The Bay Institute

Protecting and Restoring San Francisco Bay from the Sierra to the Sea

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October 27, 2004

Arthur G. Baggett, Jr., Chair
State Water Resources Control Board
P. O. Box 100
Sacramento, CA 95812-0100

RE: BAY-DELTA PLAN PERIODIC REVIEW

Dear Mr. Baggett,

This letter is submitted as the opening comments of the Bay Institute regarding Topics 2 (Delta Cross Channel gates closure) and 3 (Salmon protection objective) for the State Water Resources Control Board's (SWRCB) public workshops to consider potential amendments or revisions of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan).

We recommend that the SWRCB consider the following amendments and revisions to the Bay-Delta Plan:

1. Allow up to 15 additional days of closure of the Delta Cross Channel gates between November 1 and January 31.

2. Adopt quantitative salmon doubling objectives for each Chinook salmon run, each basin (e.g., Sacramento and San Joaquin), and each salmon-producing stream.

3. Quantify the narrative salmon doubling objective in terms of "in-river escapement," measured as multi-year average return ratios for each run, basin and stream.

In addition, the SWRCB should consider the following actions to support attainment of the narrative salmon protection objective:

4. Revise permit requirements for operation of Red Bluff Diversion Dam.

5. Review and revise the current minimum flow requirements on the salmon-producing tributaries of the Sacramento and San Joaquin Rivers.

6. Enforce compliance with the dissolved oxygen objective, and require the release of additional flows during periods when this objective is not being met and salmonids are present.

Revising the objectives for San Joaquin River flow at Vernalis and export limits at the Central Valley Project and State Water Project pumping facilities is also important for attaining the narrative salmon protection objective. We will offer specific recommendations on these revisions in commenting on Workshop Topics 6, 8 and 9. We may also provide additional comments on Workshop Topics 2 and 3 following the workshops.

Workshop Topic 2: Delta Cross Channel gates closure

Issue: Is new information available regarding the effects of operation of the Delta Cross Channel gates? Should the SWRCB amend the Delta Cross Channel Gates Closure Objective in the Water Quality Objectives for Fish and Wildlife Beneficial Uses (Table 3 of the 1995 Plan)? How should the objective be modified and what are the scientific and legal arguments in support of and against such modifications?

Discussion: The Delta Cross Channel (DCC) connects the mainstem Sacramento River to the Mokelumne River. When the DCC gates are open, nearly the entire flow of the Sacramento River flows through the DCC during flood tides (J. Burau, U.S. Geological Survey, results reported in Brown and Kimmerer, 2003). Under these conditions, a large proportion of the juvenile salmon in the river in the vicinity of the DCC are diverted into the DCC and central Delta, where numerous mark/recapture studies indicate that their survival is reduced. Recent analyses for juvenile winter-run Chinook salmon, which migrate through the lower Sacramento River and into the Delta during the winter, indicate that the proportion of the population (measured as the juvenile production estimate) that is lost at the CVP and SWP Delta export facilities is higher when the DCC gates are open during the month of December (A. Low, Department of Fish and Game, results reported in Brown and Kimmerer, 2003). The 1995 WQCP limits closure of DCC gates to a period of up to 45 days between November 1 and January 31. In practice, in most years in which Sacramento River flows are <20,000 cfs, the gates remain open some or all of the month of December. Given the 45-day limitation, closures are usually reserved for later in the season.

Recommendation: The SWRCB should amend the 1995 objective for operation of the DCC gates to allow for up to 15 additional days of closure between November 1 and January 31 in order to improve survival of winter-run Chinook salmon and other juvenile fish in the Delta. The additional days will allow for more complete protection throughout December and January, when risks to juveniles are likely to be higher.

Workshop Topic 3: Salmon protection objective

Issue: Should the State Water Resources Control Board (SWRCB) amend the narrative Salmon Protection Objective in the Water Quality Objectives for Fish and Wildlife Beneficial Uses for the San Francisco Bay / Sacramento San Joaquin Delta Estuary? How should the value or description be modified and what are the scientific and legal arguments in support of and against such modifications?

The narrative Salmon Protection Objective (from Table 3, Water Quality Objectives for Fish and Wildlife Beneficial Uses, 1995 Plan) states: "*Water quality shall be maintained, together with other measures in the watershed, sufficient to achieve doubling of natural production of Chinook salmon from an average production of 1967-1991, consistent with the provisions of State and federal law.*"

Background: In December 2001, the SWRCB convened a workshop to review the narrative salmon protection objective). At that workshop, information was presented on: 1) how the objective should be defined and quantitatively measured; 2) progress towards doubling salmon populations within the watershed, including information indicating that the objective had not been met for most Chinook salmon runs in most streams in both the Sacramento and San Joaquin basins; and 3) the status of ongoing and planned habitat restoration programs, fish protection, and water management reforms that are intended to improve ecosystem conditions and increase salmon population abundance. In January 2002, the SWRCB concluded, "more time was needed to determine whether measures currently in place and in progress will meet the narrative objective".

As of this year (2004), the SWRCB narrative objective has been in place for nine years, a period equivalent to approximately three generations of Chinook salmon. Some of the habitat restoration efforts discussed at the 2001 workshop (e.g., gravel augmentation, barrier removal, fish screen installation) have been in place for an even longer period. Others have not yet been implemented (e.g., the CALFED Bay-Delta Program Environmental Water Program) and several important environmental water management tools have not been fully utilized (see discussion of "(b)(2) water" below). During this period, comprehensive data on salmon population size (measured as adult escapement for nearly all salmon producing streams in the watershed), upstream and in-Delta flow and water quality conditions, and, for certain rivers and the Delta, survival rates of outmigrating juvenile salmon have continued to be measured and reported. Our review and analyses of these data indicate that: 1) the salmon doubling objective is not being met for most runs in most streams in both basins; and 2) progress toward increasing salmon populations has slowed and, in a number of cases, reversed. It is likely that the factors within the watershed that influence salmon population trends differ among the runs, basins, and streams, but, in most cases, it appears that both upstream and in-Delta conditions are inadequately protective of the fish and not sufficient to promote achievement of the doubling objective. In addition, proposed changes in water management and infrastructure operations within the watershed are predicted to increase the adverse impacts of these operations on salmon populations (USBR, 2004).

A. Should the objective of doubling natural production of Chinook salmon be retained?

The SWRCB's objective for doubling salmon populations in the Bay-Delta estuary from average levels measured during the 25-year period of 1967-1991 is essentially the same as that required by the federal Central Valley Project Improvement Act of 1992 (CVPIA). By basing the objective on relatively recent salmon population counts, the SWRCB (and the Congress) recognized that salmon populations throughout the watershed had already declined substantially from historical levels, the result of habitat degradation from mining, dam construction and operation, and water diversion (Yoshiyama et al., 1998). Further, quantitative data that had been regularly collected by local, state, and federal agencies for the last half century indicated that while the decline had likely slowed for at least some runs it had not been reversed; Central Valley salmon populations were not stable, commercial and sport harvest were declining, and adverse instream and estuarine conditions were preventing recovery of the stocks.

For example, average escapement numbers from the 1967-1991 period for fall-run Chinook salmon were 37% lower in the Sacramento basin and 26% lower in the San Joaquin basin than the averages measured during the 15-year period immediately prior to that (i.e., 1952-1966). For two other Sacramento basin Chinook salmon runs, the winter and late fall runs, population size declined significantly during the 1967-1991 period (linear regression, $p<0.01$, both runs), effectively reducing the average value upon which the doubling objective is based.

Because average escapements measured during the 1967-1991 period reflected depressed and declining populations, establishing a salmon population objective that was greater than those average numbers was essential to ensure sufficient efforts were made to protect and support the watershed's salmon fishery. During the 1967-1991 period, instream and estuarine conditions were inadequate to provide for protection and support of salmon populations. Achievement of the objective to double salmon populations from the numbers measured during that period on a sustainable and long-term basis will require actions to improve instream and estuarine conditions to the levels that are needed to restore this beneficial use of water resources in the watershed.

Recommendation: The objective of doubling natural Chinook salmon production is reasonable and should not be amended. Restoration on a continuing, long-term basis of salmon populations to levels that are twice the average levels measured following and during a period of population decline is a strong indicator that instream and estuarine flow and water quality conditions are sufficient to support the fish and wildlife beneficial use.

B. Should the SWRCB measure attainment of the salmon protection objective on a stream-specific or basin-wide basis?

Each of the four runs of Chinook salmon in the Bay-Delta estuary is genetically distinct and, with a few exceptions (resulting from poor hatchery management practices and habitat constriction from dams), reproductively isolated both spatially and temporally. In addition, there are at least two and possibly three genetically distinct populations of spring-run Chinook salmon within the Sacramento basin (Lindley et al. 2004). According to NOAA Fisheries, in addition to adequate population size (abundance) and population growth (see below), viable salmonid populations (i.e., those for which the risk of extinction is very low) require genetic, phenotypic, and geographic diversity (McElhany et al., 2000). Salmon populations with low genetic diversity and/or those restricted one or a small number of streams (such as winter- and spring-run Chinook salmon) are "perilously close to extirpation" (Lindley et al. 2004). Therefore, maintaining the genetic, phenotypic, and geographic diversity of Chinook salmon within the watershed is an important species protection and management objective. Quantitative salmon population objectives that fail to incorporate information on diversity and spatial structure would be biologically meaningless for Sacramento-San Joaquin watershed Chinook salmon.

Recommendation: In order to protect the critical importance of genetic, phenotypic, and geographic diversity for salmon populations, the SWRCB should adopt quantitative salmon doubling objectives for each Chinook salmon run, each basin, and each salmon-producing stream.

C. How should the SWRCB measure attainment of the salmon protection objective?

The narrative salmon doubling objective is defined in the Bay-Delta Plan as two times the average salmon population(s) measured during the 1967-1991 period. In 1995, the U.S. Fish and Wildlife Service (USFWS) published quantitative doubling goals for each of the four runs of Chinook salmon present in the watershed (fall, late fall, winter, and spring runs), for each major basin (e.g., Sacramento and San Joaquin basins), and for all salmon-producing streams within those basins (USFWS, 1995). As specified by the CVPIA's requirements to double "natural production" of salmon populations, these quantitative goals defined natural production to include ocean and in-river harvest as well as the numbers of fish that returned to spawn in the rivers. However, monitoring data for ocean and, to a lesser extent, in-river harvest are difficult to precisely attribute to individual runs, basins, or streams. Therefore, it may be easier and (for the purpose of identifying, monitoring, and evaluating the effects of localized and regional habitat restoration, water management reforms, and water quality improvements) more appropriate to define the doubling goal in terms of "in-river escapement". In-river escapement is the number of adult fish that return to spawn in the river; it does not include the number of fish that return to the river but are collected and spawned in hatcheries.

Recommendation: The SWRCB should quantify the narrative salmon doubling objective in terms of "in-river escapement", which is measured every year in nearly all salmon-producing rivers and streams in the watershed. The doubling objectives should be set at two times the 1967-1991 average in-river escapements.

The Chinook salmon life span ranges from two to five years (average: 3 years). Therefore, annual escapement counts measure, on average, only one third of the total Chinook salmon population. A change in escapement from one year to the next does not necessarily reflect a trend of increasing or decreasing population. Salmon population growth (or decline) should be measured over multiple years by comparing the number of adults that return to spawn in a river to the number of adult fish that produced them, a measure referred to as the "return ratio" or "cohort replacement rate". Assuming an average 3-year life span, the return ratio can be calculated as:

Return ratio = $(\text{escapement}_{yi+3}/\text{escapement}_{yi})$
Where:
escapement_{yi} is the number of adults returning to the river in a given year;
escapement_{yi+3} is the number of adults returning to the river 3 years later.

A return ratio that is less than 1.0 indicates the population is declining while a return ratio greater than 1.0 indicates population growth. The return ratio can be a useful approach for comparing relative production among different runs, basins and streams. It can be used to guide evaluation of effectiveness of past and ongoing habitat restoration and fish protection efforts, and to help identify for each run, basin, and stream whether there are needs for additional measures to achieve the doubling objective.

Recommendation: The recommended use of escapement numbers by the SWRCB to measure attainment of the salmon protection objective should be based on multi-year averages, e.g., a three- or six-year running average, rather than annual counts. Evaluation of salmon population status and progress towards population doubling should include calculation and analysis of return ratios for each run, basin, and salmon-producing stream.

D. Has the salmon protection objective been attained?

Sacramento Basin fall run: During the 1967-1991 period, fall-run Chinook salmon spawned in a >50-mile reach of the mainstem Sacramento River and in more than 25 tributary streams (USFWS, 1995). During the most recent six-year period (1998-2003), fall-run Chinook salmon have been counted on fewer than half of those Sacramento River tributaries (data from California Department of Fish and Game, "Grandtab", April 2004; and P. B. Moyle, University of California, Davis, for Putah Creek). Compared to the 1967-1991 period, production of fall-run Chinook salmon has declined in the mainstem, with recent escapement (1998-2003 average) at 48% of the doubling objective, and increased in the tributaries, with recent escapement at 177% of the doubling goal (Table 1). However, tributary stream production of fall-run Chinook salmon production has been concentrated in just three large streams, the Feather and American Rivers and Battle Creek, which produced more than 75% of these fish. In addition, the Sacramento basin fall-run Chinook salmon population is also heavily supported by hatchery production; the proportion of fish returning to spawn naturally in the rivers that are progeny of hatchery spawned fish is unknown.

Table 1. Comparison of natural, or "in-river", escapements of fall-run Chinook salmon in the Sacramento River mainstem and tributaries with the doubling objectives.

Sacramento Basin Fall-run Chinook salmon	**Escapement** (1998-2003 average)	**Objective** (2 x 1967-1991average in-river escapement)	**% of Objective**	**Trends** (past 6 years)
Mainstem	74,186	152,536	48%	Variable
Tributaries	356,187	201,167	177%	Increase

Until the last few years, the total Sacramento basin fall-run Chinook salmon population has remained stable (Figure 1). The population declined during the 1987-1992 drought but has since rebounded in both the mainstem river and major tributaries. Average total fall-run Chinook salmon escapement over the most recent six-year period is 122% of the doubling goal.

Sacramento Basin late-fall run: This run is restricted to the mainstem Sacramento River and to Battle Creek, although in the 1980s they were observed in several smaller tributaries and the Feather River. All of the fish collected that enter Battle Creek and, until recently, some of the fish from the mainstem river above the Red Bluff Diversion Dam (RBDD) spawned in the Coleman National Fish Hatchery. The population declined by half during the 1970s and has remained moderately stable since then (Figure 2). During the most recent six-year period, the population fluctuated but averaged just 55% of the doubling objective (Table 2)

Table 2. Comparison of natural, or "in-river", escapement of late fall-run Chinook salmon in the Sacramento basin with the doubling objective.

Sacramento Basin Late fall-run Chinook salmon	**Escapement** (1998-2003 average)	**Objective** (2 x 1967-1991average in-river escapement)	**% of Objective**	**Trends** (past 6 years)
Mainstem and Tributaries	17,032	30,895	55%	Variable or decline

<u>Sacramento Basin winter run</u>: The winter run historically spawned in Sacramento River tributaries upstream of the present location of Shasta Dam (Moyle, 2002). Closure of the dam in the 1940s restricted the winter run to a 40-mile reach of the mainstem Sacramento River immediately downstream of Keswick Dam, where reservoir releases maintained the cool water temperatures required by the fish. The winter-run Chinook salmon population declined throughout the 1970s and was nearly extirpated when low flows and intolerably high water temperatures during two consecutive years (1976 and 1977) killed virtually all incubating eggs. Two cohorts of the run were wiped out, as evidenced by extremely low escapement measured three years later (1979 and 1980, Figure 3). By the late 1980s, the winter-run Chinook salmon population had dwindled to just a few hundred fish and, beginning in 1989, the run was listed under both state and federal Endangered Species Act, first as threatened and then as endangered. The 1993 Biological Opinion for U.S. Bureau of Reclamation's Central Valley Project operations on the upper Sacramento River (NMFS, 1993) required a number of water management and operational reforms, including flow releases to maintain cool water temperatures, minimum end-of-year carryover storage to protect the run during multi-year dry periods, and re-operation of Red Bluff Diversion Dam (RBDD) to allow passage of upmigrating adult fish. The SWRCB had earlier also required flow releases to maintain cool water temperatures in the river (Water Rights Orders 90-05 and 91-01).

As a result of these improvements (as well as favorable ocean conditions), the winter-run Chinook salmon population has been increasing since the early 1990s (Figure 3). However, total population size, measured for the most recent six-year period (1998-2003), is just 12% of the doubling objective (Table 3). In addition, preliminary estimates for 2004 escapement and juvenile production (reported to the CALFED Data Assessment Team, Oct. 12, 2004) suggest that the population growth observed during the past decade has slowed and may be reversing (see Figure 3).

Table 3. Comparison of natural, or "in-river", escapement of winter-run Chinook salmon in the Sacramento River with the doubling objective.

Sacramento Basin **Winter-run Chinook salmon**	**Escapement** (1998-2003 average)	**Objective** (2 x 1967-1991average in-river escapement)	**% of Objective**	**Trends** (past 6 years)
Mainstem and Tributaries	5683	46,114	12%	Increase

<u>Sacramento Basin spring run</u>: Like the winter run, spring-run Chinook salmon have been blocked from their historical upper watershed spawning areas. The run now spawns in the mainstem Sacramento River and several smaller tributary streams (principally the Feather River, and Mill, Deer, Butte Creeks). After two decades of moderate stability, with escapement averaging >10,000 fish and most fish returning to the mainstem Sacramento River, the populations on all streams declined during the late 1980s and early 1990s (Figure 4). Since then there have been increases in the tributary populations, including one large cohort returning to Butte Creek, but the mainstem Sacramento River population has continued to decline. In 2003, no spring-run Chinook salmon were counted on the Sacramento River. During the most recent six-year period, escapement to the tributary streams was 280% of the doubling goal set for those streams (Table 4), however this measurement was driven largely by several extremely large returns to Butte Creek. In contrast, the Sacramento River population may be close to extirpation with recent average escapement just 3% of the doubling objective. For the total spring-run Chinook salmon population, 1998-2003 average escapement is 48% of the doubling objective.

Table 1. Comparison of natural, or "in-river", escapements of spring-run Chinook salmon in the Sacramento River mainstem and tributaries with the doubling objectives.

Sacramento Basin **Spring-run Chinook salmon**	**Escapement** (1998-2003 average)	**Objective** (2 x 1967-1991average in-river escapement)	**% of Objective**	**Trends** (past 6 years)
Mainstem	561	20,601	3%	Decline
Tributaries (all)	11,195	3,986	280%	Variable
Butte Creek	8,474	762	1112%	Variable
Deer Creek	1,179	2,824	63%	Increase
Mill Creek	942	1,697	55%	Increase

<u>San Joaquin Basin Fall Run</u>: Historically, the San Joaquin basin supported both fall-run and spring-run Chinook salmon. The spring run was extirpated from the basin in the 1940s and 1950s, the result of dam construction and inadequate river flows (Moyle, 2002). Today, fall-run Chinook salmon regularly return to only

four of the seven historical salmon-producing streams: the Mokelumne, Stanislaus, Tuolumne, and Merced Rivers. Since the early 1950s, fall-run Chinook salmon populations in the basin have fluctuated dramatically, exceeding 50,000 fish in some years and falling to a few hundred fish in other years (Figure 5). During the most recent six-year period, average total escapement was 54% of the doubling goal (Table 5). The San Joaquin basin fall run has experienced several multi-year periods of negative growth (i.e., return ratio<1.0) (Figure 5). The return ratio has been declining for the past nine consecutive years and fell below 1.0 in 2003.

San Joaquin Basin Fall-run Chinook salmon	**Escapement** (2001-2003 average)	**Objective** (2 x 1967-1991average in-river escapement)	**% of Objective**	**Trends** (past 6 years)
All	23,074	42,334	54%	Variable
Mokelumne	2,568	5,696	45%	Decline
Stanislaus	6,468	9,471	68%	Variable
Tuolumne	8,703	17,802	49%	Decline
Merced	5,751	8,706	66%	Increase

<u>E. What additional actions should the SWRCB consider to support attainment of the salmon protection objective?</u>

Survival and successful reproduction of Chinook salmon in the Bay-Delta estuary are affected by many factors, both anthropogenic and natural (Moyle, 2002). Several key factors are briefly described below.

<u>Barriers</u> to migration of adult and juvenile fish, including physical barriers such as dams, weirs, gates, and culverts, and environmental barriers such as inadequate water depth and intolerable water quality conditions (e.g., high temperature, low dissolved oxygen). Barriers can prevent or delay the adult fish from reaching upstream spawning areas and juvenile fish from reaching the ocean.

<u>Lethal and/or harmful water quality conditions</u> in spawning and rearing habitat and/or migration corridors. Early life stages with no or limited mobility (e.g., eggs and fry) are the most vulnerable but there are also numerous examples for adverse effects on older juveniles and adults. Elevated water temperature, low dissolved oxygen, and toxic pollutants are the most common lethal water quality conditions and these conditions are frequently related to low stream flows. Even sublethal levels of these factors are harmful, causing physiological stress, increased metabolic costs, and reduced disease resistance (e.g., as occurred in the lower Klamath River in 2002; USFWS, 2003).

Entrainment of juveniles at unscreened or inadequately screened water diversions. Most of the thousands of water diversions in the watershed are unscreened and, with the exception of the state and federal facilities in the Delta, the numbers of fish entrained are not monitored. The state and federal water project facilities in the Delta do not meet present fish screen criteria (NMFS, 1997; CDFG, 2000) and their design and operation are thought to promote extremely high predation rates on juvenile salmon (Gingras, 1997).

Predation on juvenile salmon in the rivers, estuary, and the ocean. In the watershed, high predation rates are often associated with artificial structures (e.g., Red Bluff Diversion Dam, Clifton Court Forebay) and stream alteration (e.g., gravel pits). Today, most predators are non-native, warm water fish species that thrive in river and estuarine habitats degraded by reduced flow, elevated water temperatures, and physical alterations.

Loss of floodplain, wetland, riparian, and tidal marsh habitat. Juvenile salmon use these habitats as both rearing habitat and migration corridors.

Ocean and in-river harvest of adult fish. Between 1970 and 1985, ocean harvest rates calculated for Sacramento-San Joaquin fall-run Chinook salmon by the Pacific Fisheries Management Council were approximately 60%. Since 1995, both total landings and harvest rate have declined somewhat (PFMC, 2003).

In order to address these factors, a number of habitat restoration (e.g., barrier removal; gravel augmentation), water management reforms (e.g., minimum in-stream flow and reservoir carryover storage requirements; salmon doubling stream flows recommended by the CVPIA Anadromous Fish Restoration Program, [AFRP]; use of CVPIA "(b)(2)" water to enhance stream flows and mitigate export impacts), and fish protection projects (e.g., fish screen installation; Environmental Water Account) have been proposed, planned, and/or implemented during the past two decades. In combination with the SWRCB's water quality objectives for the Delta, these projects are intended to address many of the factors described above and to promote doubling of salmon populations. Based on our analysis of current salmon population status and trends, these programs are not adequate to achieve the salmon doubling objective, and additional protection measures within the authority of the SWRCB are necessary.

1. Sacramento Basin: With the exception of fall-run Chinook salmon, salmon populations in the Sacramento basin have not met the doubling objective and, in general, have not exhibited the consistent positive population growth that would indicate progress towards meeting the objective in the near future. Although a number of effective restoration efforts have been implemented (notably barrier removal on Clear and Butte Creeks, and several large fish screen installations on

the mainstem and a few tributaries), inadequate and incomplete implementation of others has reduced their overall benefits. In addition, many severe problems, including inadequate flows on many of the smaller tributaries, have not yet been mitigated.

The SWRCB noted in the Bay-Delta Plan that "prompt and efficient actions taken to implement [the] CVPIA goal…are important to achieving the narrative salmon protection objective" (p. 29). These CVPIA efforts have not been as effective as hoped. On average, less than half of the 800,000 acre-feet of CVP water ("(b)(2) water") mandated by the Act for fish and wildlife restoration has been used in specific, discretionary fish protection actions to enhance stream flows and reduce entrainment losses at the CVP Delta pumps in order to meet the Act's (and the SWRCB's) doubling goal. Instead, most the water is used by the USBR to meet its permit requirements to comply with the Delta water quality objectives contained in the Bay-Delta Plan. In addition, the effectiveness of the use of a large fraction of the "discretionary" (b)(2) water in the Sacramento basin, to enhance flows on Clear Creek and reestablish spring- and fall-run Chinook salmon, has been greatly reduced by current RBDD operations (see below).

Anticipated future operational changes in the Sacramento basin will continue to degrade conditions for Chinook salmon. USBR recently published a detailed project description for its planned future operation of the Central Valley Project (USBR, 2004). USBR has proposed to eliminate a number of important protections that have contributed to the increases measured for the winter-run Chinook salmon population during the past decade. These changes include shifting the temperature compliance point more than 18 miles upstream (which would violate the narrative temperature objective set by the SWRCB in Water Rights Orders 90-05 and 91-01) and no longer operating to maintain a minimum carryover storage in Shasta Reservoir necessary to protect winter-run Chinook salmon during multi-year dry periods. USBR's own analyses of the effects of these operational changes predict reduced habitat area and increased mortality of winter-run Chinook salmon eggs and fry (USBR, 2004).

<u>a. Red Bluff Diversion Dam:</u> This facility, operated by the USBR, blocks passage of 70% of adult spring-run Chinook salmon, preventing or delaying their migration to spawning areas in the mainstem Sacramento River and several key tributary streams, notably Clear and Battle Creeks (USBR, 2004). This operation has undermined the ongoing restoration efforts on Clear Creek (which include a major dam removal project and use of CVPIA (b)(2) to maintain adequate flows) that are aimed at increasing spring-run Chinook salmon population abundance, diversity and distribution, and has undoubtedly contributed to the ongoing decline of the spring-run population on the mainstem Sacramento River (see Table 4). The RBDD is also closed during at least some portion of the juvenile outmigration period for all runs of Chinook salmon spawned upstream of the dam. USFWS (1981) reported mortality rates of greater than 50% for juvenile

Chinook salmon that passed through RBDD when the gates were down. Despite a draft EIS/EIR that identifies current RBDD operations as the most harmful alternative (compared to alternatives in which the gates remain open year-round or for shorter periods; TCCA and USBR, 2002), the USBR proposes to continue these RBDD operations into the future (USBR, 2004).

Recommendation: The SWRCB should re-evaluate the USBR's permit conditions for operation of RBDD.

b. Stream flows: While many of the larger rivers and streams in the Sacramento basin have minimum flow requirements in place, many of those flow objectives were established decades ago. Since that time, scientific studies and field observations (including reports of the disappearance of salmon from a number of streams in the basin) indicate that those objectives are inadequately protective. In 1995, USFWS published an extensive review of factors limiting salmon populations in Sacramento-San Joaquin watershed salmon producing streams (USFWS, 1995). Inadequate flow levels were identified as a key problem in the vast majority of streams in the watershed, and seasonally adjusted and water year type-dependent flow levels were recommended. Today, with the exception of the mainstem Sacramento River and some of its larger tributaries (e.g., Yuba River), few of these recommended flow levels (another of the "other measures in the watershed" intended to supplement Delta water quality protections and help accomplish salmon doubling) have been reliably achieved.

Recommendation: The SWRCB should initiate proceedings to review and revise the current minimum flow requirements on the mainstem Sacramento River and its salmon-producing tributaries, in order to ensure that instream flow, water quality, and habitat conditions are adequate to support salmon survival, reproduction, and early rearing. These proceedings should prioritize adoption of new flow requirements on those streams that support the three most threatened runs (winter, spring and late-fall), and/or which are experiencing continuing declines or absence of progress toward consistent population growth, and/or which frequently fail to meet flow targets recommended by the AFRP.

2. San Joaquin Basin: According to USFWS, stream flows in every river in the San Joaquin basin are inadequate to sustain and promote doubling of Chinook salmon populations (USFWS, 1995). There is clear evidence that fall-run Chinook salmon population abundance (measured as adult escapement) is directly related to stream flow conditions during the spring when those fish migrated downstream as juveniles (i.e., flows measured 2.5 years earlier) (Figure 6). Higher flows during the spring (e.g., mimicking the natural runoff pattern prior to dam construction and water diversions) improve juvenile survival and growth by increasing habitat area (including floodplain habitat), increase turbidity and

thus reduce predation, and improve water quality (e.g., reducing water temperature and increasing dissolved oxygen concentration).

a. Stream flows: As noted above, minimum flow requirements are inadequately protective of salmon populations in the basin and insufficient to support the consistent population growth that will be required to achieve the salmon doubling goal. In addition, the seasonal stream flow targets recommended by the Anadromous Fish Restoration Program (AFRP) are not being achieved in any of the salmon producing rivers in the San Joaquin basin (Figure 7).

Recommendation: The SWRCB should initiate proceedings to review and revise the current minimum flow requirements on the San Joaquin River and its salmon-producing tributaries, in order to ensure that instream flow, water quality, and habitat conditions are adequate to support salmon survival, reproduction, and early rearing. (Recommendations regarding revisions of the flow objectives for the San Joaquin River at Vernalis will be discussed in our comments on Workshop Topics 8 and 9).

3. Delta: The Delta is an essential migratory corridor and rearing habitat for all Central Valley Chinook salmon (and other anadromous fishes). Outmigrating juvenile salmon may reside in the lower rivers and Delta for weeks before entering the more saline waters of the Bay and Pacific Ocean (Kjelson et al., 1982). Environmental conditions in these areas that affect salmon are influenced by freshwater inflow conditions, in-Delta hydraulics (which are affected by barrier operations in the Delta), and water export rates.

a. Export facilities: The CVP and SWP export facilities in the southern Delta have substantial effects on Delta hydraulics and water quality. In addition, the facilities entrain and kill millions of fish per year, including juveniles of all five Central Valley Chinook salmon runs. The fish screens facilities do not meet present CDFG or NMFS fish screen criteria or even the original design criteria to which they were built and, particularly for the SWP facilities and Clifton Court Forebay, they attract large numbers of predators which consume the majority of entrained juvenile salmon (>75%; Gingras, 1997). Plans to update the facilities have been delayed indefinitely. Water exports affect juvenile Chinook salmon directly by entraining fish and indirectly by reducing their survival through the Delta; higher exports rates are correlated with reduced survival (P. Brandes, CDFG, results reported in Brown and Kimmerer, 2003). For the most endangered and vulnerable salmon run in the watershed, winter-run Chinook salmon, recent analyses estimate that from 1996 to 2003 export-related mortality through the Delta ranged from 4-18% (average: 9%) of the total juvenile population (measured as the juvenile production estimate, JPE, which is calculated from adult escapement) (P. Brandes and A. Low, CDFG, results reported in Brown and Kimmerer, 2003). Application of these data to predict the effect of these losses on subsequent adult returns suggested that Delta export operations had a negative effect on winter-run population size and was slowing the recovery of the run.

Recommendation: The SWRCB should review the current condition and operations of the CVP and SWP fish protection and export facilities and consider requiring upgrades to the fish facilities and/or revisions of the export limits to improve protection of vulnerable salmon runs. (Recommendations regarding revisions to the export limits in the Bay-Delta Plan will be discussed in our comments on Workshop Topic 6).

b. Delta Cross Channel gate closures: See discussion and recommendation for Topic 2 above.

c. San Joaquin River flows at Vernalis: The amount of flow that reaches Vernalis has a direct relationship to attaining the salmon doubling objective. As shown in Figure 6, springtime Vernalis flows (March-June) are directly related to adult escapement measured 2.5 years later. In addition, Vernalis flows, and compliance with the springtime flow objective, affect the return ratio, a measure of population growth (or decline) (Figure 8). We applied the present Vernalis flow objectives to measured Vernalis flows since the mid-1950s (using data from California Department of Water Resources "DayFlow" model) and comparing hypothetical compliance to the return ratio measured for 2.5 years later for fall-run Chinook salmon from the Stanislaus, Tuolumne and Merced Rivers. For those years when the Vernalis flow objective was (or would have been) met, the return ratio for the cohort that migrated downstream during those spring seasons was greater than 1.0 in 74% years. In contrast, for years in which the Vernalis flow objective was not (or would not have been) met, the return ratio was less than 1.0 in 59% of years.

Recommendation: The SWRCB should not allow relaxation of the Vernalis flow objective, and should consider revisions to increase spring flows. Further specific recommendations regarding revisions of the Vernalis flow objectives will be discussed in our comments on Workshop Topics 8 and 9.

d. Dissolved oxygen: Low flows and discharges of nutrient-polluted waters have resulted in extreme and chronic low dissolved oxygen conditions in the lower San Joaquin River at Stockton. Low dissolved oxygen levels can block passage of migrating adult and juvenile salmon and, for fish transported into the Stockton ship channel (usually small juveniles), can be lethal. Salmonid fishes are particularly sensitive to low dissolved oxygen and the present objective, 5 mg/l (and 6 mg/l for the September-November adult Chinook salmon migration period) is barely tolerable under some temperature conditions (Healy, 1991). Low dissolved oxygen conditions during the juvenile outmigration period are likely a contributor to the low return ratios measured for cohorts that emigrated during years with low Vernalis flows.

Recommendation: Compliance with the dissolved oxygen objective in the Bay-Delta Plan is important for helping attain the salmon protection objective. During periods when the dissolved oxygen objective is not met, particularly when salmonid fishes (Chinook salmon and Central valley steelhead) may be present in the lower San Joaquin River, the SWRCB should consider requiring the release of additional flows to the level sufficient to meet the dissolved oxygen objective.

Thank you for considering our recommendations regarding potential amendments and revisions to the Bay-Delta Plan objectives for Delta Cross Channel gate closures and salmon protection, and regarding related actions that the SWRCB should consider. Please contact us if you have any questions regarding these comments.

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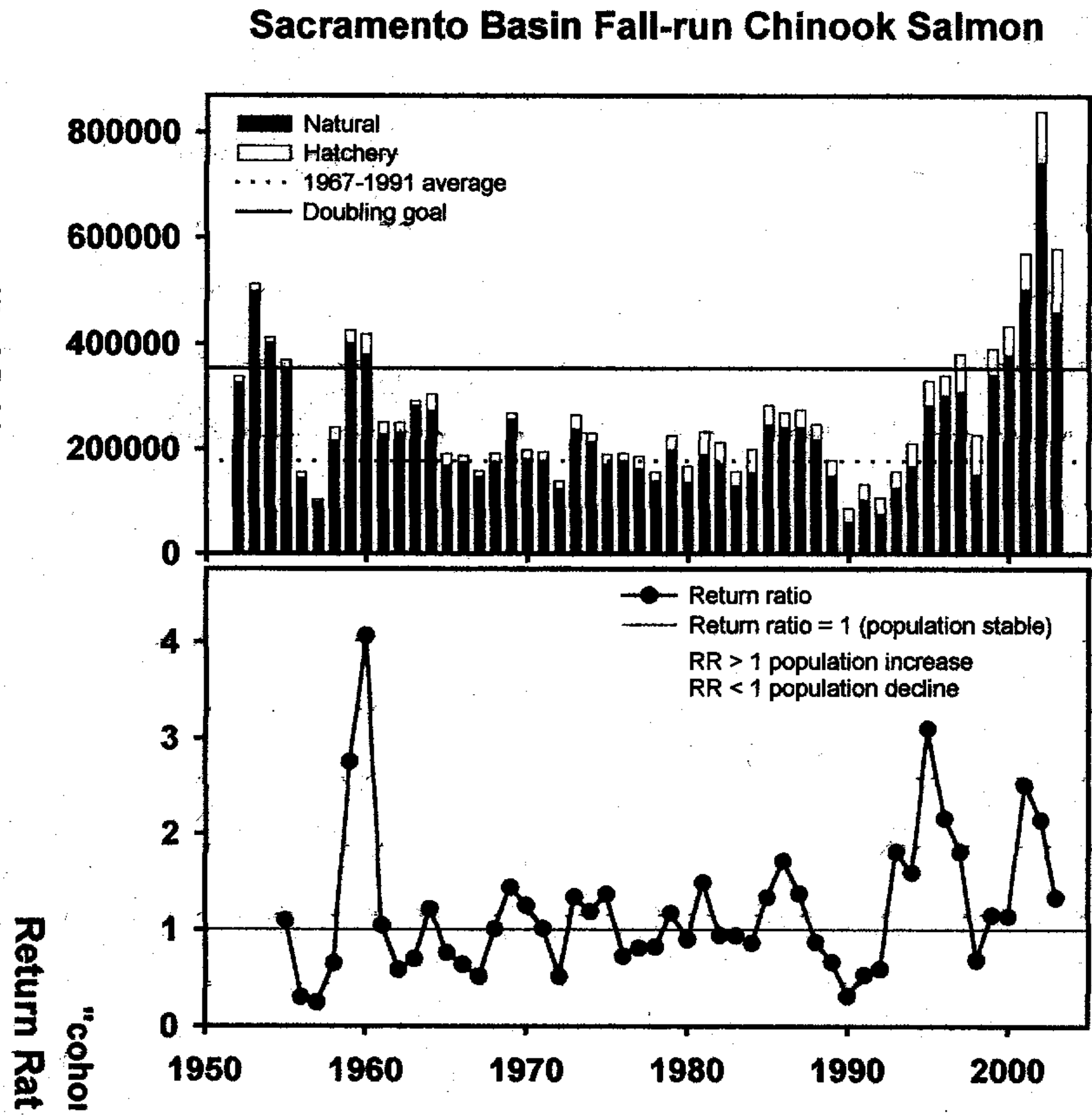

Figure 1. Escapement (top panel) and return ratio (bottom panel) for Sacramento basin fall-run Chinook salmon.

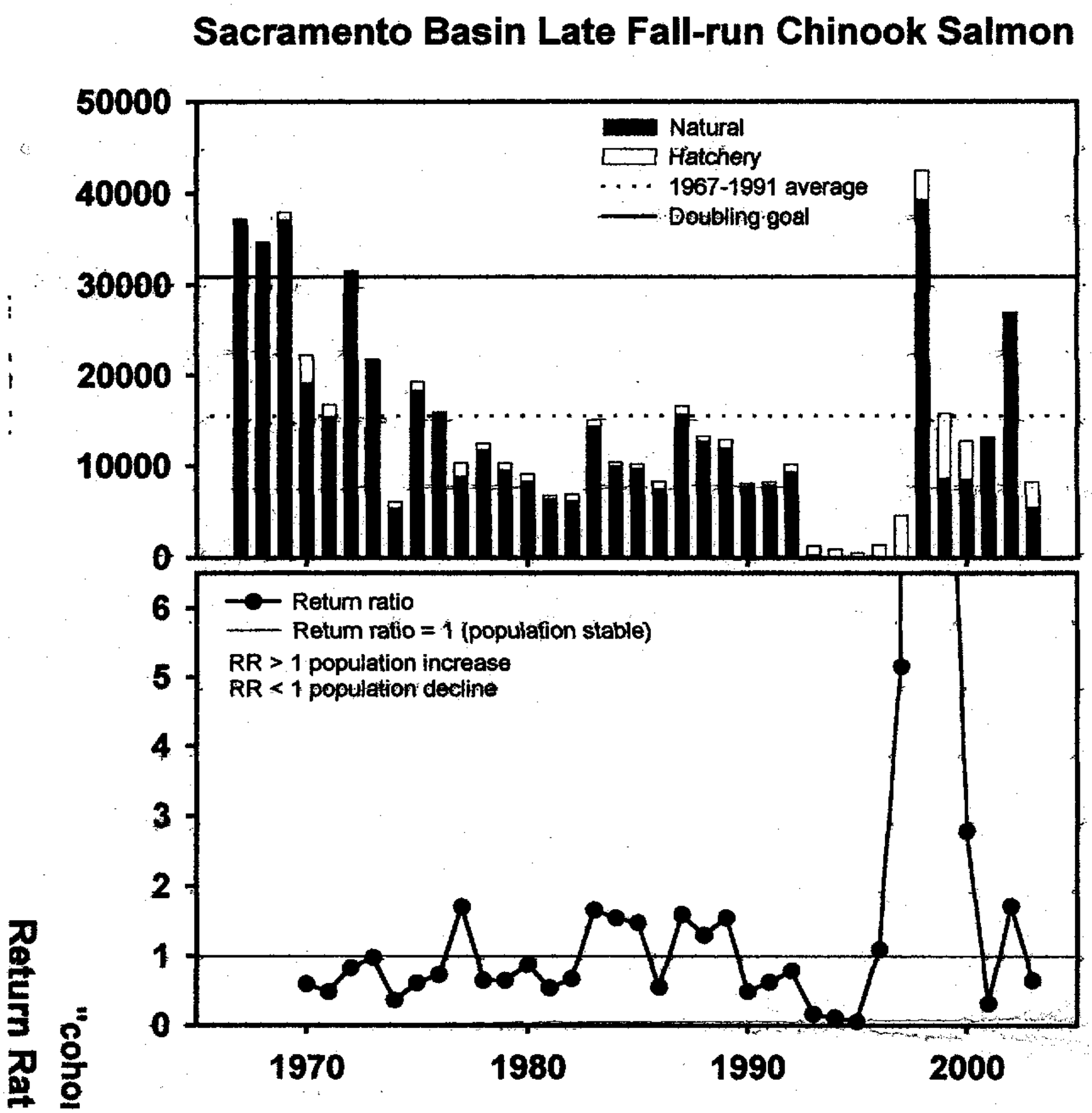

Figure 2. Escapement (top panel) and return ratio (bottom panel) for Sacramento basin late fall-run Chinook salmon.

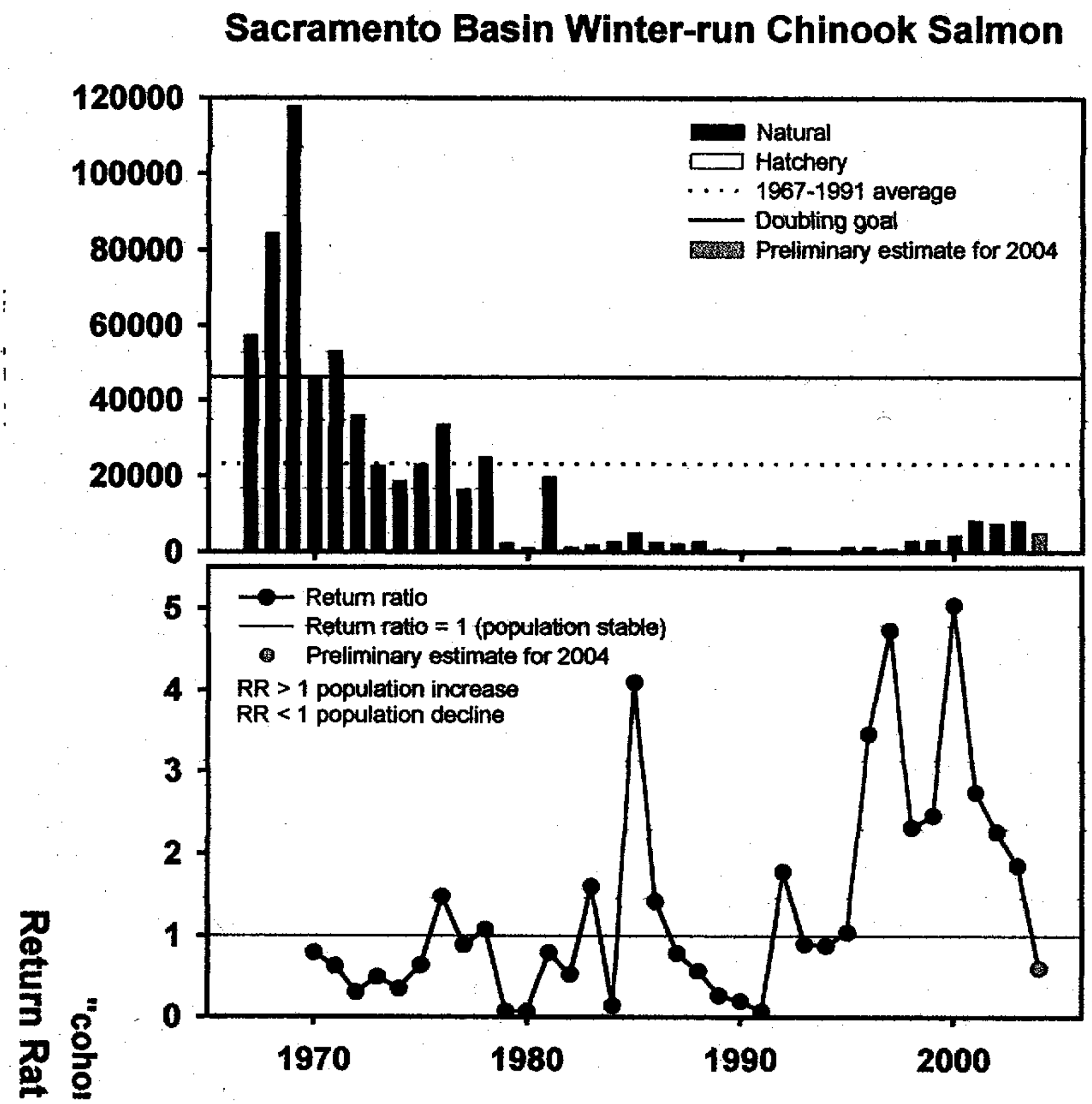

Figure 3. Escapement (top panel) and return ratio (bottom panel) for Sacramento basin winter-run Chinook salmon.

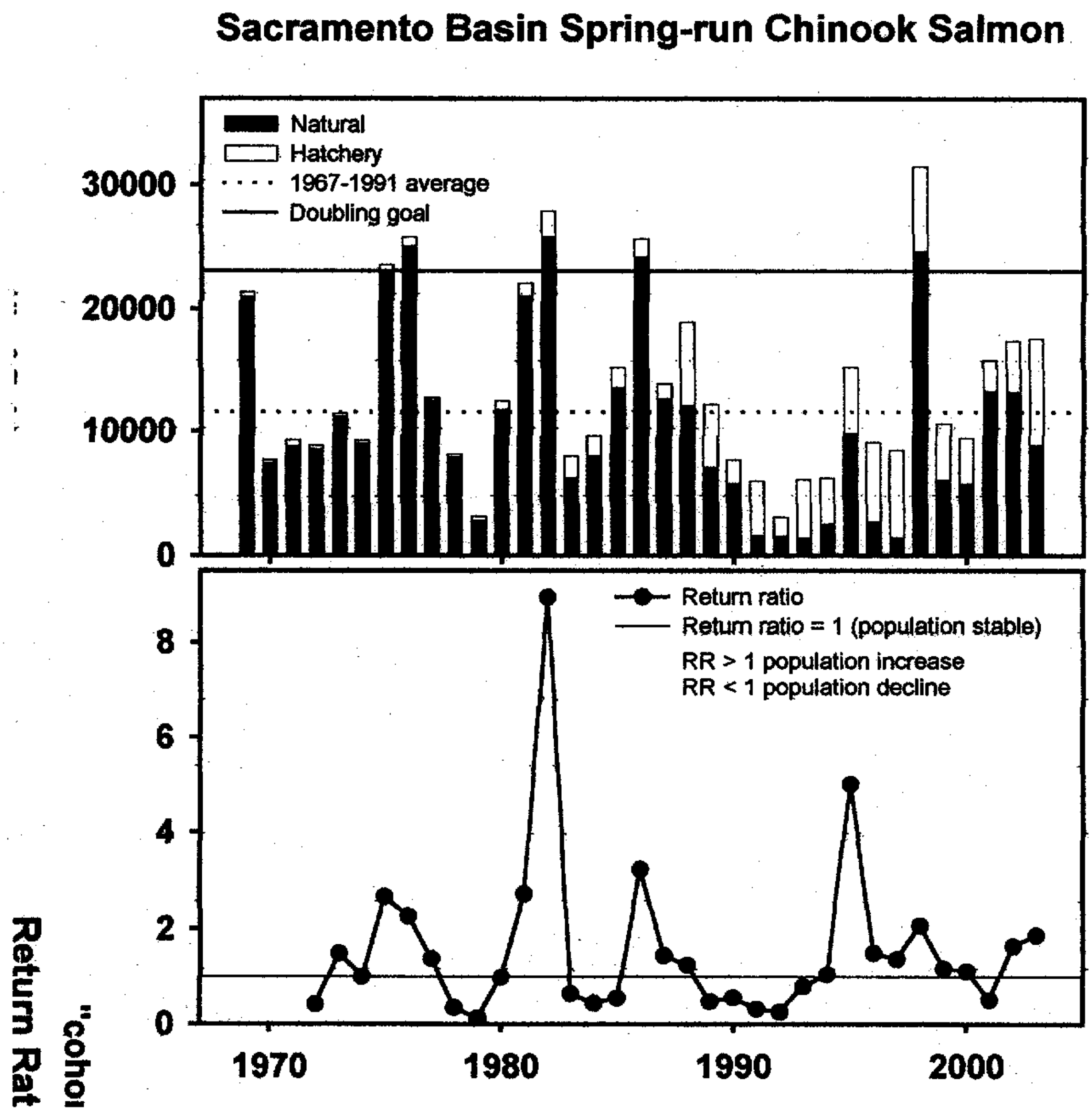

Figure 4. Escapement (top panel) and return ratio (bottom panel) for Sacramento basin spring-run Chinook salmon.

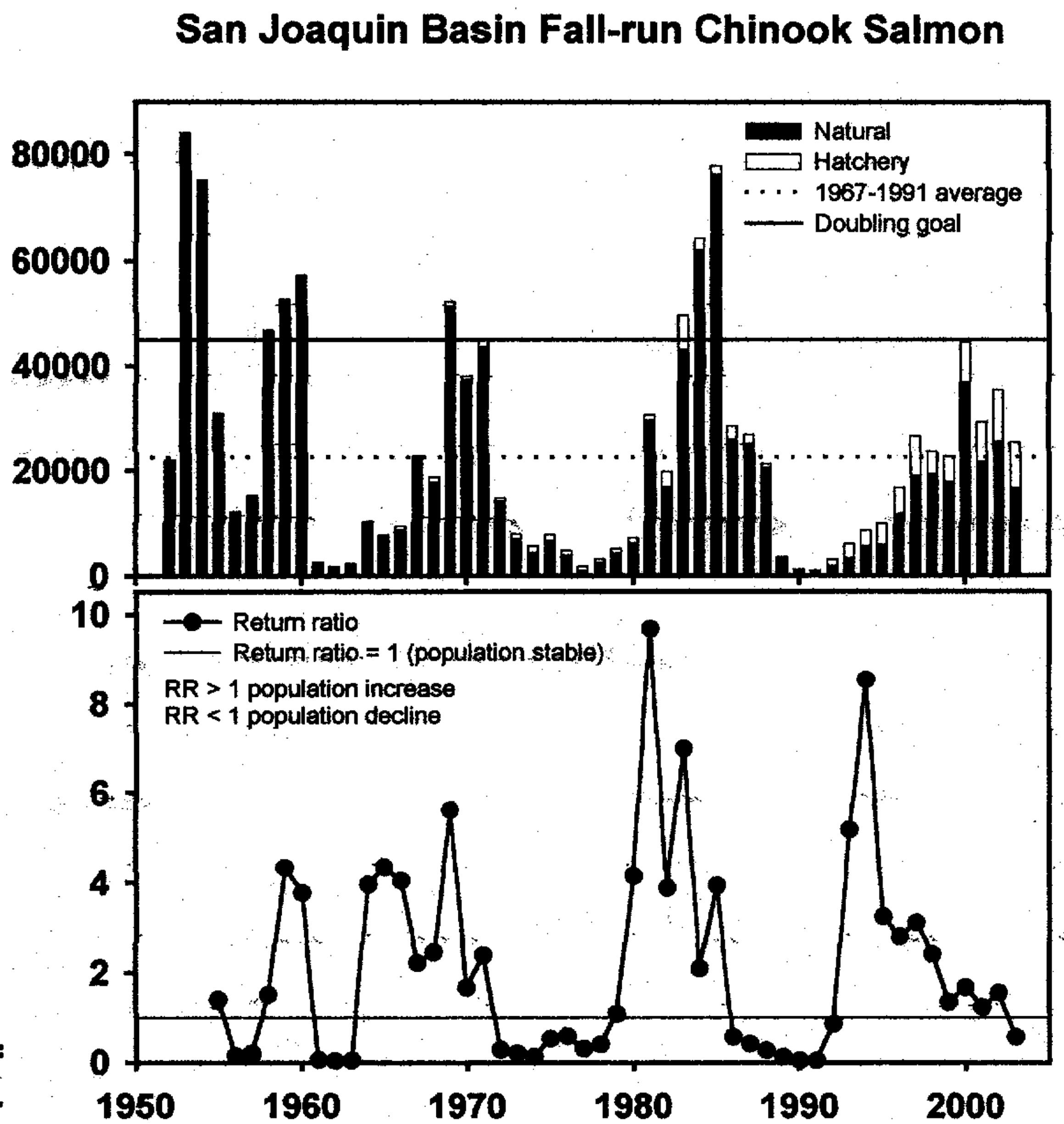

Figure 5. Escapement (top panel) and return ratio (bottom panel) for San Joaquin basin fall-run Chinook salmon.

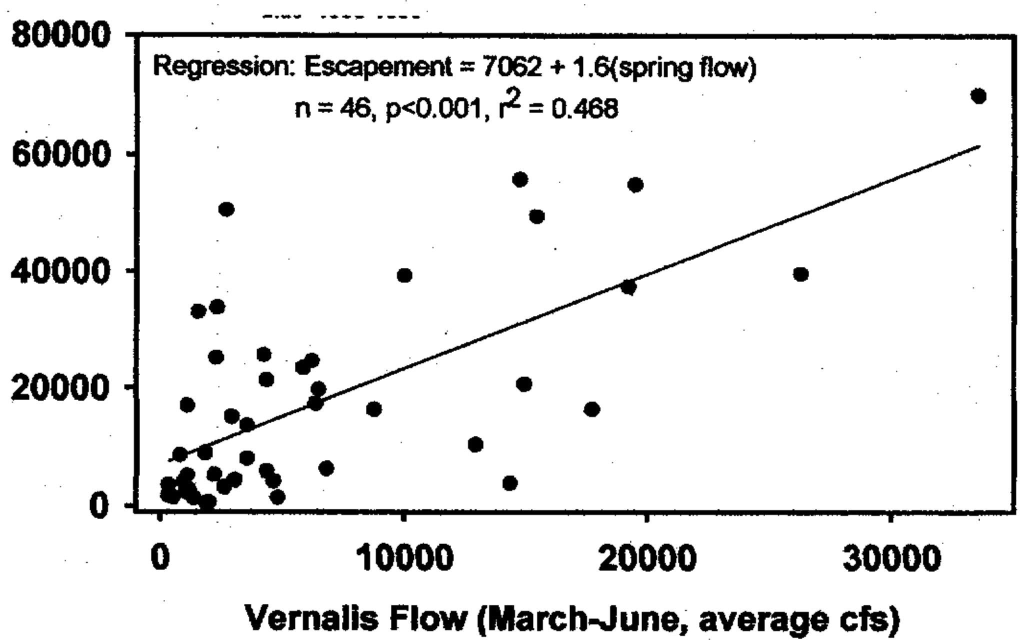

Figure 6. Escapement of fall-run Chinook salmon from the Stanislaus, Tuolumne, and Merced Rivers compared to springtime Vernalis flow conditions measured 2.5 years earlier when the fish emigrated the basin as juveniles.

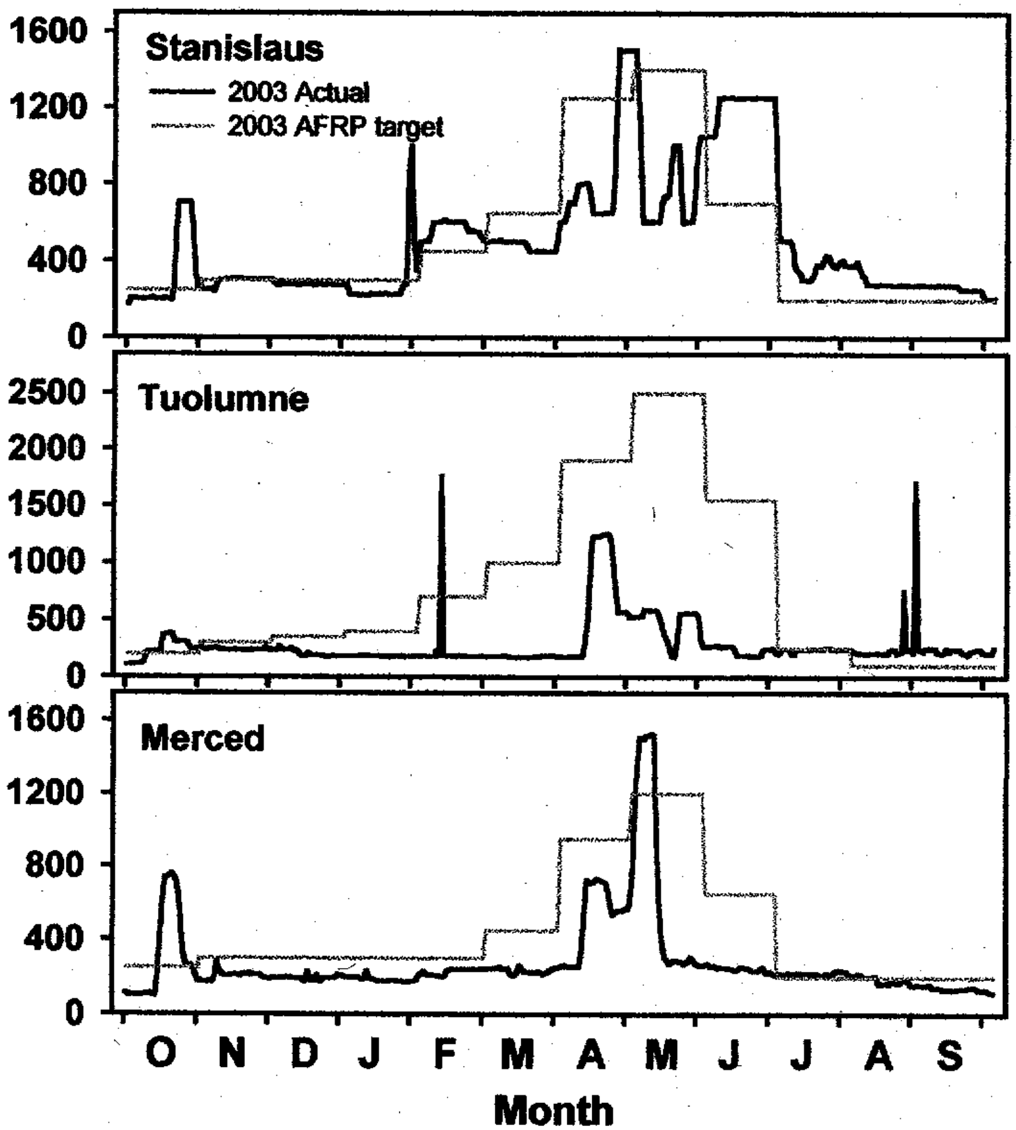

Figure 7. Actual flows (black line) on the Stanislaus, Tuolumne, and Merced Rivers compared to flow levels recommended by the AFRP for salmon doubling (gray line)in Water Year 2003.

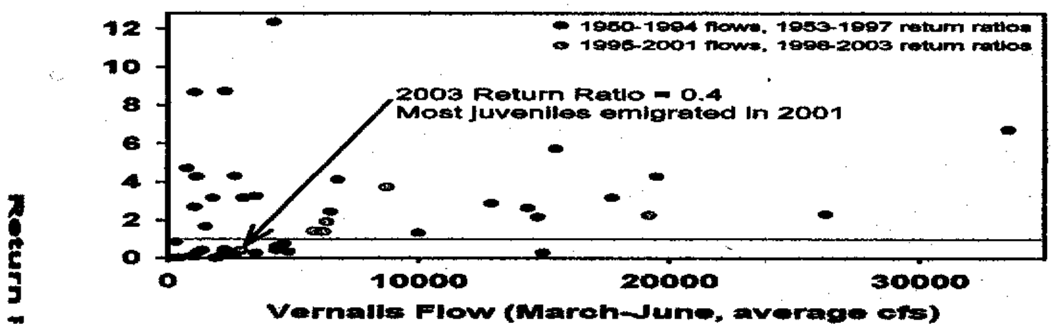

Figure 8. Return ratios for fall-run Chinook salmon form the Stanislaus, Tuolumne and Merced Rivers compared to average springtime (March –June) flows in the lower San Joaquin River at Vernalis. Black circles are for years prior to implementation of the 1995 WQCP, gray circles are for the years since the Vernalis flow objective was implemented.