Tribal Citizen Science: Investigating Current Activities and Future Aspirations

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Preface

Thank you for your interest in learning more about Tribal citizen science. Our hope is to inspire and stimulate thinking across different organizations on how they can support Tribal applications of citizen science. Discussions at the (EELC) 2019 Fall meeting led to a coalition of Tribal partners interested in better characterizing Tribal use of citizen science. Members of the EELC from the Fond du Lac Band of Lake Superior Chippewa and Santo Domingo Pueblo, other Tribal leaders, and EPA came together to learn how Tribes are conducting citizen science to understand impacts to their environment, and to identify best practices that Tribes are using to apply citizen science. This paper aims to raise awareness amongst Tribes on citizen science activities and create a meaningful network for resource sharing. In addition, this effort can serve as a guide for state, federal agencies, and other partners working together to assist Tribes using citizen science.

Abstract

Tribal use of citizen science is unique, but not well documented. We examined eight Tribal citizen science projects via information sharing sessions with project leaders to learn more about methodology, challenges, and successes of their citizen science activities. Project leaders were also asked what EPA and other agencies could do to best support Tribal citizen science efforts. The case studies cover a myriad of environmental concerns, geographic regions, and federally recognized Tribes. Similarities in project challenges included, but were not limited to, ensuring data privacy, using appropriate databases, staff turnover, and inadequate funding. Similarities in factors contributing to success included working with collaborators that provided technical support and resources, building trust with and engaging the Tribal community, and taking Tribal needs into consideration throughout project design and implementation. The main suggestions for EPA and other agencies were more funding opportunities for larger amounts across multiple consecutive years, as well as leveraging agency reach to create a website or hub for peer to peer Tribal networking.

Introduction

Citizen science is defined as involving the public in scientific research, data collection, and identification of environmental issues and/or approaches to address those issues (citizenscience.gov). Different terms may be used to describe this approach including community science and participatory science.

When we think of citizen science and Tribes, we must consider, respect, and understand the role of traditional ecological knowledge, local knowledge, and ancestral knowledge and how we apply these concepts to the work that is being done. From our perspective as Tribes, traditional knowledge is time immemorial and transcends through generations as a foundation of ecological wisdom and the intimate knowledge of the environment. Tribes are protective of the knowledge they hold, and have their own cultural context, unique to them, for sharing information within their communities. Citizen science has a definition in the context of Western science, and although community-based, is different than traditional ecological knowledge and ancestral knowledge. Native wisdom provides the context for Western scientific data and when both are considered valid, traditional ecological knowledge and citizen science data can offer a holistic insight into addressing environmental concerns for Tribes.

Tribal Nations have unique needs and considerations surrounding data privacy and sensitive cultural information as it relates to citizen science, which may not be present in non-Tribal citizen science. Tribal citizen science is also unique because the priorities, interests and needs of Tribal communities may differ compared to the wider community. Any efforts to conduct citizen science within Tribal communities must first gain trust and understanding on the purposes of such projects, how information will be collected/shared/kept private, and how they benefit Tribal members and their resource management goals.

There are few articles, publications, or research studies that document the details of contemporary Tribal citizen science. The specifics on how Tribes employ citizen science activities, including challenges and barriers encountered throughout projects, factors contributing to success, resources used, etc., remain relatively unexplored. By listening to the experiences of Tribes and learning more about these factors, federal and state partners can best support these efforts which are often critical to Tribal well-being and natural resource management. Tribal citizen science projects share a commonality with all citizen science activities, in that they must address accountability – if citizen science data reveals a threat to human or environmental health, Tribal, state, and federal governments will need to respond in order to maintain trust. EPA and state agencies can be important partners with Tribes to address concerns that arise.

In April 2019, the National Tribal Caucus (a national body of regional Tribal advisors who identify and address prominent environmental issues) had an hour-long session to discuss Tribal perspectives on citizen science. There was considerable interest expressed by Tribal leaders in raising awareness and recognition on ways Tribal cultures already incorporate community members in environmental science and in finding new ways to build Tribal citizen science activities. The discussion was wide ranging. It included comments on strategic issues like the role of science in Tribal decisions, use of EPA General Assistance Program (GAP) funding for Tribal citizen science activities, the need to keep science and politics separate, and ways to increase trust in EPA science and data. Other issues raised were more technical and operational such as the need for technical assistance in the formal processes of preparing and managing data quality plans for citizen science projects, the value of incorporating Tribal education programs, experiences with EPA Equipment Loan Programs, and difficulties encountered in melding Traditional Ecological Knowledge and other science standards. Examples of Tribal citizen science activities were provided that included both human health and environmental quality. Some of the larger Tribes reflected on how their skilled Tribal scientists might help lead Tribal citizen science efforts. Overall, there was considerable interest in defining specific ways that EPA and Tribes can work together on citizen science – a goal of this paper.

Case Studies

This report features eight Tribal citizen science projects that represent a diversity of environmental and health concerns, geographic regions, and a range of federally recognized Tribes. The case studies included below were compiled using internet searches, calls for information sharing among national Tribal workgroups, and leveraging the expertise of EELC Tribal members.

One EELC member or Tribal partner and one Oak Ridge Institute for Science and Education (ORISE) research participant conducted one-hour information sharing sessions with Tribal project leaders to learn more about each project, its concept and design, method of implementation and data collection efforts, and how communities were engaged. Other areas of interest included: project history, lessons learned, future plans and opportunities, and ideas on how EPA and other organizations can best support tribal citizen science activities. The project team shared the transcripts of these sessions with participants to conduct fact-checking and clarification. Short project summaries in the following sections are based on discussion with project leaders which describe the goals, accomplishments, and lessons learned. Full detailed case studies are included in the Appendix.
Tribal citizen science case studies included:

1. Radon monitoring by community members of the Leech Lake Band of Ojibwe
2. Studying microplastics in subsistence foods by the Sitka Tribe of Alaska
3. Microbial source tracking by the Shinnecock Nation
4. Engaging youth in measuring water quality and watershed ecology in New Mexico Pueblos by RiverSource
5. Water monitoring by the Fond du Lac Tribal and Community College
6. Monitoring aquatic invasive species by the Blackfeet Nation
7. Observing climate change and phenology by the College of the Menominee Nation
8. Researching climate change and water supply with Great Basin and Southwest Tribes by Native Waters on Arid Lands

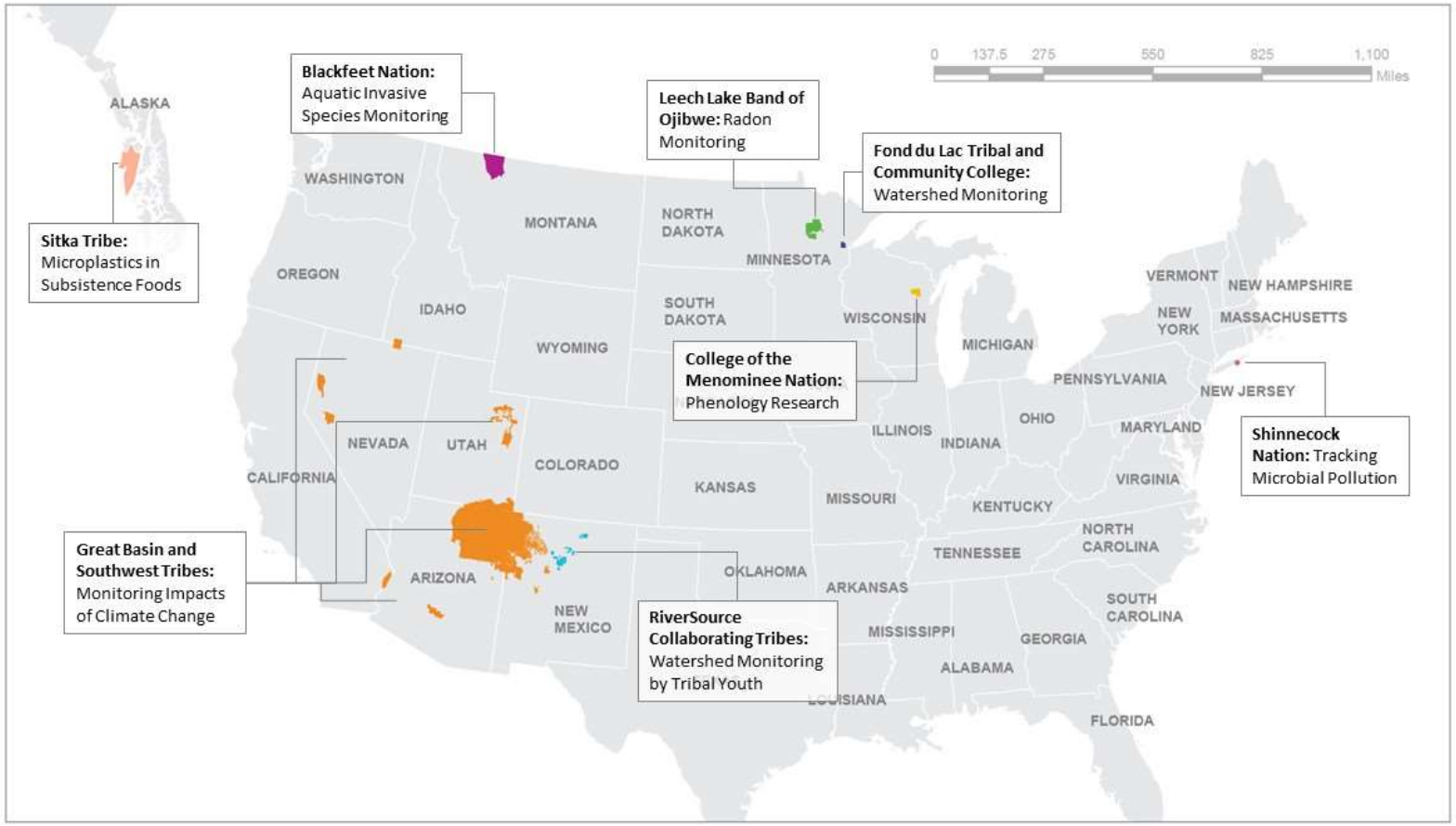

Figure 1. A map of locations of Tribal citizen science case studies.

Radon monitoring by community members in the Leech Lake Band of Ojibwe Tribe

This grant project began in 2006 to address high radon levels in residential indoor air, a major concern for the Leech Lake Band of Ojibwe Tribe. The project engaged and educated tribal members about residential radon measurement, and, where needed, cost-effective remediation.

Educating tribal community members about the health concerns of indoor radon exposure is very time-consuming and challenging. This project involved a considerable commitment to outreach, including technical (radon test) support, information booths at Tribal events, presentations at conferences, and press and educational materials. Project design also included a well-established database, sound collection/analysis process, and respecting anonymity of participants. To date, the radon monitoring project has helped mitigate radon exposure in 385 households and preemptively mitigated risk in approximately 50 buildings under construction. Project results underscore the value of funding (preferably with low or no matching funding requirements) and the importance of investing in outreach and public education.

Studying microplastics in subsistence foods by the Sitka Tribe of Alaska

This 2018 grant project was designed for Tribal community high school students to assess the existence and concentration of microplastics and associated toxins in subsistence food (shellfish) on Tribal lands and then compare levels to foods sold commercially at government food safety standards. Microplastics were present in all 200 samples collected by students on the Tribe's territory. The 4000 members of the Sitka Tribe of Alaska harvest traditional marine sustenance foods and consume shellfish at higher rates than average non-Tribal member; therefore, Tribal members are at a disproportionate risk of ingesting microplastics.

The small project yielded multiple benefits for the Tribe, but completion of the original goals was not possible. Developing the Quality Assurance Project Plan (QAPP) for this project was extremely time consuming and caused a 6-month delay, and the project was unable to test similar store-bought foods for microplastic content as was originally planned due to time constraints. Although Sitka Tribe of Alaska was not able to compare results directly to commercially purchased shellfish, their results showed generally less microplastic content than other studies of microplastics in commercial and farmed shellfish. In concluding the research, students created a presentation on the issue of microplastics, which students shared with their families and the community. That presentation was well received at regional and statewide conferences and increased the understanding of microplastics in traditional foods and how to reduce their local sources.

Microbial source tracking by the Shinnecock Nation

This project grew out of the Shinnecock Nation's water quality work with US Geological Survey (USGS). In 2013, the Tribe began microbial source tracking to complement prior water quality (USGS) assessments and to expand citizen science water sampling. The main goal of the project was to identify the source of fecal coliform in Shinnecock Bay, focusing on areas without wastewater treatment. In addition to assessing water quality and tracking fecal coliform sources, this project worked with the community to identify households wanting to upgrade their septic systems.

Engaging Tribal members in water quality protection contributes to project sustainability and project success by addressing issues of community concern, building trust and relationships, and respecting Tribal data sovereignty. The Shinnecock Nation has established a constructive working relationship with EPA Region 2 and is pleased with the spirit of collaboration and access to sensor loans programs. The project leader believes it would be helpful to have an on-line search mechanism on the EPA citizen science webpage to help Tribes find relevant citizen science projects and identify peers to network with. Although involving citizen scientists is still in the early stages, community outreach and multiple agency partnerships are seen as significant accomplishments that have resulted in access to a range of valuable resources.

Engaging youth in measuring water quality and river ecology in New Mexico pueblos

RiverSource's Watershed Watch program started in 1997 as a public-private partnership working with Tribes and Pueblos in northern New Mexico to co-create conservation projects that involve students and community members. The goals of the program are to cultivate curiosity, good stewardship practices, and entrepreneurship in Tribal youth. A key element in the program is to create self-organizing and self-sustaining "green teams" that monitor watershed health. Numerous students have gone on to careers as natural resource managers. In addition to jobs, information and data has been generated to inform land and water management practices. About 130 students present their data to the community at the end of each year. Some of the student recommendations have been incorporated into Tribal management plans.

The project developers and leaders emphasize that alignment with Tribal goals and building a foundation of trust with Tribal communities is critical. Part of this trust is observing data sovereignty; it is important with any project to make funders aware of the wishes of the Tribes regarding data sharing and use. RiverSource has turned COVID-19 challenges into opportunities by creating live videos and a YouTube channel that community scientists can follow with their (sanitized) grab n go kits, which allow them to do data collection of soil in their own yard. RiverSource believes that EPA can be more accessible to Tribal folks by providing more funding as well as guidance and systems that are understandable to Tribal folks and non-experts.

Water monitoring by the Fond du Lac Tribal and Community College

The Fond du Lac Tribal and Community College's (FDLTCC) longest-running citizen science project is their Riverwatch program that collects local water quality data. For the past 20 years, about 500 students and teachers across 25 public, private, Tribal, home, and alternative schools monitor water quality twice per year at sites in the St. Louis watershed and Lake Superior basin. This data fills a knowledge gap because the watershed is only surveyed every 10 years by conservation agencies (except the reach of the river along the Fond du Lac Reservation, which is monitored every year). Data protocols are based on the Minnesota Pollution Control Agency citizen science program as well the Wisconsin Water Action Volunteer program.

FDLTCC has sustained its citizen science monitoring despite losing funding five years ago; it now runs on the determination and involvement of schoolteachers. Unfortunately, they also experienced staff turnover because of funding loss, which is a hindrance, and equipping teachers with a protocol book and hands-on support is needed. Some factors contributing to project success are FDLTCC's long-standing

practice of consulting with the community and elders on projects, even down to details of what traditional language should be used. The project leader thinks EPA and other agencies can best support Tribal citizen science efforts by making more funding available and ensuring that funding allows for flexibility to accommodate individual Tribal needs and interests.

Monitoring aquatic invasive species by the Blackfeet Nation

On the Blackfeet Reservation in Montana, aquatic invasive species such as the zebra mussel and quagga mussel are a major threat to waterways, as they outcompete native species for food, attach to native species, and clog water intakes for power plants. Since receiving seed funding from the Flathead Basin Commission and now EPA funding, this tribal project has grown from a single boat check station to four inspection sites and is expanding to include citizen scientists that collect substrate and eDNA samples and monitor for zebra and quagga mussels and invasive aquatic plants. A science curriculum is being developed to engage middle and high school students in watershed health and invasive species issues.

Collaborations with other Federal and state agencies have been key to success, especially when they provide staff to run boat check stations. The program has had starts and stops due to funding, COVID-19, and the QAPP process; The project team had a QAPP training and review set up but due to COVID, this effort has been paused for the moment. The project lead has worked on environmental projects with the Blackfeet Nation for 28 years and believes that a good line of communication and community involvement goes a long way. In terms of data sovereignty, it is necessary to consult with the Tribal community and collaborating agencies before any data is collected to decide what will and will not be shared. Critical success factors to support further Tribal citizen science include more federal funding that accounts for costs of living increases and overhead cost increases, increasing awareness of Tribal citizen science projects, and establishing a network to share resources among Tribes.

Observing climate change and phenology by the Menominee Nation

The College of the Menominee Nation Sustainable Development Institute has several climate change research projects and activities; The Phenology Trail Project is the most notable in terms of citizen science. Phenology is the technical term for the seasonal timing of plant and animal biological changes and represents a sensitive local indicator of global climate change. Created by students and Tribal community elders to include culturally important species, the Phenology Trail can be walked by people who can record data on data sheets or in the Nature's Notebook app on stages of tree and plant growth throughout the seasons.

The project leader has been with the college for twelve years and took over the Phenology Project from another project lead seven years ago and noted that there is a learning curve, echoing the challenges of navigating staff turnover. Advice from the project leader is to be mindful of not rushing things, and have students, elders, and the community involved and listen to what elders have to say. EPA and other agencies can best support Tribal citizen science activities by providing more funding opportunities, particularly funding for multiple years in a row. Another way EPA and other agencies can help is to use their platforms and wide reach to communicate what Tribes and Tribal colleges are doing in terms of citizen science projects. An agency-supported conference on climate change and connections to traditional ecological knowledge of Tribes could be a great opportunity to share knowledge and pay respect to Indigenous Peoples and Tribal Nations.

Researching climate change and water supply with Great Basin and Southwest Tribes by Native Waters on Arid Lands

Native Waters on Arid lands started in 2015 to research climate change and water availability for agricultural practices on reservation lands. The project is a collaboration between 37 Great Plains and Southwest Tribal communities, universities, and the Federally Recognized Tribal Extension Program (Tribal members working through universities). Native Waters on Arid Lands engages youth aged k-12 as well as undergraduate and graduate students in water supply research such as water salinity, counting tree rings to determine drought periods, and comparing pre-European Puebloan modern and ancient water resource practices.

This project originated as a five-year project but is conducting important research that the team believes should be ongoing, thus they are currently looking for funding to keep certain aspects of the project going. This echoes the concerns of funding loss and staff turnover hindering project success. Project leaders indicated that EPA can support Tribal citizen science efforts by engaging with agency counterparts on agricultural issues as there is abundant research on this topic. Additionally, EPA and other federal agencies could provide multi-year funding and flexible grants that consider Tribal resources, limited staff, and adaptability needs of programs.

Lessons Learned: Success Factors

Collaborations with other groups

Meaningful collaborations within the community and with outside groups such as labs, academic institutions, and funding agencies generally bolster technical support and access to equipment required for running analyses, therefore improving project results and impact. Collaborations also allow Tribal citizen science projects to take on a life of their own after the initial seed funding is spent or staff turnover occurs, such as when teachers incorporated RiverWatch activities into their curriculum. Collaborations foster trust and personal relationships between Tribal staff and their partners, allowing entities such as EPA or academic institutions to value the resources and knowledge that Tribal communities have.

Examples:

- Monitoring aquatic invasive species by the Blackfeet Nation
- Studying microplastics in subsistence foods by the Sitka Tribe of Alaska

Community involvement

Community involvement and investment are key to running any project, particularly throughout the data collection phase. Tribes engage people, especially youth, in a myriad of ways through very diverse citizen science projects. From water and air quality monitoring to climate change and invasive species research and mitigation, topics vary as well as means of community engagement. Citizen science can be used as an avenue to connect Tribal elders and youth to share culture, traditions and language. It can expose tribal youth to both traditional knowledge and Western science and can be used to encourage them to consider a career in a natural resources and environmental protection fields. Citizen science is also a way to bring together the Tribal community, including Tribal leadership, to get involved in data

collection that can help their Tribe. The community can also help the Tribe by gathering data that the Tribe itself doesn't have the staff or funding to collect.

Under EPA GAP and Clean Water Act Section 106 and Section 319 grants, Tribal staff often include environmental outreach and education into their goals and objectives. Tribal citizen science serves as an excellent avenue for fulfilling these goals. Citizen science also lays the foundation for community trust-building and investment in any given project or environmental issue. This provides a chance for citizens to become involved in advocacy in protecting their natural resources as well as promoting environmental protection, and Tribal citizen science project leads can serve as guides in this process. As previously noted in this document, what Western science calls "citizen science" could complement a traditional ecological or ancestral knowledge approach that has been a pillar of Indigenous Peoples and Tribal Nations' ways of life for all of their existence and continued existence.

Examples:

- Engaging youth in measuring water quality and watershed ecology in New Mexico pueblos
- Water monitoring by the Fond du Lac Tribal and Community College

Sensitivity to traditional knowledge

Project leaders emphasized the importance of consulting elders to guide projects, particularly concerning which types of knowledge and data should be shared. Although all of the Tribal citizen science projects had Western science components, what made them unique from other citizen science projects was their link to the rich cultural context of the Tribal partners, and their care and consideration in incorporating non-Western ways of thinking and being.

Examples:

- Observing climate change and phenology by the College of the Menominee Nation
- Researching climate change and water supply with Great Basin and Southwest Tribes by Native Waters on Arid Lands

Data sovereignty

Data collected by federal funds is public, so it is important to not collect sensitive data with these funds if the Tribal community does not want to have it shared. If Tribes partner with an outside agency in a joint project, that agency could get a FOIA request and have to share all data that was collected. Data collected on Tribal lands regarding cultural and ecological knowledge are sacred and at the volition of Tribal community members to disclose or not disclose in detail. This is usually navigated by early and open communication with funding partners on which data will and will not be shared, and in some cases a Memorandum of Agreement may be needed to define the roles of each entity in data collection, storage and sharing. Another key aspect is making sure goals are outlined before data collection begins to determine what will be measured, at what data quality tier, and how data will be used. Throughout this project we found that some Tribes created and used their own databases to ensure data sovereignty whereas others used existing databases and only submitted data agreed upon by community elders and members. Concerns around data sovereignty are serious, but they can be navigated in a way that builds trust and leads to successful projects.

Examples:

- Radon monitoring by community members of the Leech Lake Band of Ojibwe
- Microbial source tracking by the Shinnecock Nation

Lessons Learned: Challenges Encountered

Lack of or loss of funding

Access to sustained funding would greatly improve projects' sustainability; often one round of an EPA grant will get a project off the ground and started but is not enough to ensure it continues beyond a year or the life of the grant. EPA can assist by providing more avenues for sustainable funding, or by supporting the project as they search for and apply for other sources of funding. Five-year funding cycles, as are often the standard length for Western science research projects, should also be applied to citizen science projects.

Examples:

- Researching climate change and water supply with Great Basin and Southwest Tribes by Native Waters on Arid Lands
- Water monitoring by the Fond du Lac Tribal and Community College

Navigating staff turnover

Lack of funding or capacity, among other factors, can lead to staff turnover. There is always a learning curve and time and resources put into training staff, so having one or a few permanent staff who know the project well and are experts in its implementation is beneficial. Existing staff should compile project documentation and protocols as part of succession planning. EPA can assist by communicating with Tribal citizen science project leaders to understand their challenges and needs to help support them in their role. Again, multi-year funding often ties into the ability of projects to train and keep staff.

Examples:

- Observing climate change and phenology by the College of the Menominee Nation
- Studying microplastics in subsistence foods by the Sitka Tribe of Alaska

Technical support and limited capacity

Tribal staff who manage citizen science projects are often asked to fill many roles from community outreach to specialized research, writing QAPPs, analyzing data, and to managing multiple grants. A common theme throughout the case studies is that Tribes starting citizen science projects should build in considerable time for the QAPP process and work with their EPA project officer or a QAPP specialist to follow protocols to make sure it gets approved as soon as possible. This can be challenging if staff time for this work is limited; EPA can assist by streamlining the QAPP process, creating a repository of QAPP examples, or by building in funding for QAPP writing time into the first few months of any Tribal citizen science project grants.

Examples:

- Radon monitoring by community members of the Leech Lake Band of Ojibwe
- Monitoring aquatic invasive species by the Blackfeet Nation
- Studying microplastics in subsistence foods by the Sitka Tribe of Alaska

Future Aspirations

A very important part of the information sharing sessions with Tribes was discussion about what Tribal leaders felt EPA and other agencies could do to best support their citizen science efforts. The following sections describe the most called for actions for EPA and other potential funding agencies to consider.

Increased funding and more accessible, sustainable funding

The most called for action by Tribes is for EPA and other potential funding agencies is increased funding and more accessible, sustainable funding. High match rates for funding are often not feasible for Tribes and prevent them from applying. Another aspect relates to Tribes competing against Tribes for small amounts of funding, whereas some of the funding available can be made continuous to recurring annual for all Tribes as part of the government's federal trust responsibility. The message from Tribal environmental project leaders is clear: at a Congressional level there needs to be more sustainable financial support for Tribal citizen science projects.

Work within the context of Tribal self-governance and sovereignty

Each Tribe is a sovereign nation with the right to self-determination and may or may not choose to participate in citizen science. Tribal governments can help Tribal citizen science projects by approving grant proposals and budgets, providing matching funds, and approving Memorandums of Understanding. It is up to Tribal staff and the community to communicate with their Tribal leaders on topics such as data privacy and sovereignty, community support, and the benefits to the Tribe, so that they have the backing and support of Tribal government. To prevent mistrust, the goals and objectives for data collection, management and sharing must be clearly stated, and there is often a need for multiple conversations with Tribal governmental leaders to allow time for concerns to be discussed and shared. Successful projects address Tribal concerns about data sovereignty using culturally respectful methods.

Focus on Tribal community needs and resources

Currently, much community science is driven by outside, pre-defined opportunities for grants offered for specific areas of study. Instead, Tribes would like to identify their own needs and then be able to adapt funding accordingly. Project leaders suggested that EPA could consult with Tribal communities, and then offer funding and support to address needs, rather than pre-determining needs for which funding and support are available. Agency support with technical help and expertise is often necessary for successful project completion, especially help on QAPPs for EPA funded projects. Technical assistance is available, but the process is still long and arduous, and Tribes still struggle with preparation and approval. It would help Tribes to have a streamlined or standard process for writing QAPPs; EPA and other agencies at the national level could help Tribal (and all) citizen science projects with this.

Knowledge sharing

State citizen science programs often have frameworks in place for citizen scientists to view, summarize and analyze the data they and others have collected. They can also see results of the accuracy of their data, and how the data may be used in environmental decision-making by state agencies. Citizen scientists themselves can use their data to advocate for improving human or environmental health. For Tribal citizen science projects to be successful and to gain the trust of their volunteers, these kinds of tools will need to be available. Because they are often outside the scope of a small citizen science grant, EPA and states can assist by sharing existing tools and technologies.

Create or bolster a hub for networking

Tribal project leaders felt EPA and other agencies can support Tribal citizen science activities by investing in outreach to increase awareness of grant and funding opportunities and equipment loan programs. It would be helpful to have a Tribal-specific webpage, search mechanism, or component to the EPA citizen science webpage so that Tribes can find relevant citizen science projects and network accordingly. E-Enterprise has an Online Community Inventory Platform (EEICP) for co-regulators that could be used as a foundation for further networking and information sharing. Connecting Tribes to existing citizen science projects and adapting them to Tribal needs could be a way to maximize funding and streamline the project development process. Another unique suggestion was that EPA could support a conference to showcase and connect Tribal citizen science projects.

Next Steps

EPA has shown an interest and commitment to working with Tribes on citizen science. Over the past few years, several collaborative projects between EPA research laboratories, regional offices and tribal nations have been funded. These projects address a wide range of environmental challenges and offer opportunities for collaborative research that engage EPA and tribal experts. Recent project examples include (See appendix for project details and Tribal partners):

- Investigation of Health Concerns with Traditional Use of Native Plants at Abandoned Uranium Mine Sites on Tribal Lands
- Demonstration of a Tribal Air Sensor Loan Program
- Human-centered Design to Improve Management of Household Hazardous Waste Programs in Alaskan Tribal Communities
- Enhancing Tribal Cyanobacteria Monitoring using Citizen Science
- Collocated Air Sensor Shelters for testing low cost air pollution sensors on or near tribal lands

More can be done to support Tribal citizen science and this paper can guide that support. Examples include thinking about how EPA offers grants, developing EPA guidance, creating a peer to peer network and resource-sharing hub, and collecting additional feedback from more Tribes about their needs for citizen science in environmental protection, e.g. through a survey or other mechanisms.

Another future step is to use this white paper to ensure that Tribal citizen science is incorporated into EPA-Tribal Environmental Plans (ETEPs) and EPA guidance. Note that ETEP's are jointly developed plans outlining how a tribe and EPA will work together to support the tribe's environmental goals within the context of all EPA tribal programs, including, but not limited to, the Indian Environmental General Assistance Program (GAP). This is especially important, as many of these guidance documents (106, GAP) are currently undergoing revisions. This study offers insight into the world of Tribal citizen science efforts, but these eight case studies are by no means a comprehensive picture of Tribal citizen science work. There is a multitude of important work, activities, and studies being conducted by Tribes, who are the original stewards of the natural world.

Overall, citizen science can combine Tribal world views with Western science methods in a respectful way; the aspiration is to draw the best from both spheres that best suit Tribal needs for their projects. A more comprehensive and unified approach to Tribal citizen science will yield substantial benefits for Tribes and their environmental programs and will also provide important insights for non-Tribal citizen science projects; this will benefit from EPA collaboration and support. We hope that collaborative efforts

to move from the current paradigm of singular projects by Tribes working independently to a more connected and supported system where Tribes are learning from each other and have ongoing funding and support, and access to resources.

Case Studies

Leech Lake Band of Ojibwe Radon Monitoring Project

The Leech Lake Band of Ojibwe Radon Monitoring Program uses community input to measure, monitor, and mitigate indoor air quality (radon) on the Leech Lake Reservation in Minnesota, where high levels of radon are common and of concern.

Environmental Issue: Indoor Air Quality: Radon Exposure
Location: Leech Lake Reservation, Minnesota
Tribe(s) Involved: Leech Lake Band of Ojibwe
For More Information: http://www.llojibwe.org/drm/environmental/air.html
Contact: Brandy Toft, Environmental Deputy Director, brandy.toft@llojibwe.net

BACKGROUND

The Leech Lake Air Monitoring Program (LLAP) was established in 2001 with then Air Quality Specialist Brandy Toft and has grown to include indoor and ambient air quality measurements. Circa 2006, the Tribe received a State Indoor Radon Grant (SIRG) to begin the radon-specific monitoring program in households. In Minnesota, roughly 3 in 5 households are above the radon threshold of 4.0 pC/L (though the Tribe has adopted the World Health Organization threshold of 2.7 piC/L), making it a major, but not well documented, health concern.

ABOUT THE PROJECT

The radon project started in 2006 with the goal of protecting Tribal community health. Leech Lake already had some ambient air quality projects underway. Indoor air quality has immediate impacts on health, particularly in Minnesota where high levels of radon results in the recommendation to test homes at least once every three years.

Citizen Science consists of a spectrum of public involvement when conducting research; this project falls into the less intensive engagement of the public by having Tribal members place radon test kits in their homes. These citizen scientists have their test kits collect data and data is then analyzed by a laboratory. The Leech Lake Radon Technician is available to assist any community members who request assistance in placing the tests in their homes. This project has very successful return rate of over a 60%. With past program incentives, participants could get carbon monoxide detectors for returning data, which is a good way to cover and differentiate multiple indoor air quality concerns at once. There are currently over 750 Tribal government homes and hundreds of Tribal community member owned homes involved. The Program has also deployed tests in Tribal K-12 schools where they received all except two test kits back.

WHAT DID WE LEARN FROM THE PROJECT?

Radon level trends are visualized in ArcMap and range from ambient levels to 44 pCi/L, and there are definitely hotspots around the Reservation. Some areas had very high levels of radon that needed to be mitigated urgently. So far, this program has assisted/mitigated radon in 385 households! This is a huge win as many Tribal members are living with better indoor air quality and awareness of the issue of radon. Tribal members and the Radon Technician have built a relationship of trust based on the Technician's willingness to be available to assist every step of the way. The Tribe also has a lot of control over the Program including selecting the radon tests, laboratory, and giving recipients a 10-minute radon overview and procedure for test deployment.

Limited funding and having part-time staff can hinder the project. Overall, this project funding caps at $40,000 USD, which is not very much to work with. The Leech Lake Radon Program considers themselves to be fortunate that they have a qualified Technician that is amenable to working part time and is able to work in multiple departments to meet multiple goals- this would likely be a huge hindrance to many programs.

LESSONS LEARNED FOR THE FUTURE

Convincing people that radon is a real issue is still a problem. Outreach, such as Brandy Toft has done at conferences, billboards, news articles and hosting informational booths at Tribal events is key in creating radon awareness and the funding opportunities (particularly for Tribes) to address radon.

Having a database is a critical success factor. This is a long-running Program that has a well-establish database and collection/analysis process. Keeping this level of organization and using data assigned to addresses, not names, of participants is important to protect.

KEY OPPORTUNITIES

This program is a good opportunity to bring awareness to radon as an indoor air quality issue. It has also been a good example of a radon program and via conferences has allowed Brandy to advocate and bring awareness to SIRG funding and other means to investigate radon exposure. Given access to funding and proper testing, this project could be scaled to virtually anywhere.

The Program also creates awareness in Tribal government for the construction of new buildings. The Program's focus is on radon level readings for existing structures and a secondary effort is for radon-resistant new construction. This information can be used to mitigate risk by constructing new buildings with radon controls installed. A few government buildings and over 50 homes have already been constructed with these measures, most notably a homeless shelter.

HOW EPA AND OTHERS CAN SUPPORT

More funding overall for Tribal projects/programs is needed. High match requirements for funding are not feasible for Tribes and often keeps them from applying, even for very important projects. At a congressional level there needs to be more support for citizen science projects for all Indian Country, not just at the Tribal level.

On behalf of the EPA, more outreach/awareness in advertising grant and funding opportunities and equipment loan programs is critical, as well as on behalf of SIRG and other sources of funding. Few Tribes even know that such funding is available, let alone how to set up and manage a radon project/program if given the opportunity.

REFERENCES

- Brandy Toft, Environmental Deputy Director brandy.toft@llojibwe.net
- http://www.llojibwe.org/drm/environmental/air.html

Microplastics in Tribal Subsistence Foods in Southeast Alaska

Members of the Sitka Tribe of Alaska along with students and community members collected subsistence food samples (shellfish) and tested for microplastic content. Statistically significant amounts of microplastics were found in butter clams and blue mussels and were less in general when compared to other studies of microplastics in commercial farmed shellfish. This study filled a vital data gap for microplastics research in Alaska and provided for local and state educations around microplastics in subsistence foods.

Environmental Issue: Water and Pollution, Human Health
Location: Sitka, AK
Tribe(s) Involved: Sitka Tribe of Alaska
For More Information: See references
Contact: Helen Dangel (Sitka Tribe of Alaska) helen.dangel@sitkaTribe-nsn.gov

BACKGROUND

The Sitka Tribe of Alaska is solely responsible for the health, welfare, and cultural preservation of over 4,000 members. The Sheet'ka Kwaan is the traditional territory of the Sitka Tribe and covers miles of Alaskan coastlines and islands; therefore, the Tlingit Indians have long been dependent on marine harvesting for food. Since many tribal members rely on marine sustenance foods such as shellfish much more so than non-Tribal members, Sitka Tribal members are at disproportionate risk of ingesting microplastics and other pollution accumulated in marine animals. Therefore, researching suspected microplastics in subsistence foods is both an environmental justice issue and viewed as a responsibility for the Sitka Tribe to monitor potential risks in their food system.

ABOUT THE PROJECT

The main objective of the study was to establish whether microplastics exist, and if so at what concentration, in subsistence shellfish foods for the Sitka Tribe of Alaska. The Sitka Tribe of Alaska and Mount Edgecumbe High School students collected 200 shellfish samples from a location within Sitka Tribe of Alaska's traditional territory and tested for microplastics. The target species to test for microplastics were blue mussels (*Mytilis edulis*) and butter clams (*Saxidomis giganteus*), commonly used and abundant subsistence foods for the Sitka Tribe of Alaska. Samples were collected at the Starrigavan estuary, which is the most common place to harvest shellfish. The project was initially delayed 6 months due to the length of time it took to develop the QAPP. Helen Dangel, a Sitka Tribal member, became the project coordinator right before the QAPP was approved.

The project involved citizen-scientists by including participation from the Field Science class at Mt. Edgecumbe High School, taught by Chohla Moll. Students collected samples at Starrigavan estuary during two seasons, spring and fall. An initial lab analysis took place in the spring with the students. After school let out for the summer, Helen still had many samples to process and found analysis to be more in-depth than could be done at high school level and worked with university-level interns to help with the analysis. Students were involved in a second round of sampling and analysis in the fall. Though much more labor intensive than anticipated, the project was still considered a great educational opportunity for the students, who helped with a final presentation to the community on microplastics.

Partners included the University of Alaska Southeast (UAS), who assisted with lab space and equipment, and Mount Edgecumbe High School, whose students helped in data collection and laboratory analysis. One Grant Officer and one Quality Assurance specialist from EPA Region 10 assisted in developing the QAPP, and a contracted scientist also lent expertise. Southeast Alaska Watershed Coalition and the Sitka Conservation Society were also partners.

WHAT DID WE LEARN FROM THE PROJECT?

The Sitka Tribe of Alaska found microplastics present in shellfish samples. Microplastics were found in every single butter clam tested. A literature review revealed that the amounts found are similar to what is found in other location around the world and fill a vital data gap as microplastics had not been previously researched in Alaska. Technology allowed for some microplastics to be detected, but not the smallest particles, so their levels are conservative. Microplastics have been identified but not further investigated (e.g.- compared to concentrations store bought foods, additional toxicity levels, etc.). The community was interested in results and the students were especially engaged in spreading awareness of microplastics in foods and how they end up there. However, microplastics are found in many sources of food and without a baseline to compare the subsistence food results to, the project was not as impactful/magnitude of the issue was not clear.

LESSONS LEARNED FOR THE FUTURE

Some challenges were that the project didn't get as much accomplished as planned; The project team did the initial testing phase for microplastics in subsistence foods but was not able to compare microplastic levels to similar store-bought foods. Time and funding proved to be limiting factors for this project. Samples were taken from subsistence foods, but the Sitka Tribe did not go an additional step and compare them to microplastic concentrations in local store-bought mussels; to do everything proposed in the grant would have taken at least three times more money, plus time, resources, and access to specialized equipment. If this project were to be replicated, Helen noted that the team learned a great deal and could provide guidance or a re-working of the project model to be more impactful.

Having an EPA project coordinator plus a Quality Assurance specialist is crucial in writing a QAPP. More flexibility and funding from EPA (or any grant provider) would open up more opportunities for this type of project. This project wanted to test for other compounds (namely phthalates) but the University of Alaska lab that agreed to do the tests was shuttered and it was deemed that phthalates could not be determined to come from microplastics, so these were left out of the QAPP.

KEY OPPORTUNITIES

This pilot project presents a novel opportunity to study tribal environmental issues in Alaska. Ocean microplastics are a widespread problem and this project could be re-designed, replicated, scaled, and adapted to other regions. This project also presented a unique opportunity to collaborate across Tribes, local schools, scientists, and government agencies. The majority of MEHS students are Alaskan Native and very invested in science in general, but particularly projects that are directly applicable to them. The relationship with University of Alaska Southeast allowed the Sitka Tribe to access lab instruments and technologies while also engaging high school students in meaningful scientific research.

HOW CAN EPA AND OTHER AGENCIES BEST SUPPORT?

As far as EPA support, facilitating access to more grants and multi-year funding opportunities is critical to continuing this type of work. It is often the case that EPA wants to fund as many Tribes as possible and therefore is reluctant to fund a project such as this one for another round of investigation. EPA provides funds to begin projects, but there are few opportunities to create sustainable programs unless the Tribe includes a new line of investigation or new project.

REFERENCES

- Helen Dangel, Sitka Tribe of Alaska, helen.dangel@sitkaTribe-nsn.gov
- Theo Mbabaliye, R10, Mbabaliye.theogene@epa.gov
- Michelle Davis, davis.michelleV@epa.gov
- Sitka Tribe of Alaska Quality Assurance Plan: Microplastics in Shellfish at Starrigavan Estuary Study

Shinnecock Nation Microbial Source Tracking Project

The Shinnecock Nation Microbial Source Tracking project monitors water quality in Shinnecock Bay for fecal coliform presence and attempts to determine its source. This project also acts as a liaison between cesspool/septic tank systems and Tribal members to assess who needs their system upgraded.

Environmental Issue: Water pollution (fecal coliform)
Location: Shinnecock Bay, Long Island, New York
Tribe(s) Involved: Shinnecock Nation
For More Information: See references
Contact: Shavonne Smith, Shinnecock Nation, ShavonneSmith@Shinnecock.org

BACKGROUND

The Shinnecock Nation has been working with USGS for some time on water quality issues; Seven years ago, they started Nipi Kesuk (Water Day) to present work on water quality and upgrading of septic systems. This microbial source tracking project complements previous water quality work done by the Shinnecock Nation and partners and is now expanding to include citizen scientists who will help with taking water samples.

ABOUT THE PROJECT

The main goal of the project is to identify the source of fecal matter in Shinnecock Bay, particularly the Heady Creek area. There is not a lot of wastewater treatment in South Hampton, so this is a concern. At the mouth of Heady Creek there is a drainage system that catches urban runoff from golf course and other developments. There are homes along Heady Creek that recently added septic tanks and now drain fields, so this could also contribute. As this project is just starting to gather data, all of these potential contributors and more are taken into consideration. This year, the project aims to establish its citizen science component. The Shinnecock Nation is working with the environmental department and Tribal members that are homeowners living along the shore to get folks involved with taking water samples.

In addition to assessing water quality and tracking fecal coliform sources (through EPA's Edison Lab via DNA testing), this project works in tandem with community members to identify which household sites would like to upgrade their septic systems. On Long Island, the common practice has been to install a cesspool, which is simply concrete leeching pools. The new systems include a septic tank to separate solids from the effluent and then a drain field that is closer to the surface. This encourages additional filtration, prior to reaching the water table. The Shinnecock Nation is also working with Stonybrook University to ensure effective drainage and septic systems by using a nitrogen-removing biolayer (NRB) that may prevent nitrogen from ever entering the groundwater supply. This project's engagement of Tribal members and use of partnerships make the project sustainable and beneficial to the community.

WHAT DID WE LEARN FROM THE PROJECT?

As of right now, a lot of the work is still in the developing stages as far as the citizen science aspect of this project. However, the outreach with the community and getting different agencies to engage in partnerships has been a huge accomplishment and has a lot of momentum. A diversity of partnerships has resulted in access to a range of resources and speaks to the dual goal of tracking fecal coliform and addressing degraded septic systems.

Since the nature of this project is to protect water and engage Tribal members in this process, it makes the project sustainable and a benefit to the community. Addressing issues of Tribal concern,

building trust and relationships, and respecting Tribal data sovereignty are key elements of a successful citizen science project.

LESSONS LEARNED FOR THE FUTURE

Not everyone wants to tromp through the project's marshland sites with mosquitos to collect data, so this project may incorporate biology students who are accustomed to working in these types of conditions to help with some aspects of field work.

Data sovereignty is extremely important, and this must be outlined with all other agencies and collaborators to respect Tribal autonomy. Starting open communication early about what information and data Tribes are ok and not ok with being shared is critical. The Shinnecock have a long-standing relationship working with USGS and other partners involved so this process has gone smoothly for starting the microbial tracking project.

KEY OPPORTUNITIES

This project is an opportunity to address two problems at once – water quality and upgrading of septic systems. Since this issue directly affects human health, Tribal and community members are generally very receptive. The Shinnecock Nation has been collaborating with USGS for some time and their Water Day is a great way to spread awareness within the community of water quality and septic issues as well as improve Tribal and government relations.

Collaborating with EPA Region 2, USGS, Stonybrook University, and the Tribal community is a great network-building experience for this project resulting in strong partnerships and sharing of resources. If government and other partners are willing to support, this project could be expanded to other areas.

HOW EPA AND OTHERS CAN SUPPORT

Overall, the Shinnecock Nation has a great working relationship with EPA Region 2. Willingness to collaborate and sensor loan programs have been helpful in getting this and other previous projects off the ground. It would be helpful to have a Tribal-specific page, search mechanism, or component to the EPA citizen science webpage so that Tribes may home in on relevant citizen science projects and network accordingly.

REFERENCES

- Shavonne Smith, Shinnecock Nation, ShavonneSmith@Shinnecock.org

RiverSource Inc. Watershed Watch Program

RiverSource works with Tribes in northern New Mexico to establish watershed-based science programs and experiences, among other projects. They work with youth and adults to gather water quality and other data to suit the needs of various First Nation's goals.

Environmental Issue: Water Quality
Location: Northern New Mexico
Tribe(s) Involved: Nambe, Taos, Sandia, Cochiti, Santo Domingo Pueblo, San Felipe, Santa Ana, Taos, Santa Clara, Santa Ana, San Idelfonso, and Jemez Pueblo
For More Information: www.riversource.net
Contact: Richard Schrader, rich@riversource.net, Carlos Herrera, carlos@riversource.net

BACKGROUND

RiverSource began in 1997 and is a public-private partnership working with Tribes and Pueblos in northern New Mexico to co-create conservation projects to involve students and community members. Rich Schrader started RiverSource in order to work at the local level on policy/conservation issues, originally starting with funding from a Fish and Game contract.

ABOUT THE PROJECT

The goals of the RiverSource Watershed Watch program are to spark curiosity, good stewardship practices, and entrepreneurship in Tribal youth. Building self-organizing and self-sustaining "green teams," or groups that monitor watershed health, is a key element to the Watershed Watch program. RiverSource has provided 6000 watershed-based science experiences per year for various Tribal communities in northern New Mexico.

RiverSource uses quality assured data collection techniques that are suitable for community science. They use a program QAPP that is on its fourth iteration and has been reviewed by the New Mexico Environmental Department's surface water quality bureau. Data is collected by students, paid youth interns, and adult volunteers, and data collectors range from 2nd graders to people in their 70s.

RiverSource collaborations include multiple US Forest Service districts, multiple soil and water conservation districts, multiple municipalities and towns, landowners, counties, and numerous non-governmental organizations (NGOs) and state and federal agencies. RiverSource provides the service of conducting community-based outreach to connect Tribal youth to these agencies and job opportunities in natural resource management. In addition to investing in youth futures, the project also explicitly invests in traditional knowledge by paying a stipend to elders and wisdom keepers for their time and guidance in curriculum development.

WHAT DID WE LEARN FROM THE PROJECT?

As with any project that RiverSource has helped run, everything must align with Tribal goals. RiverSource has taken its Watershed Watch program and used community-based education to put it in a cultural context to adapt to each community they serve. Also, considering scaffolding for education, or the idea that you have to start with simple program outlines for younger kids that get gradually more complex for older kids, is an ideal model since RiverSource works with second graders all the way to elders in very advanced age.

Observing data sovereignty for Tribes is often dealt with via an MOU. It is important with any project to make funders aware of the wishes of the Tribes regarding data sharing and usage. Identifying goals early in the project and communicating those to all parties involved is key. Through the Watershed Watch program and others, RiverSource has developed their own online database.

Regarding accomplishments, numerous students have graduated to become resilience practitioners, regulators, and planners; in other words, they've found jobs and careers in the natural resources field. Jobs have been created and data has been generated to steer land and water management practices. About 130 students go on to present their data to the community at the end of each year, and some students have even developed management plans for some areas.

Building trust is key but can be a challenge. This is a specific process that takes time, so all Tribal citizen science projects need to budget for this- it can often take a year to get permission from Tribal governments to do anything. Having someone like Carlos (Latinx and Cochiti Pueblo) can break through those barriers and figuring out the best method to communicate with Tribal governors through teachers or natural resource managers like Cynthia Naha also helps. Another important step is developing the support for the project and having a group within the Tribal community (rather than just one person) advocate and communicate for the project.

LESSONS LEARNED FOR THE FUTURE

As with many citizen science or interactive projects, COVID-19 has introduced a challenge in the way RiverSource functions. Right now, the team is brainstorming how to bridge this gap in ability to provide the same experiences for students as they have in the past. Access to computer and internet resources need to be considered when working with Tribal or rural communities.

RiverSource has been looking at ways to push forward in their mission and has created a 2020 summer internship program. Six individuals were hired, which operate in groups of three students with one mentor (as per current COVID regulations of groups of five or less). RiverSource follows COVID protocols and washes tools and shared instruments as well as provides personal protective equipment (masks, etc.) to participants. RiverSource will is using Zoom meetings to share knowledge with families and community.

KEY OPPORTUNITIES

RiverSource consists of several experts in working with Tribal communities, which presents a great opportunity to connect the many independent Pueblos to outside groups to work towards shared environmental conservation goals. Additionally, RiverSource has often helped diversify projects with Tribes; for example, a fish restoration project turned into a sustainable fruit tree planting effort with Santa Clara. There is often a lot you can do with funding and creative ways to accomplish goals and RiverSource has helped communities capitalize on this.

Given the move to mostly virtual platforms for the foreseeable future, RiverSource has a YouTube channel that community scientists can follow with their (sanitized) grab n go kits, which allow them to do data collection with soil on their own yard. Using multiple forms of virtual guidance and contact via Google Meets has brought community together to continue projects safely.

HOW EPA AND OTHERS CAN SUPPORT

EPA funding can be difficult to get and tedious to work with in terms of reporting, budgeting requirements, etc. There is still some resistance amongst Tribes to work with the federal government due to their contentious history. If EPA wants to be more accessible to Tribal communities, providing more funding as well as guidance and systems that are understandable to these communities and non-experts is crucial. It is important to meet people where they're at – some Tribes will need more resources than others and keeping up with funding to make programs sustainable is critical.

REFERENCES

- Rich Schrader rich@riversource.net, Carlos Herrera carlos@riversource.net
- www.riversource.net

Fond du Lac Tribal & Community College Riverwatch Project

The Fond du Lac Tribal and Community College has several citizen science projects and activities, the longest-standing of which is their River Watch program. For 20 years, High School students and community members have taken samples of streams in the St. Louis River watershed to monitor water quality and chemistry as well as survey macroinvertebrates.

Environmental Issue: Water Quality
Location: Fond du Lac Tribal and Community College, St Louis River watershed and Lake Superior Basin
Tribe(s) Involved: Fond du Lac Tribe of Lake Superior Chippewa Indians
For More Information: https://fdltcc.edu/academics/outreach-programs/environmental-institute
Contact: Courtney Kowalczak, courtneyk@fdltcc.edu

BACKGROUND

The Fond du Lac Tribal and Community College (FDLTCC) has been engaging Tribal youth and the local community in various environmental projects throughout their existence. The FDLTCC is unique in that when they conduct citizen science programs with students and community members, they focus on local tribal community issues, making sure their goals are catered and place based. Their longest-running citizen science project is their Riverwatch program. For the past 20 years, local high school students and community members have helped collect samples to test water quality and chemistry, as well as macroinvertebrate surveys, filling a knowledge gap as the watershed is surveyed only every 10 years by state agencies.

ABOUT THE PROJECT

The Fond du Lac Tribal & Community College collaborates with regional K-12 schools and college groups. They mainly work with high school students and community members to collect physical, chemical, and biological water quality data across northeastern Minnesota. Protocols are based on the Minnesota Pollution Control Agency citizen science program as well the Wisconsin Water Action Volunteer program. About 500 students and teachers across 25 public, private, Tribal, home, and alternative schools gather data twice per year at various sites along the St. Louis watershed and Lake Superior basin.

WHAT DID WE LEARN FROM THE PROJECT?

A major accomplishment of the Riverwatch project is 20 years' worth of data! This project actually lost funding five years ago and is now running on the pure determination and involvement of schools; community investment is key to sustainability and life of the project. Equipping teachers with a protocol book and a person that can be hands-on support for them is conducive to having them take ownership over the experience and data collection.

But loss of funding isn't without consequences – FDLTCC attempted to make their own database but lost funding and then didn't have money to host it. They have since tapped into the existing resource of database networks available such as International Waters Center, etc. to host their data. Staff turnover as a consequence of funding loss is also a hindrance.

LESSONS LEARNED FOR THE FUTURE

Cultural knowledge is of utmost importance and the FDLTCC has a long-standing practice of consulting with the community and elders on projects. The FDLTCC even consults with elders on what traditional language should be used when describing projects as English does not necessarily translate

word for word. Best practices with include starting communication early and giving Tribes the lead in identifying and developing their project; This lesson can be applied to working on Tribal citizen science projects or with Tribal communities in any capacity.

Other good practices and lessons to continue in the future is that FDLTCC conducted a Master Naturalist class for four years and certified the first Tribal Master Naturalists in the state, writing the curriculum to include language and traditional knowledge. The FDLTCC offered scholarships to community members to attend this class, as it is often priced beyond what community members can afford. Investing resources to get Tribal community members involved in environmental programs and projects they care about is not only a good return on investment but pays respect to the many critical roles Tribal members play in their communities.

KEY OPPORTUNITIES

At one point, Riverwatch hosted an annual one-day science symposium called the Riverwatch Congress where schools and regional professionals came in to talk about conservation, stewardship, and water quality issues. They were able to bring lots of folks together and this showed people that the Tribal community is a huge part of conservation happening in the area. Networking in this way can help build awareness and relationships between Tribal communities and other conservation stewards.

Collaborating with schools and students in the area to fill a knowledge gap has been the key aspect making Riverwatch sustainable – especially after losing funding. This is a program that the schools and students are interested in and enjoy doing and they have been able to keep conducting water quality analysis after funding thanks to this foundation of interest and familiarity with the program and protocols.

HOW EPA AND OTHERS CAN SUPPORT

As always, having more funding available overall would be ideal, but making sure funding allows for flexibility to accommodate individual Tribal needs and interests is most critical. For example, FDLTCC worked with NASA on an internship for indigenous youth, but the project had nothing to do with anything in the area or issues the Tribe was concerned about. A Tribal elder brought this to the attention of NASA, who then worked with them to research topics relevant to the community. Federal agencies must listen to Tribal priorities; allowing the community to decide project priorities and come to the EPA with proposals is both respectful of Tribal needs and most effective in addressing them. Courtney Kowalczak suggests starting the conversation early about what Tribal community concerns and needs are and what types of projects they would like to run to address them. Doing this before even putting out a grant opportunity means you could design grants in ways that address what current Tribal concerns are.

REFERENCES

- Courtney Kowalczak, courtneyk@fdltcc.edu
- https://fdltcc.edu/academics/outreach-programs/environmental-institute
- https://www.facebook.com/Environmental-Institute-at-Fond-du-Lac-Tribal-and-Community-College-278478008887826

Blackfeet Nation Aquatic Invasive Species Project

The Blackfeet Nation conducts an aquatic invasive species prevention program in the form of several boat inspection stations and a budding citizen science component to train local community members and youth to check substrate and eDNA samples in addition to creating a science curriculum to be used in middle and high schools.

Environmental Issue: Invasive Species
Location: Blackfeet Reservation, Montana
Tribe(s) Involved: Blackfeet Nation
For More Information: https://blackfeetclimatechange.com/climate-warriors/
Contact: Gerald Wagner, Blackfeet Nation Environmental Director, gwagner@3rivers.net

BACKGROUND

Aquatic invasive species such as the zebra mussel and quagga mussel are a major threat to waterways across Montana and throughout the US. These mussels often outcompete native species by filtering out algae food sources; they also attach to native species and clog water intakes for power plants. In terms of repairing damage done by these invasive species, proactive measures as opposed to reactive measures are much more impactful as no known mitigation measures currently exist for dreissenid mussels. The Blackfeet Nation, via seed funding from the Flathead Basin Commission, began an aquatic invasive species boat check station on Highway 2 in 2015 to check for and remove these invasive species for vessels going into and out of the reservation.

ABOUT THE PROJECT

Since seed funding was established and a single boat check station was installed, the project has grown to support four inspection sites at the north, south, east, and west ends of the reservation, and is expanding to include citizen scientists collecting substrate and eDNA samples and monitor for zebra and quagga mussels, milfoil and other invasive aquatic plants. From these practices a science curriculum is being developed to engage middle and high school students in watershed health and invasive species.

The program receives funding from and/or collaborates with U. S. Fish Wildlife & Parks (a state sponsored group), U.S. Bureau of Indian Affairs, Glacier National Park, their own Tribal Fish Wildlife Group, NRCS Resource Center and Montana Fish Wildlife and Parks. This project acts as a defense for folks coming in and wanting to boat on their own waterways and is also a first line of defense for the Columbia Basin river system. The project has recently been funded by an EPA Office of Environmental Justice Small Grant; the status of the citizen science component of this project is pending as a QAPP is in the process of being developed.

WHAT DID WE LEARN FROM THE PROJECT?

Overall, the program has had starts and stops due to COVID and the QAPP process. Developing a QAPP has been a roadblock in getting the citizen science substrate data collection and monitoring component started. The project team had an in-person meeting/training set up for QAPP training and review but COVID hit, so this part of the project is now in a holding pattern.

Collaborations with other Federal and state agencies have been key to success, especially when they provide funding to run the boat check stations, with the program administered by the Blackfeet Department of Environmental Protection. Collaborations with agencies are valuable for funding and staffing and sustainability of any project. Buy-in from the community is equally essential when projects are on their land and people are needed to carry out the work. Having a few key participants report back

to the community and partners is important outreach to share project progress and foster a sense of investment.

LESSONS LEARNED FOR THE FUTURE

Gerald Wagner has worked on environmental issues with the Blackfeet Nation for 28 years and, as always, a good line of communication and rapport regarding any project and the community goes a long way. In terms of data sovereignty, this means being transparent about what Tribal information will be kept confidential and which information will be reported back to the funding agencies. Consulting with the Tribal community as well as collaborating agencies on this before any data is collected or any project starts is both respectful of indigenous rights and necessary for adequate data reporting to funding agencies.

As far as logistics, it would be beneficial to have guidance from QAPP specialists early in the process and opportunities to work with them remotely. In other words, current COVID circumstances call for navigating QAPP development and the intended citizen science component of this project in a new, innovative, and safe way, and that process is not clear yet.

KEY OPPORTUNITIES

This project has been a great opportunity for collaborations across multiple agencies. It also offers perspective on how impactful Tribal community activities are in addressing environmental issues; something that is often not acknowledged. This project helps protect Tribal waters as well as the entire Columbia Basin river system – a huge geographic area – from aquatic invasive species.

The aquatic invasive species check stations are considered essential during COVID times, which again stresses how important this Tribal environmental science work is.

HOW EPA AND OTHERS CAN SUPPORT

Having more funding available overall would be ideal, especially to account for cost of living increases and overhead cost increases. Being patient and meeting Tribes where they are with resources and respecting data sovereignty is a necessity. Understanding and respect between EPA (or whomever) that Tribes maintain sovereignty over certain areas and information is critical.

Another way EPA and other federal agencies could support Tribal citizen science efforts would be to increase awareness of these Tribal projects and act as a connecting network between these efforts and potential resources such as funding, partnerships, etc. One agency plugging a project into other agency networks and funding opportunities and/or promoting awareness of current Tribal citizen science projects could greatly increase awareness and access to resources.

REFERENCES

- Gerald Wagner, Blackfeet Nation Environmental Director, gwagner@3rivers.net
- https://blackfeetclimatechange.com/climate-warriors/

College of Menominee Nation Phenology Community Science Project

The College of Menominee Nation has several climate change research projects and activities; the Phenology Trail is perhaps the most notable in terms of citizen science. Created by students and Tribal community elders to include culturally important species, the phenology trail can be walked by people who record information either on data sheets or in the Nature's Notebook app on stages of tree and plant growth throughout the seasons.

Environmental Issue: Climate Change, Traditional Ecological Knowledge
Location: College of the Menominee Nation, Sustainable Development Institute, Keshena, Wisconsin
Tribe(s) Involved: Menominee Nation
For More Information: http://sustainabledevelopmentinstitute.org/
Contact: Rebecca Edler, redler@menominee.edu

BACKGROUND

The College of the Menominee Nation Sustainable Development Institute has managed climate change/phenology projects for some time. Students and researchers work with the US Forest Service and the University of Minnesota to monitor trees and native plants over several hectares and across all seasons in the Menominee forest. As part of this project, a phenology trail was created behind the college campus that includes ten phenology stations, each of which have a sign including the Menominee name and meaning and pictures of the seasonal stages of each plant.

ABOUT THE PROJECT

The phenology trail project stemmed from climate change research at the College of the Menominee Nation with intention to put emphasis on traditional ecological and cultural indigenous knowledge. For the Menominee Tribal community, it is important to capture indigenous knowledge, particularly from elders who still have it, and pass along this knowledge to the community and visitors while still being respectful of the information they do not want shared. For each plant on the phenology trail the following questions were considered when choosing species and creating the trail: 1) how is each plant culturally relevant? 2) are there teachings that need to be shared? and 3) how is this plant used traditionally and in present times?

Folks walking the trail can choose to (or choose not to) record data on printed data sheets that are available or via the phone app Nature's Notebook. The data is considered but not used as concretely as that taken by climate change researchers over the several-hectare study area on campus/in the Menominee forest. But citizen science observations have document phenological changes in one plant species, and more changes may be apparent after more years of observation. The main aim of this citizen science project is to spark awareness and offer indigenous perspectives and emphasize cultural knowledge for folks coming through, which is everyone from Tribal community members to school-aged children.

WHAT DID WE LEARN FROM THE PROJECT?

At least five years' worth of data are needed to track any relevant phenology stage changes related to climate change; Also, data collection needs to be quite rigorous and dependable for use by USFS. For this reason, the phenology trail serves more as an awareness and educational citizen science project, whereas data collected by phenology researchers at the college is used in collaboration with the University of Minnesota and USFS to officially track climate change data. This will be a long-term dataset with a lot of work up front, so they are set up well for future analysis.

The phenology trail project has still been very successful and engaging for outreach education purposes, even if not used for intensive data collection. Rebecca has received a lot of interest from

other Tribal groups on setting up their own phenology trails, so this could be an important networking and resource-sharing opportunity.

LESSONS LEARNED FOR THE FUTURE

Rebecca Edler has been with the college for twelve years; she took over the phenology project from another project lead at the Sustainable Development Institute seven years ago, so there was a bit of a learning curve. Becoming an expert in plant identification was challenging but rewarding and input from Tribal elders helped. Identifying plants can, of course, be difficult for anyone on the trail, but has also highlighted a range of investment from citizen scientists. Some folks come to record data whereas others just want to peruse the trail and learn for personal purposes.

Advice from Rebecca is to just be mindful of not rushing things; have students and elders and community involved and listen to what elders have to say. The more people from different areas that are involved, the better outcomes will be thanks to this rich knowledge base.

KEY OPPORTUNITIES

The phenology trail project has been a foundation for other projects to stem from. For example, biology students are looking into the soil composition around traditional healing plants for antibiotic possibilities. In addition to student engagement, Tribal elders have taken a particular interest in this project as they want their traditional and cultural knowledge to be preserved when they pass. Having this interest and investment from elders, students, and the community will garner the best possible outcomes.

Any visitor can walk the phenology trail, which has been a great educational opportunity for people who might have otherwise not had the chance to learn about culturally important plant species for the Menominee, who have long been stewards of the land and have an intimate knowledge of local ecology. Tribal youth can connect to their heritage via this trail, the construction of which involved students, elders, teachers, and community members who met often to walk the trail and share traditional stories about each plant.

HOW EPA AND OTHERS CAN SUPPORT

Providing more funding opportunities and making it easier to get (preferably multiple years in a row) is necessary for Tribal citizen science projects to succeed. Another way EPA and other agencies can help is to use their platforms and wide reach to get the word out on what Tribes and Tribal colleges are doing in terms of citizen science projects. They're doing a lot of work in this arena, but it is not often recognized. Also, linking colleges would be helpful in terms of bringing awareness to citizen science projects – particularly the phenology trail. Rebecca has presented on this effort broadly and many people showed interest, but don't know how to get started. An agency-supported conference on climate change and how we track it with traditional ecological knowledge could be a great opportunity to share knowledge and pay respect to Indigenous communities.

REFERENCES

- Rebecca Edler, redler@menominee.edu
- http://sustainabledevelopmentinstitute.org/

Great Basin and Southwest Tribes - Native Waters on Arid Lands

The Native Waters on Arid Lands initiative began in 2015 and is a five-year project to understand the impacts of climate change and assess options for adapting to sustain water resources and agriculture. This project partners with researchers and Tribal communities with the goal of increasing climate resilience of Tribal agriculture and water resources on Great Basin and Southwest American Indian lands.

Environmental Issue: Climate Change, Traditional Ecological Knowledge
Location: Great Basin and Southwest US
Tribe/First Nations: Great Basin and Southwest Tribes
For More Information: https://nativewaters-aridlands.com/
Contact: Dr. Karletta Chief, kchief@arizona.edu, and Dr. Maureen McCarthy, mimccarthy@unr.edu

BACKGROUND

Through working with Tribal partners in Nevada including Pyramid Lake Paiute, Fallon-Shoshone, Washoe, and Walker River Tribes, Dr. Maureen McCarthy realized that issues around climate change and water sustainability and agriculture are unique and more challenging for Native American communities than residents in the surrounding areas. For one, Tribal communities have much more experience and understanding of climate impacts on their ancestral lands than do European settlers who only arrived in the western U.S. in the last 150 years. Thus, Native Waters on Arid Lands (NWAL) was born; four universities, the Desert Research Institute, the U.S. Geological Survey, and the First Americans Land Grant Consortium (FALCON), linking the 37 Tribal Colleges & Universities in the U.S., partnered to build a team that looked holistically at climate impacts on water resources for agriculture on reservation lands.

ABOUT THE PROJECT

NWAL started in fall of 2015 with a Tribal summit. At this summit, the most important thing the research team did, per advice from Tribal partners, was to listen carefully to different perspectives on the most important issues their Native American partners wanted addressed. The team also conducted a survey at the end of the conference. One important finding that changed the way the project was managed was that Tribes valued youth engagement as the highest priority to ensure knowledge was passed to the next generations. The research team had originally planned to engage only undergrad and graduate students. In response to input from the survey, the project team recruited a youth coordinator to engage both teachers and Native youth in middle and high school and has included citizen science component in their projects.

During NWAL Youth Days associated with climate resilience workshops, Native youth and teachers have collected and tested water samples for salinity, learned to characterize soils and vegetation in the field, counted tree rings to determine periods of drought, and toured pre-European settlement Puebloan cultural sites to compare modern and ancient water resource practices. Stories, data, and lesson plans from NWAL Youth Days and Teacher Workshops are collected and shared through the NWAL communities of practice, ArcGIS storymaps, and on the NWAL website (www.nativewaters-aridlands.com).

As an offshoot of the project, Dr. Karletta Chief did some citizen science with Northern Agency of the Navajo Nation regarding the Gold King Mine spill visiting mines and bringing Tribal members and community members together. Through these efforts, they had an elder come in and say they wanted to know impacts of spill on corn from beginning to end. The team wrote a protocol on how to test corn and crops for contamination throughout the life of the plant. They used an app called the Water Reporter-

observations such as water color, pH strips, temp, etc. are put in the app and other people in the watershed can see what is posted. Tribal members took this data and Dr. Chief's research team analyzed it in collaboration with the University of New Mexico and University of Arizona. Students also made "How to" videos on taking data correctly. Overall, there was a lot of hurt and distrust as a result of the way this spill was handled, and community science helped quell that.

WHAT DID WE LEARN FROM THE PROJECT?

Native wisdom and western science both teach us about the impacts of changes in climate to land, water, agriculture, and culture of Native communities. Taken together they show how communities anticipate and respond to droughts, floods, times of plenty, and periods of adversity. To be complete, collected and analyzed data should be seen as just one component of learning. Traditional knowledge provides the context for scientific data to reveal knowledge about change and resilience.

Flexibility of collaborators was key to success for this project as the project adapted as it went along. Also, Tribal members who were part of the community and worked at the university helped researchers understand in real-time what was happening on reservations. Through the Federally Recognized Tribal Extension Program (FRTEP), each researcher and each extension faculty had a network and other projects going on that they found synergies and opportunities in to expand their knowledge base.

Key to working with Native American communities is recognizing and respecting Tribal data sovereignty protocols. Over the past year, the Salish Kootenai College (SKC) in Montana has created the Institute for Traditional Research to further Tribal research and data sovereignty protocols. Data sovereignty starts even before the grant proposal process and continues for the duration of any research projects involving Tribal partners. Through these efforts, trust can be built in the community then the community can drive research questions, participate fully, and henceforth be involved every step of the way throughout the project.

LESSONS LEARNED FOR THE FUTURE

This project is so salient that five years hardly seems like enough time to "complete" it. To be truly effective, partnerships with Native American communities must be sustained and responsive to evolving community needs. Staff turnover and limited resources hinder sustained engagement with Tribal communities. Building trust and networks in Indian Country takes years. The NWAL team has spun-off several projects with additional federal funding and is seeking additional public and private resources to address ongoing climate and agriculture challenges in Indian Country.

There was lots of distrust and anger after the Gold King Mine wastewater spill in 2015, and Western science was not welcome for a long time after that. The Navajo already have their worldview and ways of approaching issues and Western science was not considered useful or helpful, particularly after how the oil spill was dealt with.

KEY OPPORTUNITIES

Collaborations between scientists, educators, and university extension experts were a major aspect of the NWAL project. Tribal farmers, ranchers, and resource managers from across the intermountain west study area (Southwest, Great Basin, Northern Rockies, Northern Great Plains) worked with economists, agricultural scientists, climate scientists, archeologists, educators, and communication experts to design and execute the project. Another unique aspect of this project was that a fine artist was involved whose paintings and sketches were incorporated into graphics and diagrams to capture and communicate both cultural and scientific aspects of the project. Culturally appropriate ways of reporting data to Tribal leaders and communities are essential. Complementing

written reports and publications, NWAL uses art, radio broadcasts, podcasts, webinars, storytelling, and participatory practices such as "sharing circles" as forms of outreach.

COVID19 has compounded the climate challenges facing Native American Communities. It has also renewed a strong interest in food sovereignty among Tribal youth and community leaders. Other hardships like the Gold King mine spill at the beginning of the project further emphasized its importance. Project leaders are hoping events like these, though unfortunate, continue to highlight the importance of climate change research and traditional ecological knowledge of First Nations.

HOW EPA AND OTHERS CAN SUPPORT

There was a lot of distrust from Tribes towards the EPA after handling of the Gold King Mine wastewater spill in 2015; being transparent about the data and what is going on in such circumstances is critical. Additionally, EPA came in to deal with the Gold King Mine spill from a recreational/tourism industry perspective and did not seem to consider the Tribal community relationship to the land. Traditional and cultural livelihoods should be considered in the way federal agencies address environmental issues and fostering trust by doing this is critical to a functional relationship between Tribes and EPA.

Federal agencies could be more accepting of the unique aspects of conducting research, education, and outreach projects in Indian Country including recognizing the value of both traditional knowledge and western science in grant proposals, and allowing budget flexibility and adaptability as projects evolve in response to community needs. As the COVID-19 pandemic and the Gold King Mine spill demonstrated, concurrent emergencies are the norm in Indian Country. Project flexibility is paramount to building trust and working in partnership with Native American partners. In addition to providing sustainable, multi-year funding opportunities, EPA and other federal agencies should consider Tribal resources, limited staff, and adaptability needs of programs when evaluating grant proposals.

EPA can support Tribal citizen science efforts, particularly those dealing with agriculture, by actively interacting with their federal agency counterparts. This complements the extensive research investments on agriculture, water resource, and climate issues at the U.S. Department of Agriculture, National Institute of Food and Agriculture. Capitalizing on this existing research and taking a big-picture approach to water quality, water supply, and agriculture issues could be monumental in improving the well-being of Native American communities

REFERENCES

- Dr. Karletta Chief, kchief@arizona.edu, and Dr. Maureen McCarthy, mimccarthy@unr.edu
- https://nativewaters-aridlands.com/
- https://www.youtube.com/watch?v=1ltH-FtArWY

Appendix: Examples of EPA funded projects that support Tribal Citizen Science

Below are projects funded in 2020 through the EPA Regional-State-Tribal Innovation Project Competition managed by EPA's Office of Science Advisor, Policy and Engagement. This program provides an opportunity for EPA regional staff to submit proposals for innovative projects to address state and tribal science priorities. In 2020, five tribal citizen science projects were selected that use innovative approaches to address high priority issues. These projects will engage 20 tribal partners. The work will address a wide range of environmental challenges and demonstration of community monitoring approaches for air and water pollution.

Investigation of Health Concerns with Traditional Use of Native Plants at Abandoned Uranium Mine Sites on Tribal Lands (Region 9)

Uranium mining in the western U.S. has contaminated surrounding areas with naturally occurring radioactive materials and heavy metals. These pollutants may pose human health risks via ingestion, dermal exposure, or inhalation. Tribal communities that gather local vegetation for food, medical, and other traditional uses may be exposed to contamination through direct exposure from dust on the site or from plant material that is eaten or used in other ways.

This collaborative project, co-designed by EPA and Navajo tribal scientists, will analyze potential health concerns from traditional uses of plants at abandoned uranium mine sites on Navajo Nation tribal lands. The project will combine scientific techniques with tribal experience to create a unique process for answering the questions of plant safety by citizen scientists from the Navajo communities. EPA will provide technical assistance to community volunteers who will collect plant and soil samples that will be analyzed at an EPA laboratory. The project will provide data on potential uptake, fate, and seasonal behavior of metals and radionuclides – information that can support human health and ecological risk assessments.

Partners: Navajo Nation

Collocated Air Sensor Shelters for Tribes and Citizen Science (Region 4 and 6)

Measuring air quality is the foundation of regulatory programs to reduce air pollution. Recent developments in sensor technology allow citizens scientists to measure air pollution in their communities, though the quality of data obtained from low-cost air sensors often is not equal to monitors used by government agencies. A cost-effective way to assess the performance of low-cost air sensors is to check the sensor measurements against the more expensive regulatory technology at regulatory monitoring sites.

This project, an expansion of an effort started in 2019, will leverage existing regulatory ambient air monitoring networks and expertise by deploying air sensor shelters at regulatory air monitoring sites. It will fund construction of air sensor shelters for more tribes, in partnership with additional state and local air monitoring agencies. Tribal agencies and citizen scientists can use these shelters to conduct air sensor projects. Placement of collocated testing shelters at existing regulatory air monitoring sites

allows for data comparisons between low-cost sensors and more expensive monitoring technology – a recommended method in EPA guidance for assessing air sensor measurement accuracy and uncertainty. The project team will solicit tribal, local and state interest from air monitoring agencies across the country and will select the best approximately ten locations, with preference to tribal partners.

Partners: Cherokee Nation of Oklahoma (R6) and other state, local, and tribal agency partners to be selected in R4, R6, or other regions; existing R4 partners include North Carolina Department of Environmental Quality; Catawba Indian Nation; Eastern Band of Cherokee Indians; Seminole Tribe of Florida; Mecklenburg County, NC; Broward County, FL; City of Louisville, KY; City of Jacksonville, FL; and Orange County, FL.

Enhancing Tribal and State Cyanobacteria Monitoring using Citizen Science (Regions 1 and 2)

Harmful algal blooms can produce biotoxins that adversely affect the health of people, animals, and ecosystems. Management efforts are hampered because tribal and state environmental agencies often lack information about the extent and locations of cyanobacteria blooms. Existing monitoring efforts are fragmented and use different monitoring methods and protocols, which makes the aggregation of data over geographic areas impossible. EPA and partner organizations launched the Cyanobacteria Monitoring Collaborative to overcome these barriers by working with citizen scientists, trained water professionals, and the general public to find and study cyanobacteria in waterbodies.

This project will engage several tribes and states in the Northeast U.S. to participate in the Cyanobacteria Monitoring Collaborative. The project will demonstrate how public volunteers can contribute to improved scientific understanding of cyanobacteria blooms – including real time observations that report on bloom formation and collection of water quality samples. Water samples will be analyzed by the EPA regional laboratory using a multi-fluorescence scan to determine presence of green algae, diatoms, cyanobacteria, and other organisms. The lab will also determine the presence of toxins produced by cyanobacteria. Bloom occurrence, location, duration and frequency will be documented utilizing the EPA-approved BloomWatch phone app. The lab measurements will be used to develop a cost effective, predictive tool for cyanobacteria bloom forecasting. The project benefits include a more comprehensive regional assessment of cyanobacteria bloom characteristics and occurrence trends and upgraded data visualization tools that can be used by the public and state/tribal environmental agencies.

Tribal Partners: Passamaquoddy Tribe of Maine, Maine Penobscot Indian Nation, Maine Band of Maliseet Indians, New York Seneca Nation of Indians

State Partners: Connecticut Department of Energy and Environmental Protection, New Hampshire Department of Environmental Services, Maine Department of Environmental Protection, New Jersey Department of Environmental Protection

Demonstration of a Tribal Air Sensor Loan Program (Region 10)

Communities in the Pacific Northwest that are near or on tribal lands continue to experience poor air quality during wildfire season, outdoor burning periods and residential wood heating season. EPA is now working to demonstrate air sensor loan programs in a variety of settings (e.g., urban, tribal and rural) and with a variety of loan structures (e.g., traditional libraries, tribal environmental programs, museums, conservation centers, etc.) to help communities to learn more about air quality and actions they can take to protect their health and the environment.

This project will create an air sensor loan program for airsheds that are at risk of exceeding the particulate matter (PM) air quality standard and that include underserved tribal communities. The availability of low-cost air sensors for community use provides an opportunity to engage and empower the public to learn about air quality science, gain an understanding of PM pollution and associated health risks, and learn to interpret data. Loan programs also help build capacity and expertise in air quality sensor use. While not applicable to regulatory decision-making, this project will strengthen the network of citizen science air sensor users and will inform the planned EPA best practices guide for air sensor loan programs being developed by EPA Region 9.

Partners: 1) Confederated Tribes of the Colville Reservation, the Okanogan River Airshed Partnership, and The Methow Valley Citizens Council; 2) The Confederated Tribes and Bands of the Yakama Nation, Heritage University, and Yakima Valley Air Quality Partnership; 3) The Klamath Tribes; the Burns Paiute Tribe; the Confederated Tribes of the Umatilla Indian Reservation, Oregon Department of Environmental Quality, and Oregon Tribal Health Services; and 4) the Coeur d'Alene Tribe and the Saint Maries PM Advance Partnership.

Human-centered Design to Improve Management of Household Hazardous Waste Programs in Alaskan Tribal Communities (Region 10)

Because of their remote location, Alaska's rural tribal communities have limited options for disposal of hazardous waste – which often means disposal in an unlined landfill or burning without any emissions control. Backhaul Alaska is an EPA-funded pilot program that coordinates the hauling of hazardous waste out of rural Alaskan communities using empty cargo space in barges and planes on return trips. Beginning in 2021, a 10-year plan will expand the Backhaul Alaska program to serve 160 communities across Alaska.

This project will employ a human-centered design approach (i.e., a methodology that focuses on the needs of end-users) to create a mobile application for backhaul service operations. A data management app will be created that supports different user needs including tribal and municipal government staff, citizens, program administrators, and others. The app will help individuals in rural Alaska villages manage inventory, track shipments, and submit observations that impact waste management operations. The app will also support program implementation such as optimizing transportation logistics. Anticipated project results include cost-effective program operations, reduced health and environmental risks, and support for each tribe’s capacity to manage their local backhaul program.

Partners: Alaska Department of Environmental Conservation, Alaska Native Tribal Health Consortium, Kawerak, Inc., and Zender Environmental Health and Research Group.