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Profiles

by Brad Warren

Are sockeye frying or loving the heat?

Daniel Schindler's research sheds light on warming



Daniel Schindler's work might not sound like much, but it packs a hidden wallop.

The University of Washington ecologist and his colleagues have mined sediment records and long-term data from sockeye lakes in Bristol Bay and Seattle to reveal how fluctuations in food supply — partly driven by climate change — may be redefining the future of sockeye salmon fisheries.

Schindler has no more patience for life in an office than most commercial fishermen. "I'm not a big city kind of guy," he says.

He spends his summers working as part of a long-term monitoring program on Bristol Bay's Wood River — a system that today is one of the most prolific sockeye producers on the bay. Back in Seattle, he oversees another long-running sampling program on Lake Washington, the biggest sockeye source in the Lower 48.

The sheer duration of these sampling efforts — 40 years and counting — offers a rare key to one of the biggest questions facing fisheries science today: What's an effect of global warming, and what's due to cyclical influences such as the Pacific Decadal Oscillation (PDO) and El Niño?

The long-term data show global warming has probably boosted some salmon stocks.

At least in the Wood, "We think climate is actually enhancing the sockeye production," Schindler says. "It's unclear, but the juvenile sockeye are growing increasingly faster in fresh water. That's correlated with the extension of the growing season."

Springtime, he says, now arrives almost two weeks earlier than it did 40 years ago on Bristol Bay.

Down on Lake Washington, the signs are more mixed. The Seattle lake is near the southern end of the sockeye's geographic range, in a temperate zone where rising temperatures have been linked strongly to reduced plankton production and declining fish populations.

From California to British Columbia, researchers see a troubling, temperature-related weakening of the food web off the coast. Scripps scientists, for example, have documented a 70 percent decline in plankton abundance in the California current since 1950.

The findings from Schindler and his team on Lake Washington don't yet fit neatly into this disturbing trend. But as in the bay, the long-term

data reveal the signature of global warming: PDOs and El Niños have come and gone, but temperatures have kept rising.

Schindler and colleagues have hypothesized that the early onset of spring may be starting to unhinge the food web that sustains young sockeye when they first emerge from the Cedar River into the lake. The freshwater plankton that nourish them in spring and summer — *Daphnia* — are losing out to other tiny species known as rotifers.

Rotifers thrive in the lake's unnaturally early spring. *Daphnia* don't. And young sockeye may be arriving at their favorite freshwater deli to find the shelves aren't stocked for them.

"The sockeye eat *Daphnia*, but they don't eat rotifers," says Schindler.

"It turns out there is a trend for sockeye fry to be hitting the lake earlier in recent years," Schindler explains. "When eggs are hatched in warmer water, they develop faster. So there appears to be a developing mismatch between when the juvenile sockeye hit the lake and when their food source is available in the spring."

But if young sockeye were starving, Schindler notes, it would be reasonable to look for a stock collapse. So far, the stock has wobbled but not failed, which is normal for salmon.

The 2005 return fell nearly 75 percent short of expectations, but the 2006 return was about 35 percent larger than expected.

Is trouble brewing? Time will tell. Meanwhile, warming is changing more than the sockeyes' food. Water temperatures higher than about 20 degrees Centigrade (68 degrees Fahrenheit) are considered dangerous to salmon, making them vulnerable to infection and predators. In the Ship Canal where these salmon swim to sea and back, the number of days in that danger zone has tripled — to 90 — in three decades, says Fred Goetz, an Army Corps of Engineers biologist who monitors conditions in the lake and canal system above the Corps-operated locks in Ballard.

Long-term monitoring projects like Schindler's "aren't sexy science," he concedes. But these decades-long studies are essential to understanding how rising thermometers are changing the game in fisheries.

If we are serious about sustaining fisheries in the north, and protecting stocks in the south, we need this work. ■

Brad Warren writes a monthly column about provocative people in the seafood industry. He served as editor of Pacific Fishing from 1996 to 2004.