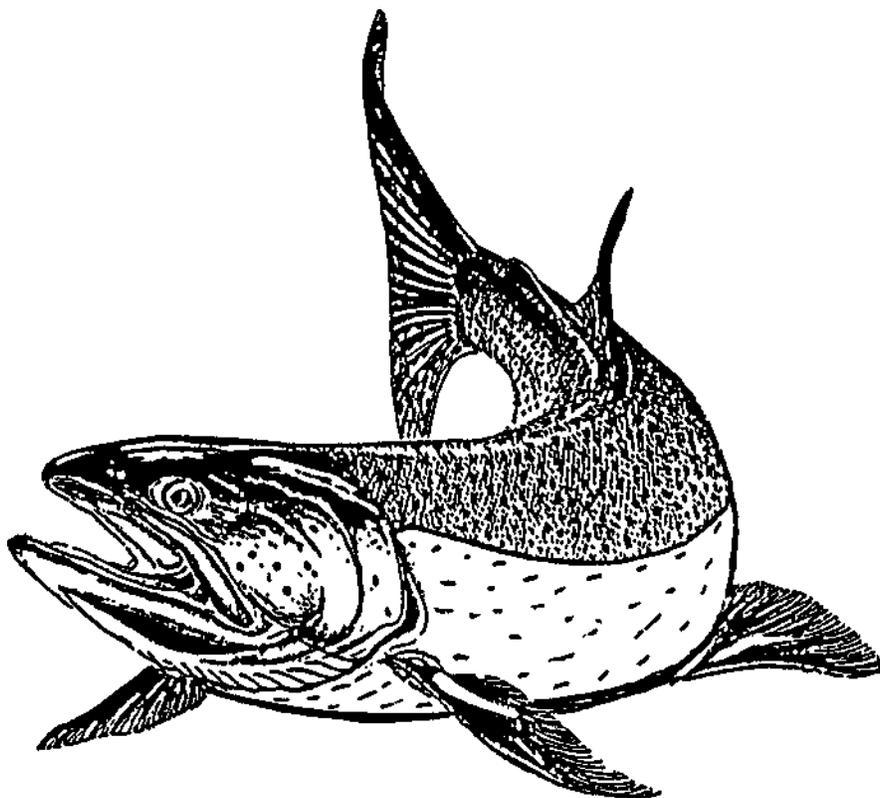




AMERICAN FISHERIES SOCIETY

HUMBOLDT CHAPTER
CALIFORNIA-NEVADA CHAPTER



1990 NORTHEAST PACIFIC CHINOOK & COHO SALMON WORKSHOP PROCEEDINGS

ENVIRONMENTAL FACTORS CONTRIBUTING TO THE DECLINE OF THE
WINTER-RUN CHINOOK SALMON ON THE UPPER SACRAMENTO RIVER

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The winter-run salmon is one of four runs of chinook salmon *Oncorhynchus tshawytscha* in the Sacramento River that is distinguished by a winter upstream migration period and a spawning period extending through late spring and early summer. Presently, the species is only found in the upper Sacramento River. Historically, the fish occurred in the rivers tributary to the upper Sacramento located upstream of Shasta Dam, a permanent barrier to upstream migration. The operation of Shasta Dam over the last 45 years, together with the associated downstream water project features, have led to a decline in the winter-run due to a number of environmental factors. The decline has been so severe in recent years that the winter run is listed as threatened by the U.S. Fish and Wildlife Service and as endangered by California.

Historic Distribution of Winter-run Chinook

The occurrence of winter-run chinook salmon in the Sacramento River upstream of Redding, California at the turn of the century is well documented in early government fishery reports. Although these early salmon workers did not consistently use the names "spring-run" and "winter-run" there were sufficient biological descriptions to identify the run of salmon. The descriptions included spawning time, size of juvenile fish at different times, and the timing, size, and condition of fish in the lower river. Winter-run chinook were reported in the upper Sacramento River near Sims in 1897 (Schofield 1900). They were reported spawning in considerable numbers in the McCloud River above Baird Hatchery during May 1897 (Schofield 1900) and opposite Baird in late April, 1903 (Rutter 1904). There also was winter-run salmon in the Pit River. The State Board of Fish Commissioners, Biennial Report (1898-1890) reported that, "it is a fact well known to fish culturists that winter- and spring-run salmon, during the high cold winters, go to the extreme headwaters of the rivers if no obstructions prevent, into the highest mountains," and that salmon are known to spawn in the Pit River above Pit River Falls and also in Hat Creek and Fall River (State Board of Fish Commissioners, Biennial Report, 1888-1890).

The records from the old Baird Hatchery (located under the reservoir where the McCloud River used to join the Sacramento River) provide the only evidence of the behavior of winter-run chinook in the years prior to the Shasta Project. Upstream migrating adult salmon were blocked by a weir that was typically constructed in August. The U.S. Fish Commission Report for 1874 states that tens of thousands (not hundreds of thousands which would perhaps be nearer the truth) passed the line of our barrier (Baird Weir) before it was complete, and that

thousands of salmon floated down dead against the weir during August and September. These salmon were no doubt a mixture of spring-run and winter-run salmon in unknown proportions. However, since salmon generally die within two weeks after spawning (and do not readily float for sometime thereafter) and winter-run salmon spawn from the middle of April through the middle of August, it is probable that the bulk of the early salmon carcasses which floated against the weir at Baird were winter-run fish.

Another indication of abundance of winter-run chinook is noted in the U.S. Fish Commission Reports of the late 1880's in which reference is made to landings of "prime salmon" by the gill net fishery at Rio Vista, California in January and February, and delivered to San Francisco. For example, of the total annual salmon landings at Rio Vista alone, more than 12 percent were winter-run fish (prime salmon caught in January and February) and 20 percent were fall-run salmon (Stone 1875).

Factors Contributing to Decline of Winter-Run Chinook

Congressional authorization for the construction of Shasta Dam (1930's) provided some level of mitigation for anadromous fish through the Salmon Salvage Plan (SSP) (Department of Interior 1946). Winter-run chinook were not specifically addressed in the salvage plan, although spawners were observed in May of 1939 and alviens in August (Hanson et al. 1940). However, the biologists working on the plan recognized that an allowance must be made for winter-run salmon in any salvage plan and that a sizable safety factor should be added to the actual salmon counts which were made during the low flow periods (Needham et al. 1941).

The SSP included some attempts to mitigate for spring-run chinook in the form of fish transfers to Deer Creek after the completion Shasta Dam. These efforts were quickly abandoned and a Main River Plan (MRP) was developed to compensate for the loss of spawning habitat above the dam. In 1949, the U.S. Fish and Wildlife Service consummated an agreement with the Bureau of Reclamation for the fishery mitigation that included a stipulation that the Bureau shall make every effort to maintain flows and temperatures in the Sacramento River which are necessary for fishery maintenance (Richardson 1987). In addition, the Bureau was relieved of the funding obligation for Coleman Hatchery, operated for fall-run chinook.

The winter-run chinook salmon must have suffered severe impacts during the construction of Shasta Dam in the early 1940's since a portion of those fish could not access suitable spawning areas. For fish that spawned below the dam site, severe mortality would have been expected to occur during the summer incubation period due to warm water discharge from the diversion dam. After the reservoir filled, environmental conditions dramatically improved below the dam. There were even some releases of cold water in the summer from a low level outlet at Shasta Dam that bypassed the powerhouse during the late 1940's (Bureau of Reclamation Memorandum 1948). However, it was recognized that the operation of the dam during the initial years of operation would not be typical of its ultimate operation and a very real danger

for continued success of the MRP was developing (Moffett 1949; Bureau of Reclamation Memorandum 1948).

The operation of Shasta Dam the first two decades after its completion greatly benefited winter-run chinook salmon as evidenced by their peak population of 117,000 fish in 1969 (Figure 1). However, during the last two decades the dam has been operated in a manner that fails to consistently supply cold water for the river and the number of winter-run chinook had decreased to less than 500 fish by 1988 (Figure 1). Increased water demands coupled with dry years have led to an increased magnitude and frequency of drawdown of the reservoir. At low reservoir elevation, release of warm water from the dam's fixed mid-level outlet has caused severe temperature induced salmon egg mortality. Lower reservoir levels also result in decreased releases to the river during the wet season, a situation that disrupts flow stability leading to increased stranding. In addition, low reservoir elevations make it more difficult to control acute chronic toxicity in the upper 30 miles of the river caused by metal discharged from Iron Mountain Mine, an Environmental Protection Agency Superfund site (National Oceanographic

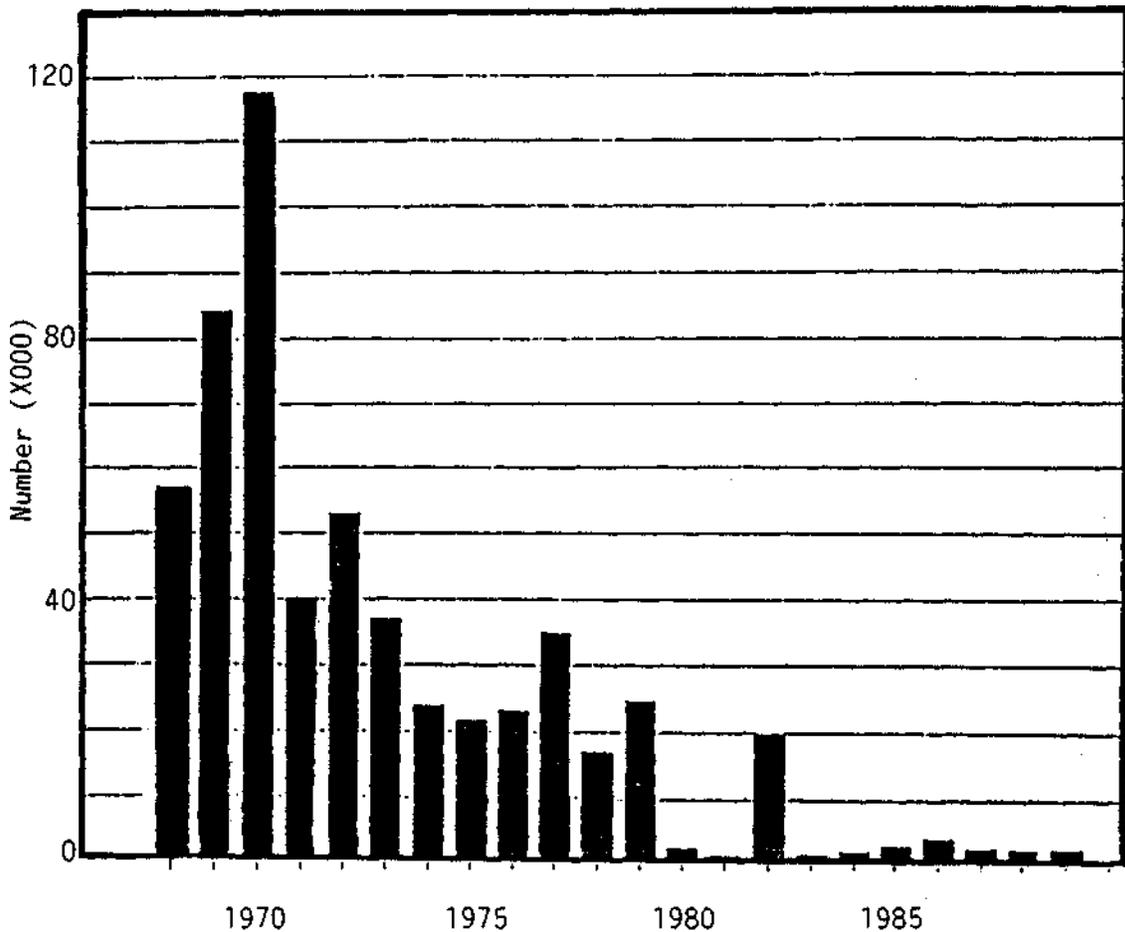


Figure 1. Number of winter-run chinook salmon migrating past Red Bluff Diversion Dam.

Atmospheric Administration 1989). The construction of Red Bluff Diversion Dam has severely impaired successful passage of winter-run adults and juveniles, as well as entraining juveniles in canals (Vogel et al. 1988). Red Bluff Diversion Dam is located 60 river miles below Keswick Dam in a river reach that does not have suitable water temperatures in the summer for egg incubation except in very wet years (Hallock and Fisher 1985).

The various environmental problems and potential solutions have been identified in the Department of Fish and Game Plan for restoration of salmon and steelhead in the Central Valley developed pursuant to California Senate Bill 2261 (Reynolds et al. 1990). This restoration plan was developed in conjunction with the salmon restoration plan for the upper Sacramento River developed under State Senate Bill 1086.

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