Water as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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The Southeast Alaska Indigenous Transboundary Commission

Written by: Frederick Olsen Jr., Executive Director

Formed in 2014 as the United Tribal Transboundary Mining Work Group, the Southeast Alaska Indigenous Transboundary Commission (SEITC) is a consortium of 15 federally recognized southeast Alaska Tribal governments created to protect Tribal lands and waterways for future generations. Each SEITC representative on our Board of Directors is elected or appointed by their Tribal Council. Tribes notify SEITC of representation by a Tribal Council resolution or letter from their Tribal President.

The Stikine, Taku, and Unuk Rivers flow from British Columbia, Canada, into Alaska.

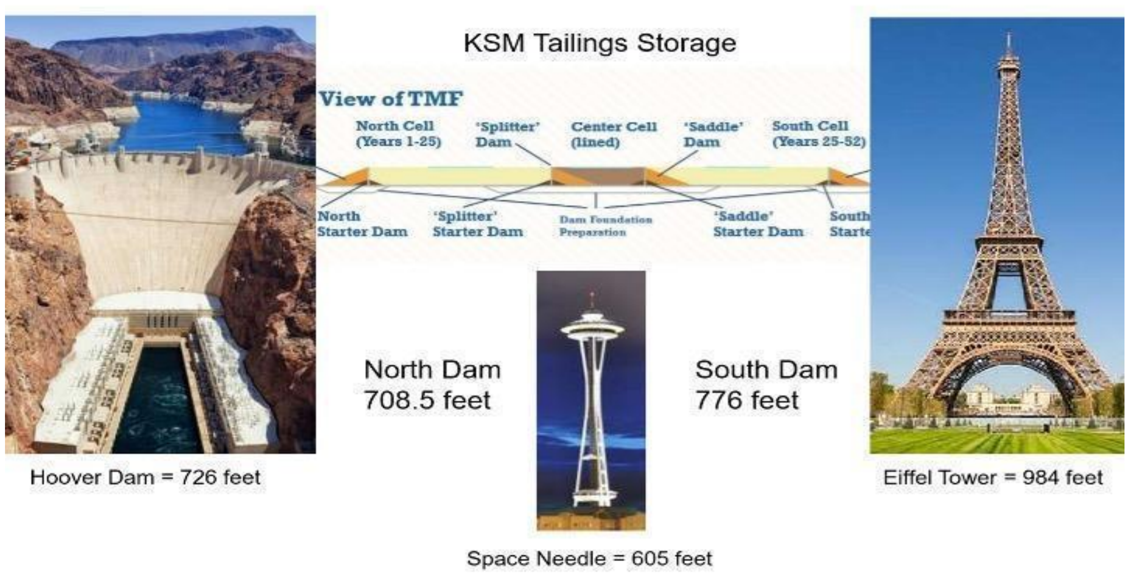
Where we live, in southeast Alaska, we are within the largest stretch of temperate rainforest left on Earth. Climate changes have already occurred in our lifetimes: paralytic shellfish poisoning is common now and each year concern grows for shellfish consumption, yellow cedars are in decline due to less lasting snowfall in winter, and fish habitats are under siege.

Tulsequah Chief Mine site, Taku River watershed, British Columbia (Credit: Colin Arisman, The Narwahl).

We seek to protect our customary and traditional ways of life and shared headwaters of our transboundary rivers. Our diverse, isolated communities depend on healthy rivers and watersheds for natural foods, medicines, and maintaining our cultural connections to the land that we've lived on since time immemorial. We have concerns regarding our shared transboundary watersheds facing threats from major industrial mining projects in British Columbia, Canada.

As polluted waters travel downstream, they destroy delicate ecosystems and devastate wildlife populations, such as those of wild salmon. While mining activities generate business in BC, the social and environmental cost is borne downstream by Indigenous communities who currently lack a say in how their region is managed.

A major way that climate change enters the transboundary equation is the so-called tailings storage facility of many industrial mining projects, aka a Lake of Poison left behind after operations cease. These lakes of poison need to be monitored for at least 200 years each. The proposed Kerr Sulphurets Mitchell (KSM) Mine would have two such dams, each taller than Seattle's Space Needle.



Huge dams proposed for passive water treatment at KSM project in BC.

As you read this, the abandoned Tulsequah Chief Mine continues to pollute the Taku River watershed since operations stopped in the 1950s. The BC government recently announced a new plan for the site and pledged nearly two million dollars but has not yet acted to clean this up. If they will not clean up a minor blemish like Tulsequah Chief, what will happen when a mega-mine's lake of poison (tailing storage facility) breaks loose into our shared watersheds? And taxpayers will pay.

For most people, we live in the middle of nowhere. We are all involved in our Native communities, and these values are part of our everyday lives. Sharing the customary and traditional values with non-Natives is essential for harmony between cultures. We continue to share life experiences on transboundary and BC rivers as a way to raise awareness. Our online visual production, "When the Salmon Spoke,"[18] helped to put a "face" to the rivers and the people who live there.

SEITC has been nurturing relationships with First Nations for several years. In order to create unity and dialogue between Alaska Tribes and First Nations sharing transboundary watersheds, SEITC has held two Indigenous leaders' summits. We are currently planning our third summit.

[18] When the Salmon Spoke: https://vimeo.com/424432430

The upcoming summit will be centered around the deterioration of the salmon stocks in the region. Attendees will be asked to research possible solutions prior to the meeting. Indigenous people have an obligation to take care of the land and water. SEITC and our First Nations partners are committed to working together to amplify clean water issues. Outreach to youth is a component of this objective. At the last summit, an Alaskan emerging youth leader attended as well as a BC university student. Plans are underway to have more youth involved with the next summit.

Southeast Alaska Tribes Face Climate Change with Partnership

Written by: SEATOR/Sitka of Alaska

Southeast Alaska is a place like no other. Coastal brown bears stalk the shores, old growth forests grow tall, and salmon serve as the lifeblood of the region. It is home to the Tlingit, Haida, and Tsimshian people, who have served as the environmental stewards of these lands since time immemorial. Their stewardship continues to this day. However, this stewardship has been forced to adapt because of climate change. The timing, abundance, and safety of subsistence foods has undergone significant changes. This is especially true for the subsistence resource shellfish. Shellfish is found in abundance throughout southeast Alaska. Typically, shellfish provide a healthy food source that is easily accessible to southeast Alaskans. However, in a changing climate, this once easily obtained food source can be deadly.


Shellfish harvested for subsistence toxin testing.

Shellfish are filter feeders. They filter seawater that is brimming with their food of choice: plankton. Once the waters warm and the sun returns in spring and summer, plankton grow wild, turning clear waters to a rainbow of colors. Some of these plankton are known as harmful algal bloom (HAB) species. If these HABs become abundant, the shellfish that consume them become toxic themselves, posing a risk to human and animal health.

The occurrence of HABs in southeast Alaska is not new or different. The Indigenous people of this area knew that during summer months shellfish were unsafe to eat. Many adages exist that describe the transition in shellfish consumption risk such as, “Don’t harvest shellfish once the herring return,” “Only harvest shellfish in months with an R,” and “Only harvest shellfish when there is snow on the mountains.” These adages, based on millennia of land and ocean observing, are no longer true in a changing climate. In fact, the state of Alaska suggests that people do not harvest wild shellfish and instead purchase it. For people who rely on subsistence, this is not a viable solution.

To ensure the access of subsistence shellfish in southeast Alaska, 15 Tribes in the region are working together to better understand when, where, and what species of shellfish can be gathered with less risk of exposure to HAB toxins. This network is called Southeast Alaska Tribal Ocean Research (SEATOR). SEATOR partners are located as far north as Yakutat and as far south as Metlakatla, spread out by nearly

500 miles of land and 18,000 miles of coastline. Partners sample plankton and shellfish in their local communities to understand the risks associated with eating shellfish in their community.

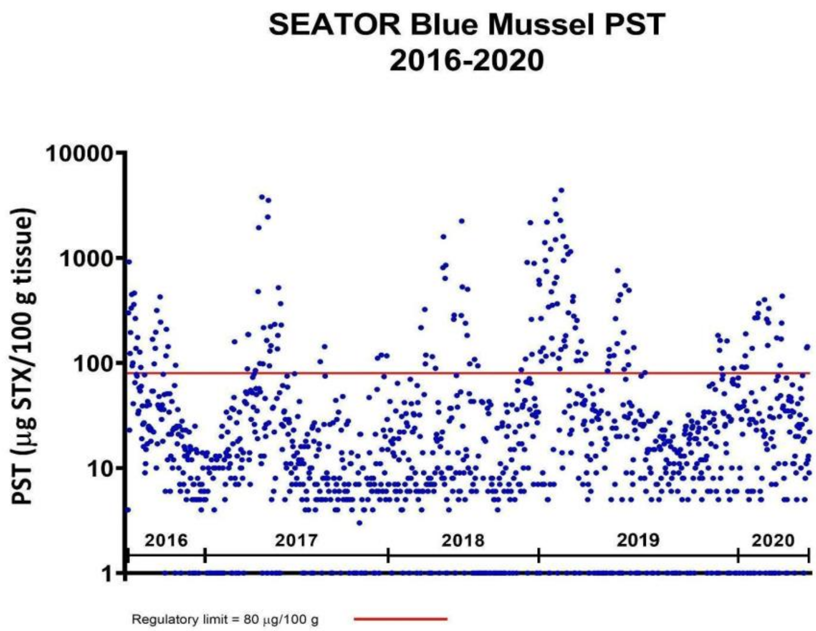
SEATOR partners scan surface seawater using a microscope looking for HAB species such as *Alexandrium* and *dinophysis. Alexandrium* is the most likely HAB species to be in Alaskan waters, and it can be very dangerous. When toxins from *Alexandrium spp.* accumulate in shellfish and people then consume those shellfish, people can get sick with paralytic shellfish poisoning (PSP). PSP can cause tingling lips and fingertips, difficulty breathing, and, in the worst cases, even death. If someone contracts PSP, they need to be treated in a hospital immediately. However, most communities in southeast Alaska are remote and rural, often hours away from medical facilities.

Alexandrium observed in a phytoplankton tow sample in southeast Alaskan waters.

In addition to looking for the presence of the HAB species in their surface seawater, SEATOR partners also send shellfish samples to the Sitka Tribe of Alaska Environmental Research Lab (STA-ERL) to be tested for toxins. STA-ERL has been in operation since 2016 and has tested over 2,000 subsistence shellfish samples for PSP toxins. The shellfish toxin data from SEATOR partner beaches is astonishing and one of a kind. Before the SEATOR data set, no data set of this magnitude ever existed in southeast Alaska. Unfortunately, what it reveals can be scary. Indigenous people from the region knew not to harvest shellfish in the summer months. The SEATOR data set supports this idea fully. Starting in April, shellfish in many communities exceed the regulatory limit for PSP toxins. However, due to changing climate conditions, some species of shellfish are exceeding the regulatory limit during all months of the year. This means that there is no longer a time of year when you can assume your shellfish will be safe to eat. During the summer months, southeast Alaska is seeing large and pervasive HABs. The shellfish accumulate the toxins from these HABs and then don’t depurate the toxins. In fact, 76% of all butter clam species tested are above the regulatory limit.

The largest of these HAB and shellfish toxin events was tracked by SEATOR in the summer of 2019. Two hundred sixteen shellfish samples were above the regulatory limit that year, and only two communities did not have any species exceed the regulatory limit. The highest sample analyzed was a blue mussel with over 4000 µg of toxin per 100 g of tissue. This is more than 50 times above the regulatory limit.

Collecting plankton and testing shellfish are not enough. The SEATOR network also needs to make sure this information is communicated to over 50,000 people living in southeast Alaska. SEATOR has an email list, a website, and a Facebook page they use to distribute data. However, the real power of the network is the environmental coordinators that live in each community. They share the message far and wide with their communities in a way that fits locally. That may be an announcement on the local radio station, a flyer up at the post office, or a sign on the local Clam Hub that is located at the entrance of the beach.



SEATOR blue mussel paralytic shellfish toxin data between 2016 and 2020. All samples above the red line exceed the regulatory limit.

The climate is changing. Subsistence resource availability is unknown. However, the SEATOR network is making huge strides to understand, adapt, and protect the people who call southeast Alaska home. In the coming years, SEATOR partner communities will continue to fight climate change with innovation and partnership.

SEATOR partners at the 2019 annual SEATOR Workshop

SEATOR Partners:
Craig Tribal Association
Chilkoot Indian Association
Hoonah Indian Association
Hydaburg Cooperative Association
Central Council Tlingit and Haida Indian Tribes of Alaska
Organized Village of Kasaan
Organized Village of Kake
Klawock Cooperative Association
Ketchikan Indian Association
Metlakatla Indian Community
Petersburg Indian Association
Sitka Tribe of Alaska
Skagway Traditional Council
Wrangell Cooperative Association
Yakutat Tlingit Tribe

Climate Change Impacts on Water Quality and Aquatic Life, Pyramid Lake, NV

Written by: Daniel Mosley, Fisheries Director – Pyramid Lake Paiute Tribe, NV

Pyramid Lake and over 30 miles of the lower Truckee River lie entirely within the reservation boundaries of the Pyramid Lake Paiute Tribe located in northern Nevada. Pyramid Lake is a terminal lake for the Truckee River Watershed. Several long-term effects have been observed due to the region's changing climate over the last 120-plus years.

Pyramid Lake loses approximately 4 feet of lake elevation annually due to evaporation, which means 424,000 acre feet (AF) of water is needed from the Truckee River flows to maintain lake level. As the population increased in western Nevada from 1900 to 1967, Pyramid Lake dropped approximately 80 feet in elevation and lost 10.7 million AF of water due to Truckee River diversions and out of basin diversions to the Newlands Project (Figure A).

During the extended drought of the 1930s, Winnemucca Lake dried up, and the original strain of Lahontan Cutthroat trout (*Oncorhynchus clarkii henshawi*) saw their last spawning run in 1938. As total dissolved solids (TDS) levels increased (Figure 2), species abundance and diversity decreased. Pyramid Lake lost two native cyprinids, the speckled dace (*Rhinichthys osculus*), and the Lahontan redside shiner (*Richardsonius egregious*). Both were important to the diet of the piscivorous Lahontan cutthroat trout. Since 1866, Pyramid Lake TDS has increased from 1,500 to 5,900 mg/L. Many snail shells can still be observed along the beach shores of the lake, the result of lowering lake levels and rising TDS in a lake that has had no outlet since the early 1900s.

Pyramid Lake received a total of only 700,000 AF of water from the Truckee River from 1987 to 1994, which resulted in a 24-foot drop in lake elevation (Figure B). During this period, Tribal water quality staff observed an anoxic layer of low dissolved oxygen at the bottom of the lake, which extended from 5 meters to 30 meters from the bottom. This anoxic layer prevented the lake from completely turning over during winter during the later years of this drought period. Pyramid Lake elevation rose 25 feet during a five-year period (1995 to 2000) and then dropped 26 feet during an extended 16-year drought through 2016.

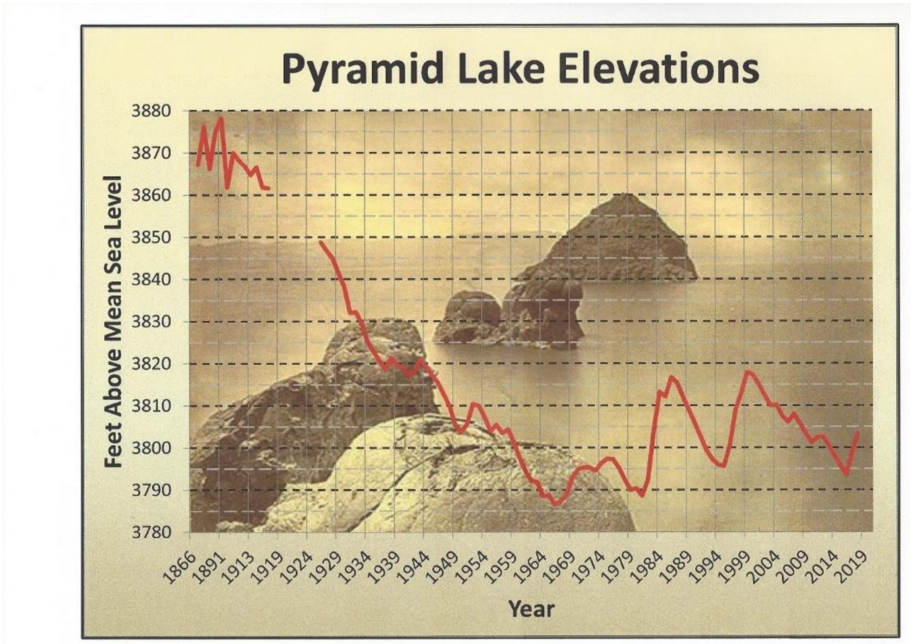


Figure A. Pyramid Lake historical water surface elevations (USGS data).

Pyramid Lake TDS increased from 1986 to 1994 and from 2000 to 2016 (Figure B). During these periods of drought, lake levels dropped 24 feet. In the early 1990s, Pyramid Lake Fisheries observed that spawning Lahontan cutthroat trout were getting smaller in size, to the point the Tribe implemented a

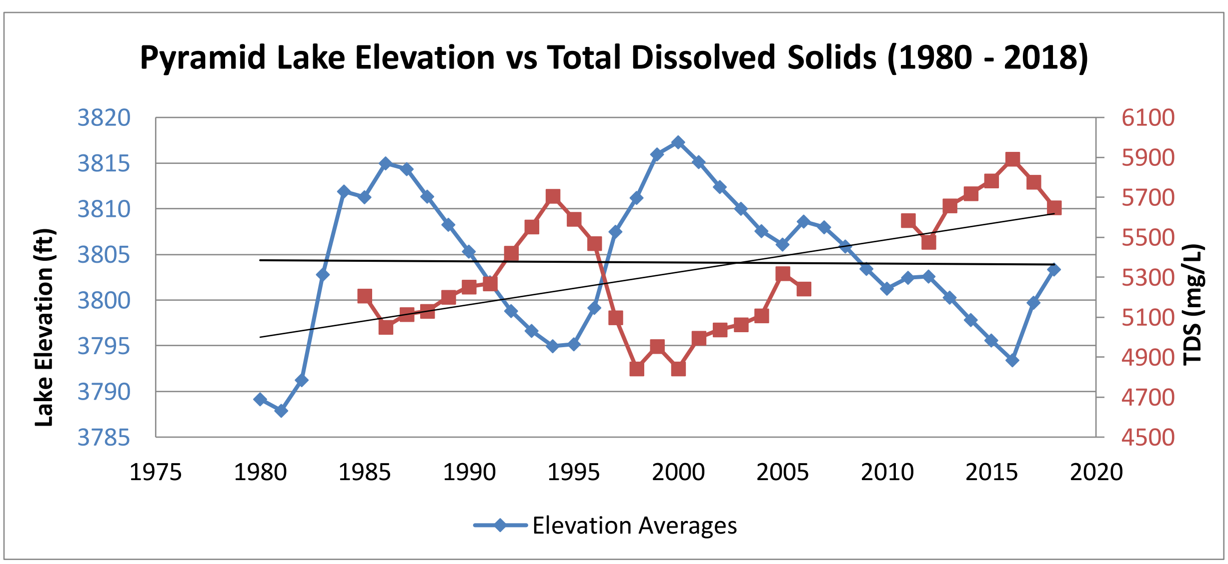
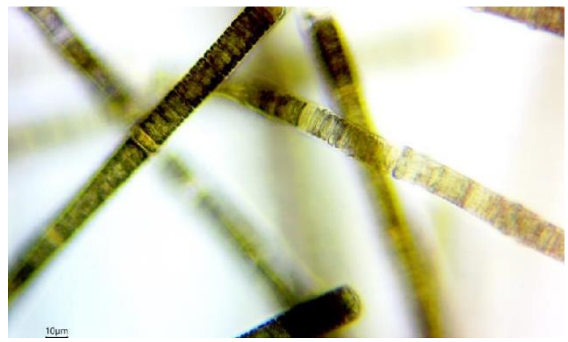


Figure B. Pyramid Lake TDS.

slot limit of 19 to 24 inches to protect bigger spawning fish. A limit of only one fish per day that was over 24 inches was implemented to protect the trophy-size fish populations. Increasing TDS levels have also affected the size and abundance of Tui Chub (Gila bicolor), the primary food source for the bigger Lahontan cutthroat trout.

Since 1987, the mean average temperature of Pyramid Lake and the Truckee River has increased over 2°C. This has led to higher water temperatures, increased levels of nitrogen, and increased occurrences of cyanobacteria blooms in Pyramid Lake. Testing results from five Pyramid Lake samples collected on 7/10/2020 and 7/14/2020 resulted in nodularin toxin concentrations from 2,000 µg/L to 10,000 µg/L, which were some of the highest toxin concentrations the contract lab had ever seen. Nodularia spumigena is a heptatoxin that can damage the liver.

Data obtained from the Western Regional Climate Center (WRCC 2020a) depicts a general warming trend for the Truckee River basin (Truckee Hydrologic Unit Code [HUC] 16050102) dating back to the early 1900s (Figure C). This warming trend has sharply increased since about 1980, continuing through the baseline period for this consultation. Since 2000, Tribal water quality staff have observed increased abundance of periphyton (filamentous algae) and tolerant benthic macroinvertebrates (planaria, snails, dipterans, etc.) during Truckee River sampling events.



Nodularia spumigena.

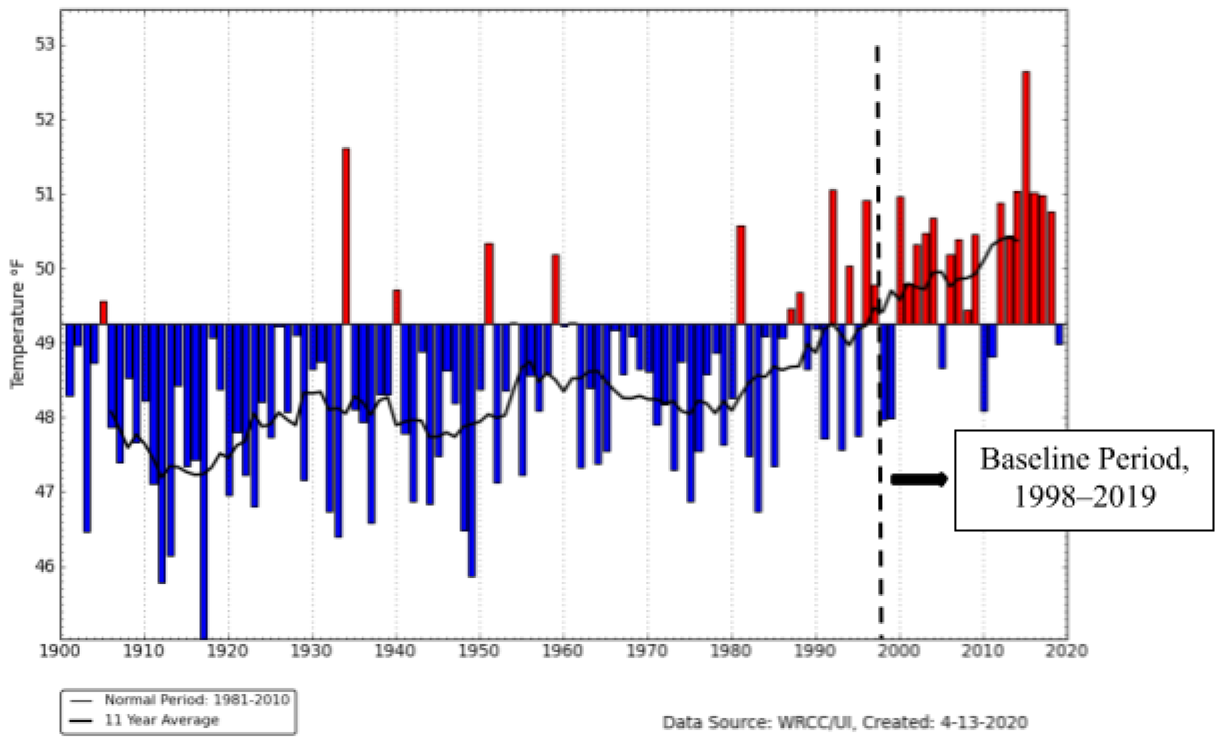


Figure C. Mean temperature by water year (ending in September) for the Truckee HUC, 1900–2019. Data source: Western Regional Climate Center (WRCC 2020a).

In conclusion, the Pyramid Lake Paiute Tribe has observed and documented evidence of climate change affecting water quality, increasing frequencies of algal blooms, and decreasing the abundance and diversity of aquatic life sensitive to warming water temperatures and rising TDS levels. This has a direct effect on the Tribe's beneficial uses and the subsistence lifestyle of Tribal members living on the Pyramid Lake Paiute Indian reservation in northern Nevada.

Harmful Algal Blooms Targeted by Grassroots Watershed Organizations

Written by: Chaylum Hogue, Watershed Fire Planner RTRL – Chickasaw Nation

Background on Chickasaw Nation Watersheds

The Blue River and the Lake of the Arbuckles are both vitally important to the south-central region of Oklahoma for ecological and economic purposes. These waters provide drinking water supplies to local communities and habitat to many native aquatic species.

The Lake of the Arbuckles has a total capacity of 108,839 acre feet with a surface area of 2,350 acres. The Arbuckle Master Conservancy District operates and maintains the Arbuckle Lake Dam and water supply infrastructure. The Lake supplies water for the cities of Ardmore, Sulphur, Davis, and Wynnewood, as well as the refinery that is located near Wynnewood. Arbuckle Lake provides water supplies for many residents and agricultural practices and is an ideal fishing location for crappie, catfish, bluegill, white bass, and largemouth bass. The Lake is also important for tourism and allows for fishing, scuba diving, camping, and hiking at the nearby Chickasaw National Recreation Area (CNRA). The Lake, part of a greater watershed, receives water from the Buckhorn, Guy Sandy, and Rock creeks, which are all sub-watersheds. The Lake also receives groundwater in the form of spring flow from the Arbuckle-Simpson aquifer.

The Blue River is a system beginning near Roff, OK, with a southeast flow to near Durant, OK, ultimately becoming a tributary of the Red River at the southern border of Oklahoma. The River spans a length of 141 miles and is one of the last free-flowing streams in Oklahoma. The river contains a number of aquatic species (such as crappie, catfish, smallmouth, spotted, and largemouth bass) that draw anglers as a means of recreation. The River also contains other aquatic species, including subspecies of orange belly darter (orange throat darter and least darter), ringed crayfish, and rabbit’s foot mussel, among others. The Blue River is an important water supply to the city of Durant on the lower end of the reach and is home to the headquarters of the Choctaw Nation of Oklahoma and Southeastern Oklahoma State University. There are landowners and producers along the stretches of the Blue River who also use it for personal water supply and for agricultural purposes, as well as mining companies that utilize the waters.

Algal Bloom Impacts on Chickasaw Nation Watersheds

Within these above-mentioned bodies of water, as may be found in many others under certain conditions around the country, is the occurrence of harmful algal blooms (HABs). The National Park Service staff for the CNRA have previously confirmed the presence of HABs. Testing conducted by the Oklahoma Department of Environmental Quality (ODEQ) had shown positive results for blue-green algae (BGA) blooms in the more remote areas of the Lake of the Arbuckles. The Lake has been listed on the U.S. Environmental Protection Agency’s (EPA) 303(d) list for impaired waters due to dissolved oxygen issues. These BGA are naturally present microscopic organisms found in these waters. The BGA are photosynthetic organisms that need sunlight to survive and are typically found in the warm, shallow waters that are undisturbed and receive more sunlight.

Algal bloom presence in Lake of the Arbuckles. Photo credit: National Park Service at Chickasaw National Recreation. Area)

The HABs can occur due to a number of factors, which results in rapid growth or blooming of these organisms. Potential causes of increase in these blooms are increases in nutrients (phosphorus and nitrates) stemming from fertilizer runoff from agriculture or residencies, sewage discharge, or urban and industrial facilities; low water flows possibly due to drought; increases in water temperature; or changes in the water chemistry, such as pH or turbidity. In the case of increasing HABs, there is the potential for detrimental effects to aquatic life, requiring prevention of consumption of water as well as prevention of recreation in affected areas. Increased numbers and surface area coverage of HABs can lead to blocked sunlight into the water column. As the algae continues to consume available oxygen, the resulting effects may include fish die-offs. In the event of high enough concentrations, there is the possibility that cities may issue warnings to discourage drinking water from the taps, as the water treatment plants may not be able to remove the toxins.

Watershed Groups Target Impairments with Support of the Chickasaw Nation

The Lake of the Arbuckles had been listed on the EPA's 303(d) list for impaired waters. The Chickasaw Nation helped bring together a group of local landowners and producers in order to address issues in the Lake and to implement a series of best management practices on private lands. This resulting group has come to be known as the Lake of the Arbuckles Watershed Association (LAWA). LAWA and the Chickasaw Nation have partnered together to begin best management practices (BMP) within the watershed. The BMPs include:

- removing eastern red cedar to allow for reduced uptake of water supplies to this species
- opening grazeable acres
- allowing return of native grasses
- increasing habitat for ground-nesting birds
- monitoring soil health on their respective properties to evaluate and manage soil health over time
- altering grazing practices
- altering application of fertilizers in order to reduce runoff into the waterways leading to the lake

The Blue River also has a watershed group that was created from local landowners and producers who were concerned about the diminishing quality of the Blue River. This resulted in the creation of the Blue River Foundation of Oklahoma (BRFO). The BRFO is also partnering with the Chickasaw Nation on many of the same best management practices that LAWA has implemented. Blue River has not seen the HABs issue as Lake of the Arbuckles has, but both groups are working to implement practices for the conservation and overall health of their respective watersheds for current and future generations.

Water Temperature Impacts in the Great Lakes Region

Written by: Kari Jacobson Hedin from the Fond du Lac Band of Lake Superior Chippewa

Tribal communities in the Great Lakes Region have hunting, fishing, and gathering rights that are all linked to good water quality, which includes water temperatures that allow cold-water fish populations to thrive. The Fond du Lac Band of Lake Superior Chippewa has treaty rights in parts of Minnesota, Wisconsin, and Michigan, and they partnered with the 1854 Treaty Authority to write a Climate Change Vulnerability and Assessment Plan. The plan states that cold-water fish species, such as walleye and trout, will likely experience population reductions as water temperatures warm due to warming air temperatures, and Band members may be impacted by not being able to harvest subsistence levels of cold-water fish species. This is already playing out in the restrictions being put in place on fishing activities on Mille Lacs Lake. On a broad scale, researchers are observing large, frequent, and persistent algae blooms along the south shore of Lake Superior, which is alarming given that this is a deep, cold, oligotrophic lake. Larger, more frequent severe storms are causing the near-shore environment to become warmer and more nutrient-rich, leading to an unprecedented increase in summer algae blooms. The region encompassing the Fond du Lac Reservation experienced a drought coupled with warm summer temperatures in 2020, which reduced streams to baseflow levels at midsummer for the first time in many years. Resource Management staff conducted their midsummer backpack electroshocking surveys for fish and recorded water temperatures in brook trout streams that were above the chronic lethal limit for brook trout. In keeping with the temperature observations, Resource Management staff caught very few brook trout in these streams, and they noticed changes in fish assemblages, including their first-ever recordings of nonnative brown trout.

Brook trout, which is vulnerable to climate change on the Fond du Lac Reservation. Brook trout are under threat of being extirpated, as the Reservation contains mainly cool-water streams rather than cold-water streams, so they don't have major groundwater inputs to maintain cold-water temperatures.

Manoomin (wild rice), which is also vulnerable to climate change on the Fond du Lac Reservation. Manoomin thrived in 2020 after a localized drought, after experiencing nearly a decade of above-normal high-water conditions.

Elders' Reflections on Climate Change Impacts, Crow Reservation, South Central Montana

Written by: John Doyle and Margaret J Eggers – Crow Environmental Health Steering Committee

The Crow Reservation is located in the heart of our traditional homelands; we have been here for centuries. Our Tribe currently has about 14,000 members; some 8,000 of us live on our Reservation, with many other members living nearby on historic Crow lands. Concerned about the impacts of climate change on our water resources and subsequent threats to community health, we interviewed 30-plus Tribal Elders throughout the Reservation about changes they have experienced in their lifetimes.

Little Bighorn River, during Crow Fair. Photo by Kristen Galbraith.

There are many ways that climate change is impacting Crow water resources and health, both directly and indirectly. Over the past 70–80 years, we have seen a steady decline in winter snowpack, increasingly milder winters, and hotter summers. The prairies used to be white all winter long, and we could ice skate throughout the winter—it never went above freezing. Spring break up of ice on the rivers was a major event, recognized in ceremonies. There would be colliding ice chunks the size of car hoods and a foot thick. Now the prairies are brown for most of the winter, and we have mid-winter thaws; the river ice is thin and melts quietly away. Severe spring floods and wildfires are becoming more common. The existing data from weather stations confirm our historical knowledge; these data show that the snowpack in our river valleys has been declining for more than 100 years and is now less than half what it once was.

The Little Bighorn River is the source water for the public water treatment plant in Crow Agency, the largest community on the Reservation and the Tribal headquarters. With less winter snowpack in the mountains, and hotter summers, the summer flow in the River is lower and warmer than ever, often no more than ankle deep. The intake pipe for the treatment plant can be half out of the water, and we foresee future summers in which the river dries up by the time it reaches Crow Agency. Part of the problem is that the irrigators are diverting more water than ever out of the river. The water users' associations, which control the irrigation systems on the Reservation, are run by and for the benefit of the non-Indian farmers and ranchers, with no enforcement of Tribal water rights by the Crow Tribe. So, the impacts of climate change on our water resources are made worse by lack of effective sovereignty.

Little Big Horn College students electrofishing to test fish for mercury contamination. Photographer unknown.

If we look back in time, it helps us understand the situation we are in now. Tribes have never been given the authority to tax, so we have no tax basis to fund our government. Instead, we have been selling our land, water, and coal to support Tribal operations. Many years ago, we were manipulated into selling the rights to the Bighorn River for power generation, with an illegitimate threat of eminent domain. Some 45 years ago, after lengthy debate, the Tribe entered into a contract for coal mining. Mining has since been providing the jobs and tax revenue to support our Tribal economy. Now, as other cleaner energy sources are becoming cheaper than coal to generate electricity, our income from coal mining has collapsed. In a local Tribal community of 7,000–8,000 people, we have lost more than 1,000 jobs. Our Tribal government no longer has the revenue to function as it once did. For instance, the Tribe no longer contracts for solid waste disposal. Instead, the dumpsters in our communities are burned almost daily, and we breathe that acrid smoke for hours. Coal mining and climate change have become divisive issues, so there is no consensus from which to plan for adaptation to current and looming climate impacts.

Emery Three Irons collecting home well-water sample for analysis, Crow Water Quality Project. Photo by John Doyle.

Tribal community nonprofits, the Tribal College, and other grassroots organizations are addressing some of our communities' needs. The Crow Environmental Health Steering Committee has been working to understand the nature and sources of water contamination, the associated health risks, and how our changing climate is impacting Tribal water resources. We have been able to provide free home well-water testing to rural families and home water coolers with refillable five-gallon jugs for those lacking safe well water to drink. Currently we are working on other mitigation strategies to help water-insecure families and to build community capacity to manage home plumbing and community water supplies. Other grassroots organizations work on educating our youth about Crow traditions around water and Western water science, on management of chronic illnesses, and on mitigating widespread food insecurity greatly exacerbated by the COVID-19 pandemic and accompanying further loss of jobs.

John Doyle, Emery Three Irons, and Mari Eggers collecting spring water sample for analysis from Chief Plenty Coups State Park, Crow Water Quality Project. Photo by Antonie Dvorakova.

Eastern Shawnee Tribe of Oklahoma's Climate Change and Water Quality Challenges

Written by: Debbie Dotson, Water Quality Officer

The Eastern Shawnee were part of an original Shawnee Tribe settled mainly in the Ohio River Valley but were relocated to Oklahoma in the early 1830s. By the 1870s, Tribal membership had declined to 69 Eastern Shawnee individuals, but current membership is approximately 3,600 and growing.

The Eastern Shawnee Tribe of Oklahoma is in the far northeast corner of Oklahoma, where 22 square miles of treaty jurisdiction borders Missouri to the east and Spring River to the west. Spring River and Lost Creek are the largest water bodies within Tribal boundaries, and both originate in Missouri and flow into Grand Lake in Oklahoma.

The Eastern Shawnee have faced several adversities through the years but have striven to become resilient, including resiliency in facing the climate changes that touch northeast Oklahoma. The Tribe is

Fishing after a flood, in what used to be a parking lot.

seeking means to be more proactive in preserving future water quality and quantity, as well as protecting the health of the people, fish, and wildlife.

Climate changes affecting water quality in the region include temperature changes, variance in precipitation frequency and amounts, and an increase in severe weather events. In the past 10 years, a severe drought, record flooding, and several tornado events greatly affected the area and every facet of life.

Parameters such as pH, salinity, water temperature, dissolved oxygen, nutrient levels, and bacteria counts are vulnerable to weather and climate changes. Many water dependent species are at risk when parameters vary for longer periods of time or to more extremes. Public health threats like harmful algal blooms, pathogens and toxins from storm water runoff, and high bacteria counts can be attributed to climate changes. Tornadoes bring debris and invasive plants, break down infrastructure, and destroy riparian trees. Small tornadoes have directly affected the area recently, as well as heavy winds with storm events.

Flooding carries in runoff pollutants, deposits sediment, washes out fish and wildlife habitat, and erodes riparian zones and infrastructure. The past three years have seen extreme rainfall events become more prominent, particularly in 2019. Severe flooding closed area towns, roads, and businesses and displaced many residents, leaving extensive damages and economic hardship.

On the other end of the spectrum, there was a recent drought from 2011 to 2013 that brought surface water levels to a very low flow, was detrimental to fish and wildlife, and reduced groundwater resources, greatly impacting our local wells, economy, and agriculture. Public health issues like algal blooms and bacteria in water also became concerns when the low flow combined with high temperatures.

Tribal culture, area socioeconomics, and agriculture are vital to Tribal resiliency. All these facets are vulnerable to climate changes. Northeast Oklahoma has a large Tribal population, with nine Tribes in Ottawa County alone. These Tribes may have differences in language and origins, but all have valuable parts of their culture related to water and the environment. Gathering of medicinal and culturally significant plants and foods as well as hunting and fishing for food are affected by variances in phenology.

Lost Creek with bank erosion visible on far side of the creek.

Lost Creek flows along the Eastern Shawnee powwow grounds, adding natural beauty to the area. Many Tribal people camp out along the creek during ceremonial times. Kids from the local area enjoy playing in the water and fishing for perch. The area is key to Tribal culture and events, and much care is taken to keep the grounds set apart. The powwow grounds at Lost Creek often have swimming advisories posted due to high bacteria counts in the summer, and those are cause for great concern for those who enjoy the creek with their family.

As with all Indigenous people, natural resources are valuable parts of Shawnee culture and tradition. Water is respected as a valuable component of Creation and something to be protected for future generations. The Eastern Shawnee Tribe of Oklahoma has an advanced Water Quality Monitoring Program (WQMP) and Nonpoint Source Pollution Prevention Program dedicated to the protection and improvement of water resources in Tribal jurisdiction and the watershed. Funding for these programs is through two U.S. EPA Clean Water Act grants.

Water Quality Officer teaching students about tree rings and climate change.

Climate change monitoring for the sector of water has been included in the WQMP for the past eight years, including daily precipitation and monthly salinity monitoring, staff training, outreach and education projects with youth, drought planning, developing articles for the Tribal newsletter, informational brochures, and hosting a regional workshop. Water Quality staff have worked closely with several federal agencies and Tribes to receive training and share information about climate effects.

For several years, bacteria sampling events have been conducted twice a week from Memorial Day to Labor Day each summer at recreational sites. Swimming advisories are posted as needed. Blue green algae monitoring was included in the program for the past two summers for Spring River. Groundwater well testing is offered to residents for free to determine whether that drinking water is still safe, even after a drought or a flood. Year-round surface water monitoring data is evaluated to note changes in water quality due to climate change, particularly related to temperature and precipitation. Information and education are a key component to the WQMP to keep the Tribe and the community aware of the status of the water quality.

The Eastern Shawnee Tribe's WQMP is a respected and long-standing program in the region and continues to pursue a more resilient future for water quality through monitoring and commitment to public health protection.

Water

Key Messages

- Climate change is negatively impacting water quality, increasing ocean acidification, leading to an increase in the frequency and duration of harmful algae and biotoxin events, increasing drought, negatively impacting water and food security, causing coastal inundation, and, in places, increasing riverine flooding. Even water storage reservoirs and flood management infrastructure operations and management are impacted. Each of these impacts can threaten local economies, human and non-human health and wellbeing, and Indigenous lifeways.
- Tribes and Alaska Natives are responding to these threats by drawing on traditional knowledge; observing and monitoring water sources and the linked hydrological, climatological, and ecological systems and connections; utilizing new tools; forming partnerships; creating adaptation and contingency plans; and through adaptation itself.

Recommendation

Emphasis should be on early, meaningful, and sustained engagement and consultation by federal and state regulatory and other agencies on both water quality and availability and on the associated food and water security impacts of contamination, ocean acidification, hazardous algal and biotoxin events, and risks associated with both drought and flooding. Tribes and Alaska Natives should be supported in implementing Tribally-led planning and solutions, partnerships, and cooperative efforts.

"Water is the life of all of us." – Felix Aripa, Coeur d'Alene Tribal elder

Climate change profoundly and deeply impacts Earth's water, broadly defined to consist of water at any location or time in the global hydrological cycle. These impacts alter the quantity, quality, or character of water used, held, or valued by Tribes and Alaska Natives, their communities, and members. Water-related impacts due to or exacerbated by climate change do not necessarily have simple cause and effect. There may be synergy among impacts; one impact may catalyze another or others, and there may be other complex interactions. However, the root causes of these impacts are the changing magnitude/intensity, frequency, or duration of extreme climatic events, together with climate change–related temperature, precipitation, and humidity/aridity trends across regions and globally. Additionally, the impacts may be cumulative or overlap in space or time. In this chapter, we consider how Tribal and Alaska Native village individuals, communities, governments, and organizations are impacted and are forced to reckon with, mitigate, and adapt to this set of specific impacts. In doing so, we draw attention to the key associated organizational, community, governmental, personal, health, economic, cultural, subsistence, and other costs.

Herein we consider impacts related to overall water quality, harmful algae and biotoxin events, ocean acidification, floods, dams, drought, and water and food security. This is by no means the complete set of water-related climate change impacts, but the elements of this set are held at the present time to be high in priority. Climate change impacts on water rights, together with water management and utilization, are also important and will be addressed in future STACC Reports.

Overall Water Quality

To assess future water quality changes, data reported under EPA's Enforcement Compliance History Online (EPA, 2017), EPA's Unregulated Contaminant Monitoring Rule, or UCMR (EPA, 2019a, 2019b, 2019c, 2019d), results from models that utilize the Water Quality Index (WQI) (Horton, 1965; Tyagi, Sharma, Singh, & Dobhal, 2013), and data from peer-reviewed journals are summarized here.

Water quality forecasts developed using a nested modeling approach that includes GCM (general circulation or climate models), emission scenarios, runoff modeling, water demand estimation, water resources management modeling, and water quality modeling are region-specific, with the most detrimental anticipated changes impacting Nevada and western Utah (up to a 26% decline in the WQI), followed by California and Arizona (up to 20% decrease in water quality) through 2100 (Boehlert et al., 2015). The remainder of the Western U.S. could anticipate up to a 14% decline in water quality. Tribes in the Central and Eastern U.S. are not immune from declining water quality; however, the IGSM-CAM (Integrated Global System Model–Community Atmosphere Model) approach, used to assess regional and global climate change, predicts a 0 to 10% reduction in the WQI scores (Boehlert et al., 2015).

The implications of the above-cited modeling predict climate change–related impacts on the WQI parameters of dissolved oxygen, fecal coliform, pH, biological oxygen demand (BOD), temperature, phosphorus, nitrogen, turbidity, and total solids. However, sustained monitoring of additional Tribal-specific regulated and unregulated pollutants will provide a more complete picture of water quality changes.

EPA's Enforcement Compliance History Online (ECHO) reports health-based water quality violations for public water systems (PWS). Focusing specifically on health-based maximum contaminant level (MCL) violations, Tribes in Alaska, Arizona, California, Iowa, Idaho, Minnesota, Montana, Utah, and Wyoming were disproportionately affected by regulated drinking water contaminants compared to non-Tribal PWS sources during 2014–2017 (Conroy-Ben & Richard, 2018). The major health-based violations included arsenic, coliform, nitrate, disinfection by-products, and the surface water/lead-copper/groundwater monitoring rules. Furthermore, unregulated drinking water contaminants and health-based contaminants under consideration for future regulation under the Safe Drinking Water Act (SDWA) were present in Tribal Public Water Systems (Conroy-Ben & Crowder, 2020).

Data from the four UCMR surveys completed to date by EPA indicate that for Tribal Public Water Systems the most frequently detected contaminants exceeding the health reference level (HRL) included 1,4-dioxane, perfluorinated chemicals (PFOS and PFOA), vanadium, strontium, chromium, and chlorate. Additionally, molybdenum, haloacetic acids (HAA5, HAA6, HAA9), germanium, and manganese were detected above the method detection limit. Sustained Tribal monitoring beyond traditional water quality parameters is necessary and should include regulated and unregulated contaminants to assess the impacts of climate change.

Additionally, unregulated drinking water sources provide water to Tribal communities, but due to the numbers of connections (< 15) and customers (< 25), these sources are not routinely monitored. Unregulated wells serve approximately 37 million Americans (Backer & Tosta, 2011) and are a source of undetected water supply contamination in Tribal communities. On the Navajo Nation, for example, up to 30% of the population is not served by a PWS (Hoover et al., 2017). There, those receiving water from unregulated sources are impacted by arsenic and uranium contamination (Corlin et al., 2016; Credo et al., 2019; Hoover et al., 2017; Ingram et al., 2020), and by many other co-occurring natural and mining-influenced metals (Credo et al., 2019; Hoover et al., 2018). These unregulated sources could see a decline in water quality with respect to metal concentration in future projections; routine monitoring in resource-limited areas will determine effects due to climate change.

In summary, Tribal water quality is complex and extends beyond standard water quality indicators. As a result of climate change, Tribes within the states predicted to have reductions in the WQI will likely also be impacted under the SDWA, UCMR, and as unregulated water sources.

Ocean Acidification

Ocean acidification is the process by which the pH of the ocean is being lowered due to the addition of anthropogenic carbon dioxide. This lowering of pH creates difficulty for calcifying organisms to form and maintain their shells (Doney et al., 2009). While the addition of atmospheric carbon dioxide is a global issue, local impacts, primarily eutrophication, have exacerbated these impacts. Given the local and global challenges, resource managers are faced with a difficult issue where changing local inputs might slow the impact on resources. Blue carbon, which is the ability for marine plants and algae to sequester carbon, is one solution that may provide help for local resource managers.

Ocean acidification has already impacted certain Indigenous food systems and has the potential to impact many more. In the Pacific Northwest, the study of these impacts has primarily been directed at important food species like Pacific salmon (*Oncorhynchus* spp.), Dungeness crab (*Metacarcinus magister*), and bivalve clams.

Pacific salmon are being impacted by ocean acidification directly and indirectly. With increased acidification, pink salmon (*O. gorbuscha*) have been shown to have significant reductions in weight and length (Ou et al., 2015). These direct physiological impacts are further amplified by the loss of prey items such as pteropods, a marine planktonic snail, a species upon which increasing acidification has been shown to have had staggering impacts (Orr et al., 2005). In the case of pteropods, these impacts are predicted to be widespread in the waters off Alaska within the next 35 years (Orr et al., 2005).

Dungeness crab is a vitally important commercial and ceremonial species among Pacific Northwest Tribes. Economically, Dungeness crab is the largest fishery for many Tribal communities in Washington state. Current levels of acidification are impacting Dungeness crab with an 8.3% increase in shell dissolution over the past two decades (Bednaršek et al., 2020). When exposed to the acidic conditions expected in the near future, larval planktonic crabs will develop more slowly through the maturation process (Miller et al., 2016). Dungeness crab are extremely vulnerable to predation during planktonic larval periods, so any additional time spent in these stages due to slower development could greatly reduce their populations.

Bivalve mollusks are considered the canary on the beach when it comes to ocean acidification’s attenuation of shell development and shell loss. Impacts from elevated carbon dioxide levels were first seen in Pacific oyster (*Crassostrea gigas*) aquaculture facilities with larval oysters dissolving in the acidic water. Under acidic conditions, larval Pacific oysters can lose over 50% of their shell mass with an overall length reduction of over 25% (Frieder et al., 2017). Ocean acidification tends to impact bivalves during their early planktonic life stages (Waldbusser et al., 2015), which will impact recruitment of new clams, oysters, and mussels. Lummi Shellfish Hatchery has been spawning, rearing, and releasing juvenile clams for decades. Most recently, their on-reservation shellfish program has been focused on the commercial manila clam harvest, with over 20 million juvenile clams outplanted every year. Additionally, they augment beaches with Pacific oysters for ceremonial and subsistence harvest. While directly outplanting juvenile bivalves is not a long-term solution, this does provide Lummi Tribal members with abundant resources to harvest, provided that the water quality is appropriate. This could potentially serve as a model for climate adaptation for other Tribes, but longer term solutions must be found for Tribal people to maintain sovereignty over their lifeways. As in the coastal Northwest, ocean acidification severely limits shell formation, leading to decreases in available shellfish stocks and reducing subsistence harvests in coastal Alaska and the coastal northeast U.S. (Doney et al., 2020).

Monitoring for Harmful Algae and Biotoxins in the Salish Sea

In the Pacific Northwest, harmful algae and biotoxin events are not uncommon occurrences, and Coast Salish people have been harvesting shellfish safely using traditional and observational methods since time immemorial (Lewitus et al., 2012; Williams, 2006). The many miles of coastline along the Salish Sea, which includes territories of sovereign Tribal nations, provide a wealth of subsistence, spiritual, and commercial resources and continue to be an important fishery (Figure 4). Human-related drivers, including global warming, nutrient runoff, and drought, are directly linked to increasing frequency, magnitude, and duration of harmful algae events (HAE). Shellfish safety concerns have prompted increased and adapted monitoring strategies so that Tribal nations can make appropriate management

Figure 4. The shared waters of the Salish Sea basin, Coast Salish Nations, Northwest Washington, USA and British Columbia, CAN.

decisions for their people. (See narratives titled *Southeast Alaska Tribes Face Climate Change with Partnership* and *Harmful Algal Blooms Targeted by Grassroots Watershed Organizations*.)

In marine ecosystems, HAE are a serious threat that cause overwhelming, persistent impacts on the environment. These can include serious health concerns for humans and wildlife, impacting the marine food web with bioaccumulation and biomagnification through shellfish and crab consumption (McCabe et al., 2016). In the Pacific Northwest, paralytic shellfish poisoning (PSP) events are considered “traditional,” and Indigenous traditional ecological knowledge indicates that PSP events have been seasonal and ongoing for hundreds of years. Recent analysis of long-term harmful algae monitoring programs also indicates that both duration and frequency of HAEs are increasing, that they are linked to climate change, and that they are anticipated to cause negative impacts on tourism, local economies, and human health in the future (Gobler, 2020). While many government resource managers are aware that shellfish harvest closures have serious impacts on economic markets, Tribal managers are keenly aware that closures also have an influence on subsistence and ceremonial harvests while threatening food sovereignty.

Figure 5. Sampling for marine biotoxins (left) in the Salish Sea, and Solid Phase Adsorption Toxin Tracking (SPATT) sampler (right), which is a passive, time-integrated toxin sampler used to track multiple toxins at the same time.

The state of Washington and British Columbia manage PSP events by testing mussels for toxins and closing commercial and recreational shellfisheries seasonally. Both Coast Salish Tribes and First Nations have sovereignty over their shellfish tidelands and work with the respective federal and state government entities for testing, so they can then manage their shellfisheries. Since 2012, all Pacific Northwest governments monitor for three main marine biotoxins (Lewitus et al., 2012), but since the 2000s, more than a dozen emergent biotoxins have been identified as potentially impacting marine shellfish and as harmful to humans (Visciano et al., 2016). These other toxins, including freshwater cyanotoxins that can accumulate in marine shellfish, are not often monitored by state governments in the marine environment (Peacock et al., 2018; Preece et al., 2017). In response, Tribal nations have been early adaptors for monitoring and utilizing new tools while also forming partnerships with academic, state, and government entities to monitor for these emergent toxins (Figure 5).

Monitoring is the first step to safe shellfish harvest, and management and policy decisions for shellfish closures need to be effectively communicated to respective Tribal nations (Figure 6). Many of the old adages that Coast Salish people are familiar with, such as, “Don’t harvest in months with ‘R,’” are no longer true. Disruption to traditional knowledge can cause harm to communities that heavily rely on shellfish harvests, but participating in adaptation planning and monitoring to anticipate climate change impacts can increase communities' cultural resilience. Tribal Natural Resource departments provide effective communication facilitating community outreach events, K–12 school education, and supporting harvesters and families during closures to ensure that their people are aware of these changes and of why shellfish are unsafe to eat.

Figure 6. Examples of biotoxin closure signs. State of Washington Department of Health biotoxin closure sign (left). Lummi Nation biotoxin opening and closure signs including Indigenous drawings. Artwork by Thayne Yazzie, Salish Sea Research Center, Northwest Indian College.

Drought and Impacts on Water Security

Water is life. People's basic uses for water include drinking, showering, washing, cooking, and caring for animals and crops. For Tribes and Indigenous peoples, water extends beyond daily consumption and is vital for cultural and ceremonial use, including the cultivation of plants and animals. Water is heavily referenced as a living entity in stories, prayers, place names, and teachings (Chief et al., 2016) and engrained in community activities such as subsistence gathering and growing of food and medicinal plants (Chief et al., 2016). The lethal combination of increasingly prevalent drought and the corresponding reductions in water availability is having drastic impacts on the land and people, particularly in the southwest and western U.S. Increasing wildfires, lack of drinking water for flora and fauna, including humans, and increasingly common water shortages have led to uncertainty concerning the future viability of current water supplies (Wehner et al., 2017).

Approximately 97% of the world's water is contained in the oceans, and over 71% of the Earth's surface is covered in water (Shiklomanov, 1993). Yet on land, in areas of human habitation there is often water scarcity. Growing populations and rising demands from municipal, industrial, and irrigation sectors have only increased in the past two decades (Dieter et al., 2018). With climate change presenting immediate visual, physical, spiritual, and mental impacts, water remains the element that has been the most sensitive to the changes in the weather and climate. In addition, the complexity of water allocations among multiple state and federal jurisdictions has led to users experiencing the impacts differently. Users that are financially secure tend to experience or see less of the impact of drought events, whereas low-income households and communities experience drought events more severely and profoundly (Stewart et al., 2020).

Tribes and Indigenous communities experience drought impacts in ways similar to other communities but can be “affected uniquely and disproportionately” (Jantarasami et al., 2018) based on their geography. Some communities are located in rural areas where the nearest hospital or grocery store can be more than 30 miles or minutes away. This includes the access and availability of clean drinking water for themselves, their livestock, and crops. In addition to encountering inadequate and increasingly unreliable access to sources of drinking water, many Tribal and Indigenous nations are currently involved in protracted water-rights settlement negotiations, yet across the country, growing demands for water only complicate the allocations previously secured (Jantarasami et al., 2018). Diminishing water supplies combined with increasing water demands has created water insecurity for Tribal and Indigenous nations.

Drought has been a contributing factor stressing already over-allocated water resources across the western U.S., but in particular across the arid southwestern region, which has a long history of drought. Historically, droughts in the Southwest have been primarily precipitation-dominated. However, with the observed increases in average annual temperatures due to human-caused climate change, the most recent series of droughts beginning in the early-2000s has been temperature-dominated (Udall & Overpeck, 2017).

In the northwestern region of the United States, drought may have profound impacts on Chinook salmon (an important sustenance for Pacific Northwest Tribes), which are especially susceptible to low streamflow and changes in stream temperatures (Crozier et al., 2020; Silver et al., 2020).

In the northern plains, drought is affecting the quality of soil health, rangeland productivity, and agricultural productivity (He et al., 2019). Specifically, on the Wind River Indian Reservation and the surrounding region, drought has caused significant water shortages, which in turn reduced the amount of irrigation available to maintain agricultural fields during the 2012–2013 season (McNeeley et al., 2017).

Precipitation Change

Factors contributing to drought include increased average temperatures during the winter months that pose a great concern where winter precipitation is transitioning from snowfall to rainfall. In the southwestern U.S., average annual snowpack in the headwaters of the Rio Grande Basin has decreased by nearly a third compared to the historical average (Chavarria & Gutzler, 2018). Similarly, under current and projected climate scenarios, mid-century streamflows in the Colorado River Basin are expected to decrease nearly 30% compared to the historical average (Udall & Overpeck, 2017). Additionally, the timing of snowmelt runoff events in the southwest is shifting toward earlier times of year, with complications for water allocation for downstream water users. Elders from the Navajo Nation in the southwestern U.S. remember “an abundance of snow which lasted for months and long monsoon seasons. Whereas now, the snowfall melts within the day and rainfall run-off has drastically increased”

(Tom et al., 2018). The implications of an ever-decreasing snowpack and changes in annual runoff in the Colorado River Basin, combined with increasing populations and water demand, suggest that water managers and dependent communities may be expected to do more with less. The Campo Band of the Kumeyaay Nation's Climate Adaptation Plan quotes multiple elders' testimonials that when they were children they experienced much rainier, snowier, and cooler conditions than today, and they report an overall decrease in rainfall since 1948 (Campo CAAP, 2018).

The Tlingit and Haida Indian Tribes of Alaska Climate Change Adaptation Plan (Tlingit & Haida CCAP, 2019) finds that trends indicate an increase in precipitation, but "due to rising temperatures, there will be less snow cover. Snow cover is a 'blanket' that protects fragile cedar roots from damaging freezing temperatures, and during the spring melt it provides salmon spawning streams with a clean, cool, and abundant water supply. A smaller snowpack equates to lower spring snowmelt runoff. Paradoxically, however, increased precipitation in the form of extreme rain events is a major factor in river and stream scour. These extreme increased flow events scour river and stream beds, potentially causing damage to sensitive salmon spawning grounds" (Tlingit & Haida CCAP, 2019).

Fluctuating precipitation rates and intensity, combined with precipitation that is shifting from occurring as snow at high elevations to occurring as rain, can directly impact Tribal energy security and water supplies (Scott et al., 2018). For example, the Metlakatla Indian Community of southeastern Alaska has long relied on local lakes for a combination of municipal water supply and hydropower. In recent years, the water supply of Chester Lake has at times dropped too low to support both the need for municipal water and the ability to run the hydro-generator, forcing the Tribe to choose to shut down the hydro-generator and rely on diesel generators for electricity. This imbalance between available water supply and demands for water and energy is due to a "shift in precipitation coupled with warmer winter temperatures that results in little to no snowpack coupled with increased energy demands" (Scott et al., 2018).

Water and Food Security—Impacts to Water-Dependent Subsistence, Hunting, and Gathering

Many Tribal and Indigenous communities are actively engaged in the cultivation or utilization of traditional nutritional and medicinal plants such as corn, reeds, acorns, sage, juniper (including Eastern red cedar), and many others (Native American Ethnobotany Database, n.d.; UVM Library Digital Exhibits, n.d.). Numerous other Indigenous communities subsist partly or entirely on the gathering, harvesting, fishing, or hunting of marine species. In nearly all such settings, food security is inextricably linked to stability and security of water in each and all of its forms: liquid, vapor, and solid.

Since time immemorial, these communities have relied on plant and animal species for food, medicine, ceremonies, prayers, and local economies (Lynn et al., 2013; Chief et al., 2016). Tribes and Indigenous communities view water not only as a resource but as a living entity acknowledged as a relative (Cozzetto et al., 2013). Increasing climate change threatens the valuable resources these communities depend on for the survival of their people, culture, and language and has created a worrisome future for those so dependent on water (Misra, 2014; Cozzetto et al., 2013).

For Indigenous peoples in the North, and in particular for the Inuit of Alaska, reliance upon water and the marine environment and its biodiversity has been and continues to be fundamental to their survival. The coastal seas and ocean provide essential elements of their overall wellbeing. In addition, traversing sea ice is required for most harvesting activities among Alaska Native communities. These profound relationships have economic, social, cultural, and spiritual dimensions inexplicable in the English language. Presently, the integrity and stability of ocean ecosystem dynamics are being seriously threatened by factors such as the loss of sea ice, ocean acidification, ocean warming, microplastics, coastal erosion, impacts to marine mammal habitat including whale calving areas, and subsequent impacts on food chains. Such conditions directly affect Alaska Native Tribal members that rely upon seals, walrus, whales, and other marine mammals.

Concerning the loss of sea ice in Alaska, the Intergovernmental Panel on Climate Change *Special Report on Oceans and the Cryosphere in a Changing Climate* underscored the unequivocal linkage between oceans, biodiversity, and climate change. The report highlights the essential dynamic between Arctic landfast ice and food security for Alaska's coastal Inuit communities. The report further emphasizes Indigenous knowledge and the importance of intergenerational significance of this in the context of such Arctic Indigenous coastal communities and their continued reliance upon the coastal environment as their principal food source (IPCC SROCCC, 2019). (See also *Chapter 4: Ecosystems & Biodiversity*.)

Food and medicinal plants are both seasonal and perennial, but for some Tribal communities, notably medicine people and subsistence gatherers, there is a specific timeline and protocol for proper harvesting. With dynamic shifts in weather patterns due to climate change, decreasing availability of potable water makes it difficult to accomplish ceremonial and subsistence responsibilities. If Tribal communities are unable to properly harvest plant species needed for a time-specific ceremony or event (Daigle et al., 2019), this may cause the event to either be cancelled or postponed to a later date. Due to these cancellations, it may present short- or long-term delays in the intergenerational teachings and sharing of cultural stories, practices, and languages, which in turn may have physiological and spiritual impacts (Swinomish, 2010; Donatuto et al., 2011). For example, if a specific cold-water species that is considered to be culturally significant for ceremonial and subsistence purposes is threatened due to warming water, then the Tribal community is in danger of becoming spiritually and economically stressed (Donatuto et al., 2011).

Threats to the Swinomish Tribe's traditional reliance on its salmon fishery, which is in decline, are compounded by the Tribe's vulnerability to sea level rise (Morrison & Tamayo, 2020). The Swinomish proactively created a climate action plan (Swinomish, 2010), and nearly 50 Tribes have followed suit. Water-related climate change impacts of concern to the Swinomish and other Tribes include but are not limited to increased flooding, ocean acidification, rising river temperatures, more-destructive storms, and habitat loss. Similarly, the Yup'ik and Athabascan critically depend upon salmon along the Kuskokwim and Yukon watersheds.

Increased frequency and intensity of heavy precipitation events are anticipated to impact many beings dependent on particular aquatic or soil moisture conditions for some portion of or all of their life cycle.

An example of this is wild rice, a being so central to Ojibwe culture that Tribal members fear a loss of identity if wild rice, which can be flooded or damaged if heavy rains fall at the wrong time, declines or disappears (Marks-Marino, 2019a; Marks-Marino, 2019b). Wild rice is one of the most vulnerable beings in the Midwest region, has already seen declines, and is susceptible to the changes described previously as well as to invasive species and increasing prevalence of pests and pathogens.

Lack of water availability or intense precipitation events may force Tribal and Indigenous people to make difficult decisions, some of which can be life changing. For example, if a family cannot continue to support themselves by growing crops or raising livestock or even provide potable water for themselves, they may be forced to relocate to unfamiliar urban areas. Lack of potable water resources and the ongoing decades-long drawn-out efforts to secure greater access to water rights create cumulative impacts that are detrimental to the mental, spiritual, and physical health of Tribal communities (Donatuto et al., 2011). If people are unable to continue the practice of traditional farming, subsistence gathering and hunting, and providing for their families, the traditional knowledges of Tribal and Indigenous cultures are at risk of being lost. Water and food security are important for the survival of not only the floral and faunal species but also for the spiritual and cultural survival of humans, the five-fingered beings.

Importance and Impacts of Dams for Tribes

For Tribal communities, dams and their reservoirs may be important and beneficial in terms of providing electricity, irrigation water, and drinking water (Church et al., 2015) as well as water for fire protection and recreation. Climate change may impact dam operations, specifically from diminished water supplies stemming from increased evaporation due to rising air temperatures and increasing drought (Ehsani et al., 2017). For instance, water storage in reservoirs in the Southwest has decreased since 2000 due to drier and warmer conditions (Scanlon et al., 2015). For the Colorado River Indian Tribes in Arizona, this meant negotiating an agreement with the Bureau of Reclamation to use less water (from the Colorado River) for agriculture in exchange for obtaining funding for the Tribes (James, 2020).

Climate change may also impact dam safety. The intensity and frequency of extreme rainfall events are increasing as a result of climate change, which in turn has caused a number of dams (most of which are nearly 60 years old) to breach across the United States (Fountain, 2020; Swain et al., 2020; Pearce, 2021). In addition, due to the age of dams and because most dams were originally built with concrete, earth, and masonry, they are subject to failure from decay, fissures, cracks, and seepage (Fountain, 2020). Within the U.S. Department of the Interior, the BIA is responsible for 900-plus dams on Tribal lands, and 138 of those dams are considered “high-hazard” and “significant-hazard” (FEMA, 2019). A dam is classified as “high-hazard” when there is a likelihood of a loss of one human life if it fails. It is classified as “significant-hazard” when there is a likelihood of economic loss if it fails (FEMA, 2019).

In contrast to the benefits noted above, dams have also presented a set of challenges to Tribal communities in terms of safety, water availability, impacts on river temperatures, erosion, land loss, and food insecurity (Church et al., 2015; Guarino, 2013). Entire villages and fishing sites have been destroyed due to numerous dams that were built along the Columbia River in the Pacific Northwest, resulting in impacts to the subsistence lifestyle of the Indigenous peoples of this region (Smithsonian Institution, 2018; Church et al., 2015). Dam operations and reservoirs may lead to increased river temperatures; if temperatures reach more than 68 degrees, unhealthy environments for cold-water fish (such as salmon) are created (Smithsonian Institution, 2018; Nichols, 2020). Salmon play a key role in maintaining food security and culture for some Tribal communities in the Pacific Northwest. The construction of large Army Corps of Engineers dams in the Missouri River Basin resulted in destruction of communities and permanent loss of land, along with all of the socio-economic and cultural trauma, some lasting and permanent, resulting from displacement from familiar, traditional, and sustaining riverside homelands and environments (Lawson, 2009).

It is especially important for state and federal government agencies involved in flood control and water supply operations and management to meaningfully engage and consult with sovereign Tribal governments and affected communities so that future operation and management of this diverse set of important water infrastructure facilities will be conducted in a manner beneficial to all communities rather than to just certain communities.

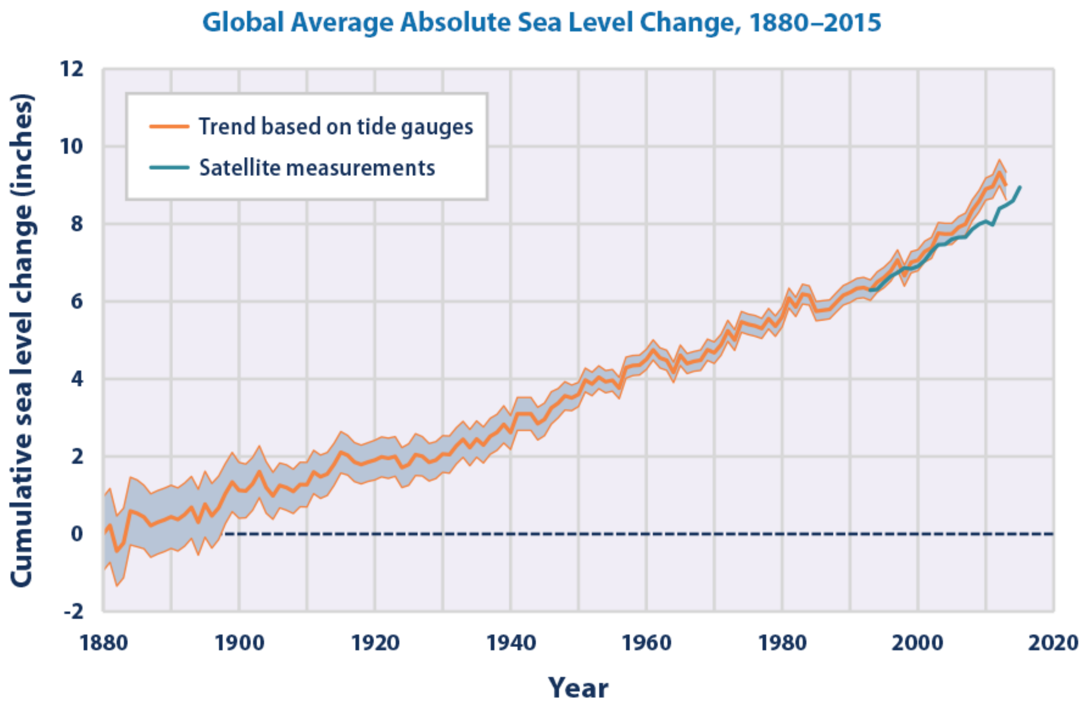
Flooding Related to Climate Change

Flooding events of all manner are captured in the geologic record. Human beings continue to be afflicted by flooding; considerable resources are expended on preparing for and responding to floods. Extreme precipitation events are projected to increase in both observed total and heavy precipitation in many, but not all, regions of North America under multiple emissions scenarios (Seneviratne et al., 2012), and this will in general lead to increased erosion and flooding and to a large set of related impacts.

Flood control and mitigation of flood impacts have yielded mixed results, sometimes inducing further development and settlement in areas that continue to be susceptible to flooding (e.g., Horn & Webel, 2019; Peralta & Scott, 2019). Flood hazards in both riverine and coastal environments are exacerbated by impacts from global climate change on the hydrologic system. Drought-induced vegetation loss, coastal and river system management practices, government policies, and natural resource extractive practices are all important related factors. An especially pernicious aspect of coastal flooding associated with sea-level rise is that this impact from changing climate will continue to grow in spatial extent and magnitude over time as the climate warms and glacial ice continues to melt (see, e.g., Kirezci et al., 2020).

The Coastal Environment

The mean global trend of absolute sea level is illustrated in Figure 7. When it comes to flooding driven by climate change, there is considerable certainty concerning what has happened and what is ongoing, and this can be coupled with model-based forecasts as to what the future is likely to bring in oceanic coastal settings.



Data sources:
- CSIRO (Commonwealth Scientific and Industrial Research Organisation). 2015 update to data originally published in: Church, J.A., and N.J. White. 2011. Sea-level rise from the late 19th to the early 21st century. Surv. Geophys. 32:585–602. www.cmar.csiro.au/sealevel/sl_data_cmar.html.
- NOAA (National Oceanic and Atmospheric Administration). 2016. Laboratory for Satellite Altimetry: Sea level rise. Accessed June 2016. http://ibis.grdl.noaa.gov/SAT/SeaLevelRise/LSA_SLR_timeseries_global.php.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Figure 7. Global Average Absolute Sea Level Change, 1880–2015. https://www.epa.gov/climate-indicators/climate-change-indicators-sea-level

In the U.S. coastal environment, rising relative sea level due to global warming–induced ice melting and thermal expansion of warming sea water causes inundation of areas formerly above sea level (Figure 8). This gradual inundation flood hazard is compounded by episodic landward flows of sea water caused by storm and hurricane surges. In some areas of the northwestern U.S. and Alaska, land masses may be uplifting relative to sea level due to tectonic movements. Also, in a limited number of places such as the Mississippi River Delta in the Gulf of Mexico, subsidence due to deltaic sediment consolidation, reduced sediment delivery by the river, or basement subsidence coupled with absolute sea level rise due to climate change collectively also drive coastal inundation (see, e.g., Wolstencroft et al., 2014; Turner, 2017). NOAA's Tides and Trends website[19] provides an excellent summary of sea level trends in North America and globally.

[19] NOAA's Tides & Currents Sea Level Trends: https://tidesandcurrents.noaa.gov/sltrends/

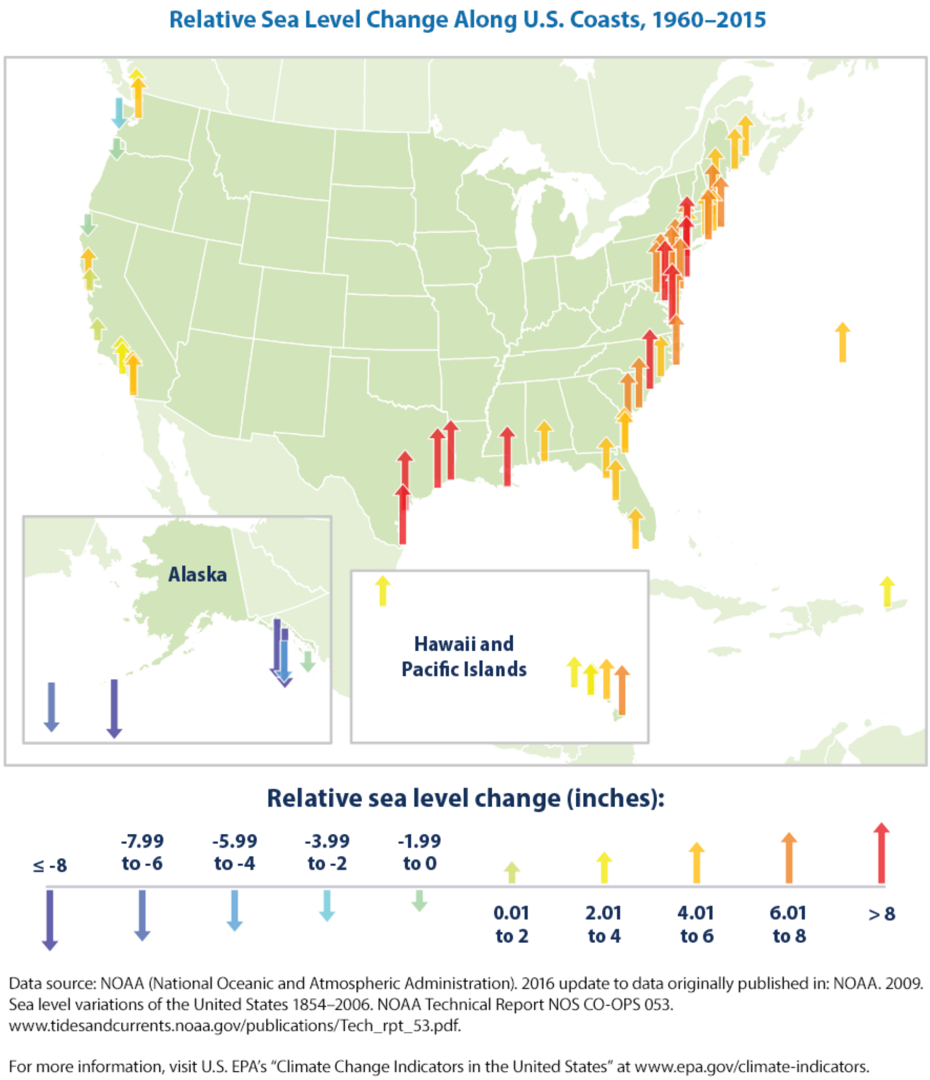
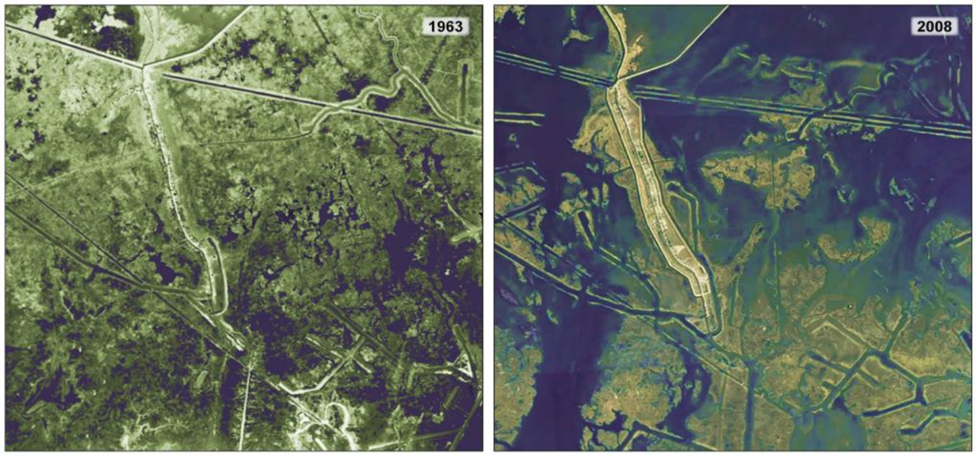


Figure 8. Relative Sea Level Change Along U.S. Coasts, 1960–2015. https://www.epa.gov/climate-indicators/climate-change-indicators-sea-level

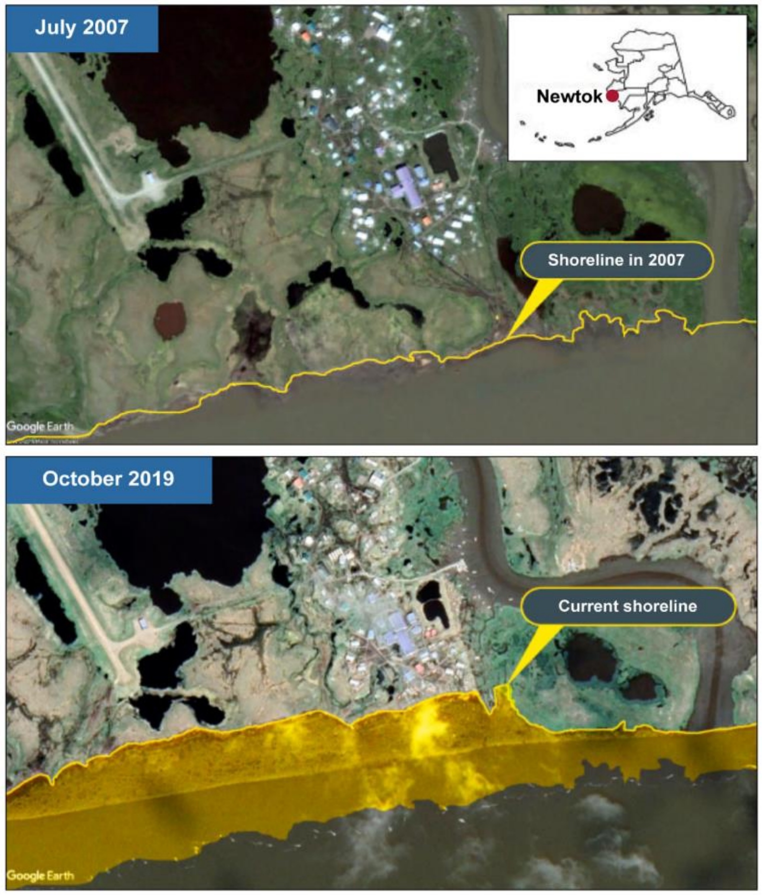
Due to their proximity to coastal shorelines, some Tribal communities—including, but not limited to, the Puyallup and Quileute Tribes in Washington state, the Isla de Jean Charles Tribal community of Louisiana, and Alaska Native villages such as Akiak, Kivalina, and Shishmaref—are especially vulnerable to coastal flooding and erosion, as they may be forced to relocate inland due to land loss, ultimately leading to loss of identity, culture, and a subsistence lifestyle (Walker, 2021; Ristroph, 2019; Puyallup Tribe of Indians, 2016; Palinkas, 2020). The remote Inupiat community in Kivalina, Alaska, is one of the most impacted coastal villages that has begun relocation, even after attempts at shoreline stabilization (Dannenberg et al., 2019). It has been observed that storm surges from strong winds combined with the increasing number of ice-free days per year are contributing to more coastal flooding in coastal Alaska communities.



Land loss at Isle de Jean Charles, Louisiana, from 1963 to 2008 (GAO, 2020).

Summarizing 2003 and 2009 U.S. Government Accountability Office (GAO) studies, the National Wildlife Federation (2011) indicated that "more than 200 Alaska Native villages were affected to some degree by flooding and erosion, and 31 villages face imminent threats that are compelling them to consider permanent relocation." Since then, the Alaska Statewide Threat Assessment (University of Alaska Fairbanks and U.S. Army Corps of Engineers, 2019) has been issued. It provides a contemporary look at threats from erosion, flooding, and thawing permafrost in remote Alaska communities, updates and supplements elements of the prior GAO and National Wildlife Federation studies, and provides risk ranking by community.

The Samish Indian Nation of Washington has observed a trend of rising sea levels over the last decade. "Intense winter storms have led to coastal flooding; king tides (which are exceptionally high tides that are both naturally occurring and predictable) have been larger than in the past (Marks-Marino, 2019c). King tides coupled with winter storms have damaged infrastructure, leading to further flooding and temporary loss of access to the mainland. Cultural sites are at great risk from the erosion caused by rising sea levels" (Marks-Marino, 2019c). The impacts of sea level rise highlight the importance of threatened communities to be considering relocation, managed retreat (Siders, 2019), or protecting existing eco-cultural resources. (See *Chapter 10: Protection-in-Place & Community-Led Relocation*.)

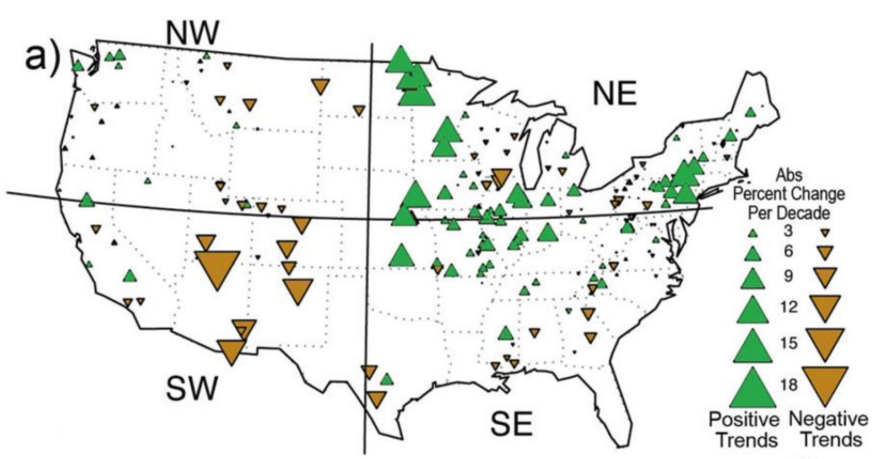


Source: Federal Emergency Management Agency analysis. | GAO-20-488

Shoreline recession (land loss) at Newtok, Alaska, (GAO, 2020) due to erosion, permafrost degradation, and storm-driven flooding.

Riverine (Fluvial) and Lake (Lacustrine) Environments

Continental U.S. decade- to century-long fluvial flooding trends (Peterson et al., 2013) indicate that the Midwest, Northeast, and upper Southeast have suffered greater flooding over time (see map below).



Recent modeling of future riverine flooding that incorporates global climate models (Hirabayashi et al., 2013; Willner et al., 2018) has yielded early results, but these forecasts have limited spatial resolution and significant uncertainty. Nonetheless, Willner et al. (2018) state that "for the United States, 42 of the 50 states, and the District of Columbia, will experience an increased flood risk if no additional protection measures are taken." These types of studies are important and will eventually become essential to inform national and regional flood planning.

Cycles of extreme flooding have severely impacted the Quapaw Nation (see narrative in *Chapter 9: Emergency Management* titled *The Quapaw Nation's Incorporation of Climate Change in Emergency Preparedness Planning*). During the 2019–2020 season, up to 80 inches of rainfall was recorded on the Quapaw Nation. The associated extreme precipitation events give rise to flooding that not only damages infrastructure and roads, but also negatively impacts planting and harvesting (Marks-Marino, 2020).

While relocation as a mitigation effort to reduce risk from riverine flooding is not a suitable approach everywhere, it increasingly makes sense to avoid the otherwise endless cycle of destruction and recovery. The Bad River Band relocated its community at Odanah, WI, to higher ground in the period 1960 to 1990 to avoid repeated devastation from the Bad River flooding (NPR, 2018). Although the cause(s) of the 1960 flooding have not been linked to climate change, the adaptation response of the Bad River Band to the hazard is highly relevant. The Band remains vulnerable to flooding. In July 2016, 10–12 inches of rain fell in the reservation area during an eight-hour period that significantly damaged transportation infrastructure and was disruptive to their access to hunting, fishing, and harvesting of traditional foods such as wild rice (Marks-Marino, 2019b).

Increasing winter air temperatures accompanying climate change may result in precipitation falling as rain rather than snow, a reduction in snowpack, and a change in timing of spring runoff, leading to flooding (Nasser et al., 2015). When snow is deposited at high elevations, it is often held for months or weeks before it runs off at a more gradual rate. However, when it is dropped as rain, the rain may quickly melt some or much of the existing snow very quickly (this is known as a rain-on-snow event), which leads to the rapid runoff into streams and rivers that causes flooding of downstream communities (Musselman et al., 2018; Puyallup Tribes of Indians, 2016). Additionally, the formation of ice dams/jams in rivers can be a major source of flooding in the spring (e.g., Rokaya et al., 2018). This can also occur in the winter due to rapid warming events, sometimes accompanied by heavy rainfall.

In recent years, rain-on-snow events have caused flooding for the Confederated Tribes of the Umatilla Indian Reservation in the Northwest. In February 2020, the Umatilla River peaked at 19,000 cubic feet per second (cfs), surpassing the previous record-high flow of 15,500 cfs recorded in 1965 (Stoelb, 2020). Immediately after the flood occurred, a state of emergency was declared for the Umatilla, Union, and Wallowa counties, including the Confederated Tribes of the Umatilla Reservation, as the flood damaged bridges, roads, homes, wastewater treatment plants, and businesses and caused major power outages (Pollard, 2020). In addition, a fish hatchery owned by the Umatilla Tribe was destroyed (Castle, 2020).

Lake-related (lacustrine) flooding and inundation occurs in addition to riverine flooding. Recent examples include high water levels in the Great Lakes area of the northern U.S. While the connection between such high water levels and climate change has not yet been demonstrated or refuted, this is an area of concern for Tribes and Alaska Native villages with lake or shoreline frontage or utilization.

For example, burial grounds with remains of Little Traverse Bay Bands of Odawa Indians' ancestors[20] were disturbed by rising Lake Michigan waters in 2020. Further to the north, the Keweenaw Bay Indian Community manages nearly 20 miles of Lake Superior shoreline, and that includes coastal roads. The lake and shore provide a fishery and drinking water and foster visits from tourists. In 2018, riverine and lake/coastal flooding impacted the Community. Recently, the Community developed a draft 2020–2025 Keweenaw Bay Indian Community Hazard Mitigation Plan,[21] which addresses both riverine and coastal flood hazards and their mitigation. For those Tribes and Alaska Native villages impacted or threatened by rising waters, a flood hazard mitigation plan is foundational to adequately address future flooding events. Such a plan can identify actions to be taken, necessary resources, individuals and organizations that will respond, and responses that can be readied for the future, etc., as these flood events are only uncertain in their magnitude, duration, and timing, and there is no question as to whether they will occur in the future.

The long-term warming of the Great Lakes is documented and significant (e.g., Anderson et al., 2021). With this warming comes a wide array of impacts to water quality, regional climates, ecosystems, and other areas, including impacts yet to be identified or quantified. Declining winter ice on the Great Lakes (Wang et al., 2017) and warmer water and air temperatures have led and will lead to increased exposure of coastal environments to cold-season wave action as coastal ice formation and duration diminishes. Warmer air temperatures will impact near-shore geomorphic slope and related processes. These impacts will be compounded when coupled with the above-described high lake water levels, regardless of the latter's cause(s).

Flood Inundation Mapping and Insurance

Regrettably, Tribes have at times borne the cost of flood-control measures implemented by other government entities, mainly the federal government. The history (e.g., Lawson, 2009) of the mid-20th-century Pick-Sloan program in the Missouri River Basin illustrates that numerous occupied, productive, and precious Tribal riverside lands were permanently taken almost entirely for the benefit of powerful external constituents, with mass displacement of individuals and communities together with lasting economic, social, food security, and cultural hardships, some permanent.

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[20] Great Lakes Now, "In Michigan, rising lake levels disturb sacred ground": https://www.greatlakesnow.org/2020/09/michigan-rising-lake-levels-sacred-ground/

[21] Keweenaw Bay Indian Community Hazard Mitigation Plan: https://www.wuppdr.org/uncategorized/2020-2025-keweenaw-bay-indian-community-hazard-mitigation-plan-draft-available-for-review-open-july-1st/

Still, there are Tribes and Villages that may benefit from enhanced flood inundation mapping initiatives and possibly from flood insurance, both of which are provided at the federal level, principally through the Federal Emergency Management Agency (FEMA). The GAO (2013) reported that:

- just 37 of 566 federally recognized Tribes were participating in the National Flood Insurance Program (NFIP)
- most Tribal lands remain unmapped by FEMA for flood risk, a consequence of prioritizing urban over rural settings
- without flood hazard maps, Tribal communities may be unaware of their flood risk, even in high-risk areas
- Tribes may lack the resources and administrative capacity needed to administer NFIP requirements, and NFIP premiums are often too high for low-income Tribal members
- some Tribes do not have reservations over which they can enact and enforce the land use ordinances that are required for NFIP participation, due to individual allotment

It is not for us to say that a given Tribe or Alaska Native village should or should not participate in the NFIP. However, it could be of great benefit to Indigenous communities if FEMA would prioritize and accelerate the progress of flood risk and forecasted inundation mapping in areas where Tribal lands and Tribal communities exist. Further, FEMA, while subject to Congressional constraints on what it can do when it comes to modifying its programs and approaches, should engage with Indigenous communities to learn how its flood-mapping and flood-insurance programs could better serve them and take timely action to correspondingly improve those programs.

Landslides

Landslide, or earth-movement, hazards are very diverse and range in size from shallow debris flows and post-fire runoff to deep-seated landslides capable of moving houses or entire landscapes. Very generally, and ruling out alpine, quick clay, and other more restricted classes of earth movement, the former types of events may be relatable to existing moisture conditions combined with shorter term intense rainfall events, whereas the latter are more likely to be associated with deeper soil moisture and groundwater conditions, compounded by geologic variables that may be related to seasonal trends in (increased) precipitation or to even longer term climatic trends persisting over years or decades. The range of earth movements under consideration here is potentially relatable to climate change, as discerned, for example in southwestern coastal British Columbia (Jacob & Lambert, 2009). As an illustration, the Hoopa Valley Tribe of northern California has experienced significant damage from previous landslides and as such has devoted a significant portion of their hazard mitigation plan to this hazard class (Hoopa Tribal LEPC, 2014).

Conclusions

Climate change impacts on overall water quality, harmful algae and biotoxin events, ocean acidification, flood and landslide hazards and risk, drought and water security, dams/reservoirs and water supply management, biodiversity and landfast ice and sea ice, along with water-linked food security are priority concerns for Tribes and Alaska Natives. Observations, experience, monitoring, measurements, and analysis (inclusive of modeling and inference) document ongoing impacts in these priority areas and provide improved forecasts as to ranges of impact(s) that may be expected.

Water quality impacts are far reaching and include ocean acidification along with increased prevalence and frequency of biotoxins that originate from algal bloom events. These climate change-induced water quality deviations from normal conditions result in a wide range of ecosystem and human impacts that include disease, illness, mortality, water insecurity, and food insecurity. Tribal and Village communities and individuals must react and eventually proact to address water quality impacts imposed by the changing climate.

Climate change–driven coastal flooding is already impacting Tribal communities. Coastal inundation will unavoidably and substantially grow both in depth and extent, given the primary cause, which is rising absolute sea level due to melting glacial ice. Increased riverine flooding in parts of the U.S. over the past several decades has been identified and is possibly linked to climate change. Forecasting of riverine flooding based on global climate models is in the early stages of development. However, the preliminary results suggest that there may be increases in riverine flooding in areas of the U.S., and some of these flood impacts will inevitably be felt and borne by Tribes and their communities. This highlights a need for improved inundation mapping by agencies such as FEMA and a focus of funding and related resources to support managed retreat for those communities in which such an approach is the preferred alternative.

Climate change–driven water-related impacts to Indigenous communities' and individuals' food and water security are real and documented. The impacts vary in location and also with time, depending on whether climate change brings higher coastal sea level, drought that is either pervasive, more frequent, or sustained ("normative drought"), or increased precipitation frequency, duration, or magnitude. Informed deliberation, decision-making, and action by Tribes and Alaska Natives so impacted require sustained efforts to mitigate and adapt. The magnitude and pervasiveness of these food and water security impacts need to be assessed and quantified on a periodic basis, e.g., every five years. A dynamic set of strategies and actions, themselves adaptive and evolving, to foster mitigation and adaptation will be necessary, as are initiatives to assess the effectiveness of actions taken. More than anything, the development and implementation of any actions taken need to happen locally, at the sovereign Tribal or Village level, and not be imposed from without.

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Chapter 4.2.1: Drinking Water Infrastructure

With the changing climate, drinking water infrastructure is a big concern for Tribes. Tens of thousands of Native American families do not have adequate access to safe drinking water. Many Tribes' water utilities lack proper operation and maintenance, adequate staffing, or sustained funding. Water infrastructure and staffing deficiencies provide opportunities to install climate-resilient projects. An example is the Chickasaw Nation and Choctaw Nation of Oklahoma: their water resources issues include extensive drought and flooding, which impact their water supply. In response, they have developed a Drought Contingency Plan and adaptation projects to address their concerns. A researched overview of Drinking Water Infrastructure as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Chickasaw Nation and Choctaw Nation of Oklahoma Leading the Way in Implementing Adaptation Projects

Written by: Chickasaw Nation and Choctaw Nation of Okalahoma

Background on the Chickasaw Nation and Choctaw Nation of Oklahoma

The Chickasaw Nation is a federally recognized Tribe located in the south-central region of Oklahoma. As a primary land holder in this 7,648 square mile region encompassing 13 Oklahoma counties, the Tribe has the potential to influence land management practices and conservation of many species in the region.

The jurisdictional area of the Chickasaw Nation includes significant water resources of importance to the diverse communities across this region. The Arbuckle-Simpson Aquifer is the principal and, in some cases, the sole source of water for 150,000 people in south-central Oklahoma, including the cities of Ada, Sulphur, Mill Creek, and Roff and the rural water districts in Murray and Johnston Counties. This aquifer is the source for more than 100 known springs, including Byrds Mill Spring, Ada's primary drinking water source. Additional water sources in the area include the Red River and the Canadian River.

The Choctaw Nation of Oklahoma is also a federally recognized Tribe and is located in southeast and east-central Oklahoma. Its jurisdictional area is 10,613 square miles and encompasses eight counties and parts of five additional counties.

The Choctaw Nation of Oklahoma is headquartered in Durant, Oklahoma. Durant draws all of its water from the Blue River, a spring-fed river originating from the Arbuckle-Simpson Aquifer (in Chickasaw Nation jurisdiction). The Blue River does not have any on-channel reservoirs, thus decreasing the potential for providing reliable supplies during periods of drought. In fact, during a drought in 2011—a year that was both the hottest and driest on record—the Blue River almost ran dry below the city's intake, and water suppliers were required to curtail use.

Climate Change Impacts to Water Resources in the Nations

The Nations are located in a region where climate models project, by mid-century, daily high temperatures to increase by up to 6°F during the summer months, 20–40 more days per year with temperatures above 100°F, and less rainfall events in general but with more intense rainfall when they do occur.

With projections of more variability in rainfall and increases in temperature, many communities already facing water scarcity could run out of water. Other communities are dealing with the intense rainfall events and the resulting flooding and soil erosion. With these intense flooding events, many communities are dealing with pollutants in the runoff and associated pressures to meet the regulatory water quality levels. With ongoing land use changes, water suppliers are focused on limitations in meeting the regulatory water quality standards on disinfection byproducts.

Nations and Consortium Members of South Central CASC

In 2012, the South Central Climate Adaptation Science Center (CASC) was funded by the U.S. Geological Survey (USGS) with two Tribal nations as full consortium members—Chickasaw Nation and Choctaw Nation of Oklahoma. As consortium members, the Nations partner with the USGS, University of Oklahoma, and other consortium members (Oklahoma State University, Texas Tech University, University of New Mexico, and Louisiana State University) on climate science research and education in their jurisdictions. They are "at the table" for strategic and tactical planning for the South Central CASC, bringing Tribal voices to the forefront of the CASC's decision-making.

Red River and Canadian River Future Streamflow Projections

The Nations led research at the South Central CASC to assess how streamflow in the Red River Basin might change in the future, given the CASC's projections of future temperature and precipitation (created by NOAA's Geophysical Fluid Dynamics Laboratory). Results showed that the western part of the Red River Basin is at the greatest risk of experiencing reduced flow. Throughout the basin, peak flows are projected to be higher and low flows to be lower, a finding that is consistent with the expectation that future floods will be more severe and droughts will be more extreme. The study also assessed the climate-induced hydrological changes on the aquatic ecosystems, including threatened and endangered species. The Nations are continuing this research in the Canadian River Basin during 2020–21 so that they have streamflow projections for all their jurisdictions.

This photo is an aquifer recharge study pond, on which the Chickasaw Nation is partnering with Oklahoma State University, East Central University, EPA Kerr Lab, and the City of Ada. Photo credit: Wayne Kellogg.

Implementation of Water Adaptation Projects

Adaptation is defined by the Intergovernmental Panel on Climate Change as "the process of adjustment to actual or expected climate and its effects" (IPCC 2014). Decisions and actions to prepare for adverse consequences of climate change are known as climate adaptation strategies.

With these and other climate-impact research results, the Nations have begun to develop water adaptation strategies. The Nations are leaders in the region, working with water providers across their jurisdictions and assisting with identifying and researching adaptation options. One project developed a drought contingency plan for the Arbuckle-Simpson Aquifer.[22] As a result of these discussions with water providers, the Nations are helping communities with many water supply planning activities that include climate adaptation, such as identifying alternative groundwater supplies for the surrounding cities. The Nations are also working with federal, state, and local partners to study opportunities for artificial aquifer-recharge options throughout their regions.

The Nations have started working with communities to examine wastewater reuse as an economically viable alternative to conventional water supply. Good opportunities for wastewater reuse by industrial users and municipalities (for example, irrigation of ball fields and parks) exist across the entire jurisdictional area. Furthermore, the Nations are partnering with communities to reduce leakage rates in water supply–distribution systems. An example of this partnership includes helping the cities of Tishomingo and Durant acquire competitive grants to install smart meters in areas known to have large water losses and increase the efficiency of their overall system. Drought contingency plans, wastewater reuse, and conservation measures are critical adaptation strategies to strengthen Tribal resiliency in the face of climate change.

[22] Arbuckle-Simpson Aquifer drought contingency plan: https://www.okainstitute.org/drought-contingency

Drinking Water Infrastructure

Key Messages

- Tens of thousands of Native Americans do not have access to safe drinking water. Climate change has the potential to exacerbate this lack of access.
- Operation and maintenance (O&M) of water systems is key to sustainability, cost effectiveness, and, most importantly, the ability to supply safe and reliable drinking water. Proper O&M require adequate funding, staffing, and technical, managerial, and financial training. Proper O&M may become even more critical with climate change as systems respond to increasingly extreme climate events and greater uncertainty with respect to water quantity and quality conditions.
- Water infrastructure deficiencies provide opportunities to install climate-resilient infrastructure.

Recommendation

Climate change is making it more urgent to increase resources for Tribal drinking water infrastructure and for operation and maintenance to eliminate disparities in safe drinking water access and increase infrastructure resilience to climate-related disasters and impacts.

Introduction

Disparities in access to sufficient, safe (meeting standards), accessible (in the home), affordable, and reliable (limited supply disruptions) drinking water contribute to health inequities and environmental injustice (Doyle et al., 2018; Roller et al., 2019). Inequities in water access have come into sharp focus in 2020, during which a record-breaking number of hurricanes have formed and millions of acres across the U.S. have burned, all amidst the COVID-19 pandemic (NOAA, 2020; NIFC, 2020). Tribes in the U.S. face disparities in drinking water access for a variety of interconnected and compounding reasons. Disparities will become exacerbated with climate change. Tribal water utilities and communities, federal and state agencies, nonprofit entities, academic institutions, and the private sector are all important partners in implementing community-led solutions to address the water-access gap for Tribal peoples and all peoples in the U.S. (Doyle et al., 2018; ITF, 2008, 2012; Roller et al., 2019).

Current State of Tribal Drinking Water

Tribal communities obtain drinking water from diverse sources, including rivers, creeks, springs, lakes, reservoirs, ponds, wells, rainwater catchments, and ice stored in cellars (Brubaker et al., 2011; Conroy-Ben & Richard, 2018; GAO, 2018). According to EPA databases, Tribes operate roughly 1,000 public drinking water systems (PWSs). The vast majority (about 97%) are small drinking water systems serving less than 10,000 customers (Conroy-Ben & Richard, 2018; GAO, 2018). Various programs within seven federal agencies provide funding for Tribal PWS construction. The agencies include the Indian Health Service (IHS), the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Agriculture (USDA), the U.S. Department of Housing and Urban Development (HUD), the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the U.S. Economic Development Agency (GAO, 2018). The Federal Emergency Management Agency (FEMA) also provides funding to help utilities lessen impacts from future natural disasters. Once built, system ownership is typically transferred to the Tribe

(GAO, 2018). Tribal households may also obtain water from non-Tribal PWSs or private systems or may haul water.

Those who haul water face particular challenges. People hauling water from unregulated sources (e.g., livestock wells) or from regulated sources but with unsanitary hauling methods may be exposed to waterborne diseases and/or contaminants. Water haulers may also pay considerably more for water. A 2004 study on the Navajo Reservation found that haulers drove an average of 14 miles one way for water at a cost of about $1,000 per year or 5% of the average annual household income—more than double the $450 per year paid by Navajo Tribal Utility Authority customers for 10 times the water (ITF, 2008).

AI/AN Households Disproportionately Lack Access to Clean Water

Data about drinking water deficiencies in Tribal communities may come from different sources and cover different aspects of the access issue; however, all sources indicate that AI/AN households disproportionately lack access to clean water. According to the *U.S. Census Bureau's American Community Survey (ACS)*, Native American households are 19 times more likely to lack indoor plumbing than white households (Roller et al., 2019).

IHS's Home Inventory Tracking System (HITS) is the main database tracking sanitation deficiencies in Tribal homes nationwide. In HITS, the term "sanitation" includes both water supply and wastewater. According to HITS, as of March 2020, 52,000 AI/AN homes (12.5%) did not have adequate sanitation. Of these, approximately 6,600 (1.6%) do not have a safe water supply or wastewater system or both, as compared to less than 1% for the U.S. general population (IHS, 2020). A large percentage of the homes in this latter category are in either the Alaska or Navajo IHS regions (IHS, 2018).

At the start of the 2020 COVID-19 pandemic, IHS identified 9,650 Navajo homes with no running water, representing about 37,000 people or 20% of the Navajo population (Navajo Safe Water, 2020). This is higher than the 6,600 homes noted in HITS as having no water supply, no wastewater system, or both.

Safe Drinking Water Act (SDWA) violations include failing to follow monitoring and reporting schedules and violating maximum contaminant levels (MCLs). A review of EPA data for Tribal PWSs in 30 states showed that monitoring and reporting violations occurred at nearly twice the rate for Tribal vs. non-Tribal customers (Conroy-Ben & Richard, 2018). If monitoring and reporting are not done, there is no way to know whether drinking water is safe. MCL violations in Tribal PWSs differed by state. In 18 states, Tribal PWSs had 50% or more MCL violations per capita than non-Tribal customers, indicating greater consumer exposure to unsafe drinking water. However, Tribal PWSs in the remaining states had similar or fewer MCL violations than their non-Tribal counterparts. The most common MCL violations in Tribal PWSs were the coliform and revised coliform rule and arsenic, followed by total haloacetic acids and total trihalomethanes, two disinfection byproducts (Conroy-Ben & Richard, 2018). Potential emerging contaminants in Tribal PWSs include perfluorooctanesulfonate (PFOS), vanadium, strontium, and, in particular, chlorate, another disinfection byproduct (Conroy-Ben & Crowder, 2020). Addressing SDWA violations is important for reducing disparities in safe drinking water access.

Tribal Drinking Water Deficiencies May Be Underestimated or Unknown

Although the above data sources help define the scope of the drinking water access problem, they may underestimate deficiencies. AI/AN are the most undercounted racial group in the U.S. Census by an estimated 4.9%, which may mean that lack of plumbing is not being accurately estimated by the ACS (NCAI, 2020). Additionally, the ACS data do not include the unsheltered, and no data are collected as to whether plumbing functions well and is reliable and if service is affordable (Roller et al., 2019).

In addition, IHS's HITS database likely underestimates sanitation deficiencies, which, as noted above, IHS defines as including both drinking water and wastewater. HITS doesn't indicate if a home's deficiencies have been assessed, meaning that deficiencies may be underestimated for homes in the database (GAO, 2018). In addition, not all Tribal homes eligible for IHS water infrastructure assistance may be in HITS. In some cases, Tribes choose to not provide information to IHS because of cultural or other concerns (GAO, 2018). IHS Oklahoma City–area officials estimated that 100,000 homes eligible for IHS assistance may not be in the database due to challenges identifying eligible homes within communities that have a mix of Tribal and non-Tribal residents and that are not on reservations (GAO, 2018). IHS Portland–area officials estimated that an unknown number of eligible homes in their region are excluded from HITS because of difficulties identifying Tribal homes in dispersed locations removed from Tribal community facilities (GAO, 2018). Suggestions for improving monitoring and tracking of Tribal sanitation deficiencies include updating HITS to indicate whether deficiencies have been assessed, targeting homes for assessment within communities for which EPA data show that water quality standards are not being met, and leveraging opportunities for collaboration between IHS and EPA (GAO, 2018; ITF, 2008). An example of leveraging could be for EPA to collect data that could be entered into IHS's database when EPA sanitary surveys are performed (ITF, 2008).

As noted above, the rate of monitoring and reporting violations for Tribal PWSs is nearly twice that for non-Tribal customers, meaning that MCL violations may go undetected and thus be underestimated.

Finally, some water systems are not regulated. These include systems serving less than 25 people and private wells (USEPA, 2020a). Water quality monitoring in such systems is voluntary and may be irregular (Roller et al., 2019). The scope of any contamination in such systems may thus be unknown.

Identification of Infrastructure Investment Needs May Be Underestimated

Two reports describe investment needs related to drinking water infrastructure. IHS's *Annual Report to the Congress of the United States on Sanitation Deficiency Levels for Indian Homes and Communities* includes costs related to both drinking water and wastewater infrastructure, reports costs related to existing needs, and is based on data in IHS's Home Inventory Tracking System. In contrast, USEPA's *Drinking Water Infrastructure Needs Survey and Assessment* focuses solely on drinking water, projects capital improvement costs over the next 20 years (thus including existing and future needs), considers projects based on eligibility for the Drinking Water State Revolving Fund, and is based on a survey it conducts and on information in IHS's databases (USEPA, 2018).

According to IHS's 2018 report, the total investment needed to bring all homes in the HITS database to adequate sanitation levels (both drinking water and wastewater) was $2.63 billion. When allocating funds to projects, however, IHS considers whether or not a project is feasible. Projects for homes in remote locations with harsh climates, unusual subsurface conditions, and high capital costs per home may not be considered feasible. In 2018, roughly 1,300 out of 1,800 sanitation-deficiency projects were considered feasible, with a cost estimate of $985 million. Projects are re-evaluated annually to determine whether costs and/or scoring have changed. Some Tribes object to the feasibility threshold because they feel that their community projects will never rank high enough to be funded (SPPW, 2011). Infrastructure costs may be underestimated due to the deficiencies in HITS.

According to a USEPA report, "The combined American Indian and Alaska Native Village water system need estimated for the 2015 Assessment is $3.8 billion in capital improvements over the next 20 years. This need includes drinking water infrastructure to increase access to safe drinking water through compliance with EPA's drinking water regulations, as well as connection of homes without piped water to existing public water systems" (USEPA, 2018). This amount doesn't include costs related to population growth, private infrastructure (e.g., private drinking water wells), or adapting drinking water systems to be climate-resilient (GAO, 2018).

Natural Disasters Significantly Impact Safe Drinking Water Access
A 2017 USEPA report indicated that natural disasters both acute (e.g., floods, hurricanes) and chronic (e.g., drought, sea level rise) were among the most significant risks to drinking and wastewater infrastructure in the U.S. (GAO, 2020b). Between 2011 and 2018, the U.S. spent at least $3.6 billion on drinking and wastewater infrastructure disaster recovery. According to the fourth National Climate Assessment, the risk of climate- and weather-related events will likely increase with climate change, potentially exacerbating disruptions in access to safe drinking water (GAO, 2020b). Tribes often have fewer resources with which to respond to and recover from disasters.

Climate Change Impacts on Tribal Drinking Water Supplies and Systems
Climate change may decrease source water quantity, increase water demands, degrade water quality, and/or damage or overwhelm the capacity of water supply infrastructure (GAO, 2020b). The types and severity of changes may differ by region; however, all regions will be affected by climate change.

Water Quantity and Water Demands
Rising air temperatures, greater evaporation, and increasing drought may all contribute to future shortages in both surface and groundwater supplies (CCG, 2016; CSKT, 2013; CTUIR, 2015; PED et al., 2019; Peterson et al., 2017; USEPA, 2015). This could result in supply disruptions and the need to find alternative water sources. Warming air may also increase water demands for the agriculture and energy sectors contributing to water shortages (GAO, 2020b). Reduced snowpack can lead to declining streamflows in some areas and summer shortages. The Confederated Tribes of the Umatilla Indian Reservation also note that reduced snowpack can decrease aquifer recharge from slowly melting snow (CTUIR, 2015). In Alaska, reduced water availability due to surface hydrology changes could cause tundra lakes used as water supplies to dry up, and residents are concerned that thawing permafrost might lead

to the ground absorbing more water, resulting in springs going dry (Brubaker et al., 2010; Kettle et al., 2017). In the Alaska Native Village of Wainwright, thawing permafrost and erosion are ruining ice stored in cellars for drinking water (Brubaker et al., 2014). Climate change could benefit some Alaska Tribes due to longer open water seasons for drinking water collection and treatment (Brubaker et al., 2010). However, this positive may be negated by water quality impacts.

Water Quality

Climate change will likely contribute to and exacerbate water quality issues in both surface and groundwaters. The strain on existing water systems will potentially necessitate additional treatment and/or the development of supplemental or alternative water sources (GAO, 2020b). Permafrost thaw, flooding-induced erosion, and wildfires followed by flooding can all contribute to increases in water turbidity. Turbidity can interfere with the chlorine disinfection process, and associated organic matter can react with chlorine, producing harmful by-products (Brubaker et al., 2011; LNRD, 2016; WRF, 2013). Warming waters can contribute to increases in harmful algal blooms, which may produce toxins beyond the capacity of Tribal water treatment plants to remove (Karuk, Stults et al., 2016; USEPA, 2016). Wildlife shifting in response to climate change can act as vectors for waterborne diseases. Declining water quantities can concentrate contaminants and pathogens (Stanke et al., 2013). Alaska Native villages in the Norton Bay area are also concerned that sea level rise, coastal flooding, and higher storm surges might lead to saltwater intrusion into coastal streams that serve as water sources (Murray et al., 2013; Johnson & Gray, 2014).

Tribes from both coasts are concerned about sea level rise-induced saltwater intrusion into coastal groundwaters (GAO, 2020b; LNRD, 2016; Murray et al., 2013; Shinnecock, 2013). During the 2013-16 drought, the Yurok Tribe observed increasing saltwater influence in some coastal water supply wells (Cozzetto et al., 2018). Wells can be impacted by floods, which can contaminate groundwaters with pathogens or toxins. Infrastructure damage can also lead to contamination of drinking water supplies.

During a workshop, Yurok Tribe community members noted further water quality impacts stemming from drought: people may consume bottled water because water supplies have run out; those bottles may become warm, which could increase their ingestion of plastic byproducts. In addition, they spoke of emotional and spiritual consequences resulting from taking water from someone else’s sacred place and where taking water may upset the balance of the place where it is needed (Cozzetto et al., 2018).

Infrastructure

Floods, wildfires, drought, permafrost thaw, and erosion can all damage water-supply infrastructure such as buildings, source water intakes, well casings, pumps, filtration, distribution lines, and water towers (Doyle et al., 2013; Brubaker et al., 2010; PED et al., 2019; USEPA, 2015). Infrastructure damage can cause treatment failures and unsafe water quality and/or service disruptions. Permafrost thaw is causing breaks in distribution lines and impacting treatment facilities in Alaska Native villages (Murray et al., 2013). Drought can lower river or lake levels below intake infrastructure and cause them to suck in mud, impacting pumps and filtration equipment (GAO, 2020b). Fire can damage well systems, allowing for contamination by chemicals, microorganisms, and fire retardants (Waksom et al., 2013).

In addition to damage, climate change can overwhelm infrastructure capacity. In Alaska, warming air contributes to algal blooms, necessitating increased filter changes and labor, resulting in greater costs (Brubaker et al., 2010; GAO, 2020b). Flood waters can infiltrate old infrastructure, overwhelming water treatment systems (Stults et al., 2016). Post-fire sediments washing down during floods can clog water intakes, shorten filter runs, and increase backwash frequency and the amounts of sludge to dispose of (Cozzetto et al., 2018). Post-fire sediments can build in and decrease reservoir capacity (GAO, 2020b).

Cascading Infrastructure Failure

Tribes have concerns about climate hazard impacts on secondary infrastructure, which could lead to cascading infrastructure failure of interconnected systems (GAO, 2020b). For instance, extreme events could disrupt power needed to operate pumps and treatment facilities or could disrupt internet needed to remotely monitor drinking water systems. These could cause service interruptions and/or unsafe water being delivered (USEPA, 2013). Extreme events like flooding could damage or overload septic systems, contaminating water supplies (PED et al., 2019; Waskom et al., 2013).

Compound Events

Compound events in which two or more climate hazards occur simultaneously or consecutively can also contribute to/exacerbate drinking water impacts (GAO, 2020b). Extreme rainfall plus storm surges can cause more extreme flooding. Drought exacerbates wildfire risk and may also contribute to flooding, as dry soils may have less capacity to absorb water (NWF, 2011). Heavier downpours after wildfires could lead to increased landslides. With limited roads on many reservations, landslides threaten water system accessibility, resulting in serious health and safety risks for whole communities.

Nonclimatic Challenges and Opportunities Facing Tribal Drinking Water Systems

In addition to climatic challenges, Tribal drinking water systems face multiple, interconnected nonclimatic challenges that may interact with, compound, or accelerate climate change impacts, and that may result in communities not receiving safe drinking water. Such nonclimatic challenges may include under-resourced personnel, legal and jurisdictional issues, infrastructural factors, financial issues, and inadequate operation and maintenance of systems. Some challenges are similar to those experienced by other small drinking water systems. Others are unique to the Tribal context (Doyle et al., 2018).

Under-resourced Personnel

Personnel running Tribal water systems face a variety of challenges. Some may be doing their work on a voluntary basis without being paid (ITF, 2012). They may have limited knowledge of and time to investigate diverse funding sources (Doyle et al., 2018). They may also have limited grant writing and administration expertise. Additionally, there are no federal requirements for water treatment plant operator certification for Tribal PWSs (Doyle et al., 2018). As a result, funding for certification may be restricted, and those hiring operators may not have a reliable way to evaluate applicants. Even if Tribal operators are interested in trainings, they may not be available within driving distance. Some repairs and upgrades may not fall within operator expertise and may thus not be completed (Doyle et al., 2013). Personnel of small drinking water systems often do not have the resources or training to address climate impacts to their systems (Ekstrom et al., 2018). Furthermore, Tribal PWSs have challenges recruiting and retaining personnel, resulting in insufficient staff operating and maintaining critically important infrastructure (Doyle et al., 2018; GAO, 2020b). This issue often stems from limited financial resources to pay operators (ITF, 2012). An insufficient workforce increases difficulties with respect to running water systems. Limited staffing can also prove challenging during emergencies when increased personnel may be needed (Cozzetto et al., 2018). Staff turnover also often results in knowledge gaps and lost institutional knowledge (Doyle et al., 2018).

Legal/Jurisdictional Issues

Tribes face complex legal/jurisdictional issues affecting their ability to establish, operate, and maintain drinking water utilities. These include land fractionation, processes obtaining rights of way, lack of clear eminent-domain authority, and conflicting regulations with respect to Tribal hiring and contract preference (Doyle et al., 2018). Grants may require a partial waiver of sovereign immunity, which Tribes may not want to provide or which require legal counsel to negotiate for each such grant received. Tribes lack authority to create water districts to raise funds through taxes and guarantee construction loans (Doyle et al., 2018). Tribes may have a history of poor environmental enforcement, which can affect utility construction and operations. For example, finding unanticipated hazardous waste when installing distribution lines can increase costs and cause delays (Doyle et al., 2018). In addition, many Tribes have not yet adjudicated their federally reserved water rights and are still in the process of negotiating with other stakeholders to quantify those rights (Cozzetto et al., 2013). Some Tribes may have litigated and won their rights, but do not have the financial resources to build infrastructure to deliver water to their communities. Climate change impacts on water quantity, quality, and timing increase legal and planning complexities and intensify concerns that Tribal water rights may be sacrificed and that human as well as environmental water needs may go unmet.

Infrastructural Factors

Existing infrastructure in many Tribal communities is aging and may have initially been built to serve smaller populations (Doyle et al., 2018; GAO, 2020b). Infrastructure may thus already be starting to fail. Moreover, such infrastructure was designed for historic climate and may not be resilient in a changing climate (GAO, 2020b). Drinking water systems may depend on secondary infrastructure such as internet and power that is not always reliable. Finally, for communities still lacking infrastructure, installation costs may be high because of low population densities, remoteness, harsh climates, challenging subsurface conditions, and legacies from being relocated to marginal areas with fewer and lower quality water supplies.

Operation and Maintenance

The importance of proper operation and maintenance (O&M) of drinking water systems cannot be overstated. Adequate O&M can extend system lifetimes, reduce the need for emergency repairs and upgrades, increase system cost effectiveness, and increase the time a utility has to amass funds to replace aging infrastructure (ITF, 2020). Funds for emergency repairs and upgrades or for recapitalizing infrastructure before its design life are diverted from providing drinking water infrastructure for those who do not have it. Adequate O&M is also critical to a system’s ability to deliver safe drinking water.

Without it, consumer health may be compromised. Proper O&M requires sufficient funding, staffing, and expertise (technical, financial, and managerial). Particular O&M challenges include high O&M costs for infrastructure serving low, widely dispersed populations in remote locations and/or challenging environmental conditions, restrictions on federal agencies with respect to using their funds for O&M, suboptimal water system operator O&M training and capacity, decreased funding for O&M training and assistance, and Tribal communities not being fully informed of the O&M costs that will be associated with new infrastructure being proposed (Doyle et al., 2018; ITF, 2008, 2011).

Financial Factors

Tribal communities are often smaller with lower population densities. Both mean that Tribes may have higher costs per household to construct, operate, and maintain drinking water systems (GAO, 2020; ITF, 2008). Tribal utilities may also face challenges with respect to charging users. Many Tribes have high unemployment and low income levels. People may not be able to afford the true costs of providing water to their homes (ITF, 2012). Moreover, some users have never had to pay for water before, having never received water from a utility, and some may have cultural objections to the commodification of water (Chief et al., 2016; GAO, 2018; ITF, 2012). Tribal politics may also affect the amount of funds available to operate and maintain water systems and the rates charged (ITF, 2012).

More broadly, federal funding for water infrastructure has decreased. In 2019, such funding was only 14% of what it was in 1977 (Roller et al., 2019). Furthermore, appropriated funding can be far below the estimated need. In 2016, for instance, Congress appropriated $99.4 million for water and sewage infrastructure, less than 4% of the $2.7 billion IHS estimated it would need to provide adequate infrastructure to all homes in its HITS database (Roller et al., 2019). In addition, the Census count is considered when distributing federal funds, including funds for water projects, and AI/AN are the most undercounted racial group (NCAI, 2020). Federal agency scoring processes may also not always prioritize water projects addressing the most severe deficiencies (GAO, 2018). Finally, with various programs within seven different federal agencies involved in funding Tribal PWS construction, it can be difficult to identify, navigate, and leverage funding sources, application processes, and funding cycles.

Recommendations

The sources reviewed above provide a large number of recommendations for addressing both the climate change related and nonclimatic challenges facing Tribal drinking water infrastructure. We have included some of the key recommendations below as well as examples of Tribally-led initiatives to address some of the drinking water challenges discussed. We refer readers to the reports themselves for further information and additional recommendations suggested.

Improving the Climate Resilience of Tribal Drinking Water Systems

- *Learn from extreme events taking place now to better prepare Tribal water utilities for the future (Ekstrom et al., 2018)*

There aren't many examples of climate adaptation among small drinking water systems. Assembling lessons learned from handling extreme events such as drought and flooding could advance climate adaptation in such systems (Ekstrom et al., 2018).

- *Make use of opportunities to upgrade or install new water infrastructure to do so in a climate-resilient way (TCCP AC, 2019)*

Climate-resilient systems provide reliable service with limited disruptions in the face of changing environmental conditions and extreme climate events. If disruptions occur, systems recover quickly (Ekstrom et al., 2018). Actions that make drinking water systems more climate-resilient include diversifying water sources, expanding storage capacity, drilling wells deeper and properly closing abandoned wells, encouraging water efficiency, upgrading water treatment, managing source watersheds to maintain clean water supplies and store water, using natural or manmade reset opportunities to elevate infrastructure above flood risk levels, installing floatable water intakes that rise and fall with reservoir levels, installing generators to provide backup power for pumps in case of power loss, and having more than one route or mode of transport to reach water treatment plants (CCS, 2011; Ekstrom et al,. 2018). Such actions include examples of both redundancy (multiple ways of accomplishing critical functions) and flexibility (ability to adjust if conditions are different than anticipated). Both are important traits of climate-resilient systems (CCS, 2011).

- *Develop and enact federal interagency climate resilience guidelines for Tribal drinking water systems (TCCP AC, 2019)*

Interagency climate-resilience guidelines could be based on already existing efforts and adapted to meet the unique contexts and needs of Tribal drinking water systems. One resource could be the USEPA's Creating Resilient Water Utilities (CRWU)[23] program.

Assisting Under-resourced Personnel

- *Provide Tribal water system operators with a paycheck and benefits (ITF, 2012)*

In some cases, Tribal water system operators may be volunteering in that role. Providing a paycheck and benefits could increase operator retention once they are trained.

- *Recruit and train Tribal members as operators (ITF, 2012)*

Tribal members may have greater incentive than non-Tribal operators to stay with a Tribal utility.

- *Increase funding for entities providing Tribally-focused technical, managerial, and financial training and technical assistance (Roller et al., 2019)*

Entities providing Tribally-focused water system training and/or peer-to-peer learning include the United Southern and Eastern Tribes, the Inter Tribal Council of Arizona, the Native American Water Masters Association, and Environmental Finance Centers (USEPA, 2020). The Rural Community Assistance Corporation hosts a Tribal Circuit Riders program. Circuit riders are water professionals who make onsite visits to help with operations, finances, and management (RCAC, 2020).

[23] Creating Resilient Water Utilities (CRWU): https://www.epa.gov/crwu

Addressing Infrastructural Considerations

- *Increase funding for operation and maintenance to extend water system lifetimes* (ITF, 2008, 2020)

Insufficient maintenance of drinking water infrastructure due to either limited financial or technical capacity can reduce system lifetimes (ITF, 2008, 2020). Increased funding for O&M could help systems to run more cost effectively and last longer.

- *Research and implement decentralized and/or alternative water treatment technologies to increase access to safe drinking water*

For communities that lack water infrastructure due to low population densities and/or challenging environments, more decentralized and/or newer technologies may provide more cost-effective options (Roller et al., 2019; GAO, 2020a). These include point-of-entry treatment (devices that treat water when it enters a home), point-of-use treatment (devices that treat water at a tap such as a kitchen faucet), remote monitoring and operation, low-pressure micro- or ultrafiltration membranes, and atmospheric water generation (producing potable water from the surrounding air) (Roller et al., 2019; GAO, 2020a). Federal, private, and nonprofit investors could support community-led research, pilot projects, implementation, and evaluation of treatment and cost effectiveness (Roller et al., 2019; GAO, 2020a). Regulators could develop standards and technical assistance for decentralized systems.

- *Make climate resilience a condition for federal funding of drinking water infrastructure* (GAO, 2020b)

A requirement to make climate resilience a condition for federal funding from programs administered by agencies such as USEPA, FEMA, HUD, and USDA could help ensure that funded infrastructure sufficiently reduces risks from climate change and limits disruptions to the provision of safe drinking water (GAO, 2020b).

Improving the Operation and Maintenance of Tribal Drinking Water Systems

Building the technical, financial, and managerial expertise of water system operators is discussed above. Various O&M financial strategies are noted below. Additional approaches include:

- *Develop partnerships with other utilities either within or outside the Tribe to reduce O&M costs and build financial capacity*

For example, the Alaska Rural Utility Collaborative partners with and supports rural communities in managing, operating, and maintaining water and sewer systems (ANTHC, 2020). It also helps communities set self-supporting rates and provides billing and collection services.

- *Allow state and federal funds to be used to support O&M costs*

For instance, in 2019, California established the Safe and Affordable Drinking Water Fund, which includes significant and continuous O&M funding for struggling water facilities (Roller, 2019).

Improving the Funding of Tribal Drinking Water Infrastructure

The Federal Infrastructure Task Force to Improve Access to Safe Drinking Water and Basic Sanitation to Tribal Communities (ITF) has developed a number of recommendations related to funding.

Federal agency recommendations include (ITF, 2008):

- Making available funding more accessible
- Using available funding more efficiently and creatively
- Improving interagency coordination to increase effectiveness of existing resources
- Collecting additional data to describe the problems and target solutions

Tribal utility recommendations include (ITF, 2012):

- Investigating whether Tribal industries or enterprises can help subsidize utilities
- Running the utility as a business and establishing fair and accepted billing and collection systems
- Maintaining utility independence from Tribal politics
- Regularly educating Tribal Councils about the true costs of providing water and educating customers that while water may be free, infrastructure to treat and deliver water is not.

Additional recommendations are detailed in ITF's 2008, 2011, 2012, and 2020 reports.

Various sources note funding priorities that include increasing federal and state funding and strategically using and leveraging funding among agencies to finance:

- Infrastructure, operation and maintenance (top recommendation of comprehensive 2008 ITF report)
- Entities providing technical assistance; technical, managerial, financial training (Roller et al., 2019)
- Community-led research, pilot projects, and implementation of alternative water treatment technologies, including evaluation of treatment and cost effectiveness (ITF, 2008; GAO, 2020)

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Chapter 5: Health & Wellbeing

The health and wellbeing of Indigenous peoples is closely tied to the health and wellbeing of the environment, and therefore climate change poses both unique threats and opportunities. First foods are a vital source of spiritual connection and have a strong history for Tribes. Climate change threatens that connection; however, Tribes like the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) of Oregon are protecting and preserving them. The Swinomish Indian Tribal Community of Washington considers the health and wellbeing of Indigenous peoples to be founded on mutually beneficial relationships among humans, nonhuman relatives, and the environment. They support and implement community-defined climate strategies and capacity building within their communities to strengthen resilience and perseverance. A researched overview of Health & Wellbeing as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Setting the First Foods Table for Climate Resilience

Written by: Teara Farrow from the Wenix Red Elk Tribe and Colleen Sanders

For the Indigenous Peoples of the Columbia Plateau, food is their culture, it is everything. Not just "food," but the First Foods that have supported and nourished this land's first stewards in a reciprocal relationship kept in a harmonic balance that can be traced back definitively at least 10,000 years into history through artifact evidence and much longer than that through the knowledge the Tribal culture and foodways preserve. The foodways of the *Weyíitletpuu* (Cayuse), *Imatalamłáma* (Umatilla), and *Walúulapam* (Walla Walla) people involve the gathering of many essential First Foods for subsistence, and the traditional Food table is set with fish, wild game, roots, and berries. Cultural land management practices emphasize preserving cold, clear water and forests that undergo periodic burning, providing Foods abundant in essential nutrients, rich oils, and sustaining energy. The Creator decreed to the People that they carry a promise, a reciprocal responsibility to respectfully care for, harvest, share, and consume traditional Foods, or they

First Foods Feast to celebrate the return of wapato at a CTUIR Tribal member's home. Photo credit: Teara Farrow Ferman.

may be lost. But neither can survive without the other, and if the Foods are lost, the People will be lost too; their fates inextricably linked. Since time immemorial, *tamánwit* has taken care of the traditional Foods and guided the CTUIR in preserving them. The climate crisis threatens to further untether Tribal people from their First Foods, but the promise that has sustained the people into modernity is the best—and only—path forward for climate adaptation rooted in environmental justice and the rights of nature.

For Indigenous peoples, the world has ended many times before. Cataclysmic events that have shaped the existing landscape of the Pacific Northwest are recorded in the stories and practices of Tribal people. When massive ice dams in the Rocky Mountains breached to release the torrential Missoula Floods that carved the Columbia River's first path to the ocean 15,000 years ago, people were living there. When Mount Mazama's caldera violently erupted, blanketing the world with ash and fire and forming what we now call "Crater Lake" over 7,000 years ago, people were living there. Indigenous people were witness to massive geological and atmospheric events that completely and rapidly altered their world, and they are still here today because of the resilience that is woven into the very fabric of Tribal culture and knowledge. In narratives told about the history of land management in the West, the falsehood that persists is one of conquering the unmanaged "wilderness" and is a lie that fundamentally erases the perpetual presence of Indigenous people who were there. Indigenous peoples are intertwined with the evolution of the landscape that they steward, and their management of it is integral to the way it has adapted to function. These traditional practices have been sustained through previous world-altering changes, so it stands to reason that they will again carry the people through this changing world, too.

The climate crisis threatens every aspect of modern life, exposing us to exponentially increasing amounts of risk: risk of catastrophic flooding and wildfire, of drought, disease, and conflict. Regarding the risk the climate crisis will create, it is helpful to remember that the land is a living being, an entity that we live not on, but **with**, and who has wants and needs. Thus, risk can be thought of as the interruption from what the land wants (its ecological steady state) to the way specific land management extorts it to be to facilitate construction, industry, agriculture, and other extractive colonial operations. Much of the need for "climate adaptation" is due to demand that the land be other than it energetically and ecologically desires, and the impacts of the climate crisis threaten to push it into a new steady state of existing, one that is wholly unfamiliar and frightening. Indigenous management values the land as it wants to be and prioritizes the species that are living prosperously on its landscape without extra inputs like irrigation, feed, or fertilizer, and thus the least risky and most resilient to new stressors. Climate adaptation must focus on restoring natural

CTUIR Tribal member gathering wapato. Photo credit: Teara Farrow Ferman.

connections to the land and prioritizing native species over colonizer frameworks by trusting the First Foods to guide policy decisions informed by science. The People and the First Foods have been keeping their promise to one another since time immemorial, and the best climate adaptation is to continue to trust in that promise and return to the First Foods.

CTUIR Department of Natural Resources Director discussing management plans for the Rainwater Wilderness.

CTUIR's land management strategies offer perspective on how this climate resilience works in practice. Flooding is a natural part of a river system and is only problematic when structures are built in the river's path. Reconnecting floodplains and restricting development allow the river to naturally express itself and create great potential for water storage to buffer summer drought. Wildfire is similar: cultural burning helps clear out the forest understory for the availability of big game and healthy plants, and Tribes historically burned as they migrated. This practice of prescribed burning clears the accumulated fuel and helps release nutrients stored in dead vegetation to be accessible in the ecosystem once again. By criminalizing cultural burning in 1910, Tribal people were kept from carrying out their responsibility, creating the conditions for the widespread megafires we are experiencing today. Tribal people even knew how to foster psycho-social resilience for their spiritual wellbeing, as strategies for maintaining community cohesion and providing emotional support are critical to adapting to a shifting world. Ceremonial practices in the Tribal longhouse offer opportunities for genuine connection, a space to share without judgment the weight we carry, to listen to the burdens that others endure, and to return once again to the First Foods and their stories.

Tribal people are at the forefront of the climate crisis because they are the continuation of a long and unbroken line of surviving the end of the world. The First Foods still keep their promise of providing for the People, and it is to this promise that we must all return in order to weather the coming storms of the climate crisis.

Health & Wellbeing

Key Messages

- Indigenous peoples' health and wellbeing (HWB) is founded on mutually beneficial relationships among humans, nonhuman relatives, and the environment; therefore, HWB is highly impacted by climate change
- Social-emotional health, water security, and first foods security (includes foods, medicines, and technologies) are key aspects of Indigenous peoples' health and wellbeing that merit increased attention and rapid adaptation at local scales due to Indigenous peoples' unique cultures and worldviews
- Indigenous peoples' resilience is strong; supporting community-defined climate strategies and capacity building within Indigenous communities will augment resilience

Recommendation

Accelerate incorporating Tribal HWB evaluations, priorities, and action plans into government policy, laws, and decision-making.

Health and wellbeing (HWB) is defined as a symbiotic state of being among humans, other beings, the environment, and the spiritual realm which arises when needs are met, when individuals and communities can act meaningfully to pursue their goals, and when individuals and communities enjoy a satisfactory quality of life (Breslow et al., 2016). Foundational to Indigenous views of HWB is being in positive, reciprocal relationships with other beings and the natural world.

Some of the largest scale and most devastating impacts from climate change are to the health and wellbeing of Indigenous peoples. Researchers have identified Indigenous peoples globally and in the U.S. as highly sensitive populations, due to colonialization and subsequent land dispossession, social exclusion, and discrimination, who are most often on the front lines of climate impacts because of close relationships with the natural world (Ford et al., 2020; Nakashima et al., 2018). Indigenous peoples also possess incredible resiliency borne from Indigenous knowledges and countless generations of connection to place (Ford et al., 2020).

Increases in extreme temperatures, precipitation extremes, vector-borne pathogens, poor air quality days, and extreme weather events all directly impact human health. These climate impacts disproportionately affect many Indigenous peoples who have higher rates of asthma, cardiovascular disease, Alzheimer's disease or dementia, diabetes, and obesity. For example, people with diabetes are more sensitive to extreme heat and air pollution (Vallianou et al., 2020). While physical health is a key component, it is not the only aspect of health vital to achieving HWB. This chapter focuses on three key aspects of Indigenous HWB that have achieved mention in large-scale Indigenous peoples' climate health assessments, but deserve more attention to the impacts and adaptive strategies occurring across the country on a local scale: social-emotional health, water security, and first foods security. It is important to keep in mind that each Indigenous community is unique, with their own beliefs, values, and worldviews that are founded on their own place-based experiences and that foster their own Indigenous knowledge. It is also key to recognize sovereignty as an overarching right and necessity to achieve HWB, including rights to health services, water, and first foods.

Social and Emotional Components of HWB
The social and emotional components of health and wellbeing have a particular importance for Tribal communities. The physical effects of climate change on people and the environment can be directly linked to detrimental consequences to an individual's identity and their ability to maintain traditions and uphold personal and community-held cultural values, which in turn have consequences for both individual and community social and emotional health (Adams et al., 2021; Bell et al., 2010). Increases in rates of mental-health issues, decreased cognitive function, violence, interpersonal aggression, and suicide have all been linked to elevated temperatures (Adams et al., 2021). Occurrences of climate-related extreme events (such as flooding or wildfire) can also impact mental health and can be expressed as "post-traumatic stress disorder (PTSD), anxiety, depression, substance abuse, and suicidal thoughts" (Adams et al., 2021). Tribal communities can be particularly vulnerable to these mental health impacts, due to disparities in health care, historical trauma, and other social determinants of health.

Serdeczny, Waters, and Chan (2016) identify these consequences through the concept of noneconomic loss and damage, which includes tangible impacts to landscapes, biodiversity, and cultural sites that lead to intangible impacts to intrinsic values, agency, and identity. Climate damage to traditional food species, for example, may lead to crises of identity in communities that are no longer able to gather those foods, to use their language associated with those plants and animals, or share the ceremonies, songs, and prayers with their community that are associated with that activity (Norgaard & Tripp, 2019). Thus, supporting social and emotional wellbeing in Tribal communities must include consideration of culturally-specific risks and needs.

Climate adaptation planning for Tribal communities must include social and emotional resilience strategies that are broadly applicable while being flexible enough to adapt to local needs and values. There is no one size fits all solution; instead, strategies need to reflect the place and its people, honoring what the community values and the vision they want to see moving forward into the future. Most importantly, approaches to climate change adaptation that build social and emotional resilience are needed to safeguard mental health and wellbeing (Doppelt, 2016). The World Health Organization illustrates that informal strategies focused on self-care and community care provide a broad base for supporting psychosocial wellbeing and help prevent the need for more intensive or formal interventions (Figure 9, World Health Organization, 2007). Furthermore, research on disaster recovery shows how building social and emotional resilience and reinforcing community cohesion improve recovery rates and reduce the likelihood of long-term mental health impacts (Aldrich, 2012). The most effective interventions for promoting social and emotional resilience in the face of disasters and trauma promote five essential elements of wellbeing: a sense of safety; calming; social connections; self- and collective efficacy; and a sense of hope (Hobfoll et al., 2007).

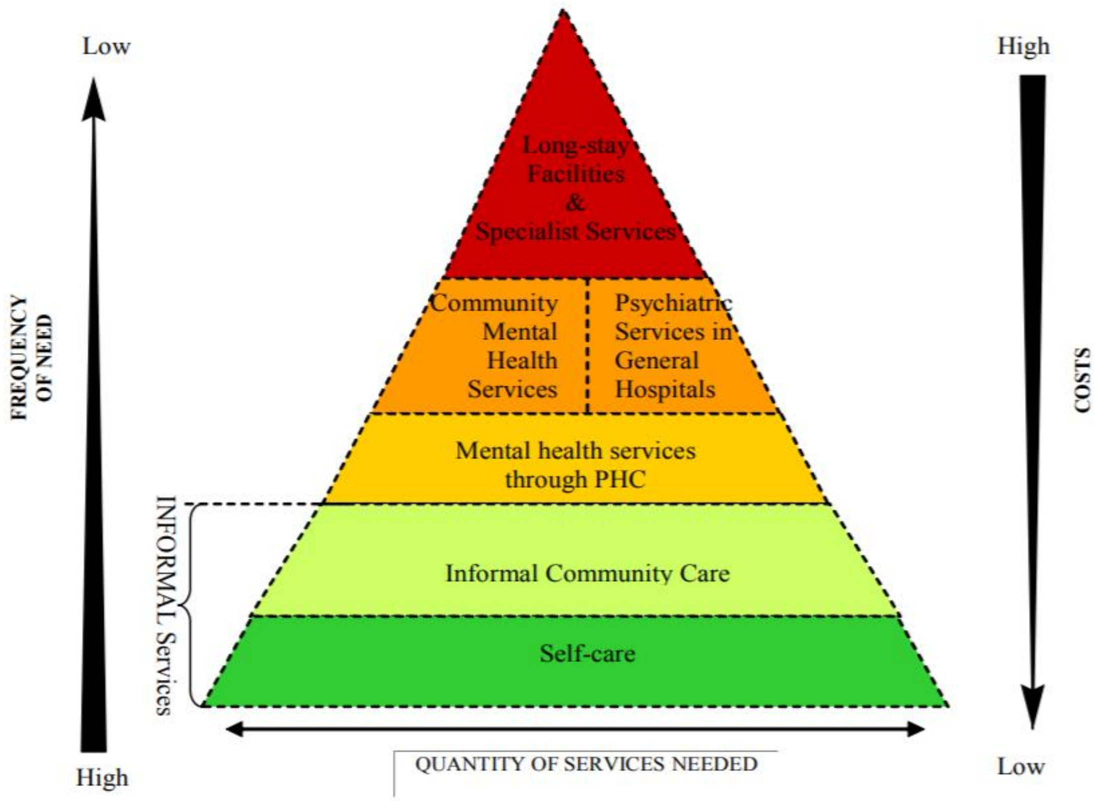

Figure 9. The Optimal Mix of Services: World Health Organization Pyramid Framework (2007).

The Pala Band of Mission Indians in San Diego County, California, has developed *Chemşhúun Pe'ícháachuqeli* (When our Hearts are Happy), a Tribal Psychosocial Resilience Framework[24] (Gaughen & Hacker, 2019) to provide an overview of several broad-based community mental health resilience approaches, using the Pala community as an example of how those approaches can be tailored. Pala's framework includes psychosocial resilience adaptation strategies that focus on coping strategies, problem-solving, self-care, and community care that incorporate the five essential elements of wellbeing. The framework is available to other Tribes who wish to develop their own psychosocial resilience strategies.

Water Security

Water security is another key facet of Indigenous peoples' HWB and is already one of the most serious environmental health issues for Indigenous peoples in the United States (USEPA, 2013; VanDerslice, 2011). The effects of climate change on Indigenous water resources are exacerbating the impacts on Indigenous HWB (Martin et al., 2020; Redsteer et al., 2013). For Indigenous peoples, water security goes beyond material definitions; water is sacred, essential to all of life. Water security also encompasses

[24] *Chemşhúun Pe'ícháachuqeli* (When our Hearts are Happy), a Tribal Psychosocial Resilience Framework: http://tribalclimatehealth.org/wp-content/uploads/2019/07/Psychosocial-Climate-Resilience-Framework_Pala-Final.pdf

maintaining relationships to safe, sustainable, traditional water sources through cultural practices and traditions which are integral to emotional, spiritual and environmental wellbeing (Cozzetto et al., 2013). As related by Apsáalooke Tribal member John Doyle:

> *This isn't just about human health, we need to ensure that all life in and along the rivers and even the water are included. This awareness is what makes us who we are as a people. We have removed ourselves and are no longer aware of how we are connected to all life. We have to remember that this is our home, and it's the home to all life.*

Climate change is having many impacts on fresh and marine waters with significant negative effects including but not limited to: ability to sustainably manage resources and infrastructure; decline and loss of culturally important aquatic species; impacts to subsistence hunting, fishing, and gathering (see *Chapter 4: Ecosystems & Biodiversity*); impacts on agriculture and ranching activities; challenges to Indigenous water rights and sovereignty; and escalated rates of land loss, erosion, and degradation. Multiple factors make Tribes more vulnerable to these impacts, including inadequate authority, lack of capacity or resources, or the power to manage Tribal lands and waters in the manner the Tribe would like (McNeeley, 2017); jurisdictional conflicts; legal and regulatory gaps; limited economic resources; poorly designed, aging, and inadequately maintained water and wastewater infrastructure; and both legacy and ongoing environmental contamination (Doyle et al., 2018; Cozzetto et al., 2013).

In Crow Agency, Montana, Tribal community nonprofits, Little Bighorn Tribal College, and other grassroots organizations are actively prioritizing, addressing, and coping with water insecurity, while upholding Apsáalooke (Crow) lifeways and values (Martin et al., 2020). The Crow Environmental Health Steering Committee has been working to understand the nature and sources of water contamination, the associated health risks, and how the changing climate is impacting Tribal water resources (Figure 10) (Doyle et al., 2013). They have been able to provide free home well-water testing to rural families, water and health education, and home water coolers with refillable five-gallon jugs for those lacking safe well water to drink (Eggers et al., 2018). Currently they are working on other mitigation strategies to help water-insecure families and to build community capacity to manage home plumbing and community water resources. Other grassroots organizations work on educating youth about Crow traditions around water and Western water science (Simonds et al., 2018), on management of chronic illnesses (Held et al., 2019), and on mitigating widespread water and food insecurity that have been greatly exacerbated by the COVID-19 pandemic and accompanying further loss of jobs (e.g., Plenty Doors Community Development Corporation,[25] The Center Pole,[26] and others). (See narrative titled *Elders' Reflections on Climate Change Impacts, Crow Reservation, Southcentral Montana* in *Chapter 4.2: Water* for more details about water security on the Crow Reservation.)

[25] Plenty Doors Community Development Corporation, http://plentydoorscdc.org/
[26] The Center Pole, https://www.thecenterpole.org/

Figure 10. Installing a weather station near Crow Agency, Crow Reservation, as part of a statewide program to provide local weather data for short-term uses and long-term climate adaptation planning.

First Foods

First foods, also referred to as traditional foods (or “our foods'' by Indigenous peoples), comprise regionally specific foods, medicines, and technologies that Indigenous peoples have relied on since time immemorial. Access to first foods, medicines, and harvesting practices is central to the health of Indigenous peoples—physically, mentally, and spiritually. Participating in first food practices has been disrupted by forced removal, relocation, assimilation, and colonial development, driving some Indigenous peoples into a nutritional transition from first foods to store-bought foods, which can be unhealthy and expensive, leading to high rates of food insecurity and chronic health problems (Fleischhacker et al., 2012; Jernigan et al., 2017). The impacts of climate change are increasing pressure on first foods systems by limiting both access to the lands and waters and the availability of the first foods (Lynn et al., 2013). Every Indigenous community across the U.S. feels the impacts of climate change on their regionally specific first foods (e.g., see narrative in this chapter titled *Setting the First Foods Table for Climate Resilience*). Below are a few of the many examples of how climate change directly affects subsistence traditions and practices.

Loss of sea ice in Alaska is one of the most drastic examples of decreasing first foods habitats, declining access to first foods, and the physical, emotional, social, economic, cultural, and environmental impacts to Alaska Native HWB (Huntington et al., 2017). The rate of climate change in the Arctic and sub-Arctic has multiple deleterious impacts upon the food security of Indigenous peoples in Alaska, such as changes in water temperatures, weather, migration patterns, and birthing success, decline in salmon returns, loss of sea ice, and threats to food preparation and storage, the safety of hunters and harvesters, and overall physical and mental health and wellbeing. These impacts and many other combined and interrelated elements require rapid adaptation to ever-changing conditions with direct, immediate consequences for Indigenous peoples' food security. In addition, corresponding management regimes imposed and controlled by state and federal agencies lack the capacity, knowledge, and expertise to keep pace with the constant changes, thereby creating another set of rigid and adverse impacts. These forces and stressors are intimately related to overall cultural integrity and vitality of traditional economic and sustainable land-tenure practices (Inuit Circumpolar Council Alaska, 2020).

The traditional timing of subsistence activities that people typically plan for has become asynchronous with the different types of gathering efforts (Herman-Mercer et al,. 2020). Moose are an important subsistence species for Alaskan Natives and Indigenous peoples of boreal forests. However, increasing temperatures are leading to decreasing moose harvests, likely because moose prefer colder temperatures and undergo stress of their thermoregulatory and health systems at higher temperatures (Hasbrouck et al., 2020); moose also typically bed down during warmer temperatures, which decreases their movement (Hasbrouck et al., 2020) Furthermore, warmer temperatures can lead to faster spoilage of meat once hunted (Hasbrouck et al., 2020). Salmon are also a fundamentally important species to Alaskan Natives and serve as the foundation of their economic, social, and cultural systems (Bisbal & Jones, 2019). "Salmon are vulnerable to changing water temperature, acidity, and other microscopic ocean conditions and, as such, can be considered a marker species for a changing climate," and observations by the Tlingit and Haida Tribes show "a direct link between Salmon and a changing climate" (Scott et al., 2018).

Tribal nations in the Northwest have significant cultural ties to salmon, and the importance of salmon to Indigenous spiritual, mental, and physical health cannot be overemphasized. Salmon have long been considered to be the cultural lifeblood of Tribes in the Pacific Northwest. In the Columbia River Basin, they have been known to refer to themselves as "Wy-Kan-Ush-Pum," which can be translated to "the salmon people." They have stories, songs, traditions, and celebrations that are based upon the salmon, which is foundational to Tribes in the Pacific Northwest.

In northeastern Maine, the Aroostook Band of Micmacs have previously relied on subsistence food sources such as moose, fish, and other seafood (Kapp, 2019). However, warmer water temperatures and habitat loss have greatly reduced the availability of eastern brook trout, the only native trout in the eastern U.S. As a result, Tribal members have of necessity turned to increased consumption of processed foods and other less healthy food sources (Kapp, 2019).

Loss of biodiversity, increasing air temperatures, and wildfires can create the environmental conditions that lead to an increase in the frequency and intensity of vector-borne diseases (Jones et al., 2008). Specifically, infectious diseases are becoming more emergent and easily transmitted via vectors (such as mosquitoes, ticks, and fleas), as they are sensitive to climatic changes (Curseau et al., 2009; Jones et al., 2008). Vectors and their pathogens prefer a warmer and more humid climate and have the ability to survive in some areas that they were not able to survive in before (Jones et al., 2008), and those ranges are expected to expand due to climate change (Sonenshine, 2018). Indigenous peoples who hunt, fish, and gather may thus be exposed to new diseases emerging in their region.

As described above, many Tribal communities depend on the hunting of moose, deer, and other big game species for sustenance. Winter ticks (*Dermacentor albipictus*) are parasites that are an increasing concern for moose and can lead to premature loss of moose's winter coats, chronic anemia, increased susceptibility to predation and disease, increased calf mortality, increased age of first breeding, and decreased adult fecundity (Weiskopf et al., 2019).

First foods are foundational to protecting and promoting Indigenous peoples' HWB resilience. The resilience in the context of climate change (and also in the COVID-19 pandemic) is built on countless generations of knowledge, experience, and the ability to adapt (Zavaleta-Cortijo et al., 2020). The Swinomish Indian Tribal Community (Washington state) developed a set of nonphysical, noneconomic Indigenous health indicators (IHI) to demonstrate the myriad connections between HWB and first foods.

The 6 IHI are community connection, cultural use, education, self-determination, natural resource security, and resilience (Figure 11). The Swinomish Climate Change Impact Assessment identified sea level rise, storm surge, and forest fires as the three most pressing climate impacts to the community (2009). Swinomish community members used the IHI to prioritize how the Tribal government focuses limited time and resources on sea level rise and storm surge impacts to important first foods habitats (Donatuto et al., 2020a). Based on the Swinomish community priorities, the Tribe developed and implemented the 13 Moons curriculum, a series of environmental health and sustainability hands-on activities teaching first foods harvest, preparation, and preservation practices, guided by Elders and experts (Donatuto et al., 2020b). In addition, the Tribe is building the first modern-day clam garden in the U.S. Clam gardens are an ancient Indigenous technology of creating rock walls at the low tideline

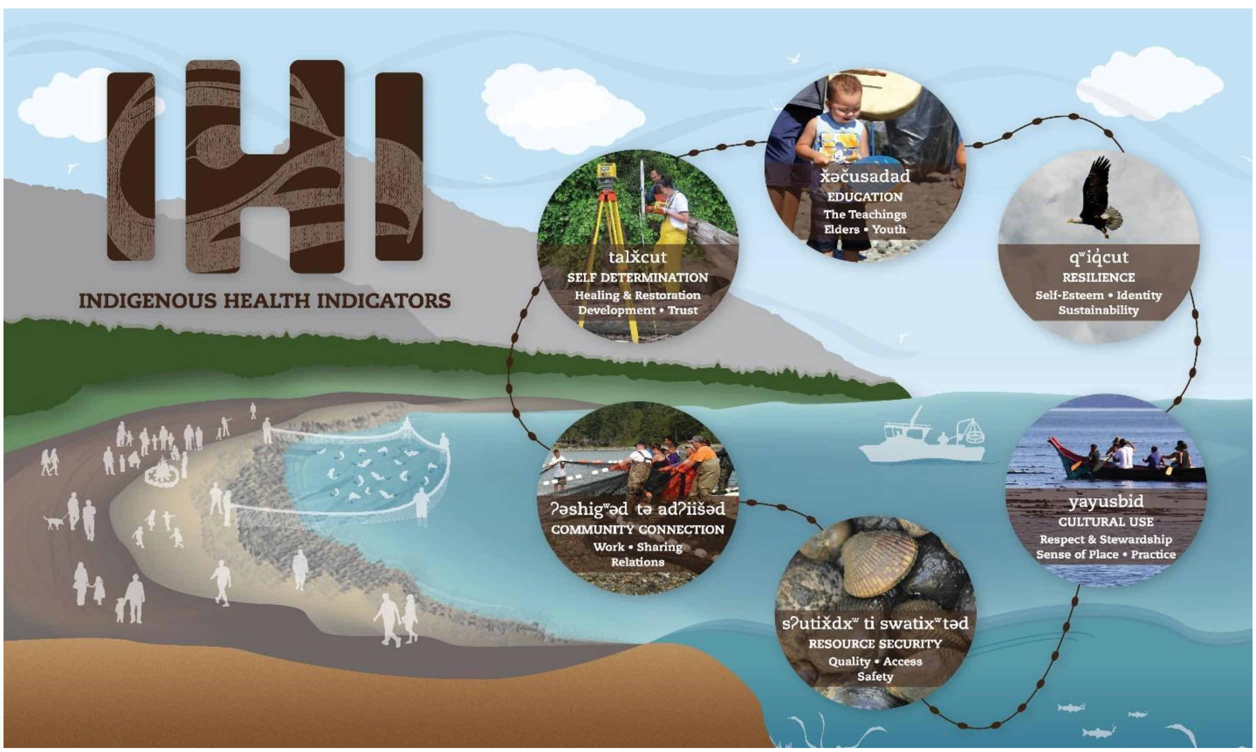

Figure 11. Swinomish Indigenous Health Indicators. This infographic depicts a scene on the beach that demonstrates all six of the IHI in action. Families are working together beach seining (fishing with nets from the beach), steaming shellfish in a fire pit, and crab fishing in the bay. Elders are telling stories to younger generations; youth are exploring and helping harvest, cook, and preserve the catch; the natural resources are accessible; people are asserting their sovereignty by being out on their lands and waters and engaged in culturally important practices, which "feed the body and the spirit" in the Swinomish way. Words at the top of each Indicator are in Lushootseed, the Swinomish language. The words in the center are most often used when speaking with people from outside of the Swinomish community. The words at the bottom are the community's words for each indicator in English.

that accrete sediment behind the wall, providing a terrace at an elevation that promotes increased populations of clams and other important first foods (Groesbeck et al., 2014). Clam gardens may also attenuate tidal surge, and the buildup of shells may buffer against acidifying oceans. The Swinomish clam garden project demonstrates the importance of supporting Indigenous community-based adaptive strategies to strengthen first foods security and HWB in the face of climate change.

Barriers and Opportunities

Many Indigenous communities are actively engaged in seeking solutions to the HWB threats from climate change. Below are barriers and opportunities to bolster Indigenous peoples' resilience and HWB:

- Increase resources for Indigenous health impact assessments, preparedness planning, and implementation of adaptive capacity programs, which are among the least funded climate change programs. Tribes do not have a tax base and therefore have limited ability to pay for public health infrastructure, education, or climate change adaptive management strategies that uphold Indigenous HWB. This is particularly true for Tribes such as the Crow and Navajo and for many Alaska Native villages who have been forced to rely on an extractive fossil fuel–based economy for survival, knowing that fossil fuels destroy their way of life but are without other options to support their families (Adams et al., 2021; Powell, 2018).
- Sustainably support multi-Tribal collaborations and Tribal government–academic collaborations that provide networks for knowledge exchange. Few such long-term collaborations exist. One example is the Climate Ready Tribes Program,[27] which is a partnership among the U.S. Centers for Disease Control and Prevention, the National Indian Health Board, and several Indigenous communities across the U.S., allowing each community to develop and implement their own priority climate HWB projects and share results with other communities (Schramm et al., 2020). With Tribal community–academic collaborative research, especially intervention research, support only federal and private funding opportunities that require that the research addresses Tribal priorities and that primarily benefit Tribes.
- Provide resources to rebuild both the physical and the legal infrastructure needed to support Indigenous models and practices of foods systems (e.g., Indigenous farming, ranching, and wild harvesting). Given support, such infrastructure—including physical infrastructure such as irrigation piping for crops, roads to drive on to access and transport foods, and wells to water livestock and legal infrastructure such as policies that allow Tribes to hunt and gather on their ancestral territories—would create jobs in rural communities, feed Indigenous peoples more nutritious food, lower the amount the federal government spends on long-term nutrition programs, and promote and protect Indigenous peoples' resilience and sovereignty (Hipp & Givens, 2020; Zavaleta-Cortijo et al., 2020).
- Build pathways for youth and Elders to develop climate adaptation and planning capacities using Indigenous knowledge. For example, schools in Alaska hired Elders and bearers of traditional knowledge to teach youth survival and cultural skills like sewing mukluks, making snowshoes, setting snares, building fish wheels, processing game, and cooking traditional foods. This intergenerational learning promoted HWB resilience through practicing traditional healing methods—keeping the mind and hands busy and taking care of the community (Ullrich, 2019).

Indigenous communities are place-based, and thus their HWB will be as unique as the places where they reside. Best practices to support increased Tribal HWB resilience and preparedness for a changing

[27] Climate Ready Tribes Program, https://www.nihb.org/public_health/climate_ready_tribes.php

climate are founded on community-driven HWB priorities. Ultimately, supporting Indigenous communities to develop and implement their own strategies will uphold and bolster Indigenous peoples' resilience.

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Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets

This chapter reviews economic development issues and opportunities that Tribes face in the age of climate change. It includes summaries pertaining to Tribal histories and trauma, harmful federal policies and subsequent land tenure issues, and the surge of economic sovereignty through renewable energy development on Tribal lands, including carbon offset markets. Recommendations are offered to reinforce and expedite Tribal economic self-determination on Tribal lands in the context of climate change. The chapter opens with the narrative of the Ute Mountain Ute Tribe of southwest Colorado, describing how this Tribe developed a large-scale solar economic development project to reduce their Tribal energy bills and decrease their dependence on fossil fuel usage. A researched overview of Economic Development as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Ute Mountain Ute Tribe's Energy and Economic Development Nexus (excerpted and adapted from ITEP's Tribes and Climate Change profile[28])

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The Ute Mountain Ute (or Núchíú) reservation lies in the Four Corners region of the Colorado Plateau covering portions of southeast Utah, southwest Colorado, and northwest New Mexico. Traditional Ute people were nomadic and utilized natural and cultural resources in these areas and beyond. Ute history, passed through generations, says that the people have lived here since the beginning of time.

Our Tribal reservation lands are located in the wide-open expanses of the semi-arid desert encompassing canyons and segments of the San Juan and Mancos Rivers. The dominant geographic landmark is the Ute Mountain, and the southern section of Mesa Verde National Park borders the reservation. This area, known as the Ute Tribal Park, provides opportunities for tourists to visit undeveloped ancestral Pueblo cliff dwellings with a Ute Mountain Ute guide. Other Ute initiatives include a farm and ranch enterprise, a construction company, two travel centers, and a casino with a hotel and RV park.

The majority of the 2,200 Tribal members reside in the capital of Towaoc near Cortez, Colorado, and there is a smaller community of 250 residents in White Mesa, Utah. The only school on the reservation is

[28] Ute Mountain Ute People: Preparing for a Warmer Climate. Profile on ITEP's Tribes and Climate Change website. http://www7.nau.edu/itep/main/tcc/Tribes/sw_utemountain

for early childhood education. A culturally focused charter school for kindergarten and first grade students will open in the fall of 2021. Students from 1st through 12th grades are bussed to the towns of Cortez, Colorado, and Blanding, Utah.

The Ute Mountain Ute Tribe has undertaken and is undertaking many climate change mitigation and adaptation actions that are also important economic development opportunities for the Tribe. We recently constructed a 1-megawatt (MW) community solar project,[29] which offsets a portion of our community members' and Tribal government electric bills. The reduction in energy bills is a welcome respite, as is the reduction in fossil fuel usage. Commissioned in March 2020, the 3,600 photovoltaic (PV) panel solar power system generated close to 2 million kWh of electricity in its first 10 months of operation. Additional community scale solar projects are scheduled for the White Mesa and Towaoc communities.

Towaoc Community Solar power plant—over 3,600 PV panels, creatively net-metered; Ute Peak in background.

A cornerstone of the Tribe's response to climate change is a transition from its former economic development model that relied heavily on fossil fuels (oil and gas) to a greener alternative. The Tribe has worked with the Department of Energy and its national labs: Sandia Labs assisted with energy planning and strategy, and the National Renewable Energy Lab assisted with youth outreach and other technical assistance. The Department of Energy Tribal Program cost-shared energy efficiency planning and the Towaoc Community Solar project and is poised to cost-share the White Mesa Solar Initiative in 2021. As envisioned by its Renewable Energy Team and the strategic planning with Sandia Labs, the community solar projects are a stepping stone to embrace the technology and look toward larger commercial-scale projects. The Tribe is actively working with multiple entities to plan, fund, and build commercial-scale solar and energy-storage projects thousands of times the size of the Towaoc project. The Tribal Councils have committed to cost-sharing approximately $1.5 million in community solar projects in the last five years. Commitment of land and other resources to commercial-scale renewable energy development is anticipated on a large scale in the next five years. Our Tribal Leaders are embracing the transition to greener revenue sources.

[29] The Journal, "Solar power comes to Ute Mountain Tribe": https://the-journal.com/articles/131295

Economic Development: Renewables, Sustainable Economies, & Carbon Offsets
Key Message
Indigenous science, knowledges, philosophies, and heritages guide Tribal self-determination in rediscovering economic sovereignty through pursuing, among other sustainable enterprises, renewable energy development, carbon sequestration via carbon markets, water and food security, and subsistence-based enterprises.

Recommendations
- Address complex land tenure, fractionation, and checkerboard jurisdictional boundary issues that persist on reservation lands and may constrain Tribal economic sovereignty.
- Invest in capacity building that increases in-house legal, technical, vocational, and varied fields of research expertise to strengthen Tribal economic self-determination while mitigating the effects of and adapting to a changing climate.

Early Federal Policy, Forced Assimilation, and Resurgent Self-Determined Tribal Economies
Federal policies have dramatically impacted Tribal economies. In many cases, early treaties between Tribal nations and the U.S. government dramatically reduced ancestral lands, while other legislative actions relocated Tribal nations from their ancestral homelands to reserved lands held in trust by the federal government. Such federal policies were designed to assimilate Tribal nations to resemble European culture and economies, which relied heavily on resource extraction for timber, minerals, and agricultural production (see *Chapter 7: Energy & a Just Transition*). Fueled by the industrial revolution during the Treaty-Making Era (1778–1868), these economies followed a linear flow of production, distribution, point of sale, consumption, and ultimately disposal of goods and services. Much of the economic development activity on Tribal lands was overseen by these forces and driven by a paradigm of steady increases in gross domestic product, job creation, and increased per-capita income. With increasing popular interest in the environment during the latter half of the 20th century in the Self-Determination Era (1968–present), and particularly with pressures to mitigate and adapt to climate change during the 21st century, more economists are proposing sustainable or "circular" economic activities. Such activities recirculate or recover limited resources (making them unlimited) (Steen-Adams et al., 2020) rather than dispose of or waste materials and goods (Prieto-Sandoval et al., 2018; Araujo Galvão et al., 2018; Geissdoerfer et al., 2017).

Through a resurgence of self-determination, guided by Indigenous science, knowledges, philosophies, and heritages (Whyte, 2015), Tribal nations are rediscovering their economic sovereignty through sustainable and climate-resilient enterprises. Such enterprises aim to avoid resource depletion, improve human wellbeing and social equity, and preserve their culture and the natural environment for future generations (Indigenous Phenology Network, 2020; Trosper, 2005). In fact, the relational approach of Indigenous peoples to their economies is immersed in Indigenous knowledge that is relational and reciprocal with the environment (Chisholm Hatfield et al., 2018; Pierotti & Wildcat, 2000; Trosper, 2005; Trosper, 1995).

Global interest in Indigenous science, expressed as Indigenous knowledge, to mitigate and adapt to climate change is facilitating its integration into the evolving, and increasingly mainstream, field of sustainable science and related policy (Cajete, 2012). While a reawakening of Indigenous knowledge provides opportunities for Tribal nations to innovate, transform, and sustain their community-based economies into the 21st century (Cajete, 2012), it also incentivizes Tribal nations to take steps to protect sensitive Indigenous information (Whyte, 2015).

Property Rights and Fractionated Interests as Obstacles to Economic Development
Tribal governments have been successful in exercising self-determination legally following the 1975 Indian Self-Determination and Education Assistance Act, Public Law 93-638 (Act). This Act authorizes federally recognized Tribal nations to enter into contracts with the U.S. government, generally called "638 contracts," to support greater Tribal autonomy and responsibility for those government programs and services administered to them through the Secretary of the U.S. Department of the Interior (Bureau of Indian Affairs, 2020). The strengthening of this relationship over recent years has led to successful economic transformations that are adaptive to climate change. However, legal barriers still remain that are largely the result of 19th century federal policies implemented during the Removal (1830–1850), Reservation (1850–1887), and Allotment and Assimilation (1887–1934) Eras to relocate, dominate, and assimilate Indigenous peoples (Miller, 2006; Miller, 2012). The Dawes or General Allotment Act of 1887, for example, resulted in a complex system of property rights on reservation lands that continues to impact Tribal economies today (Indian Land Tenure Foundation, 2020; Dippel et al., 2020; Leonard et al., 2020; Anderson, 1995).

The following are examples of Tribal land tenure types:

- <u>Tribal trust land</u>, which is inhabited and governed by Tribal nations for their beneficial use with the legal title held by the federal government. A Tribe cannot sell or lease trust land without federal government approval. Tribes may purchase additional land that can be held in trust with federal government approval. A Tribe may assign parcels of trust land to Tribal members to use for periods that last for the lifetime of an individual or family assignee. The assignment can be passed on to heirs for continued beneficial use, with Tribal approval. These lands are exempt from state or federal property taxes.
- <u>Allotted trust land</u>, in which the federal government also holds the legal title, but beneficial interest of a specific surveyed land parcel is allotted to Tribal individuals and heirs per the General Allotment Act. These lands are exempt from state and federal property taxes.
- <u>Fee-simple land</u>, which refers to formerly allotted Tribal trust lands of individual Tribal members, per the General Allotment Act, later converted from trust status to fee-simple status. Fee-simple lands may lie within, adjacent to, or outside the boundaries of Tribal or reservation trust lands (Regan & Anderson, 2014). Tribal governments, individuals, or non-Tribal individuals or entities may purchase fee-simple lands. These lands are subject to state and federal property taxes.

The concept of trust land derives from the Trust Doctrine, which expresses a fundamental principle of 19th century federal policy that established federal rights in perpetuity to lands reserved for Tribal nations (Miller, 2012). The Trust Doctrine describes the federal government's role to act as trustee for Tribal nations and, as such, assume a fiduciary or trust responsibility for Tribes. While trust land status affords Tribes the right to occupy lands for their beneficial use, it prohibits Tribal governments from mortgaging these lands—a restriction that severely limits a Tribe's ability to secure financing for construction or infrastructure investment pursuant to economic development projects (Anderson et al., 2016; Anderson, 1995). Historical and ongoing federal oversight of Tribal lands, and related natural resource management decisions on these lands, can hinder Tribes' economic development initiatives (Anderson et al., 2016; Anderson & Leonard, 2016), including renewable energy development (Ravotti, 2016). It is challenging for Tribal governments to pursue economic sovereignty if their land and related resource assets are subject to federal intervention and approval, particularly because such oversight can complicate and delay economic development projects in many instances.

In addition, the General Allotment Act, which facilitated non-Indian settlement of high-quality agricultural lands initially reserved for Tribal occupancy, ultimately resulted in fractionated land ownership (Leonard et al., 2020; Banner, 2005). A significant developmental challenge resulting from the General Allotment Act is that today single tracts of allotted trust lands often have large numbers of undivided interests from dispersed inheritance. The term "undivided interest" means that each of the beneficiaries share the tract equally—which over time becomes a meager fraction of interest. For example, on allotted trust land tracts, which can have dozens or even hundreds of owners, the majority (51%) of interest holders must be in agreement for any decision or action to be taken on that land (Shoemaker, 2015). This can be a huge undertaking for tracts with large numbers of interest holders. This constraint on land transferability makes it difficult to acquire private financing needed for land improvements and can disincentivize investments (Dippel et al., 2020). Additionally, there is no practical way for Tribes to obtain required federal approvals for land leases for economic development that require federal administration.

Tribes encounter challenges at the allotted-tract scale while also battling barriers when performing actions on a broader scale on adjacent fee-simple lands, formerly trust lands. That is, less productive agricultural lands that were allotted to Tribal individuals, combined with a lack of access to operating capital and technologies, yielded few benefits from agriculture and forestry (Anderson & Lueck, 1992) (see *Chapter 7: Energy & a Just Transition*). Subsequently, once allotments were converted to fee-simple lands following the 25-year alienation period stipulated in the General Allotment Act, a substantial number of allotted land tracts passed out of Tribal ownership (Russell, 2000; Kappler, 1902). While reservation lands are subject to both federal law and Tribal authority, state and other local law and authorities do not apply. On the other hand, because fee lands are not held in trust, they are subject to federal, state, and other local law and authorities (Jones, 2016). On many reservations, both trust and fee lands coexist side by side, creating a checkerboard pattern of multiple jurisdictional oversight and conflicting land-holder perspectives (Miller, 2012). These checkerboard jurisdictional issues greatly limit Tribes' resource management decision-making authority on land parcels within their reservations, challenge their improvements to the ecological health of surrounding lands and waters, and can ultimately derail the sustainability of their economies (Indian Land Tenure Foundation, 2020).

Federal Policies and Energy Development on Tribal Lands

While the federal government recognizes Tribal nations as sovereign entities, their utilities (i.e., electricity, water, and natural gas) are regulated by state governments, and power interconnections may be subject to inspection by state and local authorities. This jurisdictional complexity can often delay or prevent Tribal nations' pursuits of renewable energy development on Tribal lands. To further complicate matters, the development of different types of renewable energy is governed by different laws at the Tribal, state, and local jurisdictional levels. One example impacting Tribal energy development initiatives is that, as federal tax-exempt sovereign nations, Tribes are not eligible for federal financial incentives to develop renewable energy (Jones, 2016). These federal policy barriers, and ongoing ambiguity in Tribal property rights and resource institutions, deter Tribes from pursuing large-scale energy development projects. For example, Tribes must undertake 49 steps to receive federal approval to execute energy-development projects on trust lands. Even if projects successfully complete these steps, many become stuck in the pre-development phase due to lack of financing, transmission access, and tax structures that include both Tribal and state taxation (Kronk-Warner, 2013). Thus, while Tribal governments may desire to develop and execute their own energy projects, many ultimately have chosen federally approved longer term leases with outside developers (Jones, 2016) to avoid confusing taxation structures due to checkerboard jurisdiction.

The Indian Long-Term Leasing Act of 1955 requires the U.S. Secretary of the Interior to approve Tribal trust land leases for up to 25 years, with an option to extend for an additional 25-year term, for public, religious, educational, recreational, residential, or economic development purposes (Kronk-Warner, 2013). Because this federal approval also involves a lengthy process, and in order to promote Tribal self-determination, the Indian Tribal Energy Development and Self-Determination Act (ITEDSA) was passed in 2005. This federal legislation provides a framework for developing renewable energy infrastructure on Tribal lands by allowing Tribal nations to regulate the conveyance of their own energy resources. It authorizes preapproved Tribes to enter into land leases and similar agreements without federal oversight for the construction of renewable energy networks. The U.S. Department of the Interior subsequently created the Division of Indian Energy Policy Development, while the U.S. Department of Energy created the Office of Indian Energy Policy and Programs. Authorized by ITEDSA, both programs provide grants, technical assistance, low-interest loans, and loan guarantees for Tribes to these ends. Tribes are authorized to enter into Tribal Energy Resource Agreements (TERAs) with the U.S. Secretary of the Interior as long as those projects are executed pursuant to the TERA and the terms are less than 30 years (National Archives and Records Administration, 2019). While ITEDSA removes federal approval requirements for these leasing purposes, TERAs are still required (Bronin, 2016).

Less than a decade after the passage of ITEDSA, Congress enacted the Helping Expedite and Advance Responsible Tribal Home Ownership (HEARTH) Act in 2012. This federal legislation aims to streamline the environmental review process by allowing preapproved Tribes to voluntarily execute and regulate land leases on Tribal trust lands prior to completion of a federal environmental review (Warner, 2013). To date, the HEARTH Act has been used primarily for leasing of trust lands for business, agricultural, residential, public, religious, educational, or recreational purposes. However, the legislation does not authorize Tribes to execute leases for the exploration, development, or extraction of any mineral resources on their Tribal trust lands. It also extends terms to a total of 75 years maximum on existing leases (Bureau of Indian Affairs, 2014). Between 2013 and 2020, the U.S. Secretary of the Interior approved 58 Tribal agricultural and other business leasing regulations (Bureau of Indian Affairs, 2021a).

While environmental review processes and land tenure issues continue to challenge sustainable economic development on Tribal lands, this chapter presents examples of Tribal nations pursuing their economic sovereignty. Examples focus on initiatives to create sustainable Tribal economies through the development of renewable energy and carbon offset market projects.

Sustainable Tribal Economies via Renewable Energy

Historically, energy development for the purpose of developing Tribal economies has been limited to the few Tribes and Native corporations that possess fossil fuel reserves. However, the rapid growth in renewable energy markets, including wind and solar, offers a growing number of Tribes the opportunity to participate in renewable energy markets. It is estimated that Tribal lands represent approximately 6.5% of the U.S. total national technical potential for utility-scale renewable energy development (Milbrandt et al., 2018). Figure 12 and Figure 13 demonstrate that wind and solar renewable energy resources are much more widely distributed on reservation lands than nonrenewable energy resources, affording more Tribes the opportunity to develop renewable energy as sustainable economic enterprises.

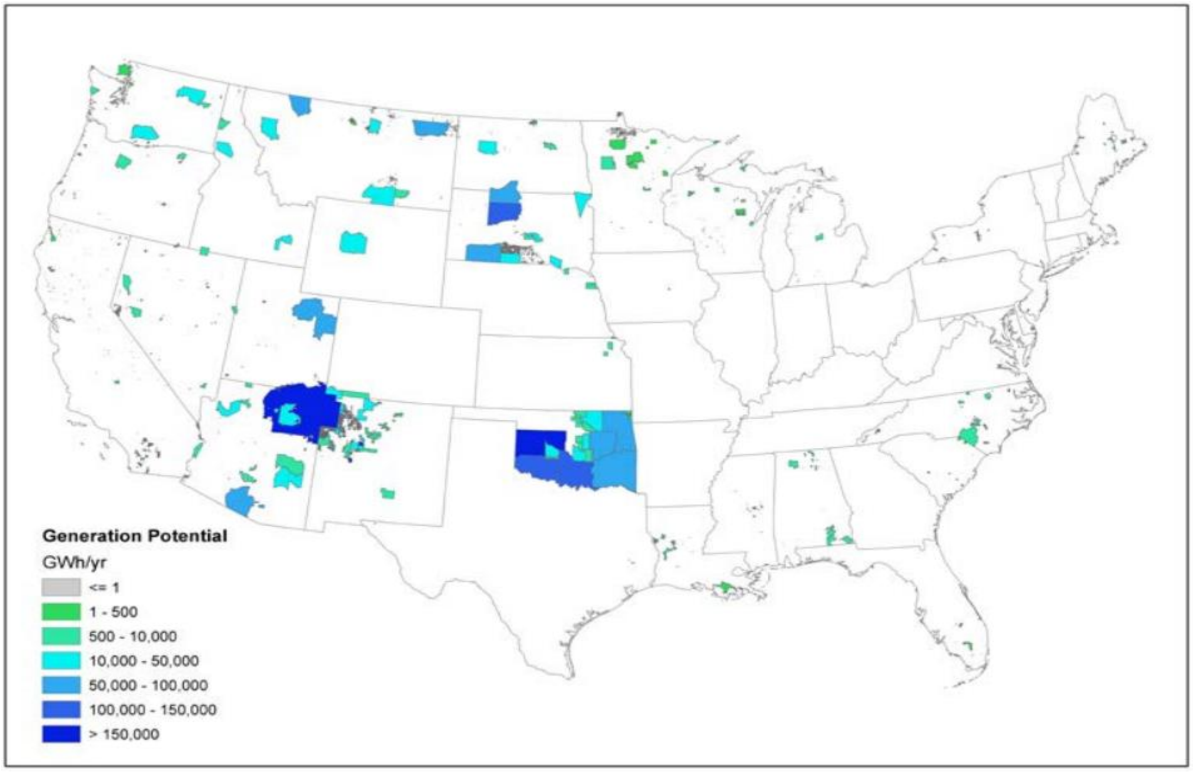

Figure 12. Wind Generation Potential by Reservation. Sources: Milbrandt et al., 2018; U.S. Department of Energy, 2018. Tribal Energy Atlas. https://maps.nrel.gov/tribal-energy-atlas/

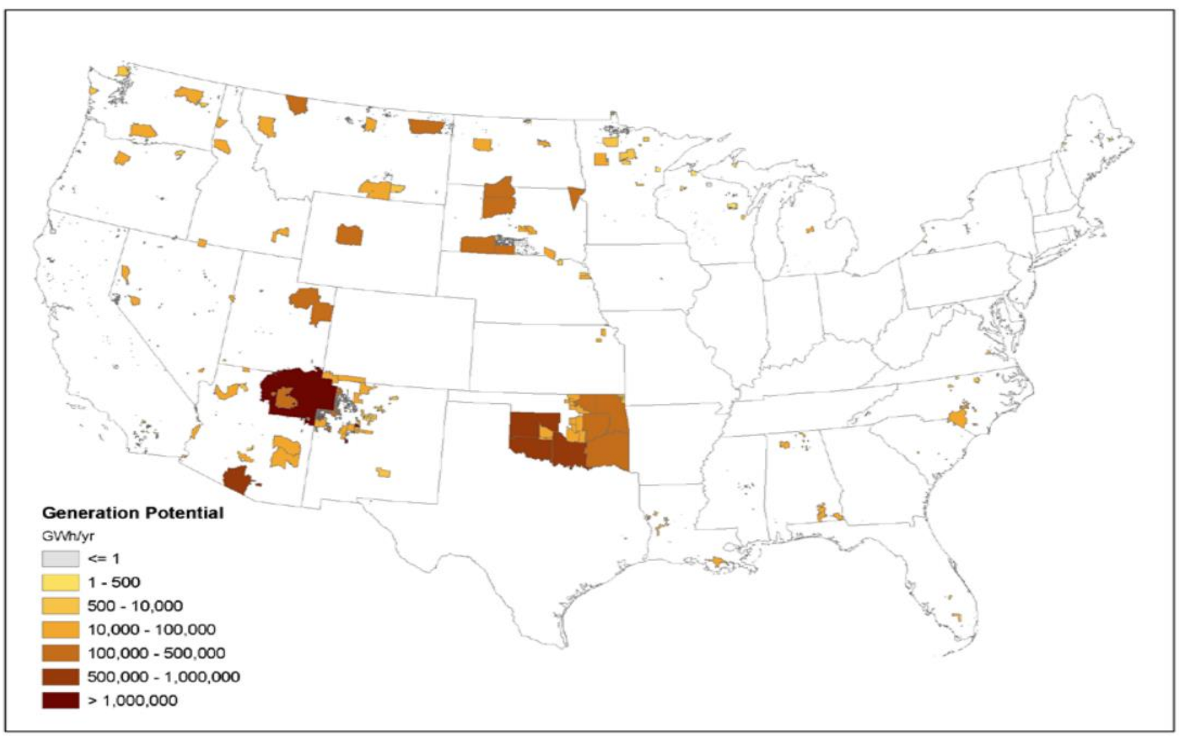

Figure 13. Solar Photovoltaic Generation Potential by Reservation. Sources: Milbrandt et al., 2018; U.S. Department of Energy, 2018. Tribal Energy Atlas. https://maps.nrel.gov/tribal-energy-atlas/

Renewable energy technologies can be developed either for self-consumption or for sale through the interconnected electrical grid. While distributed energy resources[30] and behind-the-meter[31] development each may have economic impacts, such as energy price reduction or increased energy resilience, they do not typically generate significant revenue. Utility-scale generation, however, can diversify Tribal revenue streams while helping to transition to a clean energy economy and enhance Tribal economic sovereignty. Utility-scale generation is renewable energy developed to sell at market or directly to an off-taker. The rapidly decreasing costs of solar photovoltaic (PV) technology and wind energy technologies have made this development cost-competitive when compared with conventional options such as natural gas power plants. Both an increase in available transmission line capacity due to increasing numbers of coal plant retirements and the increasing market demand for renewable energy generation from states, municipalities, and corporations have presented new economic opportunities for Tribal nations. At the same time, past investment in technical assistance and project-development education, through the U.S. Department of Energy and U.S. Department of the Interior, have prepared many Tribes to participate in larger, more complex, innovative projects to leverage the energy market for economic diversification.

One such example is the Moapa Band of Paiute Indians' solar project with First Solar. The 250-megawatt (MW) solar array displaces over 341,000 metric tons of CO_2 annually while generating new income revenues for the Tribe in the form of lease payments, consulting fees, and jobs. At peak construction, the project generated roughly 600 temporary jobs (filled first by Tribal members and then the local community more broadly), with five positions turning into long-term operation and maintenance roles (First Solar, 2020).

Solar PV can generate revenue streams at smaller scales as well. Picuris Pueblo—a community of roughly 300 members and fewer than 100 homes—has also developed solar economic enterprises. In 2015, in partnership with the Northern Pueblos Housing Authority and with grant funding from the U.S. Department of Energy, Picuris Pueblo entered into a 25-year power-purchase agreement with Kit Carson Electric Cooperative to provide electricity to the utility. The project generated over $130,000 for the Tribe in 2018 alone and provided new and likely sustainable economic opportunities for the Tribe and its communities (Kit Carson Electric Cooperative, 2017; Quanchello, 2018).

Solar is not the only opportunity for Tribal renewable energy development. In 2007, the Forest County Potawatomi Community established the goal of becoming carbon neutral in their energy generation through increased energy efficiency and the implementation of renewable energy projects. The Forest County Potawatomi Community was one of the first communities in the U.S., including non-Tribal jurisdictions, to set such a goal. Through a grant from the U.S. Department of Energy in 2010, the Tribe built a biogas facility. The Tribe worked with a local utility offtaker, which helped the Tribe reach its own energy goals while also aiding the local utility in reaching state-mandated clean energy targets. The project generates revenue through the sale of electricity to the local utility as well as through tipping fees and heat sales (Ricci, 2018; Drescher, 2020). In addition, the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians and the Coquille Tribe are pursuing offshore wind energy development in Oregon.

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[30] Distributed energy resources refer to energy generation and storage technologies that are not connected to the bulk power grid and are capable of exporting active power to a local electronic power system (Institute of Electrical and Electronics Engineering, 2018).

[31] Behind-the-meter energy generation and/or storage denotes the placement of distributed energy sources that are on the customer side of the meter (Institute of Electrical and Electronics Engineering, 2018).

Sustainable Tribal Economies via Carbon Offset Market and Renewable Energy

Examples of sustainable Tribal economies include carbon sequestration via carbon markets, green or sustainable enterprises, ecosystem services, and natural resource-based or subsistence-based economic enterprises. Table 2 demonstrates 20 Tribal nations and Alaska Native corporations that have pursued economic development opportunities to execute Tribal self-determination, establishing sustainable offset and energy projects. The following list, although not exhaustive, highlights projects established as early as 2003 and includes wind, hydroelectric, methane capture, and carbon offsets.

Table 2. Tribes and Alaska Native corporation carbon offset and renewable projects, locations, and dates that agreements were either established or projects were completed.

Tribe or Corporation Name	Project Type	Location	Dates Established or Completed
Rosebud Sioux Reservation[1]	Renewables-Wind	SD	2003
Kasigluk Traditional Elders Council[1]	Renewables-Wind	AK	2006
Village of Toksook Bay[1]	Renewables-Wind	AK	2006
Confederated Salish and Kootenai Tribes[1]	Renewables-Hydro	MT	2008
Southern Ute Indian Tribe[1]	Renewables-Methane	CO	2009
Rosebud Sioux Reservation[2]	Renewables-Wind	SD	2010
Round Valley Indian Tribes[3]	Carbon Offsets-Forest	CA	2013
Yurok Tribe[3]	Carbon Offsets-Forest	CA	2013
White Mountain Apache Tribe[4]	Carbon Offsets-Forest	AZ	2014
Yurok Tribe[5,7]	Carbon Offsets-Forest	CA	2014
Confederated Tribes of the Colville Reservation[6]	Carbon Offsets-Forest	WA	2015
Confederated Tribes of the Warm Springs Reservation[7]	Carbon Offsets-Forest	OR	2015
Mescalero Apache Tribe[3]	Carbon Offsets-Forest	NM	2015
Passamaquoddy Tribe - Joint Tribal Council[6]	Carbon Offsets-Forest	ME	2015
White Mountain Apache Tribe[4]	Carbon Offsets-Forest	AZ	2015
Chugach Alaska Regional Corporation[3]	Carbon Offsets-Forest	AK	2017
Spokane Tribe of Indians[6]	Carbon Offsets-Forest	WA	2018
Confederated Salish and Kootenai Tribes[2,8]	Renewables-Hydro	MT	2020
Ahtna, Inc. (Regional Corporation)[6]	Carbon Offsets-Forest	AK	Unknown
Huna Totem Village Corporation[6]	Carbon Offsets-Forest	AK	Unknown
Nanwalek (English Bay) Village Corporation[3]	Carbon Offsets-Forest	AK	Unknown
Port Graham Village Corporation[3]	Carbon Offsets-Forest	AK	Unknown
Sealaska Regional Corporation[6]	Carbon Offsets-Forest	AK	Unknown
Seldovia Native Association (Village Corporation)[3]	Carbon Offsets-Forest	AK	Unknown
Tyonek Native Village Corporation[6]	Carbon Offsets-Forest	AK	Unknown

Sources: NativeEnergy (2018a, 2018b, 2018c, 2018d, 2018e)[1], U.S. Department of Energy (2013, 2015)[2], New Forests (2020)[3], Spatial Informatics Group (2020)[4], Yankel (2014)[5], Finite Carbon (2020)[6], California Environmental Protection Agency (2020)[7], Montana Public Radio (2020)[8].

The Alaska Native Claims Settlement Act (ANCSA) of 1971 extinguished aboriginal land title in Alaska, dividing that state into 12 geographic regions defined by Indigenous common heritage and interests.

This division initiated the creation of 12 private, for-profit Alaska Native regional corporations and 200 village corporations. Regional corporation lands are essentially fee-simple lands with individual shareholders, and therefore individual Alaska Natives who are enrolled in these regional corporations may generate revenue from land resource assets (Resource Development Council for Alaska, Inc., n.d.). Ahtna Incorporated, one of the 12 regional corporations, is Alaska Native- and shareholder-owned with more than 2,000 shareholders, the majority of whom are Ahtna Athabascan or Alaska Native descent. Ahtna Incorporated demonstrates the largest carbon offset economic development project in the U.S. to date. Utilizing more than a half-million acres of forested lands to sequester carbon, this project has sold more than 14.8 million offset credits (Finite Carbon, 2020). Its shareholders manage the carbon offset project, creating new jobs in building carbon offset markets and renewable energy markets in general, as well as increasing economic returns on investments for Alaska Natives. The potential for growth in this new field may facilitate more Alaska Natives remaining on their ancestral homelands (Finite Carbon, 2020).

A comparatively smaller example of carbon offset economic development is in progress on Round Valley Indian Tribal lands. While this project encompasses only 5,550 acres, in 2020 it managed to sell over 500,000 offset credits. The project supported ongoing sustainable forestry objectives, such as protecting old growth while improving the health of Douglas fir and pines, reducing wildfire risk, and enhancing local livelihoods and traditional cultural uses of the forests (New Forests, 2020). The success of a project this size affirms that other Tribal nations with small-forested land bases may forge collaborative agreements to achieve economically feasible and sustainable project investments and returns.

The Confederated Salish and Kootenai Tribes (CSKT) provide a prime example of renewable energy innovation via their hydroelectric project. The dam and related infrastructure to create the Kerr Project, a federally licensed hydropower project located on CSKT land within the boundaries of the Flathead Indian Reservation, was constructed in the early 1930s. One of six CSKT enterprises, Energy Keepers, Inc., was able to acquire Kerr Project interests in 2015 (Confederated Salish & Kootenai Tribes, 2014). That is, the CSKT exercised their “unilateral and exclusive right to acquire the project” through occupation and use of the project for 20 years—through 2035—as sole licensees (Energy Keepers, Inc., 2014). In February 2020, CSKT signed a 15-year contract with a Washington state utility, Puget Sound Energy, to supply the utility with hydroelectric power. Several more prospective large customers based in Montana are also seeking to secure energy from the Tribal corporation in the near future for energy supplied by the CSKT, who renamed Kerr Dam the Seli’š Ksanka Qlispe’ Dam (Montana Public Radio, 2020). Recent figures indicate the hydroelectric plant has the capacity to generate 208 megawatts annually, equating to 1.1 million megawatt hours, or electricity for 100,000 to 110,000 homes (Energy Keepers, Inc., 2020).

A final example of a Tribal renewable energy project is the capture and use of methane on the Southern Ute Reservation. The Southern Ute Indian Tribe’s Growth Fund Department of Energy partnered with NativeEnergy to establish emission reduction credits. The project aids in preventing the release of roughly 23,000 to 60,000 metric tons of methane annually through the implementation of 28 interceptor wells piped to a compressor station located on the reservation. These wells are tied into an existing gas pipeline, with the captured gas later injected into the natural gas distribution grid and burned for thermal energy or power energy downstream (NativeEnergy, 2018e). Between 2009 and 2017, the project captured about 379,000 metric tons of methane, or the equivalent of annual energy use for about 41,000 homes. Both Wyoming- and California-based energy development entities have considered the Tribe’s project as an example that can be replicated elsewhere to balance environmental budgets in the voluntary carbon market (Mullane, 2019).

Some Tribal nations situated in more remote locations have taken part in developing renewable energy projects. In the Alaska Native Village of Kasigluk, for example, the Kasigluk Traditional Elders Council oversees three wind turbines. The developer, NativeEnergy, worked with the nonprofit Alaska Village Electric Cooperative to purchase, operate, and maintain renewable energy for both Kasigluk and the Native Village of Nunapitchuk (U.S. Department of Energy, 2009; NativeEnergy, 2018b). A combined system, incorporating a modern diesel plant with wind–diesel production, supplies power to these Alaska Native villages. High maintenance costs due to the remote location of the project include those of importing technical experts and parts needed to repair and maintain the turbines (Anonymous, 2020). Nevertheless, these and other remote communities are pursuing ways to integrate varied energy sources, reducing the overall cost of power and heating for community members. So, while some communities have faced challenges, such as maintenance costs, wind energy integration has been possible for others.

Conclusion

After two centuries of forced assimilation leading to linear economies that tend to deplete natural resources to generate jobs and income, Tribal nations are rediscovering their economic sovereignty through the pursuit of circular and self-sustaining economies. These circular economies include innovative technologies and practices for reducing and reusing waste to protect and preserve their natural environment (Prieto-Sandoval et al., 2018; Steen-Adams et al., 2020). Tribal nations are also increasingly pursuing green enterprises to enhance their climate resiliency, including renewable energy, carbon offsets, and subsistence-based trade. Such enterprises reflect the relational and reciprocal connection of Tribal nations with their environment, marking a rediscovery and resurgence of Indigenous heritages, philosophies, sciences, and knowledges (Whyte, 2015; Cajete, 2012).

While self-determination continues to transform Tribal economies, 19th century federal policies to assimilate Indigenous peoples produced a complex system of property rights on Tribal lands, challenging this transformation. For many Tribal nations, the land on which they reside, held in trust by the federal government, is the only land available to pass to future generations. The General Allotment Act (1887) in particular resulted in highly fractionated land ownership, which can hinder economic resilience on Tribal trust lands (Leonard et al., 2020; Shoemaker, 2015; Anderson, 1995; Dippel et al., 2020), disincentivizing individuals from investing in land improvements. Yet the trust relationship that the federal government established with Tribal nations early on has persisted, requiring federal approvals even today for Tribal nations to develop their energy and other natural resources on Tribal lands. Despite this federal oversight, increasing numbers of Tribal nations are pursuing substantive and innovative climate adaptation pathways, including renewable energy development, carbon sequestration via carbon markets, green or natural resource sustainable enterprises, and subsistence-based enterprises.

Recommendations

The search for solutions to enhance the world's climate resiliency is fueling research into the potential role of Indigenous knowledges to inform climate mitigation and adaptation strategies. This increased interest inspires a resurgence among Tribal nations to embrace their unique heritages in efforts to realize sustainable economies. The concern for these priorities also suggests the need for Tribal nations to formulate policies to protect and preserve the authenticity and integrity of their Indigenous knowledges (Whyte, 2015). Tribal nations will thus likely need protocols and/or internal review boards to approve and oversee all research proposed to occur on Tribal lands or that involves their citizens and traditional knowledge holders (National Congress of American Indians Policy Research Center, 2019; Steen-Adams et al., 2020). An internal review process can help Tribes determine whether it is in their best interest to enter into legal agreements at the beginning of any research to ensure that Tribal intellectual property rights are protected. This may include requirements that researchers assign their invention and patent ownership rights over to a respective Tribal nation. It may require nondisclosure agreements, between Tribal employees and prospective research or business partners, in order to protect sensitive information. Tribal nations may also determine when and whether it is necessary to protect their intellectual property at the federal level through patents and/or trademarks (National Congress of American Indians Policy Research Center, 2019).

Public policy to increase Tribal citizen access to public collegiate and vocational education programs is key to increasing the numbers of Indigenous research scientists, educators, resource planners, technicians, and other professionals needed to support climate mitigation and adaptation (Fillmore et al., 2018). This includes training and education to provide in-house technical expertise, further advancing the efforts of Tribal communities and Alaskan Native villages to develop and maintain renewable energy projects. Yet federal funding levels for Tribal colleges and universities have remained relatively flat (Fillmore et al., 2018). These institutions require adequate funding that supports targeted student recruitment, increases graduation rates, and facilitates greater Tribal access to vocational and four-year degrees.

Additional recommendations for policy to support Tribal self-determination and secure climate-resilient economies include addressing the complex land tenure system, including fractionation and checkerboard jurisdictional boundary issues, that persists on reservation lands today. Tribal economic sovereignty might be better achieved through the freedom to establish property rights institutions that complement the cultural heritage, philosophies, and histories of respective Tribal nations while also incentivizing Tribal citizen individuals and/or collectives to invest in Tribal lands. This requires addressing equitably the pervasive issues surrounding the transferability of highly fractionated trust lands as well as the sustainable management of checkerboard lands.

Additionally, increased access to both public- and private-sector opportunities, whether financial or through procurement, may help to build the legal infrastructure necessary for Tribal-resilient economic growth. For example, Tribes may obtain a third-party analysis of potential Tribal business opportunities through the use of currently available resources, such as the Bureau of Indian Affairs' Division of Economic Development’s Pathways and other such similar resources (Bureau of Indian Affairs, 2021b). To reduce the impacts of checkerboarded lands, Tribes may desire to acquire fee-simple lands to convert to trust status through the Bureau of Indian Affairs federal fee-to-trust conversion program. The benefits of converting adjacent fee-simple lands to trust status can include granting rights-of-way; entering into leases necessary to negotiate the use, sale, or protection of natural resources; developing renewable energy resources; and protecting subsistence, hunting, and traditional agricultural practices. All of these goals can benefit long-term climate-resilient economic development projects. In general, interagency collaboration can assist Tribes in leveraging funding for their economic development opportunities by providing a comprehensive inventory of available funding and technical resources, particularly those resources dedicated to renewable energy, offset markets, or other sustainable enterprise opportunities.

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Chapter 7: Energy & a Just Transition

The narratives that follow provide an overview of the issues of climate, energy, and the just transition that Tribes are implementing in their communities. The Citizen Potawatomi Nation of Oklahoma completed a comprehensive energy-utilization study that led to their expansive geothermal energy production. The Hopi Tribe of Arizona is working with partners to develop utility-scale solar PV projects to utilize the Tribe's land base and solar resources. The Red Lake Nation of Minnesota is constructing a renewable energy distribution system as a microgrid for their community and has also started a food sovereignty program. A just transition allows Tribes to be treated equally and included in the energy transition from fossil fuels to renewable energy to strengthen their sovereignty and achieve economic independence and stability. A researched overview of Energy & a Just Transition as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Geothermal Operations in the Citizen Potawatomi Nation[32]

Written by: James C. Collard from the Potawatomi Nation

A reverence for the land has always been a critical feature of Native American life. From earliest times, the Indigenous people of North America have regarded not only the land, but also water, minerals, plants, animals, and indeed the air we breathe as being resources that are available for all to use, forever. This holds true with the Citizen Potawatomi Nation as well. Sustainability is not just a passing gesture for our Nation; rather it is a guiding principle of our development strategy. This is evidenced in our desire to gain the most value from the land while ensuring its long-term viability.

The Citizen Potawatomi Nation (CPN) knows that there need be no conflict between economic development and environmental protection. Indeed, the benefits to our people of sustained economic growth cannot be maintained unless we protect the natural resources that serve as the source of our prosperity. Geothermal energy production is one of the three focal points of the CPN's natural resources management program.

[32] The information in this document is drawn from the Citizen Potawatomi Nation Integrated Resource Management Plan.

For many years, under the guidance of Chairman John Barrett, our Nation has been on the forefront of efficient and effective energy utilization. In 1999, the Chairman directed the installation of the CPN's first geothermal application at the CPN Health Clinic. In 2004, the Nation worked with the Department of Energy to produce a comprehensive study of our energy utilization. The purpose of the study was to provide an in-depth examination of our government's utilization of electric, gas, and other energy sources. This included an analysis of how to best reduce energy usage while providing quality energy services to members and creating revenue-generating energy enterprises.

The areas that were investigated included:

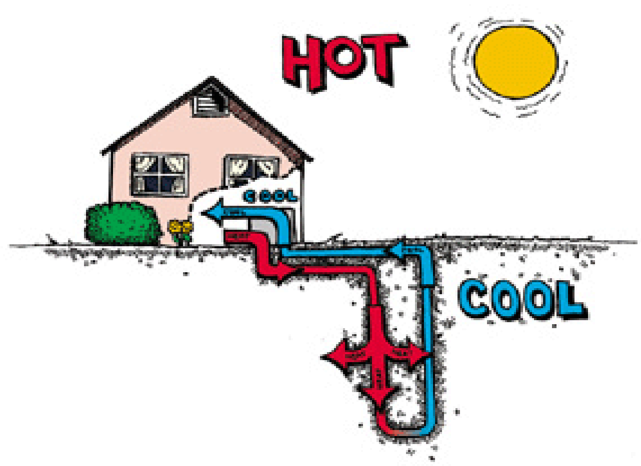
- Diversification of electric loads and changing service levels to lower electric costs;
- Heat recovery from the grocery store and casino as an energy source for adjacent buildings, a greenhouse, and possibly a car wash and laundry; and
- Integration or sharing of HVAC loads.

In addition, other possibilities were examined for their viability as alternative energy sources. These included:

- Growing, harvesting, and transporting biomass to gasification-fermentation plants being developed by Oklahoma State University
- Wind power using microturbines
- Groundwater development for water source heat pumps
- Geothermal heat pump installation
- Solar

After careful analysis it was determined that Chairman Barrett's expertise and the CPN staff's prior knowledge of ground source heat pump (GSHP) installation and operation are an asset that gives us an edge in expanding the application to Tribal facilities and also the background to begin a new enterprise in GSHP systems.

GSHPs are electrically powered systems that tap the stored energy of the greatest solar collector in existence: the Earth. These systems use the Earth's relatively constant temperature to provide heating, cooling, and hot water for homes and commercial buildings.



The campus-style arrangement in the headquarters area contains significant numbers of the CPN buildings, thereby allowing the integration of systems to produce greater efficiency. This is accomplished by installing geothermal heat pump loops to transfer energy from one building to another.

For example, one possibility is to transfer the excess heat produced from the refrigeration systems in FireLake Discount Foods to the headquarters building across the street using convective coils.

Chairman Barrett and others with CPN have experience with drilling wells and horizontal boreholes. There is also a commitment to expand this experience to installing GSHP. Revenue-generating activities that CPN currently owns provide funding to implement others when cost-effective projects are identified.

Implementation of a GSHP program reduces a number of challenges faced by the CPN when compared with other renewable energy technologies. For example:

- Tribal human and financial resource development: volatility of fuel prices leads to businesses that are unable to control energy costs and puts them at a disadvantage. GSHP is within the Tribal human and financial resources of the CPN and encourages both job development and energy-usage reductions. New business opportunities that employ Tribal members and contribute to energy control are an asset.
- Tribal renewable resource quantification: geothermal heat pumps have an inexhaustible supply of solar energy in the Earth's surface. Other renewables such as wind and surface solar are intermittent, have a higher upfront cost, require backup or storage, and have higher maintenance costs.
- Private investment vs. private developer regulations: CPN Tribal investment is sufficient for GSHPs.
- Tribal utility policies and Tribal utility formation: not required for GSHPs.

Satisfied with the results at the health clinic and curious whether or not geothermal could benefit the Tribe in future projects, Richard Kunze, the CPN Director of Public Works, contacted geothermal experts Drs. Jim Bose and Marvin Smith at Oklahoma State University. Following their advice, CPN utilized a pond on the first tee of the golf course as the heat exchanger for its second geothermal installation at the cultural heritage center. Well water used to irrigate the golf course was routed to that pond to create a constant flow.

FireLake Grand Casino is the Tribe's largest and most recent geothermal project. The 200,000-square-foot facility houses 1,800 Vegas-style games, three restaurants, and an entertainment venue.

Even with their gained experience and confidence in geothermal, CPN knew that the installation at FireLake Grand Casino would be like nothing they had ever done before. The 1,000-ton system required more than 35 miles of pipelines and ground heat exchangers that were buried in soil and submersed in water. The Tribe utilized a lagoon that holds treated wastewater to submerse the pipes. In addition, they needed 100 boreholes drilled to 400 feet deep. A third set of pipes is also submersed in the basin of a fountain located at the entrance of the casino. Installation was completed entirely by Tribal employees.

With the installation of the ground heat exchanger complete, the Tribe then began the interior installation process. The Tribe opted to hybridize the system, installing two 500-ton chillers to heat and cool the facility. A single 50-ton GSHP unit serves the administrative offices located inside the casino.

Kunze said when the project began CPN expected to save about 30% per year on energy costs and pay off the system installation in just under four years and that those estimations are holding true. Using Tribal employees helped offset the upfront costs to the Tribe. Estimated savings appear to be about $20,000 a month.

The opening of FireLake Grand Casino completes the first of a three-phase construction project for the Tribe. Plans call for the addition of a hotel and a larger events coliseum. CPN plans to incorporate geothermal for both. The hotel's geothermal system will tie into the casino's existing ground heat exchanger. Two fluid towers added during construction of the casino should prevent the need for more drilling.

With successful past projects and current ones coming online smoothly, the future for geothermal at CPN looks bright. We recently completed 25 new duplex housing units with two-ton GSHPs on each side; we are in the process of building a geothermal system that will include the FireLake Grocery Store as well as the Events Center and RV park; and we are planning to construct industrial facilities outfitted with geothermal. Our future plans are to build geothermal systems for all our new facilities, if at all possible.

The Hopi Tribe: Working Toward a Renewable Energy Future

Written by: Hopi Renewable Energy Office and Hopi Utilities Corporation

The Hopi Tribe has relied on coal as a main revenue source for half a century, just as the Southwest region relied on Hopi and Navajo coal for electricity. The coal industry provided well-paying jobs for Hopi communities, and royalties from coal mining and coal-fired electricity generation provided over 80% of the Tribe's annual budget in recent years. In return, Hopi workers used their coal and water resources to provide reliable electricity for growing cities such as Phoenix.

Hopi landscape during a rainstorm.

At first glance, this seems like a fair trade. But in fact, Hopi workers and communities have borne the brunt of health and environmental impacts from mining and coal-fired generation for decades, only to be left in the proverbial dust as the Navajo Generating Station and Peabody Mine were prematurely closed in 2019. The closure had no major impact on electric utilities or their consumers in the region, but it has left the Hopi Tribe with a massive budget deficit and a significant number of direct and indirect job losses. The plant owners gave little notice for this closure and provided no meaningful assistance for the communities that helped them operate for decades.

This is not what a just transition looks like.

The Hopi Tribe understands that the decision to retire coal plants and move toward cheaper natural gas and renewable energy is an economic one and agrees with the importance of transitioning toward renewable energy. Certainly, it is important that we transition to a clean renewable energy future—but communities impacted by coal closures should not be left behind in the process.

The Hopi Tribe is working to create new revenue and new jobs and looking toward renewable energy as a solution. Staff are exploring opportunities to develop solar projects, both as revenue generators and to improve electricity access to underserved parts of the reservation. Utility-scale solar projects are in the works, as are smaller, more distributed projects that will directly provide power to Hopi communities.

Tewa CD, community scale, ~30 kW.

Meanwhile, the same utility companies that are closing coal plants in the region are now seeking to add renewable energy generation to their portfolios. To facilitate a just transition, they should purchase this renewable energy from Hopi and other coal-impacted communities.

Utility companies can participate in a just transition that is mutually beneficial, one where communities that helped produce coal-fired electricity for so long can be included in the transition to renewable energy. Rather than being left behind as coal plants are shuttered, these communities should be empowered as partners in this transition.

Thankfully, many coal-impacted communities have the potential to produce and sell renewable energy at competitive rates. For example, the Hopi Tribe has extensive renewable energy resource potential and is currently working with partners to develop utility-scale solar PV projects to utilize the Tribe's land base and solar resources.

Residential PV, with Sandia National Laboratories Tribal tour participants.

For the sake of future generations, it is critical that we deploy renewable energy to replace dirty power plants that cause catastrophic environmental damage, drain one of the world's most precious resources (water), and heavily contribute to climate change. But it is important that coal-based communities are not forgotten in pursuit of this goal. With this in mind, the Hopi Tribe is working diligently to transition to a clean, renewable energy-based future.

Renewable Energy Development at the Red Lake Nation

Written by: Robert Blake

The Red Lake Nation (Tribe) is constructing a renewable energy distribution system, and it is kind of like a microgrid for the community. This development was approved by the Tribal council about three years ago now and was pushed for because the Tribe was finding high amounts of mercury in its walleye population. Mercury comes directly from the burning of fossil fuels.

The Red Lake fisheries is the Tribe's oldest business, and it really was because of the discovery of high mercury levels in the fishing supply that the Tribe started down this road of transitioning off of fossil fuel energy and into a renewable energy future. The Tribe has since realized that the benefits don't just end with a cheaper electricity bill; the technologies that are currently being used for the construction of the solar systems in the community can also be connected and possibly run someday by the Tribe. Now the discussions are around creating a utility for the Tribe that will work alongside the current provider but eventually be our own supplier of energy in the future. The Red Lake Energy Vision Advisory Committee is the founding board for the Red Lake Power Utility, which will not only help create the utility but will also offer a crash course on climate change impacts and adaptation policies.

The Tribal utility is also going to be the driving force around employment and entrepreneur opportunities for the community. A K–12 STEAM education program is now being developed to include the youth in this transition to renewable energy. The idea is to prepare the youth now so they have the tools to deal with climate change and take advantage of the jobs that will be created by this new renewable energy power utility.

There are also programs such as the one I collaboratively founded with the Minnesota Department of Corrections that are addressing the dual issues of workforce development and recidivism rates by training former inmates in solar installation. Although this effort is separate from the Tribe's workforce development efforts, it is an integral part in connecting social and environmental justice.

There has been a movement by the Oshkimiijiitahdah program (which is the workforce development center) to start construction of a net-zero building that would also be a training center. Red Lake would like to be the training center for northern Minnesota around renewable energy and other green technologies.

The Tribe has started a food sovereignty program and is currently growing vegetables and hemp to hopefully create a network within the community to be more self-sufficient. Tribal members want to be a climate-smart community, which has led to discussions on creating climate change adaptation plans.

If we can get the entire community moving in one direction toward a just transition off of fossil fuels, then maybe we will see the disparities that have been plaguing our community start to fall to the wayside.

Red Lake is no different than any other community trying to prepare for the climate crisis. I think what makes Red Lake unique is that we can move faster than other communities because we don’t have all the gridlock like other towns, cities, states, and the federal government has. Red Lake and other Tribal communities can actually help with the adoption of new technologies and other strategies around climate change.

We Native people have always been resilient and adaptive people: assimilation, genocide, and reorganizing have not stopped us. The climate crisis is different; I fear it threatens our existence like nothing else we have ever seen. We need to be at peace with this planet and not at war with it. Living in harmony and being at one with the environment is what has allowed Indigenous people to persevere. We must put our Mother first and treat her with respect once again if we want to continue to exist. I believe this with all my heart.

Energy & a Just Transition

Key Messages

- An Indigenous just transition is an Indigenous-led transition to an Indigenous-based, nonextractive, regenerative economy that transforms community planning and ecosystem restoration.
- Indigenous peoples have been deeply affected by extractive industries such as the fossil fuel and uranium mining industries.
- Tribal lands have tremendous renewable energy development potential, which could help Tribes achieve energy and economic independence, sovereignty, and stability.

Recommendation

Remove barriers to renewable energy development, while supporting Indigenous people in a just transition, to reduce reliance on and negative impacts from fossil fuels and nuclear energy. The most significant barriers to the development of renewable energy on Tribal lands are a lack of financing, infrastructure, training in renewable energy careers, resources to access that training, and inadequately supported Tribal leadership and staff.

Introduction

Due to land dispossession and historical federal policies, many Tribal nations have been forced, coerced, or given no better options other than to participate in extractive industries that may excessively consume resources, severely disrupt ecosystems, and/or exploit workers. The fossil fuel and nuclear energy industries, timber harvesting resulting in the deforestation of vast tracts of land, and intensive agriculture that relies on the use of pesticides and fossil fuel–based fertilizers are examples of industries that can be extractive, pollute the air and water, contribute to climate change, damage communities, and be unsustainable. Although some Tribes have benefitted economically from extractive industries, these gains are short term and not supportive of Tribal lifeways. Many Tribal nations are thus working to transition away from such extractive economies toward regenerative economies through the embodiment of the principles of a just transition. In regenerative economies, resource consumption is reduced, biodiversity is restored, and Tribal lifeways and cultures are preserved for future generations. Such economies may include renewable energy, either at the utility or distributed scale; regenerative agriculture that promotes soil and water health, biodiversity, and the wellbeing of animals; and/or forest management that protects natural and cultural resources and promotes soil carbon sequestration. This chapter focuses on the energy aspects of extractive and regenerative economies. It explores how extractive fossil fuel and nuclear energy industries have become embedded in the economies of many Tribal nations and the repercussions this has had. It also describes the components of an Indigenous just transition and renewable energy potential and actualization on Tribal lands.

A Just Transition

An Indigenous just transition is an Indigenous-led transition to an Indigenous-based regenerative economy (see below) that transforms community planning and ecosystem restoration. This means protecting Tribal sovereignty by addressing and healing broken promises made by the U.S. government and that same government investing in an Indigenous-led just transition that recognizes Indigenous people's laws, traditions, customs, and lands. A definition provided by *A People's Orientation to a Regenerative Economy (United Frontline Table, 2020)*[33] states:

> *Just Transition is a framework for a vision-led, unifying, and place-based set of principles, processes, and practices that build economic and political power to shift from an extractive economy to a Regenerative Economy. This means approaching production and consumption cycles holistically and waste free. The transition itself must be just and equitable, redressing past harms and creating new relationships of power for the future through reparations. If the process of transition is not just, the outcome will never be. Just Transition describes both where we are going and how we get there. The Just Transition framework focuses on stopping the bad to build the new by divesting from the exploitation of labor and extraction of resources and investing in cooperative labor and regeneration. Just Transition challenges the dominant worldview of colonialism, consumerism, and the concentration of power governed through violent force and advances a worldview of sacredness and care, as well as ecological and social well-being governed through deep democracy.*

The Indigenous Environmental Network hosted an Indigenous Just Transition Assembly,[34] the first of its kind, in 2019. The assembly, which consisted of Indigenous peoples from across Turtle Island, discussed what "just transition" means to Indigenous peoples, which led to a list of place-based principles. In summary, a just transition restores Indigenous lifeways; acknowledges the rights of nature; preserves and revitalizes our Indigenous languages; recognizes our rights, sovereignty, self-determination, and traditions; acknowledges Indigenous voices and the need for Indigenous ingenuity (Indigenuity); and ultimately recognizes that Indigenous peoples honor and accept their responsibility to the rights of the generations to come that allows for a world with harmony, peace, equity, and justice.

The idea of a just transition stems from labor unions around the world, advocating on behalf of generations of livelihoods and built infrastructure that is already in place. Tribes and labor unions can learn much from each other as they attempt to address the issue of an abrupt shift toward renewable and sustainable energy vocations in the broadest sense and the acknowledgment of the massive amount of groundwork to be laid out in order to achieve this shift. Just transition frameworks and guidelines have been supported by Indigenous networks and initiatives and also global organizations such as the International Labour Organization, addressing labor market policies for communities whose livelihoods are being affected by climate change (International Labour Organization, 2015).

In the context of a just transition away from fossil fuels, the term *regenerative economy* refers to the "democratization of primary production and consumption" that reduces resource consumption and restores biodiversity (Climate Justice Alliance, 2018; Front and Centered, 2020). *Extractive economies*, in contrast, are economies that extract resources, such as labor, natural resources, and culture from a community (*Id.*). Regenerative economies are "ecologically sustainable, equitable and just" and serve to "address the root causes of climate change by changing the system" (Indigenous Environmental Network, 2020). Regenerative economies are not new to Indigenous peoples, but in fact recognize the

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[33] *A People's Orientation to a Regenerative Economy* (United Frontline Table, 2020): https://climatejusticealliance.org/wp-content/uploads/2020/06/ProtectRepairInvestTransformdoc22x.pdf

[34] Indigenous Environmental Network's Indigenous Just Transition Assembly (Indigenous Environmental Network, 2020) https://www.ienearth.org/first-indigenous-just-transition-assembly/

fundamental interconnectedness of all life on the planet and have laid the foundation for Indigenous lifeways since time immemorial.

Fossil Fuels

Indigenous peoples were dispossessed of the majority of their homelands. These dispossessed lands have been degraded by pollution stemming from industrial sources, such as facilities involved in the extraction, processing, transportation, and delivery of coal, oil, and gas. Such facilities form the basis for the United States' industrial economy. Examples of U.S. policies that facilitated dispossession and degradation of Indigenous lands are the General Mining Act of 1872, the Mineral Leasing Act of 1920, and the Omnibus Tribal Leasing Act of 1938 (Mills, 2017; Royster, 2013).

Indigenous lands also became deforested and transformed into commercial agriculture, mining areas, parks, towns, suburbs, and major metropolitan areas. The ecosystems and biodiversity that Indigenous peoples stewarded became assets for the development of the U.S. economy, serving as another form of energy from natural resources. In states like Michigan, for example, major 19th century deforestation and mining furnished the basis of the industrial infrastructure needed for U.S. settlement to grow its population and economic footprint. Relevant acts of Congress include the Timber Culture Act (1873), the Desert Land Act (1877), the Timber and Stone Act (1878), and the Homestead Act (1862) (Cohen, 1958). At the same time, the U.S. incentivized many Tribes to adopt farming practices tied to the intensive agricultural methods burgeoning in the U.S. in the 19th century. The General Allotment Act of 1887 was part of sweeping efforts to liquidate reservation land into private property (see *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets*). One of the goals of the General Allotment Act was to force and incentivize Indigenous persons to become commercial farmers with nuclear family–based, monocrop farming operations (Fixico, 2011).

Federal policies widely understood as establishing government-to-government relationships between the U.S. and Tribal nations were often premised on enabling Tribes and Indigenous persons to host or lease their lands for fossil fuel extraction and transportation. Examples of such acts are the Indian Reorganization Act (1934) and the Alaska Native Claims Settlement Act (1971), among other statutes and policies to host coal, oil, and gas industries as Tribal enterprises (Philp, 1995). In the 1920s, for example, the U.S. targeted the Navajo Nation for hosting the coal industry, and scholars have widely criticized the fairness of the agreements made in terms of safety and profitability for the Tribe (Edmunds et al., 1995). (The Navajo Nation has also been heavily impacted by uranium radiation stemming from uranium mining operations that employed Tribal members; see below and Brugge et al., 2009; McElroy, 2006.) Additionally, Tribes such as (but not limited to) the Crow Tribe and the Mandan, Hidatasa, and Arikara Nation entered into the fossil fuel industry and continue advocacy for the perpetuation of these industries today (Fixico, 2011; Allison, 2015; Jorgensen, 1978). Despite the complex bureaucracy raising the costs of energy development on Tribal lands (Regan, 2014), of all trust resources, fossil fuels have provided the most economic benefit for particular Tribes engaged in those industries compared to other trust resources, including forestry and agriculture.

Given the economic benefits of fossil fuel industries, Tribes have organized to provide support and empowerment to engage in these industries more safely and consensually. The Council on Energy Resource Tribes formed in 1975 as an advocacy organization for Tribes with substantive portfolios in the fossil fuel industry and has more recently pursued sustainable energy projects. Groups like the National Tribal Environmental Council provide training and other services to Tribes in terms of their operation of energy infrastructure. The National Congress of American Indians (NCAI) has advocated for policies that support Tribal sovereignty on a number of different energy dimensions, ranging from support for Tribal development of fossil fuel resources to climate change mitigation through renewable energy (National Congress of American Indians, 2013).

At the same time, many Tribes, Alaska Native corporations, and other Indigenous peoples' governments and organizations have advocated for the continuation or reform of fossil fuel energy (Skinner, 2019). The U.S. government has largely put many Tribes in the position of having few options for dealing with economic needs (Wilkinson, 2005; Crepelle, 2018). Several Tribal governments have worked with U.S. and state politicians to endorse the deregulation of fossil fuel energy projects for Tribal governments, or for projects occurring on lands held to be sacred or economically viable by Tribes (e.g., the Arctic National Wildlife Refuge).

The U.S. government has permitted fossil fuel industries to operate in close proximity to Tribal nations and on ancestral homelands, and there is a large body of literature documenting such histories and how Tribes worked to establish greater self-determination and ownership in the development of their energy resources (Allison, 2015; Fixico, 2011; Jorgensen, 1978; Mills, 2017;). At the same time, these non-Tribal fossil fuel–extraction industries have been widely criticized by Tribes, and taken to court or administrative adjudication, for the public-health risks they pose to Tribal nations, including associations with high rates of sexual exploitation and violence in extraction zones (Deer & Kronk Warner, 2019; Deer & Nagle, 2017). The environmental and social risks have formed a cornerstone of the rationale behind the U.S. adopting Executive Order 12898 on environmental justice (U.S. Department of Energy, 2012).

Not only is the proximity to fossil fuel and other extractive industries a concern for Tribes and other underrepresented communities, but adding onto this is the colossal burden of retiring these industries on Tribal lands. The testimonial in this chapter from the Hopi Tribe stresses the long-term impacts from an abrupt mine closure, leaving the Tribe with a "massive budget deficit and a significant number of direct and indirect job losses" (see narrative above titled *The Hopi Tribe: Working Toward a Renewable Energy Future*). The International Labour Organization's *Guidelines for a just transition towards environmentally sustainable economies and societies for all* suggests that national and local governments be leaders in local active labor market policies (International Labour Organization, 2015). For an Indigenous just transition, an example could be providing access to new jobs by laying a foundation of both training and employment opportunities in technical careers for Tribal professionals. In many cases, it is not feasible in remote locations to consistently outsource or contract technical experts to maintain green industry equipment, such as wind turbines, for long-term sustainability. Technical expertise should exist from the inside out to support green industry and Tribal enterprises. Capacity is only built systemically through changes in the Tribal workforce; this means building capacity through increasing the amount of opportunities in Tribal technical career employment opportunities to support and serve Tribal and Indigenous communities.

Despite the attraction of the potential economic benefits in the fossil fuel industry, there has been a Tribal trend toward renewable energy and the curbing of dependence on fossil fuels (Norton-Smith et al., 2016). This is evidenced by actions, policies, and resolutions of numerous Tribal governments, NCAI (2013; 2019), intertribal organizations like the Affiliated Tribes of Northwest Indians, and treaty organizations like the Great Lakes Indian Fisheries and Wildlife Commission and Northwest Indian Fisheries Commission. Indigenous peoples have widely contested coal terminals and new and aging pipelines, among other cases, whether these aspects of energy infrastructure are Tribal enterprises or operations that occur near reservations or on ancestral homelands. The Lummi Nation has fought against the Pacific Gateway Coal Terminal (Williams-Derry, 2016). The Standing Rock Sioux Tribe has fought against the Dakota Access Pipeline (Fredericks & Heibel, 2018). Numerous Anishinaabe and other Tribes in the Great Lakes region are resisting Enbridge Lines 3 and 5 (Knoblauch, 2021).

Nuclear Energy

American Indians and Alaska Natives currently show no enthusiasm for nuclear energy development. It is impossible to find a Tribal government supporting the development of nuclear energy on their lands today. No energy technology has a more troubling legacy for Indigenous peoples of the United States than nuclear power. The Navajo Nation, Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe were and continue to be directly and negatively impacted by the dream of cheap nuclear energy production from the 1940s to the 1960s. While some energy-system planners and policy makers see a role for nuclear energy in a U.S. carbon-free energy future, many Indigenous peoples remain wary of nuclear energy because so much of its implementation was short-sighted and continues to place their lands and peoples at great risk.

Few citizens in the U.S. want nuclear energy production, especially in their “backyard,” until long-term solutions for nuclear waste storage are solved (Ramana, 2018). Of the array of safety and health issues associated with nuclear energy, the continuing problem of what to do with the waste produced by nuclear reactors remains unresolved. A case in point are the threats posed by the failure to solve the radioactive waste storage problem on the Hanford Nuclear Reservation (HNR) established in 1943 on the banks of the Columbia River in Washington (Niles, 2014).

The HNR (586 square miles) was established as a part of the Manhattan Project and became home to nine nuclear reactors and five plutonium-processing complexes. This site was created on lands identified by treaties (such as the Yakama Nation Treaty of 1855) to be used by the three federally recognized Indian Tribal nations of that area for customary hunting and fishing activities (Baptiste, 2005). Although most reactors were shut down by the early 1970s, pollution damage and problems persist today. It remains one of the largest toxic environmental cleanup sites in the world (Niles, 2014). Millions of gallons of dangerous radioactive waste remain on the site, and the U.S. Department of Energy (DOE) is responsible for cleaning up the site (U.S. Department of Energy, 2020a). Tribes continue to press the DOE to do more to stop ongoing contamination and threats to their customary hunting lands, fishing waters, and people (Tolson, 2014).

For the Navajo Nation, the legacy of nuclear energy is also tied to the Manhattan Project and the Hanford Nuclear Reservation: the Navajo people mined the uranium located on their lands that was used as fuel in the Hanford nuclear reactors, which has left a deadly and painful legacy (U.S. Department of Energy, 2020b). The rush to lead the world into an era of inexpensive nuclear energy demonstrated that, especially in uranium mining activities, too little was known about the deadly threats this posed for those in contact with the uranium. No place is this story more poignant than in the homeland of the Navajo Nation (McElroy, 2006). Cancer, birth defects and disabilities, and stillbirths and miscarriages related to uranium mining activity remains years after the mines were shut down (Brugge et al., 2009).

Few people are as aware of the very real threats anthropocentric climate change poses to our planet as the First Peoples of this land; few people want to find zero-carbon emission energy solutions as much as

American Indians and Alaska Natives. While some environmentalists and energy experts are seriously advocating consideration of nuclear energy development, because of the history and the still-unresolved issues of how to handle nuclear energy production waste, there remains little enthusiasm among most Tribes for addressing climate change through the use of nuclear energy. The legacy of nuclear energy has been one filled with death, danger, and threats to American Indian Tribal sovereignty, cultural traditions, health, and identity. Currently funds are available to begin the assessment and cleanup process at 219 of the 523 abandoned uranium mines. This still leaves over half of these uranium mines open and exposed (U.S. Environmental Protection Agency, 2021). The DOE's Nuclear Energy Tribal Working Group has promoted Tribal outreach, STEM (science, technology, engineering, and math) education, research opportunities around nuclear fuel and high-level radioactive waste management, as well as support for the design and construction of microreactors and small modular reactors (U.S. Department of Energy: Office of Indian Policy and Programs, 2016). Considering that sites contaminated with radioactive material involve multisectoral cleanups, increased access to a variety of leverageable resources for Tribal governments is needed (U.S. Environmental Protection Agency, 2019).

Renewable Energy

While industrialized countries rely heavily on fossil fuel energy to power global economies, there is an untapped potential of renewable energy resources, particularly within Indian Country. Tribal lands account for 5% of the total area of the U.S. and 10% of the country's renewable energy resources (National Wildlife Federation, 2010). "There are just over 400 MW [megawatts] of installed capacity of renewable energy projects on land belonging to federally recognized Tribes, including 297 MW of solar, 67 MW of wind, 31 MW of biomass, 6 MW of geothermal, and 0.5 MW of hydropower" (Institute for Energy Economics and Financial Analysis, 2019)[35] (see also *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets*).

Biomass energy is created through an assortment of sources, including wood and wood processing wastes, agricultural crops and waste materials, animal manure, human sewage, and biogenic materials in municipal solid waste (U.S. Energy Information Administration, 2020). The Bureau of Indian Affairs, in partnership with the Bureau of Land Management, promotes Tribal biomass energy production through its Tribal Biomass Demonstration Project (U.S. Bureau of Indian Affairs, 2020).[36]

While many notable Tribal biomass feasibility studies have been conducted, the Huslia Tribal Council and Menominee Tribal Enterprises (MTE) have created a unique project. Owned and operated by the Huslia Tribal Council, this biomass project provides its community with job opportunities and cost savings on heating and contributes to meeting the Tribe's Renewable Portfolio Standard (RPS) by 2025 (U.S. Department of Energy: Office of Indian Energy Policy and Programs, 2017). The MTE project is an example of an existing biomass project that was upgraded in 2013 to improve efficiency by 35% and provided the Tribe with annual savings of $462,227 and 159 tons of emissions reductions (Menominee Tribal Enterprises, 2017).

[35] For a more detailed look at the renewable energy projects on Tribal lands, refer to the U.S. Department of Energy: Office of Indian Policy and Programs (2018) National Renewable Energy Lab's Tribal Energy Atlas https://maps.nrel.gov/tribal-energy-atlas/?aL=urhvHj%255Bv%255D%3Dt%26vg4pmh%255Bv%255D%3Dt%26vg4pmh%255Bd%255D%3D1&bL=clight&cE=0&lR=0&mC=39.57182223734374%2C-100.8984375&tour=splash&zL=4

[36] Tribal Biomass Demonstration Project https://www.bia.gov/bia/ots/dfwfm/tbdp

Geothermal is another renewable energy source that Tribes are harnessing to achieve energy independence and economic growth while also preserving Earth's natural resources. The Citizen Potawatomi Nation embodies these economic and cultural ideals in their geothermal operations (see narrative titled *Geothermal Operations in the Citizen Potawatomi Nation*). The Tribe's staff have had the opportunity to gain crucial experience in developing skills necessary to implement the sustainable system themselves, thus promoting Tribal sovereignty. This is a prime example of addressing the need to form a foundation of employment in renewable energy careers in Indigenous and Tribal communities. It is worth noting that this type of renewable energy does not require Tribal utility policies or Tribal utility formation—another workaround for barriers preventing Tribes from long-term renewable energy projects. Additionally, as they have mentioned, Tribal staff have gained these skills when cost-effective projects have been identified for the Tribe. Thus, when resources are accessible, Indigenous peoples have proven their ability to take the initiative in just transition actions.[37]

There is tremendous solar energy potential on Tribal lands. For example, "the Cherokee Nation is making efforts and strides to decrease [their] carbon footprint. Cherokee Nation is utilizing solar to offset charging of electric vehicles and to power facilities. Some facilities currently being looked at for solar supplement are community buildings, charging stations, and elder homes" (personal communication, P. Manes, 2020). Similar to the Cherokee Nation, the Standing Rock Sioux Tribe is utilizing nonprofit startup funds to invest in solar panels for the Tribe. The energy harnessed from these panels will then be sold back to the state's energy grid, which could provide a cost savings of $10,000 a year for the Tribe (Kolpack, 2019). The Moapa Band of Paiute Indians is undertaking a slightly different model, as they are investing in the first utility-scale project approved for Tribal lands, which will provide power off of the reservation (Kolpack, 2019). Called the Arrow Canyon Solar Project, it is a 250 MW project anticipated to power an average of 64,000 Nevada homes (First Solar, 2020).

Wind is the most common renewable resource used on Tribal lands and is typically produced on a utility scale (Global Energy Network Institute, 2016). One example is the Oceti Sakowin Power Authority, which is comprised of six Tribes (Cheyenne, River Sioux, Flandreau Santee Sioux, Oglala Lakota, Rosebud Sioux, Standing Rock Sioux, and Yankton Sioux) and is on track to be the largest wind power development in the U.S. (Oceti Sakowin Power Authority, 2013). Initial planning for two wind installations has been completed: a 450 MW project on the Cheyenne River Reservation and a 120 MW project on the Oglala Pine Ridge Reservation (Oceti Sakowin Power Authority, 2019). Not only is the six-Tribe collaboration unique, but the governance structure is a mixture of board members and elders who speak on behalf of their respective homelands (Robertson, 2019). Another example of wind development on Tribal lands is the 25-turbine, 50 MW wind installation owned by the Campo Band of Kumeyaay Indians. In their power purchase agreement with San Diego Gas and Electric, the Tribe is earning 5% of fees from the contract (Campo Kumeyaay Nation, 2013).

The narratives included in this chapter are a testimony to the restorative and progressive strides of Tribal communities working toward a just transition. The Hopi Tribe in northern Arizona, who have historically looked to coal as a main part of their economy (see Fossil Fuels section, above), have taken it upon themselves to strategically transition from a fossil fuel economy to a renewable energy economy

[37] For more information on Tribal geothermal resource potential, review the map created by the National Wildlife Federation: The New Energy Future in Indian Country: Confronting Climate Change, Creating Jobs, and Conserving Nature https://www.nwf.org/~/media/PDFs/Global-Warming/Reports/03-23-10_NWF_TribalLands_LoRes.ashx

after the closure of the Peabody Coal Mine. The Hopi Tribe has assessed their renewable energy resource potential and have found extensive opportunities to develop utility-scale solar PV projects in their movement toward a just transition (see also the narrative titled *The Hopi Tribe: Working Toward a Renewable Energy Future*). The Red Lake Nation in Minnesota understands the intersectionality of their renewable energy development and that their microgrid for the community not only provides cheaper electricity, but also positively influences educational programs, workforce development, recidivism rates, and food sovereignty, which all encourage a climate-smart community (see narrative titled *Renewable Energy Development at the Red Lake Nation*). Although the Red Lake Nation does not have a fossil fuel-based economy from which to transition, they are developing their economic vitality through innovative business models.

Although the renewable energy potential on Tribal lands is vast, Tribes face significant energy development barriers. The most significant barriers to the development of renewable energy on Tribal lands are a lack of financing, infrastructure, training in renewable energy careers, resources to access that training, and inadequately supported Tribal leadership and staff (Jones & Necefer, 2016). Economic factors associated with financial and funding barriers are “small-scale projects are not economically feasible as an alternative to grid connection, large-scale projects require significant outside capital, and high infrastructure costs are necessary to reach remote locations” (Jones & Necefer, 2016). While renewable energy development aids Tribal sovereignty, this sovereignty renders Tribes tax-exempt, which ultimately disqualifies them from receiving tax incentives such as the Federal Production Tax Credit associated with wind development (Zimmerman & Reames, 2021). Further, high turnover in Tribal leadership and staff has proven to be another significant barrier for energy development because of the instability turnovers create within the progression and vision of a project (Zimmerman & Reames, 2021; Jones & Necefer, 2016; Congleton, 2013). Although many Tribes have shown time and again that renewable energy projects and sustainable systems can be effectively implemented and maintained, these barriers should be addressed through the creation of practical policies that will benefit disparately impacted Tribal and Indigenous communities. For further information on barriers to renewable energy development, see the *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets* section titled, “Federal Policies and Energy Development on Tribal Lands.”

Conclusion

The principles of a just transition can—and should—be applied to a transition away from fossil fuels and toward energy sources that are regenerative, place-based, reciprocal, and restorative to Indigenous communities’ wellbeing. The principles above that broadly define the scope and scale of a just transition stand in contrast to other more limited definitions that solely involve creating greener jobs (Bainton et al., 2021). To move beyond the more limited definition of green jobs, a just transition can provide a framework for analyzing the fairness and equity of the energy transition (McCauley & Heffron, 2018). Restorative justice, which focuses on repairing past harms and preventing future harm rather than on punishing the offender (*Id.*), can help to address past damages to Indigenous peoples, their lands, and environment and help ensure that a more equitable and reciprocal approach to energy development occurs.

In contrast to how the closure of the Peabody Mine on Hopi land was handled (see narrative titled *The Hopi Tribe: Working Toward a Renewable Energy Future*), when utilities and mining companies close the fossil fuel operations that are economic drivers in some Tribal communities, they have a moral imperative to ethically phase out their operations by including job training and placement, financial support during the transitional period, environmental cleanup, and a commitment to purchasing renewable energy from communities that choose to develop that energy. This is what a just transition looks like.

In addition to the examples discussed in this chapter, there are multiple examples of Tribes who are currently advancing economic development through the active use of renewable energy and their own Indigenous regenerative or circular economic models. These Tribes include the Standing Rock Sioux Tribe of North Dakota,[38] the Winnebago Tribe of Nebraska,[39] and the Moapa River Indian Reservation.[40] The actions being taken by these Tribes illustrate tremendous opportunities for Tribes to more fully implement a just transition that speaks to the issues of equity, inclusivity, and intersectionality.

Extractive industries such as the mining of fossil fuels and uranium have damaged Tribal communities while at the same time bringing short-term economic benefits. As those industries come to an end (e.g., the closure of coal mines), Tribes are often left with the lingering health and environmental impacts, but without the continued financial benefits. Tribes are finding ways to exert their sovereignty and have agency over their futures through developing renewable energy and reclaiming their original, regenerative economies, but the industries and government that created these injustices must be part of the process in implementing restorative justice and removing barriers. The voices and leadership of Tribes and Indigenous peoples must be heard and elevated, for they can and do provide models of sustainable, reciprocal, and regenerative economies.

Energy & a Just Transition References

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Chapter 8: Cultural Resources

Cultural resources are threatened by climate change. The narratives in this chapter explain how several Tribes in California are developing initiatives to protect their cultural resources from climate change impacts. The Twenty-Nine Palms Band of Mission Indians has initiated a planning process to assess these sectors' vulnerability to impacts and develop climate change–resilient strategies to protect their cultural resources. Similarly, the San Manuel Band of Mission Indians has created and implemented a landscape stewardship program for fire management and cultural resource protection. The Santa Ynez Band of Chumash Indians Environmental Office also developed a comprehensive climate adaptation plan with a focus on Chumash cultural sites and resources across traditional Chumash territory. A key recommendation from this section is to integrate the tangible and intangible cultural, spiritual, and traditional significance of plants, animals, ecosystems, and landscapes into analyses of the consequences of climate change. A researched overview of Cultural Resources as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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Summary of Climate Change Cultural Resources Survey

Written by: Sara Bliss from the Twenty-Nine Palms Band of Mission Indians

The Twenty-Nine Palms Band of Mission Indians (Tribe) recognizes the scientific consensus that the Earth's climate is changing due to anthropogenic activities on the planet. Greenhouse gasses emitted into the atmosphere from human activities have created a global warming trend that continues to alter the Earth's climate. The consequences of this worldwide trend are apparent on the Tribe's Reservation and ancestral territory of the southwest United States, manifested as highly variable temperatures and precipitation rates. The increasing variability of these climate indicators has led to extreme drought and extreme precipitation events becoming more common, resulting in higher wildfire and flash-flooding risks. These impacts pose direct and indirect threats to public health, infrastructure, and natural systems. With this understanding, the Tribe has initiated a planning process to assess these sectors' vulnerability to impacts and develop climate change–resilient strategies. The Tribe has made considerable progress in this effort; however, Tribal cultural resources have not been addressed in this context. The Tribe's cultural resources are invaluable, as they are a vital connection to traditional lifeways and ancestral stories. These cultural resources are diverse and encompass landscapes, archeological sites, flora and fauna, and spiritual practices. Climate change impacts can degrade and destroy these precious resources through acute and chronic exposure. A comprehensive assessment and adaptation plan for cultural resources is currently being developed from funding from the Bureau of Indian Affairs' Tribal Resilience Program. The Tribe is currently developing a comprehensive adaptation plan specific to its diverse cultural resources. To accomplish this, the Tribe will conduct an inventory of its cultural resources and analyze their vulnerability to climate impacts. The resulting work will be incorporated into an adaptation plan that will inform management measures for cultural resources in the context of climate change.

In our original proposal, we proposed to conduct inventories and site visits with Tribal members and elders. Since this grant was awarded in the early onset of the coronavirus pandemic, there have been many hurdles to figuring out how to receive training and meet with these important cultural knowledge bearers. Since that time, we have been researching other climate change adaptation plans and putting together a survey to understand and identify significant cultural resources to Tribal council members, Tribal members, Tribal elders, Tribal youth, agency representatives, and cultural Informants. Once we receive the survey results, we can focus our adaptation plan on these specific resources that need protection from threats of climate change. To create the survey, the information from the National Park Service Climate Change[41] research was used to formulate a table with known threats that pertain to the desert environment. These known threats include increased temperature, wind, flooding, and wildfires. Other threats include changes in seasonality, species shifts, invasive species, drought, pollution, and development. The categories affected by these threats are divided into Cultural Resources, Cultural and Natural Landscapes, and Museum Collections. This table of information is in the beginning of the survey and can be referred to during the question portion.

The online survey format helps the transition from face-to-face communication to a virtual and digital platform of gathering information. There are beneficial impacts to having digital records of communications, which can aid in long-term cultural preservation. An online format also ensures the protection of health and ease of communication between the Tribal Historic Preservation Office and the Tribal community. This is especially important during the current situation of COVID-19 and social-distancing measures. The Tribal community's health is the most important aspect of culture preservation, especially for Tribal elders and the traditional knowledge they may have. The ease of communication will enable faster results and solution-based planning like the Climate Change Adaptation Plan, which is the project the survey results are intended for. There is an office phone number listed in the survey, just in case there is confidential information that cannot be listed on the online format; the office number is also listed for any concerns and/or questions.

The survey questions are broad and open, so that communication can start from the appropriate perspective. The survey questions are first based on the known threats and then secondarily focused on the categories of cultural resources. The first section of questions asks how concerned the respondent is about each one of the known threats and gives options for Not Concerned, Neutral, Concerned, or Very

[41] National Park Service's Cultural Resources Climate Change Strategy: https://www.nps.gov/subjects/climatechange/upload/NPS-2016_Cultural-Resoures-Climate-Change-Strategy.pdf

Concerned. There is a blank paragraph at the end of this first portion for writing in additional threats and/or concerns. The second portion of the questions focuses on the categories of cultural resources: ceremonies, cultural items, landscapes, plants, sites, trails, and wildlife. The questions for each category ask, “Are there any specific resources in that particular category significant to you that need protection from the effects of climate change?” Each question leaves blank space for specific resources to be written down.

The results from the survey will be incorporated into a broad Cultural Resources Resiliency Plan. The Plan will guide the Tribe in managing its cultural resources in response to climate change impacts. This plan will prioritize the inventoried resources for action based on their significance and vulnerability. Goals will be developed for the resources that may be qualitative, quantitative, or both, with an associated timeframe for completion. Adaptation- and resiliency-focused options will be created and customized to achieve the Tribe’s goals. These options may be technological or policy-based or be derived from traditional ecological knowledge and organized according to constraints and opportunities. This plan is intended to be a living document, subject to review and revision based on current information.

An Ethos of Partnership: Stewardship of Serrano Ancestral Territory in the Midst of Climate Change

Written by: The San Manuel Band of Mission Indians

Since time immemorial, the Serrano people have maintained a close relationship with their ancestral lands, entrusted by the Creator to steward these lands in meaningful ways. Thus, the San Manuel Band of Mission Indians (SMBMI) has created and implemented a landscape stewardship program that is reflective of the Tribe’s Vision, Mission, and Values. As a part of this program, the Tribe engages in landscape stewardship efforts in a multitude of ways, including the Tribe’s partnership with government agencies as it relates to fire management and cultural resource protection.

For many years, SMBMI has made various efforts to better guide fire-related land management processes governed by their partners to include fire prevention, fire suppression, and post-fire landscape assessments. In order to contribute to prevention efforts, SMBMI has participated in archaeological surveys; performed data retrieval from various repositories; researched within the Tribe’s own records, histories, and knowledge; and decolonized these various data sets to ascertain boundaries of different types of Tribal cultural resources. These resources include but are not limited to archaeological sites, gathering areas, hunting areas, viewsheds, and ceremonial spaces. As the Tribe has become more and more equipped with this knowledge of their ancestral landscape, they have offered stronger guidance to their partners related to avoiding areas of cultural importance during various fire-prevention projects that could potentially harm resources. Such efforts include culling and removal of dead or dying vegetation, controlled burning of vegetation, weed abatement, and planning dozer lines for suppression use during a fire.

However, while the Tribe has seen success in these early planning efforts, it has become apparent in recent years that issues related to climate change are ever-increasing, making cultural resource protection that much more difficult. The number of fires that occur in the forests near the San Manuel Reservation has increased exponentially over the years, and the Tribe's partnering agencies continue to fall further and further behind in their prevention efforts. Long-term drought has led to increased bark-beetle infestation. Such infestations were predominantly in pine trees in the past, but as of 2020, there is now a surge of oak deaths due the introduction of a new species of oak borer in the area. The introduction of a new species is hardly surprising given how many tourists, unaware of the dangers of introducing nonlocal wood, are heading to the mountains and forested communities in droves to escape the frequent, increased heat in the urban areas of southern California. Further, there is a lack of education regarding vehicle fires caused by off-roading, as well as campfire safety, and the forests in the area were recently closed off to public access as a fire-prevention method. This measure was a desperate act, and it became abundantly clear that agencies, even with local assistance, are unable to sustain the increasing workload related to fire management.

This workload is further burdened by the fact that the fire season gets longer each year. Seasons previously focused on fire-prevention activities are now consumed by active fire suppression, with agencies oftentimes battling multiple fires at once. As agencies do not have the resources to handle these fires alone, SMBMI has made it a point to offer assistance wherever possible. Not only has the San Manuel Fire Department offered on-the-ground support to agency partners during active fire battles, but the Tribe has also offered real-time assistance to their cultural preservation efforts, with archaeologists and Tribal monitors actively leading dozers around culturally significant areas and implementing fast-tracked mitigation for archaeological sites that were inadvertently damaged in the initial chaos of fire-suppression mobilization. However, the Tribe's resources are often stretched thin through the bulk of fire season, and there is a concern that fire activity will only increase and the level of support the Tribe hopes to provide will become unsustainable. To further complicate matters, post-fire season lends itself to an extra set of environmental concerns, as increased, though short-lived, precipitation has made its way to the region in recent years, causing mudslides and rockfalls in areas cleared of vegetation by fire. Such acts of nature are incredibly destructive to various resources, most particularly archaeological sites subject to erosional impacts and gathering areas that managed to survive the fire. While numerous efforts are made with the Tribe's partners to identify these areas as culturally sensitive and in need of mitigation, suitable and effective actions can oftentimes take too long to implement and/or cost money the agency simply does not have.

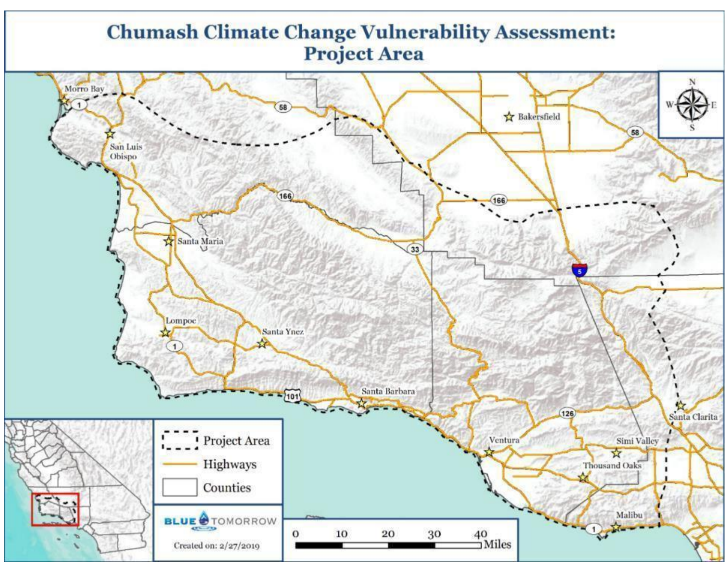
Given the overall lack of staff and funding resources that land managers and Tribes have to address these fire-related issues, cultural preservation may very well fall to the wayside, and highly sensitive resources necessary to the overall cultural wellbeing of the SMBMI community could be lost. As a result, the Tribe has ramped up their planning efforts, working with agency partners to not only identify areas of low cultural sensitivity that are suitable for long-term, repeated dozer trenching, but also to better streamline communication processes between cultural resource managers, incident commanders, and on-the-ground fire personnel during suppression activities. Further, the Tribe is looking to expand their current monitoring support by certifying additional archaeological staff and monitors for work on the fire line and even provide real-time, remote GIS support to agencies. It is with great hope that improved communication and GIS support will also roll over to the post-fire effort, allowing SMBMI to rapidly provide robust information related to foreseeable cultural resource danger and increasing the possibility that this resource damage can be effectively mitigated earlier in the post-fire review process.

Overall, the Tribe has been able to effectively and efficiently communicate information relating to Serrano culture, history, and resources, engage in a way that greatly supports the efforts of their partners, and ensure that the efforts result in cultural resource protection for the benefit of the Tribal community. Moving forward, the SMBMI hopes for continued success in co-stewardship efforts associated with fire-related land management within Serrano ancestral territory and will continue to engage in this process in a way that honors the Tribe's Vision, Mission, and Values.

Santa Ynez Chumash Cultural Resources and Climate Threats

Written by: Teresa Romero

The Santa Ynez Band of Chumash Indians, the only federally recognized Chumash band, is undertaking a number of projects and programs, both on and off Tribally owned lands, aimed at protecting cultural resources from climate change effects. This includes a comprehensive climate adaptation plan with a focus on Chumash cultural sites and resources across traditional Chumash territory. The Santa Ynez Band of Chumash Indians Environmental Office (SYCEO) is leading the efforts in collaboration with other Chumash bands.



Climate Change Effects in Chumash Traditional Territory

Throughout the traditional Chumash territory, the natural landscape has provided sources of food, medicine, building materials, and ceremonial regalia for the Chumash people. In order to evaluate climate change vulnerabilities of the Chumash community, an inventory was conducted of Chumash artifacts, cultural sites, and culturally important flora and fauna. Transportation modes used by the community were documented to determine accessibility to these cultural sites and resources.

Flora

Plants are foraged by Chumash for a variety of purposes, including food, tea, spices, medicine, and ceremonial purposes, and for materials for making baskets, canoes, and other items. A database of native plants used by the Chumash has been developed by SYCEO for 325 different species. This database contains information on plant species and cultural significance, including which plants were found pre- and post-Spanish contact, the usage of the plants (medicinal, ceremonial, material, and edible), fire-follower and fire-treatment plants, and whether these are currently being used by the Chumash community. Within this database, 207 individual plant species were noted as having cultural significance. Information collected from interviews and surveys included 74 plant species that were identified by the Chumash community as having traditionally been and/or are currently being gathered.

Approximately 76% of respondents (22 of the 29 respondents that answered this question) said that they have experienced changes in the availability of plant and animal resources in recent years, with 20 respondents experiencing a decrease in availability. For those respondents who experienced a negative change in plant- and animal-resource availability, common reasons for declines include loss of access, overharvest, drought, lack of instream water availability, and development. Shared knowledge provided by the Chumash community identified 19 plant species that have cultural uses for medicinal, ceremonial, material, and edible purposes. Of these species of cultural importance, the predominant vegetation classes include California forests and woodlands, California chaparral, California annual and perennial grassland, and California coastal scrub.

Fauna

The Chumash consider many animal species to be culturally important. These include terrestrial and marine mammals, saltwater and freshwater fish, marine invertebrates, reptiles, amphibians, and bird species. These animals were traditionally used for food, clothing, and ornamental material (such as the shells of clams) or regarded as culturally or spiritually important (e.g., coyotes, bears, and eagles).

Similar to the Tribal records for plant species, SYCEO maintains a working database of animal species with cultural significance to the Chumash. This database includes 22 different fish species, 42 reptiles, and 16 amphibian species found in the Chumash territory. Also included in this database are 46 different bird classifications from the Samala language, spoken by Chumash in the Santa Ynez Valley. Through community outreach, 48 different marine and terrestrial animals were identified as having cultural significance. Many of the animals that were highlighted by the community survey are found on the coast, including fish and invertebrate species used for food.

Summary of Climate Exposure and Impacts

Climate change effects are anticipated throughout the Chumash traditional territory. Temperature and heat waves are expected to significantly increase. Communities along the coast will experience sea level rise, coastal erosion, and an increase in flooding. Wildfires will vary from year to year, but the average annual area burned is expected to generally increase. Precipitation will also be variable from year to year, but droughts are expected to increase in the latter half of the century.

Both primary and secondary climate change effects are threats to traditional sites and artifacts. Sea level rise poses risks of damage or loss of these sites from inundation and, when combined with high-intensity precipitation events and storm surges, can lead to further threats from cliff erosion and coastal flooding. Increased wildfire prevalence and intensity also threatens traditional places throughout the region.

Other cultural impacts resulting from potential disturbances to plant and animal communities result from a multitude of primary and secondary effects, including changes to temperature, precipitation, sea- level rise, wildfire, drought, and debris flows. These in turn have the potential to alter traditional hunting and gathering practices, timing of spiritual practices, loss of local food sources, loss of traditional medicinal plants, and loss of traditional materials used for jewelry, sculptures, ceremonial pieces, basketry, nets, and lodgings.

Chumash Projects and Programs

In addition to developing the climate adaptation plan, SYCEO leads a native plant propagation program to help promote a healthier, more diverse landscape by encouraging the proliferation of native plants and organic food cultivation. SYCEO developed the first Chumash Community Garden in 2012. The garden is intended to be a demonstration of sustainable gardening techniques that expand the knowledge and palate through the plethora of vegetables and fruits grown there.

SYCEO has supported a number of projects related to the management and restoration of habitat in and around the Santa Ynez Chumash Reservation. The plant database includes native plants to use for restoring the Zanja de Cota Creek, other habitat on Tribal lands, and fire-following and fire-treatment plants. SYCEO has monitored the water quality on Zanja de Cota Creek since 2008 to evaluate overall ecosystem health and to identify sources of pollution into the creek.

Off-reservation projects include working with the U.S. Forest Service to perform on-the-ground surveys and invasive species removal in parts of the Los Padres National Forest (LPNF). An assessment is being conducted to evaluate the recovery of conifer stands burned by wildfire and to develop a restoration plan in the LPNF wilderness. These projects provide some level of adaptive capacity for protecting plant communities and habitats of Tribal importance. One of the challenges for protecting sites and resources off Tribal-owned lands is that it is dependent upon collaboration with external stakeholders.

Cultural Resources

Key Messages

- Tribal cultural resources include intangible cultural beliefs, practices, and traditions as well as tangible physical sites, landscapes, plants, and animals.
- Tribal climate change mitigation strategies should include considerations of both tangible and intangible cultural resources.

Recommendation

Integrate the tangible and intangible cultural, spiritual, and traditional significance of plants, animals, ecosystems, and landscapes into analyses of the consequences of climate change.

Indigenous peoples have lived, hunted, gathered, settled, traded, and traveled throughout North America since time immemorial. The modern descendants of those First Peoples continue to survive and thrive in the lands of their ancestors, and they maintain stewardship of what have come to be known euphemistically as “Tribal cultural resources.” Tribes have long faced many challenges in protecting and preserving these resources, including from the multiplying effects of climate change. From the erosion of ancient burials out of coastal bluffs on the Pacific coast to the disruption of habitats and life cycles for traditional subsistence foods and medicines in the Great Plains and the weathering and loss of ancient petroglyphs and pictographs in the Southwest, climate change is threatening Tribal cultural resources ranging from tangible archaeological sites to intangible cultural beliefs and values (Chang et al., 2020; Tsosie, 2015).

Tribal cultural resources are threatened by the impacts of climate change, but quantifying, managing, and adapting to those threats require a discussion of what constitutes a Tribal cultural resource in the first place. At the most essential level, cultural resources and natural resources—air, water, and earth; plants, animals, and people—are not separate. Thus, any discussion of Tribal cultural resources necessarily encompasses the natural resources on which they depend. Further, Tribal cultural resources cannot be defined in a vacuum, absent the specific cultures and histories from which they obtain their significance. The Western point of view that derives from the long history of colonization and the displacement of Indigenous peoples in North America has historically dominated the way Tribal cultural resources are identified, valued, and protected. One need only review the four criteria for listing on the National Register of Historic Places[42] to see that “significance” largely hinges on what “data” can be preserved or extracted from a “historic” site and that a cultural resource of immeasurable value to a Tribe may not qualify as significant using this Western colonial framing (King & Parker, 1998).

Cultural resources are commonly defined as having a discrete physical location, material composition, and describable, tangible characteristics, but for Tribal cultural resources this is not always the case. Tribal cultural values, practices, and traditions are grounded in both physical and metaphysical realms

[42] National Register of Historic Places: https://www.nps.gov/subjects/nationalregister/upload/NRB38-Completeweb.pdf

that encompass deeply specific and culturally distinct belief systems. For Tribes, it is not just the physical places and objects that are imbued with significance; it is the entire circle of connectedness between Mother Earth and all her children. This connection is so close that many Tribes refer to these connections as kinship relations and reference the denizens of the natural world not as what, but as who (Kimmerer, 2013). This connection is a vitally important consideration for management purposes, yet it is not always fully recognized by non-Tribal entities. For example, the U.S. Forest Service issued a General Technical Report for the Intermountain Region in 2018 that broadly defines cultural resources as “archaeological sites, cultural landscapes, ethnohistoric and historic structures and artifacts, and ethnographic resources” (Flanigan et al., 2018). This definition encompasses Tribal as well as non-Tribal cultural resources, but focuses primarily on resources that can be tangibly identified. In the case of ethnographic resources, the report acknowledges that landscapes are linked to traditional cultural uses and recommends integrating those uses with management plans, which is a good first step; however, Tribal landscape values often go beyond just the physical resources those landscapes may provide. Furthermore, the very use of the term “resources” derives from a Western framework of use and extraction that does not reflect Tribal ways of knowing, understanding, and situating themselves in both the material and the spiritual world.

Tangible Tribal cultural resources extend beyond archaeological sites, artifacts, and landscapes to encompass the plants, animals, and geographies of those places. Climate change impacts habitat and gathering areas for culturally significant species, such as wild rice in the Great Lakes, salmon in the Pacific Northwest, and oak trees in California. It also impacts geographically linked cultural practices; for example, ceremonies based on the changing of seasons and events such as the first snow on a sacred landscape may be disrupted as climate change pushes back or even prevents these events from occurring (Heinsius, 2019).

The values, traditions, histories, and knowledge associated with physical Tribal cultural resources extend the impacts of climate change from the tangible to the intangible. While these effects may not be as visible, they are just as important. In Alaska, for example, as ice melt and sea level rise accelerate, some Alaska Native villages are being forced to relocate to higher ground. This loss of place is the loss of multiple and intertwined Tribal cultural resources. Homes, buildings, structures, cemeteries, and other physical attributes of these villages are connected to cultural values, practices, and knowledges. The loss of places and the concomitant loss of the traditions, histories, and stories associated with those places are losses of immeasurable significance (Maldonado et al., 2013).

Given the tangible and intangible nature of Tribal cultural resources, developing adaptation and mitigation strategies to address the impacts of climate change presents a significant challenge. While federal agencies such as the National Park Service (NPS) are beginning to recognize the effects of climate change on cultural resources, it is instructive to note that the NPS’s “Cultural Resources Climate Change Strategy”[43] includes the word “tribal” a mere eight times in 60 pages; yet, the report is illustrated with

[43] NPS’s Cultural Resources Climate Change Strategy: https://www.nps.gov/subjects/climatechange/upload/NPS-2016_Cultural-Resoures-Climate-Change-Strategy.pdf

multiple photographs of Tribal cultural sites (Rockman et al., 2016). Much like the National Register of Historic Places listing criteria, this reveals yet again that Tribal cultural resources are generally defined physically and archaeologically, with a failure to consider Tribal traditions, knowledges, and values associated with places that cannot be defined in a material way.

To adequately adapt and mitigate climate effects to Tribal cultural resources, intangible values must be considered. To that end, Tribes themselves have been the best stewards of their own tangible and intangible resources and are developing climate change vulnerability assessments and adaptation strategies that explicitly include measures for the protection of Tribal cultural resources. The Makah Tribe, for example, established the Makah Climate Change Workgroup to develop the Makah Traditional Knowledge and Cultural Resource Assessment, which is an effort to identify and create solutions to climate change effects on the Tribe's tangible and intangible cultural resources (Chang et al., 2020). The Makah's assessment suggests focusing on traditional knowledge and community participation to establish historical baselines, identify critical resources, and suggest adaptation strategies, rather than rely solely on Western frameworks and approaches that can omit or ignore the power imbalances and inequalities that are a persistent consequence of colonialism.

Tribal traditional practices can also be used to help mitigate the effects of climate change on Tribal cultural resources. In California, climate change–driven increases in wildfire frequency and severity are being answered by programs to reintroduce traditional land stewardship practices such as cultural burning (Sommer, 2020). Tribes used cultural burning practices prior to European colonization to manage landscapes and promote healthy habitat for important plant and animal species (Anderson, 2013). For the Karuk and Yurok Tribes in the Pacific Northwest, understory fire management has reduced wildfire risks and enhanced the productivity of the California hazelnut, a vital ecocultural resource that is threatened by climate change (Marks-Block et al., 2019).

While the consideration of Tribal cultural resources is broad and inclusive of nearly every aspect of Tribal cultures, traditions, and knowledges, many Tribes are explicitly considering the effects of climate change on classically defined archaeological resources. The Navajo Nation's comprehensive climate change adaptation planning report[44] includes a chapter that considers how climate change will affect the Tribe's multiple significant archaeological sites and provides suggestions for preservation and management. It is important to note that these resources are important not just for their archaeological components but for their cultural and historic significance to the Navajo people—again, combining the tangible and intangible aspects of Tribal cultural resources (Nania et al., 2014).

Appropriate consideration of Tribal cultures, values, traditions, histories, stories, and practices is a vital component of climate change adaptation and mitigation planning. Unfortunately, since the arrival of European colonizers in North America, Indigenous peoples have borne the brunt of colonial practices and Western values that privilege an ethic of dominion over lands, waters, plants, and animals, in deep

[44] Considerations for Climate Change and Variability Adaptation on the Navajo Nation: https://www.bia.gov/sites/bia.gov/files/assets/public/pdf/idc2-060732.pdf

contrast to Tribal ethics of stewardship and communion with nature. Tribal cultural resources, defined only from the Western epistemological frame, have been valued merely for what they can reveal to science rather than by their timeless value to the peoples connected to and culturally sustained by them. Cultural and environmental justice movements are only now starting to grapple with the centuries of harm that have been done to Indigenous peoples and the places, practices, traditions, and values they have managed to maintain. Climate change is a severe threat to Tribal cultural resources that can only be mitigated if Tribal definitions of those resources are included in proposed climate solutions. Tribes must be invited to the table as full partners and not just as tokens to justice, equity, diversity, and inclusion. That means integrating Tribal knowledges and perspectives as the primary drivers of solutions and strategies for the protection of Tribal cultural resources.

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Chapter 9: Emergency Management

This chapter examines the evolution of Tribal emergency management programs and how Tribes apply emergency management principles to climate change initiatives. Some Tribes have qualified for unique funding through the Federal Emergency Management Agency (FEMA). For example, the Quapaw Nation of Oklahoma incorporated climate issues into their FEMA Hazard Mitigation plan. The Standing Rock Sioux of North Dakota detail their fight against the Dakota Access Pipeline and Keystone XL Pipeline, and the Santee Sioux Nation of northeast Nebraska describes how historic flooding caused severe damage. These Tribes stress the importance of storytelling in Tribal emergency management. A researched overview of Emergency Management as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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The Quapaw Nation's Incorporation of Climate Change in Emergency Preparedness Planning

(excerpted and adapted from ITEP's Tribes and Climate Change Profile[45])

Written by: Craig Kreman, Environmental Engineer – Quapaw Nation and Dara Marks-Marino, Institute for Tribal Environmental Professionals

The Quapaw Nation has been seeing the impacts of climate change primarily by way of increases in extreme weather patterns: years with extreme rainfall (365 consecutive days from 2019–2020 saw over 80 inches of rainfall, which was 30 inches above average) are then juxtaposed with seasons of drought. The overarching approach that we are taking to account for climate change is in our emergency management planning.

In 2016, Quapaw's Department of Public Safety Emergency Management officer applied for and received a FEMA grant to create a hazard mitigation (HazMit) plan. This grant allowed us to hire a consultant to develop the more technical aspects of the plan, such as elements

[45] ITEP's Tribes and Climate Change profile of the Quapaw Nation: http://www7.nau.edu/itep/main/tcc/Tribes/plns_Quapaw

involving in-depth GIS mapping, data collection, tabulation, and graphing. FEMA had recently begun requiring the inclusion of a climate aspect in HazMit plans, and by October 2017, we achieved the significant accomplishment of becoming one of the first to incorporate climate into a HazMit plan and have it approved.

Chapter 5 of the Quapaw Nation's HazMit Plan[46] is dedicated to climate change and defines the relationship between climate change and hazard mitigation, the current indications of climate change, the projected future impacts and responses to climate change, and the potential of climate change to impact hazards. Many of the identified impacts of climate change are felt across the region and the world (such as the potential for drought, flooding, severe weather, and wildfire), and others are less common (such as the unknown impact of climate change on earthquakes, which "could be exacerbated as a result of increased liquefaction, due to increased flooding issues. Such scenarios also have the potential to increase the development of sinkholes or mine collapses.") (Bridgeview Consulting LLC, 2017)

Quapaw Powwow Grounds Flooded December 2015. Photo courtesy Quapaw Nation.

Including climate risks in our HazMit Plan has brought significant opportunities for the Quapaw Nation. From a monetary point of view, it has opened the door to receiving other grants from FEMA that can be directed toward pre-disaster mitigation, and, importantly, these grants have either limited or no matching funds requirements. This is critical for many Tribes because matching funds (which are often 40–50% of the project cost) can be a prohibitive factor in embarking on these investments. It is also a win-win situation: grants from FEMA allow the Quapaw Nation to prepare for, mitigate, and address disasters, elevating our sovereignty and reducing the need for a FEMA response when the inevitable emergencies arise.

[46] A copy of the Quapaw HazMit Plan can be obtained by contacting Craig Kreman at ckreman@quapawnation.com.

Just as importantly, including climate risks in our HazMit Plan has deepened the collaboration across Tribal departments. Our Environmental Department and Department of Public Safety have long had a close working relationship, each valuing the synergies between them, and the Quapaw Nation has long been supportive of addressing climate related issues, but this plan has introduced sustainability and climate considerations into the vision of all Tribal functions. This extends to the Quapaw Cattle Company, which is currently working with the Tribe to return mine-altered landscapes back into agricultural fields to better grow corn, beans, and wheat, as well as grazing pasture for cattle. Our Environmental Department also works with the Tribal Historic Preservation Office and Tribal elders to ensure that cleanups of Superfund sites do not impact cultural aspects and that subsistence foods like wild onion, wild asparagus, arrowhead root, and duckweed are all considered when planning for climate and hazard mitigation.

Photo courtesy of Craig Kreman, Quapaw Nation Environmental Office

Another advantage of including climate in our HazMit Plan is that planning for emergency response and hazard mitigation reaches across boundaries that can otherwise be prohibitive for getting buy-in from important stakeholders. For example, although our Tribal elders and leadership are cognizant of climate change, there can be resistance from other sectors on taking climate action. But no one in the area is resistant to incorporating specific preparations and planning to mitigate hazard risks, especially as it relates to flooding. As demonstrated by the steps of the Quapaw Cattle Company, even ranchers in the area are discussing permaculture, silviculture, sustainable agriculture, and using biochar to enhance soil and vegetation.

The Downstream Casino Resort resides along the tri-state marker of Oklahoma, Kansas, and Missouri. Photo courtesy of Quapaw Nation.

The Quapaw Nation's ultimate goals are to not only plan for future risks and mitigate them to the greatest extent possible, but also to become as self-sustainable as we can. Our efforts on self-sustainability have ramped up in the last 10 years and include raising and processing our own meat to supply food for Tribal members, youth in their educational centers, and those who eat at the casinos; raising bees and harvesting the honey to be used in menu items in the casinos as well as selling the honey locally, which has the added benefit of aiding those in the area with allergies; processing and roasting our own coffee; brewing our own beer (another use for the local honey!); and simply utilizing as much of our local products, materials, and plans as possible.

Climate change is a risk multiplier, so framing emergency management planning with the anticipated—albeit unpredictable—impacts at the forefront is one of the keys to our resiliency.

Standing Rock Sioux and Emergency Preparedness

Written by: Doug Crow Ghost from the Standing Rock Sioux Tribe, Great Plains Water Alliance

As the Water Administrator for the Standing Rock Sioux Tribe, I wear a lot of hats. A big focus of the Water Administrator's office is to review, issue, and monitor water permits. We review water projects, maintain fluidity, and ensure that the reservation has water to meet the needs of the people. I'm also the Chairman of the Great Plains Tribal Water Alliance and the liaison between the Army Corps of Engineers and the Standing Rock Sioux Tribe to deal with impacts of the dams and other projects throughout the region. This means that much of my time in the past several years has been fighting the Dakota Access Pipeline and also the Keystone XL Pipeline. Dealing with the Corps is a full-time job, since everything they do impacts our lands and our resources. As water levels fluctuate, we see erosion of cultural sites, especially burial sites in the riparian areas that were flooded or impacted during the Sloan-Pick Plan. Permitting of pipelines by the Corps directly impacts our sovereignty, our safety, and our health, since an oil spill would be disastrous for our communities.

Now, as we experience climate change, we're seeing dryness across the landscape and big changes in the normal water cycle, which in turns affects wildlife migrations, sacred plants, and culturally significant species across the area. This is impacting cultural activities for our Tribal members, since these resources are more difficult to find and less abundant than ever before. Climate change is impacting our water tables and our surface water availability and is creating added challenges in working with the Corps. For example, during the Bomb Cyclone in 2019, they couldn't manage the amount of water coming through the system and ended up flooding several Tribal Nations, including Cheyenne River and Pine Ridge. We are also seeing increasing uncertainty for how pipelines will function in a changing climate. The dryness of the soils and the extreme weather we get mean that pipelines have increased friction and instability and are more likely to burst. This is why it's so important that we continue to fight pipelines and assert our sovereignty over our resources.

Added to all these challenges are things like the current COVID-19 pandemic. Fortunately, here at Standing Rock we haven't had any serious outbreaks, but we are remaining vigilant. We do regular testing, and we have plans in place to deal with these situations. In fact, we modelled our COVID Response Plan off our emergency response plan that was put in place several years ago to deal with a disaster such as a flu epidemic or even a train derailment. I'm part of the incident command team, and I'm currently the acting commander, since I have disaster training and experience from my time in the military. So now we are dealing with responding to a pandemic, fighting pipelines, dealing with the Corps, and trying to plan ahead for the impacts of climate change. As you can imagine, we're pretty busy these days.

Santee Sioux Nation and the Flooding of 2019

Written by: Paige Hingst from the Santee Sioux Nation

The Santee Sioux Nation reservation sits in a beautiful area of northeast Nebraska along the Missouri River. The Village of Santee is the focal point of the reservation, housing Tribal Headquarters and administration buildings. Roughly 1,000 members live on the reservation, with 333 members living directly in Santee.

In early March of 2019, a bomb cyclone hit northeast Nebraska, raising temperatures to 60 degrees Fahrenheit and dumping 1.5 inches of rain. The quickly melting snow and the inability of the frozen ground to absorb the precipitation led to unprecedented runoff into local streams and rivers. Many of the rivers were still frozen over with a thick layer of ice that was broken up and dislodged by the powerful flow of water, thus creating massive chunks of ice that traveled downstream, taking out anything in their path.

Trooper Viterna #480 standing next to ice chunks from the Niobrara River that were left behind after causing all kinds of damage.

Santee was not spared from the destruction of this flood. Five power lines were toppled by floodwaters and ice, leaving the community without power for six days. In addition, damage to the town's main water line caused a break that left the village without water for several days. Several families and elderly citizens had to be evacuated to the casino. The Tribe would eventually shut down to deal with the destruction of the flooding.

All services that the Tribe would usually provide had to be put on halt. For eight days, no waste collection services were available. Roads and bridges were flooded, damaged, or completely destroyed, limiting access to residential and business locations that relied on this service.

Highway 12 at the western edge of the Santee Sioux Reservation. Road completely destroyed by the flooding of 2019.

Not only did the Tribe have to deal with the catch up of day-to-day waste collection, they then had to deal with the debris left over from the flooding. According to studies regarding waste management during floods, two to three times more waste is generated and collected after floods than during normal operations. This can be very overwhelming for a small Tribe that only employs two full-time waste collectors.

With resources being limited, this historic flooding caused major issues for the Tribe. It took several months after the flood to assess damage, clear debris, and clean inundated homes of flooded materials. The high-water table led to wastewater backing up in 13 homes, causing a lot of damage and increasing solid waste materials that needed to be disposed of. With only two employed waste collectors, the collection, transportation and disposal of waste was severely hindered. Tribal members had to wait weeks or even months before their waste was collected due to damaged roads and bridges.

After months and months of assessments, cleanups, and debris clearing, the Tribe finally was able to move on from the flooding. The Tribe is currently working on a Climate Adaptation Plan and hopefully will have something in place by 2021. But how does one prepare for a disaster like this when it was so unexpected, especially when it comes to solid waste management? When roads and bridges are damaged, access is limited to certain areas of a reservation. For Tribes, flooding can have severe impacts to their economy, infrastructure, culture, and environment.

March 14, 2019. Highway 12. About ½ mile is the turnoff to go to Santee. Access was completely blocked by large chunks of ice and floodwaters. The white house in the picture belongs to the Santee Sioux Nation Land Manager. He lost everything in this flood.

Over the last century, Nebraska has seen an increase in annual precipitation totals of about an inch (Shulski & Williams, n.d.). This increase is due to more precipitation in the spring. Future modeling projections show a general wetting trend, with changes in timing and intensity. By mid-century, winter and spring will be 15–25% wetter, summer will be 5–15% drier, and fall will be 5% wetter. Heavy precipitation events along with multiday precipitation events will increase by 25% by mid-century. This shows a need for stormwater management and flood planning and response. We anticipate that climate change will continue to intensify storms and flooding events. But the Santee Sioux Nation is resilient and will continue to find ways to prepare for this, and other, climate related emergencies.

Emergency Management
Key Messages

- It is estimated that currently less than 25% of all Tribal nations have an Office of Emergency Management, and less than 10% of those have full-time emergency managers. Without a Tribal emergency management program, it is deeply challenging to implement and adhere to a number of federal mandates and policies.
- Native Americans have a long and varied history of storytelling and culturally unique ways of communicating with one another and with other communities. When seeking to communicate with Tribes, this rich tradition of storytelling and oral histories should be incorporated.
- Barriers such as a lack of effective leadership at state and federal levels of government have prevented Tribal emergency management programs from making greater progress on responding to and mitigating climate-driven hazards.

Recommendation

Increase resources and support at the state and federal levels to develop Tribal emergency management programs across Tribal nations. Increase coordination with Tribal nations to respond to and prepare for climate-driven hazards.

This chapter explores the relationship between climate change and that of emergency management by looking at the history of emergency management and then addressing the evolution of Tribal emergency management programs. The last part of this chapter will cover the intersection of these two realms, with specific examples of the impacts of climate change in American Indian and Alaska Native (AI/AN) lands.

The History of Federal Emergency Management

On March 31, 1979, President Jimmy Carter signed Executive Order 12127, creating the Federal Emergency Management Agency (FEMA). FEMA coordinates the federal government's role in preparing for, preventing, mitigating against, responding to, and recovering from all domestic disasters, whether natural or manmade, including acts of terror (FEMA, 2020a). FEMA is relatively young, celebrating its 42nd anniversary this year. Tribal nations, on the other hand, as Indigenous residents of the regions, have been practicing emergency management since time immemorial.

The Importance of Storytelling in Tribal Emergency Management

In research conducted by the Pacific Northwest Seismic Network (PNSN), scientific recognition of the earthquake hazards presented by the Cascadia Subduction Zone (CSZ) is relatively recent. Yet Native Americans have been aware of this fault for centuries, as the Native populations have lived on the Cascadia coast for thousands of years, transferring knowledge from generation to generation through storytelling (Ludwin et al., 2005).

In 2007, the United States Geological Survey (USGS) identified a massive earthquake that spawned a huge tsunami that occurred in 1700 (Satake & Atwater, 2007). Across the ocean, Japanese seismologists documented a tsunami in 1700 without any accompanying earthquake. Modern seismologists have attributed this tsunami to a 9.0 earthquake generated by the Juan de Fuca plate. This occurrence has long been documented by Indigenous peoples of the Pacific Northwest (PNW) in traditional stories passed down through the generations.

In a peer-reviewed paper, seismologists emphasized the probability that the Cascadia Subduction Zone would yield tremendous earthquakes (Heaton & Kanamori, 1984). Heaton followed this paper with another about PNW Native American stories that inferred their people were impacted by tsunamis in the past. In the 1990s, a PNSN research scientist began collecting and organizing other Native American stories and traditions that seemed to be related to earthquakes and their effects on the people of Cascadia before westerners arrived (Pacific Northwest Seismic Network, 2019). Native traditions tell of shaking and flooding along the Cascadia coast and estimate the date and time of day of the last earthquake by using stories that count the number of generations since its occurrence. These stories are common among the Native people in the Pacific Northwest. The Tribal elders tell the stories:

"The tide came in but never left. There was a whale in the river, and the people couldn't figure out how it got there." Makah Elder Helma Ward (Paulson, 2002)

The Hoh and Quileute Tribes tell the story of a thunderbird–whale battle that caused the "trembling of the earth beneath and a rolling up of the great waters." The Makah talk of canoes in trees, homes destroyed, and lives lost (People—Run to High Ground, 2018). The Tribal elders related more recent stories of standing in the waters off the Washington coast fishing and watching the waters recede quickly, exposing their nets on dry land, followed by the quick return of the waters, strong enough to knock them over. These stories led to the subsequent correlation of an earthquake off the coast of Japan with the tsunami-like activity off the Washington coast (Zambrano et al., 2019). These stories are not unique to the Pacific Northwest. A collection of stories by Dr. Betty Mae Jumper, a legendary storyteller of the Seminoles of Florida, includes the story of the little frog that tells us to pay attention to the frogs singing, as a warning that the rains are coming soon (Jumper et al., 1994; Seminole Tribe of Florida, n.d.). Recently, Inuit Elders, of the Canadian Arctic, Greenland, Siberia, and Alaska, have told NASA that the Earth's axis has shifted (Dagan, 2015).

Native Americans have a long and varied history of storytelling and culturally unique ways of communicating with one another and with other communities. When seeking to communicate with Tribes, this rich tradition of storytelling and oral histories should be incorporated (NCAI & Pyramid, n.d.). Research has been conducted to examine the way Tribes communicate; the work has been done to collect these stories, and yet not enough has been done to share and incorporate these important findings. There remains a strong disconnect between the way the federal government continues to communicate with the Tribes. While FEMA has improved its Tribal curriculum to include some story telling, it continues to focus on PowerPoint and the loading dock methodology, which is often foreign to Indigenous education. The development of Tribal emergency management curriculum that incorporates storytelling as a means of communicating with Tribes could help the Tribal emergency management and higher education communities bridge this gap.

The Current Environment of Tribal Emergency Management

As of the date of the issuance of this report, the FEMA website does not acknowledge Tribal emergency management agencies in its database (FEMA, 2020b). The closest database that could be found that reflects the number of Tribal emergency management agencies was located at the National Tribal Emergency Management Council's website and is reflective of only those agencies that self-report or are publicly listed for information sharing (NTEMC, 2011). It is estimated at this time that less than 25% of all Tribal nations have an Office of Emergency Management, and less than 10% of those have full-time emergency managers (Zambrano et al., 2019).

Without a Tribal emergency management program, it is impossible to implement and adhere to a number of federal mandates and policies imposed upon the Tribal nations, such as National Incident Management System (NIMS) compliance, mandatory hazard mitigation plans (HMPs) to receive hazard mitigation funding, and the important work that must be conducted to address climate change. If found noncompliant, Tribal nations are susceptible to a loss of funding or ineligible to apply for a disaster declaration.

The Context of Emergency Management Related to Climate Change

To understand the intersection of climate change and Tribal emergency management in the U.S., it's critical to understand the context. This includes understanding the organizational structure of FEMA within the Department of Homeland Security as well as the National Response Framework (NRF) (2019), which dictates how FEMA operates (see Figure 14). Under the existing paradigm, FEMA and the NRF are necessary for effective Tribal emergency management and are increasingly relevant for addressing climate change impacts. It's been shown that climate change is exacerbating natural hazards, including the frequency, intensity, and severity of events such as coastal and riverine flooding, heat waves, wildfire, and hurricanes (Abatzoglou & Williams, 2016; Emmanuel, 2017; Walsh et al., 2018).

The NRF provides foundational emergency management doctrine for how the federal government responds to all types of incidents. The NRF is built on scalable, flexible, and adaptable concepts identified in the NIMS to align key roles and responsibilities across the U.S. The structures, roles, and responsibilities described in this framework can be partially or fully implemented in the context of a threat or hazard, in anticipation of a significant event, or in response to an incident. Implementation of the structures and procedures described herein allows for a scaled response, delivery of specific resources and capabilities, and a level of coordination appropriate to each incident (Department of Homeland Security, 2019).

The NRF also advances progress under the National Security Strategy of the United States of America. The framework helps achieve the strategy's first pillar: to "protect the American people, the homeland, and the American way of life." To accomplish this goal, the strategy calls for initiatives to strengthen the United States' ability to withstand and recover rapidly from attacks and natural disasters (President of the United States of America, 2017).

The NRF is a framework for all types of threats and hazards, ranging from accidents, technological hazards, natural hazards, and human-caused incidents. This framework is utilized to implement NIMS and describes whole community coordinating structures and response activities. The framework outlines government, private sector, and nongovernmental roles to reinforce the National Response Framework for collaborative incident response (Department of Homeland Security, 2019).

In the NRF, the term "incident" includes any occurrence, natural or manmade, that necessitates a response to protect life or property and includes planned events as well as emergencies or disasters of all kinds and sizes. The NRF's structures and procedures address how federal departments and agencies coordinate support for local, state, Tribal, territorial, and insular area governments and how governments at all levels work in unity with private sector and NGOs (Department of Homeland Security, 2019).

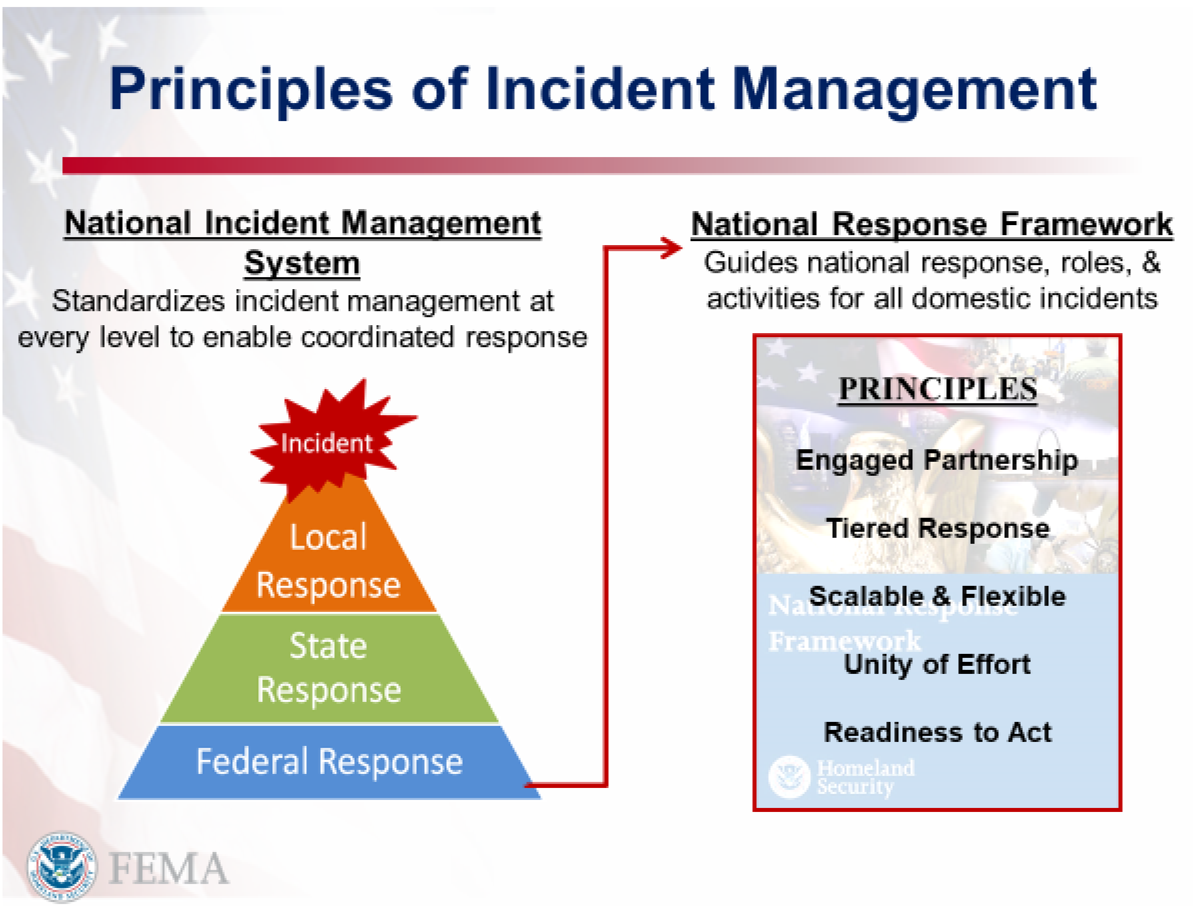

Figure 14. The Principles of Incident Management under FEMA and how the National Incident Management System operates under the National Response Framework. The principles and the framework are increasingly important as climate change is exacerbating hazards and increasing the scope of Tribal emergency management.

Tribal Managed Response

The United States has a trust responsibility with federally recognized Indian Tribes and recognizes their right to self-government. This trust doctrine requires the federal government to protect Tribal treaty rights, lands, assets, and resources while providing support through statutory authority and other programs. Under the Stafford Act (1988), federally recognized Indian Tribes may directly request their own emergency and major disaster declarations, or they may request assistance under a state request. In addition, federally recognized Indian Tribes can request federal assistance for incidents that impact the Tribe but do not result in a Stafford Act declaration. Given their unique position, Tribal governments often have planning and response requirements that are the equivalent to state and local operational coordination during an incident. For example, there are 21 healthcare coalitions that are multiagency coordination groups (MACS) that integrate member organizations with the jurisdictional agencies in the geographic areas in which they operate. Healthcare coalitions are invaluable as public–private partnerships integrating healthcare facilities with emergency medical services, public health, and emergency management. Many Tribal nations have developed coalitions with groups of Tribal governments for the purposes of pursuing funding opportunities, addressing federal government mandates, and addressing emergency management, including the impacts of climate change. One of the largest coalitions conducting this type of work today is the National Tribal Emergency Management Council (NTEMC).

Tribal coordinating structures vary depending on a variety of factors, such as individual Tribal capabilities, population size, and economic circumstances. Tribal nations may have internal coordinating structures and facilities for incident response as well as others that include bordering states and neighboring jurisdictions.

Emergency support functions (ESFs) are included within the National Response Framework to "describe federal coordinating structures that group resources and capabilities into functional areas most frequently needed in a national response" (FEMA, 2020c). ESFs cover 15 different areas of emergency management, including transportation, communications, information and planning, search and rescue, and more. It is important to understand the ESF structure because climate change has a unique impact on each and every one of them. (See Table 3.)

A Tribal Nation's Work on Climate Change Looking through the Lens of ESFs

Over the past decade, for example, the Swinomish Indian Tribal Community has been addressing the impacts of climate change on ESF #8, Public Health and Medical Services. In 2008, the Tribe received a two-year grant from the U.S. Department of Health and Human Services, Administration for Native Americans. In year one, the Tribe conducted an impact assessment, outreach, and strategy (Swinomish, 2009). In year two, the Tribe developed recommendations and an action plan (Swinomish, 2010).

The Tribe reviewed climate data and conducted broad impact analysis, risk-zone mapping, inventory of at-risk assets, and vulnerability and risk analysis. As this work unfolded, the Tribe found the data pointing to direct health impacts caused by increasing wildland fires (ESF #4: Firefighting), which have been exacerbated by climate change. The Tribe chose to produce an impact assessment regarding wildfire risk zones on the reservation (Swinomish, 2009).

Emergency Support Functions (ESF)	Description
1. Transportation	Coordinate the opening of roads and manage aviation airspace for access to health and medical facilities or services.
2. Communications	Provide and enable contingency communications required at health and medical facilities.
3. Public Works & Engineering	Install generators and provide other temporary emergency power sources for health and medical facilities.
4. Firefighting	Coordinates federal firefighting activities and supports resource requests for public health and medical facilities and teams.
5. Information & Planning	Develop coordinated interagency crisis action plans addressing health and medical issues.
6. Mass Care, Emergency Assistance, Temporary Housing, & Human Assistance	Integrate voluntary agency and other partner support, including other federal agencies and the private sector, to resource health and medical services and supplies.
7. Logistics	Provide logistics support for moving meals, water, or other commodities.
8. Public Health & Medical Services	Provide health and medical support to communities, and coordinate across capabilities of partner agencies.
9. Search & Rescue	Conduct initial health and medical needs assessments.
10. Oil & Hazardous Materials Response	Monitor air quality near health and medical facilities in close proximity to the incident area.
11. Agriculture & Natural Resources	Coordinate with health and medical entities to address incidents of zoonotic disease.
12. Energy	Coordinate power restoration efforts for health and medical facilities or power-dependent medical populations.
13. Public Safety & Security	Provide public safety needed security at health and medical facilities or mobile teams delivering services.
14. Cross-Sector Business & Security	Be informed of and assess cascading impacts of health or medical infrastructure or service disruptions, and deconflict or prioritize cross-sector requirements.
15. External Affairs	Conduct public messaging on the status of available health and medical services or public health risks.

Table 3. Emergency Support Functions and Descriptions

Examination of these data revealed that impacts on human health from climate change included heat-related illness (exhaustion, stroke), respiratory problems (asthma, air quality), opportunistic viruses (West Nile, flu), emerging health threats (fungal), and toxins/pollutants (food, air, water). All of these dramatically impact Swinomish Tribal traditions and culture, including but not limited to beach seining, fishing, native plants harvesting, shellfish harvesting, and cultural sites (Swinomish, 2009, 2010).

The Swinomish Tribe determined that there were several major challenges in responding to climate change that have become focal points for implementing their action plan:

- Many disciplines and many moving parts
- Data uncertainties and gaps
- Complex issues and changing circumstances
- Public perceptions and communication
- Funding opportunities, sources, and availability
- Long, indefinite timeframes for impacts

Climate Change and Tribal Lands

Tribal nations have been cognizant of human-caused climate change for several decades. However, many barriers have prevented Tribal emergency management programs from making greater progress to address climate impacts. Chief among these barriers is the lack of resources and support at various levels of government, especially at the federal level from 2016–2020. The lack of leadership at the federal level led to minimal coordination at multiple levels of government, including local, state, federal, and Tribal. Due to this lack of leadership and coordination, Tribal nations are seeing increasingly severe impacts related to emergency management, including coastal erosion and flooding, wildfires, and extreme weather events.

Alaska is often considered ground zero for climate change in the U.S., and the implications for emergency management are stark. Thawing permafrost, shifting animal migrations, melting glaciers, eroding coastlines, increasing wildfires, and many other impacts are making it increasingly challenging to address emergency management in Alaska Native communities (Zielinksi, 2015). For example, the impacts of the encroaching Bering Sea on many villages are of utmost concern for human life and safety. The photo below of Kivalina shows the community’s threatened coastline and efforts to address this issue through shoreline protection. In many cases, the only means of transportation in and out of rural Alaska Native villages is in jeopardy, as damage to critical infrastructure such as airport runways are eroding or are being swallowed by the rising seas. Homes, community buildings, and other critical infrastructure are severely at risk from climate-related impacts in rural Alaska, making emergency management a key department in the effort to address climate change (Bronen & Chapin, 2013; USACE, 2009).

The picture above shows the community of Kivalina, located on the coast of northwest Alaska. The shoreline armoring in the foreground is evidence of extensive efforts to reduce erosion and protect the community from further impacts. Credit: ShoreZone Survey

Wildland Fires in the West

In the past two decades, many Western states have had their hottest summers on record, including the warmest August on record in 2016 (NOAA, 2020). In 2016, snow levels were well below average and snowmelt in the mountains occurred much earlier, leading to the largest decline in end-of-season snow water equivalent since 1980 (Easterling et al., 2017; Hayhoe et al., 2018). In 2015, millions of trees had died in California alone, pushed beyond repair by the record-breaking temperatures and dryness, which reached so far into the soil that even deep-rooted trees could not find moisture. By the next year, the mortality count soared to 100 million (USDA-FS, 2016). High elevations saw nearly 80% tree mortality with 150 million trees dead since the drought's onset (Cal Fire & USDA-FS, 2019). Similar conditions could be found throughout Oregon, Washington, Idaho, and Montana. Higher temperatures and drought continue to increase the frequency of wildland fires (see *Chapter 4: Ecosystems & Biodiversity* for more).

Climate change continues to create exceedingly dry trees and vegetation, fueling some of the largest and most intense wildland fires in recent history (Inciweb, 2020a; Inciweb, 2020b). The Confederated Tribes of the Colville Indian Reservation reported consecutive years of Washington state record-breaking wildland fires. In September 2020, the Cold Springs Fire, one of five major fires burning on the reservation simultaneously, grew to 189,923 acres or approximately 296 square miles. On the reservation, 78 primary structures and 60 secondary structures were lost to the fire (NWPB News, 2020).

In the 2020 fire season, fire radiative power (FRP), defined as the rate of radiant heat emitted by a fire, was measured in the California and Oregon fires. This FRP was reported to be the highest fire intensity in the past 18 years (Borunda, 2020). Across the West, state health departments were overloaded distributing personal protective equipment to residents due to the smoke, contaminants, and poor air quality deemed unsafe to breathe. This was exacerbated by the COVID-19 pandemic, which was already maxing out resources across local, state, and Tribal governments. All of these impacts have serious implications for Tribal emergency management departments directly and indirectly through near-term hazard mitigation, emergency response, and the long-term health and safety of Tribal communities. As multiple emergency incidents are compounded, as they did in 2020, the coordinating structure under NIMS becomes completely compromised, increasing the exposure for at-risk populations.

Extreme Weather in the South

As discussed, extreme weather events are becoming more prevalent, more frequent, and having greater and longer lasting physical, ecological, sociological, cultural, and economic impacts than previously documented (Abatzoglou & Williams, 2018). In the Southeast, many Native American communities have been subject to increasing frequency and severity of hurricanes and flooding events. Recent hurricanes have devastated many parts of the United States, but the U.S. Gulf Coast has been particularly vulnerable to tropical storms and hurricanes. Recent studies have shown that one of the many impacts of climate change on this region has been the greater frequency and intensity of extreme weather events (Carter et al., 2018). In the summer of 2020, the National Weather Service ran out of letters in the alphabet to use for naming Atlantic tropical storms and hurricanes, an event that has only happened once before, in 2005 (Helmore, 2020). The increase in the intensity and frequency of extreme weather exacerbated the ongoing effects of the COVID-19 pandemic, causing tremendous loss of housing, increased homelessness, food insecurity, and economic losses, particularly across minority and Indigenous communities. There remains a strong need for long-term, justice-centered recovery support (Dermansky, 2020; Maldonado & Peterson, 2021). Many southeastern Tribes have been severely impacted by climate change due to the continued colonial-driven injustices, coupled with limited Tribal emergency management programs in this region. Yet Tribal communities are leading actions to protect their lands and lifeways from the rising seas and extreme weather events (Baniewicz, 2020; see also *Chapter 10: Protection-in-Place & Community-Led Relocation*).

In the U.S., Indigenous communities and nations are represented by diverse groups of 574 federally recognized Tribes, 66 state-recognized Tribes, and around 400 Tribes that exist outside either jurisdiction (Government Accountability Office, 2012; National Conference of State Legislatures, 2020). The majority (approximately 80%) of state-recognized Tribes live in the southeastern U.S., with over half of these state-recognized Tribes residing on the Gulf Coast or hurricane-prone areas (McKinley et al., 2019). State-recognized Tribes, as well as unrecognized Tribes, often have decreased access to many resources available to federally recognized Tribes and do not have reservation land (National Conference on State Legislatures, 2016). Federally recognized Tribal members are eligible for healthcare through Indian Health Service (IHS) as part of the trust responsibility and supported through many treaty agreements, case law, Congressional acts, and executive orders, whereas state and non-federally recognized Tribes do not receive these services.

Indigenous communities in the bayous of Louisiana and the Gulf Coast bear particular risk to hurricanes and tropical storms (McKinley et al., 2019; Soqo, 2020). For example, Isle de Jean Charles Biloxi-Chitimacha-Choctaw Tribe's land area has shrunk by 98% since 1955, forcing many Tribal members to move inland and "causing mass changes to Island life." (See narrative titled *Preserving Our Place: Isle de Jean Charles* in *Chapter 10: Protection-in-Place & Community-Led Relocation*.)

There are limited studies on hurricane impacts on state- and non-federally recognized Indigenous peoples that reside in the southern Gulf Coast region (McKinley et al., 2019). One exception is a study where a group of researchers utilized the Framework of Historical Oppression, Resilience, and Transcendence (FHORT) to examine ways that historical oppression and other factors may further affect the livelihoods of and increase adversity for Indigenous peoples as compared to other ethnic groups of this region. Results from this study showed that because most of the southeastern Tribes are state-recognized or unrecognized, their ability to access emergency funding and other resources following natural hazard and extreme weather events such as flooding and hurricanes is limited, and therefore the overall wellness of these Tribal communities is impacted (McKinley et al., 2019). Despite these barriers, many of the Tribes continue to be leaders in coastal restoration and adaptation efforts (Baniewicz, 2020).

In 2016, Hurricane Matthew brought unprecedented flooding to the Lumbee River basin, home to the state-recognized Lumbee River Indians of present-day North Carolina, and may be a preview of the trend for future hurricanes in the region (Emanuel, 2018). Model projections of the combined forces of future flooding from hurricanes, declining water availability along the Lumbee River, and more frequent and intense droughts in the southeastern U.S. suggest changing conditions never experienced by ancestors of the Lumbee. These climatic changes and the lack of federal resources create numerous barriers for adapting to climate change. Yet the Lumbee are confident that, even in the absence of federal recognition, they can adapt to climate change and other 21st-century challenges by using their Indigenous knowledge and their connection to place (Emanuel, 2018).

Conclusions

Across the United States, Native communities are being disproportionately impacted by climate change due to a legacy of colonization, land theft, and broken treaties. This legacy is perpetuated by policies that create haves and have-nots across Tribal nations based on federal recognition status. Under the current emergency management paradigm, most Tribal nations do not have adequate resources to deal with increasing wildfire and hurricane seasons or the damaging effects of widespread riverine and coastal erosion, among other hazards. Tribal emergency management is embedded under FEMA, which requires working directly with federal, state, and local government before, during, and after times of crisis. Yet the lack of flexibility and direct support across these levels of government creates barriers that prevent Tribal emergency managers from having the resources and capacity they require. Native peoples have been practicing emergency management and adapting to a changing climate since time immemorial, but under the current paradigm these historical practices and institutions have been altered and destroyed. A new paradigm must be established in which federal and state partners support Tribal nations through an increase in resources, improved coordination across all levels of government, and respecting Tribal sovereignty. This will benefit Native and non-Native communities alike, and, importantly, it will empower Tribal nations to continue their deep connection to the land.

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Chapter 10: Protection-in-Place & Community-Led Relocation

Climate change is forcing Tribes to pursue protection-in-place and community-led relocation. The narratives that follow reflect the difficulties faced by communities, the strategies being implemented, and the resilience of affected Tribes. The Isle de Jean Charles Biloxi-Chitimacha-Choctaw Tribe of Louisiana has developed a Tribal Resettlement Plan with the vision of their Tribal resettlement acting as a living and active bridge to their ancestral Island, and the Yup'ik people of Kotlik, Alaska, are in the process of a community relocation due to the lack of sea ice no longer protecting their coast from sea surges. A researched overview of Protection-in-Place & Community-Led Relocation as they relate to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendations that the authors have identified.

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Written by: Chantel Comardelle

Isle de Jean Charles is a small ridge of land in southern Terrebonne Parish, Louisiana. "The Island" is home to the Isle de Jean Charles (IDJC) Biloxi-Chitimacha-Choctaw Tribe of Louisiana. The IDJC Tribe settled the Island in the early 1800s, having been pushed into "uninhabitable" lands by European settler colonialism, slavery, and social inequality.[48]

The IDJC Tribe adapted to the changes of living on a secluded island accessible only by boat,[49] living solely off the land and surrounding waters. Soon after settling, the Tribe began farming rice and corn and raising cattle to provide for their families. The Tribal children were denied public education until 1952. In

[47] Preserving Our Place: Isle de Jean Charles: https://nonprofitquarterly.org/preserving-our-place-isle-de-jean-charles/

[48] "The Island," Bienvenue, Halito, Welcome to Isle de Jean Charles, accessed August 17, 2020, www.isledejeancharles.com/island.

[49] "Isle de Jean Charles wasn't always an island. Residents who didn't want to row a pirogue—a flat-bottomed canoe—across the water to nearby town Pointe Aux Chênes could take the wagon trail through the marsh if the tide wasn't high," from Yawn, A.J. (2020, March 3). "As Gulf swallows Louisiana island, displaced tribe fears the future." The American South.

the 1930s, a missionary school was developed on the mainland, in Pointe-aux-Chênes, to which the children went by pirogue; and in the 1940s the Baptist Mission built a church on the Island, which was used as a school.[50]

Island Road August 2020 one day after Hurricane Laura. Photo: Chantel Comardelle

The "Island Road" connecting the Island to Pointe-aux-Chênes was built in 1953, opening the IDJC Tribe to a new world. Crossing the marshland, and wide open to erosion and flooding, this narrow roadway is considered to be both vulnerable and to have added to the Island's erosion[51]. Since 1955, the Island has experienced a 98 percent erosion rate, causing mass changes to Island life. Family homes have flooded and been destroyed by hurricanes.[52] In 2011, the road underwent restoration and elevation; the Tribe was told this would be the final fix. Since 2017, the road has regularly flooded due to the increasingly extreme weather patterns.[53]

The IDJC Tribe has enjoyed generations of bountiful provision from the Island from seafood, agriculture, livestock, and trapping, and the Island has been rich in Native traditions and culture. But our Island is now unable to sustain life fully for our entire IDJC Tribe because of climate change-induced sea level rise, environmental disasters, and subsidence due to levees on the Mississippi River.[54]

The IDJC Tribe has slowly begun to leave the Island due to loss of houses, loss of work, and repeated flooding, starting with Hurricane Carmen in 1974.[55] With each storm, more families have left. Hurricane Lili, in 2002, brought the greatest loss—over fifty families, due to severe flooding and damage.[56] As a result, we are separated, displaced, and losing the ways in which we transfer our knowledge.

Grandparents and Elders are not spending daily time with the children. Younger families are choosing to move off the Island for sustainability. We are losing our survival skills, our sustainable ways of living with and off the land and marsh. The fisheries are not producing the same quality and quantity of catch as decades before. Marsh grasses are dying, and the estuaries are becoming more salt based. Additionally, crude oil from the 2010 Deepwater Horizon Oil spill disgorged into our marsh, closing off our traditional fishing grounds and forcing young folks to change careers in order to provide for their families.[57]

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[50] See "Education," www.isledejeancharles.com/island.
[51] See "The Road," www.isledejeancharles.com/island.
[52] Robynne Boyd, "The People of the Isle de Jean Charles Are Louisiana's First Climate Refugees—but They Won't Be the Last," Natural Resources Defense Council (NRDC), September 23, 2019.
[53] "The Road," www.isledejeancharles.com/island.
[54] "Land Loss," Restore the Mississippi River Delta, accessed August 21, 2020.
[55] Boyd, "The People of the Isle de Jean Charles Are Louisiana's First Climate Refugees."
[56] Yawn, "As Gulf swallows Louisiana island, displaced tribe fears the future."
[57] Chelsea Harvey, "The gulf oil spill literally caused wetlands to sink beneath the waves, scientists say," *Washington Post*, November 21, 2016.

The crafts, traditions, and how we live together with what is around us are disappearing. Basket weaving, which has been a strong connection to our ancestors, is declining—only a handful of Elders are still able to engage in the craft. Our lifeways that make the IDJC Tribe who we are have been cut off. Our younger generations are no longer here to learn from the Elders. The slow exodus of people forced to leave has caused a rift blocking our natural flow of history and cultural transfer.[58]

Aerial image of Isle de Jean Charles 2018. Photo: Isle de Jean Charles Biloxi Chitimacha Choctaw Tribe

We have long held hopes of reuniting our IDJC Tribe in a safe, sustainable, new community, and putting our traditions and culture back together. In 2000, and then in 2002, Tribal council members advocated for the U.S. Army Corp of Engineers and local government officials to help our Tribe overcome the changes. Attempts to help our Tribal citizens move were stalled, due to outside forces and social injustice;[59] but continued planning for resettlement and to reunite the Tribe proved to be helpful when the state of Louisiana applied for the Housing and Urban Development (HUD) National Disaster Resilience Grant in 2015, which included our Tribal Resettlement plan, and then when the state of Louisiana was awarded a grant of $48 million in 2016 to build our envisioned resettlement.[60] We envision our Tribal resettlement as a living and active bridge to our ancestral Island. Our relationships, ways of life, and identity will be supported by a community center, a museum, and gatherings on acreage inland—all toward the entire Tribe moving back together.[61]

But that hope to breathe Spirit into our Tribe has dwindled due to the state of Louisiana's slow response and improper execution of the HUD National Disaster Resilience Grant. In the last significant amendment,[62] the state made it clear that the IDJC Tribe was no longer a beneficiary of nor involved in the grant process.[63]

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[58] For more on the history of Isle de Jean Charles, see Andrew Yawn, "Why is Isle de Jean Charles disappearing? A timeline of land loss," The American South, *Daily Advertiser*, updated March 1, 2020.

[59] The community the Tribe was looking to move into protested the development. See "Terrebonne officials visit Isle de Jean Charles," *Houma Today*, October 19, 2009; and Charquia Wright, "Unmasking Western Science: Challenging the Army Corps of Engineer's Rejection of the Isle de Jean Charles Tribal Environmental Knowledge under APA Arbitrary and Capricious Review," *UCLA Law Review*, March 26, 2020.

[60] Coral Davenport and Campbell Robertson, "Resettling the First American 'Climate Refugees,'" New York Times, May 2, 2016.

[61] See "Tribal Resettlement," accessed August 21, 2020.

[62] Louisiana Office of Community Development—Disaster Recovery Unit, *State of Louisiana Substantial Amendment No. 5: Introduction of New Activities and Project Narrative Clarifications for the Utilization of Community Development Block Grant Funds Under the National Disaster Resilience Competition (NDRC) Resettlement of Isle de Jean Charles*, Disaster Recovery Initiative, U.S. Department of Housing and Urban Development, submitted to HUD: April 23, 2019.

[63] "[T]he planned resettlement of Louisiana's Isle de Jean Charles Biloxi-Chitimacha-Choctaw Tribe, whose ancestral island has nearly disappeared, has been mired in a conflict over tribal sovereignty. The tribe's leaders say they're not being treated as co-collaborators—in fact, they learned about the state's purchase of land for resettlement by reading a press release. State officials say they have tried to work with those leaders but are 'not in a legal position' to acknowledge the sovereignty of a tribe that is not federally recognized" (Barry Yeoman, "As Sea Level Rise Threatens Their Ancestral Village, a Louisiana Tribe Fights to Stay Put," Natural Resources Defense

Isle de Jean Charles 2018. Photo: Isle de Jean Charles Biloxi Chitimacha Choctaw Tribe

The grant did not turn out to be the catalyst for recreating the self-sustaining society we once loved, but we remain committed to our vision. The Tribe has invested in "Preserving Our Place," a movement to preserve the Island and the IDJC Tribe's long legacy of traditions, culture, and history.[64] In November 2019, the IDJC Tribal Council approved the first Tribal Museum Policy. The establishment of our own Tribal Museum and Culture Center, the first step to realizing our goals, has many moving parts. Community gardens, storytelling activities, craft demonstrations, and historical exhibits are just the tip of the iceberg.

The effort to ensure that the Island does not erode and the IDJC Tribe does not erode along with it is the most important piece of this puzzle. For a displaced, impoverished, and marginalized community, the means to undertake such a task are minimal.

In order to fully accomplish our goal, we, the people of the Tribe, the community, and the country, must ensure that the communities facing climate migration and resettlement are fully resourced. Communities dealing with these grave climate conditions need everyone to rally behind their vision to ensure the preservation of their place and come alongside them in solidarity. The solidarity should include everyone, from the federal government to philanthropy. The Government Accountability Office issued a report in July 2020, stating, "We recommended Congress consider establishing a federally-led pilot program to help communities interested in relocation."[65] The report clearly states that there are many complex problems with the current resettlement plan.

For more information on the Isle de Jean Charles Tribe and other communities, follow our story on www.isledejeancharles.com and on our Facebook page.

Resilience in Kotlik, Alaska

Written by: Philomena Keyes, Tribal Resilience Coordinator – Village of Kotlik

Adapting to climate change along with intensive development pressures on our coasts will be an ongoing challenge into the future. The intensifying impacts of climate change are already leading to changes in our coastal environments. People within our coastal communities will need to become more aware of climate change effects and either accept the changes and live with them or start adapting their

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Council [NRDC], April 13, 2020). And see Julie Dermansky, "Isle de Jean Charles Tribe Turns Down Funds to Relocate First U.S. 'Climate Refugees' as Louisiana Buys Land Anyway," *DeSmog* (blog), January 11, 2019; and Julie Dermansky, "Critics Say Louisiana 'Highjacked' Climate Resettlement Plan for Isle de Jean Charles Tribe," DeSmog (blog), April 20, 2019.

[64] "Preserving Our Place" (project and website page in process), accessed August 21, 2020.

[65] "CLIMATE CHANGE: A Climate Migration Pilot Program Could Enhance the Nation's Resilience and Reduce Federal Fiscal Exposure," U.S. Government Accountability Office, July 6, 2020, gao.gov/products/GAO-20-488.

communities so that they become more resilient to the impacts of climate change that we are already experiencing.

2013 fall storm flooding.

There are clearly benefits from increasing people's awareness of climate change impacts and acting now to adapt and provide for a more resilient community in the future.

Climate change already affects the lives and culture of our Yup'ik people who depend on traditional ways of acquiring and storing their food. It is the most pressing environmental issue of our time, affecting all regions, nations, Tribes, and both current and future generations. Without cold, the ice on rivers and coastlines is thinner and travel becomes dangerous, making hunting, fishing, and other activities more challenging, and this can lead to loss of life and infrastructure.

Much of the landscape of southwestern coastal Alaska is tundra, which is becoming unstable. There are no large trees that can be used as a lumber source for new homes or buildings, and there is limited or no gravel for foundations and roads. Most building materials must be shipped in seasonally.

The lack of sea ice worries community members during the winter storm and flood season because that is what protects us from chunks of ice flowing into the Kotlik River. The river is open longer, and the ice is thinner and less stable. Structures and homes are now a few feet from the riverbank. Outbuildings and sheds, food storage areas, drying racks, smokehouses, the AC Retail Store, utility poles, personal homes, and public buildings are all threatened.

In 2013, a particularly strong storm surge flooded the Kotlik slough, causing severe damage when ice chunks were shoved up the banks. The surge and ice chunks destroyed the water and sewer facilities, damaged homes and buildings, and destroyed the boardwalk through the village. The main sewage-discharge line was damaged, and for a long-time residents had to use "honey buckets," which are 5-gallon pails lined with garbage bags, for toilets. These are difficult to manage and dump. The broken sewage line spilled raw sewage on the ground, and the flood water spread the sewage throughout the community. It has now become typical to have regular coastal flood warnings, with sea levels rising more than 10 feet and storm surges pushing water upriver.

Because of the severity of erosion and the lack of land to construct homes and businesses, the option to relocate the community to a whole new site was taken into consideration by members of Kotlik.

In 2018, a survey on community relocation was conducted by the IGAP Departments from two of the three Tribes in Kotlik. 82% were willing to move to higher grounds, and 61% of the participants were willing to move without utilities. The two relocation sites suggested by the community were Reindeer Camp, located northeast of Kotlik near Coffee Point, and Hamilton, which is located upriver from Kotlik. The majority of the votes went toward Reindeer Camp.

2013 fall storm damage to the community.

The main barrier we face while dealing with the rapidly changing climate in our village is funding. The Village of Kotlik Tribe is coordinating with agencies across the federal government system to ensure that they work together effectively to receive funding and technical assistance for the village. The planning and application process takes up a lot of time. Currently the Kotlik Tribe is completing studies to assess the long-term risks to our current site and the habitability of our two desired relocation sites.

While working on the long-term relocation plan, the Kotlik Tribe decided to migrate high-risk homes to a new subdivision within the village, but the actual project will not be underway until 2022. By then, a few of the threatened homes will definitely either be destroyed or unlivable.

While waiting to move forward with our projects, significant environmental threats can occur. Once homes, sheds, and other property end up in the river, fuel, hazardous material, human waste, snowmobiles, ATVs, and boats could also be released into the river. Exposure of hazardous waste in the river could contaminate drinking water, fish, and birds. Costs from environmental cleanup, medical costs related to injuries or deaths, and costs of residents' relocation could result in much higher costs than avoiding relocation of homes at all.

Home affected by permafrost and erosion and that is a first priority to move away from the riverbank. However, it cannot be moved due to an unstable foundation.

Currently our safety, wellbeing, and future are at stake. If we do not mitigate the impact of climate change and unpredictable storms on our community, we will be forced to leave. With the high demand for assistance from concerned individuals, the Tribe was forced to seek emergency funding in 2019 to elevate and move homes away from the eroding riverbank to protect them in the event of another natural disaster. This project concluded in the fall of 2020.

Protection-in-Place & Community-Led Relocation

Key Messages

- Climate change impacts on infrastructure can be an existential threat to communities and profoundly impacts the health, wellbeing, and safety of residents as well as Tribal lands, territories, and resources.
- Many Tribal communities are pursuing adaptation actions, including protection-in-place, moving infrastructure within or adjacent to the current site, and community-led relocation.
- Lack of funding, agency coordination, local capacity, and technical assistance are the primary barriers to protecting infrastructure.
- Nationwide, at least $6.2 billion is needed over the next 50 years to protect, replace, and move existing Tribal infrastructure (ATNI, 2020; DOI, 2020). This amount includes at least $175 million needed annually nationwide over the next 10 years.
- Due to inequitable regulatory barriers and program design, small Tribal communities are generally disadvantaged or excluded from federal programs relevant to climate adaptation.
- There is an immediate, urgent need for action to support Tribal nations and Indigenous communities on the frontlines of the climate crisis.

Recommendations

- Provide at least $175 million annually for proactive adaptation projects that empower and honor community decision-making, sovereignty, and self-determination, consistent with the federal government’s trust and treaty responsibilities. This can be accomplished by dedicating funding to a lead agency and reducing barriers that Tribal communities face in accessing existing programs and resources.
- Create an all-of-government coordination structure to support Tribes in addressing environmental threats.

Flooding in Buckland, Alaska, May 2021. Photo credit: John Jones.

Background

Identification of the Problem

Widespread loss of Tribal infrastructure due to climate change is occurring now. The physical and cultural infrastructure includes, for example, Tribal gathering points and accessways to essential lands, waters, and all living relatives for practicing traditions, cultural practices, hunting, fishing, and other harvesting activities (DLGSC, 2018). Maintenance of these types of infrastructure is critical to public health, livelihoods and economies, community wellbeing, culture, and heritage (ATNI, 2020), especially considering many Indigenous peoples' profound relationship with their homelands. Even if global greenhouse gas emissions are reduced to zero today, impacts will increase in severity due to inertia in the climate system. Current federal programs and policies are ineffective at supporting Tribes with adaptation actions, including protection-in-place, moving a portion of the infrastructure within or adjacent to the current site, and community-led relocation (GAO, 2020; UUSC & Rising Voices-Working Group, 2021). Tribes across the country are leading climate adaptation actions and challenging legal and policy issues (Burkett et al., 2017). There is an immediate, urgent need for action to support Tribal nations and Indigenous communities on the frontlines of the climate crisis and uplift the actions of which they have long been at the forefront.

Tribal nations and Indigenous communities across the U.S. are being forced to involuntarily respond to the impacts of climate change on community infrastructure, livelihoods, and culture (Bennett et al., 2014; GAO, 2020; Jantarasami et al., 2018; Steen-Adams et al., 2020). Impacts such as flooding, erosion, wildfire, permafrost degradation, and decreased access to and abundance of food are compounding long-standing and existing threats, social disparities, and historical traumas and injustices. These impacts, combined with the legacy of settler colonialism and worldview of ecological domination (Whyte, 2018), are harming the interrelated conditions of Indigenous health, food security (Inuit Circumpolar Council Alaska, 2020: 47), language, economies, cultural practices, social networks, and more (ATNI, 2020; Brown et al., 2012). The current laws, regulations, management structures, and bureaucratic systems derived from historical processes of structural violence (IDJC, 2019), the lack of culturally appropriate institutional mechanisms to support adaptation responses, and inequitable adaptation policies magnify Tribal disenfranchisement by disrupting traditional lifeways, livelihoods, communities, cultures, and spiritual connections to place (Lowlander Center, 2015; Maldonado & Peterson, 2018; Marino, 2015, 2018).

The impacts of climate change on Tribal infrastructure are widespread across the U.S. For instance, at least 144 Alaska Native communities face some amount of infrastructure damage from erosion, flooding, and permafrost thaw (UAF et al., 2019). In the Pacific Northwest, due to threats from tsunamis, storm surge, and riverine flooding, the Hoh Tribe, Quileute Tribe, and the Quinault Indian Nation, for example, have been working to move villages and critical community facilities to higher ground for over a decade (Burkett et al., 2017; Papiez, 2009; Quileute Tribe, 2011, 2017; Quinault Indian Nation, 2017, 2019; Sharp, 2019; Smith, 2020; Walker, 2012). In coastal Louisiana, the Isle de Jean Charles—home of the Isle de Jean Charles Biloxi-Chitimacha-Choctaw Indians of Louisiana—has lost 98% of its landmass since 1955 due to rising sea level and erosion, including caused by oil and gas companies dredging canals through marshland (Comardelle, 2020; Lowlander Center, 2015; see narrative titled *Preserving Our Place: Isle de Jean Charles*).

Responses to climate impacts to infrastructure include protection-in-place (e.g., building a seawall, hardening shorelines to reduce erosion, and using sand bags), moving a portion of community infrastructure to an adjacent, safer area that is less vulnerable to climate change impacts, and community-wide relocation to a new site, which is the option of last resort when protection-in-place is no longer feasible (see Figure 15). Tribes continue to face vast unmet infrastructure needs across response strategies, particularly for implementation (there is more support for planning) (ATNI, 2020; GAO, 2009, 2020; House Select Committee, 2020; Steen-Adams et al., 2020).

Figure 15. Common types of solutions to climate impacts to infrastructure in Alaska Native communities. Source: DeLue, M.; Alaska Climate Adaptation Science Center. ANTHC, DCRA, et al., draft report.

As the Intergovernmental Panel on Climate Change (IPCC) and other scientists have affirmed, the Arctic is experiencing rates of warming at least two times as fast as other regions of the globe (Anisimov et al., 2007). With approximately 40% of the total number of Tribes in the political subdivision that makes the U.S. an Arctic state, this should be a substantive cause for concern. In Alaska, over the next 50 years, $4.35 billion will be necessary to protect existing infrastructure in 144 threatened communities (ANTHC, DCRA, et al., draft report). $90–110 million annually is required over the next 10 years. The vast majority of this unmet need is required to implement solutions, such as building sea walls, moving houses, creating new subdivisions, and replacing infrastructure that cannot be moved (ANTHC, DCRA, et al., draft report).

None of the 144 environmentally threatened Alaska Native communities have completed site-specific risk assessments that include climate change. Funding risk assessments for these communities is estimated to cost $32 million and is the highest near-term priority to support adaptation actions from protection-in-place to community-led relocation. These risk assessments should be completed by 2025. Completing risk assessments can effectively address the remaining gaps in our understanding of the threat to Tribal communities.

For Tribes in the contiguous U.S., the total estimated funding needed for infrastructure project implementation and needs assessment is at least $1.9 billion over the next 25 years (ATNI, 2020). This value consists of $462 million for planning and $1.4 billion for implementation. If this value was spread out over 25 years, it would equate to about $75 million per year for the implementation of projects that have already been identified. However, these numbers are significantly underestimated, as infrastructure planning has not been conducted or completed for most Tribes in the lower 48 states. The cost estimates that were documented only included those identified during a limited period of time and only include the physical, tangible impacts (ATNI, 2020).

To date, there has been limited progress to support protection-in-place or community-led relocation actions in the 144 Alaska Native Tribes and communities that the 2019 Denali Commission Statewide Threat Assessment found to be facing some amount of infrastructure damage from erosion, flooding, and permafrost thaw (UAF et al., 2019; see also GAO, 2009). For example, the Traditional Council of Newtok in Alaska has monitored local erosion for decades, leading to initiating a relocation planning process in 1994 (Newtok Planning Group, n.d.; Swan, Naquin, & Tom, 2015). However, it took nearly two decades before the first Newtok residents moved to their new site at Mertarvik (Newtok Planning Group, n.d.). The relocation is still incomplete due, in part, to the challenges of securing funding for infrastructure at the new site (Ristroph, 2017).

Barriers

There are several distinct challenges and barriers faced by environmentally threatened Indigenous peoples and communities across the U.S. regarding unmet human needs and funding access. Presently, there are limited funds and institutional support for community-wide responses, including relocation (GAO, 2020; Maldonado et al., 2013), and no lead entity or overarching structure, resulting in entire relocation processes held up when problems unfold with one agency (GAO, 2009). Comprehensive and coordinated responses are needed to facilitate a clear and organized management plan (UUSC & Rising Voices-Working Group, 2021). Unclear federal leadership, such as no federal agency having the authority to lead federal assistance for climate-driven relocation, inhibits the ability of federal agencies to provide effective assistance to communities (ANTHC, DCRA, et al., draft report ; Bronen & Chapin, 2013; GAO, 2009; GAO, 2020; Herrmann, 2017; Maldonado et al., 2013; Meeker & Kettle, 2019; Newtok Planning Group, 2007; Ristroph, 2019).

"The three primary challenges and barriers faced by environmentally threatened communities are: (1) Insufficient funding to support all stages needed to address environmental threats; (2) Difficulty navigating the objectives and limitations of the programs and processes to address environmental threats; (3) Coordinating piecemeal funding into a cogent response is slow, exhausting, and ultimately increases the cost of the solution." (ANTHC, DCRA, et al., draft report)

Regulations, requirements, and the design of most federal programs relevant to climate adaptation disadvantage or exclude small Tribal communities (ANTHC, DCRA, et al., draft report). Furthermore, federal programs that can address environmental threats often do so without providing adequate technical support (ANTHC, DCRA, et al., draft report; Steen-Adams et al., 2020).

Recommendations

<u>Alaska Native Tribes</u>

The immediate urgency of the climate crisis and the problems and barriers articulated above calls for urgent solutions. The following recommendations specific to the needs of Alaska Native Tribes were made to the DOI Bureau of Indian Affairs Office of Trust Services Tribal Resilience Program (2020) and are currently being expanded by the State of Alaska and Alaska Tribal Organizations to Alaska Native Tribes with proposed review by representatives of Alaska Native Tribal Government Consortia.

1. **Provide a clear, explicit policy directive to federal agencies to adjust existing programs to better meet the needs of Tribal communities' climate change adaptation efforts**. This includes identifying and eliminating challenges faced by Tribes in accessing agency resources and services.

2. **Provide a single, committed source of funding for environmentally threatened Alaska Native communities.** Piecemealing funding is expensive, slow, and increases the cost of the solution. A lead funding agency that provides adequate technical support would significantly increase the efficiency of federal support for Alaska's threatened communities.

3. **Increase funding to federal programs with a demonstrated track record of success.** In addition to creating a lead funding agency with dedicated funding to address gaps, funding should be continued or increased to federal programs that have proven effective for addressing environmental threats. Examples include the Denali Commission Village Infrastructure Protection Program and the Bureau of Indian Affairs Tribal Climate Resilience Program.

4. **Design programs to be equitable.** Resources should be allocated to communities based on risk, funding should be set aside for small communities, and agencies should identify alternatives to cost-match requirements, including providing 100% federal cost share for Alaska Native communities. The Denali Commission Statewide Threat Assessment Combined Rank can be used as a criterion for risk-based decision-making.

5. **Create an all-of-government coordination framework designed to support Alaska Native Tribes and communities with climate change adaptation.** An all-of-government coordination structure within Alaska is needed to facilitate interagency collaboration, leverage resources, and coordinate expertise across all levels of government, nongovernmental organizations, and the private sector. Such actions should be guided by and done in collaboration with Alaska Native Tribal governments.

American Indian, Alaska Native Tribes, and Indigenous Communities, Including Native Hawaiians and Pacific, Caribbean, and Other Islanders

We also recommend the following that apply more broadly to American Indian, Alaska Native Tribes, and Indigenous communities, including Native Hawaiians and Pacific, Caribbean, and other islanders. Given the global conditions of climate change, these recommendations need to be urgently acted upon:

1. **Uphold the right to proactively adapt, within a sustainable, just, holistic, and transformative human-rights framework.** Indigenous peoples across the U.S. have proactively adapted to their respective environments and ecosystems. They are also experts at sustainable development, and for centuries and millenia they have maintained a holistic worldview, understanding their interrelated place in the natural world. Therefore, proactive planning should be done consistent with the *United Nations Declaration on the Rights of Indigenous Peoples* (United Nations, 2007), which the United States government announced its support of in 2010 (White House, 2010). Such a human-rights framework directly contributes to transformative and just actions in response to the impacts of climate change.

2. **Uphold the federal trust responsibility to Tribes facing protection-in-place and relocation**. The U.S. government has both a trust responsibility and fiduciary obligations to provide support. Ensure that the federal government upholds its trust responsibility to Tribes facing issues related to protection-in-place and relocation through government-to-government relationships and direct consultation. Rather than demanding Tribes conform to agency requirements, these efforts must honor the right of self-determination and sovereignty and be guided by Indigenous

peoples' knowledge and wisdom. Provide resource support for options for Tribes whose rights on existing reservations are threatened by climate change. "The loss of land does not mean the loss of rights. Treaties also include water and hunting rights, not just the land" (RV, 2019; see also House Select Committee, 2020). The process of securing land for community relocation is extremely challenging. Land-exchange programs that can facilitate access to more viable lands could better support communities facing these challenges and uphold the federal trust responsibility (Steen-Adams et al., 2020).

3. **Support community-led and community-wide adaptation that empowers and honors community decision-making, sovereignty, and self-determination** (IDJC, 2019; Lowlander Center, 2015; Maldonado & Peterson, 2018; Steen-Adams et al., 2020). Current barriers to community-wide adaptation strategies such as relocation create a denial of the distinct rights of Indigenous peoples displaced by climate change, especially rights to life, self-determination, sovereignty, food security, physical and mental health, housing, and physical and cultural integrity and heritage (Bronen, 2011; House Select Committee, 2020; Maldonado et al., 2013; UUSC, 2017). The right to self-determination is the prerequisite for adaptation strategies, including the relocation process (Bronen et al., 2018; see also Jantarasami et al., 2018; NRC & AIJ, 2017). Self-determination means that Indigenous peoples have the right to identify their priorities and to make decisions regarding adaptation and mitigation strategies, which includes the right to make fundamental decisions about when and how to address environmental threats and where their community is located (Bronen, 2011, 2014), as well as the right to free, prior, and informed consent, which is sourced in the right of self-determination (Article 10, United Nations, 2007).

   The Indigenous peoples who are adapting should be the ones framing the adaptation response strategies and priorities, not the supporting institutions. Adaptation support must occur not only at the individual and property-owner level, but also at the community and collective level, established through relationships and practices, as opposed to geographical boundaries (Marino et al., 2019). Climate change adaptation and resilience responses are most effective when they are community-led, from the visioning through implementation and beyond, to meet community priorities and ensure success after the physical resettlement (Clement, 2021; Lowlander, 2015; Marino et al., 2019; Steen-Adams et al., 2020). Most federal policies and programs are written and designed based on individual—not collective—rights. For many Tribes, nations, and Indigenous communities, being recognized as a community, and not just individuals, requires flexibility of policies to provide and gain community-wide support. Providing support only at the individual level for processes such as relocation further disrupts community cohesion and perpetuates harms such as loss of culture and identity incurred through forced assimilation policies (Maldonado, Marino, & Iaukea, 2020). Such objectives should be realized at both the national and international level within the context of the UN Framework Convention on Climate Change and all related documents and bodies.

   The framing and language around adaptation responses should also uphold community or collective rights, actions, and self-determination. There is danger in the current public discourse framing adaptation movements as "managed retreat," calling to question managed retreat by and for whom (Philippe et al., 2020).

4. **Maintain continued access to land, waterways, traditional foods, and cultural resources that Indigenous peoples use as traditional ways of life.** Even in relocation, although the land is no longer permanently habitable, Indigenous peoples have a right to maintain access and stewardship of place, including exercising cultural practices (Lowlander Center, 2015; Steen-Adams et al., 2020). Such matters should be undertaken in collaboration and cooperation with Tribal governments and consistent with federal trust responsibilities and the *UN Declaration on the Rights of Indigenous Peoples*.

5. **Appoint a lead federal funding agency for the implementation of protection-in-place and community-led relocation in Tribal communities.** This also includes increasing funding to effective federal, state, and local programs and making programmatic and policy changes to existing programs.

6. **Prioritize implementation funding and the full costs of adaptation actions from protection-in-place to community-led relocation.** The full costs of protection-in-place and relocation—from visioning to implementation and continued support—must be properly accounted and budgeted for; otherwise, those relocating will unjustly bear the externalized costs (Steen-Adams et al., 2020). Substantial commitment to protect existing infrastructure as well as closing infrastructure gaps should be recognized in every protection-in-place and relocation response (ANTHC, 2019; ANTHC, DCRA, et al., draft report; Clement, 2021; Comardelle, 2020; GAO 2020; House Select Committee, 2020; Kawerak, 2019; Keyes, 2020). Expand beyond benefit-cost analysis, which does not account for the distribution of costs and benefits or important social and cultural factors for survival and sovereign rights. Include nonmaterial components like histories, practices, and ways of life, critical social services, as well as hunting, fishing, harvesting, and other cultural practices that are essential to thriving, healthy communities (Maldonado, Marino, & Iaukea, 2020). Tribes and Indigenous peoples should not be strapped with cost sharing or funding match requirements (Steen-Adams et al., 2020; UUSC & Rising Voices-Working Group, 2021), including alleviating the onerous burden to respond to risk assessments. All threatened Tribal communities should receive technical assistance and funding to complete site-specific risk assessments to develop informed solutions. Data collection and risk assessments are estimated to cost at least $32 million for Alaska communities alone and should be completed by 2025 (ANTHC, DCRA, et al., draft report). In collaboration with the communities' identification of the metrics to use, an independent monitoring group could help evaluate whether community plans and priorities are being met and include a mechanism to accommodate the community's right to redress.

> "Risk assessments are necessary to help communities answer, 'Can we continue to live here?' and, 'If yes, how can we continue to live here?' Completing community-specific risk assessments should be done as soon as possible," (ANTHC, DCRA, et al., draft report).

7. **Innovate creatively.** Workforce development and innovative creation of infrastructure and a strong economy are key elements for rebuilding vibrant communities adversely impacted by conditions triggered by others and beyond their control. In the context of protection-in-place and community-led relocation, Tribes must have access to programs that employ innovative technology in regard to durable infrastructure, which may also contribute to strong local

economies and workforce development and overall cultural integrity. In order to be comprehensive, such objectives should be integrated into federal responses to the climate crisis as well as the unmet needs of Tribes and their communities.

Conclusion

Proactive planning for adaptation strategies must support community-led adaptation that empowers and honors community decision-making, sovereignty, and self-determination, consistent with the federal government's trust and treaty responsibilities and the *United Nations Declaration on the Rights of Indigenous Peoples*. The right to self-determination is the prerequisite for adaptation strategies, including protection-in-place and the relocation process. Climate change adaptation and resilience responses are most effective when community-led, from visioning through implementation and beyond.

Tribal leaders and organizers are taking actions, choosing dignity over victimization (RV, 2016). For example, in their community's vision statement, the Alaska Native Village of Shishmaref does not focus on relocation, but rather on being a "safe and resilient community. We want to be a viable community that respects and honors our Inupiat culture and traditional values" (HDR with Rim First People, Cox, & Eningowuk, 2016). Shishmaref leaders started using "site expansion" instead of "relocation" to enable more projects for the community in place, such as a new fuel tank farm, a new health clinic, an expansion to their public school, work on getting paved roads, a new washeteria, and repairing and upgrading the airport; tens of millions of dollars are still needed for shoreline protection, and there's a need for potable water (HDR with Rim First People, Cox, & Eningowuk, 2016; Maldonado et al., 2021).

The Isle de Jean Charles Biloxi-Chitimacha-Choctaw Indians of Louisiana, despite the "state of Louisiana's slow response and improper execution" of the U.S. Housing and Urban Development National Disaster Resilience Grant for the Tribe's resettlement, is continuing to pursue community resettlement, committed to keeping their community intact and preserving their place (Comardelle, 2020). The Isle de Jean Charles Biloxi-Chitimacha-Choctaw Indians of Louisiana, Pointe-au-Chien Indian Tribe, Grand Caillou/Dulac Band of Biloxi-Chitimacha-Choctaw, Atakapa-Ishak-Chawasha Tribe of the Grand Bayou Indian Village, and the Native Village of Kivalina, faced with climate-forced displacement, came together with partners to file an official complaint to the United Nations for their experiences of "ongoing human-rights violations caused by the United States government" (Alaska Institute for Justice, 2020).

Several Washington coastal Tribes are developing their own proactive plans for relocation actions to safeguard the health and safety of their citizens (for example, see Hoh Indian Tribe, 2009; Quileute Tribe, 2017; Quinault Indian Nation, 2017). The Shinnecock Indian Nation in New York has implemented innovative solutions to "restore their shoreline and protect their land" from sea-level rise through their Coastal Habitat Restoration Project (Varanasi, 2019).

These efforts must be supported by programs and policies that respect, recognize, empower, and honor community decision-making, sovereignty, and Indigenous peoples' right of self-determination.

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Chapter 11: Solid Waste

Tribes are experiencing impacts from climate change to their solid waste systems and management, and the following narratives describe some of the challenges they are facing and solutions they are implementing. The Grand Portage Indian Reservation of Minnesota opened an industrial composter at Grand Portage transfer station to protect their waterways. Due to increased Arctic temperatures, the Inupiaq village of Little Diomede in Nome, Alaska, has lost valuable ice for landing planes to backhaul waste and recyclables and to burn waste from a distance. The Prairie Band Potawatomi Nation of Kansas details their climate related issues of an evolving waste management program. The Pueblo Tribes of New Mexico implement vast education programs to prevent illegal dumping. A researched overview of Solid Waste as it relates to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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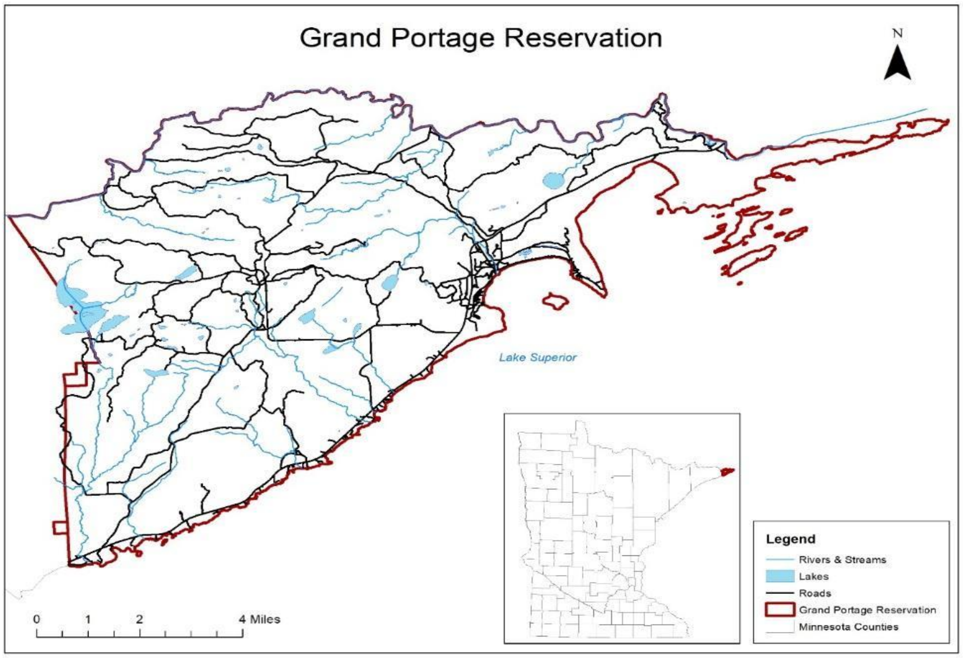
Grand Portage Band of Lake Superior Chippewa Transfer Station

Written by: Krishna Woerheide, Environmental Specialist – Grand Portage Band of Lake Superior Chippewa

Location:

The Grand Portage Indian Reservation is located in the extreme northeastern corner of Minnesota and consists of 56,000 contiguous acres of rugged and remote terrain, devoid of rail service, airport, or incorporated towns. The Reservation has a total enrollment of 1,098 members and a population living on the Reservation (Indian and non-Indian) of about 565. Approximately 42 miles of perennial and 55 miles of intermittent streams flow through the Reservation. These streams and their tributaries drain into Lake Superior and generally flow along steeply graded channels incised in bedrock. The Pigeon and Reservation Rivers flow along the northern and western boundaries, respectively. The Pigeon River watershed has a total drainage area of about 600 square miles (most of this area, about 95%, is in Canada) and encompasses the northern one-third of the Reservation. There are 17 inland lakes that collectively comprise about 816 acres, and there are about 7,204 acres of wetlands within the Reservation boundaries. Our Water Quality, Wetlands, and Non-Point Source departments work diligently to ensure the safety and quality of Reservation surface and ground waters. To date, there is no contamination of any of the waters from Reservation solid waste. Our transfer station was relocated in 2016 due to its proximity to a cold water trout stream and the projection that flooding in that area could potentially contaminate both the stream and Lake Superior.



Grand Portage Reservation

Community Served:

The Tribal enterprise consists of the Grand Portage Lodge and Casino, Trading Post, Car Wash, and Marina. The Reservation Tribal Council (RTC) provides services for the community and its members, including the following programs and departments:

- Emergency Management
- Grand Portage Health Services
- Human Resources
- Human Services
- Community Center
- Elderly Nutrition Program
- Emergency Medical Services
- Structural Fire Protection
- Construction
- Water and Sewer
- Trash service
- Maintenance
- Tribal Historic Preservation and Museum
- Veterans Affairs
- Headstart and Daycare

Aerial view of the Grand Portage transfer station.

The RTC has established the Grand Portage Trust Lands and Natural Resources Agency (Trust Lands) as the governing body for natural resource management. Trust Lands departments include:

- Land Use/Realty
- Conservation
- Biology
- Forestry and Wildland Fire
- Environmental

Industrial composter at Grand Portage transfer station

Description of Service:
In 1986, the Grand Portage Tribal Council opened a transfer station. Waste haulers are contracted to take solid waste from the Grand Portage transfer station 150 miles away to Western Lake Superior Sanitation District in Duluth, Minnesota, where it is later deposited in a certified landfill in Sarona, Wisconsin. There is no curbside pickup, so all residents bring their waste to the transfer station, and the closest waste hauler is in Grand Marais, 40 miles away.

Amount of Trash Disposed:
In 2017, the community generated approximately 7,000 yds^3 of household garbage and 900 yds^3 of larger household waste, plus cardboard and other recyclable materials, a large number of appliances, tires, scrap metal, and various household hazardous waste items.

Solid Waste Equipment at the Transfer Station:
There are ten 8-yard dumpsters for household garbage, a 30-yard roll-off for larger waste, a trailer for cardboard, and most recently an industrial composter for food waste.

Challenges:

- Financing the high cost of transporting garbage from our remote location
- Teaching people what should go in the dumpsters and what should not
- Ensuring that people do not bring trash from off the reservation

Opportunities:

- Funding from the Minnesota Pollution Control Agency to purchase composter
- Funding from Indian Health Services to assist with recycling containers and signage for casino
- Mentorships and courses through ITEP

Areas for Potential Assistance:

- Better storage location and method for household hazardous waste
- Suggestions for better layout of transfer station
- Options for baling and selling certain recyclables (aluminum, plastic, tin, cardboard)

Climate Change in U.S. Arctic: Little Diomede's Solid Waste Challenges

Written by: Opik Ahkinga from the Native Village of Diomede and Anahma Shannon, Kawerak, Inc.

Recyclable household hazardous waste getting loaded onto the plane out on the ice runway, the village of Little Diomede in the background. Photo by Opik Ahkinga, April 2010

About 15 years ago, the ocean surrounding the island of Little Diomede, the United States' farthest northwest location and home to the Inupiaq village of Little Diomede, Alaska, would freeze, creating ice more than four feet thick. In the depths of winter, once the ice froze, the locals would clear a 2,000-foot ice runway in front of the village so that small passenger planes could land. Those passenger planes would bring people and goods in from the hub community of Nome, and they would backhaul people and sometimes recyclable waste out. The ice runway would only last about five months each year, January–May, but it was enough to count on and made the recycling of aluminum cans, plastic bottles, electronics, and even lead-acid batteries efficient.

2013 was the last year of the ice runway in Diomede. Since then, warm Arctic temperatures and tumultuous ocean currents have made the ice surrounding the island weak, ever-moving, and unstable for landing planes. In the winter of 2018, the ice almost didn't form at all, finally firming up in late February for about a month.

In the past, the ice provided not only a means for getting waste out of the village, it also provided a place to burn trash far away from the community. Trash collectors would take the community's trash far out on the ice and light it afire to reduce the mass of waste. Little Diomede is an island of granite rock, and no landfill is possible anywhere on the island. The only waste management solution for the community is to burn trash, and now with the lack of sea ice, they are forced to burn trash right in the community in an enclosed burn unit with a stack. While this is better than open burning, the unit is not an incinerator, and the smoke from the burning waste still affects the air quality of the nearby houses.

First-ever tidal storm waves on February 20, 2018. Winter ocean is usually frozen around Little Diomede this time of year. Photo credit: Sistuq Ozenna, February 2018.

With the onset of COVID-19 in the year 2020, the waste stream has been negatively impacted by the amount of plastic waste the community has had to burn. The City of Diomede sanitation workers have seen an uptick in plastic hand-sanitizer bottles, store-bought masks, and plastic gloves, all of which must be burned in the burn unit every few days.

In addition to the impact to solid waste management, the absence of the ice in recent years has affected the villagers' ability to conduct subsistence activities, such as crabbing through the ice and hunting seal and walrus, which they get by hunting on the ice. The diminished ice also leaves the community vulnerable to extreme weather-event impacts, such as raging winter storms. When the ice was thick, the waves could not reach the village. Now that there is no ice, the winter water crashes into the community, damaging vital infrastructure like the power plant and water sanitation system.

Diomede elder Orville Ahkinga looks out the helicopter window at the open water surrounding the island in winter. Photo by Opik Ahkinga, February 2018

Orville Ahkinga, an 82-year-old elder leader of Diomede, said that in his entire life he had never seen open water during this time of year until 2018. He leaves us with these words: "Climate change is real…just like the elders predicted when I was a young boy."

Operator Safety and Resilience in Our Changing World

Written by: Virginia LeClere from the Priarie Band of Potawatomi Nation

The Prairie Band Potawatomi Nation (PBPN) Division of Planning and Environmental Protection manages an evolving waste management program that includes waste disposal and recycling services, composting, household hazardous waste collections, and outreach/education. Our Department employs a nine member staff responsible for implementing environmental planning and utility programs for the Nation. This includes three full-time Waste Disposal Operators and two back-up operators. Our operators log over 500 miles throughout the week, traveling on the highway, paved rural roads, dusty gravel roads, and low-maintenance dirt roads. They complete residential, commercial, and institutional waste and recycling routes in all seasons and weather conditions. In between route schedules, they sort and bale recyclables that are collected

Flash flooding washed out a drain tube on the PBPN Reservation main arterial road. Photo taken on June 4, 2015, by PBPN Road and Bridge staff.

through our single-stream program; maintain our facilities, vehicles, and equipment; and address illegal dumping violations. Safety awareness and accident prevention eclipses all other aspects of the job. We've discussed the statistics ranking their occupation in the top 10 or top 5 most dangerous occupations in the U.S. in our weekly "huddles," where our operators hash out transportation, equipment, and route observations.

In addition to the expected traffic and mechanical hazards of the job, climate change creates yet another safety variable. With increasingly frequent and extreme weather events, it isn't unusual to encounter flooding and damage to transportation infrastructure. The damages range from moderate inconveniences such as impassable, muddy driveways forcing operators to reroute residential waste service delivery to the more severe damages from Kansas tornadoes and flash floods that create life-threatening road hazards. In 2015, the PBPN experienced an exceptionally stormy, volatile spring. One storm in late May rendered several Reservation roads impassable for a short period of time, but the main arterial road of the Reservation was extensively damaged when a drain tube washed out and a large sinkhole suddenly swallowed up over 20 feet of road.

Heat-related climate stressors such as drought and overall warmer temperatures also affect the safety aspect of our operation. Extreme summer heat can cause fatigue and illness. Our operators reported low morale, exhaustion, and concerns/fears about working alone during prolonged extreme heat events. Also, winters in Kansas seem to be increasingly warmer and dryer. Mosquitos thrive after warm winters. Drought draws mice, raccoons, and other rodents in search of water into our sorting and compost facilities and even to the inside of our trucks.

Our cultural beliefs foretold this climate impact on our health. Potawatomi people have always prayed for cold winters and abundant snow. We're told the cold winters kill sickness and disease. We also wash our faces in the first snow of the season to keep us healthy and strong throughout the winter. The gradual but imminent warming and diminishing cold winter season increases exposure to disease-carrying vectors and heat-related illness, just as our cultural telling predicted.

Rodents, like the raccoon pictured, regularly visit PBPN waste facilities and equipment in search of food and water.

The constant safety vigilance, daily operational challenges, and additional climate variables can be wearing on our operators, but they plan, communicate, and adapt by necessity. The waste utility program is critical to Tribal infrastructure, and the PBPN waste operators' daily performance directly impacts the health and safety of our community.

Managing Solid Waste in the Face of a Changing Climate

Written by: Cynthia Naha

As the effects of climate change are felt with each passing season, precipitation that should fall in the form of snow, sleet, and rain, which feeds our ecosystems, our watersheds, and most importantly, our rich cultures and traditions as Tribal people, diminishes. When we think about solid waste management, we often do not correlate a connection to climate change. But as we continue to develop sustainable programs to manage our waste, perhaps the effects of a changing climate should be considered, especially as we continue to face challenges with illegal dumping, transportation to and from the landfill, and community support and buy-in.

Here in the arid Southwest, and more specifically, New Mexico, where drought is eminent and wildfires have wreaked havoc on our forests, we have seen the lack of care by many at places of recreation throughout the state, as well as within our Tribal homelands. When we experience a high volume of illegal dumping, mixed with a drier climate, there is the potential for fires to start at these dumpsites. This can lead to a more catastrophic event, especially when we do not know what materials are contained within them. Despite efforts to maintain outreach and education on why illegal dumping is not beneficial to our lands, waters, and air, challenges are still present, even when options of proper waste disposal exist. As we look across our environment and see the impacts of overgrazing, we can begin to understand that our lands lack good soil quality. During severe monsoonal events, trash in illegal dumpsites gets washed down the land with sediment and eventually ends up in our surface water, causing potential contamination. This juxtaposition of droughts and wildfire that are followed by floods combine with the problem of waste that has been illegally dumped, compounding the impacts to an ecosystem that is already stressed from climate change.

As the effects of climate change continue to be felt, developing Indigenuitive programs is necessary for the overall management of our waste and how we can ensure we are not creating more harm to our Mother Earth. I am fortunate to work with land managers in various capacities to collaboratively define shared stewardship and co-management of our rangelands, our forests, and our waterways. It is important to remember that the work we are doing is not just for our survival, but for the survival of the next seven generations. I believe in reciprocity. Through the regenerative work we are learning more about, and through the identification of innovative strategies based on our local/traditional knowledge, we can manage our lands to ensure resilience in the face of drought, wildfire, and other extreme weather events that we have witnessed becoming more intense and disastrous.

Solid Waste

Key Messages

- The component of Tribal solid waste systems that is most affected by climate change and has the furthest reaching implications is that of infrastructure. An infrastructure system that continues to be stressed has lasting impacts on the amount of illegal dumping on Tribal lands, the transportation of waste in and out of Tribal communities, and the supply and demand of local recycling markets.
- The data gaps that exist in the world of Tribal solid waste management are extensive and cause a delay in responding to the demands of new conditions created by climate change.

Recommendation

Allocate funding through a streamlined federal funding process (perhaps an interagency clearing house or memorandums of understandings) to ensure Tribal infrastructure is prepared to withstand changes in climate and extreme weather events, and collaborate with Tribes to develop an inventory and evaluation of infrastructure related to solid waste in Tribal communities. This should include roads, facilities, and equipment. Focus on regional coordination to allow for idea sharing around climate change impacts, adaptations, and resources already available to help eliminate data gaps.

Tribal Solid Waste

In most traditional Native American communities, recycling and waste recovery were at the core of the community culture. For example, at Acoma Pueblo, Pueblo Indian women crafted clay pots that were meant to last for years. When those pots broke, the broken pieces were ground into powder, soaked, and turned back into clay to craft new pots (USEPA, 2016). This example of a historical practice of waste recovery and recycling can be found throughout Turtle Island.

The broken windows theory explains that visible signs of disorder in an environment promote further disorder and misbehavior. This principle was developed to explain the decay of neighborhoods in an atmosphere of urban blight, but can be applied to many reservations and Tribal communities that are impacted by solid waste issues. Traditionally, Tribes dealt with these issues in various ways. In the Hidatsa, Mandan, and Arikara villages, the Black Mouth Society encouraged or punished citizens whose habits became untidy (National Park Service, 2019). In Cheyenne societies this was the work of the Dog Faces (PBS, 2001).

The juxtaposition of traditional knowledge with that of modern technology has negatively impacted solid waste programs across Indian Country. As these communities try to shift back to resource recovery, waste diversion, and recycling as core values, traditional methods of telling people when and how to dispose of waste have largely been replaced by codes and regulations enforced by Tribal police.

The effects of climate change, including an increase in temperatures, a change in precipitation trends (both droughts and floods), an increase in the number and severity of storms, and more extreme weather events, are causing a drain on Tribal environmental, in particular solid waste management, programs that lack both the staff and the financial resources to adapt to these new conditions. More recently, Tribes have adopted strategies to educate community members about waste problems by sponsoring community cleanup days, during which numerous Tribal departments work with community members to clean up roadways, illegal dumps, and other problem areas. They may waive fees at pick-up locations and offer helping hands with heavy objects. Many Tribal communities promote recycling and composting while teaching the principles of sustainable material management. Additionally, Tribes participate in household hazardous waste disposal events and are working to promote industry buybacks of hard to dispose of items.

The management of solid waste occurs through a variety of methods, including landfilling, incineration, recycling, composting, waste reduction (through sustainable materials management), reuse, and debris management, to name a few. All of these options come with a host of environmental implications that must be considered. The future of Tribal solid waste planning must account for factors involving climate change in order to be successful. Many of the management strategies mentioned above have components that are declining in quality due to the changing climate, and others have the potential to reduce the rate at which the climate is changing if handled properly. Many Tribes are already aware of this and are working toward solutions, while others are trying to understand all the potential effects as they determine how to best move forward. A current lack of data in the area of solid waste management (including the number, location, and size of illegal dumpsites; information on Tribal solid waste codes; and a comprehensive list of the number, size, and status of Tribal landfills and transfer stations, among others) further complicates an already challenging situation. Although resilience and resource stewardship have always been fundamental components of Indigenous communities, these traditional lifeways are key factors in developing flexible solid waste programs in Indian Country that are protective of human health, the environment, and the culture of the people who live there.

Solid Waste and the Health of a Community

The management of solid waste can be linked to both the human health and the cultural health of a community. There are a number of proven linkages between poor solid waste management and adverse health outcomes (Figure 16). These health issues can be associated with every step of the waste management process both directly and indirectly. The specific waste management activity, listed in Table 4, can have a number of environmental impacts, including contamination of water, air, soil, landscape, and climate.

As is evident in the Prairie Band Potawatomi Nation's narrative in the beginning of this chapter, solid waste landfills and illegal dumps are the most common sources of land pollution on Tribal lands. Although illegal dumping is not uniquely a Tribal issue, it becomes an exceptionally malignant problem for historically underserved communities that struggle with environmental self-determination, and it is a glaring concern for Native populations tied so closely and inextricably to the land entrusted to them. In many Native cultures, land is considered to be much more than just property and natural resources, but as identity and as a residence for ancestors and nonhuman relatives (Figure 17). According to Dr. Robin Wall Kimmerer, in Native culture, one's identity is inseparable from the land (Kimmerer, 2020).

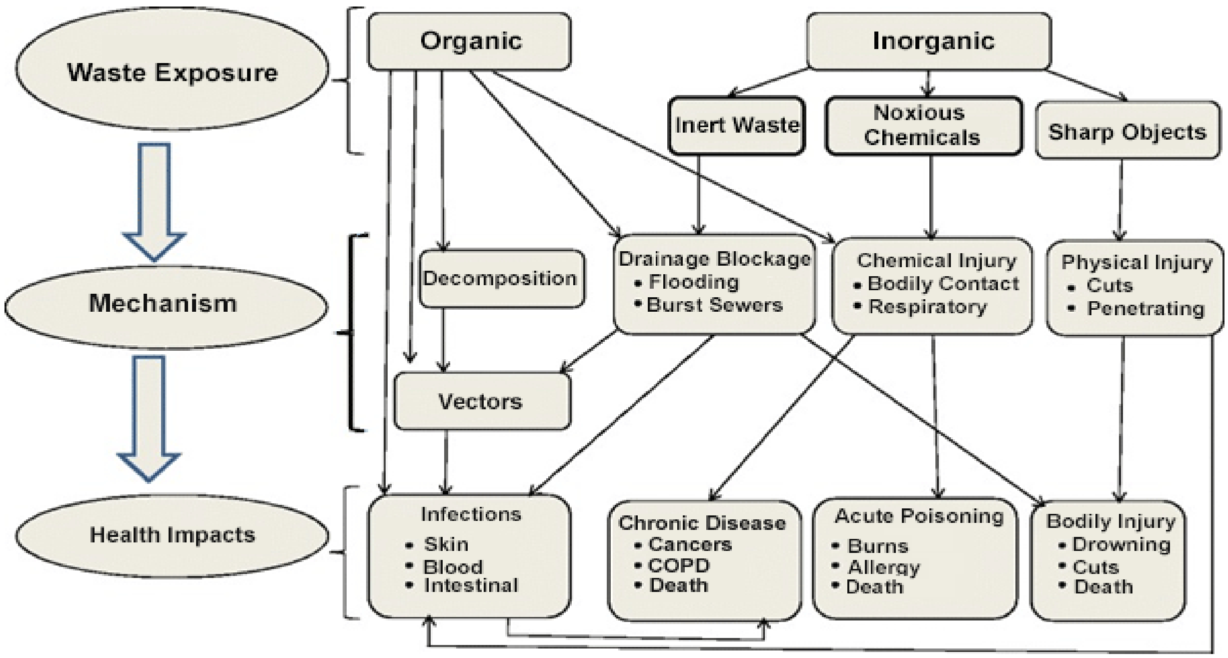


Figure 16. A framework for understanding the linkages between poor solid waste management and adverse health outcomes (Ziraba et al., 2016)

Climate Change Effects and their Impacts on Tribal Solid Waste Management

Many components of Tribal solid waste management are being made worse due to climate change. In many Native cultures, climate changes were foretold by ancestors (Christo, 2020; Daley, 2019; Wang, 2020). Rising temperature is an indicator of climate change, and extended periods of increased heat impact landfill and transfer-station operations. These changes now create conditions that promote an increase in the number of pests (Ziska et al., 2018), harmful dust, pollutants, particulate matter (USEPA, 2002), and extreme working conditions (Centers for Disease Control and Prevention, 2020), requiring Tribes to allocate additional resources from already strained budgets for equipment and staffing.

Changes in precipitation trends also influence solid waste issues in Indigenous communities. Determining a location for a landfill or a transfer station already takes into consideration factors such as accessibility, operating hours, road conditions and on-site irrigation requirements. With more unpredictable precipitation trends that range from catastrophic flash flooding to historically unprecedented drought, siting these facilities becomes even more challenging. Remote disposal facilities have the added complication of pervasive illegal dumping. This can be seen in many of the Pueblos in New Mexico (see narrative titled Managing Solid Waste in the Face of a Changing Climate). Erosion is one of the contributing factors to this. Flash flooding events create new ditches, ravines, and gullies that attract illegal dumping,

Table 4. Main environmental impact of municipal solid waste management. (Giusti, 2009)

Activity	**Water**	**Air**	**Soil**	**Landscape**	**Climate**
Landfilling	Leachate (heavy metals, synthetic organic compounds)	CO_2, CH_4, odor, noise, VOC's	Heavy metals, synthetic organic compounds	Visual effect, vermin	Worst option for greenhouse gas emission [a]
Incineration	Fall-out of atmospheric pollutants	SO_2, NO_x, N_2O, HCl, HF, CO, CO_2, dioxins, furans, PAHs, VOC's, odor, noise	Fly ash, slags	Visual effect	Greenhouse gases [a]
Composting	Leachate	CO_2, CH_4, VOC's, dust, odor, bioaerosols	Minor impact	Some visual effects	Small emissions of greenhouse gases [a]
Land-spreading	Bacteria, viruses, heavy metals	Bioaerosols, dust, odor	Bacteria, viruses, heavy metals, PAHs, PCBs	Vermin, insects	Small emissions of greenhouse gases
Recycling	Wastewater	Dust, noise	Landfilling of residues		Minor emissions
Waste Transport	Spills	CO_2, SO_2, NO_x, dust, odor, noise, spills	Spills		Significant contribution of CO_2

CO_2 – carbon dioxide; CH_4 = methane, VOC's = volatile organic compounds; SO_2 = sulfur dioxide; NO_x = nitrous oxides; N_2O = nitrous oxide; HCl = hydrochloric acid, HF = hydrofluoric acid; CO = carbon monoxide and PAH's = polyaromatic hydrocarbons

[a] Assuming no energy recovery.

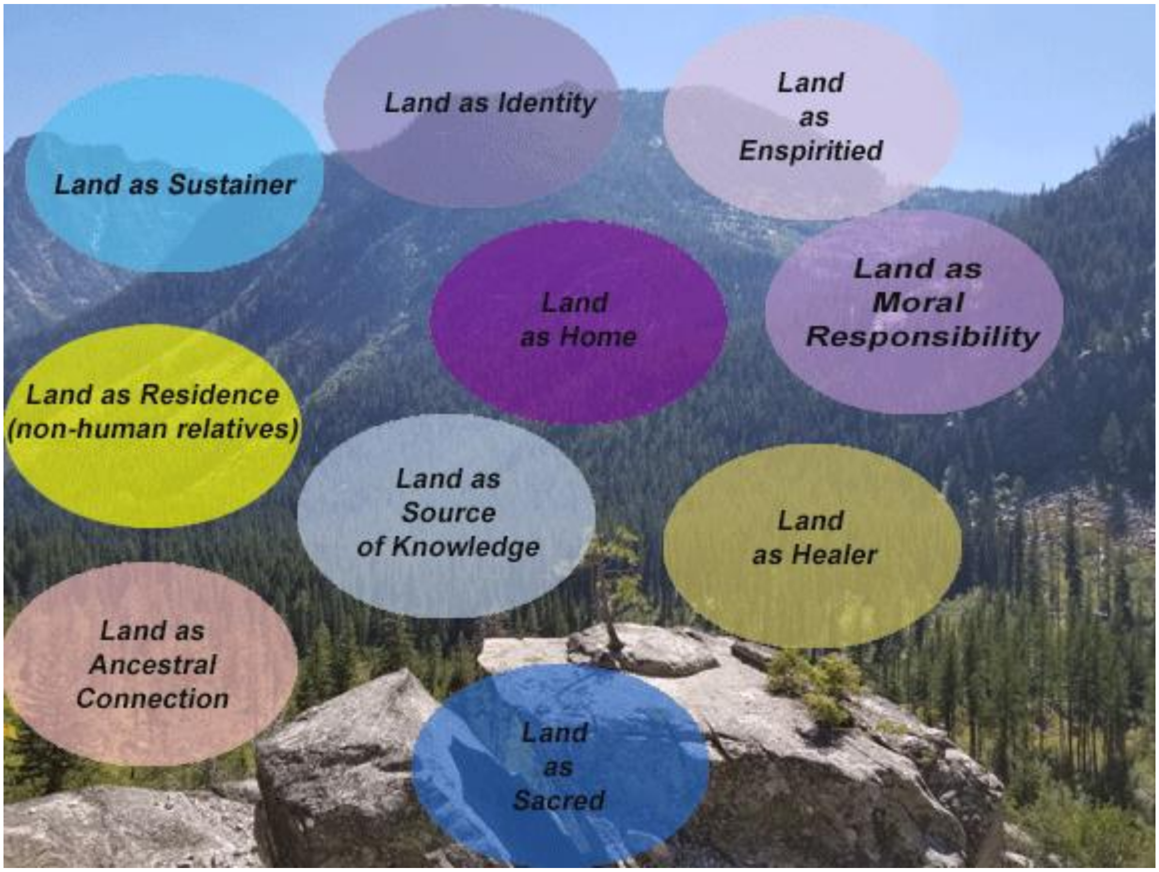


Figure 17. Based on "What does land mean in Native cultures?" (Kimmerer, 2020)

and as more instances of flash flooding occur, there will be more locations that become sites for this nuisance. There are currently over 1,000 open dumpsites in the Sanitation Deficiency System (SDS) managed by Indian Health Services that meet the requirements outlined for size, location on Tribal lands, and evidence in a GIS system (Shuman, 2020). A lack of consistent reporting and verification of these dumpsites and their severity make it challenging to create a benchmark for future comparison.

Floods will impact landfill design (Brand, 2020), and problems associated with drought will cause issues with vegetative caps that keep the soil in place and prevent the waste from being either blown away or washed into the community's water supply. In drier climates, periods of drought coupled with illegal dumping can even lead to an increase in wildland fire. At Superfund, brownfield, and underground storage tank sites, climate change can impact the water table and determine the success or failure of cleanup strategies. This can be particularly evident in cleanups where vapor intrusion is an issue. Moreover, erosion at these sites requires more carefully designed caps that can withstand the forces of flash floods and tidal surges.

The increase in the number and severity of damaging weather events that will impact Tribal lands requires creating comprehensive debris management plans. Whether these weather events are coastal storms, tornadoes, wildfires, or winter icing, many Tribes currently lack the necessary staff or current plans to handle debris management on a large scale. Waste collection can increase by a factor of two or three following a flood event. The types of solid waste will also change markedly as people remove and discard ruined carpet, insulation, drywall, and other porous materials contaminated by flood waters.

The increase in extreme weather events is detrimental to roads, the vehicles that use them, and operators who must drive and maintain them. Many Tribal communities are located on rural land without easy access to a landfill, transfer station, or recycling center to properly dispose of waste. According to the U.S. Department of Transportation, the fatality rate on rural roads is two times higher than on urban roads (U.S. Department of Transportation, 2020). On the Navajo Nation, residents of 56 Navajo Chapters (approximately 80,000 residents) do not have any sort of trash pickup service and have to take their solid waste to either a transfer station or a convenience collection point. If a resident of the Navajo Nation is hoping to take their waste directly to a landfill, the distances range from as little as six miles to over 50 miles. The average distance from a Chapter House to a solid waste landfill is 40 miles, and many of these miles require traveling on rural or unmaintained roads (Navajo Nation, 2002). Reservations that do have well-managed landfills, transfer stations, or recycling centers or are located near urban areas often have a network of rural roads that rely on consistent maintenance even in the best weather situations. As this already-challenged infrastructure becomes increasingly degraded, the likelihood that residents will travel these roads to properly dispose of trash diminishes, and the number of illegal dumps is projected to rise.

Beyond the increase in illegal dumping, the damaged and degraded roads also continue to complicate the transportation of waste and recycling to and from these communities. In Grand Portage, waste travels almost 250 miles from its starting point at a reservation transfer station to its final resting point in Wisconsin (see map of route below). (See narrative titled *Grand Portage Band of Lake Superior Chippewa Transfer Station*.) These long distances from a Tribal transfer station, across the reservation, to a larger (often non-Tribal) landfill often require many miles on rural roads.

Climate change is also impacting how solid waste handlers in Indian Country must deal with recycling. According to the Census of Fatal Occupational Injuries Summary from the Bureau of Labor Statistics (BLS), “recycling material collectors” is already the fifth most dangerous job in the U.S. (Rosengren, 2017). Working alone in very hot and very cold environments represents an added hazard to an already dangerous job. In addition to the impacted quality of roads being a strain on the Tribal recycling programs, once-viable markets for recyclables have all but disappeared, leaving more and more materials heading for the landfill. For this reason, the importance of waste reduction through sustainable materials management (SMM) is an even more vital component to Tribal solid waste programs as well as to the general health of the environment. Moving forward, the focus on SMM needs to be a national effort and should emphasize a reduction in packaging, more national takeback programs, and creating market demand for the recycling and reuse of as many products as possible. (See *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets*.)

Route from Grand Portage Band of Lake Superior Chippewa Tribal transfer station (Minnesota) to landfill (Wisconsin).

In addition to the solid waste infrastructure issues plaguing Tribal communities, there are a number of other factors and systems in Native communities that will be increasingly challenged as the climate continues to warm. Far beyond the reaches of the road system, many Alaska Native villages rely on sea ice as an integral part of how waste is transported out of their communities. Given that sea ice is now present in much smaller quantities and for much less of the year than ever before (Ramsayer, 2020), the amount of time available to remove this waste has become limited. Backhauling waste out of Alaska is a necessity, and the inability to reliably predict when periods of ice will occur is a detriment to how Native villages are able to plan for the removal of waste. As planes and barges are unable to make the same trips as in past years, these villages must create new solutions to deal with their solid waste issues. On Little Diomede Island, halfway between Alaska and the west coast of Siberia (see location map below), the solid waste that is unable to be transported out of the community is burned. An increasing number of plastics (in the form of masks, bottles, and gloves) are being brought to the island and are negatively impacting a community that once relied on an environment filled with sea ice to isolate the burning activity from the island's population (see narrative titled *Climate Change in U.S. Arctic: Little Diomede's Solid Waste Challenges*).

Location of Little Diomede Island (Stevens, 2017)

Many Tribes are actively engaged in seeking solutions to the ongoing challenges mentioned in this chapter and are heavily involved in remediation and stewardship of their land. The Yurok Tribe has great solid waste codes and enforcement mechanisms that allow them to be excellent stewards of the land. Tribes continue to focus on growing their resilience during these changing climate conditions. The following is a list of opportunities that could aid these communities in the face of climate change:

- Encourage the creation of regional recycling processing facilities. This would decrease emissions from transportation and wear on Tribal vehicles and rural Tribal roads, thus decreasing the illegal dumping that would occur there.
- Encourage the development of regional businesses that are in need of recycled feedstock. Prioritizing these local and regional markets is key to ensuring the success of Tribal recycling programs.
- Support the enhancement of composting programs and the removal of food waste from landfills. Many Tribes are faced with food scarcity issues among their Tribal members. There is a strong desire on the part of Tribes to create food security and food sovereignty programs through the creation of compost to bring these systems full circle.
- Create and support programs that require a reduction in packaging material or require a takeback component at the product's end of life. These programs help lessen the burden on Tribal solid waste programs.
- Support a Tribe's data sovereignty, while ensuring they have resources that allow them to utilize this data to create solutions to their solid waste issues. This could include assisting Tribes in better recording their open dumpsites or cataloging baseline information.

- Continue to support infrastructure upgrades to ensure Tribes have the ability to access and create successful solid waste sites. The modern road system has given the U.S. access to all types of luxuries that many reservations have not previously had access to. Climate change adds additional burdens and challenges to an already taxed system.

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Chapter 12: Emerging Topics

While emerging topics related to Tribes and climate change span a vast array of topics, workforce development and collaborative, cross-jurisdictional planning are of particular importance for addressing the cultural cascades experienced by Tribes. The narratives in this section provide examples of several organizations that are working with Tribal communities to develop future leaders and partnerships using nontraditional forms, including camps, working groups, and music. The Native Youth Community Adaptation and Leadership Congress (Congress) builds future Indigenous leaders in conservation and climate change. Since 2015, the Congress has trained approximately 450 high school students, representing more than 85 Tribes and more than 30 states and territories, including Alaska, Hawaii, and American Samoa. Then, in the video narrative that is linked and transcribed, Katherine Paul of the Indigenous indie-rock band Black Belt Eagle Scout and the PTM Foundation share the way they communicate indigeneity and climate action through their music. Lastly, the Climate Science Alliance is assisting Tribes in developing partnerships for Tribal cultural and community resilience through their Tribal Work Group (TWG), which focuses on Tribal priorities, evaluating complementary Western and traditional restoration and management practices that can complement and advance unique and innovative approaches to address climate impacts. The TWG integrates collaborative approaches to bring cultural values and traditional knowledge to the forefront. A researched overview of Emerging Topics as they relate to Tribes and climate change follows these narratives, beginning with the Key Messages and Recommendation that the authors have identified.

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The Native Youth Community Adaptation and Leadership Congress

Written by: Jennifer Hill, U.S. Fish & Wildlife Service

Since the 1990s, the United States Department of the Interior (DOI) and the U.S. Fish and Wildlife Service (FWS) have made it their priority to work with American Indian Tribes for the purpose of natural resource management. DOI's Bureau of Indian Affairs (BIA) and FWS created the Native Youth Community Adaptation and Leadership Congress (NYCALC) in 2015 to strengthen the relationship between federal agencies and Tribal communities. NYCALC's mission is “to develop future conservation leaders with the skills, knowledge, and tools to address environmental change and conservation challenges to better serve their schools and home communities.” Annually, FWS’ National Conservation Training Center in Shepherdstown, West Virginia, hosts the weeklong Congress, except in 2020 due to the COVID-19 pandemic.

Student canoes on outdoor trip. Courtesy USFWS/Alejandro Morales.

The Congress is a highly collaborative effort involving a wide range of partners beyond the initial coordination between FWS, Bureau of Indian Affairs, and New Mexico Wildlife Federation. Today, more than a dozen federal and nongovernmental agencies comprise the NYCALC Steering Committee, with support from another dozen organizations.

NYCALC empowers the next generation of Native youth to return home with the ability to address conservation issues and enact social change. How? NYCALC provides training in leadership principles, foundational community concepts, and conservation and outdoor skills. The schedule offers a series of STEM (science, technology, engineering, and mathematics)-related workshops, presentations, activities, and more. Central to the curriculum is how we use Open Space Technology. This approach empowers the students to set their own agenda. The students identify their topics of interest, from how climate change is affecting traditional foodways to networking to climate resiliency to the importance of learning from elders. They work in teams to research their topics, then present their action plans in front of a panel of judges.

Student demonstrates traditional corn dance. Courtesy USFWS/Alejandro Morales.

Through the Congress, we have engaged emerging Native leaders in this program. Since the Congress began, approximately 450 high school students have participated, representing more than 85 Tribes from all of FWS’s geographic regions with students from more than 30 states and territories, including Alaska, Hawaii, and American Samoa. Annually, the Congress recruits approximately 30 college-age students through a nomination process conducted by participating federal agencies and organizations to act as Junior Faculty (mentors for high school students).

Congress funders extend learning to the next generation of Native leaders through mini-grants. Organizers make these resources available to empower the students to apply lessons learned once they return home to address social change and conservation priorities. To date, several students have used mini-grants to address climate-related issues that impact their communities. Project examples include planning and installing community gardens, learning traditional growing and harvesting, addressing climate resiliency within communities, growing aquaponics, starting a recycling project, and attending climate-related workshops and conferences, to name a few.

For more information and to see NYCALC students in action, please visit nycalc.org.

Music, Indigeneity, and Climate Change: A Short Film[66]

Produced by: Coral Avery, BIA Pathways Intern – Affiliated Tribes of Northwest Indians and Belén Rodriguez, Verité – Doris Duke Conservation

[Text on screen: Katherine Paul of the Indigenous indie-rock band Black Belt Eagle Scout and the PTM Foundation—a nonprofit started by the pop-rock band Portugal, the Man—joined this project to share the way they communicate indigeneity and climate action through their music.]

Katherine Paul (00:20):
I am from a really beautiful area of the Swinomish Indian Tribal community. It's in Northwest Washington state in the Pacific Northwest. It is incredibly beautiful. There's so much beauty in the water, in the land, in the people and the animals of this area. And so I have that foundation and I guess foundational view of, of how I, of how I look at life. At the shows I would start acknowledging, you know, the, the ancestors of the land. And it was a lot of time like a learning tool, but then also when there are people who did know that information and are those Indigenous ancestors and relatives from that area, that was a really, a valuable way to, to honor, honor those people and honor the land.

[Singing]

[Text on screen: Land Acknowledgements are a step to bring awareness to the issues faced by local Native communities.]

[Text on screen: Grammy Award winning band, Portugal, The Man, has always cared deeply about the communities surrounding them. In 2017, they realized that they could help make a real difference. PTM Foundation is now the primary vehicle for Portugal, The Man to engage, advocate for, and reinvest in the communities they grew up around, currently belong to, and believe in.]

Speaker 2 (02:27):
While our advocacy, philanthropy, and community engagement work is primarily centered around universal issues related to human rights, mental health, and the environment, our organization puts a specific focus on highlighting the stories of Native peoples.

Katherine Paul (03:04):
I started this project to be able to express who I am and try and figure out my life and try and figure out my identity. And when I started it, I was, you know, having a lot of emotions and using music as a, as a therapeutic way. I think it's, it's really helpful to be able to, you know, hear sound and to get things out of yourself through sound. That love of the land, that love of the people, that love for the animals. It really stems like the importance of being able to take care of that and being able to nurture and being

[66] Music, Indigeneity, and Climate Change: A Short Film: https://www.youtube.com/watch?v=sVo0u95lWbw&feature=youtu.be

able to fight for justice for our climate and for Mother Earth. I think for words of encouragement and inspiration, I think it's important to just try and contribute to the community that you're, that you're from, or if you don't have one, try, try and find that community and be a part of it.

Katherine Paul (04:06):
For the longest time I wasn't sure who I was when I was growing up and I wasn't sure what my identity would be and how I'd choose to express that. That's how I got involved in music is through going to shows and being involved in, in that music community. One of my songs is called "Loss & Relax," and it's about that journey home. And it's about like, kind of big feelings about the land. And I think now also the fact that I've moved back home, I've moved home to Swinomish, I think in the future there are definitely going to be songs about that and about how I feel returning home.

Katherine Paul (04:50):
[Singing]

[Text on screen: With our ancestors beside us, indigenous peoples are creating a better future for the next 7 generations. Our art, music, activism and cultural revitalization further the fight for social and climate justice around the globe. Thank you to Katherine Paul and the PTM Foundation for your time on this project and your continued dedication to indigenous rights and activism everywhere.]

Paradigm Shift: Climate Science Alliance Catalyzing Partnerships for Tribal Cultural and Community Resilience

Written by: The Climate Science Alliance

Photo credit: Condor Visual Media

Incorporating Indigenous values and perspectives can help us connect climate adaptation planning to other aspects of our society like community health, cultural diversity, and human wellbeing. While this holistic approach is something that Indigenous communities have practiced since time immemorial, it is not the dominant approach for non-Tribal land managers and planners. We view this approach as a paradigm shift in Western conservation planning and management, and this new paradigm is central to the Climate Science Alliance’s (CSA’s) commitment to amplify Indigenous voices and integrate traditional practices, values, and knowledge into conservation planning to support and protect people and places. Throughout Tribally-led efforts, we are working to decolonize the conservation planning process with Tribes as leaders in the paradigm shift, reclaiming the process as well as their role in stewardship of their ancestral lands that lie beyond reservation boundaries. Our collaborative work brings Tribal science and approaches to the forefront of landscape planning, integrating Tribal priorities, concerns, and cultural considerations as well as ongoing Tribal climate adaptation planning efforts into a large-scale intertribal vision. Specifically, this effort relies on a unique intertribal collaboration among 20 different Tribal nations coupled with a robust network of collaborators, including land managers, conservation planners, local researchers, youth, and community members.


Members of the Tribal Working Group participate in climate adaptation roundtable discussions and seed-banking site visits. Photo credits: Climate Science Alliance.

Convened in 2017 by the CSA at the request of Tribal partners, the Tribal Working Group (TWG) is made up of over 30+ members representing 20 Tribes and Tribal organizations across southern California. The TWG's focus is on building, supporting, and accelerating Tribal resilience under climate change through Tribal–science partnerships that integrate Western and traditional values and practices. Tribal communities are often both under-resourced and among those most susceptible to the impacts of climate change (e.g., increased wildfire risk and reduced water security), yet Tribes are often not included in the planning process. To address this discrepancy, we are partaking in a collaborative effort that will leverage existing research and catalyze actions that advance Tribal resilience by promoting the integration of cultural values into the planning process. Our team includes climate adaptation and outreach specialists from the CSA and researchers across the region with expertise in cultural and natural resource planning and actionable science and, most importantly, is led by TWG members. As a community of practitioners, we are building on the leadership and vision of the TWG coupled with a foundation of regional climate research and a strong stakeholder community to advance approaches to climate adaptation strategies and solutions through the equal valuations of traditional and Western science.

With a focus on Tribal priorities, we are evaluating complementary Western and traditional restoration and management practices that can complement and advance unique and innovative approaches to address climate impacts. Our approach is unique in that it not only focuses on Tribal engagement and priorities, but on a collaborative approach to bring cultural values and traditional knowledge to the forefront. Building on our climate research and collaborative efforts, we are developing strategies that are customized to have an immediate and direct impact both within and outside Tribal communities. Our projects reflect long-term development of collaborative conservation and climate adaptation work—both research and application—that catalyzes activities and builds bridges between Western and Indigenous perspectives of connectivity and conservation to break away the boundaries and lines drawn on maps that separate us. We are addressing the needs of multiple Tribes and laying a foundation to support Tribal climate adaptation efforts that benefit conservation and connectivity goals in tandem with culture, community, health, and wellness.

To learn more about the TWG and our Tribally-led projects to advance transformational climate adaptation, please visit https://www.climatesciencealliance.org.

Photo credit: Climate Science Alliance

Emerging Topics

Key Messages

- Integrating Tribal workforce development and supporting Tribal Colleges and Universities can lead to greater climate resiliency and Tribal sovereignty and can create opportunities to educate and train future Indigenous generations in climate-related fields if administered additional funding and resources.
- There are many climate-related cultural cascades, including economic and social, Indigenous relationships with the natural world, and pandemics.
- Tribal nations are sovereign, and the U.S. federal government, in meeting its intent to address climate, environmental justice, and racial justice, should work collaboratively to support Tribes to engage in internal diplomatic relations. Other collaborations across jurisdictions and Tribal governments should be considered to enhance climate-planning efforts.

Recommendation

Recognizing that climate-related cultural cascades, including economic and social, affect Indigenous relationships with the natural world, Tribes and Tribal partners should support collaborative climate-planning efforts across jurisdictions and Tribal governments, including Tribal Colleges and Universities and other workforce development opportunities such as prioritizing Indigenous knowledge and labor. These practices will lead to stronger climate resiliency and sovereignty efforts.

Introduction

Climate change is a complex, interdisciplinary, and transdisciplinary topic. While the preceding chapters of this report focus on specific topics, this chapter highlights the emerging issues Tribes face in relation to climate change and includes subsections on workforce development, mainstreaming climate change considerations into planning, climate change planning and implementation occurring simultaneously, funding issues related to climate change adaptation planning and implementation, social implications, climate-related cultural cascades, policy issues, and Tribal leadership and engagement.

Integrating Workforce Development

Indigenous peoples are emphasizing the importance of youth involvement in climate change initiatives to prepare the next generation for leadership and employment. One example of this is the work of the Native Youth Community Adaptation and Leadership Congress (NYCALC) (see narrative titled *The Native Youth Community Adaptation and Leadership Congress*). Students face challenges and barriers to their capacity to continue in educational programs, which has an effect on the transition of students into the workforce. For example, Tribes have less access to broadband services, which is a disadvantage for Native American students who often live in remote, rural reservations (Center for Native American Youth, 2020). This is especially problematic during the current pandemic, given most education has switched to online and virtual platforms.

There are promising programs with strong federal support. Tribal Colleges and Universities (TCUs), for example, are important institutions for students to transition from education to their careers as professionals. "TCUs are unique institutions that combine personal attention with cultural relevance, in such a way as to encourage American Indians—especially those living on reservations—to overcome the barriers in higher education" (AIHEC, 1999). There are 32 accredited TCUs, and a major advocacy organization focused on their advancement, the American Indian Higher Education Consortium in Washington, DC. While the science programs at TCUs represent one key avenue for students to take, further support would open additional mentorship and training opportunities that would guide students with an initial interest in climate change work. Another program is the BIA Pathways Program, which includes educational programs and internships that foster the greater involvement of young persons in careers stewarding trust lands. Given the impacts of climate change on trust lands, BIA Pathways is a critical vehicle for young persons to launch meaningful careers in environmental stewardship and climate change planning.

For professionals seeking employment or upgrades in their training, there continue to be challenges that affect Tribal peoples' capacity to prepare for climate change. For example, there may be training programs available within particular sectors related to climate change skills, but no sufficient jobs available within Tribal departments. There is an important opportunity to develop jobs that are in line with Tribal values and stewardship of the Earth, which is evident within the just transitions and green-jobs movement (*see Chapter 7: Energy & a Just Transition*). Black Mesa is a prime just transition example because the closure of the Mohave Generating Station allowed for the restoration of Hopi and Navajo water sources, as well as allowed for economically stimulant opportunities to emerge, such as the Green Economy Fund and Commission, the Native American Business Incubator Network, the Black Mesa Solar Project, the Navajo Wool Market Improvement Project, and the Food Sovereignty Project (Cha, 2020; Gearon & Johns, 2016). It is also important to understand that Indigenous persons living in urban centers can have greater potential to work in climate change related fields. While many Indigenous persons live in large urban centers, their interests and values are often left out of discussions about workforce training. For recommendations of how to include Indigenous voices and support Native workforce development, refer to the National Congress of American Indian's report *Empowering Tribal Workforce Development.*[67]

Addressing Workforce and Local Hire through Protect-in-Place, Mitigation, & Relocation
As Tribes increasingly face the impacts of accelerated climate change, there is an opportunity to justly and creatively address Indigenous career and workforce development issues. These workforce issues can transcend long-standing inequity issues. Mitigation and adaptation that includes protect-in-place, managed retreat, relocation, Indigenous food security, and energy transition all require innovation and infrastructure (see *Chapter 10: Protection-in-Place & Community-Led Relocation*).

In Alaska, Tribes and regional Tribal consortiums are increasingly including workforce and employment goals in adaptation plans. In the southwest area of the state, the Association of Village Council Presidents, a federally recognized Tribal government consortium of 56 Yup'ik villages in the Yukon-Kuskokwim Delta, identified increasing employment in science, engineering, and fish and game management as a priority. On-the-job training programs to apply emerging technologies in energy generation are identified as actions they plan to implement in their regional 2019 climate adaptation strategy (Beck et al., 2019). The Village of Newtok has workforce development and local hire as priorities that guide the Newtok Planning Team and were included in their first relocation plan, the

[67] NCAI's Empowering Tribal Workforce Development:
https://www.ncai.org/ptg/NCAI_WORKFORCE_DEVELOPMENT_BRIEF_v2.0_2020.pdf

Mertarvik Strategic Management Plan. Also included is a series of guiding principles that Newtok Traditional Council developed and adopted by resolution. One of these principles is about local hire, which states, "Development should: ... Hire community members first." Workforce development was also identified as a strategic focus area in the plan: "Develop a skilled workforce that can pursue, construct, and maintain infrastructure at Mertarvik and help close and restore Newtok." A priority action of the plan is, "Assess existing local workforce skills and identify skills needed to complete upcoming projects; create a training plan to address labor needs and fill strategic skill sets" (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs, 2012).

The Mertarvik Strategic Management Plan serves as the "umbrella document" to other parts of the relocation effort. For example, local hire was a key element of the Mertarvik Housing Master Plan,[68] which describes how community residents were involved in the construction of the demonstration home designed by the Cold Climate Housing Research Center (CCHRC). Aside from the CCHRC instructors, all construction labor was locally hired by the Tribe. As the housing master plan notes, "the local crew who built the home will be able to put their skills to use in future projects. Besides providing well-paying jobs to local residents, this design drastically reduces the cost of construction. The resident family was required to provide at least one household member to take the construction course and work with the crew on the project. The resident was given thorough instruction in all aspects of their home's components, operation, and maintenance requirements" (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs, 2012).

Although Tribal communities are making strides to address workforce development and local hire issues, there is not only a need for Tribes to build workforce capacity, but to retain this capacity. The *Assessment of Indian Forests and Forest Management in the United States*, prepared by the Indian Forest Management Assessment Team (IFMAT), is currently a three-series report, with its most recent addition published in 2013. In the IFMAT III report, workforce education, recruitment, and retention of Tribal professionals in natural resource management were specifically included. Prominent recruitment and retention barriers highlighted within the IFMAT III report include compensation, remote locations, small organizations, and increasing populations of eligible retirees, all of which make it difficult to establish a long-term career within Tribal forest management and natural resources (IFMAT, 2013). The linkage between Tribal colleges and Tribal natural resource and forestry professionals is also suffering from lack of funding for training and continuing education opportunities as well as inconsistent staffing. To bring Tribal forestry up to the level of other forest ownerships, the IFMAT recommends a minimum investment of $100 million and an additional $12.7 million for staff recruitment, retention, and development (IFMAT, 2013).

An additional emerging topic that would be beneficial to Tribes is defining what they believe is workforce development in their climate adaptation and mitigation plans. There are different levels of building capacity. For example, in addition to the "blue collar" workforce, additional capacity will be needed to train Indigenous peoples to work on the actual planning and all other related jobs that require higher education or high-level technical skills and training. These jobs include training

[68] Mertarvik Housing Master Plan: https://www.commerce.alaska.gov/web/Portals/4/pub/mertarvik_housing_master_plan.pdf

Indigenous engineers, planners, project managers, and IT experts to implement and support climate adaptation work.

Rising Role of Tribes in Observing Networks
Indigenous peoples have firsthand knowledge and intimate relationships with the land, air, and sea and, through existing and evolving observation networks, are contributing to the knowledge of the impacts of climate change. Local observers are involved in community-based monitoring or work hand-in-hand with scientists, researchers, and data collectors to provide a clear image of current changes. Observations and a keen awareness of the relationships within the natural world are seen holistically within a worldview that includes people as part of the land or ecosystem. With the onset of the abrupt disruption that came with the global COVID-19 pandemic, there is increased awareness of the significant role local Indigenous observers have in contributing to sustainable observation networks regionally and globally. This observation can align and be defined through an Indigenous framework. In the spring of 2020, the Arctic Observing Summit (AOS), Call to Action, recognized the leadership role of Indigenous peoples in the region in maintaining "critical long-term scientific observations and research infrastructure" (AOS, 2020).

Mainstreaming Climate Change Considerations into Planning
There are opportunities to transform how adaptation planning is approached and mainstreamed into existing Tribal planning efforts and documents. Certain environmental areas, such as "natural resources" and "wildlife" that are represented in Tribal agencies and programs, have opportunities to incorporate adaptation planning in their existing work and to address common areas across Tribal programs to harness shared resources and capacities. Adaptation planning can be included in all planning processes and planning documents in Tribal governments. Given current and future projected climate disruptions, adaptation planning is an active process and occurs simultaneously with implementation.

Tribes are often understaffed and overworked with a limited amount of time and resources to focus solely on climate change. Integrating climate change into already ongoing planning and implementation efforts can be more efficient, less time-consuming, and more cost-effective and can lead to actions that are more sustainable in the long term. Examples of plans in which climate change can be considered include FEMA Tribal Hazard Mitigation Plans and EPA Tribal Environmental, Community Comprehensive, and Land/Resource Management Plans (Dalton et al., 2018; Pletnikoff et al., 2017).

The Bureau of Indian Affairs also produces a variety of plans that could include climate change considerations. Such plans include forest management, wildland fire management, irrigation projects, fish and wildlife, agricultural resources, and integrated resource management, which is a comprehensive management planning program for Tribes that incorporates aspects of planning with various federal agencies. This planning process allows Tribes to do one plan that crosscuts many agencies/issues and reduces the number of plans required instead of working on a separate plan for each issue. The inclusion of climate change could take place as part of regularly occurring plan updates.

Climate Change Planning and Implementation Can Occur Simultaneously
In a typical planning and implementation paradigm, planning occurs first while implementation follows once the planning has been completed. There may be a variety of reasons behind such a paradigm, including optimizing the allocation of adaptation resources and avoiding maladaptation. For many

Tribes, though, climate change impacts are happening now, time and resources to develop plans and shepherd them through Tribal Council approval may be limited, and there is an urgency to take action. Thus, some Tribes are conducting the two processes simultaneously. In addition, some Tribes have found that taking actions in conjunction with the planning process can help build momentum. Tribal communities throughout Alaska, such as Newtok, Napakiak, Point Lay, and Point Hope, have been responding to climate change for decades. In these cases, Tribal communities are taking action before long-term planning occurs. Examples include elevating and relocating buildings and adapting to the change in distribution and abundance of fish and wildlife by traveling farther and using different tools (Nelson and Andrew, 2020).

Funding Issues Related to Climate Change Adaptation Planning and Implementation
Inadequate funding remains one of the greatest barriers for Tribes to create and implement climate adaptation plans (Wotkyns & Gonzalez-Maddux, 2014). Lack of federal funding in turn slows Tribal adaptation planning, extenuating the adverse impacts Tribes face from climate change. A recent publication about the Climate-Ready Tribes Initiative (2020) recommends that specific funding be allocated to Tribes to avoid competition from non-Tribal applicants, as well as simplification of funding applications and technical assistance throughout application processes. Furthermore, TCUs, as the gateway for Tribal workforce development, have an opportunity to advance climate adaptation initiatives, yet also lack the financial resources to adequately support research, education, and outreach related to climate adaptation (Fillmore, Singletary, & Phillips, 2018).

Cross-Boundary Collaborative Implementation
The impacts of climate change are often interconnected and complex, sometimes crossing artificial jurisdictional lines. Collaborative responses at larger geographic scales have the potential to be more cost efficient, inclusive with respect to decision-making, and effectual and sustainable in terms of their benefits for people, nonhuman relatives, and places (Reuling et al., 2015). Tribes are participating in a variety of cross-boundary, collaborative projects. One example is the Rio Grande Water Fund. The Fund was established in 2014 by The Nature Conservancy (TNC) in the aftermath of the 2011 Las Conchas Fire in New Mexico, which grew to more than 150,000 acres. The fund covers a geographic area extending from Belen, New Mexico, north to the Colorado border and includes a number of Native American Pueblos as well as the cities of Albuquerque and Santa Fe, New Mexico (TNC, 2014). The goal of the fund is to "generate sustainable funding for a 20-year program of large-scale forest restoration treatments" to ensure a continuous supply of clean water for the region's people and wildlife (TNC, 2020a; TNC, 2020b). Fund investors include federal, state, county, and city sources as well as private individuals and foundations. Santa Clara Pueblo and others are participating in the planting of "tree-islands" in burned areas of the Jemez Mountains to serve as seed sources for the future. The project engages youth and contributes to workforce development (TNC, 2020). The Pueblo of Jemez is involved in a project to restore the eroded channel of San Antonio Creek. Other examples of cross-boundary, collaborative management and restoration in which Tribes are participating include the U.S. Forest Service's Collaborative Forest Landscape Restoration Program (CFLRP) and the Roundtable on the Crown of the Continent, which includes entities from Montana, Alberta, and British Columbia and Tribes and First Nations residing therein (CFLRP, 2020; Kelly and Kusel, 2015; Reuling et al., 2015).

Additional Collaborative Responses
Collaborative responses to climate change should also "incorporate indigenous values and perspectives to broaden climate adaptation planning to other aspects of society such as, community health, cultural

diversity, and human wellbeing" (see narrative titled *Paradigm Shift: Climate Science Alliance Catalyzing Partnerships for Tribal Cultural and Community Resilience).* The Climate Science Alliance[69] engages in this paradigm shift, as the organization is "committed to amplifying Indigenous voices and integrating traditional practices, values, and knowledge into conservation planning to support and protect people and places," (see narrative *Id*.). Beyond climate adaptation planning efforts, collaborative and interdisciplinary approaches to climate mitigation and action extend to climate justice efforts. One such project is a recently produced video, Music, Indigeneity, and Climate Change,[70] which captures the story of musicians communicating Indigeneity and climate action through song (see narrative titled *Music, Indigeneity, and Climate Change*).

Social Implications

There is a growing body of literature that explores the relationship between climate change and gender violence within Indigenous communities (Acosta et al., 2020; Chase, 2018; Dankelman, 2010; Deer & Nagle, 2017; Vinyeta et al., 2015; Whyte, 2014). Women and two-spirit people are affected in greater ways by certain types of climate change impacts, given their responsibilities and work within their communities. There are also connections to how masculinity is affected by climate change (Vinyeta et al., 2016). These gendered effects can create stresses on mental health, community cohesion, and cultural integrity. Energy and fossil fuel extraction are connected to gender violence and the trafficking of Indigenous persons (Deer & Nagle, 2017; Sweet, 2014). While each Tribe is different, there are nonetheless concerns that in some cases Tribal leadership positions favor heterosexual men (Green, 2007).

Climate change is also closely connected with the maintenance of Indigenous languages. Indigenous persons have understood Indigenous languages as encoding knowledge about climate change and representing temporal, spatial, and spiritual dimensions of relationships with environmental and climatic systems. Changes in climate can also change habitats that are the referents of Indigenous languages and their uses. In response, some Tribes have developed educational initiatives aimed at restoring and maintaining traditional knowledge and languages. For example, many Alaska Native villages hold culture camps that allow elders to share knowledge about traditional language and patterns of ecosystem use (Noodin, 2019; Norton-Smith et al., 2016; Kofinas et al., 2010). There is an urgency associated with education and maintenance of Indigenous languages, which includes both the issue of knowledge of climate change and how climate change can threaten opportunities to communicate through Indigenous language.

Oral history, which is shared through storytelling, must also be included in the process of data collection as it relates to climate change. Some Indigenous stories are over 10,000 years old and provide a solid foundation and baseline for climate change data marking. Utilizing the elders for Indigenous knowledge and storytelling for timeline changes is vital to the survival of this cultural element and the gathering of information that predates modern science monitoring.

[69] Climate Science Alliance: https://www.climatesciencealliance.org/

[70] Music, Indigeneity, and Climate Change: https://www.youtube.com/watch?v=sVo0u95lWbw&feature=youtu.be

Climate-Related Cultural Cascades

Climate cascades are an emerging issue, with a growing number of studies demonstrating tipping points. A climate cascade occurs when climate change triggers high levels of sequential reorganization of ecosystem, biogeochemical, and Earth system processes that are interlinked, coupled, or connected (Lenton et al., 2019).

Kelp forests, for example, are a foundation species and provide multiple benefits to ecological communities and people (Eger et al., 2020; Naar, 2020). They provide habitat and nurseries for a multitude of species, including fish, shellfish, and crustaceans. The canopy they provide alters the surrounding environment and stabilizes it. They remove and store carbon and other pollutants from the water. They dampen wave energy, reducing shoreline damage and erosion. Bull kelp in northern California has been reduced by over 90% by a variety of factors. Kelp is sensitive to temperature and is globally threatened by marine warming and heat waves induced by climate change (Smale, 2020). Outer coastal southern giant kelp and bull kelp populations are more affected than Pacific Northwest populations that are currently maintained by cold upwelling, although there is concern about future warming and climate impacts on shallow areas of inland marine waters such as the Puget Sound (Calloway et al., 2020; Smale, 2020). Combined climate and nonclimate stressor-induced loss of these kelp forests leads to multiple and cascading failures in ecosystem services and functions, changes in species interactions and composition, ecological simplification, and associated economic and cultural values (Eger et al., 2020; Naar, 2020).

There is still considerable uncertainty and disputes over the occurrence, extent, attribution, and predictability of cascades, but they have been demonstrated in some systems and in the geological record (Harley et al., 2006; Steffen et al., 2018). Cascades and tipping points are not ubiquitous, as systems may exhibit resilience in response to climate change (Ford et al., 2020). The ability to understand and predict climate cascades is improving but complex.

A growing body of research documents cascading climate impacts on economic and social, trade-related, financial, market, aid, and other socioeconomic factors associated with abiotic and biotic changes (CASCADES, 2020; Lawrence et al., 2020). These cascades arise from the complex connections, relations, and interactions among multiple systems, climate and nonclimate drivers, and direct and indirect impact pathways.

Recent research also supports the existence of cultural cascades that reflect strong human–environment relationships of Indigenous peoples with the natural world (Yletyinen et al., 2019; Yletyinen et al., 2020). These strong relationships can be both a source of vulnerability and a source of resilience, influenced by factors related to place, agency, institutions, collective action, Indigenous knowledge, and learning (Ford et al., 2020). Tribes are experiencing climate impacts in the context of multiple nonclimate factors such as historical and ongoing traumas, urbanization, territorial encroachment, habitat, and landscape fragmentation (Ford et al., 2020). Tribes are also experiencing considerable pressures from other emerging climate change impacts such as wildfires and pandemics.

Climate change impacts on the severity and extent of wildfires have multiple effects on Tribes. Tribes have historically used traditional knowledges of fires in cultural burning practices to manage the environment for culturally desired species (Steen Adams et al., 2019). Patch-scale and low-intensity wildfires are being replaced by landscape-scale and high-intensity wildfires that have many long-lasting consequences. Some of the cascading consequences include significantly increased erosion, escalating costs of firefighting and diminished funds available for other Tribal needs, loss of forest-related economies, loss of the ability to continue traditional, spiritual, and cultural practices on the land, and the erosion of traditional knowledge (Norgaard, 2014). These impacts can be exacerbated by the denial of Tribal access to use cultural burnings. Reciprocally, the use of cultural burning can help prevent and increase Tribal resilience to potential climate cascades (Long & Lake, 2018).

Pandemics can also lead to cultural cascades. Pandemics have multiple origins, such as through higher human population numbers and densities and wildlife-borne zoonotics. There is growing evidence that climate change can directly influence the origin and spread of pandemics or indirectly affect them through human responses to climate change, as well as influence the spread of pandemics through culturally important wildlife populations (Azevedo et al., 2020; Sanderson & Alexander, 2020). Pandemics have impacts on the cultural and economic activities of Tribes through lockdowns and restrictions of markets and nonmarket consumption of wild game (Lane, 2020). The current COVID-19 pandemic is disproportionately affecting both Tribes and Tribal elders and restricting the practice and transmission of Indigenous knowledges. The death of knowledge holders may have long-lasting and potentially transformational impacts on Tribes (Chinn, 2021; Smith-Morris, 2020). Detailed studies are lacking, but there are some signs that Tribes have solutions to prevent or mitigate these impacts, such as through forest protection and restoration and the use of traditional knowledges (Sen, 2020; Smith Morris, 2020).

Much more work needs to be done on understanding and characterizing cultural cascades in the context of climate change. Outstanding questions include: what determines whether a given impact or set of impacts results in increased resilience or vulnerability to a cascade? If a cascade occurs, what determines the depth or extent of a cascade and whether impacts are reversible or irreversible? Are there indicators for an approaching cultural tipping point?

Tribal Leadership & Engagement

The energy transition away from fossil fuels is a critical mitigation step for climate change. Yet there are questions about whether there will be genuine Tribal leadership in the energy transition or whether Tribes will be passive actors while others make decisions. Currently, Tribes are in situations of dependency regarding where their energy comes from. Tribes have long histories of having to adapt to the fossil fuel industry, including their efforts to stop the U.S. from leasing Tribal lands to private companies at lower rates of profitability and concerns about safety and environmental risks. Given this history, it is important that the energy transition not repeat the problems of the past. A growing literature is showing that the U.S. energy sector has still not created programs in which Tribes can emerge as leaders. (See *Chapter 7: Energy & a Just Transition*.)

Although Tribes are not the largest consumers or producers of fossil fuels in the U.S., there is tremendous potential for Tribal governments to reduce greenhouse gas emissions. Since the *Energy & a Just Transition* chapter highlighted the renewable energy development potential for Tribes, this chapter will showcase another means of carbon reduction, the sale of carbon credit markets. Recently, The National Indian Carbon Coalition (NICC)[71] has supported three projects: the Lower Brule, the Fond du Lac

[71] National Indian Carbon Coalition (NICC): https://www.indiancarbon.org/about-us/

Band of Lake Superior Chippewa, and the Keweenaw Bay Indian Community[72] with carbon credit projects. In July 2020, The Fond du Lac Band of Lake Superior Chippewa "approved a forest-based carbon sequestration project...which will quantify greenhouse gas emission reductions that exceed current forest management practices...sequestering more than 77 metric tons of carbon dioxide...and earning the Tribe approximately $4 million over a 40-year timeframe" (NICC, 2020). These types of projects exemplify the potential Tribes have to mitigate climate change through greenhouse gas reduction efforts as well as provide financial prosperity and stability for the Tribes. (See also *Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets*.)

Conclusion

While there are an extensive number of emerging issues pertaining to Tribes and climate change, the authors of the STACC Report highlighted the issues most pertinent at this time. The examples featured in this chapter intend to support and uplift Tribal climate change mitigation and adaptation efforts and to provide pathways forward for success.

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CONCLUSIONS, KEY MESSAGES, & RECOMMENDATIONS

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The 2021 *Status of Tribes and Climate Change Report* demonstrates the unique impacts from climate change experienced by Tribes and the many ways in which Tribal communities are responding and leading the way. Gaining an understanding of Tribal worldviews, Indigenous knowledges, and the increased vulnerabilities that many Tribal communities face may lead to improved responses to climate change in the U.S. and greater environmental and social justice for the original peoples of this land. When we recognize we are not separate from our natural environment and value justice, equity, and respect for all of our relations, we may collectively achieve a society in which all can thrive.

The close relationship that Tribes have with their lands, waters, resources, and heritage includes a responsibility to one another, to all relations, and to the past and future generations of human and nonhuman relatives alike. One way of understanding the holistic systems of Indigenous peoples is that they are generally tightly interwoven with many compounding dimensions such that impact on one dimension can lead to cascading impacts on other dimensions. Close Tribal reliance on and interconnectedness with the natural world make them particularly vulnerable to cascading effects, but also particularly well-positioned to recognize, adapt to, and mitigate both current and future climatic changes. Many climate accounts do not address the intangible dimensions of climate change or characterize the dimensions as psychological, social, or spiritual categories, which are important considerations and are often a focal point of Tribal experiences and responses.

The challenges facing Tribes in relation to climate change are complex and involve many aspects that are either unique to them or amplified by cultural, environmental, historical, economic, livelihood, political, legal, and other contexts. The historical context of settler colonialism and failures to adequately uphold Tribal treaties as the supreme law of the land must be taken into account in understanding climate impacts on Tribes. The health and broader cultural impacts of the initial wave of settlement are now being repeated under COVID-19 failures to protect Tribes, such as water and food insecurity, job losses, access to healthcare, and the digital disconnect.

Tribes must be closely involved at all stages of climate action cycles, from conceptualization, proposals, development, and design to implementation, management, monitoring, review, and revision. There are actions Tribes can—and do—take for their own territories and homelands. Tribes must be involved in characterizing and developing indicators of these impacts on their own terms. Treaty, Tribal trust, human rights, and obligations arising from constructive arrangements between Tribes and the United

States must be fully implemented in order for Tribes to exert their sovereignty to address climate impacts and advance their resiliency.

The authors of the STACC Report have indicated the following Key Messages and Recommendations:

Chapter 1: History of Indigenous Peoples in NCAs

Key Message

Indigenous peoples have been substantively involved in national and international climate assessments for decades, and this involvement has grown, including more Indigenous engagement and authorship on the third and fourth National Climate Assessments. There is still much work to be done to engage and include Indigenous perspectives, knowledge, and expertise in climate assessments.

Recommendation

Future reforms to make NCAs more inclusive should acknowledge, learn from, and build on Indigenous peoples' involvement throughout the history of the U.S. Global Change Research Program.

Chapter 2: Worldviews, Knowledges, & Social Impacts

Key Messages

- Indigenous peoples have their own systems of governance that have norms of behavior for land use and land care.
- A growing dialogue among some Indigenous peoples articulates Indigenous knowledge systems through an understanding that all things are interconnected.
- Legacies left by colonialism in economic, social, environmental, and educational systems have altered lifeways, traditions, practices, customs, and values of Indigenous peoples, influencing their understanding of how climate change affects their daily lives and opportunities for adaptation.

Recommendation

Climate change policy and climate science fields should respect Indigenous self-determination in governance and knowledge exchange. Indigenous peoples should be consulted meaningfully from the earliest stages of policy and research development. Legal, policy, ethical, and cultural best practices and requirements should be followed to make consultation meaningful.

Chapter 3: Actionable Science & Collaborative Climate Planning

Key Messages

- Tribes are investing efforts in adaptation planning and projects to keep their communities, ecosystems, and people healthy. In doing so, they are implementing the most cutting-edge work on climate. Tribal nations are actively creating climate-vulnerability assessments, adaptation plans, and hazard-mitigation plans. Protecting traditional knowledges is an important part of these processes.
- Locally relevant and regionally specific information is needed to understand local climate impacts and develop solutions that incorporate local, traditional, and Western knowledge for holistic solutions.
- Actionable science co-produced in partnership with Indigenous peoples can support Tribal resource management decision-making.

Recommendation

Support Tribal sovereignty and self-determination through Tribally-led climate adaptation planning to allow Tribes to prepare for climate uncertainty and associated risks. Management decision-making should involve consultation with Tribes early and often, co-production of actionable science, and the incorporation of local knowledge.

Chapter 4: Ecosystems & Biodiversity

Key Message

Indigenous peoples' worldviews are often explicit in their centering of relationality, responsibility, and reciprocity as critical concepts. These concepts may inform Indigenous responses to climate change impacts. Examples of these impacts include increases in destructive wildfires and invasive species and decreases in ice cover due to warming temperatures. Indigenous actions to address climate change are vast, but some specifics include cultural burning, protection of keystone species, and observation and evaluation of invasive species before deciding how to respond.

Recommendation

Indigenous peoples' self-determination as practitioners of biodiversity conservation and ecological protection should be respected and reinforced. This can be accomplished through collaboration across jurisdictions; consultation and consent in the first stages of land and water planning, research, and management processes; increasing support mechanisms for the exercise of Tribal sovereignty; and the removal of barriers to Indigenous peoples' rights to implementing land management practices. Special measures need to be taken to provide access to and management of off-reservation areas to promote the retention of culturally valued species to the maximum extent possible. This helps to ensure the promotion and maintenance of Indigenous economies, traditional knowledge systems, livelihoods, meanings, and identities. Where retention is not feasible, measures are needed to support Tribes in making new relationships with newly arriving living beings.

Chapter 4.1: Air

Key Messages

- The federal government must uphold Tribal sovereignty, authority, and co-management rights for air quality management. Impediments to exercising sovereignty could be removed. For example, Tribes should be allowed to perform traditional fire-prevention activities on their lands, such as cultural burning of the landscape to prevent wildland fires.
- Tribes experience disproportionate impacts from poor air quality, including smoke/fine particulates, heat, and humidity, all of which can be connected to climate change. These factors are believed to impact rates of mortality and morbidity from COVID-19.

Recommendation

Fully engage Tribes as co-regulators in the very first stages of air quality regulatory planning, development, implementation, and enforcement. Adequate funding of air quality programs for staffing, monitoring, and emergency response to air quality issues supports Tribal sovereignty, as does addressing underlying causes of environmental, social, and health inequalities and injustices with the full participation of Tribal peoples.

Chapter 4.2: Water

Key Messages

- Climate change is negatively impacting water quality, increasing ocean acidification, leading to an increase in the frequency and duration of harmful algae and biotoxin events, increasing drought, negatively impacting water and food security, causing coastal inundation, and, in places, increasing riverine flooding. Even water storage reservoirs and flood management infrastructure operations and management are impacted. Each of these impacts can threaten local economies, human and non-human health and wellbeing, and Indigenous lifeways.
- Tribes and Alaska Natives are responding to these threats by drawing on traditional knowledge; observing and monitoring water sources and the linked hydrological, climatological, and ecological systems and connections; utilizing new tools; forming partnerships; creating adaptation and contingency plans; and through adaptation itself.

Recommendation

Emphasis should be on early, meaningful, and sustained engagement and consultation by federal and state regulatory and other agencies on both water quality and availability and on the associated food and water security impacts of contamination, ocean acidification, hazardous algal and biotoxin events, and risks associated with both drought and flooding. Tribes and Alaska Natives should be supported in implementing Tribally-led planning and solutions, partnerships, and cooperative efforts.

Chapter 4.2.1: Drinking Water Infrastructure

Key Messages

- Tens of thousands of Native Americans do not have access to safe drinking water. Climate change has the potential to exacerbate this lack of access.
- Operation and maintenance (O&M) of water systems is key to sustainability, cost effectiveness, and, most importantly, the ability to supply safe and reliable drinking water. Proper O&M require adequate funding, staffing, and technical, managerial, and financial training. Proper O&M may become even more critical with climate change as systems respond to increasingly extreme climate events and greater uncertainty with respect to water quantity and quality conditions.
- Water infrastructure deficiencies provide opportunities to install climate-resilient infrastructure.

Recommendation

Climate change is making it more urgent to increase resources for Tribal drinking water infrastructure and for operation and maintenance to eliminate disparities in safe drinking water access and increase infrastructure resilience to climate-related disasters and impacts.

Chapter 5: Health & Wellbeing

Key Messages

- Indigenous peoples' health and wellbeing (HWB) is founded on mutually beneficial relationships among humans, nonhuman relatives, and the environment; therefore, HWB is highly impacted by climate change

- Social-emotional health, water security, and first foods security (includes foods, medicines, and technologies) are key aspects of Indigenous peoples' health and wellbeing that merit increased attention and rapid adaptation at local scales due to Indigenous peoples' unique cultures and worldviews
- Indigenous peoples' resilience is strong; supporting community-defined climate strategies and capacity building within Indigenous communities will augment resilience

Recommendation

Accelerate incorporating Tribal HWB evaluations, priorities, and action plans into government policy, laws, and decision-making.

Chapter 6: Economic Development: Renewables, Sustainable Economies, & Carbon Offsets

Key Message

Indigenous science, knowledges, philosophies, and heritages guide Tribal self-determination in rediscovering economic sovereignty through pursuing, among other sustainable enterprises, renewable energy development, carbon sequestration via carbon markets, water and food security, and subsistence-based enterprises.

Recommendations

- Address complex land tenure, fractionation, and checkerboard jurisdictional boundary issues that persist on reservation lands and may constrain Tribal economic sovereignty.
- Invest in capacity building that increases in-house legal, technical, vocational, and varied fields of research expertise to strengthen Tribal economic self-determination while mitigating the effects of and adapting to a changing climate.

Chapter 7: Energy & a Just Transition

Key Messages

- An Indigenous just transition is an Indigenous-led transition to an Indigenous-based, nonextractive, regenerative economy that transforms community planning and ecosystem restoration.
- Indigenous peoples have been deeply affected by extractive industries such as the fossil fuel and uranium mining industries.
- Tribal lands have tremendous renewable energy development potential, which could help Tribes achieve energy and economic independence, sovereignty, and stability.

Recommendation

Remove barriers to renewable energy development, while supporting Indigenous people in a just transition, to reduce reliance on and negative impacts from fossil fuels and nuclear energy. The most significant barriers to the development of renewable energy on Tribal lands are a lack of financing, infrastructure, training in renewable energy careers, resources to access that training, and inadequately supported Tribal leadership and staff.

Chapter 8: Cultural Resources

Key Messages

- Tribal cultural resources include intangible cultural beliefs, practices, and traditions as well as tangible physical sites, landscapes, plants, and animals.

- Tribal climate change mitigation strategies should include considerations of both tangible and intangible cultural resources.

Recommendation

Integrate the tangible and intangible cultural, spiritual, and traditional significance of plants, animals, ecosystems, and landscapes into analyses of the consequences of climate change.

Chapter 9: Emergency Management

Key Messages

- It is estimated that currently less than 25% of all Tribal nations have an Office of Emergency Management, and less than 10% of those have full-time emergency managers. Without a Tribal emergency management program, it is deeply challenging to implement and adhere to a number of federal mandates and policies.
- Native Americans have a long and varied history of storytelling and culturally unique ways of communicating with one another and with other communities. When seeking to communicate with Tribes, this rich tradition of storytelling and oral histories should be incorporated.
- Barriers such as a lack of effective leadership at state and federal levels of government have prevented Tribal emergency management programs from making greater progress on responding to and mitigating climate-driven hazards.

Recommendation

Increase resources and support at the state and federal levels to develop Tribal emergency management programs across Tribal nations. Increase coordination with Tribal nations to respond to and prepare for climate-driven hazards.

Chapter 10: Protection-in-Place & Community-Led Relocation

Key Messages

- Climate change impacts on infrastructure can be an existential threat to communities and profoundly impacts the health, wellbeing, and safety of residents as well as Tribal lands, territories, and resources.
- Many Tribal communities are pursuing adaptation actions, including protection-in-place, moving infrastructure within or adjacent to the current site, and community-led relocation.
- Lack of funding, agency coordination, local capacity, and technical assistance are the primary barriers to protecting infrastructure.
- Nationwide, at least $6.2 billion is needed over the next 50 years to protect, replace, and move existing Tribal infrastructure (ATNI, 2020; DOI, 2020). This amount includes at least $175 million needed annually nationwide over the next 10 years.
- Due to inequitable regulatory barriers and program design, small Tribal communities are generally disadvantaged or excluded from federal programs relevant to climate adaptation.
- There is an immediate, urgent need for action to support Tribal nations and Indigenous communities on the frontlines of the climate crisis.

Recommendations

- Provide at least $175 million annually for proactive adaptation projects that empower and honor community decision-making, sovereignty, and self-determination, consistent with the federal government's trust and treaty responsibilities. This can be accomplished by dedicating funding to a lead agency and reducing barriers that Tribal communities face in accessing existing programs and resources.
- Create an all-of-government coordination structure to support Tribes in addressing environmental threats.

Chapter 11: Solid Waste

Key Messages

- The component of Tribal solid waste systems that is most affected by climate change and has the furthest reaching implications is that of infrastructure. An infrastructure system that continues to be stressed has lasting impacts on the amount of illegal dumping on Tribal lands, the transportation of waste in and out of Tribal communities, and the supply and demand of local recycling markets.
- The data gaps that exist in the world of Tribal solid waste management are extensive and cause a delay in responding to the demands of new conditions created by climate change.

Recommendation

Allocate funding through a streamlined federal funding process (perhaps an interagency clearing house or memorandums of understandings) to ensure Tribal infrastructure is prepared to withstand changes in climate and extreme weather events, and collaborate with Tribes to develop an inventory and evaluation of infrastructure related to solid waste in Tribal communities. This should include roads, facilities, and equipment. Focus on regional coordination to allow for idea sharing around climate change impacts, adaptations, and resources already available to help eliminate data gaps.

Chapter 12: Emerging Topics

Key Messages

- Integrating Tribal workforce development and supporting Tribal Colleges and Universities can lead to greater climate resiliency and Tribal sovereignty and can create opportunities to educate and train future Indigenous generations in climate-related fields if administered additional funding and resources.
- There are many climate-related cultural cascades, including economic and social, Indigenous relationships with the natural world, and pandemics.
- Tribal nations are sovereign, and the U.S. federal government, in meeting its intent to address climate, environmental justice, and racial justice, should work collaboratively to support Tribes to engage in internal diplomatic relations. Other collaborations across jurisdictions and Tribal governments should be considered to enhance climate-planning efforts.

Recommendation

Recognizing that climate-related cultural cascades, including economic and social, affect Indigenous relationships with the natural world, Tribes and Tribal partners should support collaborative climate-planning efforts across jurisdictions and Tribal governments, including Tribal Colleges and Universities and other workforce development opportunities such as prioritizing Indigenous knowledge and labor. These practices will lead to stronger climate resiliency and sovereignty efforts.

Appendix A: Funding

Recommendation

Increase funding mechanisms that are reflective of the unique needs of Tribal nations, including resources for workforce development, overall capacity building, implementation of climate adaptation projects, and zero cost-share grants.

APPENDIX A: FUNDING

Funding Recommendation

Increase funding mechanisms that are reflective of the unique needs of Tribal nations, including resources for workforce development, overall capacity building, implementation of climate adaptation projects, and zero cost-share grants.

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Introduction

Tribal climate change initiatives depend on accessible and sustained support. When funding is not available within Tribal governments, external sources of funding are critical. Federal grants, support from foundations, and even private sources of funding can ensure that Tribes have the resources necessary to see projects through from planning to implementation. While grants specific to climate change can be extraordinarily beneficial, other types of grants and funding sources can help Tribes to accomplish climate-related goals through a wide range of initiatives that pertain to other Tribal departments, including natural resources, public health, education, economy, and more.

This funding appendix seeks to highlight key resources to assist Tribes in developing funding strategies for Tribal climate change projects. The appendix uses the overall structure of the report to highlight examples of grants by sector and then identifies several recommendations related to increasing funding and improving support for Tribes working to address climate change.

Analysis of Funding Climate Change at Tribal Nations

Throughout the *Status of Tribes and Climate Change Report*, the authors highlighted major themes in funding climate change at Tribal nations. Some of these major themes include:

- Importance of the federal trust responsibility
- Capacity issues and lack of in-house technical expertise
- The lack of baseline funding combined with project-by-project funding cycles, making building broader resilience a challenge
- Grant requirements can create a heavier burden on smaller Tribal administrations
- Employee retention issues connected to funding, which lead to a loss in productivity
- Time delays and bureaucratic processes as roadblocks in a time-sensitive field
- The need for increased implementation funding to turn planning into action
- The need for funding to scope the potential for a project or build relationships to create or sustain projects
- The lack of flexible gap-seed funding to get something started or help sustain until permanent funding can be found (especially in a time of COVID, funds were reallocated to address critical needs while leaving projects and planning without the resources to pick up again once it is safe to do so)

General Recommendations
Throughout this Report, the authors discussed ways to improve funding efforts in their respective sectors or areas of focus. Each of these sectors or areas of focus may have specific recommendations that are unique. In this section, a general overview is provided that more broadly reiterates recommendations for funding that might assist climate adaptation and mitigation for Tribal nations.

1. Invest in Tribal administration to improve staff retention and build capacity for addressing climate change. Staff turnover and lack of capacity are challenges with any organization, and even more so for Tribal nations trying to address climate change. Finding and retaining talented, capable staff is a significant barrier to addressing climate change and is often constrained by insufficient funding. Ways to improve this might be funding a full-time climate change coordinator position at each federally recognized Tribal nation or allocating funding for multiple part-time positions. This could be funded through various entities such as the EPA's General Assistance Program or through BIA's Tribal Resilience Program.

2. Remove cost share from climate change related grants for Tribal nations that meet needs-based requirements. Currently, there are federal grants that still require some type of cost-share requirement that is out of reach for a large number of Tribal nations. For example, FEMA's Hazard Mitigation Assistance Programs require 10% cost share, which makes them inaccessible for most Alaska Native communities (ANTHC, 2020).

3. Provide incentives for collaboration across departments within Tribal administrations. Much like any bureaucracy, there is rarely cross-departmental coordination within Tribal governments. For an existential threat like climate change, all resources and efforts could be brought to bear within the Tribal government. While it should not be mandatory, funders could encourage and incentivize this type of coordination through their proposal-scoring process by explicitly valuing this coordination in the criteria.

4. Utilize resources at the state level when they exist. For example, the California state government has programming and funding in place for climate change related planning and projects. Many of these funding sources also have dedicated funding calls for federally and state-recognized Tribes. Specifically, the California Strategic Growth Council Tribal Government Challenge Planning Grant Program provides funding for California Tribes to conduct planning to identify solutions to reduce greenhouse gas emissions, improve clean energy access, and advance climate adaptation and resiliency on Tribal lands and in Tribal communities. Similar funding opportunities are available across North America.

Funding Resources
Federal grants provide a direct source of support for Tribes to address a wide range of climate change related issues. Grants.gov is a key source of information on available grants, deadlines, Tribal eligibility, and other information. Several federal agencies have websites with information dedicated to showcasing sources of funding to address climate change. The Environmental Protection Agency, for example, lists current and recent grants related to climate change that may be of interest to Tribes here: https://www.epa.gov/research-grants/climate-change-research-grants.

There are numerous sources of information on Tribal climate change grants, including several organizations that provide regular listings of grants that may pertain to Tribal climate change efforts. These funding clearinghouses and databases include:

- Institute for Tribal Environmental Professionals Climate Change Funding Resources. This page includes a list of relevant grants and resources to assist Tribes seeking funds for climate change

efforts. ITEP also includes funding notices in their monthly newsletter.
https://www7.nau.edu/itep/main/tcc/Resources/funding

- Tribal Climate Change Guide. This online database is part of the Pacific Northwest Tribal Climate Change Project at the University of Oregon. The searchable database is updated weekly and includes a search mechanism to assist users in identifying funding sources by geography, sector, or other key search terms. https://tribalclimateguide.uoregon.edu/
- Climate Adaptation Science Centers funding resources
- Bureau of Indian Affairs Climate Adaptation Science Center Tribal Liaisons
- American Indian Higher Education Consortium

Grants by Sector

The following section includes examples of grant sources that could assist Tribes in addressing issues aligned within the STACC Report. This is not a comprehensive list but could be expanded over time.

Ecosystems & Biodiversity, Air, and Water

- **National Coastal Resilience Fund.** The National Coastal Resilience Fund restores, increases, and strengthens natural infrastructure to protect coastal communities while also enhancing habitats for fish and wildlife. Established in 2018, the National Coastal Resilience Fund invests in conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that minimize the impacts of storms and other naturally occurring events on nearby communities.

- **Bureau of Reclamation WaterSMART Grants:** Water and Energy Efficiency Grants. The objective of this funding announcement is to invite states, Tribes, irrigation districts, water districts, and other organizations with water- or power-delivery authority to leverage their money and resources by cost sharing with Reclamation on projects that seek to conserve and use water more efficiently; increase the production of hydropower; mitigate conflict risk in areas at a high risk of future water conflict; enable farmers to make additional on-farm improvements in the future, including improvements that may be eligible for Natural Resources Conservation Service (NRCS) funding; and accomplish other benefits that contribute to water supply reliability in the western United States. https://www.grants.gov/web/grants/view-opportunity.html?oppId=319158

- **Wildlife Conservation Society Climate Adaptation Fund**: The WCS Climate Adaptation Fund provides a total of $2.5 million in grant awards between $50,000 and $250,000 to conservation nonprofit organizations each year. Eligible applicants must be U.S.-based nonprofit conservation organizations with approved IRS 501(c)(3) status, but the funding organization encourages collaborative projects. https://www.wcsclimateadaptationfund.org/program-information

- **Indian Land Tenure Foundation** makes grants to Indian nations and nonprofit organizations for land-related initiatives in education, cultural awareness, economic opportunity, and legal reform. https://iltf.org/grants/

- **NOAA Sea Grant**. State Sea Grant Programs provide funding opportunities for a variety of topics within Sea Grant's strategic priorities. The NOAA Sea Grant website provides a table with opportunities available within each state program. Sea Grant supports students on their path to marine and coastal careers. NOAA Sea Grant also supports undergraduate and graduate students in finding career development opportunities through scholarships, internships, and fellowships. For more information on NOAA Sea Grant funding opportunities, visit https://seagrant.noaa.gov/Funding.

- **NOAA Climate Program Office.** The NOAA Climate Adaptation and Mitigation Program (CAMP) supports research, programs, projects, and other activities related to NOAA's mission, primarily through collaborations among scientists and professionals in areas of mutual interest across the full spectrum of NOAA climate sciences. https://www.climate.noaa.gov/Funding-Opportunities/A-Cooperative-Agreement-for-Climate-Adaptation-and-Mitigation-2021-Funding-Opportunity

Drinking Water Infrastructure

- **Tribal Resource Directory Matrix of Federal Assistance for Water and Wastewater Treatment Services.** The Environmental Protection Agency has shared a Tribal Resource Directory Matrix of Federal Assistance for Water and Wastewater Treatment Services. The Tribal Infrastructure Task Force Federal partner agencies have developed a matrix summarizing the various federal assistance vehicles for water and wastewater treatment services in Indian country and Alaska Native villages. This matrix was developed in 2018 and includes links to information on grant programs, loans, and other funding sources to address water and wastewater infrastructure. The matrix can be found here: https://www.epa.gov/sites/production/files/2019-03/documents/itf_funding_eligibility_matrix_pdf_dec_2018_508c.pdf

Health & Wellbeing

- **National Indian Health Board Climate Ready Tribes Grants**. https://www.nihb.org/public_health/climate_resources.php#funding

- First Nations Development Initiative. Native Agriculture and Food Systems Scholarships (NAFSI). Applications are now being accepted for the NAFSI Scholarship Program, which aims to advance Native food sovereignty and improve overall health. First Nations will award 20 to 25 scholarships of $1,000 to $1,500 each for the 2020–2021 academic school year to Native college students majoring in agriculture and agriculture-related fields. https://www.firstnations.org/grantmaking-scholarship/

- **The Christensen Fund**. Includes a focus area related to agrobiodiversity and food sovereignty. Their grants support Indigenous peoples' efforts to secure and exercise their rights to their land, territories, resources, and sovereign systems of governance. They currently do not have any open application windows for funding in 2020 and will be unable to respond to any unsolicited proposals. Please check back for information regarding funding opportunities for 2021. https://www.christensenfund.org/funding/

Economic Development

- **Native American Business Development Institute Grant**. The U.S. BIA is soliciting proposals from Tribes for technical assistance funding to hire consultants to perform feasibility studies of economic development opportunities located in designated Opportunity Zones. These grants are also intended to fund applicants to obtain qualified guidance on how the development projects, businesses, or technologies they propose can attract investments from an Opportunity Fund. https://www.federalregister.gov/documents/2020/06/17/2020-13063/native-american-business-development-institute-nabdi-grant-solicitation-of-proposals

Energy & a Just Transition

- **U.S. Department of Energy. Energy Deployment on Tribal Lands**. The Office of Indian Energy Policy and Programs includes current funding opportunities here: https://www.energy.gov/indianenergy/funding. The Office of Indian Energy Policy and Programs also maintains a database of Tribal Energy Projects. https://www.energy.gov/indianenergy/tribal-energy-projects-database

- **The Tribal Solar Accelerator Fund** aims to catalyze the growth of solar energy and expand solar job opportunities in Tribal communities across the United States. https://tribalsolaraccelerator.org/

- **U.S. DOI's Tribal Energy Program** provides financial and technical assistance that enables Tribes to evaluate and develop their renewable energy resources and reduce their energy consumption through efficiency and weatherization. The program also offers education and training opportunities designed to foster clean energy–technology adoption, promote green jobs and growth, and strengthen native communities. https://www.energy.gov/indianenergy/office-indian-energy-policy-and-programs

Cultural Resources

- **The National Park Service (NPS) Cultural Resources, Partnerships, and Science directorate** administers a variety of federal grant programs that help protect our nation's significant historic and cultural sites and preserve our diverse cultural heritage. The State, Tribal and Local Plans & Grants division (formerly the Historic Preservation Grants division) works in partnership with other Cultural Resource programs to administer grant programs. https://www.nps.gov/history/tribes/financial_assistance.htm
- **BIA Tribal Climate Resilience Fund** has been used for climate planning for cultural resources in Southern California. https://www.bia.gov/bia/ots/tribal-resilience-program

Emergency Management

- **Federal Emergency Management Agency Hazard Mitigation Grants**. FEMA's hazard mitigation assistance provides funding for eligible mitigation measures that reduce disaster losses. More information is available here: https://www.fema.gov/grants/mitigation. Specific programs include:
  - Hazard Mitigation Grant Program (HMGP). Assists in implementing long-term hazard mitigation planning and projects following a presidential major disaster declaration.
  - HMGP Post Fire Grant. Assistance available to help communities implement hazard mitigation measures after wildfire disasters.
  - Flood Mitigation Assistance (FMA) Program. Provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured annually under the National Flood Insurance Program.
  - Building Resilient Infrastructure & Communities (BRIC). Supports states, local communities, Tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards.
  - Pre-Disaster Mitigation (PDM) Program. Provides funds annually for hazard mitigation planning and projects.

Protection-in-Place & Community-Led Relocation

- **BIA Tribal Climate Resilience Program**. Provides direct support for adaptation planning and capacity building (including planning, training and workshops and travel support), ocean and coastal management planning, and relocation, managed retreat, or protect-in-place planning. Funded annually since 2011. More information on guidelines and awards available here: https://www.bia.gov/bia/ots/tribal-resilience-program

- **Climate Justice Resilience Fund (CJRF)**. The Arctic is warming twice as fast as the rest of the world. Its residents face risky travel across melting ice and tundra, rapid change in important wild food sources, and severe coastal erosion that is forcing whole communities to relocate. CJRF gives grants to help Indigenous communities in Alaska, Canada, and Greenland strengthen their resilience to these climate change issues. https://www.cjrfund.org/arctic-grants

- **U.S. Department of Housing and Urban Development (HUD) Healthy Homes Technical Studies Grant Program** assists academic institutions, nonprofit and for-profit organizations (provided no fees are charged for services), states, Native American Tribes, and local governments to develop the most promising, cost-effective methods for identifying and controlling housing-related hazards and build local capacity to operate sustainable programs to prevent, minimize, and control housing-related hazards in eligible residences. https://www.hud.gov/program_offices/healthy_homes/hhi/hhts

Solid Waste

- **EPA Hazardous Waste Management Grant Program for Tribes**. Provides financial assistance to Tribal governments and Tribal consortia for the development and implementation of hazardous waste programs; for building capacity to improve and maintain regulatory compliance; and for developing solutions to address improper management of hazardous waste on Tribal lands. https://www.epa.gov/tribal-lands/hazardous-waste-management-grant-program-tribes

Education and Outreach

- **NOAA's Environmental Literacy Program** provides funding to communities across the country to help them build the environmental literacy necessary for resilience to extreme weather events and other environmental hazards. https://www.noaa.gov/office-education/elp/grants

- **EPA Environmental Education Grants**. Under the Environmental Education Grants Program, EPA seeks grant applications from eligible applicants to support environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. https://www.epa.gov/education/grants

Funding References

[ANTHC] Alaska Native Tribal Health Consortium. Center for Environmentally Threatened Communities. 2020. Appendix C. Summary of Relevant Findings.

APPENDIX B: RESOURCES FOR TRIBES

Background

With the increasing number of projects addressing climate change, there are a growing number of resources. Many of these resources are based on the needs of a wide range of nonprofit, for-profit, academic, federal, and state agencies and Tribal and Indigenous communities.

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Adaptation Clearinghouse

An online database and networking site that serves policymakers and others who are working to help communities adapt to climate change. Powered by Georgetown Climate Center and users like you.

AirNow and AirNow Tribal Partners

The AirNow system, developed in 1998 by the EPA, NOAA, NPS, and several state, local, and Tribal partners, provides the public with easy access to real-time national air quality information. The AirNow Air Quality Index informs the public about the existing air quality and the associated health effects of concern and, through a system of numbers and colors, helps people understand what actions they can take in order to protect their health. Twenty-nine Tribal partners in 13 states are actively engaged in AirNow.

Alaska Native Tribal Health Consortium (ANTHC)

A nonprofit Tribal health organization designed to meet the unique health needs of Alaska Native and American Indian people living in Alaska.

- Alaska Rural Utility Collaborative Building Self-Supporting Communities

American Indian Higher Education Consortium (AIHEC)

Provides leadership and influences public policy on American Indian and Alaska Native higher education issues through advocacy, research, and programmatic initiatives; promotes and strengthens Indigenous languages, cultures, communities, lands, and Tribal nations; and, through its unique position, serves member institutions and emerging TCUs.

ASPIRE Study

Studying the impacts of wildfire smoke on indoor air quality and mitigating exposure to community members; Hoopa Valley Tribe is a partner in this study.

ATNI: Affiliated Tribes of Northwest Indians: Climate Change Project

Provides guidance in developing and implementing administrative and legislative actions related to Indigenous peoples and climate change.

Chemşhúun Pe'ícháachuqeli **(When our Hearts are Happy), a Tribal Psychosocial Resilience Framework**
Designed to help Pala and other communities consider how to safeguard mental and emotional wellbeing when preparing for the impacts of climate change, this report is part of Pala's National Indian Health Board funded Climate Change Adaptation Plan, which incorporates health and wellbeing strategies.

Climate Adaptation Knowledge Exchange (CAKE)
Launched in July 2010 and managed by EcoAdapt, CAKE is a knowledge-sharing platform featuring high-quality climate change adaptation case studies, tools, and resources spanning all phases of the adaptation process (assessment, planning, implementation, evaluation, and monitoring).

Climate Impacts Group: University of Washington
The Group develops and delivers scientific information that is both useful to and used by the decision-making community by fully integrating research with stakeholder engagement.

Climate Ready Tribes Program
This program is a part of National Indian Health Board's nationally focused public health program and is funded by the Centers for Disease Control and Prevention (CDC).

Climate Science Alliance (CSA) safeguards natural and human communities in the face of a changing climate through leading activities and creating partnerships that increase awareness of climate change impacts, promote solutions, and facilitate action.

- La Jolla Band of Luiseño Indians Climate Adaptation Plan The 2019 Climate Adaptation Plan for the La Jolla Band of Luiseño Indians is a living document that provides a foundation for the Tribe to address climate change impacts to a variety of sectors, including natural resources, infrastructure and economy, health and wellness, and community and culture.
- Manzanita Band of Kumeyaay Indians Tribal Resilience Strategy (2020) Phase II of the Tribe's vision for the Manzanita Tribal Resilience Project *(in progress, more updates TBA)*
- "San Diego Wildlife, Climate Change, and You!" A public campaign was created with a web page and pocket guide targeted specifically for the public to learn more about the findings of the assessment and the 10 things they could do to help

Confederated Tribes of the Colville Reservation

- Smoke Ready Community Resources
  Creating a Smoke Ready Community was an online meeting held to gain information about how to effectively engage with the community on what to do when there is a smoke event and how to minimize exposure. All interested partners were welcomed, including decision and policy makers, government representatives, business owners, and citizens. The effects of wildfire smoke on human health and the impact it has on the communities within the Colville Reservation and Okanogan River Airshed were discussed.
- DIY Box Fan Filters, Colville Tribes Air Quality program
  DIY user's guide developed to assist Tribal members in protecting themselves from wildfire smoke using low-cost materials.

Congressional Research Service (CRS)
The CRS serves as shared staff to Congressional committees and members of Congress, and services come in many forms: reports on major policy issues, tailored confidential memoranda, briefings and consultations, seminars and workshops, expert Congressional testimony, and responses to individual inquiries.

- Wildfire Statistics

Creating Resilient Water Utilities (CRWU) (EPA)
This initiative provides drinking water, wastewater, and stormwater utilities with practical tools, training, and technical assistance needed to increase resilience to climate change. Through a comprehensive planning process, CRWU assists water utilities by promoting a clear understanding of potential long-term adaptation options for decision-making related to water utility infrastructure financing.

Cultural Resources Climate Change Strategy (National Park Service (NPS)
The purpose of this Strategy is to set out the broad scope of cultural resources in relation to climate change and identify major directions of action in cultural resources and climate change for the NPS.

Federal Emergency Management Agency (FEMA) Tribal Funding, Mitigation, and Planning Resources
This site provides resources for Tribes to prepare for emergencies, including trainings, funding opportunities, and preparedness tips. Includes the Tribal Mitigation Planning Handbook, which is a tool for Tribal governments to use in developing a mitigation plan that meets the requirements of Title 44 of the Code of Federal Regulations, Section 201.7 (44 CFR 201.7).

Guidelines for Considering Traditional Knowledges in Climate Change Initiatives is a publication intended to be an informational resource for Tribes, agencies, and organizations across the United States interested in understanding traditional knowledges in the context of climate change.

Indian Environmental General Assistance Program (GAP) Act
Commonly referred to as IGAP. Authorized by the EPA to provide GAP grants to federally recognized Tribes and Tribal consortia for planning, developing, and establishing environmental protection programs in Indian country and for developing and implementing solid and hazardous waste programs on Tribal lands.

Indigenous Environmental Network (IEN) Indigenous Just Transition Assembly
The IEN and Haskell Indian Nations University gathered frontline Indigenous leaders from across Turtle Island and Haskell students at the first-ever Indigenous Just Transition Assembly in 2019. The website provides information about the Indigenous Principles of Just Transition.

Institute for Tribal Environmental Professionals (ITEP)
Created to act as a catalyst among Tribal governments, research, and technical resources at Northern Arizona University (NAU), various federal, state, and local governments, and the private sector in support of environmental protection of Native American natural resources. Established at NAU in 1992 in cooperation with USEPA. ITEP accomplishes its mission through several programs, including Air Quality, Environmental Education Outreach Program (EEOP), National Tribal Air Association (NTAA),

Tribes and Climate Change Program (TCCP), Tribal Pesticides Council Program, Volkswagen (VW) Technical Assistance Program, National Tribal Water Council (NTWC), and several other partnership and committee groups.

ITEP's Tribes and Climate Change Assessments and Adaptation Plans
This spreadsheet contains a comprehensive list of Tribal vulnerability assessments and adaptation plans that are publicly available. The list is part of ITEP's Tribal Climate Change Adaptation Planning Toolkit and #9 on the list of toolkit resources, which can be downloaded as a zip file or as individual documents.

Legal Justice Coalition and the Rising Voices Community Relocation & Site Expansion Working Group
This coalition developed a set of policy recommendations to guide policy makers' response to the climate crisis and to address the shortfalls of the current response. At the heart of these policy recommendations is the need to center the agency, leadership, and self-determination of frontline communities in addressing climate-forced displacement.

National Climate Assessment (NCA)
These proceeding reports assess the science of climate change and variability and its impacts across the United States, now and throughout this century. Each report serves as the official U.S. Government's "State of the Union" about climate change impacts.

- NCA3 (2014) The full report provides an in-depth look at climate change impacts on the U.S. It details the multitude of ways climate change is already affecting and will increasingly affect the lives of Americans.
- NCA4 (2018) Volume II: Impacts, Risks, and Adaptation in the United States

National Indian Carbon Coalition (NICC)
An Indian-led nonprofit program that helps Tribal nations and individual Indian landowners take advantage of carbon credit and enter environmental commodities markets through the development of carbon sequestration or offset projects.

National Register of Historic Places
Guidelines for Evaluating and Documenting Traditional Cultural Properties (U.S. Department of the Interior, National Park Service, Interagency Resources Division). Technical information on comprehensive planning, survey of cultural resources, and registration in the National Register of Historic Places.

National Renewable Energy Lab's (NREL) Tribal Energy Atlas
This application shows the data generated and collected as part of the NREL study "Techno-Economic Renewable Energy Potential on Tribal Lands."

National Weather Service Watch, Warning, Advisory Display

- NOAA's National Weather Service and Storm Prediction Center
- Fire Weather Outlooks
- Severe Weather Outlooks

National Wildlife Federation—The New Energy Future in Indian Country: Confronting Climate Change, Creating Jobs, and Conserving Nature

Produced by the National Wildlife Federation Tribal Lands Program in collaboration with the University of Colorado Law School, Institute for Tribal Environmental Professionals, National Congress of American Indians, Native American Fish and Wildlife Society, and Native American Rights Fund. (2010)

Native Youth Community Adaptation and Leadership Congress (NYCALC)

The mission is to develop future conservation leaders with the skills, knowledge, and tools to address environmental change and conservation challenges to better serve their schools and home communities. This program is created in partnership with U.S. Fish and Wildlife Service, National Park Service, Bureau of Indian Affairs, U.S. Forest Service, and New Mexico Wildlife Federation.

New Mexico Tribal Resilience Action Network (NM TRAN)

This working group is a collaboration of ad-hoc Tribal staff and leaders, former war chiefs, Tribal council members, and others interested in improving adaptation and resilience to the effects of climate change on their communities and surrounding landscapes.

NOAA and National Weather Service's Weather Prediction Center

- Provides U.S. 3-7 Hazards Outlook. These products are only created Monday through Friday. Please exercise caution using this outlook during the weekend.
- Excessive Rainfall Forecasts

NOAA Climate Prediction Center (CPC) Seasons Outlooks

The CPC issues maps showing the probability of exceeding thresholds of above and below normal conditions for temperature and precipitation.

- Drought Monitor and Outlooks

Okanogan River Airshed Partnership

Seeks nonregulatory projects, programs, and partnerships in the Okanogan River airshed to increase understanding of and help reduce $PM_{2.5}$ air pollution.

Pacific Northwest Seismic Network (PNSN)

The PNSN is an organization dedicated to reducing impacts of earthquakes and volcanic eruptions in the states of Washington and Oregon by providing accurate and fast information about earthquakes and ground motions to scientists, engineers, planners, and the public. To monitor earthquake and volcanic activity across the Pacific Northwest, the University of Washington and the University of Oregon cooperatively operate the PNSN, which is sponsored by the U.S. Geological Survey, the U.S. Department of Energy, the State of Washington, and the State of Oregon.

PurpleAir: Real-Time Air Quality Monitoring

Using a new generation of laser particle counters to provide real-time measurement of $PM_{1.0}$, $PM_{2.5}$, and PM_{10}, PurpleAir sensors are easy to install and require only a power outlet and WiFi. They use WiFi to report in real time to the PurpleAir map.

Safe and Affordable Funding for Equity and Resilience (SAFER)
This site provides information on a set of tools, funding sources, and regulatory authorities designed to ensure that one million Californians who currently lack safe and affordable drinking water receive it as quickly as possible. The SAFER program also aims to reach sustainable operations for all of the state's drinking water systems and is a critical element for achieving the goals of safe, accessible, and affordable water for all Californians.

San Diego County Ecosystems: Ecological Impacts of Climate Change on a Biodiversity Hotspot
The full technical report, as included in California's Fourth Climate Change Assessment. The San Diego County Ecosystems Assessment was part of California's Fourth Climate Change Assessment as a technical report. The Climate Science Alliance led the creation of multiple products to help translate science in real time to various audiences, helping individuals see themselves as part of the solution.

Smoke-Ready Toolbox for Wildfires by the EPA
Public health officials and others can use the resources in the Smoke-Ready Toolbox to help educate people about the risks of smoke exposure and actions they can take to protect their health.

Status of Tribal Air Report (STAR)
Outlines the successes, challenges, and needs of Tribal air programs, including an extensive budget analysis. Published by the NTAA and intended to provide an understanding of the importance and impact of Tribal air programs. Nationally vetted Tribal needs, priorities, and recommendations are all outlined, and the successes and challenges experienced by the environmental professionals are highlighted by way of personal narratives submitted by the Tribes. This annual report has been published since 2014.

Swinomish Indigenous Health Indicators (IHI)
The indicators are a set of community-scale, nonphysical aspects of health that are integral to Coast Salish health and wellbeing. The IHI reflect deep connections between humans, the local environment, and spirituality. IHI provide a template for resource-based communities to tailor in order to suit their own unique connections and health priorities.

The Center Pole
A Native nonprofit grassroots organization founded in 1999. Our "Living Culture" campus is located at the foot of the Little Big Horn Battlefield National Monument on the Crow Indian Reservation in Montana. The Center has expanded its work to include diverse interwoven projects and programs that meet the expressed needs of its people for a stronger Crow community. The expansion includes an alternative energy demonstration project, food sovereignty, digital archives, an art and culture facility, an Indigenous media and education center, and a radio station to give the Crow people a voice.

Tribal Biomass Demonstration Project
Project is designed to provide Indian Tribes with greater autonomy over the management and development of their energy resources. The Bureau of Indian Affairs, in partnership with the Bureau of Land Management, is implementing the Project to promote biomass energy production for federally recognized Indian Tribes and Alaska Native corporations.

Tribal Climate Adaptation Menu
Developed by a diverse group of collaborators representing Tribal, academic, intertribal, and government entities in Minnesota, Wisconsin, and Michigan, the Menu provides a framework to integrate Indigenous and traditional knowledge, culture, language, and history into the climate adaptation planning process. Developed as part of the Climate Change Response Framework, the Tribal Climate Adaptation Menu is designed to work with the Northern Institute of Applied Climate Science (NIACS) Adaptation Workbook and as a stand-alone resource.

Tribal Climate Change Network & Project by the University of Oregon
The Project is funded by diverse partners, including the Bureau of Indian Affairs, the Affiliated Tribes of Northwest Indians, the North Pacific Landscape Conservation Cooperative, and the USDA Forest Service Pacific Northwest Research Station. The project focuses on understanding needs and opportunities for Tribes in addressing climate change, examining the government-to-government relationship in a climate context, and exploring the role of traditional knowledge in climate change studies, assessments, and plans.

Tribal Climate Tool
This tool is designed to help Tribes in the Pacific Northwest and the Great Basin area understand how the climate is expected to change in places that they care about. It provides maps, graphs, tables, and descriptions of projected changes. *(Note: Works best in Google Chrome)*

U.S. Department of the Interior Indian Affairs Tribal Biomass Demonstration Project
This project provides more effective and accessible ways for Indian Tribes to develop their energy resources, generate revenue, and improve the wellbeing of their communities. It also provides the Bureau with an avenue to assist Tribes in securing reliable, long-term supplies of woody biomass materials.

United States Geological Survey and Climate Adaptation Science Centers
A partnership-driven program that teams scientific researchers with natural and cultural resource managers and local communities to help fish, wildlife, waters, and lands across the country adapt to changing conditions.

- Regional Climate Adaptation Science Centers (CASCs): NW CASC, NC CASC, SW CASC, SC CASC, NE CASC, SE CASC, AK CASC

The network is composed of the National Climate Adaptation Science Center (NCASC) and eight regional CASCs, formerly named the Climate Science Centers, covering the continental U.S., Alaska, Hawai'i, and the U.S. Affiliated Pacific Islands. Each CASC is based out of a host university in its region, and most are composed of multi-institution consortia, which include university and nonuniversity partners.

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