Note: this and other projects were left unpublished due to the transition to the Trump administration. The original included a social media reel that would have accompanied the piece, with photos and videos of the fish viewer in action.

HED: With these salmon snapshots, a picture is worth a dozen data points

DEK: Collaboration with a tribal community in Northern California has led to new ways to do fisheries science that are safer for the fish, and produce more accurate data.

NOAA Fisheries scientists have studied populations of salmon along the West Coast for decades. But the Winnemem Wintu, a tribal community whose ancestral homeland sits along the Winnemem Waywaket (McCloud River) in Northern California, have developed a lifelong reciprocity with *nur* (Chinook salmon) since time immemorial.

Now as close partners in salmon recovery, the tribe's deep spiritual relationship with salmon has pushed scientists to rethink their methods, and inspired new innovations that are both less invasive and more scientifically accurate.

"Working with the Winnemem Wintu has really inspired us to look beyond our typical tools and methods and adopt their hands-off fish philosophy," said Rachel Johnson, a research fisheries biologist with NOAA Fisheries' Southwest Fisheries Science Center. "This collaboration has led to new approaches to monitoring that are more humane and respectful, and that produce more accurate science faster.

One innovation, now coming to fruition, arose out of a simple challenge from Chief Caleen Sisk, the Spiritual Leader and Tribal Chief of the Winnemem Wintu.

"Chief Sisk basically said, 'I hate what you do to our fish. Do it differently,'" recalls Carson Jeffres, an adjunct professor and NOAA affiliate, who, with Johnson, co-leads a research lab at the Center for Watershed Sciences at UC Davis.

Chief Sisk's request was in regards to how scientists gather data about winter-run Central Valley Chinook salmon, an endangered population of fish and a NOAA Species in the Spotlight. Our scientists are re-introducing Winter-run Chinook to the McCloud river in California. The McCloud is a free-flowing river above Shasta dam that offers vital habitat and cold, fresh water that salmon need to survive and reproduce.

To understand how salmon are benefitting from the reintroduction, researchers and tribal community partners measure the length of fish as they make their way toward the ocean. Typically, scientists place fish on a small platform with a built-in ruler called a "fish board." But this method requires briefly removing the fish from water, a stressful experience for an adolescent salmon.

Chief Sisk suggested a different approach as a compromise: why not measure the fish while it's still swimming?

"I caught myself saying, 'but we've always done it this way,'" Jeffres said. "One of the things I value working with the tribe is, they help us realize these things that we've done for so long maybe aren't always the best way to do it."

A Fish Not Out of Water

While the idea was simple enough, Jeffres said creating the "fish viewer" was easier said than done.

The process started at Jeffres' local library that had a maker's space: he would bring coffee to a friendly librarian, and she would help him use the library's 3D printer to tinker through some ideas.

Jeffres teamed up with Jamie Ward, a member of the Winnemem Wintu tribe and western trained scientist, to conscript a group of engineering students at UC Davis to help create some initial designs using criteria rooted in indigenous values.

"I work to connect the dots between Western science and traditional ecological knowledge," said Ward, who is now a field researcher with the Center for Watershed Science at UC Davis. He works closely with Jeffres and other NOAA Fisheries scientists, as well as the Winnimem Wintu community, on projects concerning the McCloud reintroduction.

The group combined existing equipment to create an early prototype of the fish viewer. Fish are scooped from a bucket with a cup (inspired by a bath toy from Ward's two-year-old daughter). A trap door at the bottom of the cup releases the fish into a narrow aquarium with a one-centimeter grid etched across its faces. A mounted camera sits a fixed distance away from the aquarium and snaps a photo.

But the prototype was nowhere near perfect. Jeffres would continue to develop new models each week, 3D printing a new design to hand off to Ward, who would drive it up to the McCloud river and put it into action. Ward would solicit feedback from the cultural resource specialists and agency field biologists who were measuring fish, and bring those ideas back to Jeffres. This back-and-forth process went on for several months.

"It's fun. I love it. But I'll be honest, it became a little stressful," said Jeffres, who admits he is much more of a fish biologist than an engineer. "There were days where I'd wake up at three or four a.m. to get a viewer out by seven that morning."

Better, Faster Fish Science

The hard work paid off with a tool that has become increasingly useful and more accurate than previous methods. The team is measuring fish that weigh only a few grams and are about the size of a pinky finger.

“They're so small that a drop of water on your fingers makes a big difference when you weigh them,” Jeffres said.

The fish viewer alleviates those sources of error. The researchers can derive length and weight by measuring the distance between 16 points they digitally mark on the fish photos.

“We get more data that is more accurate and consistent over time,” Jeffres said. “Which is beautiful — and faster!”

The researchers currently place the points manually, but Jeffres said a PhD student on his team is creating a machine-learning algorithm that will analyze the image and place the points automatically, further speeding up the process.

All told, Jeffres said the new viewer allows scientists to gain more accurate data in well under a minute per fish and the fish never have to leave water.

Just the beginning

Jamie Ward, who plays an important role balancing both Indigenous and western science perspectives, thinks the viewer will continue to evolve.

“We see it as a beginning,” he said. “We want this to become the standard.”

Ward believes the same concept can be applied to other fish species and with larger adult fish. This piece of basement-built technology, born out of hard work, ingenuity, and collaboration, might transform how scientists accomplish basic fisheries science.

But for Jeffres, it is the process of working together to fix a problem that is most fulfilling.

“It’s the warm and fuzzy part,” he said. “To actually see change in that space and bring those other voices into the conversation has made me, a fish lover, think about fish differently. We can do it better.”