Sacramento River Winter-run Chinook Salmon

Biennial Report
2002 - 2003

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. This report summarizes winter-run population status, harvest management conservation measures, research, Central Valley-wide restoration programs, and restoration and management actions for 2002 and 2003.

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 scientifically-based recommendations for winter-run management. 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.

The Department is also participating in the NOAA Fisheries recovery planning process for the Central Valley domain, which was initiated in 2003. Over the next two years, DFG will participate on the Technical Recovery Team that will identify population delisting criteria, factors for decline, limiting factors, early actions for recovery, and research, monitoring, and evaluation needs for winter-run Chinook, as well as spring-run Chinook and steelhead.

POPULATION STATUS

ADULT RUN SIZE ESTIMATES

In 2002 and 2003, the Sacramento River winter-run Chinook salmon population showed some continuing recovery from the extremely low returns observed in the early 1990's. However, the population remains well below draft recovery goals established for the run. Draft recovery goals (defined in NMFS[1] 1997) include a mean annual spawning abundance of 10,000 females over any 13 consecutive years.

ESTIMATES BASED ON CARCASS SURVEY DATA

Since 1996, the Department 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 fish counts at Red Bluff Diversion

[1] National Marine Fisheries Service (NMFS) is currently NOAA Fisheries.

Dam (RBDD) 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.

In 2003, calculation of the escapement estimate from carcass survey data followed a different methodology than in prior years. The number of adult females was estimated using only the adult female data from the carcass survey and applying the Jolly-Seber model. The number of adult males was then derived from the adult female estimate, using the male-to-female sex ratio for the winter-run population observed by the USFWS at the Keswick Dam trapping station. The number of grilse was estimated based on the ratio of adults to grilse found in fresh fish sampled in the carcass survey. In prior years, the carcass survey estimated adults without separating the sexes.

Estimates of winter-run escapement in 2001, 2002 and 2003, calculated based on the carcass survey data, are shown below. 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. Estimates are based on the application of the Jolly-Seber model.

Year	Grilse	Adults	Total
2001	787	7,333	8,120
2002	412	6,948	7,360
2003	535	7,598	8,133

ESTIMATES BASED ON RED BLUFF DIVERSION DAM COUNTS

From 1967 to the present, annual winter-run escapement has been estimated based on counts made at Red Bluff Diversion Dam (RBDD). These data can be used to evaluate long-term trends in the winter-run population. 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 from 1986 through 1999 have been revised since the previous winter-run annual reports, based on a quality control program conducted by the Department's Northern California - North Coast Region.

In 2002, the estimated number of winter-run Chinook salmon passing RBDD was 9,169. Approximately 17% of this estimate consisted of two-year-old fish, or grilse. In 2003, the estimated number of winter-run Chinook passing RBDD was 9,757. Approximately 37% of this estimate consisted of two-year-old fish. The 2002 and 2003 estimates are the highest since the early 1980's, and indicate continued recovery from the extremely low population levels in the early 1990's.

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 26 through August 20, 2002, and May 20 through August 6, 2003 (Department of Fish and Game, Northern California - North Coast Region). In 2002, a total of 610 redds was observed; 98.2% 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 2003, a total of 878 redds was observed; 99.3% of these redds were observed in the upper reaches from Keswick Dam to the Airport Road Bridge. In 2002, one redd was observed downstream of Red Bluff Diversion Dam (River Mile 243); in 2003, three redds were observed below this point (Table 2). These data indicate a significant upstream shift in the distribution of winter-run spawning in recent years. Since the construction of new fish ladders at Anderson-Cottonwood Irrigation District (ACID) Dam in 2001, a greater proportion of the population has spawned in the reach between Keswick Dam and ACID than in previous years.

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. It was planned to be in operation for 10 years.

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. However, the project has exceeded its expected 10-year life span and recent changes have been made to facilitate the eventual close-out of the program. 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 WRCBP program. All winter-run captive broodstock previously held at Steinhart were transported to BML. Currently, winter-run captive broodstock are held at LSNFH and BML. Over the next several years, it is expected that all winter-run Chinook captive broodstock activities will be transferred to LSNFH.

PROPAGATION PROGRAM

In 2002, the U.S. Fish and Wildlife Service (USFWS) collected adult winter-run Chinook at fish traps at Keswick Dam and Red Bluff Diversion Dam for use as broodstock at the Livingston Stone National Fish Hatchery (LSNFH). Winter-run Chinook broodstock were collected during the months March through July. All fish collected were assessed for phenotypic indicators of run classification and tissue samples were collected for a genetic population assignment. Ninety-six

adults meeting the phenotypic and genetic selection criteria were retained for broodstock. Matings were conducted by splitting eggs of each female into two or more lots and fertilizing each lot with the milt from different males. A total of 231,375 eggs were collected from 95 family groups.

An additional ninety-five adult female winter-run Chinook broodstock were transferred to LSNFH from the captive rearing program at the Bodega Marine Laboratory (BML). Eggs collected from each captive broodstock female were fertilized with milt from a separate male collected from the Sacramento River, creating 94 family groups. A total of 122,411 eggs were spawned from matings of natural and captive-origin adults. The spawning of these captive-reared females marks the second year of a three year study to compare growth, development, phenotype, and survival of progeny of captive broodstock and natural origin winter-run Chinook.

On January 30, 2003, 233,613 brood year 2002 winter-run pre-smolts 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.

Broodstock for brood year 2003 winter-run Chinook were collected at the fish trap at Keswick Dam from February through July 2003. Eighty-five adult Chinook salmon met the phenotypic and genetic selection criteria and were retained for broodstock at LSNFH. An additional 100 winter-run adult females were transferred to LSNFH from the captive rearing program at BML. A total of 363,910 winter-run Chinook eggs were spawned; 140,641 from captive broodstock females and 223,269 from females collected from the Sacramento River.

On February 5, 2004, 218,617 brood year 2003 winter-run pre-smolts were released into the Sacramento River at the Caldwell Park boat launch in Redding. All juvenile winter-run Chinook salmon in this release group were coded-wire tagged and adipose fin clipped. Progeny of captive broodstock matings were tagged with a unique tag code to allow future differentiation from progeny of natural broodstock.

GENETICS RESEARCH

Recent studies of Central Valley Chinook salmon have employed several molecular genetic markers, 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.

Hedgecock et al. (2001) submitted a final report to the USFWS in which they described a model that they developed to estimate the effect of artificial propagation on the effective size of the natural winter-run Chinook population. This model was used by the USFWS in 2002 and 2003. Also, Arkush et al. (2002) found that inbreeding and homozygosity at an MHC gene locus in captive-broodstock origin winter-run Chinook negatively affected their resistance to disease.

NOAA Fisheries, in collaboration with the Department, is initiating a major new study of salmon population genetics in the Central Valley (Garza 2001). This project, funded by CALFED, will provide a comprehensive assessment of genetic population structure and distribution of genetic diversity for Central Valley spring, fall, late fall, and winter-run Chinook salmon. Results of the study will be used to help guide recovery and restoration efforts. A standardized population genetic database will be established, which will integrate existing data and be adequate in both geographic coverage and size to evaluate remaining questions about genetic population structure of Central Valley Chinook. The specific population parameters provided by this database will include: (i) population boundaries and times of divergence among populations, (ii) levels of gene flow between populations, and (iii) straying rates and levels of hybridization with hatchery-raised fish. In 2002 and 2003, tissue samples were collected from winter-run Chinook for analysis in this study.

HARVEST MANAGEMENT CONSERVATION MEASURES

SACRAMENTO RIVER RECREATIONAL FISHERIES

Angling regulations adopted by the Commission in 1990 for the mainstem Sacramento River were designed to prevent harvest of upstream migrating winter-run Chinook salmon and other depleted stocks. Based on the best available data at the time these regulations were implemented, the no-retention periods for Chinook salmon in the Sacramento River were expected to cover the entire period when adult winter-run would occur in these areas.

However, data from the Department's Central Valley Salmon and Steelhead Harvest Monitoring Project indicated that a relatively high inland sport harvest of winter-run Chinook salmon may have occurred in late December 2000 and early January 2001 in the Sacramento River, immediately prior to the no-retention period for salmon. Winter-run were identified in the harvest based on recovery of coded-wire tagged hatchery-origin fish. Based on these data, the Department requested an emergency regulation change which was approved by the Commission on October 24, 2002, and went into effect on January 1, 2003.

The emergency action prohibited the retention of Chinook salmon in the Sacramento River from Bend Bridge to the Carquinez Bridge from January 1 (formerly January 15) through July 15, and in the American River from the Jibboom Street Bridge to the mouth from January 1 (formerly January 15) through July 15. This emergency regulation, with revised reach boundaries, was made permanent by the Commission on June 20, 2003 (effective date of change: August 7, 2003). Since the revised regulation went into effect, no additional coded-wire tagged winter-run

have been observed in the inland sport harvest, indicating the new regulations may be adequate to protect winter-run from inland harvest.

Current sport fishing regulations for Chinook salmon in the Sacramento River are shown below:

Reach	Open Season	Bag Limit
Sacramento River from the Deschutes Road Bridge to 500 feet upstream from Red Bluff Diversion Dam.	Jan. 15 through July 31	0 salmon
Sacramento River from the Deschutes Road Bridge to 500 feet upstream from Red Bluff Diversion Dam.	Aug. 1 through Jan. 14	2 salmon
Sacramento River from 500 feet upstream from Red Bluff Diversion Dam to 150 feet below the Lower Red Bluff (Sycamore) Boat Ramp	Closed to all fishing	
Sacramento River from 150 feet below the Lower Red Bluff (Sycamore) Boat Ramp to the Carquinez Bridge (includes Suisun Bay, Grizzly Bay and all tributary sloughs).	July 16 through Dec. 31	2 salmon
Sacramento River from 150 feet below the Lower Red Bluff (Sycamore) Boat Ramp to the Carquinez Bridge (includes Suisun Bay, Grizzly Bay and all tributary sloughs).	Jan. 1 through July 15	0 salmon

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-run Chinook is the consultation standard set out in the National Marine Fisheries Service's (NMFS) 2002 Biological Opinion (BO). The BO, which covers the 2002 and 2003 fishing seasons beginning May 1 and ending April 30, requires that commercial and recreational seasons south of Point Arena not change substantially relative to the 2000 and 2001 season. NMFS will issue a new biological opinion prior to 2004 seasons that will also specify the commercial and recreational seasons south of Point Arena. Those specifications are anticipated to be similar to those in effect since 2000.

Cohort analysis of recoveries of coded-wire tagged winter-run Chinook, produced at Livingston Stone National Fish Hatchery, indicate that ocean fishery impact rates occur primarily on recreationally-caught age 3 fish. Spawner reduction rates (the fraction of potential adult spawners killed by the fishery) are estimated to be 0.26, 0.23, and 0.24 for 1988, 1999, 2000 cohorts, respectively (Interagency Workgroup Report to the PFMC February 19, 2004).

RECREATIONAL FISHERY CONSERVATION MEASURES

In 1969, CDFG initiated a study to estimate the contribution of Sacramento River winter-run Chinook to ocean fisheries and spawning escapement (Hallock and Reisenbichler 1980, Hallock and Fisher 1985). The study utilized 720,000 wild winter-run Chinook juveniles which were captured immediately upstream from Red Bluff Diversion Dam during September and October of 1969, 1970, and 1971, marked with a fin clip and then released back to the river. Marked fish were recovered in ocean fisheries and at RBDD. Prior to the listing of winter-run Chinook in 1989, the recreational fishery off most of California had opened in mid-February and 28% of all recoveries of the fin-clipped winter-run Chinook occurred in the February and March recreational fishery. To avoid some of this early season harvest, the opening of the recreational season was delayed by two weeks in 1992 in the area south of Point Arena (San Francisco and Monterey port areas). In 1996 and 1997, NMFS issued new biological opinions for winter-run Chinook that required further reductions in winter-run Chinook mortality. In 1997, the opening of recreational fisheries south of Point Arena was delayed to reduce fishery impacts on winter-run 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-run Chinook protection. A 24-inch minimum size limit (total length) was also in effect south of Horse Mountain through May 31 (winter-run Chinook are generally smaller than abundant Central Valley fall-run 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 enacted when fishing with bait and angling by any other means than trolling, to reduce the hooking mortality of released salmon.

COMMERCIAL CONSERVATION MEASURES

Recoveries of coded wire tagged winter-run Chinook produced at Livingston Stone National Fish Hatchery indicate that commercial fisheries account for only about 25% of the ocean harvest of winter-run Chinook. Measures to control the commercial take of winter-run Chinook have included prohibitions on commercial seasons below Point Arena occurring prior to May 1 or after September 30, and increased minimum size limits. Special gear restrictions were also put into effect for commercial "mooching" similar to those required for the recreational fishery, including the use of barbless circle hooks, to reduce the mortality rate of released salmon.

FMP OBJECTIVES FOR WINTER-RUN CHINOOK AND NMFS JEOPARDY STANDARD

At the November 2001 PFMC meeting, NMFS proposed initiating an FMP amendment that would specify management objectives for Sacramento River winter-run and spring-run Chinook

stocks. The Department has been actively engaged in this effort. The interagency workgroup formed to analyze the available harvest data and develop management objective proposals delivered a progress report to the PFMC at the March 2004 meeting. The ESA consultation standards for winter-run and spring-run Chinook set out in the NMFS' 2000 and 2002 biological opinions on spring-run and winter-run Chinook are expected to be extended, with some minor modifications to the recreational season opening off San Francisco and the recreational minimum size limits prior to May 1.

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, all 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, and 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.

The CALFED ERP has awarded more than $476 million to date for more than 400 projects. Ecosystem restoration efforts continued to improve habitat and address the needs of key species in 2002 and 2003. Fish screening and passage projects received the highest level of funding compared to other project categories.

The CALFED ERP has funded the rotary screw trap monitoring program at Red Bluff Diversion Dam since 2001. This program provides valuable monitoring data on the timing and relative abundance of juvenile winter-run Chinook emigrating from the upper Sacramento River.

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. In each of fiscal years 2002 and 2003, the AFRP program provided $2.8 million in funding for restoration projects. The AFRP has funded the Upper Sacramento River winter-run Chinook carcass survey program since 2001.

NOAA FISHERIES RECOVERY PLANNING

The NOAA Fisheries initiated comprehensive recovery planning for listed salmonid species in the Central Valley in 2003. NOAA Fisheries 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, NOAA Fisheries has developed an approach, in coordination with NOAA Fisheries' Northwest Region, which is tailored to California recovery planning issues.

The 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, and Central Valley steelhead.

NOAA Fisheries appointed a Central Valley Technical Recovery Team (TRT) to begin the recovery planning process in 2003, including two representatives from the Department. The team is 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, NOAA Fisheries 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 Chinook

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. Identification of winter-run Chinook at the water project diversions is based on a size-at-date criterion. If the take reaches the latter level, re-initiation of consultation under the ESA is mandatory.

For the period October 2001 through May 2002, the incidental take limit (red light) was set at 39,823 juveniles. Juvenile winter-run were lost at the Delta facilities from early December through late April 2002 (Figure 2). Peak losses occurred in early January and again in early March. The cumulative winter-run Chinook loss for the season was 3,338, well below the authorized incidental take limit.

For the period October 2002 through May 2003, NOAA Fisheries established a yellow light level of 21,367 juveniles and a red light limit of 42,735. Juvenile winter-run were lost at the Delta facilities from mid-December through early May (Figure 3), with peak losses occurring in late December and again in early March. The cumulative winter-run Chinook loss for 2002-2003 was 6,816, again well below the incidental take limit.

In early January 2002, high losses of older juvenile Chinook (winter-run and spring-run) coincided with a high loss of adult delta smelt, triggering an export curtailment at the SWP facility for several days for fishery protection. Again from December 27, 2002 through January 2, 2003, a curtailment was made at the SWP facility to reduce entrainment losses of older juvenile Chinook.

The Delta Cross Channel (DCC) gates can be closed for up to 45 days in the November through January period to prevent juvenile salmon from entering the DCC from the Sacramento River and passing into the interior Delta, where their survival is relatively poor. The gates also are closed when high river flow can cause scouring and increased flood risk. In 2001, the DCC gates were closed on November 21 for fish protection. With the exception of a five-day period, the gates remained closed through January 2002. In late 2002, the DCC gates were closed on December 3, and with the exception of a six-day period, remained closed through the end of January 2003. The DCC gates are always closed from February 1 through May 20.

COLEMAN NATIONAL FISH HATCHERY RE-EVALUATION

The USFWS is continuing to comprehensively monitor and evaluate hatchery propagation programs at the Coleman and Livingston Stone National Fish Hatcheries. Since 1999, a key process used by the USFWS for soliciting input from agencies and stakeholders about potential hatchery impacts has been the Hatchery Reevaluation Process. A primary goal of the Reevaluation Process is to integrate operations at the Coleman National Fish Hatchery with the proposed Battle Creek Salmon and Steelhead Restoration Project. To date, substantial progress has been made through the Reevaluation Process, leading to the development and analysis of several alternative strategies for operating the hatchery facilities. To address outstanding biological uncertainties related to operating a large-scale mitigation facility in a watershed

targeted for restoration of natural salmonid populations, the USFWS is continuing to work with agencies and stakeholders and plans to develop a Hatchery Adaptive Management Plan (HAMP). The Department will continue to work with the USFWS, other agencies, and stakeholders through the development of the HAMP.

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. Monitoring the effectiveness of these screens continued in 2002 and 2003.

ANDERSON-COTTONWOOD IRRIGATION DISTRICT FISH LADDER AND SCREEN

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. Post-project monitoring at the ACID restoration project indicates the new screen and ladders are operating effectively.

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 2004. Construction will begin in 2005. The total project cost exceeds $70 million, of which $50 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. Over the last decade, the U.S. Environmental Protection Agency (EPA) Superfund Program 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 completed construction of 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. There were no significant exceedances of dissolved metal concentrations in the Sacramento River in 2002 and 2003.

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. The Trustee council has funded certain conservation activities in Battle Creek.

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, NOAA Fisheries, 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 2002 and 2003, 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. Pursuant to the 1993 Biological Opinion, the 2002 compliance point to meet the 56 degree F temperature criteria for spawning and egg incubation was set at Jellys Ferry on the upper Sacramento River. Data from the winter-run Chinook aerial redd surveys in 2002 showed only one winter-run Chinook redd occurring downstream of Jellys Ferry. Very low egg loss due to temperature induced mortality therefore occurred in the 2002 brood year.

The 2003 compliance point to meet the 56 degree F criteria was set at Bend Bridge on the upper Sacramento River. Data from the 2003 winter-run Chinook aerial redd survey showed only three redds occurring downstream of the compliance point. Very low egg loss due to elevated water temperatures therefore occurred in 2003.

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 more than 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, the dam gates have been raised seasonally 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 congregation of predatory fish below the dam.

An environmental document was completed to evaluate alternatives to provide safe passage of adult and juvenile anadromous fish at RBDD while providing a reliable water supply for agriculture. Alternatives under consideration included various sizes of screened bankside pumping plants and various periods of gate closures. Three feasible alternatives included 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 USBR did not select an alternative from among those in the environmental document, leaving the existing operation in place at the dam. The USBR may consider selecting an alternative after completion of a new Biological Opinion for Central Valley Project operations which includes RBDD. 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 2003.

Year	Grilse	Adults	Total	Year	Grilse	Adults	Total
1967	24,985	32,321	57,306	1986	496	2,101	2,596
1968	10,299	74,115	84,414	1987	277	1,909	2,186
1969	8,953	108,855	117,808	1988	1,008	1,878	2,886
1970	8,324	32,085	40,409	1989	125	571	696
1971	20,864	32,225	53,089	1990	43	387	430
1972	8,541	28,592	37,133	1991	19	192	211
1973	4,623	19,456	24,079	1992	80	1,160	1,240
1974	3,788	18,109	21,897	1993	137	250	387
1975	7,498	15,932	23,430	1994	124	62	186
1976	8,634	26,462	35,096	1995	29	1,268	1,297
1977	2,186	15,028	17,214	1996	629	708	1,337
1978	1,193	23,669	24,862	1997	352	528	880
1979	113	2,251	2,364	1998	924	2,079	3,002
1980	1,072	84	1,156	1999	2,466	822	3,288
1981	1,744	18,297	20,041	2000	789	563	1,352
1982	270	972	1,242	2001	3,827	1,696	5,523
1983	392	1,439	1,831	2002	1,555	7,614	9,169
1984	1,869	794	2,663	2003	3,585	6,172	9,757
1985	329	3,633	3,962				

Table 2. Estimated Redd Distribution of Winter-run Chinook Salmon on the Sacramento River by DFG Aerial Counts.

RIVER REACH	2002		2003	
	No.	%	No.	%
Keswick Dam to Anderson Cottonwood Irrigation District (ACID) Dam	**297**	**48.7**	**578**	**65.8**
ACID Dam to Highway 44 Bridge	**134**	**22.0**	**151**	**17.2**
Highway 44 Bridge to Airport Road Bridge	**168**	**27.5**	**143**	**16.3**
Airport Road Bridge to Balls Ferry Bridge	**7**	**1.1**	**3**	**0.3**
Balls Ferry Bridge to Battle Creek	**3**	**0.5**	**0**	**0.0**
Battle Creek to Jellys Ferry Bridge	**0**	**0.0**	**0**	**0.0**
Jellys Ferry Bridge to Bend Bridge	**0**	**0.0**	**0**	**0.0**
Bend Bridge to Red Bluff Diversion Dam	**0**	**0.0**	**0**	**0.0**
Red Bluff Diversion Dam to Tehama Bridge	**1**	**0.2**	**3**	**0.3**
Estimated Total Number of Redds	**610**		**878**	

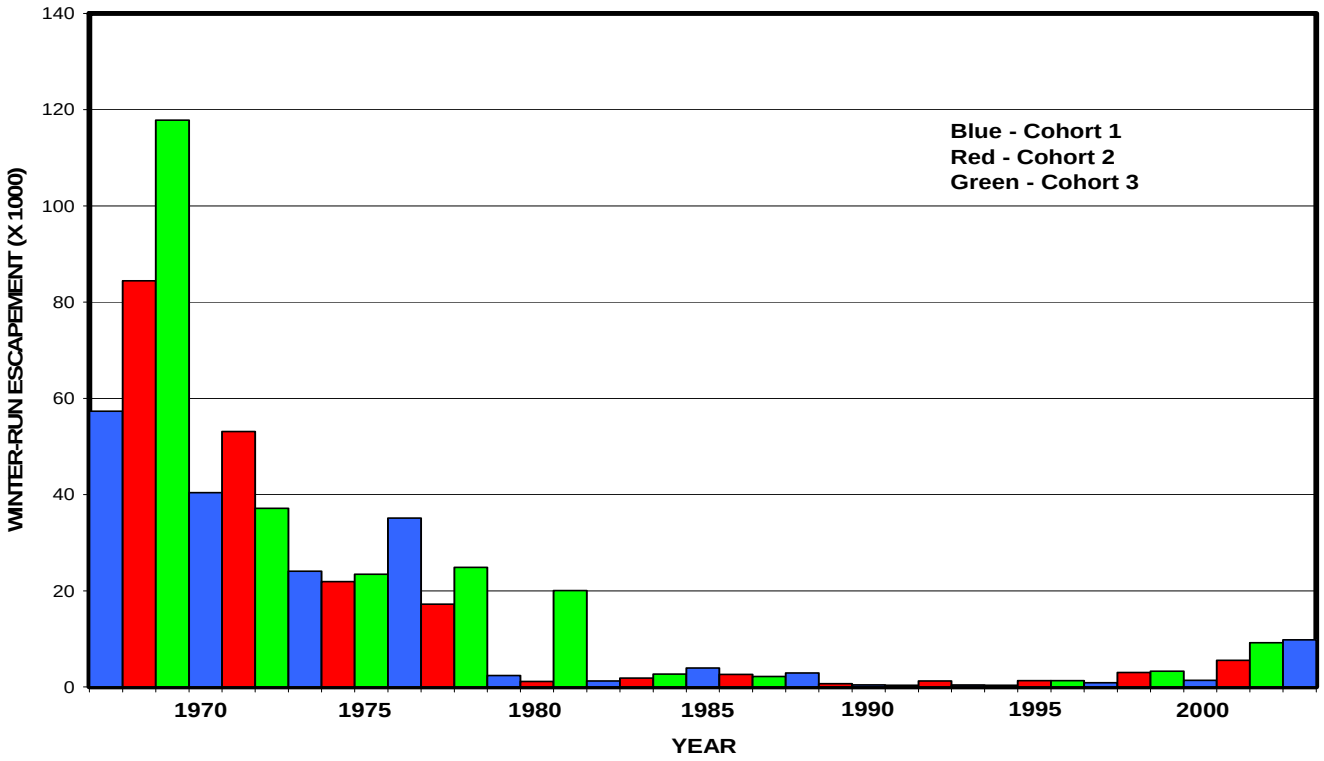

Figure 1. Winter-run Escapement Estimates Based on Red Bluff Diversion Dam Counts, 1967- 2003.

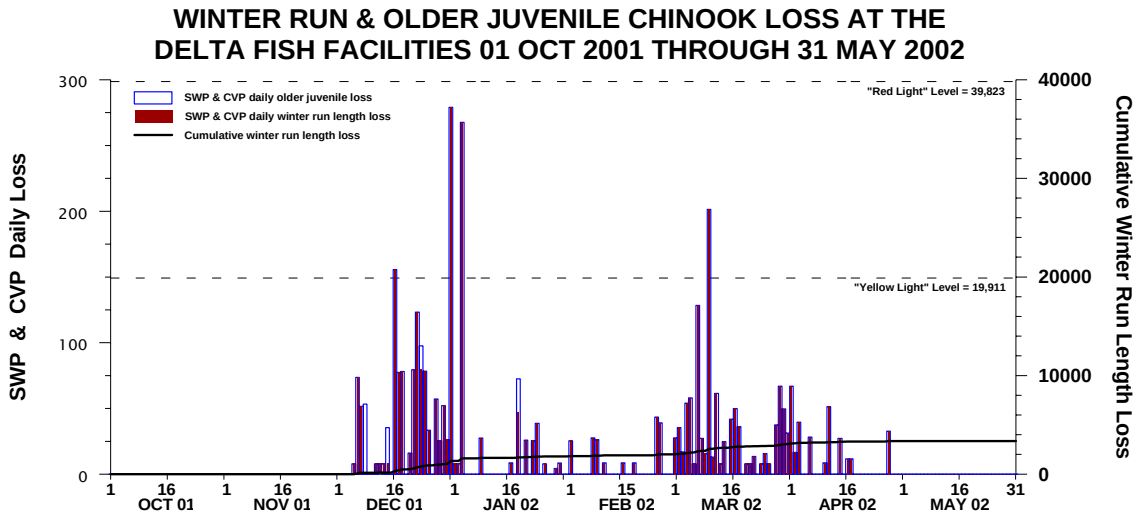

Figure 2. Juvenile Winter-run Loss at the CVP and SWP Delta Facilities, October 2001 – May 2002.

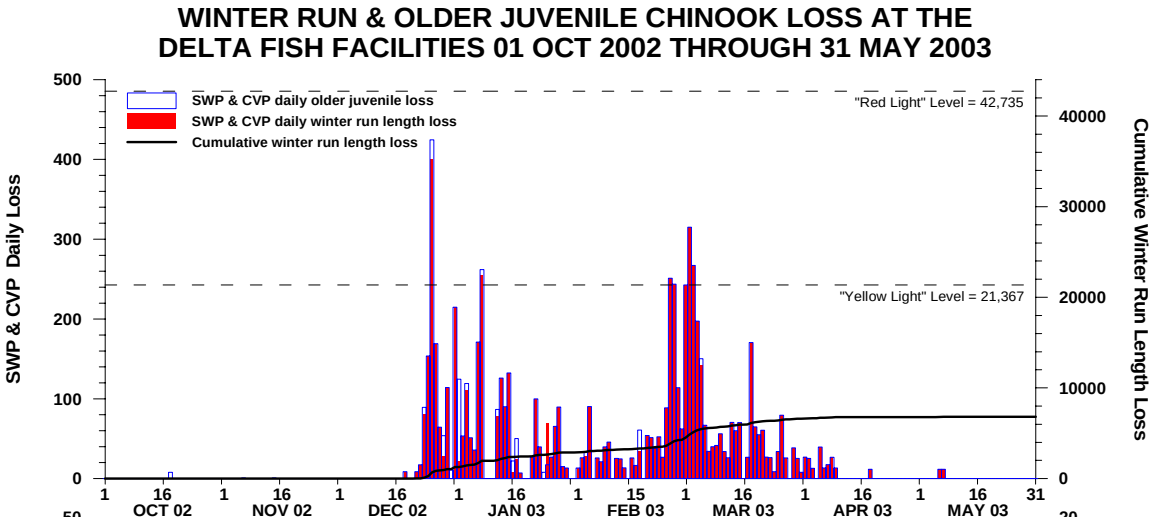

Figure 3. Juvenile Winter-run Loss at the CVP and SWP Delta Facilities, October 2002 – May 2003.

REFERENCES

Arkush, K.D., A.R. Giese, H.L. Mendonca, A.M. McBride, G.D. Marty, and P.W. Hedrick. 2002. Resistance to three pathogens in the endangered winter-run Chinook salmon (*Oncorhynchus tshawytscha*): effects of inbreeding and major histocompatibility complex genotypes. Can. J. Fish. Aquat. Sci. 59: 966-975.

Banks, M.A., V.K. Rashbrook, M.J. Calavetta, C.A. Dean, and D. Hedgecock. Analysis of microsatellite DNA resolves genetic structure and diversity of Chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. 2000. Canadian Journal of Fisheries and Aquatic Sciences 57: 915-927.

Bartley, D., B. Bentley, J. Brodziak, R. Gomulkiewicz, M. Mangel, and G.A.E. Gall. 1992. Geographic variation in population genetic structure of Chinook salmon from California and Oregon. U.S. National Marine Fisheries Service Fishery Bulletin 90:77-100 (authorship amended per errata, Fishery Bulletin 90[3]:iii).

Garza, J. C. 2001. Comprehensive assessment of genetic population structure and diversity for Central Valley Chinook salmon. Research proposal to CALFED.

Hallock, R.J. and F.W. Fisher. 1985. Status of winter-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River. Calif. Dept. of Fish and Game, Anad. Fish. Br., Office Rept., January 25, 1985. 28 pp.

Hallock, R.J. and R.R. Reisenbichler. 1980. Freshwater and ocean returns of marked winter-run and late fall-run Chinook salmon, *Oncorhynchus tshawytscha*, from the Sacramento River. Calif. Dept. of Fish and Game, Anad. Fish. Br., Office Rept. September 15, 1980. 9 pp.

Hedgecock, D., M. Banks, V. Rashbrook, H. Fitzgerald, S. Sabatino, D. Churikov, W. Eichert, and P. Hedgecock. 2001. Genetic maintenance of hatchery and natural origin winter-run Chinook salmon. Anadromous Fish Restoration Program Cooperative Agreement between U.C. Davis and USFWS, 1998-2001. Final Report.

Kim, T.J., K.M. Parker, and P.W. Hedrick. 1999. Major histochemical complex differentiation in Sacramento River Chinook salmon. Genetics. 151:1115-1122.

Myers, J.M., and ten coauthors. 1998. Status Review of Chinook salmon from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-35.

National Marine Fisheries Service. 1997. Proposed recovery plan for the Sacramento River winter-run Chinook salmon. Southwest Region, Long Beach, CA. August 1997.

Nielsen, J.L. 1995. Mitochondrial DNA Frequency Distributions in Chinook Salmon from the Sacramento-San Joaquin Basin and Guadalupe River 1992-1994. Report to California Department of Fish and Game.

Nielsen, J.L., M.C. Fountain, D.R. Sundermeyer, E.L. Heine, C.L. Malone, and O.L. Avelino. 1999. Microsatellite Variation in Chinook Salmon Spawning Runs from the Central Valley, California, 1992-1997. Report to California Department of Fish and Game.

Snider, B., B. Reavis, and S. Hill. 2002. Upper Sacramento River Winter-run Chinook Salmon Escapement Survey, May-August 2001. California Department of Fish and Game, Stream Evaluation Program Technical Report No. 02-1.

Snider, B., B. Reavis, and S. Hill. 2001. Upper Sacramento River Winter-run Chinook Salmon Escapement Survey, May-August 2000. California Department of Fish and Game, Stream Evaluation Program Technical Report No. 01-1.

Snider, B., B. Reavis, S. Hill. 2000. 1999 upper Sacramento River winter-run Chinook salmon escapement survey May – August 1999. Stream Evaluation Program Technical Report No. 00-1. California Department of Fish and Game, Habitat Conservation Division, Sacramento, CA.

Snider, B., B. Reavis, S. Hill. 1999. 1998 upper Sacramento River winter-run Chinook salmon escapement survey May – August 1998. California Department of Fish and Game, Water and Aquatic Habitat Conservation Branch, Sacramento, CA.

Snider, B., B. Reavis, S. Hill. 1998. 1997 upper Sacramento River winter-run Chinook salmon escapement survey April – August 1997. California Department of Fish and Game, Environmental Services Division, Sacramento, CA.

Snider, B., B. Reavis, S. Hamelberg, S. Croci, S. Hill, and E. Kohler. 1997. 1996 upper Sacramento River winter-run Chinook salmon escapement survey. California Department of Fish and Game, Environmental Services Division, Sacramento, CA.