Sacramento River Winter-run Chinook Salmon

Biennial Report
2000 - 2001

Prepared for the Fish and Game Commission

California Department of Fish and Game
Habitat Conservation Division
Native Anadromous Fish and Watershed Branch

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INTRODUCTION

The Sacramento River winter-run chinook salmon was listed as endangered under the California Endangered Species Act on September 22, 1989. Since that time, the Department of Fish and Game (Department) has submitted annual reports to the Fish and Game Commission, summarizing the population status and management and recovery actions taken each year. Beginning in 2000, the reporting frequency was changed to a biennial basis.

The Department remains strongly committed to the protection and recovery of the Sacramento River winter-run chinook. In the summer of 2001, the Department formed an internal Winter-run Technical Team to improve winter-run science and management. The mission of the team includes identification of winter-run monitoring, research, and management needs, exchange of technical information, and development of sound technical recommendations for winter-run management. Team members include staff from the Native Anadromous Fish and Watershed Branch, Habitat Conservation Division, Marine Region, Northern California - North Coast Region, and Sacramento Valley - Central Sierra Region. The Department plans to develop a technically based management approach that includes appropriate monitoring and analysis to support a progressive adaptive management program for the entire life cycle of winter-run chinook.

This report summarizes winter-run population status, harvest management conservation measures, research, Central Valley-wide restoration programs, and restoration and management actions for 2000 and 2001.

POPULATION STATUS

ADULT RUN SIZE ESTIMATES

The Sacramento River winter-run chinook salmon population has shown some recovery in the past two years, but the population remains well below recovery goals established for the run. Recovery goals (defined in NMFS 1997) include a mean annual spawning abundance of 10,000 females over any 13 consecutive years. In 2000, the estimated number of winter-run chinook salmon passing Red Bluff Diversion Dam (RBDD) was 1,352. Approximately 58% of this estimate consisted of two-year-old fish. In 2001, the estimated number of winter-run chinook passing RBDD was 5,523, the highest estimate since the early 1980s. Approximately 69% of this estimate consisted of two-year-old fish. Estimated run sizes based on counts at RBDD since 1967 are shown in Table 1 and Figure 1. Run size estimates based on RBDD counts for 1986 to 2000 have been revised since the previous winter-run annual report in 2000, based on a quality control program conducted by the Department's Northern California - North Coast Region.

Since 1996, the Department's Stream Evaluation Program has conducted an annual carcass survey for winter-run chinook in the upper Sacramento River (Snider et al. 1997; Snider et al.

1998; Snider et al. 1999; Snider et al. 2000; Snider et al. 2001; Snider et al. 2002). Until 2001, carcass survey data were used to study the age and sex composition of the spawner population, pre-spawning mortality, and temporal and spatial distribution of spawning activity, but the RBDD data were used to estimate annual winter-run escapement. In 2001, after evaluation by the Department's Winter-run Technical Team, the Department recommended use of the carcass survey data to estimate winter-run escapement.

Three models are used to estimate population size from the carcass survey data, the Petersen, Jolly-Seber, and Schaefer models. The Department recommends the use of the Petersen estimate for tracking long-term population trends of winter-run chinook, because escapement estimates can be made based on the Petersen model in every year the carcass survey is conducted. For applications where the most accurate single-year escapement estimate is needed, the Department recommends use of the winter-run escapement estimate based on the Jolly-Seber model. The Jolly-Seber model has more rigorous data requirements than the Petersen model and adequate data for applying the Jolly-Seber model may not be obtained every year.

Estimates of winter-run escapement in 2000 and 2001, calculated based on the carcass survey data, are as follows: (These estimates include naturally spawning winter-run chinook in the upper Sacramento River, of both wild and hatchery origin, but do not include fish trapped at Keswick Dam and retained for hatchery broodstock.)

	Estimated Total Escapement	
Year	Petersen model	Jolly-Seber model
2000	6,670	4,343
2001	12,797	7,996

Winter-run escapement estimates from the 1996 through 2001 carcass surveys are shown in Table 2 and Figure 2.

REDD DISTRIBUTION

The distribution of spawning winter-run chinook salmon was monitored by weekly aerial redd surveys in the upper Sacramento River, conducted from April 28 through August 16, 2000 and May 2 through August 14, 2001 (Department of Fish and Game, Northern California - North Coast Region). In 2000, a total of 588 redds was observed; 79.1% of these redds were observed in the upper reaches of the survey area from Keswick Dam (River Mile 302) to the Airport Road Bridge (River Mile 284). In 2001, a total of 1,396 redds was observed; 94.8% of these redds were observed in the upper reaches from Keswick Dam to the Airport Road Bridge. In 2000, no redds were observed downstream of Red Bluff Diversion Dam (River Mile 243); in 2001, six redds were observed below this point (Table 3).

CAPTIVE BROODSTOCK PROGRAM

The Winter-run Captive Broodstock Program (WRCBP) was initiated in 1991 when the adult run size was estimated at only 191 fish and it was recognized that it might become impossible to secure wild adults for an artificial propagation program. This experimental program was designed as a hedge against the potential of a catastrophic cohort failure or extinction of the run in the wild.

Since its inception, the program has housed captive fish in at least two separate facilities in order to reduce the potential of losing the entire broodstock to a catastrophic event. Originally, Steinhart Aquarium (San Francisco) and Bodega Marine Laboratory (BML, Bodega Bay) each housed a portion of the broodstock. In 1998, Livingston Stone National Fish Hatchery (LSNFH) also began holding winter-run captive broodstock. In 2001, Steinhart Aquarium terminated most of its participation in the WRCCB program. All winter-run captive broodstock previously held at Steinhart were transported to BML. Steinhart Aquarium continues its participation in the WRCCB program by maintaining a display tank holding a small number of excess captive winter-run progeny with a description of the plight of endangered salmon. Currently, winter-run captive broodstock are equally distributed between LSNFH and BML.

PROPAGATION PROGRAM

In 2000, the U.S. Fish and Wildlife Service (USFWS) trapped adult winter-run chinook from March through July in fish traps at Keswick Dam and RBDD. All fish collected were assessed for phenotypic indicators of run classification and tissues were sampled for genetic analysis. Eighty-nine adults meeting specific genetic selection criteria indicating they were genetic winter-run were retained for the artificial propagation program at LSNFH. Approximately 216,000 eggs were taken from April through July.

Brood year 2000 winter-run juveniles were released on February 1, 2001. Approximately 166,000 winter-run, approximate size 80 mm., were released into the Sacramento River at the Caldwell Park boat launch (River Mile 299) in Redding, California. All juvenile salmon in this release group were coded-wire tagged and adipose fin-clipped (USFWS 2001a).

In 2001, the USFWS collected adult winter-run chinook from March through July in fish traps at Keswick Dam and RBDD. One hundred two genetically identified winter-run adults were retained as broodstock at LSNFH (USFWS 2002). An additional 100 winter-run adult females were transferred from the captive rearing program at BML. Eggs collected from captive broodstock females were fertilized with milt from naturally produced males collected from the Sacramento River. Growth, development, phenotype, and survival of captive broodstock progeny will be compared to progeny of natural origin winter-run adults to assess the potential value of the captive broodstock program to the recovery of winter-run chinook. A total of approximately 340,000 eggs were spawned from natural and captive-origin adults during June and July, 2001.

Brood year 2001 winter-run juveniles were released on January 30, 2002. Approximately 252,500 winter-run, the largest number of winter-run juveniles released from a single brood year to date, were released into the Sacramento River at the Caldwell Park boat launch in Redding. As in 2001, all juvenile salmon in this release group were coded-wire tagged and adipose fin clipped. Progeny of captive broodstock matings were tagged with a unique coded-wire tag code to allow future differentiation from non-captive broodstock progeny.

GENETICS RESEARCH

Recent research has confirmed the genetic differentiation of Sacramento River winter-run chinook from other chinook runs in the Central Valley. These studies have employed several molecular genetic techniques, including allozymes (Bartley et al. 1992; Myers et al. 1998), mitochondrial DNA (Nielsen 1995), microsatellite DNA (Nielsen et al. 1999; Banks et al. 2000), and a major histocompatibility complex (MHC) gene (Kim et al. 1999). The results of these studies have provided important insights into the genetic structure of chinook populations in the Central Valley. Among these insights are (i) Central Valley chinook salmon are well differentiated from coastal chinook salmon populations, (ii) differentiation between populations in the same river with different run times has apparently occurred independently in these two areas, and (iii) within the Central Valley, major genetic units are generally congruent with adult run-time (fall, winter, and spring-run). In each of the studies, winter-run chinook were found to be highly distinct from other chinook runs in the Central Valley.

In addition, Winans et al. (2001) published a review of the 20-year history of genetic stock identification (GSI) of chinook salmon in the Pacific Northwest. Results from four California ocean test fisheries were used to demonstrate the use of GSI to protect depleted chinook salmon stocks, including winter-run chinook. Hedrick et al. (2000) reported on the impact of hatchery supplementation on the overall effective population size of winter-run chinook.

HARVEST MANAGEMENT CONSERVATION MEASURES

SACRAMENTO RIVER RECREATIONAL FISHERIES

The current salmon sport fishing regulations for the Sacramento River, which have been in effect since 1990, consist of time and area closures, gear restrictions, and zero bag limits. The specific measures are outlined below:

1) Area closed to fishing for the entire year
    a) The Sacramento River from Keswick Dam to 650 feet below the dam.
    b) The Sacramento River from 500 feet upstream from Red Bluff Diversion Dam to 1,375 feet below the dam.

2) No salmon may be retained for the entire year, no lure over 2-1/4 inches allowed, only barbless hooks may be used, and no salmon may be removed from the water
    a) The Sacramento River from 650 feet below Keswick Dam to the Deschutes Road Bridge

3) No salmon may be retained from January 15 through July 31
    a) The Sacramento River from the Deschutes Road Bridge to the Bend Bridge

4) No salmon may be retained from January 15 through July 15
    a) The Sacramento River from the Bend Bridge to the Carquinez Bridge

SAN FRANCISCO BAY RECREATIONAL FISHERIES

Recreational ocean salmon fishery regulations apply to the area within San Francisco Bay from the Carquinez Bridge to the Golden Gate Bridge.

OCEAN COMMERCIAL AND RECREATIONAL FISHERIES

The Pacific Coast Salmon Plan (FMP) was developed by the Pacific Fishery Management Council (PFMC) to manage west coast ocean salmon fisheries. The current FMP conservation objective for Sacramento winter chinook is based on the jeopardy standard of the National Marine Fisheries Service's (NMFS) 1997 Biological Opinion (BO). The BO requires constraints on ocean harvest sufficient to produce a 31% increase in the adult spawner replacement rate relative to the 1989-1993 mean of 1.35. Thus a replacement rate goal of 1.77 is currently required. Each season, the Winter Chinook Ocean Harvest Model (WCOHM) is used by the PFMC's Salmon Technical Team to analyze ocean fishery regulation options to ensure they meet this replacement goal. Although the WCOHM is based on the recoveries of marked (fin-clipped) wild winter chinook collected during the 1970s, it is still the best tool available for meeting NMFS ESA requirements.

Ocean fishery impacts on Sacramento River winter chinook returning in 2001 primarily occurred during the 2000 season. Both commercial and recreational fisheries were constrained by regulations specifically enacted to protect winter chinook. Using mark-recapture carcass surveys, the Department estimates the 2001 winter chinook adult run size to be 11,581 (Peterson). In 1998, the adult run size was estimated to be 5,391 using the same methodology. Thus the three-year adult spawner replacement rate for 2001 was approximately 2.14 (higher than the target rate of 1.77).

RECREATIONAL FISHERY CONSERVATION MEASURES

Prior to 1997, the recreational fishery south of Point Arena never opened later than the first Saturday in March; however coded-wire tag data collected in the ocean fisheries during the 1990s showed that approximately 75% of all winter chinook impacts occur in the recreational fishery. In 1997, the opening of recreational fisheries south of Point Arena (San Francisco and Monterey port areas) was delayed to reduce fishery impacts on winter chinook. In the Monterey port area, the season opener was delayed two weeks and the San Francisco port area opener was delayed four weeks. These two- and four-week delays continued in their respective ports through the 1999 season.

In 2000, the season openers in the Monterey and San Francisco port areas were each delayed an additional two weeks to increase winter chinook protection. A 24-inch minimum size limit (total length) was also in effect south of Horse Mountain through May 31 (winter chinook are generally smaller than abundant Central Valley fall chinook) and no more than two single-point, single-shank barbless hooks could be used when fishing north of Point Conception. Special gear restrictions (e.g., circle hooks) were in effect when fishing with bait and angling by any other means than trolling, to reduce the hooking mortality of released salmon.

COMMERCIAL CONSERVATION MEASURES

Since commercial fisheries have historically impacted winter chinook during the latter half of the season, the minimum size limit south of Point Arena increased from 26-inch to 27-inch on July 1, 2000 to help reduce retention of the generally smaller Sacramento River winter chinook. Special gear restrictions were also in effect for the first time when fishing with bait and angling by any other means than trolling. Similar to the recreational fishery, barbless circle hooks were required to reduce the hooking mortality of released salmon. The season was also constrained by time and area to help reduce fishery impacts. The area south of Point San Pedro closed on August 27, primarily to protect winter chinook.

FMP OBJECTIVES FOR WINTER CHINOOK AND NMFS JEOPARDY STANDARD

According to the 1997 BO: "In the absence of new and compelling information, the requirement for a 31% increase in the adult replacement rate will remain in effect through the 2001 salmon seasons..... At the end of this period, NMFS will review the available information and reassess the need for restrictions on ocean harvest." At the November 2001 PFMC meeting, NMFS proposed initiating an FMP amendment to develop a comprehensive set of management objectives for Sacramento River winter and spring chinook stocks.

In March 2002, the PFMC will consider amending the FMP to provide specific recovery and long-term conservation objectives for Sacramento River winter and spring chinook. To accommodate this process, NMFS will issue a two-year BO on winter-run chinook.

CENTRAL VALLEY-WIDE RESTORATION PROGRAMS

CALFED BAY-DELTA PROGRAM

The CALFED Bay-Delta Program, established in May 1995, has the ambitious goal of achieving recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; supporting similar recovery of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimizing the need for future endangered species listings by reversing downward population trends of native species that are not listed.

The CALFED Bay-Delta Program consists of several key program elements that will help achieve ecosystem restoration and species recovery. One of these elements, the Ecosystem Restoration Program (ERP), was developed to guide restoration actions and ensure attainment of ecosystem health (also called ecological integrity). The strategy described in the ERP to restore ecological integrity is based on the restoration of ecological processes that are associated with streamflow, stream channels, watersheds, and flood plains, which in turn support habitats and associated species. In addition, the CALFED Program established the Environmental Water Account (EWA), Environmental Water Program (EWP), Multi-species Conservation Strategy (MSCS), and Science programs, designed to work in conjunction with the ERP to increase protection of listed species in the Delta, improve streamflow regimes, and ensure the application of sound scientific principles in ecosystem restoration actions.

The CALFED Program is following a three-phase process to achieve broad agreement on long-term solutions. In the first phase, the CALFED Program developed a range of alternatives, consisting of hundreds of actions. The Program conducted meetings and workshops to obtain public input, prepared a Notice of Intent and Notice of Preparation pursuant to NEPA and CEQA, and held public scoping sessions to determine the focus and content of the EIS/EIR. The first phase concluded in September 1996 with the development of a range of alternatives for achieving long-term solutions to the problems of the Bay-Delta estuary. During Phase II, the Program conducted a comprehensive programmatic environmental review process. A draft programmatic EIS/EIR and interim Phase II Report identifying three draft alternatives and program plans was released on March 16, 1998. The release of the documents was followed by a 105-day public comment period. On June 25, 1999, CALFED again released a draft programmatic EIS/EIR followed by a 90-day comment period. The final programmatic EIS/EIR was released July 21, 2000 followed by the Record of Decision (ROD) on August 28, 2000. The ROD completed Phase II. Program implementation is occurring in Phase III.

Early implementation of CALFED ecosystem restoration projects began in 1996, even as the many elements of the CALFED Bay-Delta Program were being designed and debated. With extensive public participation, the CALFED agencies have established through the ERP and MSCS a “Single Blueprint” for restoration and species recovery within the geographic scope of the ERP. This blueprint is intended to ensure close coordination of future restoration efforts with a common goal and approach.

The ERP/MSCS has established a goal of "recovery" for winter-run chinook salmon. Recovery is achieved when the decline of a species is arrested or reversed, threats to the species are neutralized, and the species' long-term survival is assured.

Various commitments were made in the CALFED ROD to ensure funding for ecosystem restoration. In Stage 1 (the first seven years of implementation following the ROD), CALFED plans to invest over $1 billion in ERP projects, in accordance with the priorities established in the Strategic Plan, in addition to funds necessary for the EWA program. The CALFED Conservation Agreement Regarding Multi-Species Conservation Strategy requires that the ERP must be funded in the amount of at least $150 million annually through Stage 1. An additional $50 million will be allocated annually for the EWA for the first four years. The ESA commitments described in the CALFED ROD include an operational EWA and benefits of the ERP. For the ERP, the CALFED Agencies have proposed a combination of state funding (including Proposition 204 funds), federal funding, and user fees.

From 1997 through 2001, the CALFED effort has led to ecosystem restoration grants for 326 projects, totaling $336 million. Additionally, in 2001, 50 projects for Watershed stewardship were approved for $19 million. The majority of these projects benefited Central Valley salmon, either directly or indirectly.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT PROGRAM

The Central Valley Project Improvement Act (CVPIA), enacted in 1992, amended the authority of the Central Valley Project (CVP) to include fish and wildlife protection, restoration, and mitigation as having equal priority with other CVP purposes. Section 3406 (b) of the CVPIA directs the Secretary of the Interior to develop and implement programs and actions to ensure that by 2002, the natural production of anadromous fish in Central Valley streams will be sustainable, on a long-term basis, at levels at least twice the average levels of natural production in the 1967 through 1991 baseline period.

The Anadromous Fish Restoration Program (AFRP) was established in 1995 by Section 3406(b)(1) of the CVPIA. The AFRP staff, with help from other agencies and groups, established baseline production estimates for Central Valley streams for naturally produced chinook salmon and other anadromous species. Baseline production estimates were developed using population data from 1967 through 1991. Production targets for anadromous fish were determined by doubling the baseline production estimates.

Numerous actions to improve the natural production of anadromous fish, including winter-run chinook, have been funded by the CVPIA program since 1992. Over $466 million has been expended to date; approximately $72 million was obligated in fiscal year 2000 alone to implement the CVPIA. (USDOI 2000)

NATIONAL MARINE FISHERIES SERVICE RECOVERY PLANNING

The National Marine Fisheries Service (NMFS) will initiate comprehensive recovery planning for listed salmonid species in the Central Valley in 2002. NMFS is required under the Federal Endangered Species Act (ESA) to assess factors affecting the species, identify recovery (delisting) criteria, identify the entire suite of actions necessary to achieve these goals, and estimate the cost and time required to carry out the actions. In California, NMFS has developed an approach, in coordination with NMFS' Northwest Region, that is tailored to California recovery planning issues.

The NMFS Central Valley recovery planning domain includes the Sacramento River basin downstream from Keswick Dam, the Sacramento/San Joaquin Delta, and the San Joaquin River Basin, from the confluence of the Merced River downstream. This domain encompasses the Evolutionarily Significant Units (ESUs) for Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, Central Valley steelhead, and also federal candidate species fall/late fall-run chinook salmon.

NMFS anticipates appointment of a Central Valley Technical Recovery Team (TRT) to begin the recovery planning process by the spring of 2002. The team will be composed of experts in salmon biology, population dynamics, conservation biology, ecology, and other relevant disciplines. The Central Valley TRT will work closely with existing technical teams, such as the CALFED Science Program.

RESTORATION AND MANAGEMENT ACTIONS

EFFORTS TO REDUCE INCIDENTAL TAKE AT THE CVP/SWP DELTA FACILITIES

Each year, the NMFS establishes incidental take limits for juvenile winter-run chinook salmon at the Central Valley Project (CVP) and State Water Project (SWP) Delta export facilities, pursuant to conditions of the 1993 Winter-run Chinook Salmon Biological Opinion (as amended August 2, 1993; October 6, 1993; December 30, 1994; May 17, 1995; and August 18, 1995). The take limits are based on the estimated number of juvenile winter-run entering the Delta each year. A warning or "yellow light" level is set at 1% of the estimated number of juveniles entering the Delta; an incidental take "red light" level is set at 2% of the estimated number of juveniles entering the Delta.

For the period October 1999 through May 2000, the incidental take limit (red light) was set at 5,794 juveniles. Juvenile winter-run were lost at the Delta facilities from mid-January through mid-April 2000 (Figure 3). Peak losses occurred in mid- to late February. The cumulative winter-run loss for the season only slightly exceeded the red light incidental take limit in 2000.

For the period October 2000 through May 2001, the NMFS established a yellow light level of 3,702 juveniles and a red light limit of 7,404. Juvenile winter-run were lost at the Delta facilities from December through April (Figure 4), with peak losses occurring in early March. The cumulative winter-run loss for 2000-2001 was 19,988, significantly exceeding the red light level.

When the incidental take at the pumps reaches the red light loss level identified in the NMFS Biological Opinion for winter-run chinook, reconsultation is required. This reconsultation took place in 2001 through the CALFED Data Assessment Team (DAT) and Water Operations Management Team (WOMT) interagency processes. When winter-run take was high during February and March of 2001, decisions were made by biologists and project operators on a daily basis to protect juvenile winter-run using the available resources. Recommended actions included pumping curtailments, as well as other measures, to reduce take of juvenile winter-run during critical time periods. Pumping curtailments totaled over 200,000 acre-feet in January, February, and March. Since most of the loss occurred at the State Water Project, the CALFED Environmental Water Account (EWA), available for the first time in 2001, was used to compensate the State Water Project for reduced diversions at the state pumping plant.

Following the period of high winter-run loss in 2001, the NMFS initiated an extensive review of factors contributing to the loss. NMFS, in coordination with the U.S. Fish and Wildlife Service (USFWS) and the Department, is currently in the process of reviewing the methodology used to estimate the number of juveniles entering the Delta each year. In addition, Department biologists are improving techniques for estimating winter-run production and the relationships between spawning and abundance and distribution of subsequent life stages. The goal is to improve the ability to track winter-run numbers through the system to identify production bottlenecks and potential adaptive management opportunities.

COLEMAN NATIONAL FISH HATCHERY RE-EVALUATION

The USFWS is continuing a comprehensive re-evaluation of artificial propagation at the Coleman National Fish Hatchery. A project description including potential operational modifications and alternative management strategies will be completed in 2002. The Department has been involved in specific aspects of the re-evaluation and will continue to be involved in the concurrent federal ESA consultation process.

In June 2001, the USFWS completed a biological assessment for the NMFS on the effects of Coleman National Fish Hatchery (CNFH) and Livingston Stone National Fish Hatchery (LSNFH) on ESA-listed Central Valley populations of anadromous salmonids, including Sacramento River winter-run chinook salmon (USFWS 2001b). The NMFS will issue a Biological Opinion and incidental take authorization based on the biological assessment to cover the incidental take of all ESA-listed salmonids impacted by the artificial propagation activities.

UPPER SACRAMENTO RIVER FISH SCREENS

State-of-the-art fish screens have been installed at several major water diversions on the upper Sacramento River, including Glenn Colusa Irrigation District, Reclamation District 108, and Reclamation District 1004. These projects have involved cooperative efforts of several agencies, and were funded by a variety of sources.

ANDERSON-COTTONWOOD IRRIGATION DISTRICT FISH LADDER AND SCREEN

Past operations of facilities at Anderson-Cottonwood Irrigation District (ACID) on the upper Sacramento River resulted in significant mortality of anadromous fish, including winter-run chinook. Impacts included stranding of juvenile fish due to river flow fluctuations made to accommodate flashboard adjustment of the dam, excessive releases of canal water via waste gates that falsely attracted adults into the waste ways, and release of toxic herbicides from the canal into the river's tributaries. Operations associated with these sources of mortality have been modified to avoid fish mortality.

The antiquated and damaged fish ladders and fish screen at the ACID Dam were replaced in 2001 with state-of-the-art facilities, costing more than $10 million. CVPIA and CALFED funds were received for design, permitting, and construction of two new fish ladders and a fish screen system. These facilities will allow adult salmon access to the three miles of quality spawning habitat above the dam and the broodstock collection facility for LSNFH. Screens will provide safe juvenile passage downstream of the canal.

The Department will continue to participate in post-project monitoring at the ACID restoration project, including finalizing the operations and maintenance agreement for the new screen and ladders.

BATTLE CREEK

The Battle Creek Restoration Project is an example of a cooperative approach to solving environmental problems through CALFED's ecosystem restoration process. The project design provides future certainty for both the environment and industry in a key watershed. The stream reaches being restored are located in the foothill reaches of Battle Creek where Pacific Gas and Electric Company (PG&E) operates a series of nine hydroelectric dams and canals affecting 42 miles of habitat suitable for all five runs of native anadromous salmonids. The project's environmental documentation is scheduled for completion in 2002. Construction will begin in 2002. The total project cost exceeds $50 million, of which: $27 million is being provided by CALFED for facility improvements; $20 million is being provided by PG&E for flow improvements; and $3 million is being provided by the David and Lucille Packard Foundation for the adaptive management program.

IRON MOUNTAIN MINE

Iron Mountain Mine has had a long history of degrading water quality and significantly impacting anadromous fish populations in the upper Sacramento River. The mine property discharges and surface runoff contain a complex mixture of toxic metals. Concentrations are sufficient in up to 25 miles of the Sacramento River to result in mortality of early life stages of salmon and steelhead. Thirty years ago, the primary method of toxicity control in the river was dilution manipulation. Contaminated runoff from Iron Mountain Mine is impounded in a dam on Spring Creek and metered out into the river in proportion to uncontaminated water releases from Shasta and Whiskeytown dams.

Over the last decade, the U.S. Environmental Protection Agency (EPA) provided significant pollution control by ordering the construction and operation of treatment plants to reduce metal loading, and water control systems to enhance treatment and dilution systems. The pollution control system currently in operation removes up to 75% of the toxic metals being emitted from the site. The EPA Superfund Program is constructing a large new dam on Slickrock Creek to collect and treat additional contaminants, bringing the level of pollution control to approximately 95% reduction of toxic metals.

The EPA has also required the establishment of an $11 million dollar trust fund to be used for salmon restoration in the upper Sacramento River. The fund is intended to compensate for all past damages resulting from the contamination. This restoration fund will be coordinated with other funds directed for the upper Sacramento River from the CALFED program.

In 2000 and 2001, hydrologic conditions were not extreme and pollution control facilities functioned as designed, providing suitable water quality conditions in the Sacramento River below Keswick Dam. The Department will continue to participate with other resource agencies in EPA's decision making process for implementing pollution control actions. In addition, the Department will participate in the Trustee council that will coordinate the expenditure of the trust fund for salmon restoration in the upper river.

UPPER SACRAMENTO RIVER WATER TEMPERATURE CONTROL

Water temperature control in the upper Sacramento River is critical for the restoration/recovery of winter-run chinook salmon. In past years, significant egg mortality occurred in the upper river due to elevated water temperatures. The NMFS Winter-run Biological Opinion for the operation of the CVP and SWP (February 1993) requires CVP operations to meet specific temperature criteria in the upper river. State Water Resources Control Board Orders 90-5, 91-1, and 92-2 also require compliance with temperature objectives in the upper river. In 1997, construction was completed on the Temperature Control Device (TCD) at Shasta Dam. The TCD allows better temperature management in the river, while allowing power generation.

The Department currently participates in the Upper Sacramento River Temperature Task Group,

an interagency team composed of representatives of the USFWS, NMFS, Western Area Power Administration (WAPA), State Water Resources Control Board, and U.S. Bureau of Reclamation (USBR). The team identifies water management alternatives and TCD operations on a real-time basis that minimize temperature impacts on winter, spring, and fall-run chinook in the upper river.

In 2000, storage and runoff conditions in the Sacramento River basin were sufficient to enable the USBR to manage temperature conditions in the upper river for successful spawning and egg incubation of winter-run chinook. The TCD generally performed well. However, at the end of the summer period, the TCD appeared to leak warm water into the upper gates that were closed. Changes were made to conserve the coldwater pool in Shasta Reservoir for the fall period, but had no significant impacts on winter-run chinook because they occurred relatively late in the season.

In 2001, the storage and runoff conditions were not as favorable as the previous year, making it infeasible to manage temperature conditions in the entire winter-run spawning reach. It was feasible to manage for successful egg incubation in the uppermost 90 percent of the winter-run habitat, thereby limiting the estimated temperature induced mortality of winter-run embryos to a low rate.

The Department will continue to participate in the Upper Sacramento River Temperature Task Group to identify management alternatives for water temperature control on a real-time basis.

RED BLUFF DIVERSION DAM PROJECT ALTERNATIVES

The Red Bluff Diversion Dam (RBDD) has had a 30-year history of seriously impairing passage of adult and juvenile anadromous fish. Juvenile migrants have been vulnerable to canal entrainment and high levels of predation at the dam. Adult passage is blocked or delayed due to the inadequate ladders and hydrology of such a large river. Since 1987, there has been seasonal raising of the dam gates for periods of six to nine months consistent with the NMFS Winter-run Biological Opinion. Monitoring has shown that the nine-month raising of the dam gates allows unimpaired passage of most winter-run chinook and significantly reduces the congregations of predatory fish below the dam.

An environmental documentation process is currently underway to evaluate alternatives to provide safe passage of adult and juvenile anadromous fish at RBDD while providing a reliable water supply for agriculture. The Tehama-Colusa Canal Authority received a CALFED grant for the environmental decision making process and has completed a preliminary draft environmental document and advanced designs. Alternatives under consideration include various sizes of screened bankside pumping plants and various periods of gate closures. Three feasible alternatives include pumping from bankside plants and raising dam gates for either 9, 10, or 12 months of the year. The latest segment of the winter-run chinook adult migration would benefit from increased periods of gate removal. The Department will continue to participate in the environmental decision making process for RBDD fish passage.

Table 1. Annual Estimated Winter-run Chinook Salmon Run Size at Red Bluff Diversion Dam, 1967 through 2001.

Year	Grilse	Adults	Total	Year	Grilse	Adults	Total
1967	24,985	32,321	57,306	1985	329	3,633	3,962
1968	10,299	74,115	84,414	1986	496	2,101	2,596
1969	8,953	108,855	117,808	1987	277	1,909	2,186
1970	8,324	32,085	40,409	1988	1,008	1,878	2,886
1971	20,864	32,225	53,089	1989	125	571	696
1972	8,541	28,592	37,133	1990	43	387	430
1973	4,623	19,456	24,079	1991	19	192	211
1974	3,788	18,109	21,897	1992	80	1,160	1,240
1975	7,498	15,932	23,430	1993	137	250	387
1976	8,634	26,462	35,096	1994	124	62	186
1977	2,186	15,028	17,214	1995	29	1,268	1,297
1978	1,193	23,669	24,862	1996	629	708	1,337
1979	113	2,251	2,364	1997	352	528	880
1980	1,072	84	1,156	1998	924	2,079	3,002
1981	1,744	18,297	20,041	1999	2,466	822	3,288
1982	270	972	1,242	2000	789	563	1,352
1983	392	1,439	1,831	2001	3,827	1,696	5,523
1984	1,869	794	2,663				

Table 2. Estimated Winter-run Escapement, Upper Sacramento River Winter-run Carcass Survey, 1996-2001

Petersen Model

Year	Grilse	Adults	Total
1996	156	664	820
1997	165	1,888	2,053
1998	110	5,391	5,501
1999	441	1,821	2,262
2000	178	6,492	6,670
2001	1,216	11,581	12,797

Jolly-Seber Model[1]

Year	Grilse	Adults	Total
2000	116	4,227	4,343
2001	760	7,236	7,996

[1] Due to data limitations, Jolly-Seber estimates could only be calculated for 2000 and 2001 carcass surveys.

Table 3. Estimated Redd Distribution of Winter-run Chinook Salmon on the Sacramento River by DFG Aerial Counts.

RIVER REACH	2000		2001	
	No.	%	No.	%
Keswick Dam to Anderson Cottonwood Irrigation District (ACID) Dam	34	5.8	484	34.7
ACID Dam to Highway 44 Bridge	157	26.7	215	15.4
Highway 44 Bridge to Airport Road Bridge	274	46.6	624	44.7
Airport Road Bridge to Balls Ferry Bridge	32	5.4	55	3.9
Balls Ferry Bridge to Battle Creek	35	6.0	2	0.1
Battle Creek to Jellys Ferry Bridge	10	1.7	2	0.1
Jellys Ferry Bridge to Bend Bridge	46	7.8	8	0.6
Bend Bridge to Red Bluff Diversion Dam	0	0.0	0	0.0
Red Bluff Diversion Dam to Tehama Bridge	0	0.0	6	0.4
Estimated Total Number of Redds	**588**		**1,396**	

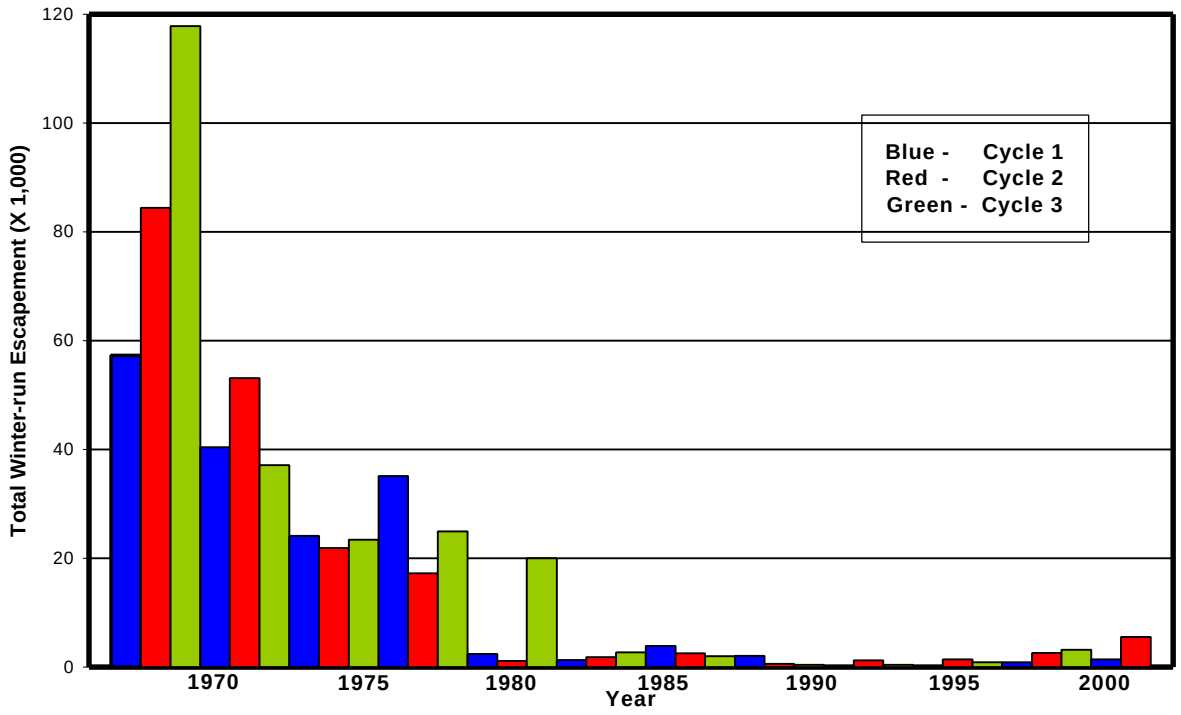

Figure 1. Winter-run Escapement Estimates Based on Red Bluff Diversion Dam Counts, 1967- 2001.

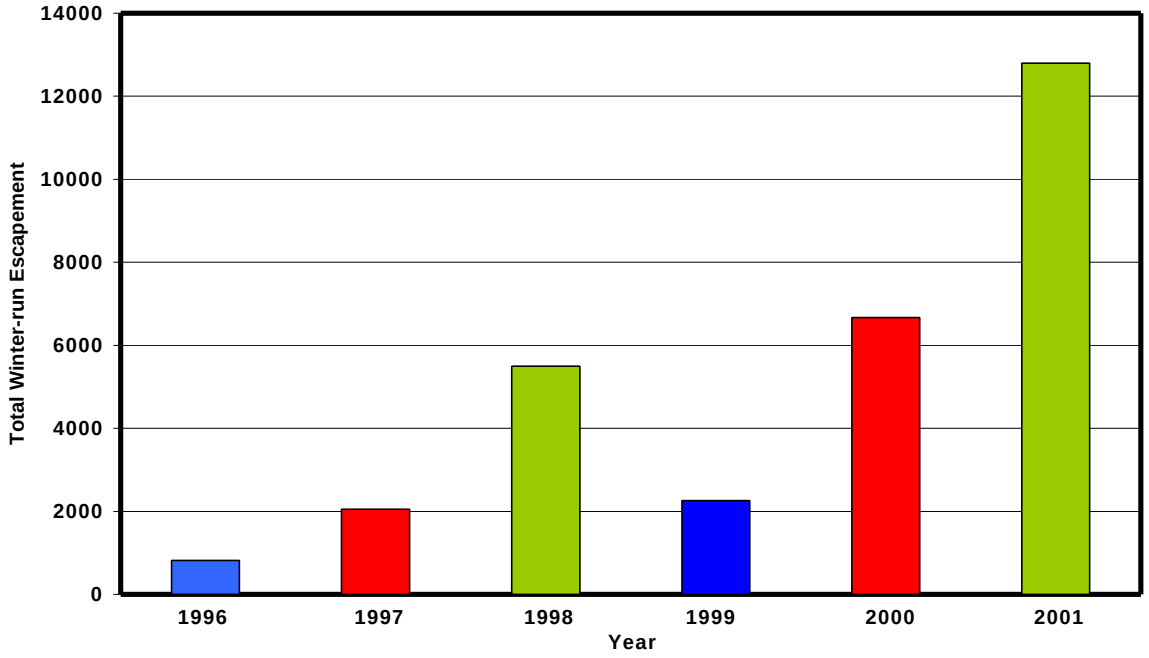

Figure 2. Winter-run Escapement Estimate Based on Carcass Survey Data (Petersen Model).

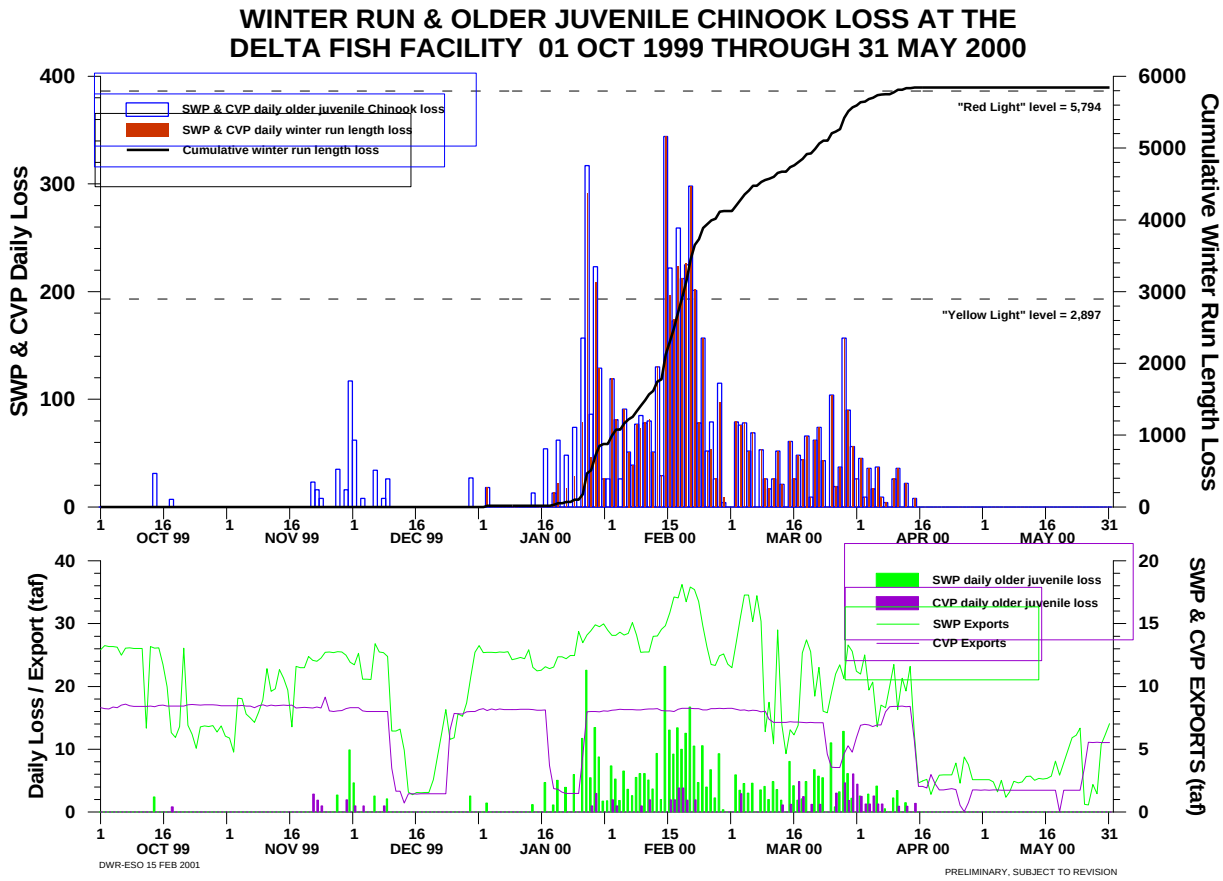

Figure 3. Juvenile Winter-run Loss at the CVP and SWP Delta Facilities, October 1999 – May 2000.

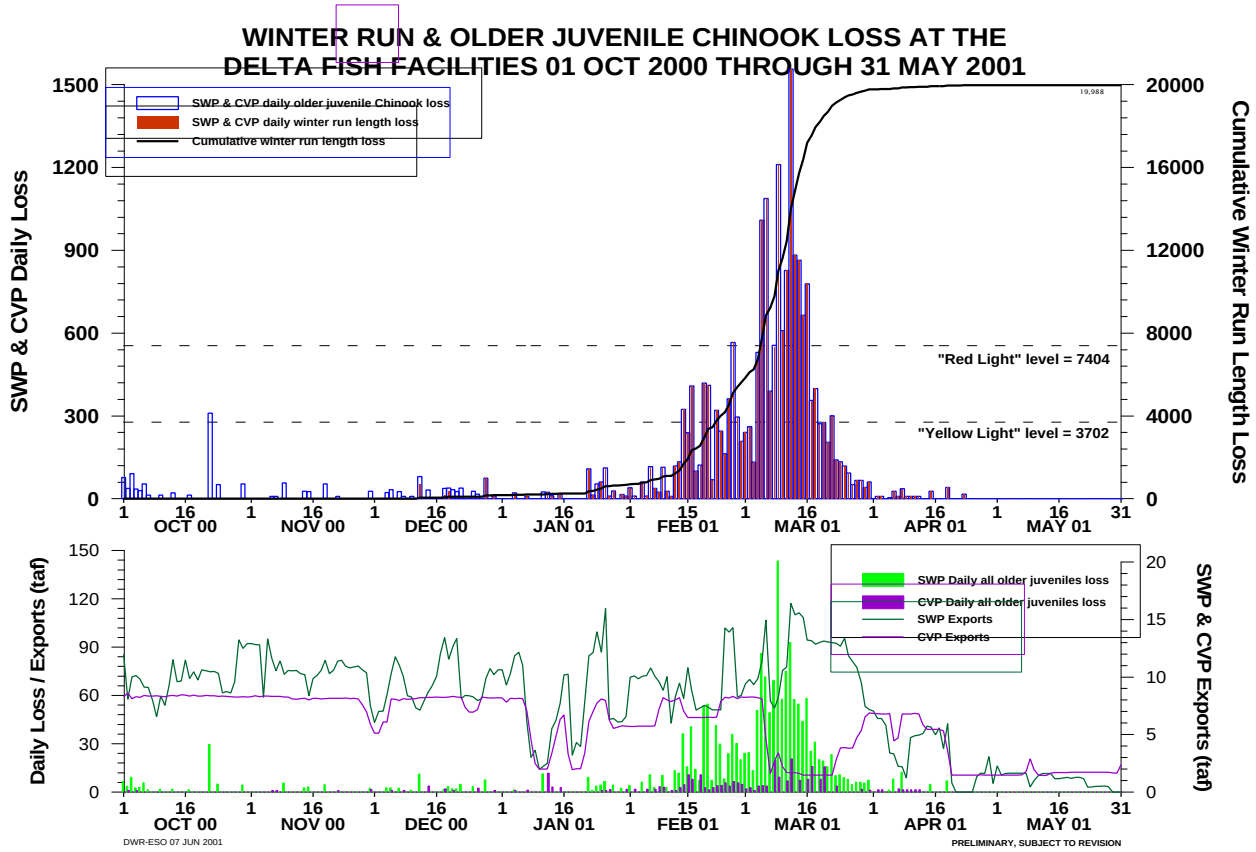

Figure 4. Juvenile Winter-run Loss at the CVP and SWP Delta Facilities, October 2000 – May 2001.

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