

**National EPA-Tribal Science Council (TSC)
Fall 2022 Face-to-Face Meeting**

EPA Research Triangle Park Facility
Research Triangle Park, North Carolina

December 6–8, 2022

MEETING SUMMARY

Tuesday, December 6, 2022

Opening Session

Gathering, Roll Call, Welcome, Opening Blessing and Passing of the TSC EPA Co-Chair Torch

Neil Patterson Jr., TSC Tribal Co-Chair, Tuscarora Nation; Brenda Rashleigh, Outgoing TSC Agency Co-Chair, Office of Research and Development (ORD), U.S. Environmental Protection Agency (EPA); Tim Canfield, Incoming TSC Agency Chair, ORD, EPA; Dana Adkins, TSC Region 3 Representative, Chickahominy Nation; Kacee Deener, Deputy Director, Office of Science Advisor, Policy and Engagement (OSAPE), ORD, EPA; Maureen Gwinn, Principal Deputy Administrator, ORD, EPA; Chris Robbins, Deputy Assistant Administrator for Management, ORD, EPA; and Rusty Thomas, Director, Center for Computational Toxicology and Exposure (CCTE), ORD, EPA

Neil Patterson Jr. welcomed the TSC members and guests to the face-to-face meeting, which was being held near his ancestral homelands, before the Tuscarora people were relocated to what is now New York. He opened the meeting in the Tuscarora language according to Tuscarora traditional practice, which he described as “the words that come before all else.” The traditional opening acknowledges the people in the room and the miracle of being able to gather in one place. It acknowledges the journey that each individual took to be present, including missing family and friends left behind and the challenges (thickets and thorns) of the journey itself. The opening acknowledges that those present are “piling their minds together in the center” to engage in productive and meaningful discussion. First, people are acknowledged, then the Earth, then plants and animals, and finally the sky world. After the opening, Dana Adkins provided the blessing.

Brenda Rashleigh welcomed everyone to the TSC meeting, noting that it had been a pleasure and an honor to serve as Co-Chair of such a special group and that it was good to be able to meet again in person and build on the work that began at the Eastern Band of Cherokee Indians. She acknowledged the members of the Agenda Development Team, who planned a diverse meeting with a theme of connectedness. She thanked the ORD senior leaders in attendance for understanding the importance of this meeting and working with Tribal partners.

Kacee Deener provided an overview of some of OSAPE’s functions, including implementation of EPA’s scientific integrity policy, oversight of human subjects research, coordination with Tribes, and management of such partnership groups as the TSC. She congratulated the TSC on its 21st anniversary. The TSC first met in December 2001 at the Gila River Indian Community and Ak-Chin Indian Community. Kacee thanked Brenda for her leadership of the past 2 years; Brenda and Neil led steadily during the pandemic, as the TSC quickly transitioned and successfully held three Virtual Science Meetings. Brenda’s thoughtful approach and dedication served her well in her leadership role, and she worked closely with ORD scientists throughout her tenure to ensure that their research included Tribal science priorities. Kacee officially passed the TSC EPA Co-Chair torch to Tim Canfield, who brings a broad range of experience to the role. He has worked as a Federal employee for the past 36 years, serving

in four different agencies. For the past several years, he has worked with the Chickasaw Nation on water resilience. Kacee also acknowledged the two former TSC EPA Co-Chairs present—Ted Coopwood and José Zambrana—and appreciated the commitment of the three senior ORD leaders in attendance.

Maureen Gwinn welcomed the attendees to EPA's flagship research facility in Research Triangle Park (RTP), North Carolina, and congratulated the TSC on its anniversary. She explained that ORD is the research arm of EPA and provides the scientific foundation for credible decision-making to support EPA's mission of protecting human health and the environment. ORD's science is transparent and collaborative, benefiting EPA and its stakeholders and partners. The office provides information, resources and technical support to States, Tribes and communities, and the TSC provided input to help shape the research portfolios of ORD's six National research programs. Research conducted under these research programs is implemented through EPA's offices and centers. The six programs recently published their *Strategic Research Action Plans for Fiscal Years 2023–2026* (FY23–26 StRAPs), which contain four times the number of Tribal research projects than the previous FY19–22 StRAPs, with projects focused on wildfires, climate change, ecosystem resiliency, emergency management and knowledge co-production. The national research programs are combining their efforts on crosscutting priorities, such as environmental justice, climate change, cumulative impacts, community resilience, emerging contaminants and children's environmental health. ORD looks forward to increasing its coordination with Tribes to inform solutions for their most pressing challenges. Maureen explained that Chris Frey had asked her to inform the TSC members that ORD's commitment to working with Tribes is inspired by the recent [Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships](#). ORD agrees with EPA Administrator Michael Regan's acknowledgment of the importance of EPA's Tribal work.

Chris Robbins explained that he is based in RTP and appreciates the continued interactions that he and the facility have had with the TSC and other EPA-Tribal Partnership Groups. These engagements have strengthened ORD's abilities to meet Tribal science needs. He noted that Bruce Rodan and Scot Hagerthy had spoken to the TSC in December 2021 and November 2022, respectively, about ORD's current research planning and how Tribal science priorities and needs have been incorporated into the FY23–26 StRAPs. EPA has a long history of Tribal consultation and honoring Tribal sovereignty and Tribal voices. He described the LEED-certified RTP facility, which houses 15 of EPA's 22 offices and includes major centers for air, climate and energy research. At 1.2 million square feet, it is the largest facility built by EPA and uses 40 percent less energy than standard buildings of a similar size. The campus includes 10 acres of dedicated open space, including meadows and Discovery Lake, and contains 1.6 miles of trail systems. The campus supports more than 100 bird and wildlife species and houses a butterfly garden—with native plant species and larval host plants—that provides a sanctuary for butterflies and pollinators. To help preserve and protect the environment, the campus facilities were built into the natural contour of the land, and the amount of impervious surfaces was limited.

Rusty Thomas welcomed the TSC members and explained that CCTE's mission is to rapidly evaluate human health and environmental risks resulting from exposure to environmental stressors, as well as ensure that the freshwater environment supports human well-being. Unofficially, the center serves as the Google of toxicology, exposure and freshwater ecology research. CCTE's overarching goals are to reduce the time it takes to thoroughly toxicity test chemicals, expand understanding of exposures to chemicals, develop actionable data and tools for decision-making, and reduce the time required to characterize freshwater systems. This is important because only 26 percent of the active Toxic Substances Control Act inventory has undergone human health toxicology studies, and only 16 percent has undergone ecotoxicology studies. Humans are exposed to tens of thousands of chemicals, and CCTE uses and develops computational toxicology tools (e.g., [CompTox Chemical Dashboard](#), [ECOTOX Knowledgebase](#)) to predict these exposure levels and the effects of chemicals on freshwater ecology. The center engages in a variety of activities, including developing real-time assessments of the Great Lakes

and other freshwater environments, working with the Minnesota Department of Health to screen contaminants of emerging concern, structurally categorizing PFAS to identify testing candidates, using the R2R2R (Remediation to Restoration to Revitalization) Process to restore habitat near a culturally significant Ojibwe site in Minnesota, and helping revitalize culturally significant species (e.g., wild rice) in the Great Lakes region. Rusty thanked the TSC for providing valuable input about Tribal science needs and priorities that could be incorporated into CCTE's research.

Ted Coopwood asked Rusty how CCTE researchers think about and incorporate children's environmental health measures into their work. Rusty responded that the work has been guided through a partner engagement process and integrates data from a children's health standpoint. Researchers have studied baby products and toys and incorporated the data, particularly as related to developmental phases, into decision-making to inform children's health priorities in a holistic manner. CCTE researchers also participate in the EPA Children's Health Protection Advisory Committee (CHPAC). Maureen added that ORD works closely with the Office of Children's Health Protection (OCHP). For example, the Health and Environmental Risk Assessment, Chemical Safety for Sustainability, and Safe and Healthy Communities Research Programs meet regularly with OCHP, and the CHPAC informs ORD children's health research priorities.

Shasta Gaughen commented on ORD's partnership with the Minnesota Department of Health and the fact that Minnesota Tribes rely on many plant species for their traditional uses. She asked how ORD works with Tribes to protect culturally important species. Kathie Dionisio responded that the Health and Environmental Risk Assessment Research Program has performed work on exposure factors and different patterns of use that are more specific to Tribal communities. Shasta explained that California discussions focus on how chemical uptake by plants affects Indigenous health. Indigenous health indicators need more exposure data.

In response to a request from Brenda to speak about environmental DNA, or eDNA, Rusty explained that CCTE is trying to be innovative in this area and use tools and technology to identify invasive species, particularly in the Great Lakes and other freshwater bodies, and assist in decision-making.

Rory O'Rourke asked how Tribes can connect with CCTE to work on contaminants of emerging concern. Rusty stated that they may contact him (thomas.russell@epa.gov), Kathie (dionisio.kathie@epa.gov) or Monica Linnenbrink (linnenbrink.monica@epa.gov). Participants will be hearing from Dan Villeneuve about research from a multispecies perspective to understand salmonid risk from a contaminant of emerging concern. Kacee added that each region has a Regional Science Liaison whose job is to connect States and Tribes with ORD research. Several grant programs allow ORD partnerships with the regions and stakeholders to perform short-term, applied research. Eliodora Chamberlain suggested that Minnesota Tribes could reach out to Janette Marsh or the Region 5 Regional Science Liaison, Carol Braverman, for assistance in protecting culturally important species.

Following the welcoming remarks, the participants introduced themselves.

Tribal Civics 101: Understanding the Tribal–Federal Relationship

Neil Patterson Jr., TSC Tribal Co-Chair, Tuscarora Nation, and Shasta Gaughen, TSC Region 9 Tribal Representative, Pala Band of Mission Indians

Neil explained that the Tribal Caucus had met several times to discuss this meeting and identify useful, educational actions that they could take. The decision was made to “go back to the basics,” and Shasta had volunteered to provide this presentation.

Shasta, who holds a doctorate in cultural anthropology and a master's degree in Indigenous peoples law, provided an overview of the U.S. historical and legal basis for Tribal sovereignty and the inherent right to

self-govern. In *Worcester v. Georgia* (1832), Chief Justice John Marshall stated that Indian Nations were considered distinct, independent political communities, and the term “Nation” as applied to them means “a people distinct from others.” Treaties, executive orders and laws affirm Tribal sovereignty, and the Federal government has a trust responsibility to protect Tribal lands and sovereignty. Tribes are part of a three-part Federal system that includes Federal, Tribal and State governments, which distinguishes Tribes from States.

Shasta highlighted the history of Federal Indian policy in the United States, summarizing landmark agreements, documents, acts, laws and Supreme Court cases.

Treaty Era (1778–1820)

- Articles of Confederation (1777): The articles gave Congress the sole right to regulate trade and manage all affairs with Indians.
- Northwest Ordinance (1787): The ordinance stated that Tribes’ lands and property shall “never be taken without their consent.” Although this was codified, it was not adhered to by the Federal government.
- U.S. Constitution (1787): This document gave Congress the power to regulate commerce with foreign Nations and Indian Tribes.

Removal Era (1820–1850)

- *Johnson v. M’Intosh* (1823): This Supreme Court decision established the doctrine of discovery, which declared that “discovering” Nations hold title to the land, Tribes only have the right of occupancy (“aboriginal title”), and Indian lands can be transferred only to the Federal government (i.e., not purchased by private citizens). This was the first case in the Marshall Trilogy, which formed the basic framework of Federal Indian law in the United States.
- Indian Removal Act (1830): This act relied on the doctrine of discovery and allowed the Indians to exchange lands located in existing U.S. States and Territories for land west of the Mississippi River. Although the exchange was theoretically voluntary, Tribes were pressured to sign and re-sign removal treaties and often did not understand the details of these treaties.
- *Cherokee Nation v. Georgia* (1831): This Supreme Court decision established Federal trust responsibility, treating Tribes as “dependent Nations” (i.e., wards to a guardian, which established a paternalistic relationship). This was the second case in the Marshall Trilogy.
- *Worcester v. Georgia* (1832): This Supreme Court decision established that States did not have jurisdiction over Tribes, and Tribes could not be forced to move. Despite this, Cherokees, Choctaws, Seminoles and other Indigenous peoples were pressured into signing removal treaties (e.g., Treaty of New Echota, 1835), which led to many different trails of tears when President Andrew Jackson refused to enforce the decision. This was the third case in the Marshall Trilogy.

Reservation Era (1850–1887)

This era relied on the removal and settlement of Tribes on land reserved for Tribes and is characterized by the “peace” policy. Under this policy, Christian organizations attempted to change Indigenous beliefs and teach Christian values, the military discouraged traditional practices, and the Federal government forced a transition to agricultural practices. Congress began making Indian policy by statute following the Indian Appropriations Act of 1871, which ended the practice of entering into treaties with Tribes, thus ending the era of treating Tribal Nations as fully independent sovereigns. As a result, when a Supreme Court decision ruled in favor of Tribes, a Federal law negating the decision or enacting regulations in response to it generally occurred within a few years.

- *Ex parte Crow Dog* (1883): This Supreme Court decision ruled that the Federal government did not have jurisdiction over Indian-on-Indian crime on reservations.
- Major Crimes Act (1885): This act codified Federal jurisdiction over all major crimes on Tribal lands.
- *U.S. v. Kagama* (1886): This case challenged the Major Crimes Act, but the “ward to his guardian” language in *Cherokee Nation v. Georgia* was ruled to confer a guardian responsibility and extra-constitutional source of power. This Supreme Court decision paved the way for the General Allotment Act.

Allotment and Assimilation Era (1887–1934)

Indian boarding schools were established so that Indian children could be assimilated into U.S. culture. The goal was to “kill the Indian, save the man” in the words of Richard Henry Pratt, who established the Carlisle Indian Industrial School, the first Federally run Indian boarding school. As a result of *Lone Wolf v. Hitchcock*, Indian children were legally kidnapped, forced into the schools, and punished for speaking their language and practicing their traditions in an effort to solve the so-called “Indian problem.”

- Dawes (General Allotment) Act (1887): The goal of this act was the assimilation of individual Tribal members into U.S. culture and the destruction of communal living and other Tribal ways of life by creating private property. All unallotted lands were ceded to non-Indians, resulting in the loss of 90 million acres of Tribal lands. This attempt at ethnocide was the single most destructive action taken against Indians.
- *Lone Wolf v. Hitchcock* (1903): This Supreme Court decision established congressional plenary power over Indian affairs and the power to abrogate pre-existing treaty obligations, allowing the Federal government to allot and sell Tribal lands without Tribal consent.
- Indian Citizenship Act (1924): This act granted Tribal members U.S. citizenship as another means to further the goal of full assimilation.

Self-Government Era (1934–1953)

- Indian Reorganization Act, or IRA (1934): The Meriam Report of 1928 described the deplorable conditions for Indians across the United States and spurred Congress to pass this act. The act ended allotment, placed Tribal lands in permanent trust status, and encouraged Tribes to develop constitutions. Tribes that did not vote to opt out and reject the assignment of a constitution were automatically given IRA constitutions. Although the act was intended to enhance Tribal sovereignty, Tribal-developed constitutions still required oversight and approval by the U.S. Department of the Interior (DOI).

Termination Era (1953–1968)

- House Concurrent Resolution 108 (1953): This resolution ended Indians’ status as wards and was meant to terminate Tribal trust status and the Federal government’s responsibility to Tribes.
- Public Law 280 (1953): This unfunded mandate gave States concurrent criminal jurisdiction over Tribes without Tribal consent. This created jurisdictional voids because States refused to budget and provide police on Tribal lands.

Self-Determination Era (1968–present)

- Indian Civil Rights Act (1968): This act recognized Tribes’ inherent sovereignty; Tribes are not required to adhere to the U.S. Constitution. The act provided Federal protection to Tribal citizens while enforcing most of the U.S. Bill of Rights, with the exception of religious aspects because many Tribes have religious-based governance.
- *Morton v. Mancari* (1974): This Supreme Court decision found that Tribal citizenship is a political (not racial) classification. This landmark case allowed progress in Indian law in other areas.
- *Santa Clara Pueblo v. Martinez* (1978): This Supreme Court decision determined that Tribal citizens could not sue a Tribal government in Federal court and gave Tribal governments and courts jurisdiction over Indian Civil Rights Act violations. This decision provided the legal basis for Tribal self-determination and jurisdiction.

Shasta highlighted key concepts that are important for those working with Tribes.

- Inherent Tribal sovereignty: The right to self-govern.
- Trust responsibility: The obligation of the Federal government to protect and support Tribal Nations.
- Plenary power: Congressional authority to make Indian policy.
- Government-to-government relationship: Relationship between Tribal officials and Federal officials with decision-making power (i.e., not powerless representatives of decision-makers).
- Consultation: Requirement that Federal agencies consult with Tribes on actions that have Tribal implications.

Shasta added that race is a cultural construct, as well as biological. The United States has added a political construct to racial classification as well. The blood quantum component of the Dawes Act is based on lineage, and many Tribes still use this as a basis for membership. The political construct of race in the United States, and its inconsistencies, are illustrated by laws that state that 51 drops of blood out of 100 are needed to classify individuals as Indians, whereas other laws classify anyone as having even one drop of African blood as Black.

Shasta finished the presentation by asking the Tribal Caucus members to help answer the questions that had been submitted by EPA staff prior to the meeting.

What do Tribes like to be called (e.g., Tribes, Indigenous people, Indians)?

Shasta noted that the 3 million Tribal citizens in the United States are likely to provide 3 million different answers to this question. Neil prefers references to be as specific as possible, and he would like to be referred to as Tuscarora, rather than as a Native American or Indigenous. He also noted that it is important to remember that many of these names are English in origin. Billy Longfellow agreed that it is important to be as specific as possible. For example, the Passamaquoddy is a culture, as well as three different Tribes: Passamaquoddy Tribe of Indian Township and Passamaquoddy at Sipayik in Maine and Peskotomuhkati Nation at Skutik in Canada. Shasta encouraged everyone to learn how to pronounce the names and practice saying them.

Karen Gude asked whether the term “Tribal community” is acceptable. The TSC members agreed that it depends on context. For government-to-government purposes, it is not correct; however, some work is performed with specific communities within a Tribe, in which case the term is acceptable. The term became more commonly used following an executive order that associated Tribes with environmental justice communities. Neil further explained that the Diné is a large confederacy that includes Nations

within the confederacy and communities within the Nations. Scott Walz added that the Tribe's preference should be used.

How do we talk about traditional ecological knowledge (TEK)? Is "incorporating" TEK into ORD research the wrong word?

Shasta noted that language matters. "Acknowledged" could be used, but it is possible to acknowledge something and still ignore it. "Consider" may be a better term. Brenda added that the term should be a respectful word connoting that the TEK will be used in decision-making. Beth Jackson stated that it is a Tribe's decision whether to share TEK, especially because EPA does not have many protocols in place to protect Tribal data once the data are in EPA's possession.

How do Tribes feel about environmental justice?

Neil explained that when the concept was introduced in the 1990s, the Tuscarora Nation wondered why Tribes were included because they are sovereign Nations with treaties and a government-to-government relationship. Environmental justice does not exist; it should be called environmental injustice. Shasta added that "environmental justice" does not do enough to address the social, economic and political justice issues that lead to environmental injustice. Neil noted the connection to the underpinnings of Federal Indian law and efforts to repeal the doctrine of discovery. A Supreme Court Justice considered progressive—Ruth Bader Ginsburg—relied on the doctrine to rule against the Oneida Indian Nation of New York in 2005. Environmental justice cannot be achieved until mainstream science is decolonized.

If I am interested in talking to a Tribe, how do I approach them and who should I talk to?

The group agreed that a Tribe's environmental director should be contacted about environmental issues; elected officials are not appropriate to contact regarding these issues. It also is important to not arrive at a Tribal Nation without prior contact. A relationship must be established with a Tribe, and individuals must perform research to initiate such a relationship.

Is it appropriate to mention Thanksgiving?

The group agreed that this topic is best avoided. Abraham Lincoln established the official holiday in response to the Civil War.

Are there traditional gender roles (i.e., roles limited to one gender), and have they evolved over time?

All cultures tend to have traditional roles, but they do not necessarily indicate value or a hierarchy. For example, Pala women generally make baskets, and Pala men generally make pottery; neither is more valuable. Neil noted that Tribes may be patriarchal or matriarchal, and individuals must not assume anything about any particular Tribe.

Are there cultural norms that must be followed (e.g., the removal of shoes is considered respectful in some cultures)?

Shasta explained that this will depend on the Tribe. Any formal expectations most likely will be explained to a visitor, and visitors should not be afraid to ask about expectations if none have been explained prior to the visit. Being respectful is important.

Caucus Sessions

The Tribal and EPA Caucuses met separately to discuss individual Caucus business.

Poster Session

TSC members were able to view the following posters and interact with RTP staff:

- *A Floodplain Map of the Conterminous United States Developed Using Random Forest*, Jeremy Baynes, Center for Public Health and Environmental Assessment (CPHEA), ORD, EPA
- *Advancing Science Partnerships for Indoor Reductions of Smoke Exposures (ASPIRE)*, Amara Holder, Center for Environmental Measurement and Modeling (CEMM), ORD, EPA
- Air Sensors
 - *Enhanced Air Sensor Guidebook*, Rachelle Duvall, CEMM, ORD, EPA
 - *New Resources on the Air Sensor Toolbox*, Rachelle Duvall, CEMM, ORD, EPA
 - *Sensor Toolkit*, Karoline Barkjohn, CEMM, ORD, EPA
- *Application of Weight-of-Evidence Approaches for Decision-Making Related to Protecting Aquatic Life From Excess Nutrients*, Caroline Ridley, CPHEA, ORD, EPA
- *Culturally Informed Brownfield Redevelopment: A Methodology for Learning About Communities*, Brittany Kiessling, Center for Environmental Solutions and Emergency Response (CESER), ORD, EPA
- *Development of a Semi-Quantitative Non-Targeted Analysis Workflow for Emerging PFAS*, Shirley Pu, ORISE Fellow, CCTE, ORD, EPA
- *Effects-Based Tools to Support Consumers in Tapwater Use Decisions: A Multi-Case Study Summary*, Elizabeth Medlock Kakaley, CPHEA, ORD, EPA
- *Exposure Characterization of a Cyanobacteria Harmful Algal Bloom at Clear Lake, California: Data Collection Methodology*, Elizabeth Hilborn, CPHEA, ORD, EPA
- *Fentanyl Cleanup*, Lukas Oudejans, CESER, ORD, EPA
- *Flushing Aqueous Film-Forming Foam (Firefighting Foam) and PFAS From Plumbing Pipes*, Jeff Szabo, CESER, ORD, EPA
- *Mapping Livestock and Poultry Production by County With the USDA Census of Agriculture*, Hannah Slep, CPHEA, ORD, EPA
- *Using Systematic Evidence Mapping to Track the Development of Toxicokinetic Models of PFAS From 2000–2021*, Rogelio Tornero-Velez, CCTE, ORD, EPA

Science Talks and Discussion

Ongoing Pollinator Research at EPA ORD

Tom Purucker, CCTE, ORD, EPA

Tom Purucker explained that neonicotinoids (neonics) are the most widely used insecticides in the world. Neonics are neurotoxins that are highly toxic to insects, which comprise the majority of described life on Earth and can be vitally important to humans. Neonics are highly persistent in the environment, and one study found them in 75 percent of global honey samples. Neonics have replaced organophosphates and carbamates as primary insecticides, particularly because they have lower relative risks to humans. Tom showed a series of graphs of neonic, organophosphate and carbamate insecticide applications over time to illustrate this point.

EPA's Office of Pesticide Programs (OPP) registers pesticides under the Federal Insecticide, Fungicide and Rodenticide Act, which is quite permissive. The Endangered Species Act, however, is very protective. Tom displayed two charts as examples of OPP's complex and complicated regulatory screening process for pesticides. ORD provides research to strengthen the science used in this process.

Tom described several neonic research projects. One project is a collaboration between ORD and The Ohio State University involving field and laboratory components to quantify neonic concentrations in

exposure media related to pollinators. The project collected basic data on bee colonies for use in modeling, tests the effects of relevant exposure levels on nurse bees and larvae, and examines neonic movement and degradation in hive-like conditions. Another project described how pesticides affect the acetylcholine receptor adverse outcome pathway network of honeybees, which have highly specific neurons that control complex behavior; neonics disrupt this activity and decrease long-term colony success. ORD has collaborated with the U.S. Department of Agriculture (USDA) to modify Varroa Population—a USDA colony simulation model used by beekeepers to track the health of their hives—to account for pesticide exposure and risk. Honeybee toxicity inferred from colony studies is being used as an alternative for toxicity tests. ORD also has published an updated honeybee colony code.

ORD plans to broaden its work to include non-*Apis* pollinators, particularly endangered species. ORD continues to use honeybees as a surrogate for other bee species and plans to determine the relative sensitivity of honeybees to non-*Apis* bees and other insect pollinators. ORD also may investigate potential linkages in pollinator declines and plants covered by the Endangered Species Act. Additional planned pollinator research includes sensitivity distribution studies for multiple species, development of exposure/effect and high-throughput toxicokinetic models, and hummingbird exposure/effect studies.

Shasta asked how CCTE translates this information for a general audience. Tom replied that communication is part of the mission of USDA, which has a budget dedicated to communicating about pollinators. ORD's role is to provide legally defensible science about pesticides; sometimes the science will result in updated pesticide labels, which help inform farmers and beekeepers.

EPA Research on Assessment and Management of Harmful Algal Blooms (HABs)

Anne Rea, CPHEA, ORD, EPA

Anne Rea explained that HABs occur when algal or cyanobacteria populations become dense enough to cause negative environmental, human or animal health effects. Exposure usually occurs through contact with contaminated water, ingestion of contaminated water or seafood, or inhalation of aerosols. A variety of research needs exist, including tools to predict toxic bloom occurrence, economic analyses of bloom impacts, evaluation of management actions, and development of ambient water sensors.

ORD's HABs research is organized into three areas: (1) assessing adverse health outcomes from HABs exposure, (2) supporting management of HABs and their effects, and (3) developing tools to characterize and assess risk from HABs. In the first area, ORD is assessing the effects of HABs and their toxins on human and animal health and exploring the chemical, physical and biological characteristics of HABs that are associated with adverse health outcomes. Specific projects include evaluating the effects of cyanobacteria on human 3D skin tissue models, comparing the toxicity of liver toxins found in freshwater bodies, and developing a method for detecting cyanotoxins in fish tissue. In the second area, ORD is exploring source water interventions and researching drinking water treatment options. Specific projects include testing biological control measures, developing low-cost engineered media to remove nutrients that contribute to bloom formation, and evaluating methods for quantifying toxins in waste streams. In the third area, ORD is conducting monitoring, developing models and software, and characterizing the development and intensity of HABs. Specific projects include continuing work on the [CyAN app](#), developing an early detection method, and exploring machine-learning models to predict toxins and biomass.

Rory asked about the division of HABs research between EPA and the National Atmospheric and Oceanic Administration (NOAA). Anne explained that NOAA focuses on marine forecast, with some work in the Great Lakes. EPA focuses on coastal areas (up to 3 miles from shore), estuaries and freshwater bodies.

Rory asked about the challenges to forecasting blooms, especially because the level of algae growth does not always correlate with toxin levels. Anne agreed that this is challenging, and no silver bullet exists for forecasting because of the number of factors involved (e.g., temperature, nutrients, wind speed). ORD is working on science to develop operational forecasting.

Laboratory Tours

TSC members were provided laboratory tours by RTP staff:

- *PFAS: Nontargeted Analysis*, Mark Strynar and James McCord, CEMM, ORD, EPA
- *PFAS: Destruction Using Incineration at the Rainbow Furnace and Alternate PFAS Destruction Methods*, Jon Krug and Bill Linak, CEMM, ORD, EPA
- *Burn Hut Demonstration*, Amara Holder, CEMM, ORD, EPA
- *Aerosol Wind Tunnel: Research on Airborne Pathogen Treatment Technologies During the Pandemic*, Katherine Ratliff, Shawn Ryan and Worth Calfee, Homeland Security Research Program, ORD, EPA

The meeting was recessed at 5:00 p.m. following a brief wrap-up.

Wednesday, December 7, 2022

Day 1 Recap

Tim provided a recap of the Day 1 presentations, adding his thanks to Kacee's for Brenda and Neil's leadership during an unprecedented time. He noted that EPA senior leadership had prioritized their time to be present at the meeting and that Shasta's presentation had helped participants understand a very complex topic. Beth and Page Hingst appreciated the poster session, and the group agreed that they would have liked that session to be longer.

Tribal Plenary Keynote

Tribal Climate Change Impacts and Resilience in the United South and Eastern Tribes (USET) Region
Casey Thornbrugh, Program Manager and Tribal Climate Science Liaison to the Northeast and Southeast Climate Adaptation Science Centers, USET

Billy introduced Casey Thornbrugh, who explained that he is a citizen of the Mashpee Wampanoag Tribe, or People of the First Light, and had moved back to his ancestral homelands so that his daughter could experience his Tribe's culture and language. He introduced the participants to his family and Tribal Nation through photographs. His mother inspired his passion and focus on working to benefit Tribal Nations. Casey provided some background on his Tribal Nation, which is one of two Federally recognized Tribes of the Wampanoag people. Against a Tribal vote, the State turned Mashpee reservation lands into the town of Mashpee, causing the land to fall out of Tribal control. The Tribe became Federally recognized in 2007 and was able to place 321 acres of land in trust in 2016. The Trump administration attempted to repeal the trust and take back the Tribe's land, demonstrating that nothing is certain and that Tribes are affected by the political landscape.

Casey's interest in climate science began in middle school when his sister gave him a weather journal and he began taking detailed records. He has taught weather and climate classes to Tribal Nations and has worked with Tribal elders and communities to make climate science education more culturally responsive. Language and culture are science. While working on his ancestral homelands, he found creative methods to help oysters survive in impaired waters and adapted his work to four seasons.

Science is a knowledge or way of knowing, and Indigenous knowledge is science. Tribal Nations and societies have collected observations, experiments, studies, measurements and explanations that have formulated knowledge over millennia. For example, the Indigenous people in Chaco Canyon, New Mexico, used angles, the sun and seasons to plan their lives, culture, community and structures. The south-facing walls of local structures are perfectly parallel to the sun's path, and buildings are oriented to the winter and summer solstices. This allowed buildings to be shaded in the summer and in direct sunlight in the winter. Calendars also were built into the structures and indicated when it was time for certain seasonal activities. The culture was in sync with the seasons because it had to be to survive. Most science textbooks do not include such examples of Indigenous knowledge, but it is critical for Indigenous students to learn about them. Casey recommended the book *Native Science: Natural Laws of Interdependence*, by Dr. Gregory Cajete.

Answers to environmental issues are increasingly sought from Indigenous knowledge, as well as “Western” science, so called because Europe was considered the most western land when the term became embedded. Western science does not stand alone and is influenced by Asian, Middle Eastern and African science. European countries have developed from common culture and language, and Tribal Nations are no different. U.S. geography would be quite different if Tribal lands had been kept intact and Tribal Nations had been respected as fully sovereign and afforded the space to evolve and develop as Nations with no interference (i.e., as the United States and other global countries have developed).

Tribes have had experience with climate change since time immemorial, and changes in landscapes and climate live within rich Tribal stories that agree with mainstream scientific findings. Climate is always changing, but the climate change of the 20th and 21st centuries is on the order of decades or within a generation. This poses a greater immediate effect on Tribal homelands. Tribal Nations must respond to shorter winters, warmer summers, more frequent and costly weather events, sea level rise, coastal flooding, and warmer oceans. These events affect cultural spaces and culturally significant species.

Casey explained that USET—founded by the Eastern Band of Cherokee Indians, Mississippi Band of Choctaw Indians, Miccosukee Tribe of Indians of Florida and Seminole Tribe of Florida—now serves 33 Tribal Nations. The USET logo includes a tree with four roots surrounded by 33 peace pipes. The tree is a Seminole symbol representing Tribal sovereignty and self-governance, the roots represent the founding Tribes, and the peace pipes represent the member Tribal Nations. USET enhances the development of Federally recognized Tribes, improves the capabilities of Tribal governments, and assists USET members with public policy issues. USET works with Tribal Nations as sovereign governments with agencies. For example, Tribal departments of environment and natural resources are considered agencies that protect Tribal environmental health, parallel to EPA's function within the Federal government.

USET applied for funding to establish the Climate Change Resilience Program, and Casey serves as its manager. The program provides training, technical support, review of Tribal climate change vulnerability assessments and climate resilience plans, and writing retreats for Tribal professionals tasked with writing these plans. The program hosted an in-person Tribal climate resilience camp in summer 2022 to help professionals develop climate strategies for their Tribes. USET has established Tribal Climate Science Liaisons to connect Tribal Nations with regional U.S. Geological Survey (USGS) Climate Adaptation Science Centers.

Casey described the climate adaptation efforts of Tribal Nations in the USET region, including cultural species inventories, frameworks and summits. Casey recommended the WAMPUM adaptation framework by Dr. Kelsey Leonard, in which WAMPUM is an acronym for Indigenous-led climate adaptation: witness, acknowledge, mend, protect, unite, move. Tribes are reacquiring ancestral land; land is

sovereignty, and having control over their land allows Tribes to make their own climate adaptation decisions. Adaptation is challenging when cultural spaces are not under the Tribe's jurisdiction.

Casey described respectful engagement with Tribal Nations:

- Consider the “why” and be honest.
- Do unto others as they would do unto themselves, which requires learning about their history, values and culture.
- Attempt to understand the world from Tribal perspectives.
- Use terms that Tribes would use for themselves and terms of high esteem and self-respect (e.g., resilient, tenacious), rather than terms like “disadvantaged.”
- Learn or ask the proper name and pronunciation of the Tribal Nation.
- Use correct human-to-human engagement, honesty and transparency.
- Show respect for peoples' time, priorities and situations.
- Understand that Tribal Nations have their own laws, rules and protocols.
- Understand that Tribal leaders are the equivalent of presidents and prime ministers and that Tribal councils are legislative bodies.
- Think more along the lines of “consent,” rather than mere “consultation.”

Traditional geography is not taught in mainstream K–12 education. The expectation for American geography is that people have a basic awareness and knowledge of U.S. States, capitals and major cities and world countries. It also is important to be aware and have knowledge of the names and locations of Tribal Nations, particularly local ones. Acknowledgement and visibility of Tribal Nations is key.

USET provided comments during the recent White House Tribal consultation on Indigenous knowledge, stating that Indigenous knowledge—which has been practiced and passed down by Tribal cultural and spiritual leaders since time immemorial—must be recognized. Individual knowledge is based on cultural, spiritual and religious beliefs, as well as the observed experiences of natural surrounding environments. These beliefs and observations have directed individual and communal actions to ensure balance with and respect for these environments. Federal agencies must work with Tribal Nations to accurately define Indigenous knowledge to incorporate holistic beliefs and practices respective to each unique Tribal Nation. The use and application of Indigenous knowledge in Federal decision-making processes also must reflect this ideology, and Federal agencies must respect any willingness or unwillingness to share Indigenous knowledge and cultural information.

In closing, Casey provided links to [USET](#), [USET-OERM Climate Program](#), [Bureau of Indian Affairs Branch of Tribal Climate Resilience](#), [Northeast Climate Adaptation Science Center](#) and [Southeast Climate Adaptation Science Center](#).

Tim explained that he works with the Chickasaw Nation, which has a traditional language program. He wondered how many other Tribes might have a program that would allow non-Tribal members to learn a few basic words of greeting and respect. Casey responded that traditional language status varies among Tribes, depending on their access to their languages and the frequency of their use. His Nation is working internally to restore the traditional language, and it is private at this point. He recommended asking a Tribe whether it is respectful to learn the language; most will understand that the request is coming from a place of respect.

Science Topics of Interest

Before introducing the science topics of interest, Neil explained that he had recently gone hunting with his son. As he helped his son harvest a deer, he realized how much Indigenous knowledge is present in

the process, which includes specific language and practices that are thousands of years old. From the deer, he made venison jerky using traditional processes. Sharing the harvest is an important part of his culture, and he shared the jerky with the participants. He spoke of the visceral way to gain knowledge by “eating” the knowledge.

6PPD and 6PPD-Quinone

Introduction to 6PPD and 6PPD-Quinone

Heather Goss, Office of Water, EPA

Heather Goss explained that a paper published in *Science* in December 2020 indicated that a ubiquitous chemical from tires—6PPD-quinone—caused prespawn salmon mortality, a long-observed phenomenon in West Coast urban streams. 6PPD-quinone is an oxidation product of 6PPD, which is added to virtually all tires to prevent ozone damage. Formed as the tire interacts with ozone, the compound is carried into stormwater.

This is a national issue; 6PPD-quinone also is toxic to brook, rainbow and steelhead trout and Chinook salmon. On the West Coast, adult female coho salmon have been dying before they can spawn in urban streams, which can lead to extinction. This has unacceptable implications for Tribal treaty rights. Although the fish appear to be in good physical condition, they experience loss of equilibrium and gaping behaviors; Heather showed a video illustrating these behaviors. Salmonid mortality from 6PPD-quinone is not an unusual occurrence. Field sampling of stormwater has detected 6PPD-quinone at or above the 50-percent lethal concentration (LC₅₀) for coho salmon. This level occurs in West Coast waters each time it rains.

The *Science* publication resulted from a collaboration of researchers from the University of Washington Tacoma, University of Washington, Washington State University, U.S. Fish and Wildlife Service (FWS), and NOAA. This discovery was the product of decades of research, much of which was supported by EPA’s Puget Sound Geographic Program. EPA continues to support research on 6PPD-quinone

Anticipated Research and Coordination on 6PPD-Quinone

Annette Guiseppi-Elie, National Program Director, Chemical Safety for Sustainability Research Program, ORD, EPA

Annette Guiseppi-Elie summarized EPA’s research plans to address 6PPD-quinone, which involve investigating its effects, leveraging regional partnerships to understand exposure hazards, and exploring external collaborations to fill research gaps. The four 6PPD-quinone research projects under the FY23–26 StRAPs (1) characterize emissions from vehicle brake and tire wear, (2) investigate the ecological effects of tire-wear particles and 6PPD-quinone on marine benthic communities, (3) perform high-throughput hazard screening for 6PP-quinone, and (4) evaluate modeled green infrastructure solutions to reduce effects from contaminated urban stormwater runoff. Dan will speak about the third project.

ORD collaborative research with regional partners includes identifying the prevalence, extent and toxicity of 6PPD compounds in ambient air particulate matter (PM) and evaluating how 6PPD-quinone causes lethal and sublethal toxicity in a range of potentially susceptible species. Annette finished by noting four potential collaboration opportunities: Cross-EPA 6PPD-Quinone Workgroup; Interstate Technology and Regulatory Council 6PPD-Quinone Workgroup; National Science and Technology Council Joint Subcommittee on Environment, Innovation and Public Health; and EPA Puget Sound Geographic Program.

Evaluating the Bioactivity of the Ubiquitous Tire Preservative 6PPD-Quinone

Dan Villeneuve, CCTE, ORD, EPA

Dan explained that coho salmon prespaw mortality has been a problem in the Pacific Northwest since the 1990s, with mortality rates of 60 to 100 percent in urban Seattle streams. These fish have 90 percent egg retention at their deaths. This constitutes a significant threat to endangered salmonid populations and their ecosystems. The 6PPD and 6PPD-quinone LC₅₀ for coho salmon, as well as the concentrations of 6PPD-quinone in roadway runoff and urban receiving waters, are known. Unknowns include additional sensitive species and life stages, potential chronic effects, mode of action, and prevalence across the country.

The research was conducted under the Regional Research Partnership Program, or R2P2, and initially, 6PPD-quinone and associated analytical standards were not commercially available. Region 10 eventually was able to obtain a small amount of 6PPD-quinone for testing, but the sample mass did not allow large-scale aquatic exposure studies, so CCTE used its existing battery of alternative assays. Screening assays indicated that 6PPD and 6PPD-quinone neurotoxicity and developmental neurotoxicity are unlikely drivers of coho toxicity. Researchers used zebrafish embryo-larval toxicity assays to explore the sensitivities of other species and life stages and found that 6PPD, not 6PPD-quinone, is toxic to developing zebrafish. To identify the safe concentration and potential mode of action, the researchers used ecological high-throughput transcriptomics and found that 6PPD is more potent than 6PPD-quinone to larval fathead minnows but not at environmentally relevant concentrations. Therefore, the results of CCTE's three initial assays were consistent with science that has emerged during the last 18 months that indicates that only certain salmonids and trout have been shown to be sensitive.

The researchers also investigated a rapid, sensitive and cost-effective screening assay to evaluate potential replacement chemicals and urban runoff samples. CCTE developed a high-throughput phenotypic profiling (cell painting) assay adapted to a rainbow trout gill cell line to make the assay more relevant for ecological toxicity. Results indicated that 6PPD-quinone was more than 1,000 times more potent in gill cells than 6PPD and was second only to rotenone in potency. This assay appears viable as a high-throughput screening assay for potential 6PPD replacements and is suitable to screen urban runoff samples. Further investigation of this assay has been proposed as a 2023 Regional Applied Research Effort, or RARE, project in Region 10.

Shasta asked how the research could be applied to policy or used to make changes in the public sector. Annette explained that ORD provides the science to the program offices to allow them to make policies based on credible science. The last set of studies that Dan described was used to develop a method that the Office of Chemical Safety and Pollution Prevention (OCSPP) uses to identify alternative pesticides. José added that the State of California is working on regulations for 6PPD-quinone and microplastics, and the Interstate Technology and Regulatory Council 6PPD-Quinone Workgroup is another resource in this area. States often are in front of Federal agencies in terms of responding to threats and instituting regulations.

Janette asked whether similar effects are seen in Great Lakes salmon populations. Dan was unsure but expected that the results would be similar. USGS is working with EPA Region 5 to examine 6PPD concentrations in the Great Lakes and their tributaries to determine whether they reach the LC₅₀. The species have not been tested directly to be able to compare the relative toxicity with that of coho salmon. Academic partners are pursuing answers to these questions.

Ted asked whether fish consumption advisories have been updated based on the data. Dan replied that no evidence exists that humans are sensitive to 6PPD or 6PPD-quinone modes of action, and the route of exposure is not relevant to humans. Annette added that this is a research gap that ORD will explore.

Scott asked the ORD scientists to expand on green infrastructure as a potential solution. Annette replied that the Safe and Sustainable Water Resources Research Program will begin a project under the FY23–26 StRAP to examine green infrastructure as a model to use in the future. Dan noted that this project was added to the current StRAP because, prior to the identification of 6PPD-quinone as the cause, anecdotal evidence in Washington State indicated that green infrastructure decreased prespaw mortality.

Air Topics

Air Quality and Wildland Fires Research Update

Bryan Hubbell, National Program Director, Air, Climate and Energy Research Program, ORD, EPA

Bryan Hubbell explained that ORD is investigating emissions from wildland fires, air quality measurements during smoke events, and health and ecosystem impacts of smoke and developing risk communication and interventions to reduce smoke exposures. ORD and its partners are developing, testing and applying emerging air measurement technologies to measure smoke emissions and air quality effects. ORD provided quality assurance research to allow PurpleAir sensor data to be included as a layer on the [AirNow Fire and Smoke Map](#). ORD also is improving the understanding of wildland fire smoke effects on human health, especially in at-risk populations (e.g., hemodialysis patients, pregnant women, newborns), as well as effects on ecosystems and sensitive plants and animals. For example, ORD developed the HexFire simulator, which integrates fire simulators with ecosystem models to be used by non-wildfire experts.

ORD has continued to support the Wildfire ASPIRE (Advancing Science Partnerships for Indoor Reductions of Smoke Exposures) Study, in partnership with the Hoopa Valley Tribe, Missoula City–County Health Department and Central California Environmental Justice Network. Field studies monitor indoor and outdoor PM_{2.5} concentrations in commercial and public buildings during smoke events. Laboratory studies assess various air-cleaning technologies in an environmentally controlled room. The new ASPIRE-Health component assesses the use of low-cost air cleaners in homes to improve indoor air quality; the Hoopa Valley Tribe and Tulare County, California, are participating in this pilot. The [Cleaner Indoor Air During Wildfires Challenge](#) stimulates the development of innovative, low-cost and sustainable approaches to reduce outdoor air pollutants in homes during smoke or high-pollution events. Phase 1 (written concepts) is complete, and Phase 2 (prototype evaluation) is underway.

ORD conducts research to determine the most effective communication approaches for sharing information about air quality, health risks and actions to reduce exposure to wildland fire smoke effects. The Science to Achieve Results grants program sponsors [12 projects across the country](#) that investigate such interventions and communication strategies. With the U.S. Forest Service, National Institutes of Standards and Technology, and DOI, EPA developed the [Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire \(CAIF\): A Case Study in the Western U.S.](#) for land management purposes because prescribed fire can reduce wildfire smoke-related health effects. Finally, ORD is working on a Regional–ORD Applied Research, or ROAR, project with the Navajo Nation on using low-cost sensors to ensure air-quality improvements following stove replacement and home weatherization. Bryan encouraged Tribal members to contact him at hubbell.bryan@epa.gov.

Wildfire Smoke Air Monitoring Response Technology (WSMART) Program

Lara Phelps, Division Director, Air Methods and Characterization Division, CEMM, ORD, EPA

Lara Phelps provided an overview of WSMART, another component of ORD’s air quality and wildland fires research. ORD is increasing its research on how toxic gases travel and affect human health. The highest quality air monitors are located in a few select locations, so ORD is determining how to fill data gaps in the remainder of the country, as well as what methods and models are needed and how to

communicate more effectively. WSMART was initiated in 2021 to support White House and EPA Administrator goals to address threats from wildfires.

WSMART loans three easy-to-use, nonregulatory air monitors: PurpleAir, Thingy AQ and Vehicle Add-on Mobile Monitoring System (VAMMS), which was developed and built onsite at RTP. Thingy AQ is a multipollutant monitor on a private data platform. VAMMS is a mobile system that allows any vehicle to be rapidly set up to map real-time PM_{2.5} concentrations while driving, and these data are uploaded to an ORD-created web application called RETIGO (Real-Time GeoSpatial Data Viewer). ORD partners with EPA regions and the Office of Air and Radiation (OAR) to loan these monitors to Tribal, State and local air organizations to meet their supplemental monitoring needs; organizations use the [online request form](#). A WSMART team member responds to Tribal requests within 1 to 3 days, scheduling an initial 20-minute conversation to discuss needs. WSMART provides quality assurance/quality control checks, training and user guides and continually uses feedback to improve its offerings.

Lara described three deployments in 2022 in Alaska (Native Village of Tetlin Tribal Council), California (Monument Fire) and Oregon (Cedar Creek Fire). In 2022, 29 loan recipients used WSMART equipment: 12 Tribal organizations, all of which requested PurpleAir sensors; 14 air resources advisors, all of which requested VAMMS and some of which requested Thingy AQ; and three State and local organizations, with varying equipment requests. Loan recipients were located in Alaska, California, Colorado, Idaho, Nevada, North Dakota, Oregon and Washington. In 2023, WSMART will continue its loan program and conduct research and development, including improving monitoring systems, developing a VAMMS-X prototype with a carbon monoxide sensor, and analyzing WSMART data. A publication describing the application of VAMMS at a large wildfire is under development.

Lara provided links to additional resources: [EPA Air Sensor Toolbox](#) and [Air Quality Sensor Performance Evaluation Center, or AQ-SPEC](#). Lara may be contacted at phelps.lara@epa.gov, and she provided contact information for two WSMART team members: Amara Holder (holder.amara@epa.gov) and Gayle Hagler (hagler.gayle@epa.gov).

Katie asked whether VAMMS and Thingy AQ can relay real-time information to the community. Lara responded that the VAMMS RETIGO database is accessible, but the Thingy AQ database is private. Individual users can pull the private data and communicate to their communities, but not through the Thingy AQ interface. CEMM is working on assisting communities with messaging and how to package and communicate air quality information effectively and efficiently. ORD continues to work with OAR to add instruments to allow constant publicly available information while ensuring that the data are comparable to each other.

Katie asked whether CEMM is evaluating the Clarity Node-S. Lara indicated that this sensor is being evaluated, as are the Lunar Outpost Canary-S and QuantAQ to determine whether the latter can be used for measurements that are inhibited by dust and integrated into the toolbox. Bryan added that CEMM is exploring ways to use Bipartisan Infrastructure Law and Inflation Reduction Act funding to provide communities with low-cost air monitors and allow them to analyze and share their data.

One Health Action Session

Tribal Science: One Health in Action

Tonya Nichols, One Health Coordinator/Science Advisor for Healthy Security and Biodefense, ORD, EPA, and Lauren O. Davis, One Health Program Analyst, ORD, EPA

Tonya Nichols explained that the World Health Organization, Food and Agriculture Organization of the United Nations, World Organization for Animal Health, and United Nations Environment Programme developed One Health to acknowledge the harmonization needed for the health of humans, animals,

plants and the environment. She displayed a diagram that illustrates this concept and read a portion of [the quadripartite agreement](#), which defines One Health as “an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.” Tonya described One Health as “We are all connected.” She cited the Cherokee saying “*nigada gusdi didadadvhni*” (“we are all related”).

Tonya displayed EPA’s newly designed and approved logo, which communicates that human health is closely connected to the health of animals and the shared environment. The Federal government’s definition of One Health is “an integrated, systematic and unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.” TEK is a similar knowledge base that promotes balance and interconnectedness. One Health requires everyone to work together through integrated networks of practitioners of community health, public health, environmental health, plant health and animal health.

Changes in land use and climate create new complex interactions among humans, animals and the environment that result in zoonotic infections, invasive encounters, and loss of ecosystem services and biodiversity (e.g., loss of traditional foods). Tonya described the 1993 hantavirus outbreak in the Four Corners region, during which Navajo elders shared TEK that allowed Federal public health authorities to determine the source of the outbreak, which highlighted the effects of imbalance in the environment. Tonya cited several examples of new interactions as a result of changes in land use and climate, including coyotes learning to use traffic lights in major cities, forced changes in Inupiaq whale-hunting practices, and unusual environmental events shared by members of Alaska’s Local Environmental Observer Network, or LEO Network.

Lauren O. Davis explained that balance is needed, and connectance is what it is all about. Elements of One Health are—

1. Multiple and integrated sources of hazards to humans, animals and plants in their shared environments.
2. Multiple exposure pathways that connect humans and animals.
3. Combined health impacts across multiple sectors.
4. Socioeconomic factors that increase exposure to chemical hazards and pathogens that affect disease prevention and mitigation strategies.
5. Ecological and evolutionary effects of climate change that affect the health of humans, animals and plants.
6. Population and community health vulnerabilities.

Lauren invited the participants to share what the term One Health means to them. Many organizations use the image of an umbrella to describe the scope of their One Health mission or program because so many topics may fall under the umbrella. Lauren and Tonya displayed examples of One Health umbrellas, and participants were provided with a “Tribal/Regional One Health Umbrella” worksheet to develop One Health umbrellas for their organizations and to help contribute ideas for EPA’s One Health umbrella. In-person and virtual participants were encouraged to share their One Health stories and umbrella ideas with Tonya (nichols.tonya@epa.gov) and Lauren (davis.laureno@epa.gov), to be shared on EPA’s [One Health website](#).

Tonya closed the session with an Arapaho saying, “When we show respect for other living things, they show respect for us.” She also shared the Cherokee saying, “*nigada dedadanilvgi* (respect all things).”

Working Lunch: TSC Caucus Discussions of Co-Production of Research

The Caucuses met separately to prepare for the full TSC discussion on co-production of research.

TSC Discussion of Co-Production of Research

Prior to the discussion, Chris Frey, who joined the meeting for Day 2, provided remarks. He noted that he had been honored to take part in the TSC's meeting at the Eastern Band of Cherokee Indians, and he continues to pursue opportunities to engage with Tribal Nations on important topics. The discussion on TEK at that meeting was very formative in terms of his own thinking, and he would like ORD to partner with Tribes on the respectful use of Indigenous knowledge that Tribes are willing to share. EPA and Tribes must work together to face critical challenges. ORD is beginning implementation of the FY23–26 StRAPs, which were developed using input received from Tribes during listening sessions, through EPA-Tribal Partnership Groups and during Tribal consultation. He co-led a session at the recent National Tribal Operations Committee (NTOC) meeting and spoke at the 2022 Tribal EPA Region 9 Conference and 2022 Oka' (Water) Sustainability Conference. He has experienced a shared sense of purpose in all of his experiences with Tribes. Having a peaceful and common purpose is important, and ORD would like to support Tribes' rights to self-determination.

Before leading the discussion on co-production of research, Tim noted that this discussion is only the beginning of this effort. The TSC will engage in many more conversations in the future to ensure that Tribes truly collaborate in and benefit from co-produced research. He noted that Tribal communities involved in co-produced research must be asked what their values, needs and expectations are to ensure that the information that they receive is valuable and beneficial to them. He asked the participants to consider what yardstick of measure could be used to determine success and what success would look like at the beginning, middle and end of a project.

Neil commented that, from an Indigenous perspective, this is an existential discussion because there are many ways of knowing—emotional, spiritual, body and mind—and this knowledge is nested inside beliefs and a larger worldview. Those who do not share beliefs and the larger worldview cannot co-produce knowledge. The co-production of data or information is a more realistic goal. The DIKW pyramid describes a hierarchy of knowledge, with *Data* serving as the bottom of the pyramid, then above that *Information*, above that *Knowledge*, and *Wisdom* at the top of the pyramid. EPA and Tribes can work together on only the first two layers of the pyramid without a shared belief system. For example, the Tuscarora way of making decisions could never be meaningfully applied by EPA because of the differences in belief systems.

Neil stated that, in terms of success, one yardstick is the number of acres of their traditional ancestral territories that Tribes have access to and ability to care for. Another measure is the number of Tribes that have adequate protection of their own knowledge. Federal agencies must support Tribal ways of knowing. Protection of Tribal knowledge must be in place before Tribes participate in co-produced research efforts.

Shasta noted that Tribes are being asked about how to assimilate Indigenous knowledge into the dominant scientific framework. ORD's process includes a beginning, middle and end, but Tribal ways of knowing are not linear. Tribal ways of knowing cannot be altered to fit the linear narrative. It is important for ORD and Federal agencies to consider Tribal perspectives, but this must be done with respect and caution. For example, the new Federal TEK guidelines have some issues (e.g., no mention of protection of Tribal data) despite consultation. Tribes do not have time to engage in all of the consultations in which they are asked to participate.

To illustrate a measure of success, Shasta gave an example of an interaction between the Pueblo of Zuni and FWS. FWS decided to kill off an invasive species of fish, and during consultation, the Zuni explained that this solution was unacceptable because in their belief system, all fish—invasive or not—are their children. FWS ignored this input. Success would have been FWS honoring the Zuni belief system and working together to identify a solution acceptable to both parties or giving management of the fish completely to the Zuni, given that they were the original managers of the waters.

Because mainstream science is linear, Kathie wondered whether it is even possible to align traditional belief systems with mainstream science.

Neil noted that the intentions behind production of knowledge often differ, and Tribes do not seek knowledge for purely academic reasons, which sometimes is the case for mainstream science. In Tuscarora, “knowledge holders” do not exist; knowledge is for the community. Tuscarora also are comfortable in the “not knowing.” One Tuscarora measure of success is, “Are we still giving thanks?”

Neil mentioned the traditional metaphor of the boat (mainstream science) and canoe (Indigenous knowledge) traveling the river in parallel. Each vessel accepts and respects the other’s knowledge, but they do not try to co-produce knowledge. The primary purpose is to maintain peace between the two knowledge systems and not co-opt each other’s knowledge. Neil has noticed that some knowledge systems have the worldview of cooperating; others have the worldview of comparing and contrasting.

Beth stressed the need to be respectful, and Federal agencies must accept the validity of Indigenous knowledge and allow this knowledge to inform decisions.

Shasta can appreciate the One Health concept, but a great deal is missing: culture, knowledge, history, tradition, stories, protocols and so forth. These aspects may be what the concept of co-production is missing. What amount of cooperation between the two vessels is needed? Science is a way of looking at the world, and all individuals in their own way are scientists. The scientific method includes observing, hypothesizing, testing and reaching conclusions. One cannot say that Indigenous science does not follow this approach.

Tim explained that he has been in meetings in which ORD has discussed how to include Tribal input in its research to inform policy, and the term “co-production” was introduced during these discussions. He acknowledged that knowledge is not linear, but ORD engages in a linear 4-year research cycle and needs linear measures of success. Although EPA and Tribes do not appear to be on the same page currently, he would like EPA and Tribes to work together to provide the peace that Neil mentioned.

Louie Rivers stated that “co-production” is a term that mainstream science uses to describe research with environmental justice and minority communities. EPA is attempting to apply this term to sovereign Nations, which may need to be reconsidered. Perhaps a term that denotes a connection and common purpose, rather than assimilation, should be chosen instead.

Chris noted that the goal is to aim for practicality (i.e., co-production of data vs. knowledge). The boat and canoe may be able to travel at the same speed next to each other and communicate with each other to co-produce data and information. Although mainstream science focuses on species and populations, rather than individuals, researchers still can respect that Indigenous knowledge respects individuals, and they can find solutions to help individuals.

Shasta commented that mainstream science teaches to ignore all of the traditional ways of knowing except for the mind. Individuals are taught to ignore their “gut feelings,” even though data from mainstream science itself have shown the value of gut feelings.

Sustainability Tour

Matt Rait and Ishani Padmaperuma provided the TSC members with a tour of the RTP facility and campus that highlighted many of the facility’s sustainable features.

The meeting was recessed at 4:30 p.m. following the tour.

Thursday, December 8, 2022

The Importance of Children's Environmental Health in Tribal Science Priorities

Ted Coopwood, OCHP, EPA

Ted grew up in deplorable conditions in a forgotten area of Indiana, where he had friends who died from asthma; had behavioral problems from lead exposure and, as a result, did not graduate from high school; and were constantly sick from exposure to pesticides and contaminated water. These experiences led him to be passionate about advocating for children and protecting children's environmental health. He recently attended a Tribal youth event sponsored by the Boys & Girls Clubs of America and found that decades later, these children told stories similar to those of his childhood; children cannot continue to be forgotten.

Ted explained that OCHP works with EPA program offices and regions to assess health risks that may disproportionately affect children, and his role on the TSC is to add children's health priorities into Tribal science priorities. Ted described a variety of OCHP activities, including sponsoring the [Children's Environmental Health: A Workshop on Future Priorities for Environmental Health Sciences](#), modernizing the [America's Children and the Environment](#) web tool, and serving on [CHPAC](#) and the [President's Task Force on Environmental Health Risks and Safety Risks to Children](#). OCHP also performs education, outreach and communication on best practices to protect children from negative environmental effects.

It is important to focus on children because of their developing systems, unique exposures and lack of political voice. EPA's Tribal science priorities include air pollution, PFAS and climate change, all of which children are more vulnerable to than adults. Ted also pointed to EPA resources related to children's health, including the [2021 Policy on Children's Health](#), Cross-Agency Strategy #2 in the draft [FY 2022–2026 EPA Strategic Plan](#), and [America's Children and the Environment, Third Edition](#). EPA's children's health intramural research informs public health decisions, advances scientific understanding of potential early life susceptibility to environmental stressors, and informs community efforts to protect children's health.

The President's Task Force on Environmental Health Risks and Safety Risks to Children, led by EPA and the U.S. Department of Health and Human Services, comprises 17 Federal agencies and cabinet-level principals. The task force, which meets monthly, offers an opportunity to elevate children's environmental health issues to the highest levels. CHPAC comprises external experts who advise the EPA Administrator on regulations, research and communications related to children's health; CHPAC's next advice letter will focus on children and agricultural pesticides.

Pediatric Environmental Health Specialty Units (PEHSUs) house a network of health care experts in children's environmental health who provide advice for concerned parents. Although it takes more than 50,000 hours to become a medical doctor in the United States, less than 5 of these hours are spent on environmental health. PEHSUs have trained 97,000 doctors and health care professionals on environmental health since 2015.

Ted closed by stating that his role in OCHP is to take the science and translate it so that more children do not grow up with the environmental exposures that he did.

Billy explained that the basements of 30 to 40 homes on his reservation continually experience moisture issues, which are never fixed. Tribal children and elders are exposed. Ted will put him in contact with the Region 1 Children's Environmental Health Coordinator, Kathleen Nagle.

Page commented that high radon is present on her reservation, but the Tribe does not have funding for radon mitigation. She has pursued many avenues and contacted many staff at EPA, but no one has been

able to help. Ted volunteered to work with her because it is important to keep going until a solution is found; there is no issue that cannot be solved.

Neil noted that his generation is the last outdoor generation. It is necessary to focus on relearning and invigorating traditional lifeways. To decrease exposures, children should increase their time outside in forests and rivers. It is possible to decrease exposure in the built environment, but emphasis should be placed on the need for green spaces. The low-cost, common sense, culturally appropriate solution is re-engaging with the land.

Caucus Sessions

The Tribal and EPA Caucuses met separately to discuss individual Caucus business.

TSC Business Session

The Caucus Chairs provided a report out of the Caucus sessions. Neil reported that the Tribal Caucus would like to revisit the TSC's previous white papers on climate change and TEK. Updating the TSC's Tribal science priorities is an important priority for the Tribal Caucus. To allow the Tribal Representatives to communicate the TSC's work to their regions and Tribes, an enhanced TSC website that includes meeting presentations and other media if possible (e.g., recordings of the laboratory tours) would be very helpful. It also would be helpful if EPA could provide support to Shasta for her efforts on the Tribal research protocols and data protection effort that she is working on with José. Neil emphasized that the Tribal Caucus needs more time to meet as a Caucus during the TSC's face-to-face meetings. The NTOC allows the National Tribal Caucus to meet for at least a full day together.

Tim reported that during their Caucus session, the EPA Representatives had reflected on what they had heard the previous day about co-production of research. They talked about how to move forward on the co-production of data and information, as co-production of knowledge does not appear to be feasible. EPA would like to explore options with its Tribal partners to develop a shared, open, comfortable space. EPA and Tribes do not need to enter each other's vessels, but they can travel alongside each other to produce data and information together. There can be no hidden agenda, and open communication will be necessary before EPA and Tribes can establish the details of solving problems together. Building relationships and showing respect are critical, and EPA understands that these aspects will be different for every Tribe with which it works. The words "work together" are easy to say, but the operational aspects are more challenging. EPA is willing to take slow steps together with Tribes.

The TSC members discussed potential meeting locations for 2023, including the Santee Sioux Nation and Ponca Tribe of Nebraska (co-hosted location), Pala Band of Mission Indians in California, and ORD Robert S. Kerr Environmental Research Center in Ada, Oklahoma. The Tribal Caucus acknowledged that holding one of the 2023 meetings at the Ada laboratory had been discussed previously, but the Tribal Representatives would like to hold both 2023 meetings in Tribally hosted locations. Tim thought that holding meetings at both Tribal and EPA locations would bring balance and allow Tribal and EPA members to learn from one another in their "home" locations. He also pointed out that meeting in Ada would allow the TSC to meet representatives of Tribes in Oklahoma. The TSC will continue to discuss the issue and will need to make a decision early in 2023 so that Monica can submit the required paperwork for contractor support.

Shasta would like to see the EPA Administrator at TSC meetings. Generally, each TSC Tribal Caucus member is his or her Tribe's equivalent of the U.S. Secretary of the Interior and/or EPA Administrator, and they make time to attend. Ted noted that EPA Deputy Administrator Janet McCabe is very active in attending meetings to hear about important topics, such as children's health and Tribal science, and OCHP has been successful in getting her to attend children's health events. He could invite her to attend a

TSC meeting. Shasta noted that Deputy Administrator McCabe had attended the 2022 Tribal EPA Region 9 Conference.

Monica and Ted recognized Brenda's and José's accomplishments as past TSC EPA Co-Chairs, as well as Neil's longevity in the role of TSC Tribal Co-Chair. They are smart, thoughtful and truthful, making them excellent leaders.

Monica also recognized the following individuals who were not present but had recently left the TSC: Craig Kreman, Quapaw Nation; Karen Hamernik, OCSPP, EPA; Amanda Hauff, OCSPP, EPA; Luke Hullinger, Regions 1 and 5, EPA; Monia Ben-Khaled, Region 8, EPA; and Justin Bleiler, Region 8, EPA.

Finally, Monica presented two TSC members with milestone certificates: Beth Jackson, who has served on the TSC since its inception in 2001 and was present at the inaugural meeting, and Kai Tang, who has served more than 10 years and never missed a face-to-face meeting.

Tim honored the memory of Dave Jewett, former TSC EPA Co-Chair, who passed away in August.

Closing and Adjournment

Neil explained that in Tuscarora tradition, it is his responsibility to close the meeting because he had opened it. At the beginning of the meeting, the participants had piled their minds together. At the end, they together bank up the embers so that the embers stay warm and glowing until everyone can gather together again.

After providing the closing in the Tuscarora language, Neil adjourned the meeting at 12:10 p.m.

**National EPA-Tribal Science Council (TSC)
Fall 2022 Face-to-Face Meeting
Participants**

Neil Patterson Jr.

TSC Tribal Co-Chair
Tuscarora Nation (Region 2)

Page Hingst

TSC Tribal Vice Chair
Santee Sioux Nation of Nebraska (Region 7)

Tim Canfield

Incoming TSC EPA Co-Chair
U.S. Environmental Protection Agency
Office of Research and Development

Brenda Rashleigh

Outgoing TSC EPA Co-Chair
U.S. Environmental Protection Agency
Office of Research and Development

Dana Adkins

TSC Member
Chickahominy Indian Tribe (Region 3)

Billy Bunch

TSC Member
U.S. Environmental Protection Agency
Region 8

Eliodora Chamberlain (Virtual)

TSC Member
U.S. Environmental Protection Agency
Region 7

Ted Coopwood

TSC Member
U.S. Environmental Protection Agency
Office of Children's Health Protection

Lauren O. Davis

U.S. Environmental Protection Agency
Office of Research and Development

Kacee Deener

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Office of Science Advisor, Policy and Engagement

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Chris Frey

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Shasta Gaughen

TSC Member
Pala Band of Mission Indians (Region 9)

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Office of Water

Karen Gude

TSC Member
U.S. Environmental Protection Agency
Office of Water

Annette Guiseppe-Elie (Virtual)

U.S. Environmental Protection Agency
Office of Research and Development

Maureen Gwinn (Virtual)

U.S. Environmental Protection Agency
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Bryan Hubbell (Virtual)

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Beth Jackson

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Office of Science Advisor, Policy and Engagement

Billy Longfellow

TSC Member
Passamaquoddy at Sipayik (Region 1)

Janette Marsh (Virtual)

TSC Member
U.S. Environmental Protection Agency
Region 5

Tonya Nichols

U.S. Environmental Protection Agency
Office of Research and Development

Rory O'Rourke

TSC Member
U.S. Environmental Protection Agency
Region 10

Barbara Okorn (Virtual)

TSC Member
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Region 3

Alexa Olsen

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Louie Rivers

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Monica Rodia

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Office of Science Advisor, Policy and Engagement

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Region 2

Rusty Thomas

U.S. Environmental Protection Agency
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Casey Thornbrugh

United South and Eastern Tribe Inc.

LaDonna Turner

TSC Member
U.S. Environmental Protection Agency
Region 6

Joshua Tweeton

TSC Member
Spirit Lake Tribe (Region 8)

Dan Villeneuve

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Scott Walz

TSC Member
Shakopee Mdewakanton Sioux Community
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Elizabeth Hilborn

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Amara Holder

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