

www.epa.gov/research

# SCIENCE IN ACTION

# Working with Tribes to Assess, Manage, and Improve Ecosystem Function through EPA's Science to Achieve Results (STAR) Grants Program and Collaborative Research Projects

EPA is working with Tribes to address and mitigate ecological and human health impacts from environmental contaminants and stressors. These efforts are supported through cooperative research and grants that reflect Tribal Lifeways, and Traditional Knowledge (TK)/Traditional Ecological Knowledge (TEK). The traditional values and cultures of Alaska Native and American Indian people are what make these communities distinct. This accumulated knowledge and understanding of Tribal homelands, also called TEK, is their connection to the environment.<sup>1</sup>



Figure 1. Chemehuevi Indian Tribe (CIT) members constructing vegetated island with native plant species. Photograph provided by Daniel Heggem.

Below are highlights and examples of how tribes have used collaborative projects with EPA to assess and manage their surrounding surface water resources, improve ecosystem services, improve environmental resiliency, and reduce overall risks to the environment and human health. What were the main challenges? One of the many goals of a tribe's environmental and natural resource department is to maintain and restore functionality of watersheds, which help protect tribal beneficial uses and values for those water bodies. Disturbances (for examples, diversion dams, stormwater water discharge, construction, and channelization, etc.) occurring within a watershed, or adjacent to a stream corridor, may temporarily or permanently alter the functionality of the water body as well as cultural and ecological interactions.

## What were approaches taken to address this challenge?

Both EPA scientists and Tribal resource managers/scientists took a variety of approaches to address the challenges of managing ecosystems on tribal lands. Two important components are conducting Riparian Proper Functioning Condition (PFC) Assessments and incorporating TEK. The projects discussed below highlight specific examples and outcomes from using these approaches.

# What is a Riparian Proper Functioning Condition (PFC) Assessment?

PFC refers to how well the physical processes within watersheds can provide and produce desired and valued ecosystem services over time (e.g., fish habitat, livestock and/or wildlife forage, water purification, carbon storage and nutrient cycling). The term PFC is used to describe both an assessment process, and a determination of the condition of a riparian-wetland area. A PFC assessment identifies the drivers (vegetation, hydrology, soil and landform) of ecosystem physical processes to determine trends in the riparian ecosystem. It also assesses whether tribal environmental goals, including Clean Water Act objectives (e.g., water quality standards, aquatic habitat), are being met. It can then be determined what management changes are needed to address environmental and ecological risk factors to maintain or return the water body to the proper functioning condition.



Figure 2. Lower Truckee River channel post 2017 spring snowmelt flood event. Photograph provided by Robert K. Hall.

# How is TEK integrated into a PFC Assessment?

TEK reflects each tribe's own set of knowledges and lived experiences and is critical to how tribes interact with their local environment. Integrating PFC with TEK is a more comprehensive approach for assessing ecological and physical conditions on tribal lands.

<sup>&</sup>lt;sup>1</sup> National EPA Tribal Science Council. 2011. Integration of Traditional Ecological Knowledge (TEK) in Environmental

Science, Policy and Decision-Making. https://archive.epa.gov/region9/tribal/web/pdf/tribalecological-knowledge-env-sci-policy-dm.pdf

"After performing PFC assessments on our Tribal streams and wetlands, we threw out our old management plans and started new ones according to the results of our assessment. It put Tribal goals, Tribal values and culture in the center of our plans which looks at the ecosystem as a whole. I really found it useful in completely changing my mindset of how we're managing our ecosystems and waters on the reservation." Jacquelyn Barnum, Cabazon Band of Mission Indians (California)

#### Case Studies

Regional Sustainable Environmental Science (RESES): Floating Vegetation Islands: Using TEK for Development of Leading Indicators of Ecosystem Function for BMP Effectiveness, Water Quality Standards, Biological Criteria, and Control of Harmful Algal Blooms (HABs), Arizona

Harmful algal blooms (HABs) occur when an abundance of nutrients (nitrogen and phosphorus), light and temperature increases, causing a proliferation of phytoplankton in lentic (ponds, lakes, reservoirs) and slow-moving stream (lotic) ecosystems. Cyanobacteria (prokaryotes) algal mats can produce microcystin toxins.



Figure 3. Vegetated Island on CIT, Lake Havasu, CA. Photograph provided by Daniel Heggem.

The objective of this study is to evaluate the effectiveness of floating vegetated islands to remove nutrients from the water column within the Chemehuevi and Colorado River Indian Tribes (CRIT) reservation areas along Lake Havasu and the Colorado River. Lower nutrients mean fewer algal blooms. Through TEK, culturally relevant plants (needle-spiked rush, gilia and Parry's beargrass) were identified and incorporated into the design and planting of multiple floating vegetation islands. These native species were known to absorb more nutrients and were adapted to the local ecosystem.

This project was funded by the EPA Sustainable and Healthy Communities Research Program.

Gertie's Creek, Georgina Island, Lake Simcoe, Ontario, Canada: Commission for Environmental Cooperation (CEC) Project 15: Georgina Island The purpose of this study was to identify and reverse significant ecological alterations occurring within the Gertie's Creek watershed from human activities.



Figure 4. Perched culverts under Chief Joseph Snake Road (CJSR) prior to replacement. Georgina Island, Lake Simcoe, Ontario, CA. Photograph provided by Daniel Heggem.

Reduced flows in Gertie's Creek resulted in the natural stream (lotic) riparian habitat not advancing out of an early seral silver maple and eastern hemlock vegetated swamp (forested wetland) habitat.



Figure 5. Gertie's Creek below CJSR. Wetland bog with silver maple and hemlock vegetation. Photograph provided by Daniel Heggem.

The riparian PFC assessment indicated the entire watershed was not in balance with the water and sediment being supplied and lacked a diverse riparian vegetation. Visual assessment of other smaller lentic and lotic ecosystems indicates that hydrologic flow is an issue for Georgina Island.



Figure 6. Gertie's Creek with new bottomless culverts under CJSR. Photograph provided by Daniel Heggem.

Using TEK, the tribal partners informed the PFC assessment by sharing historical uses of the waterway (e.g. aquatic habitat, and species of local plants and fish). The Georgina Island Chippewa First Nation initiated an adaptive management plan to restore Gertie's Creek to its potential condition as a woody debris and fine gravel spawning habitat by removing perched culverts and replacing with larger bottomless culverts.

Participants in this project gained a better understanding of their local ecosystem and engaged in positive interactions with EPA staff.

This sub-project was funded by EPA in collaboration with CEC under the Using Ecosystem Function and Tribal Ecological Knowledge together to Build Resilience and Adapt to Climate Change Over North America project, and completed in 2017. "After taking the PFC training, I can assess stream and wetland riparian functionality without having to spend thousands of dollars on sampling, which I find useful for an organization or a tribe not fortunate to get tens of thousands of dollars every year." John Flores, San Pasqual Band of Mission Indians (California)

#### Alaska Native Tribal Health Consortium (ANTHC), Anchorage, Alaska

Alaska Native Villages are vulnerable to the threats of an ever-changing environment, especially related to the impacts on subsistence practices and water quality, and health impacts of emerging diseases/zoonosis. The ANTHC in Anchorage, in collaboration with the University of Alaska-Fairbanks, is looking at ways to assess, monitor, and adapt to the threats of a changing environment. The purpose of this project is to determine impacts to the sustainability of food and water sources in remote Alaska Native villages. The objective is to strengthen Rural Alaska Monitoring Program (RAMP) activities through environmental monitoring, trainings, and development to support community education; and protection of traditional lifeway practices.



Figure 7. Filter paper blood sample (red strips) from a harvested animal placed out to dry under piece of wood. Photograph provided by Dr. Jim Berner, ANTHC.

ANTHC is working with local hunters to train them to measure terrestrial and aquatic wildlife for diseases found in the blood (e.g., Tularemia, Toxoplasma and Brucella) using filter paper blood test kits (FP). These dried filter papers (FP) are also being used to determine contaminants such as mercury and measures of chemical feeding ecology (C and N stable isotopes) for traditional marine food species. Researchers are assessing cyanotoxin contamination in samples of walrus and seal stomach and intestinal contents from spring hunts. ANTHC is also testing fresh water from three coastal regions of the Bering Strait region for cyanobacterial toxins, microcystin and nodularia, to investigate the effect of the longer frost-free season in northwest Alaska.



Figure 8. Photo of an algal bloom in Hotham Inlet near Kotzebue taken by Alex Whiting (Environmental Protection, Native Village of Kotzebue). Photograph provided by Dr. Jim Berner.

This research is providing methods, data and recommendations to Alaska Native villagers and decision-makers that inform strategies for safely harvesting and consuming traditional diets while providing information to reduce exposure to, and infection by, emerging contaminants.

During trainings and meetings held with Alaska Native Villages from 2014 to 2017, researchers exchanged information with local subsistence hunters and Alaska Native villagers and collaborated with local biologists and other health and wildlife officials. ANTHC staff and their partners have presented their findings at local, national and international meetings, and at EPA workshops.

In the ANTHC project, tribal knowledge was key to this project. Researchers relied on local subsistence hunters and fur trappers to help identify which animals to sample and body tissues to collect, as well as the primary data collectors for field samples. Fur trappers also donated carcasses and fecal materials to the study as part of an effort to track movement of pathogens between various animal species. Community members were also important in reporting incidents that were related to contaminated meat and spring waters and considered key reporters and observers of emerging spread of zoonotic diseases and other contaminants.

This project was funded by EPA through the STAR program in support of EPA's Sustainable and Healthy Communities Research Program.

#### The Swinomish Indian Tribal Community (SITC) in La Conner, Washington

The Swinomish are intrinsically linked to their coastal habitat and are vulnerable to environmental conditions that result in adverse impacts to traditional foods, cultural sites, and tribal community health and well-being. Through this project, the SITC are characterizing local coastal hazards of sea-level rise, storm surge, and wave energy along the Swinomish Reservation shoreline. The objective is to create a planning document to preserve aquatic habitats for first nation foods (e.g., juvenile clams), and culturally significant sites. This research develops opportunities and planning tools to build adaptive capacity using a sustainable systems-based approach that can be disseminated using a multi-pronged education approach.

#### Connections between health and local natural resources such as clams



Figure 9. Presentation slide provided by Tribal Elder Larry Campbell and Dr. Jamie Donatuto

Because of this project, the SITC have:

- Characterized potential impacts from storms on the shoreline;
- Educated nearly 80 Tribal members via workshops and interviews;

- Provided an assessment of climate-related impacts on community health and well-being;
- Developed a comprehensive update of the Swinomish environmental change Adaptation Action Plan;
- Carried out Science, Technology, Engineering, and Math (STEM) training through internships for four Northwest Indian College (NWIC) undergraduate students and a Native American graduate student from Western Washington University; and
- Students have also conducted biological surveys, supported project objectives, collected field samples, and developed workshop materials.

Trainings and outreach are ongoing with Swinomish and other Coastal Salish communities. Grantees and researchers have participated in national conferences and EPA workshops and webinars providing information on this project to Tribal community members, school children, the public, university students and researchers and government agency staff.

In the Swinomish project, a Tribal leader and elders are key members of the research team advisory group. Tribal members participated in workshops and interviews to provide an assessment of climate-related impacts on community health and well-being. They evaluated which community health indicators were most important in relation to impacts from the changing climate. They also evaluated and identified sites that were significant to the community in the context of first foods and cultural practices that would be most sensitive to climate-related impacts.

This project was funded by EPA through the STAR program in support of EPA's Sustainable and Healthy Communities Research Program.

#### The Yurok Tribe in Klamath, California

The Yurok Tribe is extremely vulnerable to hydrologic changes due to their geographic location and continued reliance on surface waters and aquatic resources by tribal members. This study is identifying areas of water resource vulnerability and resiliency and assessing impacts on Yurok food security and tribal health. The purpose of the project is to increase the Tribe's adaptive capacity to prepare and respond to environmental change.



Figure 10. Algal bloom. Picture courtesy of Susan Keydel (EPA Region 9)

The objective is to inform the Yurok Tribal members of vulnerabilities and inform and mitigate the impacts of environmental factors on the community's health and resources. This research includes collecting locational and temperature data on 27 tributaries and 19 springs; collecting location information on public and private source water intakes; sampling domestic water sources for waterborne disease; and identifying toxins associated with harmful algal blooms in 19 creeks and 4 Klamath River mainstem sites.

The Tribe has undertaken sampling and verification of levels of domoic acid and paralytic shellfish poison in marine mussels, identified significant drought impacts such as reduced areas of ground water recharge, and collected and characterized water quality data endpoints such as dissolved oxygen (% and mg/mL), pH, conductivity, and temperature on tributaries.



Figure 11. The LEO mobile app helps users report unusual environmental observances back to the LEO Network.

The Yurok are now recognized as a new hub for the Local Environment Observer (LEO) Network, as a result of their partnership with ANTHC. Through their efforts, the Yurok have documented Tribal community observations and concerns regarding environmental change on critical Yurok resources. In response to these concerns, they are developing tools and adaptation strategies for use by community members and decision makers.

Yurok staff and their collaborators have also conducted workshops, community meetings, and directed staff interviews throughout the course of the grant. The grantees have participated in national conferences and EPA workshops and webinars. Audiences/stakeholders have included Yurok and other Tribal community members, academic researchers, the public and technical staff from government agencies.

Yurok researchers documented Tribal community observations and concerns regarding environmental change. The important subsistence resources such as eels and marine mussels were identified for sampling and monitoring. Tribal knowledge was also necessary to identify waterways and creeks that were critical for usage, e.g. as freshwater sources and for reporting health issues such as gastrointestinal (GI) outbreaks, which led to more targeted water monitoring and discovery of E. coli and coliform in community source water. This project was funded by EPA through the STAR program in support of EPA's Sustainable and Healthy Communities Research Program.

## Engaging Tribal Knowledge holders in research grants

The research plans and projects were guided by input from Tribal elders and community members. Tribal members and students were involved as research team members, field staff or research paper co-authors. TEK and community participation were valued and protected throughout the research process.

#### Summary

EPA's research laboratories and its extramural grants program (STAR) provide resources to tribes to address environmental concerns. EPA provides technical support, research expertise, and grant funding to tribes/tribal organizations and their partners. Tribes incorporate TEK, their technical expertise and resources and support from EPA to improve environmental management and health protection. The case studies discussed above demonstrate how these approaches were used to assess the condition of tribal natural resources, identify environmental health priorities, and reduce adverse impacts on the environment and the community's health.

EPA and Tribal staff, researchers and Tribal communities can enhance their mutual learning, share technical expertise and build on scientific and cultural exchanges through these positive interactions. These projects are making a real difference in the lives of Native American people.

Additional benefits include increasing opportunities for community environmental education and awareness, and hands-on science, technology, engineering, and math (STEM) opportunities for Native American students and youth.

#### The Science to Achieve Results (STAR) Program

https://www.epa.gov/research-grants The STAR program supports research on the assessment and reduction of risk in susceptible populations, including research to better understand the health effects of environmental contaminants on tribal populations. STAR funds research on the environmental and public health effects of air quality, environmental changes, water quality and quantity, hazardous waste, toxic substances, and pesticides.

Tribal grants discussed were funded under the 2013 Science for Sustainable and Healthy Tribes Solicitation.

*Opportunities for STAR grants funding* STAR funding opportunities are available at <u>https://www.epa.gov/research-</u> grants/research-funding-opportunities.

#### **PFC Training for Tribes**

Tribes can request a PFC training/workshop by contacting John Lin. All trainings are 3-4 days long with a course agenda consisting of in-class presentation and at least 4 field visits depending on how many stream and wetland assessment sites the host Tribe would like to have completed.

The most recent Tribal proper functioning condition (PFC) training was held for sixteen different tribes from central and northern California from June 4-7, 2018. For more information, contact John Lin, <u>lin.john@epa.gov</u>, or Bob Hall, <u>hall.robertk@epa.gov</u>.



This research summary was developed by Dan Heggem (retired, wearing hat in the picture), Robert K. Hall, John Lin, and José Zambrana in the EPA National Exposure Research Laboratory and Cynthia McOliver in the EPA National Center for Environmental Research.

#### Acknowledgements

Sincere thanks and appreciation to the EPA technical staff and external peer reviewers who provided timely and insightful comments on this document. We respectfully acknowledge the Tribal Elders, leaders and community members who supported or participated in these projects. We also appreciate the input of our individual communications teams.

We recognize and encourage future scientific and technical collaborations with Tribal knowledge holders, scientists/researchers, environmental program managers, and academic partners.

#### Resources

National EPA Tribal Science Council. 2011. Integration of Traditional Ecological Knowledge (TEK) in Environmental Science, Policy and Decision-Making. https://archive.epa.gov/region9/tribal/web /pdf/tribal-ecological-knowledge-env-scipolicy-dm.pdf

PFC (Proper Functioning Condition). What It Is-What It Isn't-Lentic. https://www.blm.gov/or/programs/nrst/fil es/PFC\_%20Is\_Isn\_t\_%20Lentic1.pdf. Last accessed on July 19, 2018.

Local Environmental Observer Network. https://www.leonetwork.org/en/#lat=51.0 531&lng=-114.0626&zoom=7. Last accessed on July 19, 2018.