Long-Term Study of Chinook Salmon Spawning on a Smith River Tributary

Jim Waldvogel, Sea Grant Extension, Crescent City, California



Background

This study annually estimated the minimum number of spawning fall chinook along a section of the West Branch Mill Creek, a tributary of the Smith River near the California-Oregon border, from 1980 to 2002. The consistent use of one survey method along the same stretch of creek for 23 years has made it possible to link trends in salmon spawning and growth to habitat change due to changing oceanic conditions and creek flows, and to draw conclusions about the timing and number of salmon runs, the age composition of spawning salmon, and the ratio of males to females. Several groups have cited the study's findings as objective metrics of the region's ecological value. This information has helped to preserve old-growth redwoods around Mill Creek.

Project

California Sea Grant Extension Marine Advisor Jim Waldvogel initiated and developed the salmon survey in 1980 to address a lack of fisheries information for the Smith River in Del Norte County. He selected the West Branch as the study site because of its history as a salmon stream, accessibility and manageable size for fieldwork. "The conditions were right for walking around," Waldvogel said. "It always had good runs, but it was not such a big creek that it would take a lot of people to walk it."

Waldvogel's method for surveying the West Branch was to walk the creek and visually count all live chinook and fresh chinook carcasses. Carcasses were measured and sexed, and scale samples were taken to age the fish. Water and weather conditions were also recorded. The surveys were conducted weekly – creek flows and weather permitting–during the November through February chinook spawning season.

Results

Presented here are highlights from his survey. The complete report has been published by California Sea Grant in "Fall Chinook (*Oncorhynchus tshawytscha*) Spawning Escapement Estimate and Age Composition for a Tributary of the Smith River, California—23-Year Analysis" by Jim Waldvogel.

"Excellent" Salmon Habitat – The minimum number of spawning chinook along the 1.7-mile study section ranged from 31 in 1990 to 361 in 2001, with a mean of 151. This translates into 78 salmon per mile. According to the Oregon Coastal Index, 40 salmon per mile is the benchmark for "excellent" salmon habitat. The West Branch met this distinction in all but two years, 1989 and 1990, when there were only two inches of rain in early December. "Low creek flows prevented chinook from moving into the study section," Waldvogel said.

One, Two, Three 'Runs' – The survey documented the existence of three distinct fall salmon "runs." The first run was the largest, accounting for an average of 70 percent of all fish tallied. The timing and spatial distribution of these runs is comparable to long-term records for Elk River, just to the north in Curry County, Oregon.

The patterns of redd (a salmon "nest") residency by female chinook were also similar to those observed on Elk River. Female residency time decreased as the spawning season progressed from about 10-21 days for salmon in the first run to about 5-10 days for the third run.

Age of Spawners – Four-year-old females were the most numerous age group of fish during the first half of the study; 3-year-old females were predominant during the second half. About 90 percent of all females observed in the West Branch were either 3 years old or 4 years old.

California Sea Grant Extension Program
Russell A. Moll, Director • Paul Olin, Extension Director • Marsha Gear, Communications Director
University of California, San Diego, 9500 Gilman Drive, Dept. 0232, La Jolla, CA 92093-0232
Communications Phone: (858) 534-4446 • Fax: (858) 453-2948 • Web: http://www.csgc.ucsd.edu

"We don't know if this is a cyclical thing or part of a cycle in the Pacific Decadal Oscillation," Waldvogel said, referring to the abrupt shift in the age distribution of females.

Based on his observations, males started spawning at a younger age than females and were more widely distributed in age. About 30% of males counted in the creek were 2 years old; about 27% 3 years old; about 24% 4 years old, and 15% 5 years old. "Big females may have a hard time getting up small tributaries," Waldvogel said. "They are so loaded with eggs." This might explain why so few 5-year-old and 6-year-old females were seen.

Size, Growth and Gender – Previous studies have shown that the number of North Pacific salmon nearly doubled from 1975 to 1993, while the average size of adults at maturity decreased during this same period. This pattern was not observed on the West Branch. All year classes exhibited slight increases in mean length, consistent with trends observed for Sacramento River chinook.

There were some exceptions to this trend. For example, El Niño episodes in 1982-83, 1992-93 and 1997-98 were associated with decreases in average fish length. The effects on size were especially evident for younger fish, which suggests young fish are more stressed by El Niño conditions than older ones.

In terms of overall length, females were on average about 6 percent shorter than males. The exception was for 3-year-old females who were on average about 82.0 centimeters, compared with 79.7 cm for males. Waldvogel said there was no obvious explanation why females would be larger at this age.

Redd Counts – There were an average of 117 fresh redds and 69 females along the study section each year, translating to 1.8 fresh redds per female. Redds were often as large as 5m wide x 9m long. Waldvogel counted redds with the hope of finding a correlation between the number of fresh redds and the number of spawning fish, providing a link that might supplement spawning counts. Such a link, however, was not observed.

Hook Scars – Waldvogel counted carcasses with hook scars to examine what percent of fish were "interacting" with fisheries, which ranged from 0-28%, with an annual weighted average of about 5%. The frequency of hook scars decreased during the study, likely reflecting tightening regulations on salmon fishing. The timing of chinook runs on the Smith River, which occur later than others, also reduces contact with commercial fisheries, he said.

Applications

In 2002, the conservation group Save-the-Redwoods League raised $60 million to buy and transfer 25,000-acres of Mill Creek redwood forest to the state parks department. Almost $20-million of the property's value was associated with the presence of salmon and their habitat, as documented by Waldvogel and others.

His study was also used to prevent the relocation of coastal Highway 101 through undeveloped parts of Mill Creek. This highway project would have cost taxpayers as much as $60 million. Instead, Caltrans decided to straighten the curves on the existing road, at a cost of about $12 million.

More recently, Stillwater Sciences in Arcata mentioned Waldvogel's study repeatedly in its 2006 report, "Mill Creek fisheries monitoring program: ten-year report," prepared for the California Department of Fish and Game and Save-the-Redwoods League.

The California Department of Fish and Game presently funds a local consulting group to continue the West Branch salmon survey.

Publication

Waldvogel, Jim, 2006, Fall Chinook (*Oncorhynchus tshawytscha*) Spawning Escapement Estimate and Age Composition for a Tributary of the Smith River, California—a 23-Year Analysis, 32 pages

For More Information

Jim Waldvogel, Marine Advisor,
Sea Grant Extension Program, Crescent City, California
Tel: 707.464.4711 • Email: cedelnorte@ucdavis.edu

Jim Waldvogel

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(Front Left) Reuven Walder, (Center) Jack Kelly Clark
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