Vitamin discovered in rivers may offer hope for salmon suffering from thiamine deficiency disease

January 4 2024, by Steve Lundeberg

Credit: Pixabay/CC0 Public Domain

Oregon State University researchers have discovered vitamin B_1 produced by microbes in rivers, findings that may offer hope for vitamin-

deficient salmon populations. The findings were published in Applied and Environmental Microbiology.

The authors say the study in California's Central Valley represents a novel piece of an important physiological puzzle involving Chinook salmon, a keystone species that holds significant cultural, ecological and economic importance in the Pacific Northwest and Alaska.

Christopher Suffridge, senior research associate in the Department of Microbiology in the OSU College of Science, and doctoral student Kelly Shannon examined concentrations of thiamine and the microbial communities in rivers of the Sacramento River watershed. Thiamine is the compound commonly referred to as vitamin B_1 and is critical to cellular function in all living organisms.

"This study is the first-ever report of thiamine compounds in salmon spawning rivers and the associated gravels where salmon spawn," Suffridge said. "This source of thiamine has potential implications for reducing health impacts on naturally spawning salmon that are suffering from thiamine deficiency complex."

Thiamine deficiency complex (TDC), an emerging threat to the stability of West Coast salmon populations, has affected salmon and trout in lake systems in northeastern North America and Atlantic salmon in the Baltic Sea.

Chinook salmon in the Central Valley have recently been diagnosed with TDC, the researchers note. Afflicted female salmon that return to rivers and streams to spawn can pass the deficiency on to their hatchlings, which have problems swimming and experience high mortality rates.

"In California, most hatchery-spawning Chinook salmon are treated with thiamine to prevent TDC," Suffridge said. "However, it was previously

unknown if there was a source of thiamine in the environment that could potentially rescue naturally spawning salmon afflicted with TDC. We have now identified microbially produced thiamine in natural salmon spawning habitats."

"It's a complicated issue," Shannon added. "The broader context is that Central Valley Chinook salmon, as well as some populations of salmon in other places, are becoming thiamine deficient because of shifts in their diet in their feeding grounds."

Historically, Shannon said, Central Valley Chinook salmon ate a diverse, healthy diet consisting of many different species of prey fish. But in recent years, shifts in the ocean ecosystem have caused northern anchovy populations to explode, meaning they've become the primary dietary component for salmon. This change in diet is the likely cause of TDC, he said.

"Northern anchovies are high in an enzyme called thiaminase that degrades thiamine," Shannon said. "So by the time many California Central Valley Chinook salmon are ready to spawn they have been feeding on so many anchovies that they have become deficient in thiamine from the activity of the thiaminase enzyme in anchovies."

The results of the new study implicate river sediments as likely sources of microbial thiamine, which could supplement early life stages of Chinook salmon that experience TDC, he said. Future studies will examine to what degree environmental thiamine acquisition by adult Chinook salmon, their incubating eggs and hatched fry could alleviate the negative health outcomes caused by TDC.

"It was unknown if the vitamin could even be measured in rivers in the first place, and the thiamine concentrations we measured were much lower—more than a million times lower—than a hatchery thiamine

bath," Shannon added. "The data have implications for salmon health but are not concrete enough to say anything definitive. More research is needed to determine what role the environmental thiamine might play, but obviously learning that it's there is an important first step."

The collaboration included Rick Colwell, a professor in the OSU College of Earth, Ocean, and Atmospheric Sciences, and Hailey Matthews, who graduated from the Oregon State Honors College in June 2023.

Also taking part in the study were scientists from the National Oceanic and Atmospheric Administration, the University of California, Davis, Bronx Community College and the California Department of Water Resources.

More information: Christopher P. Suffridge et al, Connecting thiamine availability to the microbial community composition in Chinook salmon spawning habitats of the Sacramento River basin, *Applied and Environmental Microbiology* (2023). DOI: 10.1128/aem.01760-23

Provided by Oregon State University