From: Dante Nomellini, Jr. <dantejr@pacbell.net>
Sent: Monday, July 28, 2014 6:04 PM
To: BDCP.comments@noaa.gov
Cc: Dante John Nomellini Sr.
Subject: DJN_Sr Part Three CDWA Comments on Draft BDCP Plan & EIR_EIS
Attachments: DJN_Sr Part Three CDWA Comments on Draft BDCP Plan & EIR_EIS.pdf

Attached hereto please find the following document entitled:

"DJN_Sr Part Three CDWA Comments on Draft BDCP Plan & EIR_EIS" (approx. 3 MB).

Also, here is a link to download a copy of "Exhibit 30" to those comments (approx. 67.4 MB): https://www.hightail.com/download/ZUcweFlkR0ZrWStFQk1UQw

Please reply to this email acknowledging receipt of that document and that downloadable Exhibit 30.

Thank you,
Dan Jr.
Attorney for the Central Delta Water Agency

Dante J. Nomellini, Jr. ("Dan Jr.")
Attorney at Law
Nomellini, Grilli & McDaniel
Professional Law Corporations
235 East Weber Avenue
Stockton, CA 95202
Mailing address:
P.O. Box 1461
Stockton, CA 95201-1461
Telephone: (209) 465-5883
Facsimile: (209) 465-3956
Email: dantejr@pacbell.net

CENTRAL DELTA WATER AGENCY

235 East Weber Avenue • P.O. Box 1461 • Stockton, CA 95201
Phone (209) 465-5883 • Fax (209) 465-3956

DIRECTORS
George Biagi, Jr.
Rudy Mussi
Edward Zuckerman

COUNSEL
Dante John Nomellini
Dante John Nomellini, Jr.

July 28, 2014

BDCP.Comments@noaa.gov

Re: Draft Bay Delta Conservation Plan and
Draft Bay Delta Conservation Plan EIR/EIS
DJN Sr. Part Three

THE USFWS AND NMFS HAVE FAILED TO PROTECT THE PUBLIC TRUST AND CARRY OUT THEIR DUTIES UNDER NEPA BY ALLOWING THE USBR TO ACT AS A CO-LEAD AGENCY AND IN-TURN TURNING OVER DIRECTION AND CONTROL OF CONSULTANTS TO THE DWR.

The USBR and DWR are the agencies exporting excessive amounts of water from the Delta and violating the conditions of their water right permits and licenses. Their allegiance with their contractors who receive water exported from the Delta is without question. Their past conduct and the revolving door of employment between such public agencies and such water contractors should raise the antenna of any public agency and public official with responsibility for protecting the public interest and trust and in particular the responsibility for acting in good faith to assure a rigorous exploration and objective evaluation of all reasonable alternatives. The most obvious alternative which is being ignored is the need for reduction in water demand on the Bay-Delta Estuary due to the SWP and CVP exports which are by law to be limited to water which is surplus to the present and future needs, including fish and wildlife needs of the Delta and other areas of origin. The purpose and need basis for the BDCP DEIS/EIR includes the "up to full contract amounts" purpose which is an inappropriate constraint on an EIS to support a fifty (50) year take permit from agencies responsible for protecting endangered species. The purpose statement for an EIS to support USFWS and NMFS action should clearly include a statement requiring consideration of a range of alternatives from reducing exports to zero to an upper level of what can be reasonably demonstrated to be amounts and times when water is truly surplus to the present and future needs of the Delta and other areas of origin including fish and wildlife.

THE FAILURE OF DWR TO COMPLY WITH LEGAL REQUIREMENTS FOR ACCESS TO PRIVATE PROPERTY DOES NOT EXCUSE THE NEED FOR INFORMATION AND DATA NECESSARY FOR GOOD FAITH COMPLIANCE WITH NEPA OR CEQA.

BDCP DEIR/EIS Appendix 4a in section 4A.1 provides:

> "Under CEQA and NEPA, state and federal lead agencies are required to undertake a certain amount of original research and analysis in order to obtain the information required to prepare legally sufficient environmental impact reports (EIRs) and environmental impact statements (EISs). Although there is no bright line rule articulating precisely how much effort is required, the applicable general principle is that lead agencies must undertake thorough investigations in light of what is reasonably feasible under the circumstances facing a particular proposed 'project' or 'major federal action'."

In Appendix 4a after an excusatory explanation of DWR efforts to gain access to private property, it is concluded that

> "In short, DWR has done all that is reasonably feasible under the circumstances to conduct thorough investigation of the impacts of all of the BDCP alternatives."

What is not included is that DWR did not comply with the statutory and constitutional requirements protecting private property rights. Whether due to political pressures to get "Sh*t" done (See Exhibit 7) they didn't want to take the time to comply with law or whether they wanted to avoid the due process to landowners and cost to the water contractors of providing legally required compensation, their efforts were not conducted in good faith.

Also absent from the obviously self serving explanation by DWR is that relevant data including boring data was obtained by DWR from access to cooperating landowners lands on Mandeville Island and Bacon Island in June and July of 2012 which was not revealed in the Draft EIR/EIS in the November 2013 posting of boring data although it was compiled on about April of 2013. See Exhibit 30 which contains the data which was not posted or acknowledged.

Lead agencies other than DWR with adequate funding from the water contractors or the applicant agencies could have made efforts to obtain the necessary data. Failure to proceed in compliance with law is not a valid excuse.

In any event, the NEPA lead agencies have failed to comply with 40 CFR 1502.22 which in pertinent part provides:

"§1502.22 Incomplete or unavailable information

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.

(a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

(b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and (4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, 'reasonably foreseeable' includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." (Emphasis added.)

The required disclosures, relevance of the data not obtained and theoretical data substituted for such information have not been provided. Exhibit 31 is a copy of the typical DWR requested Temporary Entry Permit which indicates the data which was claimed necessary for the proper preparation of the BDCP EIR/EIS. The relevance, foreseeable significant adverse impacts and the "agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community" must be provided.

THE DISCLOSED AND UNDISCLOSED SOIL BORING SAMPLES COLLECTED BY DWR WERE IN SIGNIFICANT PART NOT HANDLED PROPERLY, NOT ADEQUATELY TESTED FOR CHEMICAL COMPOSITION, AND NOT ANALYZED IN A MANNER TO PROVIDE A GOOD FAITH DISCLOSURE OF IMPACTS FROM REUSE OF TUNNEL MATERIAL.

The Reusable Tunnel Material Testing Report dated March 2014 and the supporting "Laboratory Reports" are located on the BDCP EIR/EIS website under "Supporting Technical Studies." The proposed Reuse of Tunnel Material includes deposit near the various access tunnel shafts for the purpose of habitat restoration and as fill on subsiding Delta islands. In order to evaluate the impacts the specific material that is likely to be extracted from the particular tunnel shaft should be analyzed as to the impacts at the particular location where it is to be deposited.

At page 2-4 of said Reusable Tunnel Material testing report, it is explained that testing was based on a composite sample created by mixing "soil core from nineteen borings (elevation -100 ft. to -170 ft.). Table 3-3 on pages 3-9 to 3-13 show the constituents where there is an exceedence of minimum soil screening concentration for human health. Table 3-5 on page 3-21 shows the constituents where there is an exceedence of an ecological screening guideline. At page 3-23, the following statements are made:

> "However, exposure of people, wildlife and plants to conditioned soil has not been fully assessed under unrestricted-use conditions, creating an uncertainty for potential adverse effects. If RTM is to be placed in the environment where people could contact the soil, either directly (e.g., through skin contact) or indirectly (e.g., as airborne particulate, or as leachate in surface or drinking water), then human health risk assessment(s) will need to be developed." (3.2.5)

> "Although the tests performed indicate favorable results for reusability of RTM, if conditioned soil is to be placed in the environment for large-scale uses then additional plant growth tests may be required by regulatory agency and/or permitting agency authorities." (3.3.2)

At page 3-24, the following statement is made:

> "The safety of human or animal consumption of agricultural crops grown in the conditioned soil was outside the scope of this study. Consultation with the California Department of Food and Agriculture would be required to evaluate this issue further."

On the Bates-Stamped pages Case Narratives are presented for the various samples used for the March 2014 Reusable Tunnel Material Testing Report. The following statement is made for numerous samples used for the testing report:

> "Samples were received out of prescribed holding time and without thermal preservation. <u>The samples were analyzed upon client advice to proceed with the analysis.</u>" (Emphasis added.)

This statement is made on the following pages:

Bates Pages 4001,
5001,
5011,
5021, and

8011

The sample dates collected as reflected on the sample test results don't appear to be correlated with boring dates. See Figure 1-1 on page 1-3 which shows the nineteen borings from which the cores were taken and mixed. The borings are scattered over thirty (30) miles with most in the north. Chemical composition for each boring is not given and thus the impact in each area of deposit cannot be determined.

Chemical analysis of the core samples for each of the borings should have been performed so that impacts at each of the reuse sites could be examined based on the results from the borings which reflect the material to be deposited at the particular reuse site. The composite sample precludes such analysis.

THE BDCP AND DRAFT EIS/EIR HAVE FAILED TO FORTHRIGHTLY SEGREGATE THE MITIGATION REQUIREMENTS AND ALLEGED BENEFITS OF THE BDCP FROM THE MITIGATION REQUIREMENTS AND AFFIRMATIVE OBLIGATIONS OF THE SWP AND CVP UNDER OTHER PLANS AND LAWS.

At page 4 of the BDCP Executive Summary, Footnote 3 correctly provides the requirements for BDCP as follows:

> "The BDCP is responsible for the mitigation of its effects. The mitigation actions and mitigation requirements of the BDCP must be additive to the mitigation obligations of other plans (i.e., BDCP mitigation cannot supplant the mitigation obligations of other plans and vice- versa)."

SWP and CVP compliance with yet to be fulfilled existing obligations does not provide a legitimate basis for granting a fifty (50) year take permit. The projects are obligated to meet the current biological opinions which have recently been upheld by the 9th Circuit Court of Appeals. The CVPIA anadromous fish restoration requirements are in place but compliance is lacking. (Exhibit 32 is the Listen to the River: An Independent Review of the CVPIA Fisheries Program December 2008 which discusses the non-compliance.) The projects are required by SWRCB D-1641 to meet specific Bay-Delta water quality objectives which they continue to violate. (See discussed in DJN Sr. Part One and Exhibits 19 and 20.) The projects are to provide salinity control and an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban and recreational development in the Delta and as a precondition to the export of water from the Delta. (See discussion in DJN Sr. Part One, Water Code section 12200 et seq. and Exhibit 14, page 12.) The projects are to maintain the interior Delta as a "common pool" or source for both local supply and export and the management of releases from storage for use outside of the area must be integrated to the maximum extent possible to provide salinity control and such adequate supply for the Delta. (See particularly Water Code 12200 and 12205 and Exhibit 14, page 11, second paragraph and page 44, second paragraph.) The projects cannot directly or indirectly deprive the Delta and other areas of origin of water needed for all present and future purposes including future maintenance of fish resources. (See discussion in DJN Sr. Part One and Water Code section 11460 et seq.) The SWP must preserve fish and wildlife. (Water Code section 11912.) Mitigation must also be provided by the SWP and CVP for the adverse impacts such as: Diversion of the San Joaquin River by the CVP which deprives the Delta and fish of the historic high quality natural flow of the San Joaquin River; SWP and CVP actions to provide water to the west side of the San Joaquin Valley which result in degradation of the San Joaquin River water quality due to direct discharge of high salinity return flow and drainage water and indirectly the accretion to the river of high salinity groundwater; SWP and CVP inducement of upstream diversion and consumption of water; SWP and CVP storage of winter and spring natural flushing flows, project inducted salinity intrusion from the West caused by export pumps, lowered water levels in the vicinity of the export pumps, destruction of anadromous fish spawning habitat due to construction of reservoirs which submerge such habitat and otherwise block fish passage to such habitat, relocation of and damage to special status fish such that critical habit designations restrict activities in the Delta, increased temperature and other impacts. The SWP and CVP must also comply with Water Code section 85054 Co-equal goals and Water Code section 85021 Reduction of reliance on Delta for future water supply needs.

Compliance with law is not a benefit but an obligation of the projects. Compliance with already existing requirements and obligations is not additive.

THE BDCP HAS FAILED TO ADEQUATELY IDENTIFY CHANGED CIRCUMSTANCES, PLAN RESPONSES AND ALLOCATE FUNDS IN THE EVENT THAT THEY SHOULD OCCUR.

The BDCP Executive Summary at page 24 sets forth the changed circumstances for which there must be a planned response and allocation of funds in the event that they should occur. The listing includes: levee failures, flooding, new species listing, wildfire, toxic or hazardous spills, drought, non-native invasive species or disease, climate change and vandalism.

The BDCP Public Draft Plan Implementation 6.4.2 Changed Circumstances at page 6-31 provides the following to define "changed circumstances."

> "In the context of the ESA, changed circumstances are defined as 'changes in <u>circumstances affecting a species or geographic area</u> covered by a conservation plan that can reasonably be anticipated by plan developers and the [USFWS and NMFS] and that can be planned for.' The NCCPA similarly defines changed circumstances as 'reasonably foreseeable circumstances that <u>could affect a covered species or geographic area</u> covered by the plan' (50 CFR 17. 3,50 CFR 222. 102, and Fish & Game Code 2805(c)." (Emphasis added.)

With regard to "Changed Circumstances" there are four major deficiencies in the BDCP:

1) BDCP limits its focus to the physical habitat in a particular geographic area and ignores other "circumstances affecting a species." The obvious purpose of the law is to protect the species. Habitat without fish is not a solution. All of the circumstances necessary to have fish must be assured to be in place. For example, in the case of drought there must be cold water in the rivers upstream of the Delta for successful spawning of winter run chinook salmon. Without winter run salmon, the conservation measures for such are not effective. The planned response and "allocated funding" to assure the provision of such cold water are not identified.

2) BDCP assumes if the changed circumstances are addressed in the modeling that there is no need to provide a planned response and an allocation of funds. The BDCP itself requires the assurance that it will be carried out. Real funding must be identified and allocated. It is quite apparent that the real funding for the BDCP has not been identified and certainly not allocated.

3) The process for response has no substance and certainly no enforceable deadline for response. Adaptive management and monitoring could be applied until the endangered species are extinct, and

4) Real funding is not identified in any meaningful way and is certainly not allocated. There is no identification of funding sources with supporting documents to verify that it will be available in the future and certainly no allocation of such funding. The fifty (50) years of permitted take must be accompanied with specifically allocated real funding.

The BDCP is not meaningfully responsive to the requirements. By way of example, with regard to levee failure, the following is provided in 6.4.2.2.1 pages 6-35 and 36:

> ". . . The site of the levee failure will be evaluated to allow adequate time for the Implementation Office to contact and coordinate with the responsible flood management entity. For example, the Implementation Office may need to obtain permission from the local entity to access the property.
>
> The Implementation Office will follow the same procedure for site assessment as it will for a BDCP-related levee failure. The Implementation Office will also coordinate with the responsible flood management entity to ensure that the responsible entity repairs the levee. The responsible flood management entity will therefore assume financial responsibility for the costs of the remedial action, including for the levee repair work and the restoration of the affected reserve system lands. However, to ensure that the repair work occurs quickly and permit

<u>compliance is not compromised, the Implementation Office may need to assist the responsible local flood management entity (e.g., provide funding to be reimbursed or complete repairs and be reimbursed.</u>"

No assurance is provided that the local flood management entity will be solvent and there is no assurance that the Implementation Office will assist or has the financial capability to assist. The word "may" does not provide certainty.

In addition to the major deficiencies, the "changed circumstances" have been redefined to narrow the obligation. The net result is that there is no real assurance that all elements will be in place for the species of concern to recover or survive. In BDCP Public Draft Chapter 8 at page 8-101, the appropriations to the CVPIA Restoration Fund are set forth in Table 8-53. For the period of 1994-2002, the total amount is $866,829,000. Even with such funding, the CVPIA 3406(b)(1) objective that "by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991" has not been achieved.

> "the term 'anadromous fish' means those stocks of salmon (including steelhead), striped bass, sturgeon, and American shad that ascend the Sacramento and San Joaquin rivers and their tributaries and the Sacramento-San Joaquin Delta to reproduce after maturing in San Francisco Bay or the Pacific Ocean"

Exhibit 33 contains the CVPIA AFRP Graphs showing the production and obligated target for only some of the anadromous fish. Comparable graphs are not provided for other anadromous species such as striped bass, sturgeon and American shad. The graphs show that the target has not been met for the major populations of salmon and steelhead. The amount of funding needed to achieve such foreseeable changed circumstance and the specific allocation of such funding is not provided.

This submittal constitutes Dante John Nomellini, Sr.'s Part Three with Exhibits 30 through 33.

Yours very truly,

DANTE JOHN NOMELLINI, SR.
Manager and Co-Counsel

Note: Exhibit 30 is enclosed separately due to its large size.

BDCP1632

Project: **Bay Delta Conservation Plan (BDCP)**

OWNER: The Bernice Silva Trust (50%); Guido Bandoni 1993 Living Trust (3/8ths); Louie Bandoni, Diane Bandoni and Julie Shearn (1/8th)

DWR Parcel No(s). DCAP-426 – San Joaquin County
APN: 129-180-35g

TEMPORARY ENTRY PERMIT

OWNER gives permission to the Department of Water Resources of the State of California (DWR) and its officers, employees, agents and contractors, to enter with all necessary equipment onto OWNER's land in the county of San Joaquin, State of California, generally described as Assessor's Parcel No(s). 129-180-35g, marked on the attached map (Property). This permission is granted for the purpose of conducting the activities described in Exhibit A of this Permit, including ground and aerial surveys, engineering, biological, geological, archaeological, floral and faunal studies, Phase 1 Environmental Site Assessments, and for other incidental purposes as may be required. This permission is subject to the following conditions:

1. DWR will exercise reasonable precautions to avoid damages and to protect persons and property. DWR's survey and investigation team members shall read and heed all signs posted as notification of potentially hazardous chemical substances used on the Property.

DWR agrees not to unreasonably interfere with operations on the Property. DWR shall limit vehicular and pedestrian access to those routes reasonably identified by OWNER or his/her representative. If access is by dirt roads, every effort will be made by DWR to avoid producing excess dust and to avoid access by vehicles where muddy conditions could cause damage to the roads.

DWR acknowledges that the Property may include, without limitation, the use of pesticides, herbicides, fertilizer or other chemical substances (collectively "Substances"). DWR hereby agrees to accept and assume any and all risks of injury or damage arising from or relating to entry upon or use of the Property including, without limitation, injury or damage from exposure to Substances, except for such risks caused by the gross negligence or intentional tortuous conduct of OWNER.

2. DWR understands and agrees that any information gathered on OWNER's property in accordance with activities described in Exhibit A of this Permit and for other incidental purposes as may be required is highly sensitive and strictly confidential, and shall be maintained by DWR with the utmost confidence. DWR agrees that such information about the Owner's property, operations, practices, the land's environmental data, etc. obtained by the implementing agency or any of its employees, officers agents, contractors and/or representatives shall remain strictly confidential and shall not be disclosed or revealed to outside sources or used for any manner inconsistent with this Permit agreement, except as required by law.

Subject to conditions listed in Civil Code Section 1798.24, DWR shall establish and implement appropriate and reasonable administrative, technical, and physical safeguards to ensure the security and confidentiality of records.

[Continued on Page 2]

OWNER's Name, Address, and Phone No.

____

____

Phone No.____________________

▶ ____________________
Signature

▶ ____________________
Signature

Date: ____________________

Recommended for Acceptance:

▶ ____________________
Quentin Green, Land Agent Date

____
▶ Carolyn Dabney, Senior Land Agent Date

ACCEPTED:

Department of Water Resources of the State of California

▶ ____________________
Allan T. Davis,
Supervising Land Agent

Date: ____________________

CONSENT OF TENANT(S)

We, the Tenants of the Property described in this Temporary Entry Permit, are under lease with OWNER, hereby consent to the execution of this Temporary Entry Permit. We also agree that all damages payable will be paid to OWNER as described above.

____
Signature

Date: ____________________

____
(Mailing Address of Tenant if different than above)

Phone No: ____________________

Exhibit 31

Project: **Bay Delta Conservation Plan (BDCP)**

OWNER: The Bernice Silva Trust (50%); Guido Bandoni 1993 Living Trust (3/8ths); Louie Bandoni, Diane Bandoni and Julie Shearn (1/8th)

DWR Parcel No(s). DCAP-426 – San Joaquin County
APN: 129-180-35g

[Continued from Page 1]

3. DWR will only record information of the type indicated within the delineated area(s), and will not record or disclose any inadvertently observed information of significance, such as special status species or its location, outside of the delineated area(s) unless otherwise required by law.

4. OWNER assumes no liability for loss of property, damage to property, or injuries to or deaths of agents, contractors, or employees of DWR by reason of the exercise of privileges given under this Permit.

5. $500.00 represents the probable damage amount of compensation for entry by DWR and/or its contractors. OWNER will receive this sum up front upon execution of this Permit.

6. Nothing in this Permit precludes OWNER from filing a claim(s) with the State Victim Compensation and Government Claims Board for any loss or expense that OWNER or its tenant may suffer that is caused by DWR or that is due to exercise by DWR of the rights granted by this Permit if the actual damages and interference exceeds the amount paid by DWR.

7. In addition to the payment made pursuant to Paragraph 5 of this Permit, DWR agrees to indemnify and hold OWNER harmless from any physical damage, including physical damage to OWNER's crops, actually and proximately caused by the activities authorized by this Permit. DWR also agrees to either reimburse OWNER for any damage to OWNER's roads, fences, or other property occurring by reason of the exercise of rights granted herein, or to replace or restore said Property.

8. DWR's access to the Property may occur at various times during the day. In some instances, depending on the species being studied, DWR access may also occur in the late evening or after dark. To complete the studies, DWR staff will require access to the Property for one (1) day up to sixty (60) **non-consecutive days**. DWR will give OWNER a minimum of five (5) days verbal notification to be followed by written notification; however, when practical, DWR will attempt to provide OWNER more notice. The verbal notification will include a description of the activities that will be conducted on the Property and as much as possible, a description of the area to be surveyed. The written notification will confirm the verbal notification and will provide OWNER information pertaining to the purpose of the various types of studies to be conducted on the Property and the point of contact(s) for DWR. If so indicated by OWNER prior to entry by DWR, DWR shall only come onto the Property with a representative of OWNER and shall be escorted during DWR's entire visit. OWNER understands that no compensation will be provided for any expenses related to escorting DWR staff on the Property.

9. Following compilation of the data gathered and within sixty (60) days of OWNER's written request, DWR will provide OWNER with all data, including but not limited to notes, surveys, reports, and photographs, obtained from any investigation on the Property.

10. This permit expires on December 31, 2011, but DWR's access to the Property during that time period will be limited to no more than sixty (60) non-consecutive days.

11. OWNER does not waive any claim or right of legal action.

Exhibit A

TYPES OF STUDIES AND SCOPING ACTIVITIES

For purposes of the Temporary Entry Permit, all survey-related activities will be led by qualified and trained DWR personnel and/or authorized representatives (contractors/consultants) under the direction of a DWR Project Manager. DWR may conduct the following checked activities:

☒ **I. GEODETIC MAPPING**

Geodetic mapping involves measuring the shape and area of the Property by using the exact position of geographical points as a reference. The geodetic mapping activities will require the installation of targets on the Property and then using a small aircraft to take photographs while flying over the Property. All flights will occur during daylight hours and two (2) flights will be required. Those flights will be spaced several weeks apart. Mapping will require from one (1) to three (3) site visits. Site visits may last up to eight (8) hours in duration and will require two (2) persons on the first site visit and one (1) person on any subsequent site visits.

In addition to the small aircraft, equipment used to complete the mapping activity will include standard survey trucks and, if the Property is muddy, all terrain vehicles for property access. A tripod, a hand-held receiver, antenna and data collector unit will also be used. The targets will be set by using a sledgehammer to drive iron pipe flush with the ground surface. The iron pipes will be placed at the center of an aerial ground target. GPS surveying equipment will then be used to determine the exact location of the target. If livestock is present, chicken wire (or a similar type of fence fabric) will be installed around the target marker by using a hand-held staple gun and hammer. Staff will return with GPS equipment to resurvey, check, clean, and repair the target when necessary. After the second aerial flight has been completed, staff will return to remove target material from the ground surface. Property owners may elect to retain the iron pipes installed on the Property for future use.

Field surveying will occur to study possible future project alignments. Surveying activities will require the use of two (2) by two (2) inch wood lath-stakes with flagging. Stakes will be placed in the ground following a linear progression that may traverse the Property. Survey crews consisting of three (3) to five (5) individuals will be on site during daylight hours. Site visits may occur on non-consecutive days and may take from six (6) to sixteen (16) hours to complete. Survey crews will use a vehicle and hand-held field surveying equipment to complete field surveys.

Geodetic, mapping, and surveying activities in the study area may have a significant impact on any future design, scheduling and/or cost of a preferred alignment for a future project.

☒ **II. ENGINEERING GEOLOGY**

Geologic activities will include field surveying, mapping and geotechnical exploration. The geotechnical exploration will include auger and/or mud rotary drilling, soils sampling using a Standard Penetometer Test (SPT) barrel, Modified California spoon, Hydro-punch, and Shelby tubes, Cone Penetometer Testing (CPT), resistivity surveys, and the installation and monitoring of groundwater monitoring wells. The excavation of test pits is possible. Prior to exploration activities, several site inspections will be needed to evaluate access, potential environmental restrictions, potential cultural and archaeological resources, the locations of underground utilities, etc.

Site exploration will be performed in phases. Phases will measure electrical resistivity, drill exploration, and the possible excavation of test pits. Activities for each phase can last from a few hours to a few days and are described as follows:

A. Electrical Resistivity Measurements. Electrical resistivity measurements will be taken that require personnel to set up equipment and perform tests. Electrical resistivity equipment consists of hand-held and suit case-size equipment. Four (4) one-half inch diameter steel probes are temporarily hammered about twelve (12) inches deep into the ground and are connected together with wires. Measurements of voltage and current are taken between pairs of electrodes. Test measurements take approximately thirty (30) minutes to complete. At completion probes and equipment are removed. Measurements may require up to three (3) vehicles and up to four (4) staff on site at any one time including a geologist or geophysicist to set up the equipment and perform the tests, and an environmental monitor. Vehicles may include the geophysicist's pick-up truck, a geologist's vehicle, and an environmental monitor's vehicle.

B. Geologic Test Pits. Geologic test pits may be excavated to obtain the engineering characteristics of the in-situ soils. Soil samples may also be obtained. The geologic test pits generally will not exceed twenty (20) feet long by four (4) feet wide, and are normally much smaller. Geologic test pits will be excavated to a depth of approximately twelve (12) feet using a standard size backhoe, equivalent in size to a John Deere, Model 580. The excavation of test pits may require from two (2) to four (4) persons including an equipment operator and a helper, and a geologist to direct the work. In addition, an environmental scientist will be at the site. Vehicles will include the back-hoe operator's truck, a geologist's vehicle, and the environmental monitor's vehicle. Once test pits have been inspected and sampled, they will be backfilled with native materials.

C. Drill Exploration. Drill exploration will generally be performed using a six and a half to 8-inch diameter auger or 94mm (3.7 inch) to 134mm (5.3 inch) diameter mud rotary drill rig. The drill rig is usually truck-mounted and powered by an industrial engine with 200 to 300 cubic inches of displacement, equipped with a muffler and spark arrester. Soil samples will be obtained for testing. Upon completion of drilling, holes will be sealed using cement-bentonite grout. The depth of test holes will vary from about five (5) feet to two-hundred and twenty-five (225) feet. An associated truck or small loader with a "Baker Tank" or drums may be on site to dispose of drilling mud and cuttings resulting from rotary drilling. Additional vehicles may be present at short time intervals to deliver supplies. The drilling time required for each drill hole is normally less than 2 (two) to five (5) work days. Weather, site conditions and/or mechanical breakdown may lengthen the drilling time. Drilling activities may require up to four (4) vehicles and up to six (6) staff on site at any one time. Cone Penetrometer testing (CPT) will require a Rig (generally truck-mounted) to push a hole, a tender truck and/or a driller's pick-up truck and trailer with grouting equipment, a geologist's vehicle, and an environmental monitor's vehicle.

D. Monitoring Wells. Monitoring wells may be installed at any of the drill exploration sites to measure groundwater elevation. The monitoring well may consist of one or more screened well points. Access to the monitoring well will be through a bolted well-cover, flush with the ground surface, or a lockable metal monument. Beneath the bolt-on-well cover, individual well castings will have padlocked caps. It is estimated from one (1) to two (2) persons and one (1) vehicle will return to the site for monitoring purposes. Site visits may last up to thirty (30) minutes in duration and will occur on non-consecutive days.

E. Underground Service Alert ("USA"). Prior to drilling or digging, USA (Underground Service Alert) will be contacted to mark all known utility lines.

The only dust hazard associated with equipment used for Engineering Geological activities is dust resulting from driving to and from drill sites. The results of geologic, surveying, mapping and geotechnical exploration activities in the study area may have a significant impact on any future design, scheduling and/or cost of a preferred alignment for a future project.

☒ III. UTILITIES

Inventory of existing utilities will consist of a review of public records and a walking survey of the Property. Records review and walking surveys are completed in compliance with best practices as outlined by the California Public Utilities Commission. Site reconnaissance consists of ground surveys with minimal ground disturbance. Shallow scraping of surface soils, one (1) to three (3) inches deep, in small, localized areas may be required. Upon completion of site reconnaissance DWR will restore the Property, as near as possible, to its original condition.

☒ IV. CULTURAL RESOURCES

Studies of cultural resources include both archaeological surveys and architectural and historic resource evaluations. A site visit will be conducted in order to perform a Phase 1 Cultural Resources Inventory in compliance with the California Environmental Quality Act and the National Historic Preservation Act implementing regulations.

Archaeological surveys involve walking across the Property and recording any archaeological resources that are observed on the ground surface and will follow the Secretary of the Interior's Standard's for the Identification of Historic Properties. If the ground surface is not visible due to vegetation, surveyors may use a hand trowel or a small shovel to perform minimally invasive clearance of vegetation, scraping soils to a depth of one (1) to three (3) inches, in small, localized areas. Upon completion of vegetation scraping, DWR will restore the Property, as near as possible, to its original condition.

Different types of strategies are employed when conducting cultural surveys. An intensive strategy uses 15-meter transects, depending on the likelihood of encountering significant cultural resources. This approach will be modified only when unsafe situations or impassable terrain are encountered. In such areas, a moderate to cursory strategy will be employed using meandering and 20-meter or greater transects. The surveys will proceed at an estimated rate of thirty (30) acres per day per person. Depending on the number of surveyors and acreage, the Property may be accessed for up to five (5) days.

Site visits will include condition assessments which will involve ground-truthing of previously recorded or known cultural resources. Using cursory surveys, an archaeologist will verify the accuracy of site records and site locations, as well as the presence or absence of artifacts and/or human remains. Most known cultural resources are listed as prehistoric archaeological sites that primarily include burial mounds and/or habitation sites, along with some lithic scatters and baked clay deposits. Numerous historic era resources, such as architectural and engineering features, also exist throughout the study area.

A random sample survey will be conducted for these resources. These types of visits include, but are not limited to, single day field inspections.

Photographs and Global Positioning System (GPS) location readings will be taken for archaeological, architectural, and historic era resources. Architectural and historic era resource evaluations will involve noting the structures present on the Property (houses, barns, sheds, etc.) and historic era features (e.g., levees) within the study area.

The presence of cultural resources within the study area that are eligible for listing in either the California Register of Historical Resources, or the National Register of Historic Places may have a significant impact on any future design, scheduling and/or cost of conveyance planning or restoration opportunity for a future project. In the event that a preferred alternative or restoration opportunity areas are chosen, an intensive cultural resources survey will be conducted.

☒ V. ENVIRONMENTAL STUDIES

The environmental surveys involve a variety of specialties and primarily consist of observations made by environmental scientists. Minor ground disturbances with a shovel or hand trowel may be required. Any holes will be filled and compacted immediately. Regardless of the surveys to be conducted, DWR will restore the Property, as near as possible, to its original condition.

A. Botanical Surveys: Surveys will include walking the Property, recording plant species, collecting unknown plant species, photographing plants and habitats, and conducting wetland delineations (when applicable). The Property will be accessed by small vehicle and/or a small boat. Hand-held GPS receivers, cameras, and notebooks will be used to complete the surveys. Hand-held shovels will be used to dig holes approximately two (2) feet wide by two (2) feet deep in order to study soils if wetland delineations are required. Any disturbance of property soils will be minor and will be returned to the original condition to the best extent possible. All botanical surveys and delineations will be conducted during daylight hours during the months of February through October. It is anticipated that botanical surveys will take from one (1) to four (4) days to complete and that from one (1) to six (6) persons may be on the Property at a time. Should wetlands be found, an additional one (1) to four (4) days may be needed to complete delineations.

B. Fisheries Studies: Habitat evaluations for various sensitive fish species may include evaluation of water depth, flow velocities, water quality, riparian vegetation, and channel substrate. Fish sampling in adjacent sloughs may require vehicle access for transport of nets and other sampling equipment. Fisheries Studies fall into two categories and are described as follows:

1). Fisheries Surveys will include surveying all rivers and streams on the Property that may be within a sensitive fish species distribution range, and will include the visual evaluation of habitat including upland and riparian vegetation. Activities to conduct water quality sampling of temperature and dissolved oxygen content, water depth and flow-velocities will include the use of a vehicle, a small boat or kayak, binoculars, buckets, seines and nets, fish measuring boards and microscopes. The days and hours required to complete surveys will occur two (2) weeks a month, for three (3) days each week, and may last up to eight (8) hours each day in order to complete the surveys. It is anticipated surveys will occur between September and May.

2). Hydrologic Surveys will include identification and characterization of drainage, streams, creeks, storm water drains, and storm water flow patterns that may impact water quality. Equipment required to conduct hydrologic surveys will include a vehicle and a small boat. All hydrologic surveys will occur during daylight hours and will take from two (2) to four (4) persons to complete the survey. Surveys may require from one (1) to six (6) site visits to complete and will occur on non-consecutive days during the wet and dry seasons.

C. Wildlife Surveys: Habitat evaluations will be completed for all sensitive species in the study area with the potential for surveys to determine whether sensitive species are present as well as their distribution on the Property. Surveys of wildlife fall into four generalized categories and are described as follows:

1). Vernal Pool Surveys: In the office, aerial photograph interpretation with soil characterizations for likelihood of vernal pool presence will be completed. In the field, locations of vernal pools based on vegetation, soil characteristics, ponding, and the presence of invertebrates will be determined. These determinations are made through driving surveys (where appropriate), walking surveys, and dip-netting in ponded pools. Digital photographs documenting the pools will be taken. A handheld Global Positioning System (GPS) unit will be used to document the approximate location of each pool. Additional equipment that may be used includes a thermometer, a depth measuring tool, rubber boots, and binoculars.

DWR's intention is to continue dipnetting in ponded pools within two (2) weeks following a significant rain event and then every two (2) weeks thereafter until the pools have completely dried down for the season. Therefore, during the rainy season, DWR teams may visit the Property every two (2) weeks for approximately six (6) to eight (8) months beginning as early as October and ending as late as May. Protocol level surveys require that these surveys continue for two (2) seasons. Once it is determined that a vernal pool has a listed fairy shrimp or tadpole shrimp species, then the pool will no longer need to be surveyed. In this case, a determination will be made as to whether the entire property will require continued surveys. All activities will occur during daylight hours.

2). Reptilian and Amphibian Surveys: Evaluations of aquatic and terrestrial habitats for sensitive species of reptiles and amphibians will occur on the Property and will include at the very least visual surveys. In addition to visually assessing the quantity and quality of habitats, surveys aimed at locating the presence of specific sensitive species may also be conducted. Specific surveys have been proposed for three (3) species of reptiles and amphibians at this time: California tiger salamander (CTS; Ambystoma californiese), California red-legged frog (CRF; Rana draytonii), and Giant garter snake (GGS; Thamnophis gigas). Other sensitive reptile and amphibian species will be recorded during the course of these surveys. All surveys described below will require at least one team of two (2) biologists working together at a particular location. The number of teams could vary from one to many depending upon the amount of habitat available on the Property. It may be the case that each two-person team will occupy separate vehicles, resulting in multiple vehicles on site for each survey. All sensitive species observed will be photographed, when possible, and their locations recorded using a GPS.

a). CTS Surveys. CTS surveys will include visual encounter surveys for eggs and aquatic sampling for larvae. The habitat will also be mapped, photographed, and characterized using a GPS, camera, depth meter, turbidity meter, thermometer, and salinity meter. The egg surveys for CTS will typically take place concurrently with vernal pool invertebrate surveys. However, in non-vernal pool habitat (e.g., stock ponds) that has the potential to support CTS, surveys for CTS eggs may also be conducted. These surveys will involve walking the perimeter of a water body, visually surveying for eggs. Surveys will be conducted during daylight hours, potentially as often as once every two (2) weeks, beginning in November and extending through February. Three (3) aquatic larvae surveys will also be conducted using a dipnet, seine, and/or cast net to sample the water body for CTS larvae. These surveys are typically conducted once per month from March through May; however, actual timing of the surveys may need to be adjusted depending upon rainfall and ponding duration.

b). CRF Surveys. CRF surveys involve searching for eggs and larvae, as well as for juveniles and breeding adults. The habitat will also be mapped, photographed, and characterized using a GPS, camera, depth meter, turbidity meter, thermometer, and salinity meter. CRF egg surveys occur during daylight hours and involve walking along the edges of potential breeding habitat visually searching for egg masses using binoculars and documenting any species of frogs and toads observed. In addition, surveys for juvenile and adult CRFs will take place at night beginning one (1) hour after sunset, using headlamps, flashlights, and binoculars. Both the egg surveys and juveniles and breeding adult surveys will be conducted approximately once a month from January through March. Surveys for CRF larvae will be conducted approximately once a month during daylight hours from April through June.

c). GGS Surveys. GGS surveys involve visually searching for snakes and hand capturing them, as well as attempting to capture them in aquatic traps. The habitat will also be mapped, photographed, and characterized using a GPS, camera, depth meter, turbidity meter, thermometer, and salinity meter. Visual surveys for GGS involve walking the Property, typically in the morning hours, from mid-March through late-September, using binoculars, and capturing observed snakes by hand. Trapping surveys take place between May 1, and October 1, and involve placing floating modified minnow traps in the water and leaving them on-site for approximately two (2) weeks for each trap-line. Multiple trap lines may be set on the Property if sufficient habitat exists, or two trapping efforts may be necessary to capture different activity levels determined by ambient temperature changes. Traps must be checked daily during daylight hours. All captured snakes are photographed and processed using the following equipment: cameras; tape measures; spring-scales; measuring calipers; micro-cauterizers; PIT tags, syringes, and tag readers; scissors; and vials with ethanol for preserving tissue samples.

3). Avian Surveys: On-site evaluation of habitat for sensitive bird species will include observations from vehicles and may also involve walking surveys of the Property. Species-specific surveys will be conducted primarily by walking transects through appropriate habitat. Equipment used will include vehicles, binoculars/spotting scopes, cameras, and GPS units. Surveys will generally require two (2) days work with up to eight (8) hours per day; in a few cases four (4) days of surveys may be required. Surveys may be conducted for multiple years, although surveys on most parcels will be completed in a single survey season. In those rare instances involving multi-year survey periods, there may be as many as ten (10) days of surveys over the multi-year survey period. It is anticipated surveys will occur from March through September.

4). Mammal Surveys: Equipment required for all mammal surveys may include four-wheel drive trucks, all-terrain vehicles (ATVs), maps, GPS units, flagging, computer equipment, and kayaks/canoes.

a). Riparian Brush Rabbit and Riparian Wood Rat Surveys. Surveys for Riparian Brush Rabbit and Riparian Woodrat will include on site habitat analysis and where appropriate, via species-specific trapping in riparian scrub and riparian forest habitat. Rabbit and Woodrat surveys may use species-specific traps, track plates, and auto photography units. The Rabbit and Woodrat surveys may take as many as ten (10) days per year, eight (8) hours in duration and may occur in the early morning, evening, or night hours.

b). Bat Species Surveys. Habitat evaluation surveys for various sensitive bat species will be conducted, and in very few instances, habitat may be surveyed for the bat species themselves, via mist netting and passive auditory surveys during the evening. A minimum of two-person crews will be involved for each survey. In addition, bat surveyors may use solar panel-powered bat auditory recording equipment left on site for a two-week period, and in very rare instances, bat mist nets that would be monitored by bat biologists during on-site evening observation periods. The bat surveys may take as many as ten (10) days per year, up to eight (8) hours in duration and may occur during morning, afternoon, evening, and night hours.

c). Salt Marsh Harvest Mouse Surveys. Salt marsh harvest mouse surveys may be conducted between April and October by a two-person crew. Depending on the amount of habitat present the crew may exceed two people. Evaluation of habitat may occur on the Property and will include visual walking surveys. Surveys generally take place once over five (5) consecutive days during the hours around dusk and dawn. Equipment used includes vehicles, GPS, cameras, thermometers, wind meters, aluminum live-traps, pin flags, rulers, calipers, scissors, and hand lenses. The anticipated survey months are February through November. Surveys will be for the durations previously described and will occur on two consecutive years. Survey requirements and entry on the Property are subject to change depending on the result of the first year's surveys.

D. **Recreation Surveys.** Recreational Surveys will include identification and observation of any existing recreation use on the Property as well as adjacent waterways. Identification and observations will require: documentation of the types of recreational activities on the Property and type of equipment used by recreationists; the estimated number of recreationists who use the Property; interviews to gain information about visitor origin, residence, and habits; determining the season(s) of use (if any); and scoping the potential for future recreational use. Studies will require a two (2) person team for each site visit. Equipment used for the surveys will include hand-held cameras, binoculars, and clipboards. Personnel will use a vehicle while on site. Site visits will occur between 7:00 a.m. and 7:00 p.m. A typical site visit takes less than one (1) hour to complete; however, in some instances to obtain meaningful observations of activities and/or interviews with recreationists, some site visits may take up to twelve (12) hours to complete. Depending on the type of recreation being observed, personnel may visit the site once a day, or up to five (5) times per day. Recreational activities tend to be seasonal and will be observed on non-consecutive days between the months of March and November. During those months personnel may be on the Property for up to thirty (30) non-consecutive days for one or more site visit each day.

E. **After-Survey Monitoring**. In addition to the surveys described above, information concerning the occurrence of threatened or endangered species at sites containing potential habitat for the species, or sites designated as critical for the species, must be obtained through properly conducted surveys carried out by a permitted biologist.

Environmental surveying and monitoring activities in the study area may have a significant impact on any future design, scheduling and/or cost of a preferred alignment for a future project.

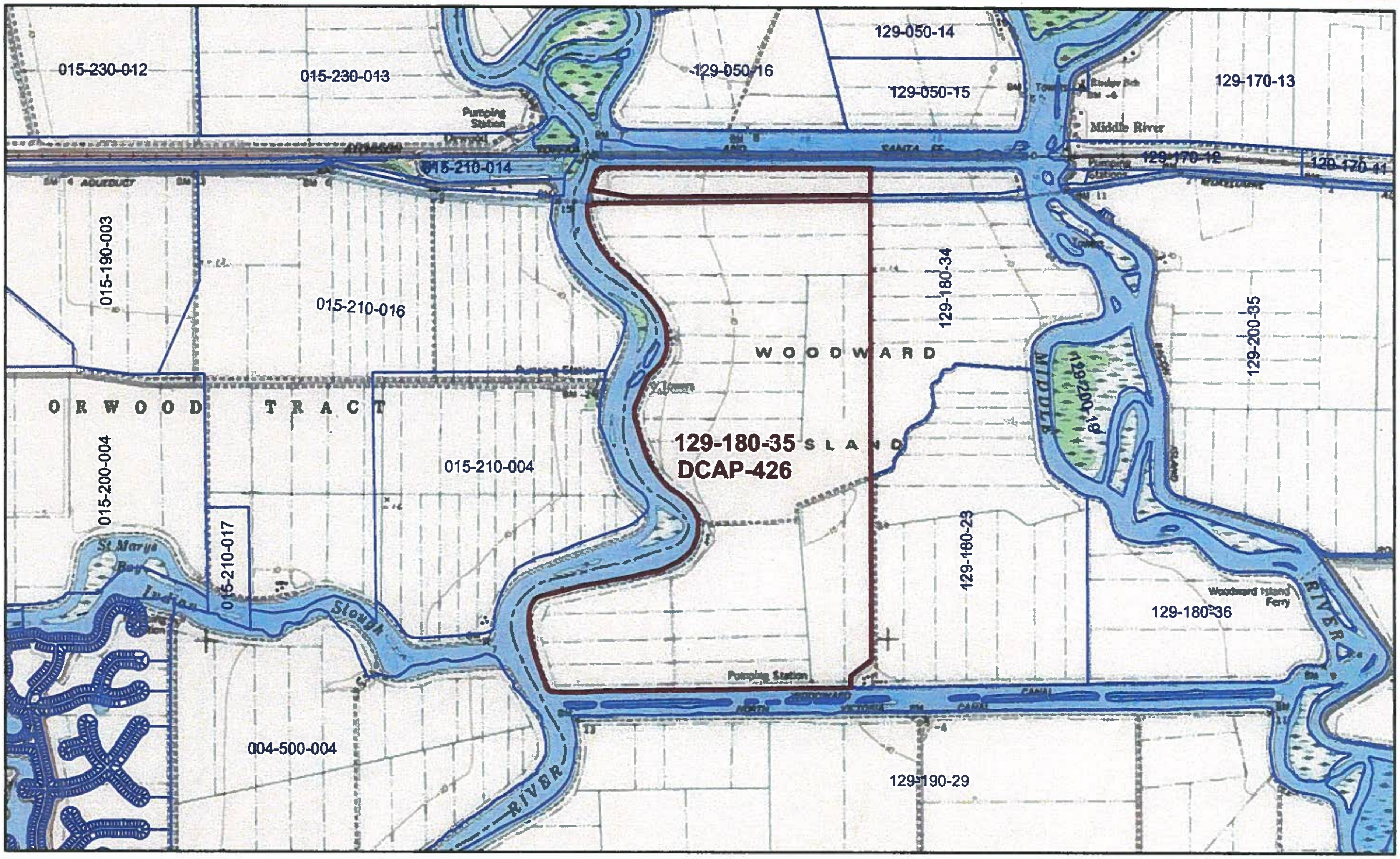
☒ VI. PHASE 1 ENVIRONMENTAL SITE ASSESSMENT

The purpose of the Phase 1 Environmental Site Assessment is to evaluate the study area for potential environmental hazards or degradation caused by the release of hazardous materials. The study area can consist of all parcels and adjacent properties within and outside the study area, including access roads and staging areas. This investigation will include the review of historic land use and land title records, federal and state regulatory agency environmental databases, consultation with local environmental health officials, and communication with the current land owners or operators.

Phase 1 Environmental Site Assessment will include entering the Property to perform site reconnaissance in accordance with the American Society of Testing Materials (ASTM), Standard Practice for Environmental Site Assessment; Phase 1 Environmental Site Assessment Process Designation 1527-05 and newly adopted federal regulations pursuant to 40 Code of Federal Regulation, Part 312 – Standards and Practices for all Appropriate Inquires. Site assessment will include the use of a 3/4 ton pickup or a kayak or canoe where appropriate, and will include walking the Property, making visual observations, and documenting visual observations and recording locations of "recognized environmental conditions" using GPS, digital photography, and tape measures. Should it be determined that the collection of samples are necessary, a hand-auger, three (3) inches in diameter will be used to auger to a maximum soil depth of fifteen (15) feet. A shovel will be used for surface work and replacement of soil extracted from the collection of samples. Any disturbance of property soils will be minor and will be returned to pre-survey conditions to the best extent possible. Whenever possible, a predetermined sampling location will be identified prior to taking samples.

Site visits will occur only during daylight hours, most likely between the hours of 8:00 a.m. to 7:00 p.m. and will require from one (1) to three (3) staff persons on site. Visits may last up to a day and a half in duration. If the Property is large in size, multiple visits may be required, but no more than five (5) site visits will be required for Phase 1 Environmental Site Assessment activities.

The presence of recognized environmental conditions within the study area may have a significant impact on any future design, scheduling and/or cost of a preferred alignment for a future project.



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DELTA HABITAT CONSERVATION AND CONVEYANCE PROGRAM PARCEL EXHIBIT - ALL TUNNEL

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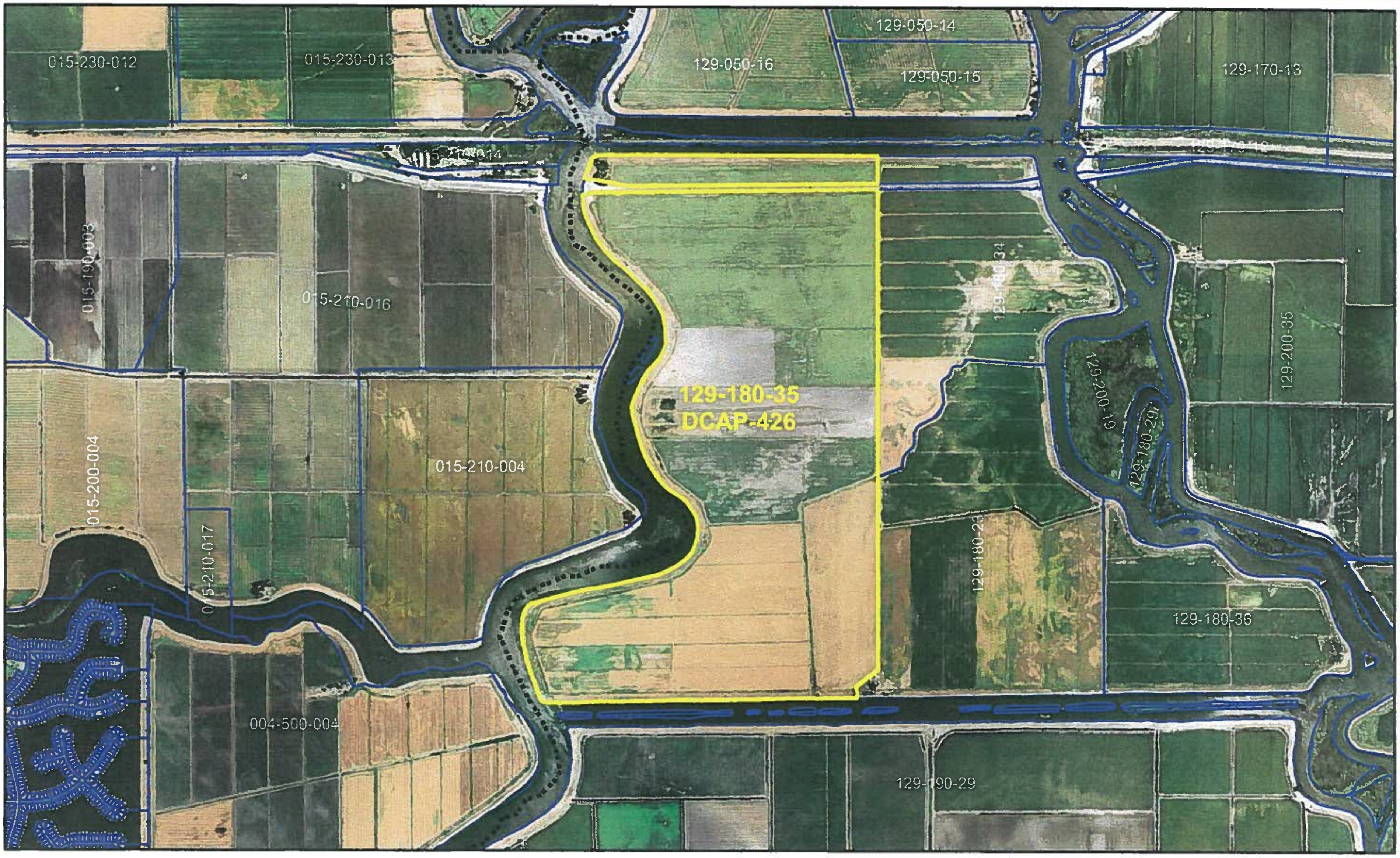

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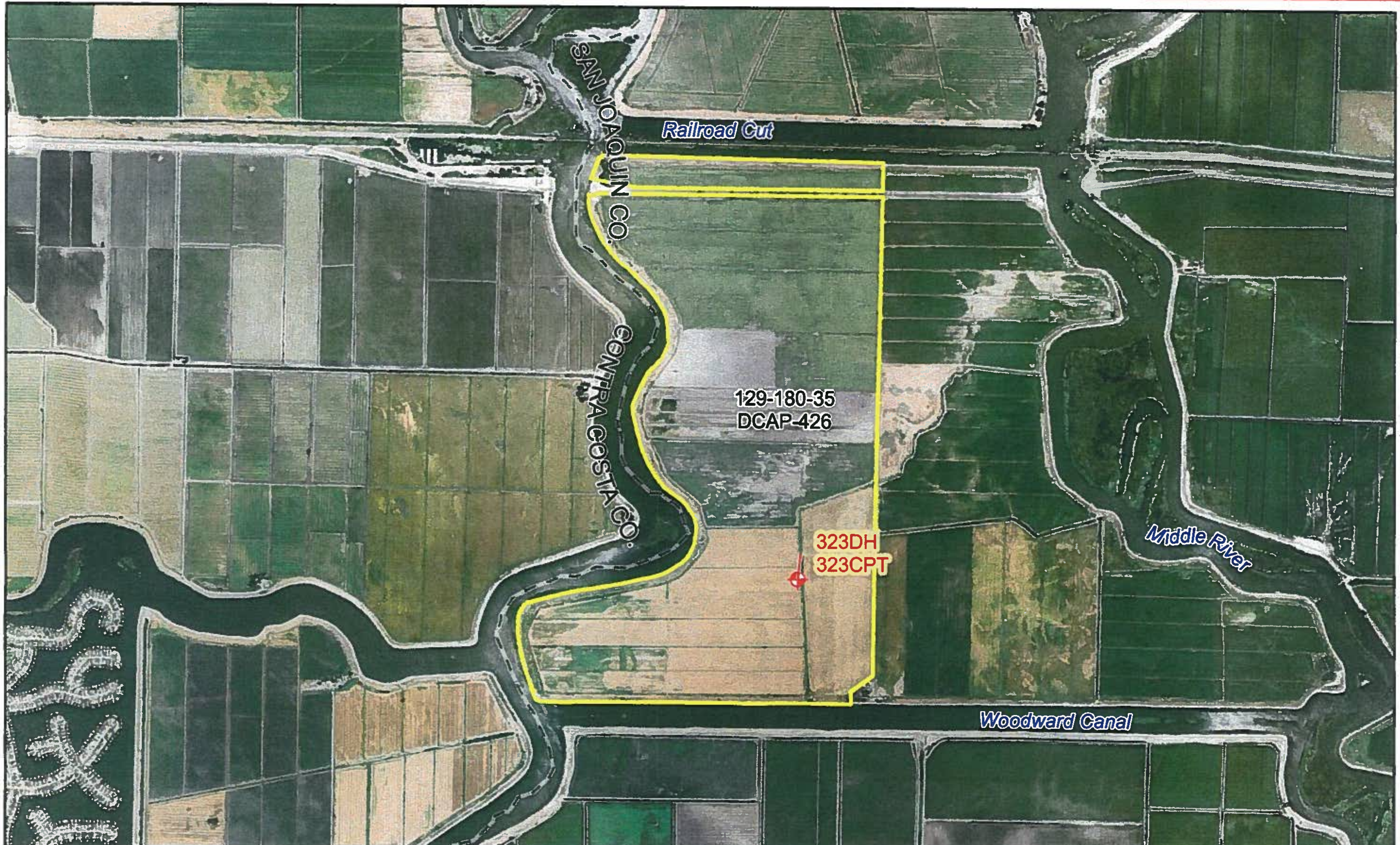

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DELTA HABITAT CONSERVATION AND CONVEYANCE PROGRAM
PARCEL EXHIBIT - PROPOSED BORINGS

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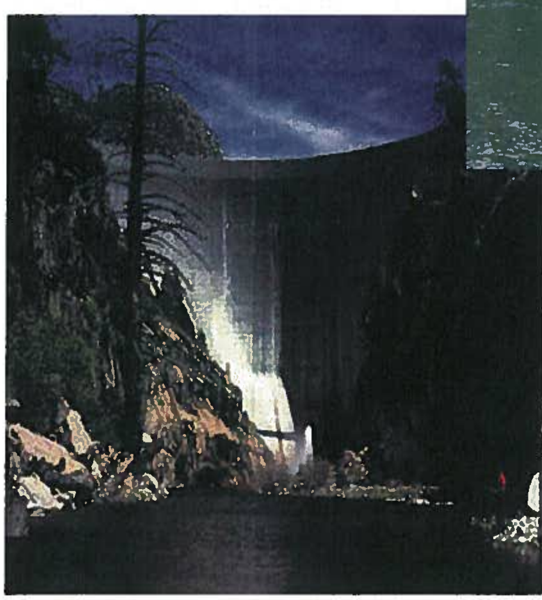
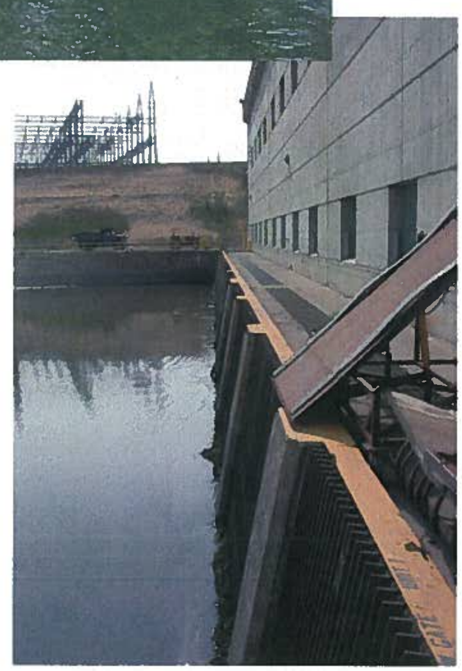
Listen to the River:
An Independent Review of the CVPIA Fisheries Program





December 2008

Exhibit 32

BDCP1632

Listen to the River: An Independent Review of the CVPIA Fisheries Program

Prepared under contract with Circlepoint for the
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U.S. Fish and Wildlife Service

December 2008

Independent Review Panel

Ken Cummins, PhD.: Senior Advisory Scientist, California Cooperative Fishery Research Unit, Adjunct Professor, Fisheries Department, Humboldt State University

Chris Furey, J.D.: Policy Analyst, Bonneville Power Administration

Albert Giorgi, PhD.: President and Senior Scientist, Bioanalysts, Inc.

Steve Lindley, PhD.: Ecologist, National Marine Fisheries Services lab, Santa Cruz

John Nestler, PhD.: Cognitive Ecology and Ecohydraulics Team, US Army Corps of Engineers Research and Development Center; Adjunct Professor, Department of Civil and Environmental Engineering University of Iowa and University of Georgia; Co-director Tropical Environmental Research, University of Puerto Rico

John Shurts, J.D., PhD.: General Counsel, Northwest Power and Conservation Council; Adjunct Professor, Portland State University and University of Portland

Expanded panel biographies are included as Appendix B.

The document is the product of the panelists and does not reflect the opinions or positions of the agencies or organizations they represent.

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Listen to the River: An Independent Review of the CVPIA Fisheries Program

Executive Summary

In 1992 Congress directed the Department of Interior to develop and implement a program that makes "all reasonable efforts" to ensure and sustain on a long-term basis a doubling of the number of naturally produced anadromous fish in Central Valley rivers and streams by 2002. Doubling did not happen by the legislative goal of 2002, or by 2008, nor is it likely to ever occur unless renewed commitments and improvements are made to the CVPIA program.

What we do know is that while a few small populations of chinook salmon have shown apparent gains, on the whole the Central Valley's naturally produced anadromous fish populations stayed relatively even or declined from 1992-2005. Recent surveys have indicated that over the last several years, fall-run chinook populations have collapsed. As a result, the federal government closed the ocean salmon fisheries south of Cape Falcon to protect Central Valley chinook stocks in 2008, a first-time event. Many of the same species continue to be listed as threatened or even endangered under the federal and State endangered species acts, as is the Delta smelt, another Central Valley fish in collapse and perhaps on the verge of extinction. Federal courts have recently invalidated as inadequate federal plans to address the requirements of these species under the federal Endangered Species Act.

Why has this happened? The Bureau of Reclamation (Reclamation) and the Fish and Wildlife Service (Service) are the Interior Department's co-leads on an anadromous fish restoration program mandated by Congress' 1992 Central Valley Project Improvement Act (CVPIA). Have the agencies failed to implement their assigned mission effectively? The agencies have implemented a slew of activities in sixteen years costing nearly a billion dollars. They have addressed some of the valley's serious impediments to salmon and steelhead survival. These improvement include installing state-of-the-art screens at big irrigation diversions; installing and implementing a water temperature control device at Shasta Dam; improving fish passage operations at Red Bluff Diversion Dam; dedicating stored water in the Sacramento River mainstem and a number of the tributaries to benefit spawning, rearing and migration; removing passage barriers and improving channel conditions in a number of tributaries; and more. It is likely that matters would be even worse without these improvements. Still, the apparent population gains have been modest, and even those gains may not hold for the future. Conditions outside the control of the federal agencies – in particular, drought and conditions in the ocean – are likely contributing to the recent collapse of fall-run chinook at some level. However, these conditions do not explain the lack of improvement in status of most anadromous fish populations since 1992.

The specific "doubling" mission itself may make little scientific or policy sense, especially within the time frames demanded. Yet it is also far from clear that the agencies have done what is possible and necessary to improve freshwater conditions to help these species weather environmental variability, halt their decline and begin rebuilding in a sustainable way. A number of the most serious impediments to survival and recovery are not being effectively addressed, especially in terms of the overall design and operation of the Central Valley Project system.

Underlying this independent review of the CVPIA anadromous fish program, asked for by the federal agencies, is the question why the CVPIA program has not been successful in achieving its mission. In this report, we identify scientific, institutional and programmatic obstacles to the success of the CVPIA, drawing conclusions from the information provided. Based on these conclusions, we make recommendations to Reclamation and the Service on how these obstacles might be overcome, including:

1. The Interior Department, at the highest department and agency levels, needs to rethink the entire approach to the CVPIA anadromous fish restoration program. There needs to *be* an overarching, discretely and comprehensively organized and staffed Anadromous Fish Restoration Program, led by one official highly placed in the agency that has the funding and implementation responsibility. This lead must have management authority and appropriate staff to utilize all the activities, tools, authorities and personnel together to support the overarching program. Program reform will require active involvement at the Assistant Secretary level within Interior, taking fundamental responsibility to ensure program success. This may sound obvious, but it is *not* the way the agencies are organized now to implement the CVPIA.

2. Next, the agencies need to go back to initial program guidance and assumptions and rebuild the program plan. That plan must organize the program around an explicit framework and conceptual foundation that links possible actions to desired environmental change, which is then both systematic and honest about the potential for these environmental changes to yield improvements in the biological performance of the focal species. The program needs a linked framework of actions, objectives and ultimate goals tied together with an explicit scientific foundation explaining these relationships. The program also needs an explicit adaptive management effort infused throughout to identify uncertainties, risks and potential; direct monitoring and management attention at resolving uncertainties; and plan for different courses of action at different levels of risk depending on how uncertainties and conditions resolve over time.

3. The agencies should develop a more expansive view of the authorities at their disposal to address the problems, especially with regard to water management and project operations. The agencies have followed a more restrictive view of their authorities than appears legally necessary or appropriate to the seriousness of the mission – certainly the federal courts believe the agencies have more tools at their calling. Reclamation in particular needs to embrace this mission with equal zeal to its

core mission of water supply and find a way to bring these two missions into balance and improve ecological conditions in a highly managed river system. To be successful, Reclamation will need to revitalize its mission working both with its agency partners and with its contractor partners who have a fundamental economic stake in helping Reclamation be successful in integrating anadromous fish improvements as a baseline program cost of delivering water.

4. In redesigning the program plan, the agencies must do a fundamentally better job addressing the problems at the system-wide scale. The program appears able to identify and attack discrete limiting factors at a local and reach-specific level – e.g., install the temperature control device at Shasta Dam, improve a significant diversion screen here, add more gravel there, take out this weir blocking passage, increase flows 100 cfs in this reach, and so forth. The root of any population improvement lies in these actions, typically focused in a few subbasins or reaches. Even these estimates of salmon population gains carry high uncertainty. The program effectively ignores the larger system problems that inhibit the natural production of anadromous fish:

- headwaters dams that have taken away most of the spawning and rearing capacity in the valley;
- highly regulated flows and diversions completely out of balance with natural flow regimes to which these species are adapted;
- rivers levied and channeled and disconnected from floodplains to such an extent that natural river habitats and rearing conditions are largely absent; and
- environmentally degraded conditions for fish in the Delta due to water exports, degraded water quality, entrainment, and predation that are a significant source of poorly addressed mortality.

The agencies need to fully use their authorities to understand and address the system problems, or ask Congress for additional authorities and guidance.

5. Finally, the CVPIA will not be successful in isolation from other activities within the region. Interior should use the CVPIA program to take a leadership role in collaboration with the other efforts attempting to improve fish populations, habitat conditions, and ecosystem function in the Central Valley.

Listen to the River: An Independent Review of the CVPIA Fisheries Program

Organization of this Report

Independent Review

The Office of Management and Budget (OMB) evaluated the progress of the Central Valley Project Improvement Act (CVPIA) program in 2006. OMB had concerns that stemmed in part from the disparity between the "double by 2002" objective, and the current status of Central Valley anadromous fish populations. OMB questioned the lack of measurable performance goals for program implementation, especially goals that could relate to factors within the control of the agencies in program implementation.

OMB recommended that the agencies undertake a comprehensive program review, including an independent science review. In 2008, Reclamation and the Service organized this independent review in response to the OMB critique, seeking to address four objectives:

- Improve the effectiveness and efficiency of programs and implementation actions to achieve the fish restoration goals of the Act;
- Enhance the agencies' ability to learn from and optimize program actions;
- Improve the transparency and accountability of the fish restoration programs to management, stakeholders, and the public; and
- By achieving the first three objectives, enhance public understanding and support for the program and continuing restoration activities.

The agencies hired contractors to organize, facilitate and conduct the independent review of the CVPIA anadromous fish program. Six panel members were selected, vetted and appointed to the review committee. Brief biographies of the panel members are included in Appendix B. The review panel began its work in May 2008. The agencies and the contractors provided the panel with background information on the program. The information provided to the panel included presentations by agency personnel at five public sessions in Sacramento in late May and early June 2008.

Consistent with the review objectives above, the agencies developed a set of ten questions for the independent review panel to consider during its review. The questions ask the panel to assess the effectiveness of different CVPIA programs and activities in contributing to the doubling of anadromous fish populations, how well the agencies have identified, prioritized and responded to the factors limiting the natural production of anadromous fish, and how well the agencies have monitored and evaluated and learned from the actions that have been implemented. The review objectives and questions have guided the panel in reviewing the program and preparing this report. Appendix A includes the ten specific questions asked of the panel and provides short answers to each one based on longer discussions within the body of this report.

Report Organization

We have organized this report into four parts and supporting appendices:

Part 1: CVPIA Background
Part 2: Implementing the CVPIA
Part 3: Program Limitations and Recommendations
- **Section 3a** Improve the Program's Science-Based Framework
- **Section 3b** Reorganize Program Structure and Management
- **Section 3c** Improve Implementation by Making Full Use of CVPIA Authorities
- **Section 3d** Improve Collaboration With all Related Programs in the Central Valley

Part 4: Major Recommendations

Appendices
- **A** Critical Questions and Panel Responses
- **B** Panel Biographies
- **C** Examples and Additional Information
  - **C1:** Ecological Risk Assessment/Ecosystem Management Example and Further Considerations
  - **C2:** Understanding the Entire Picture: Gravel Augmentation
  - **C3:** Columbia River Monitoring and Evaluation Example
  - **C4:** Information System Example
  - **C5:** Additional Discussion on Management Structure and the Glen Canyon Example
  - **C6:** Additional Discussion of CVPIA Funding
- **D** References

Acknowledgments

The panel expresses its deep appreciation for the assistance and cooperation of personnel from the Bureau of Reclamation and the Fish and Wildlife Service in what had to be a thankless effort to educate the review panel in a few weeks about what they have lived and learned for years and, in some cases, decades. Thanks are also due to John Spranza of PBS&J for his assistance in so many ways substantive and logistical, to Dave Wegner for his many insights, and to the people of CirclePoint and particularly, Mary Bean for review process logistics. The panel reserves its greatest appreciation for the excellent assistance of Patti Kroen, mighty facilitator.

Part 1: CVPIA Background

The Central Valley Project and Anadromous Fish

The Central Valley Project (CVP) is one of the world's largest water storage and conveyance systems. In a re-engineering of the Sacramento and San Joaquin rivers, the project includes 20 dams and reservoirs capable of storing 11 million acre-feet of water; 11 power plants; diversion facilities for moving water out of the rivers for other uses, including powerful pumps that export millions of acre-feet of water south and west out of the Sacramento/San Joaquin Delta (Delta); 500 miles of major canals and aqueducts; and various related facilities. The CVP, managed by Reclamation in the Interior Department, conveys about 20 percent of the state's developed water from the Sacramento, Trinity, American, Stanislaus, and San Joaquin rivers to agricultural and municipal water users and wildlife refuges in the Sacramento and San Joaquin valleys and the San Francisco Bay area. Reclamation must coordinate CVP operations with the State Water Project (SWP), which also conveys additional millions of acre-feet of water away from the Delta. The SWP, managed by the California Department of Water Resources, stores water in the Feather River and also diverts water out of the Delta for use by agricultural and municipal water users in the Sacramento and San Joaquin valleys, the San Francisco Bay area, and the central and southern California coastal areas.

Demands for water from the Sacramento/San Joaquin system escalated continually over the last century, a pattern that state and federal agencies expect to continue. Construction and operation of the CVP and SWP have altered flows, reduced water quality, and degraded environmental conditions and reduced habitat for fish and wildlife in the Central Valley from the headwaters to the Delta. This includes the native anadromous fish of the Central Valley -- winter, spring, fall and late-fall chinook, steelhead and sturgeon. Adult runs that once numbered in the millions have been reduced to thousands or less.

The transformation of the natural Sacramento/San Joaquin river systems into a massive water storage and delivery system includes dams and diversions that have blocked access for anadromous salmonids to much of their historical habitat. Development of the CVP and State Water Project has significantly modified the natural hydrologic, geomorphic, physical and biological systems. The modified river system significantly impacts the native salmon and steelhead production as a result of fragmented habitats, migration barriers, and seasonally altered flow and habitat regimes. Hatcheries produce salmon and steelhead for release within the CVPIA watersheds, including two federal facilities and several state facilities operated by the California Department of Fish and Game.

The alteration of the hydrologic and biologic systems has put at risk of extinction three of the basin's four evolutionary significant units (ESUs) of native anadromous fish: Winter-run chinook are listed as endangered under both the California and federal endangered species acts; Spring-run chinook and steelhead are listed as threatened. Fall-run chinook exist in depleted numbers and are a candidate for listing. Green sturgeon are listed as threatened under the federal ESA. The non-anadromous Delta smelt are endangered.

The Central Valley Project Improvement Act (CVPIA) of 1992

To address the environmental challenges presented by the Central Valley Project while preserving the water supply benefits, Congress passed the Central Valley Project Improvement Act in 1992 (CVPIA). Central to the CVPIA legislation is a directive to the Department of the Interior to include fish and wildlife protection, restoration, enhancement, and mitigation as project purposes having *equal* priority with power generation, irrigation and domestic water uses. The stated purposes of the CVPIA are:

- To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;
- To address impacts of the Central Valley Project on fish, wildlife, and associated habitats;
- To improve the operational flexibility of the Central Valley Project;
- To increase water-related benefits provided by the Central Valley Project to the state of California through expanded use of voluntary water transfers and improved water conservation;
- To contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and
- To achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors. *CVPIA, Section 3402*

Congress directed the Secretary of the Interior, "immediately upon the enactment of the [CVPIA]," to operate the Central Valley Project "to meet all obligations under state and federal law, including but not limited to the federal Endangered Species Act and all decisions of the California State Water Resources Control Board establishing conditions on applicable licenses and permits for the project [decisions largely concerning water quality]." *CVPIA, Section 3406(b)*

With regard to anadromous fish in particular, Congress, in Section 3406(b)(1) of the CVPIA, directed Interior to:

> *Develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991;* Provided, That this goal shall not apply to the San Joaquin River between Friant Dam and the Mendota Pool, for which a separate program is authorized under [a separate subsection of CVPIA]; . . . And provided further, That in the course of developing and implementing this program the Secretary shall make all

> reasonable efforts consistent with the requirements of this section to address other identified adverse environmental impacts of the Central Valley Project not specifically enumerated in this section.

Interior is to develop this anadromous fish program "in consultation with other state and federal agencies, Indian tribes, and affected interests," and review and update the program every five years. Congress defined "anadromous fish" for the purposes of this program to include not only native salmon, steelhead and sturgeon, but also the introduced striped bass and American shad – fish that are competitors with and predators on native salmonids.

In developing this anadromous fish program, the CVPIA requires that Interior give "first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection." Congress further directed the Secretary "to modify Central Valley Project operations" so as "to provide flows of suitable quality, quantity, and timing to protect all life stages of anadromous fish," followed by a specific reference to statutory tools and authorities the Department is to use to provide the water for these flows and by the direction that "[i]nstream flow needs for all Central Valley Project controlled streams and rivers shall be determined by the Secretary based on recommendations of the U.S. Fish and Wildlife Service after consultation with the California Department of Fish and Game."

Following Section 3406 (b)(1) is a long list of operational changes, actions, tools, and authorities – some quite specific and discrete, some general and on-going – that Interior is to use to help achieve the anadromous fish restoration purposes of the CVPIA:

3406	(b)(2)	Dedicated project yield
	(b)(3)	Water acquisition program
	(b)(4)	Tracy Pumping Plant mitigation
	(b)(5)	Contra Costa Pumping Plant mitigation
	(b)(6)	Shasta Temperature Control Device
	(b)(7)	Meet flow standards and diversion limits
	(b)(8)	Short pulses of increased flows
	(b)(9)	Minimize harmful flow fluctuations
	(b)(10)	Minimize passage problems at Red Bluff Diversion Dam
	(b)(11)	Rehabilitate Coleman National Fish Hatchery
	(b)(12)	Clear Creek restoration
	(b)(13)	Restoring and replenishing spawning gravel
	(b)(14)	Modify and improve Delta Cross Channel control structures
	(b)(15)	Construct Head of Old River Barrier
	(b)(16)	Comprehensive assessment and monitoring program (CAMP)
	(b)(17)	Resolve passage problems at Anderson-Cottonwood ID
	(b)(18)	Striped bass restoration
	(b)(19)	Maintain carryover reservoir storage
	(b)(20)	Mitigate fully adverse impacts of Glenn-Colusa ID pumping
	(b)(21)	Anadromous fish screens

(b)(22) Agricultural waterfowl incentives program
(b)(23) Trinity River restoration

Sections 3406(c) and (d) add provisions specific to restoration in the southern end of the San Joaquin River, water needs in Stanislaus River, and water supply for wildlife refuges. Finally, Sections 3406(d), (e) and (g) and 3408 add further authorities and requirements, including provisions for the modeling of ecosystem parameters in areas affected by the CVP, for investigations and studies regarding water operations, water conservation and efficiency, and habitat restoration, and for monitoring of results and assessing the biological benefits of implementing the CVPIA fish restoration program.

The CVPIA legislation authorized a “Restoration Fund” as a main source of funding for restoration activities. The Act designated a number of sources for the revenues to go into the Restoration Fund, including mandated contributions from contractors who receive deliveries of water from the Central Valley Project. The CVPIA allows up to $50 million per year (in 1992 dollars) to be appropriated to Interior from the Restoration Fund to carry out CVPIA programs, including the anadromous fish programs. The act recognizes that additional appropriations may be made available for CVPIA programs as well, as has been the case.

Part 2: Implementing the CVPIA

What have the agencies done with the responsibilities and authorities assigned by Congress in the CVPIA? What has worked and what lessons can the agencies take from those successes?

In this part we describe how the agencies have implemented the CVPIA following passage in 1992. We take a look at what the agencies view as success stories, and identify both lessons and limits associated with those successes.

Implementing the CVPIA, 1993-2008

With passage of the CVPIA in 1992, the Department of the Interior delegated the responsibility for implementing the anadromous fish provisions to Reclamation and the Service as co-program leads. Reclamation was given responsibility for managing the Restoration Fund, developing program budgets, and managing program activities that involve engineering, operations, design, and construction. The Service has primary responsibility for defining the biological requirements of the focal species, conducting necessary studies on the fish and their habitat requirements, and planning, implementing and managing many of the habitat restoration activities of the program.

In the implementation provisions in Section 3406(b), Congress included a number of actions that the agencies had already initiated before 1992, including the design of a temperature control device at Shasta Dam and fish screen improvements at two of the largest irrigation district diversions. For this reason, CVPIA implementation at first largely involved the continuation of a set of on-going activities.

Meanwhile, the Service led an internal effort to begin a comprehensive plan for the CVPIA anadromous fish mission, culminating in a 1995 "Working Paper" to identify *Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California*. The Service analyzed available information to estimate the baseline (1967-91) populations of naturally produced adult returns of anadromous fish, using a formula to subtract a hatchery proportion from estimated run sizes. None of these estimates carry error terms. The agencies then doubled those estimates to arrive at numbers to represent the congressionally mandated goal for sustainable, long-term, natural production of anadromous fish in Central Valley rivers and streams "at levels not less than twice the average levels" attained during the baseline period:

chinook, all	990,000
fall-run chinook	750,000
late fall-run chinook	68,000
winter-run chinook	110,000
spring-run chinook	68,000
steelhead	13,000
white sturgeon	11,000
green sturgeon	2,000
striped bass	2,500,000

American shad	4,300

The Working Paper effort also identified factors limiting natural production across the Central Valley, in the mainstem Sacramento and San Joaquin rivers, in the Delta, and in every relevant tributary.

Based on the Working Paper, the agencies produced a draft "restoration plan" in 1997. The draft restoration plan became part of an extensive NEPA process to review proposed CVPIA implementation, resulting in a Programmatic EIS and Record of Decision in 2000. This then led to the adoption of the *Final Restoration Plan for the Anadromous Fish Restoration Program: A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California* (January 2001).

The Final Restoration Plan

The Final Restoration Plan articulated six objectives that must be met to achieve the program population goals:

- Improve habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity, and timing, and improved physical habitat
- Improve survival rates by reducing or eliminating entrainment of juveniles at diversions
- Improve the opportunity for adult fish to reach their spawning habitats in a timely manner
- Collect fish population, health, and habitat data to facilitate evaluation of restoration actions
- Integrate habitat restoration efforts with harvest and hatchery management
- Involve partners in the implementation and evaluation of restoration actions

Based on the limiting factors identified in the Working Paper, the Final Restoration Plan included 70 pages of tables, organized by mainstem reach and tributary, identifying what the agencies considered to be reasonable actions to address these limiting factors. For each action, the plan identified state, federal and local entities that were potential partners with Reclamation and the Service in implementing the action; the "tools" or subsections of Section 3406(b) that could be used to implement the action; and the priority for the action. The criteria used in the Final Restoration Plan to prioritize proposed actions within particular watersheds included the extent to which the action would directly promote natural channel and riparian habitat values and natural processes (flow, water temperature, water quality and riparian area protection and improvement) and the extent to which the action fell within one of the activities explicitly called out in the various subsections of Section 3406(b).

The Final Restoration Plan also identified priority watersheds. Criteria used to prioritize watersheds included the capacity to increase production relative to the baseline (which meant giving priority to watersheds with more severely degraded habitat yet amenable to significant change), presence of special status species including species listed under the ESA, and the presence of CVP facilities.

Given these criteria, the plan assigned the Delta the highest priority for action, given that it is highly degraded, due in part to CVP (and State Water Project) operations, and that all anadromous fish pass through the Delta as juveniles and adults and many rear there. In the next level of priority are the Sacramento mainstem, given that it provides habitat for listed winter-run chinook, is a primary area for production or passage of most species, and is strongly affected by the CVP; tributaries of the upper Sacramento with a high potential for sustaining natural production of spring-run chinook and steelhead (Clear, Battle, Antelope, Mill, Deer, Big Chico, and Butte creeks); the American River, only because it is strongly influenced by CVP dam operations; and the mainstem San Joaquin River and its lower tributaries, because it is highly degraded with low production and possibly has a distinct run of fall-run chinook.

The Final Restoration Plan set a vision of one comprehensive, overarching Anadromous Fish Restoration Program, with all the actions and authorities in the CVPIA as the supporting tools integrated into that one program. The agencies implement the CVPIA however, in a way that bears little resemblance to the integrated, coordinated, holistic vision of the Final Restoration Plan.[1]

How the Agencies Implement the CVPIA Program

Separate Programs

The agencies have organized themselves to implement the anadromous fish provisions of the CVPIA as a series of separate programs, managed and funded individually, each one implementing a different subsection of CVPIA Section 3406(b) – colloquially known as the “b”s. For example there is a (b)(13) spawning gravel program; a (b)(12) Clear Creek restoration program; a (b)(17) Anderson-Cottonwood Irrigation District diversion screen program. The agencies even implement a separate (b)(1) Anadromous Fish Restoration Program, which the statute and Final Restoration Plan viewed as the overarching program, to implement habitat restoration actions in certain watersheds.

Program(s) Management

Each “b” has been assigned a Program Activity Manager or lead from one of the two agencies, with a co-lead manager from the other agency. Agency personnel share responsibility to develop a program plan for just that “b” and annual work plans (largely disconnected from the science-based Working Paper effort and the Final Restoration Plan, at least from what the panel can tell), with separate budgets and implementation schedules. Each agency has also designated an overall CVPIA Program Manager as co-leads. The organizational structure indicates that these two people do not actually manage these disparate programs into an integrated whole. Instead, the co-leads sit to the

1 The Final Restoration Plan itself is not on the CVPIA website and is rarely mentioned in work plans or other CVPIA implementation or review documents.

side and largely coordinate activities among separately managed programs. Granted, some of these programs may be grandfathered in from 1992 but it would seem that after 16 years that these programs could have been organized to fit into an integrated CVPIA approach.

Actions Implemented

Through these separate programs, the agencies have implemented hundreds of actions over 16 years of the CVPIA. These range from major capital improvements, such as the Shasta Dam water temperature control device ($84 million) and the Glen-Colusa Irrigation District diversion fish screen ($41 million), to on-going efforts in more than a dozen tributaries to improve and protect riparian habitat conditions in stream reaches, to water management operations to improve flows for anadromous fish spawning, rearing and migration. For the time period of 1993-2007, CVPIA program obligations have exceeded $930 million to implement activities in Sections 3406 and 3408 of the CVPIA. For additional detail on CVPIA funding and task allocation, see Appendix C6.

Monitoring and Evaluation

The agencies have organized monitoring and evaluation (M&E) efforts in much the same disconnected way. M&E is conceived and accomplished either as its own separate "b" or divided across the set of separate "b"s. Section 3406(b)(16) directs the agencies, "in cooperation with independent entities and the State of California," to establish "a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley to assess the biological results and effectiveness of actions implemented pursuant to this subsection." Funding for the (b)(16) Comprehensive Assessment and Monitoring Program (CAMP) is to be allocated among three sources: the Restoration Fund, a separate, "non-reimbursable federal expenditure", and an expected contribution from the state.

CAMP has its own separate implementation plan, while the Final Restoration Plan is largely silent on program M&E. The CAMP plan has the dual objectives of (1) assessing the overall or cumulative effectiveness of CVPIA actions in meeting the production targets and (2) assessing "the relative effectiveness of categories of Section 3406(b) actions (e.g., water management modifications, structural modifications, habitat restoration, and fish screens) toward meeting AFRP production targets."

As the program is implemented however, it appears that most if not all of the monitoring and assessment of the specific "b" activities are not part of CAMP. Instead M&E is included in the work plans and budgets for the separate "b"s, funded and implemented as part of the distinct program activities. Additional data collection, assessment and modeling occurs in other CVPIA programs, including an Instream Flow Incremental Methodology (IFIM) program and an effort to develop ecosystem and water systems operation models called for in 3406(g).

Coordination with Other Programs and Activities

The CVPIA anadromous fish program is not the only program in the Central Valley attempting to improve habitat for fish or otherwise improve ecosystem conditions in the Sacramento and San Joaquin rivers. The most significant parallel effort has been the state and federal multi-agency collaboration known as CALFED. In the information presented to the panel describing actions of a specific type or in specific areas it was at times hard to know where CVPIA stopped and CALFED began. This indicated a certain amount of coordination at the level of specific actions. The panel was presented with little information indicating any level of coordination or consistent, integrated planning at the *program* level. It is not clear whether Reclamation or the Service, even with their extensive authorities under the CVPIA, play a significant role in CALFED.

Other related efforts underway in the Central Valley include the Bay Delta Conservation Plan planning process and the Delta Vision process, both state-coordinated efforts driving at comprehensive solutions to the Delta problems that involve numerous agency and non-governmental entities. From the information presented to the panel, CVPIA seemingly has little coordination with these efforts. Some CVPIA coordination does occur in certain watersheds with the California Department of Fish and Game (e.g., Butte Creek), but with little systematic coordination or input at the program level, at least as far as the panel was informed. This is also true of the activities of the state Water Resources Control Board, especially as that agency has confronted the significant water quality problems in the rivers and the Delta over the past decades.

Reclamation, as it operates the CVP, cooperates with the California Department of Water Resources, which operates the parallel storage and pump system of the State Water Project, to produce a unified Operations Criteria and Plan (OCAP). In turn the OCAP partners are engaged in separate ESA Section 7 consultations with NOAA Fisheries and the Service to determine if these joint system operations jeopardize the continued existence of listed salmon, steelhead, sturgeon and Delta smelt. It would seem that CVPIA activities and personnel should be central to the OCAP plan, the Section 7 consultation, and the agencies' efforts to satisfy the requirements of ESA (that is, after all, one of the directives of the CVPIA). The panel received no information or presentations on the involvement of the CVPIA program or personnel in the ESA consultation effort, in the determination of the biological requirements for these species from an ESA perspective to avoid jeopardy, and in the determination of what actions the agencies should be taking to meet the ESA.

What has worked? What CVPIA actions have been effective?

One of the agencies' goals for the CVPIA Independent Review is to improve the effectiveness and efficiency of programs and implementation actions. The agencies asked questions for the review panel to consider about the effectiveness of different CVPIA programs, actions and activities in contributing to meeting the doubling goal. We are able to highlight a number of program elements that appear to have made conditions better for anadromous fish, some of which may serve as building blocks to future success.

Final Restoration Plan

The Final Restoration Plan and the underlying planning efforts were a good and useful exercise. The initial planning effort to identify the limiting factors at the watershed and reach scale appears to be sound. There are some exceptions, such as the absence of the invertebrate prey base for juvenile salmonids, further discussed in Part 3 of this report.

The Final Restoration Plan built solidly on the watershed-scale foundation by identifying sets of actions to address identified limiting factors. The Plan also identified a sound set of general principles, objectives and prioritization criteria for the program as a whole. The Plan correctly conceives of an integrated, comprehensive Anadromous Fish Restoration Program consisting of linked objectives, limiting factors, strategies, and actions, in which the distinct program activities in the various sections of Section 3406(b) are just some of the tools to support the integrated program.

If the agencies were to organize program management and implementation in the way conceived of in the Final Restoration Plan, that would be an improvement in and of itself. We believe the agencies need to improve the plan by developing an integrated science-based conceptual framework for the CVPIA anadromous fish program. And the agencies need to adjust the plan's focus to incorporate a system or basin level perspective. These recommendations are described in Part 3. The Review Panel believes that the Final Restoration Plan provides a good foundation, and the plan itself could be adapted to include the improved program framework and conceptual foundation.

Individual Actions that Have Improved Conditions

The agencies correctly recognized a number of serious impediments to the survival and productivity of salmon and steelhead and have taken action to address these impediments. In a *qualitative* sense, these actions may have been effective in making freshwater conditions better for salmon and steelhead and should contribute in the long run to improved natural production. These actions include:

- Installing and operating the Shasta Temperature Control Device;
- Improved and continued efforts for passage at Red Bluff Diversion Dam;
- Completion of state-of-the-art screen and passage improvements at the diversions for the Glen-Colusa Irrigation District and Anderson-Cottonwood Irrigation District;
- Screening most of the larger diversions in the system;
- Completion of the water supply improvements for the Coleman Hatchery that allowed access into 40+ miles of habitat in Battle Creek;
- Removal of Saeltzer Dam and channel structure improvements in Clear Creek;
- Butte Creek restoration, including removal of passage barriers, construction of screens and ladders on diversions, and increased in-stream flows through diversion changes;

- Implementation of the Vernalis Adaptive Management Plan and other flow improvements in the San Joaquin River; and
- Acquisition of more than 1.3 maf of water and dedication of that water to improve flow conditions for anadromous fish in particular river stretches.

Butte Creek Experience

The Butte Creek example is instructive as to how effective the program can be at the watershed level with the right context. Rehabilitation of Butte Creek has been a multi-agency and multi-stakeholder effort to recover spring-run chinook and steelhead in a basin with severely degraded habitat but with high biological potential. Butte Creek is one of only three Central Valley creeks that still had a sustaining spring-run chinook population. Butte Creek has a physical context in which most if not all of the limiting factors are within the authority of the various agencies and partners to address.

The primary goal of the Butte Creek effort is restoration and maintenance of watershed function, a component of which is achievement of the AFRP doubling goal. Contribution to the CVPIA doubling goal was secondary, achieved as a *consequence* of focusing on tasks to achieve the primary goal of improving habitat and water quality conditions for anadromous species. This is an important lesson for the program as a whole.

The Working Paper identified many limiting factors to natural production in Butte Creek, including insufficient streamflow, barriers to adult passage to upstream habitat, juvenile entrainment at dams and diversions, riparian habitat degradation due to land uses, and illegal harvest. The Final Restoration Plan identified nearly 40 actions to address these limiting factors. These included water acquisitions, diversion removals and other actions to increase in-stream flows; new or improved fish ladders and screens; extensive removal of small dams and other passage barriers; riparian habitat improvements and protection (such as re-vegetation, floodplain reconnection, acquisition of protective easements) to restore and protect habitat for spawning and rearing; fishing regulation changes; flow and temperature modeling to enhance scientific understanding and guide restoration action; and site-specific life-history studies and other monitoring and assessment work. Over the last 15 years, most of the actions have been initiated, many have been completed, and nearly all the limiting factors have been attacked to some degree at a cost of approximately $45 million. Implementation includes numerous public and private partners.

Estimates of spawning productivity and capacity and of juvenile production have increased commensurately. The result has been an estimated increase of adult returns of spring-run chinook *eleven*-fold over the 1967-91 baseline average estimate of approximately 1,000 fish. Fall-run chinook estimates are four times the baseline estimates.

There are reasons to be cautious about the measures of success even in Butte Creek. The quality of all baseline and current natural production estimates and data are problematic (discussed below). Constraints on natural production remain, both in the creek basin (especially remaining passage barriers to additional spawning capacity) and out of the basin (river conditions down to and through the Delta). Flow improvements in Butte Creek are dependent on transfers of water from the West Branch of the Feather River, with obvious implications for the Feather and for the ability to sustain these transfers and flows over time. Sustaining improved biological response in Butte Creek over a long time and over natural environmental variation is also not assured, yet that is the only goal that ultimately matters. And the relative contribution of Butte Creek production to basin-wide production is quite small. All these cautions are important, but our point here is to emphasize the elements of success.

The Limits of Success

Increases in estimated population numbers, such as seen in Butte Creek, are rare in CVPIA implementation. Conditions for anadromous fish may have improved in certain areas and in certain respects, but not in others. Population gains are limited at best, and in some watersheds populations are declining. Rebuilding and sustaining natural production in the Central Valley will take far more work, significant change in river conditions, increased funding, many complicated, expensive and unproven actions, and decades of time. Even as we recommend major changes in how the program is conceived, organized and managed, we also counsel patience for a long-term effort to produce habitat and water quality conditions needed to increase and sustain natural production of anadromous fish.

The problems of determining how salmon and steelhead may benefit from management actions and the search for solutions are not peculiar to the Central Valley. As anadromous fish programs in the Pacific Northwest and elsewhere have also learned, the complex life cycle of anadromous fish and the range of poorly understood, potential environmental influences on these fish make it nearly impossible to assign causality to any specific protection or mitigation action with a response in adult returns of naturally produced fish. This is especially true of actions intended to improve the freshwater habitat conditions for these fish. For example, we are unlikely ever to be able to say with any degree of certainty how screening a particular irrigation diversion has affected adult returns because the mortality "signal" associated with the irrigation diversion must be considered against the "noise" of all other sources of dependent and independent sources of mortality. That is not to say that more cannot be done than the CVPIA program is doing to assess or estimate these effects – much more – only that even in the best of programs, this is a fundamental difficulty.

At this time, it is not possible to evaluate in a systematically, quantitatively rigorous way, the effectiveness and efficiency of particular CVPIA actions. The following is a summary list of specific reasons, which are discussed in more detail in Part 3:

- The **doubling goal is problematic,** so assessing the ability of the various programs to contribute to achieving the doubling goal is similarly problematic.

- The **lack of trustworthy population estimates**, and especially the lack of adequate information on the extent of hatchery influences on natural production, makes it nearly impossible to evaluate the effectiveness of any action in altering the natural production of anadromous fish populations in the Central Valley.
- The **inability to separate the effects of both natural and anthropogenic confounding influences** that are outside of the control of the agencies, adds to the difficulty in assessing how CVPIA actions have changed or might be capable of changing natural production numbers.
- There seems to be **minimal CVPIA monitoring and evaluation aimed precisely at the questions asked –** that is, how program activities might affect ecological function and thus natural production of juveniles or adults.
- There are **few quantitatively rigorous evaluations of program action**. For example, we encountered limited assessments that estimated survival gains, or expected changes in productivity associated with screening irrigation diversions, opening habitat blocked by passage barriers, or from implementing altered flow regimes.
- We assume that the agencies have correctly identified most of the factors limiting natural production, primarily through best professional judgment. But merely identifying limiting factors is not enough. A **more formal assessment of key hypotheses is required. This would include an estimate of the biological potential inherent in rectifying each limiting factor**. Without this systematic assessment it is hard to evaluate the comparative effectiveness the assorted actions (tools) undertaken to improve anadromous fish populations.
- **Three of the limiting factors most responsible for the severe decline of natural salmon and steelhead production in the valley have not been addressed by the CVPIA program**: 1) the construction of storage dams that block access to much of the historical habitat for anadromous fish, 2) extensive alteration of the channel of the mainstem Sacramento River, and 3) the substantial export of water out of the system, especially in the Delta. Without addressing these three systemic factors, significant increases in natural production of salmon and steelhead may be achievable only in certain watersheds and is not likely to translate into meeting the “doubling” goal at the scale of the entire basin.

Clear Creek Experience

Clear Creek exemplifies the dichotomy of an apparent local success that looks different when viewed through the lens at the program or system scale. The restoration efforts in Clear Creek are superficially similar to the efforts in Butte Creek, and the results in Clear Creek have been held out as a success on a scale similar to those of Butte Creek. Yet the differences between the two experiences turn out to be far more significant for the panel’s program critique than the similarities.

Clear Creek restoration is its own "b": Section 3406(b)(12) calls upon the agencies to "develop and implement a comprehensive program to provide flows to allow sufficient spawning, incubation, rearing, and outmigration for salmon and steelhead from Whiskeytown Dam as determined by instream flow studies conducted by the California Department of Fish and Game after Clear Creek has been restored and a new fish ladder has been constructed at the McCormick-Saeltzer Dam."

In implementing Section 3406(b)(12), the agencies identified two broad aims for the Clear Creek activities. The first has been to rebuild spring-run chinook population numbers. The once-abundant spring-run chinook in the Central Valley historically spawned at high elevations and high gradients. The unimpaired Clear Creek historically supported spring-run chinook, but their distribution was limited to elevations below about 1300 feet and they were probably not very abundant (Yoshiyama et al 2001; Lindley et al. 2004). Clear Creek also had habitat available for fall-run chinook.

The problem is that much of the historic spring-run chinook habitat in Clear Creek is now blocked by Whiskeytown Dam, part of the 70-90% of historical spring-run chinook habitat no longer accessible across the Central Valley. (Much of what is still available is in Butte Creek and two other, Mill and Deer Creek.) Central Valley spring-run chinook is now listed under the federal ESA as much for this reason as any other. The CVPIA agencies acknowledged that Clear Creek no longer had viable spring-run chinook or steelhead populations (DeStaso, 2008). The agencies have no plan and may have no authority to open access to spring-run chinook habitat in Clear Creek above Whiskeytown Dam.

CVPIA implementation in Clear Creek has turned into an experimental effort to create and sustain spring-run chinook habitat on an unusual stream and topography template. The agencies are engaged in a largely unprecedented experiment with little or no scientific merit to create and sustain a short stretch of spring-run chinook spawning habitat below 1000 feet of elevation, largely through the use of cool water releases from Whiskeytown Dam and other habitat manipulations, especially gravel additions.

With some *apparent* success: The agencies presented information that Clear Creek snorkel counts indicate 60-100 adult spring-run chinook in Clear Creek for each year through most of the 2000s, climbing to nearly 200 in 2007. In terms of a doubling of the numbers of spring-run chinook from a completely degraded baseline of essentially 0, this might be and has been considered effective action under the CVPIA, although it would need to be sustained and verified statistically. But in terms of a strategy to restore sustainable, viable, de-listable populations of spring-run chinook in Clear Creek and then for the basin as a whole, it would seem to hold almost no long-term promise.

The second goal of the Clear Creek restoration program under the CVPIA, and what appears to be the main production aim of so many of the restoration programs throughout the CVPIA, is to improve and sustain Clear Creek as a *fall-run chinook* production area. Again, the information presented indicated success. The agencies set a fall-run chinook "doubling" goal for Clear Creek of 7,000 adults, and then exceeded that goal with a

15-year average of fall-run chinook adult counts at nearly 12,000. This is one of the very few areas in the CVPIA program in which adult counts have exceeded the doubling goal (along with Butte Creek, for both its spring- and fall-run chinook goals).

The fall-run chinook estimates mask some significant watershed and system ecological issues that call into question this *apparent* success. The Clear Creek doubling goal is based on an estimated pre-CVPIA baseline from 1967-91 of 3,500 adult fall-run chinook, the lowest average of any span of years in the available Clear Creek record. Many years in the 1970s and 1980s show virtually no adult fall-run chinook in Clear Creek. Doubling this estimate may look like success in a narrowly focused lens. But it also may mean little in terms of significantly increased and sustained anadromous fish production in the Central Valley because Clear Creek does not appear to have been a big producer of fall-run chinook in historical terms. Population information indicates that the 7,000 fall-run chinook target may in fact be in the range of the creek's historical fall-run chinook production capacity in the lower stretches of the creek.

The recent 12,000 average adult count may be well *above* Clear Creek fall-run chinook spawning and rearing capacity, as further indicated by the fact that the data shows that Clear Creek fall-run chinook *juvenile* production and productivity has not risen to match the increased adult counts and has been declining since 2000. One hypothesis is that natural production of fall-run chinook is not rising in Clear Creek, but instead that *hatchery origin* adult fall-run chinook are showing up in Clear Creek counts, attracted by cool water releases. These fish may not necessarily be contributing to Clear Creek fall-run chinook spawning. Sustaining any of the fall-run chinook increase is questionable, as adult fall-run chinook numbers declined again sharply in the last two years, down to an estimated 5,000 in 2007.

What conclusions can be drawn from Clear Creek? Habitat rehabilitation actions in Clear Creek, especially the removal of Saeltzer Dam, the restoration of more normative channel structure in the lower reach of the creek, and improving normative flow releases, are positive for salmon and steelhead habitat in Clear Creek. These improvements, if maintained and built upon, might allow the agencies to realize and sustain increased natural production of spring- and fall-run chinook salmon and steelhead from Clear Creek. We are not likely to know this with any certainty for decades. If doubling extremely low natural production baseline numbers in individual watersheds is truly the CVPIA's driving goal, Clear Creek has at least a good chance at being a long-term success story.

Replicating these results in other watersheds within the Central Valley is proving to be problematic. For example, an effort based on a similar premise under roughly similar conditions in the Stanislaus River (upstream blockage to habitat) has yet to result in a significant change in juvenile or adult production estimates.

Widening the lens to the basin level, it is hard to conclude that the Clear Creek improvements contribute to the overall CVPIA effort of substantially increasing natural production throughout the system and solving the ESA problems. A sustained increase in fall-run chinook production, which is what Clear Creek may achieve in the watershed, may be a real but modest gain. Even that is unknown until the agencies expand the monitoring effort to understand better the relationship between apparent increasing adult fall-run chinook returns in the creek and decreasing juvenile production.

The agencies must acknowledge that their effort to create spring-run chinook habitat on an unlikely template has no real potential to produce large numbers of spring-run chinook. The agencies also have no plan to provide access to historical spring-run chinook habitat, which is what seems necessary to significantly increase natural production and possibly lead to de-listing of spring-run chinook. Before the CVPIA effort invests much more money trying to reproduce spring-run chinook habitat in unlikely elevations and gradients across the valley, the agencies must produce a compelling theoretical basis for this effort.

Part 3: Program Limitations and Recommendations

After 16 years of implementation the CVPIA anadromous fish program is not close to its stated doubling goal, nor has it solved the problems that led to the listing of several species of salmon and steelhead under the ESA. The review panel has identified a number of impediments that constrain the ability of the program to achieve success as defined in the CVPIA. The problems, and the panel's recommendations to address the problems, are not minor.

We believe the agencies have not developed a proper conceptual foundation and framework for the program; have organized and managed the program in an compartmentalized way rather than an integrated, systematic and scientific way; have not addressed system-level problems as well as local and watershed-level problems; have failed to prioritize and address effectively the problems in the Delta; and have underutilized their CVPIA authorities, especially with regard to water management and the issues in the Delta. All of these have contributed to a program that has been unable to identify and attack the fundamental system-level problems and realize the greatest biological benefit in an effective way.

In Part 3 of this report the Panel describes in more detail these weaknesses and provides recommendation on ways to address them. **Section 3a** focuses on the program itself, recommending ways to improve the science-based conceptual foundation and framework for the program. **Section 3b** focuses on how the agencies have organized and currently manage the program and recommends fundamental changes in this regard. **Section 3c** focuses on program implementation, especially on the use of CVPIA authorities to attack the biggest problems in the system. Finally, in **Section 3d**, we recommend ways in which the program should better coordinate with other efforts in the region.

Section 3a: Improve the Program's Science-Based Framework

To increase the probability of success, the agencies need to redesign and implement an integrated program to improve the status of anadromous fish in the Central Valley. Other big river restoration programs across the nation, from the Everglades to the Columbia, have organized their water and ecosystem programs around an *ecological risk assessment* and *adaptive ecosystem management* paradigm. These approaches allow the agencies to identify the ecosystem characteristics, ecosystem functions and habitat attributes that are degraded at different geographic levels; the relative biological potential to be gained from addressing these degraded attributes; the interconnected effects of addressing distinct problems at different scales; and the relationship between addressing these conditions and other human and natural effects on the system.

In this section we first describe a set of problems or limitations associated with the way in which the agencies currently understand, plan, monitor and evaluate the CVPIA anadromous fish program. We discuss these limitations and provide recommendations specific to each set of problems. We then recommend the agencies step back and address the larger issue of overall program design.

Our primary recommendation is that the agencies develop an integrated science-based conceptual foundation and framework for the CVPIA anadromous fish program, incorporating an ecological risk assessment/adaptive ecosystem management approach.

Limitations with the Current Program Approach

We have arranged a diverse set of problems into four categories. These problems are symptomatic of the absence of a well-articulated vision and framework for the restoration goals of the CVPIA anadromous fish program, including the relationship of the program to the broader regional dynamics. These problems restrict CVPIA's ability to meet its goals. The categories are:

- The nature and effect of the doubling goal itself;
- The compartmentalized and reductionist nature of an approach focused on local limiting factors but weak on identifying and addressing system-level problems;
- Limitations associated with the monitoring and evaluation components of the program; and
- Most important, the absence of a well-articulated, clear, and explicit vision and program framework that describes program objectives in terms of the desired status and function of the ecosystem characteristics from the headwaters through the Delta that anadromous fish need and that must be

realized by an effective program, analyzed within the context of realistic future human demands on that system.

Problems inherent in the "doubling goal"

One of the central objectives of the fisheries portion of the CVPIA is the "doubling goal."[2] Congress directed the Department of Interior, in Section 3406b(1), to "*ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991*." The act defines "natural production" to mean "fish produced to adulthood without direct human intervention in the spawning, rearing, or migration processes." To make the goal operational, the agencies define the key terms and make certain baseline population estimates. The agencies decided that natural production would mean fish born in natural environments, *including* the offspring of fish born in hatcheries. The agencies targeted for doubling those populations of each anadromous species where the agencies had production or abundance data available for the baseline period estimates. The agencies summed these population doubling goals to determine the system-level doubling goals.

We recognize that Congress imposed the doubling goal on the agencies, and thus they had to make the best of a bad situation. The goal has several important limitations that make it difficult to guide and evaluate the implementation of a program to improve anadromous fish in the Central Valley. These include:

- **The scientific rationale for adopting the index and for its magnitude is not clear**.
- **Estimating natural production is inherently problematic** under the conditions present in the Central Valley. The result is that **the baseline is unreliable and natural production levels are actually unknown.** In other words, doubling adult returns is relatively meaningless as a target if the estimated abundance of the base population is unreliable. Estimating changes in the natural production in a meaningful manner is similarly problematic given variances (presumably large) of the population estimates have not been calculated.
- **Continued reliance on hatchery fish to contribute to natural production is not consistent with the CVPIA goal** of sustaining natural production over the long term.
- **Ocean and river harvest practices and production targets to support harvest are not well coordinated with efforts to increase natural production.**

2 The agencies tend (incorrectly) to treat the doubling goal as the *only* goal or objective relevant to anadromous fish in the CVPIA. This is a subject addressed below, most prominently in Section 3c.

- **The stated goal to increase the production of both native salmonids and exotic predators/competitors (e.g., striped bass and shad) is internally inconsistent.**
- **Many factors beyond control of the CVP affect survival through returning adults,** so that measuring natural production through returning adults may say little about the effectiveness of program activities.

Problems with the doubling goal and their impact on CVPIA are explored in the following paragraphs.

Population Estimates

A number of factors contribute to the lack of confidence in anadromous fish population numbers. Population estimates for the baseline and current periods are not available for all anadromous fish (e.g., steelhead south of Red Bluff). For most others, the baseline and current population data is scientifically suspect largely due to variability and unreliability of counting methods and lack of variance calculations. Where there is no or unreliable baseline population statistics it is impossible to determine a reliable doubling target. An example of population estimation problems is the low CVPIA "doubling target" of 13,000 for Central Valley steelhead. The target is derived from a baseline average of a mere 6,500 naturally-produced steelhead, representing populations spawning in tributaries above Red Bluff. Historically, at least, there were large amounts of steelhead in other tributaries (Lindley et al 2006). The goal for steelhead reflects the historical limitations in the ability to count steelhead, rather than any comprehensive estimate of abundance.

Natural Production Estimates

Natural production of chinook and steelhead is also difficult to estimate because of the substantial straying of adult hatchery fish throughout the valley. The presence of unmarked hatchery fish on the spawning grounds is problematic both for determining the baseline condition (i.e., the levels of natural production in 1967-1991) and for estimating the current levels of natural production. Reliable numbers for hatchery straying are not available, nor is the percent of hatchery fish in the total population known. In addition, the fraction of hatchery fish derived from the less-than-reliable information is assumed constant, but recent reports suggest that this fraction has been rising over time, especially for fall-run chinook and steelhead (Good et al. 2004, Barnett-Johnson et al. 2007). It is possible that rising fractions of hatchery fish are masking actual declines in the abundance of natural populations of fall-run chinook. The result of this lack of data is that the estimates of natural production, both baseline and current, may be off by orders of magnitude.

Natural Production Definition

Another issue is the broad definition of "natural" production. Using the agencies' operational definition, hatcheries may prop up the abundance of fish spawning in the wild even to levels that are above carrying capacity, in the extreme case maintaining sizable runs of fish in habitats incapable of supporting a self-sustaining run of fish. Thus, the doubling goal could be met in a quantitative sense, but not be sustainable on a long-term basis as required both by the CVPIA and for de-listing under the ESA.

Levels and Trends in Population Baseline

The doubling goal also glosses over other important aspects of the baseline. Foremost among these is that any baseline is better characterized in terms of both levels *and* trends. Some populations or runs were declining steadily over the baseline period, and the average abundance over that period is not a complete description of their status. Using an average obscures the fact that before the level can be raised, the decline must be halted. When this declining trend is also recognized, the fact that some populations achieve levels of abundance close to the baseline level could be viewed as success, because this represents a significant increase in abundance for the population compared to its level at the end of the baseline period.

Arbitrary Nature of Doubling Goal

Besides the data and interpretation problems, the arbitrary nature of the doubling goal is problematic. Doubling some populations may not ensure long-term sustainability or allow for recovery under the ESA. For other populations, doubling may not even be feasible given the tools available through the CVPIA. For example, more than 80% of historical spawning habitat for spring-run chinook and steelhead and nearly 100% of winter-run chinook habitat (Yoshiyama et al. 2001, Lindley et al. 2007) are above impassable dams. It is not clear to the panel whether there is enough spawning and rearing habitat below these barriers to support populations that double even a degraded baseline, much less to take the species out of jeopardy.

The problematic nature of the doubling goal and the data issues mentioned above pose a number of challenges to creating a successful restoration program and demonstrating its success based on that goal. The CVP facilities and operations have had complex effects on the physical and biological environment of Central Valley streams, while the doubling goal simplistically suggests that these effects can largely be mitigated by finding ways to make this system produce more fish. Ecologists and salmon biologists have increasingly recognized that high population abundance is a property of a species that emerges from other characteristics, especially diversity (McElhany et al. 2000, Hilborn et al. 2004). This evolving viewpoint should shift the focus of CVPIA salmon restoration to restoring ecological function of habitats in order to support life history and genetic diversity. When ecological function is restored, increases in species abundance and production will follow, as will long-term population sustainability.

Ecological function is best restored by (re)creating the natural processes that create, maintain and disturb habitats. Other provisions of the CVPIA recognize this concept, especially the directive in Section 3406(b)(1)(A) to "give first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures." But protecting and restoring ecosystem function seems largely ignored by a program targeted, monitored and explained to the panel as focused nearly entirely on doubling the baseline abundance estimates for chinook salmon.

Native and Non-native Anadromous Fish Goals

A related issue is that the CVPIA doubling goal applies to all anadromous species, some of which are non-native such as striped bass. These species are part of a trophic network that prey upon and compete with salmonid species. Doubling all anadromous species may not be a consistent goal. For example, striped bass are highly piscivorous after two years of age (Stevens 1966), and predation by a larger striped bass population on juvenile winter-run chinook may impede recovery of winter-run chinook (Lindley and Mohr 2003). Bottom et al. (2005) hypothesize that American shad may have altered the structure of food webs in the Columbia River, with potentially deleterious effects on salmonids.

Cumulatively, these problems make the goal of doubling natural production insufficient by itself for guiding the CVPIA anadromous fish program and assessing its performance. Rather, the program should focus on the goal of restoring ecological function as the path to increasing and sustaining species abundance and productivity.

Concerns with the agencies' approach to limiting factors

One of the questions the agencies asked the review panel to answer was "[h]ow well have the CVPIA anadromous fisheries programs identified and addressed the most important limiting factors within and across the watersheds for the different anadromous fish populations?"[3] As highlighted above it appears the agencies have largely identified the local factors limiting natural production. They have made these identifications most often through best professional judgment, not on the basis of statistical or quantitative information on the biological effects of current conditions. However, the identification of limiting factors is not enough. There is no statistical information or informed hypotheses regarding the biological potential that could be realized from addressing each limiting factor. This makes it difficult to prioritize the limiting factors or to evaluate the comparative effectiveness and efficiency of actions to address these limiting factors and increase salmon and steelhead numbers. In addition, the agencies have primarily focused on identifying and addressing limiting factors at the local or watershed level, and have done less to identify and address the broader basin- or system-level limiting factors constraining Central Valley anadromous fish populations.

The agencies' work to identify limiting factors began in the mid-1990s "Working Paper" effort described above in Part 2. The Working Paper identified factors limiting the natural production of salmon and steelhead in the mainstem sections of the Sacramento and San Joaquin rivers, in 25 watersheds, and in the Delta. Of the 28 areas analyzed, 25 identified flow as a limiting factor, and flow constraints appeared first, implying highest priority. The other limiting factors and corresponding actions were a

3 The question itself also embodies one of the central weaknesses of the CVPIA anadromous fish program – the fact that the "program" and thus the question, is actually conceived of and implemented as a set of distinct and disconnected "programs." This is discussed elsewhere.

smorgasbord of problems and actions to improve salmonid production apart from improved flows, such as gravel augmentation and diversion screening. In about half of the areas, passage barriers, insufficient spawning gravel, un-screened water diversions, warm temperatures, and inadequate riparian cover (especially to protect against bank erosion of fines) were identified as limiting, with the priorities varying within each area. Water quality problems (including toxic contaminants) and illegal fishing were identified as limiting factors in about one-third of the areas, while approximately 20% identified a variety of land uses and project operations. Sport and commercial fishing, loss of floodplain habitat, operation of hatcheries, and losses to predators were identified as limiting in 10 to 15 % of the areas. Impact of exotic species and scarcity of large woody debris (LWD) were suggested as limiting in individual watersheds.

In general, the identified limiting factors appear reasonable at the watershed level. However, one factor potentially limiting to salmonid production that has not been included in the list is availability of an invertebrate food base for juvenile salmonids. This includes both aquatic and terrestrial invertebrates, linked to in-stream invertebrate habitat features and to riparian cover that generates the terrestrial food items. The lack of consideration of the food factor carried over into implementation. For example, the impact of gravel additions on invertebrates and the invertebrate food base has been evaluated for only one gravel addition in one watershed. Because food is potentially limiting to juvenile salmonids in all habitats, regular evaluation of invertebrate populations and their habitats should be a standard part of the limiting factors analysis and of the monitoring procedures at most sites. Invertebrate monitoring can provide useful information for biological dynamics and as indicators of water quality states.

In sum, the Working Paper provided an extensive listing of limiting factors particular to each watershed, especially for salmon and steelhead (the analysis is less comprehensive for other anadromous fish, such as sturgeon). The Final Restoration Plan largely followed the lead of the Working Paper in the identification of limiting factors and corresponding actions, with the addition of prioritization criteria and a related “reasonableness” screen. Information provided to the panel indicates that most of these limiting factors have been attacked to varying degrees. However monitoring has not produced convincing data showing progress toward the goal of increasing natural production. This is in part due to the absence of a hypothesis-driven or statistically-based evaluation of the biological potential to be realized from addressing any particular limiting factor or sets of limiting factors. Without that evaluation, the agencies have no ability to focus on the actions that might provide the greatest response.

We recommend that a quantitative analytical framework or model be used to rank the importance of the most critical limiting factors on both the watershed and system level. We have not seen any use of an analytical method or model that permits this step. For the vast majority of identified limiting factors, the absence of such a framework makes it impossible to quantitatively prioritize limiting factors or evaluate the potential effectiveness of the restoration actions. For instance, we have no way to determine the extent to which survival gains realized in the upper parts of the system could be negated by highly adverse effects further downstream, particularly in the Delta.

There are numerous methods or models that could be helpful in this regard. In the Pacific Northwest a number of habitat/survival models have been employed to identify key parameters driving survival during specific life stages and across the salmon life cycle, including 1) the Ecosystem Diagnosis and Treatment (EDT) model (Lestelle et al. 1996), 2) the All-H Analyzer model that integrates effects from hatchery, habitat, hydroelectric projects, harvest and marine residence, and 3) a freshwater-marine regression model approach developed by NOAA as applied to Skagit River salmon populations (Greene et al. 2005). In a more focused assessment, Hillman (2004) developed a method to estimate the potential survival gains from assorted tributary habitat actions, as called for in the 2008 Biological Opinion for the Federal Columbia River Power System. Similarly, Properly Functioning Conditions identified by NOAA scientists (NMFS 1996, 1999) provide guidance on these matters. We suggest that these or similar modeling tools may be applicable to the CVP. As a note, the EDT model is currently being used to characterize fishery benefits elsewhere in the Central Valley, as associated with the re-watering of the lower San Joaquin River (Dr. Chip McConnaha of Jones and Stokes, personal communication).

The agencies identified a reasonable list of the factors limiting salmonid production. The agencies did not develop statistical information or informed hypotheses regarding the biological potential that could be realized from addressing limiting factors both at the watershed and system scale. This makes it impossible to prioritize limiting factors or evaluate the potential effectiveness of the restoration actions. We recommend that a quantitative analytical framework or model be used to rank the importance of the most critical limiting factors on both the watershed and system level.

Problems with monitoring and evaluation

The CVPIA program identifies an extensive monitoring and evaluation (M&E) component. We find similar limitations in this component that restrict the agencies' ability to assess progress and provide meaningful direction to the program's diverse suite of actions. These include:

- M&E actions appear compartmentalized and not part of a system-level plan.
- Absence of a standard set of protocols for conducting and reporting monitoring and evaluation prevents efficient information sharing and learning.
- The program lacks an integrated database system where monitoring and evaluation results from the program and from related activities by others in the Central Valley may be archived and accessed in a standard format.
- The collective M&E activities are not part of an integrated strategy that can provide input to an effective risk assessment and adaptive management process.

We briefly discuss each of these problems with M&E in turn.

As stated previously, M&E activities are not integrated into a coordinated program framework for the anadromous fish program. In general, M&E is not coordinated across the entire program but rather is conceived, implemented and managed either as its own separate "b" or divided in disconnected sections across the "b"s. Neither approach is satisfactory. The CAMP program described earlier has the potential to evolve into an integrated M&E approach, consistent with the revised program framework discussed later in this section.

The program does not have a standard set of protocols for conducting M&E activities across watersheds, within a watershed, or across the different activities represented by the "b"s. There may be informal or implicit agreement as to how certain environmental or fish responses (e.g., smolt abundance, adult escapement, fish distribution) should be monitored and estimated. And it appears that CAMP would like to implement a systematic approach to monitoring adult and juvenile abundance, if agency coordination and funding issues can be resolved. These efforts are not sufficient. Developing and using standard protocols for monitoring and reporting will be critical elements of a comprehensive M&E plan for the program integrated into a revised program framework. This will need to include a systematic statistically-based sampling design (location, frequency, duration, replication) for collecting a variety of environmental and population response data across the basin.

To our knowledge, no integrated database management system exists to house and manage environmental and biological monitoring data. Archiving monitoring information in either a centralized or dispersed but integrated database system is critical for documenting changes in key indices over the decades. Integrating the CVPIA data with the monitoring data gathered by others in the valley is similarly critical. The panel provides an example of an Information System in Appendix C4.

The value of M&E is obtained when the observations are used to test hypotheses about how the system will respond to management actions. It is in the process of hypothesis generation, testing, and hypothesis refinement that managers learn about the system and reduce the risk of undesired outcomes. To be used effectively, program M&E should be connected to appropriate models of the system that can capture hypotheses, make predictions about system response and the possible potential to be gained from different actions, and identify appropriate endpoints for monitoring. Monitoring and evaluation in its present state in the CVPIA does not appear to be part of such an integrated program framework and consequently has limited value to managers. This is why it is not possible to answer many of the questions asked of the panel about program effectiveness even though the program has been in place for 16 years. The value of data increases exponentially when it is used to address specific management concerns and is available to other researchers. Good data management is critical to the implementation of adaptive management and risk assessment programs. The panel provides an example of the approach taken in the Columbia River system for Monitoring and Evaluation in Appendix C3.

M&E activities are not integrated into a coordinated framework for the anadromous fish program, nor are standard protocols or an integrated database utilized. We recommend the agencies develop an M&E plan consistent with the overarching program framework described later in this section. This will include developing a standard set of monitoring protocols and an integrated multiagency data management system, and then using the information collected within a scientifically valid adaptive management program.

Absence of overarching program vision and analytical framework

The program may have an ultimate goal or mission set by Congress, but during the presentations we did not otherwise observe an explicit, cohesive statement or schematic describing the agencies' overarching strategy for the program to achieve that mission. Nor did we see an integrated restoration vision of the system change necessary to increase and sustain natural production of anadromous fish. The vision for CVPIA implementation should be defined in terms of restoration goals and environmental outcomes, placed in a broader context. The CVPIA restoration vision should describe a desired future condition once the collective set of actions are in place and describe the sequence, types, and magnitude of environmental changes needed to achieve the vision. This exercise is important in its own right, and ultimately sets the stage for ecosystem predictive models.

We did see elements, especially in the Final Restoration Plan, which could be organized to form a more holistic program vision. The Plan implies a salmonid-centric and watershed based vision. Limiting factors in specific salmon-bearing watersheds are identified and a suite of actions prescribed to improve those conditions within individual watersheds. The implied expectation is that the collective actions within watersheds will cumulatively produce conditions that increase salmonid production and move the populations toward the doubling goal. To accomplish the goal an assortment of tools are applied at strategic locations with the expectation that the collective effect will enhance survival and ultimately double natural production.

Many of these watersheds are connected in series, and the populations spawned in tributary rivers and streams all ultimately encounter and pass through the lower mainstem Sacramento or San Joaquin rivers and then the Delta. However, we saw no indication that the program attempts to integrate expected survival changes across the entire geographic route of a species or stock. Of particular concern is the perceived survival bottleneck in the Delta, which all species encounter during both their downstream and upstream migrations. Without a more comprehensive vision and integrated framework, it is difficult to place tributary-specific actions in a broader context. The panel is concerned that the agencies cannot ascertain if gains in upper watersheds are protected through the system or are swamped or offset by losses lower in the system, without both a more holistic vision and supporting analytical framework.

The agencies do not have an overarching vision for the program to achieve the mission set by Congress. The agencies need an integrated restoration vision of the system changes necessary to increase and sustain natural production of anadromous fish in the context of other desired benefits from the rivers.

Spawning Gravel Experience

The CVPIA's spawning gravel activities provide a useful illustration of the program limitations discussed so far. One of the highlighted and most common activities of the CVPIA program is the addition of spawning gravel below blockages in the Central Valley. Gravel augmentation is the current CVPIA program in a microcosm, complete with all its limitations. For example:

- Gravel augmentation is its own "b" for specific watersheds, implemented and managed as a separate program. Gravel augmentation also takes place in a number of the other watersheds as an activity implemented under what the agencies sometimes consider to be the distinctly separate Section 3406(b)(1) Anadromous Fish Restoration Program. It is not clear to the panel that the different and separately managed gravel "programs," even as they are placing gravel in similarly situated watersheds, coordinate and communicate to any significant degree, and they are certainly not managed as part of one program.
- The lack of spawning gravel is identified as a limiting factor almost everywhere. However, we saw no systematic analyses of the extent to which this is actually one of the key constraints to natural production in the areas augmented, and especially no analysis to determine the biological potential to be gained by placing these amounts of gravel into these reaches.
- The agencies did not identify any indices or measurements of change in stream conditions and habitat functions expected to result from gravel additions. Nor did we see the agencies able to verify whether fish observed using the gravel additions represent new spawners at the watershed scale or merely a redistribution of the existing population. It may be, for example, that the areas affected below the dams were more important for rearing, and the main limiting factor to be addressed is the loss of materials moving through the system that provide habitat and food for the prey base for rearing juveniles. This may be why, as the panel learned, that gravel addition in the Stanislaus River is resulting in physical habitat changes and spawning at those sites but no detectable increase in juvenile production is measured lower in the river. We saw no indication that factors like these were systematically considered, analyzed or monitored.
- The time and resources devoted to the gravel programs illustrate the way the CVPIA program has focused intently on trying to solve problems at the local or watershed scale without sufficient consideration of the value of these efforts at solving a system-level problem. Yet without a more comprehensive vision and integrated framework, it is difficult to place the value of such tributary-specific actions in this broader context.

The agencies should not try to solve these limitations in a piecemeal fashion. What follows instead is a recommendation that the agencies develop an integrated science-based conceptual foundation and framework for the CVPIA anadromous fish program incorporating an ecological risk assessment/adaptive ecosystem management approach. *See* Appendix C2 for further discussion of the gravel programs as an example of the limitations with the agencies' current program approach.

A Revised Program Approach is Needed

The agencies must develop an integrated science-based conceptual foundation and framework for the CVPIA anadromous fish program incorporating an ecological risk assessment/adaptive ecosystem management approach.

The effectiveness of the CVPIA fisheries program should be improved by adopting the ecological risk assessment and ecosystem management paradigm that has emerged from other large-scale ecosystem management efforts in the US over the past 15 years. In addition to adopting this conceptual foundation, the agencies will need to reorganize and manage the program differently in significant ways to deal effectively with the complexity of the problem, a topic discussed below in Section 3b. The approach offered here directly addresses weaknesses identified above by:

- Providing the conceptual foundation for a clearly articulated vision and a detailed framework that connects actions to environmental and population responses across watersheds;
- Providing the modeling base for estimating the potential change that might be expected from different actions or suites of actions;
- Integrating the limiting factors and the corresponding actions into a more cohesive holistic restoration approach at the system level;
- Allowing for performance indices that may be more informative than adult return estimates of natural production; and
- Providing a comprehensive framework for monitoring and evaluation and subsequent learning.

The CVPIA fisheries programs would benefit greatly from application of what can be called the ecological risk assessment and ecosystem management approach (e.g., Harwell 1997, Harwell et al. 1999a and 1999b, Gentile et al. 2001). This approach is being applied in other large-scale ecosystem restoration programs, including the Everglades, the Colorado River, the upper Mississippi River, and the Columbia River. It is an adaptive management framework for managing ecosystem restoration, and application of this approach would be consistent with the Interior Department's recent initiative to use adaptive management (Williams et al. 2007).

The approach provides both a conceptual foundation for the program and a way to build an integrated program framework on that foundation. Central to the approach is describing the set of relationships that link human actions in the Central Valley to environmental change and then linking that environmental change to biological response in the focal species with conceptual models. Kimmerer et al. (2005) provides an example of such a conceptual model for the Central Valley ecosystem. Human actions alter physical conditions in the habitat, which in turn affect biological characteristics or responses for target species such as growth rates and life-stage specific survival probabilities. The first set of relationships, which may be described in a model, identify the social and natural systems that link human activities and natural variation to conditions and changes in the physical environment. The second set of relationships, again appropriate for a model (or as part of one combined model), links these environmental conditions and changes to the biological characteristics of the species of interest. Together, these relationships represent the state of knowledge about causes and effects between human actions and environmental change and between environmental change and population response, about the relative *magnitude* of possible change and the sensitivity of the system to different types of change, and about key uncertainties and the measurements needed to reduce these uncertainties.

The essential elements of an ecological risk assessment and ecosystem management approach include:

- A program vision, which describes what the program is trying to accomplish with regard to fish and wildlife, in the context of other desired benefits from the river;
- Specific restoration goals that are consistent with the vision
- A conceptual ecosystem model that links stressors (called limiting factors in the CVPIA) through hypothesized pathways to environmental and biological endpoints and identifies appropriate measures
- The implementation strategies or actions intended to lead to the desired changes in the environmental conditions and biological endpoints;
- A monitoring and evaluation program with a reporting system and adaptive management plan.

The program vision should acknowledge that humans are part of the ecosystem and that restoration actions should seek to restore ecological functions while balancing the needs of people and the biological endpoints of interest. Such a vision is best obtained from a process involving stakeholders. The vision is translated into restoration goals, which set targets for various environmental (e.g., hydrographs) and biological endpoints (e.g., anadromous fish population abundance), typically with reference to historical conditions and functions.

While all of these elements are necessary for program success, the relationship among the elements is critical. They must be tightly coordinated so that information can move easily through the program. As they implement restoration actions to address limiting factors, the agencies should view their actions as experimental tests of hypotheses about environmental and biological responses. They then must effectively transfer the results of their actions back to the larger program so that hypotheses can be adjusted and future actions benefit from what is learned.

The conceptual ecosystem model at the heart of this approach provides the scientific foundation for the ecological risk assessment/ecosystem management framework. An example from the Everglades is summarized in Appendix C1; here, we cover the essential features of the ecosystem conceptual model shown in the figure below. The conceptual model should be hierarchical. At the upper level, the model describes how anthropomorphic drivers create stressors on the environment and change environmental endpoints. Changes in environmental endpoints create limiting factors or stressors upon biological endpoints (e.g., populations of anadromous fish). The main challenge of creating the conceptual model is describing the linkages or pathways between stressors and endpoints. Such pathways are, in effect, hypotheses about how stressors affect endpoints, and predict how altering stressors will alter environmental or biological endpoints. When endpoints are measured, these predictions can be compared to observations and hypotheses can be refined, which in turn may alter restoration strategies and goals. Harwell et al. (1999) proposed that report cards, which summarize the continuous effort to measure and assess program success through the monitoring and evaluation of key responses in the ecosystem from various actions taken relative to restoration goals, can serve a useful function in tracking progress. The panel notes that some of the steps necessary to use this approach have been taken (especially the identification of limiting factors and some biological endpoints), but many have not.

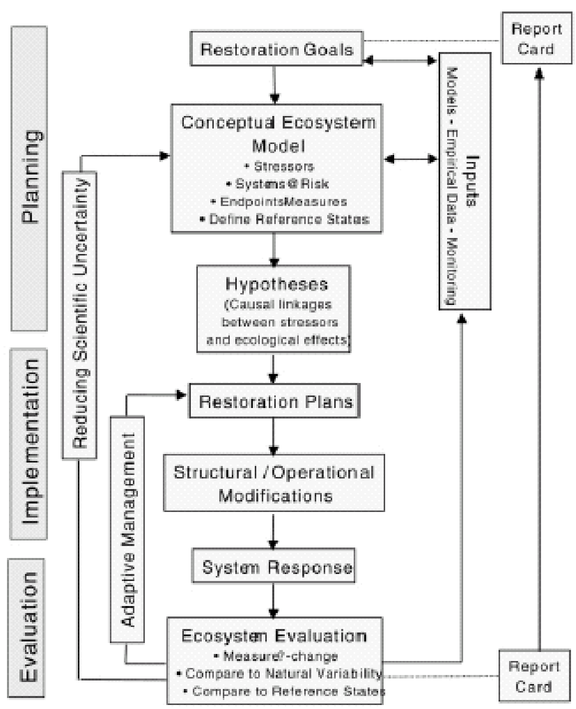

Figure 3a-1. Schematic representation of the ecosystem management and ecological risk assessment approach that is based on an explicit conceptual ecosystem model. From Harwell et al. 1999b.

We recommend the agencies develop an integrated science-based framework for the CVPIA anadromous fish program incorporating an ecological risk assessment/adaptive ecosystem management approach. Appendix C1 includes further discussion of this approach, including an example of how it has been applied in the Everglades, suggestions for how it might be applied in the CVPIA program, and additional considerations on monitoring and evaluation consistent with this approach.

Section 3b: Reorganize Program Structure and Management

The Department of Interior must change the structure of the program so that one decision-maker implements a unified program with an overarching framework of integrated goals and objectives grounded in the conceptual foundation discussed above and supported by the suite of specific activities managed as one program.

The difficulties in meeting the CVPIA goals and objectives are in no small part due to problems related to program organization and management. The present CVPIA program organization and management structure cannot successfully achieve either existing or likely future natural resource goals unless reshaped and managed around a revitalized conceptual framework for an integrated program.

In this section we first discuss problems with how the CVPIA is organized and managed and then recommend changes necessary to implement an effective program.

Weaknesses in Program Management

The agencies produced a Final Restoration Plan describing one unified CVPIA anadromous fish program, with a coordinated and inclusive set of objectives and implemented with a variety of tools and directions in the statutes. Such a unified and coordinated approach would have the ability to complement and achieve program goals. Unfortunately, the program is not organized, managed and implemented in this way. Instead, there is no integrated "program". Rather, there are many "programs"; nearly separate fiefdoms existing as a collection of the loosely related but distinct "b"s, thrown together under the CVPIA name, implemented without an overarching management structure operating under an integrated program framework. The "b"s are individually managed with, at times, divergent approaches. And the "Anadromous Fish Restoration Program" transforms from the umbrella program in the Final Restoration Plan to simply another one of the separate "b"s. The problems are illustrated by the CVPIA organizational chart shared with the panel, which showed a set of separately managed programs and the CVPIA co-lead "program managers" sitting off to the side with little role in the management or administration of the "programs" at all, but instead an undefined coordination role.

The absence of a unified program organized around a conceptual framework is one of the reasons the program appears to be a compartmentalized effort that lacks strategic planning and decision-making. As a result the program is unable to address the larger system issues, has a disjointed M&E program, exhibits little of the traits expected from effective adaptive management, and is unable to effectively coordinate with related programs in the region. An uncoordinated approach also creates boundaries to the free flow of useful information and program-wide prioritization. We observed that most researchers and technicians seemed unclear how or even whether their local efforts related to or contributed to the overall program.

The CVPIA and program management does not appear sufficiently elevated within the agencies and the Department of the Interior to effectively implement a complex integrated program of this magnitude with such serious social, economic and political stakes. Yet we saw no indication of any involvement in this program by officials in either agency above the co-lead coordinators or in the Department of Interior. The existing co-lead approach inefficiently distributes responsibilities between the agencies at a level too low to effectively manage and coordinate a multi-agency program such as the CVPIA. Nor is science appropriately elevated into the decision-making process. The result is that the co-leads and other personnel are left to muddle through implementation and budget decisions for the individual programs without a systematic way to incorporate scientific insights and oversight appropriately across the entire suite of activities within a coordinated program framework.

The CVPIA program managers have no mechanism to administer an integrated program or ensure that requests for data and information are honored in a timely way or consistent form. Staffs in both agencies implementing the CVPIA "programs" are not solely dedicated to it, having responsibilities outside the CVPIA program. On the other hand, there appear to be activities related to anadromous fish in the Sacramento and San Joaquin rivers that involve personnel or contractors of the two agencies yet they have no connection to the CVPIA anadromous fish program. This suggests the CVPIA program is not viewed as a high priority within either agency or Department of Interior as a whole. The CVPIA anadromous fish program should be *the* driving force in the valley for attacking the ecosystem problems related to the reengineering of the rivers, taking the leadership role among all entities.

Instead, the current organizational structure and compartmentalized program framework make it difficult for the CVPIA program to blend with other ongoing programs within the Central Valley that feature ecological restoration or biodiversity conservation. The lack of program coordination between CVPIA and other federal and State programs in the Central Valley and Delta results in wasted effort and dollars spent on redundant and even inconsistent activities. While there is some indication of integration and coordination between watershed personnel from different programs, we find no evidence of a program-level management structure that can highlight and capitalize on these linkages. Changes to the management structure of the CVPIA and the development of an integrated conceptual foundation for the program should facilitate effective linkage to allied programs within the basin.

The current organization of the CVPIA program limits scientific input and integration at the level needed to implement the ecological risk assessment and adaptive management approach described in the previous section. Many of the program's scientists actively engaged in scientific inquiry are found at the watershed level, with little apparent opportunity to participate in scientific consideration of system level responses to watershed actions and to plan implementation strategies that best take advantage of system effects and synergies. This also means the CVPIA program coordinators lack the scientific interface necessary to make sound budget decisions to support overall program goals. Data sharing both among watersheds and at the program level is hindered by the incomplete development of a central and accessible information repository that results in ineffective methods to systematically learn from data collected.

The weakness with CVPIA program organization and management is reflected in and exacerbated by the way funding is determined and allocated across the program tools (i.e., the "b"s). Funding is unstable from year-to-year, tied to variations in the ability of the CVP to deliver water to contract users, and has been declining recently. And funding is compartmentalized across the disparately managed "b"s. The program budgets and allocates funds for the different Section 3406 and 3408 activities as separate budget line items. Agency funding decisions seem to be a negotiated budget allocation among separate statutory entitlements, when the agencies should be allocating funds to high priority actions identified through a science-based conceptual framework. The current allocations appear to be largely guided by historical allocations, by the extent to which a proposed activity is its own "b", and by what appeared (in the anecdotes provided to the panel) to be agency ad hoc decisions and seat-of-the-pants determinations as to which activities and areas are most important for the moment. The agencies did not describe a systematic method for making allocation decisions based on performance criteria and review methods rooted in a scientific-based program framework.

Funding for the CVPIA initially increased from its inception, but annual funding has shown a recent decreasing trend. Annual expenditures peaked at $82 million in 1998, and have not exceeded $74 million since 2002. The last few years have shown a decline in obligations to an estimated $59 million in 2008. The trend of decreased investment in its actions to improve fish conditions creates a challenge for how to best take advantage of shrinking dollars. This would appear impossible if overarching program management remains absent and the program lacks a science-based conceptual framework systematically guiding decisions.

Recommendations to Reorganize Program Structure and Management

The Department of Interior must change the structure of the program so that one decision-maker implements a unified program with an overarching framework of integrated goals and objectives grounded in the conceptual foundation discussed above and supported by the suite of specific activities managed as one program. Specific recommendations include:

- Elevate the program in Reclamation and the Department of Interior. This means active involvement at the Assistant Secretary level within Interior with fundamental responsibility to ensure success of the program. In Reclamation itself, the Program Manager must sit at a sufficiently high level of responsibility to effectively implement the program across both the Bureau and Service. This would replace the co-lead concept. We understand there are several examples of programs within the Department of Interior with this structure, such as the Central Utah Completion Act and the Glen Canyon Adaptive Management Program. The figure below illustrates the management structure of the Glen Canyon program. This program is further described in Appendix C5.

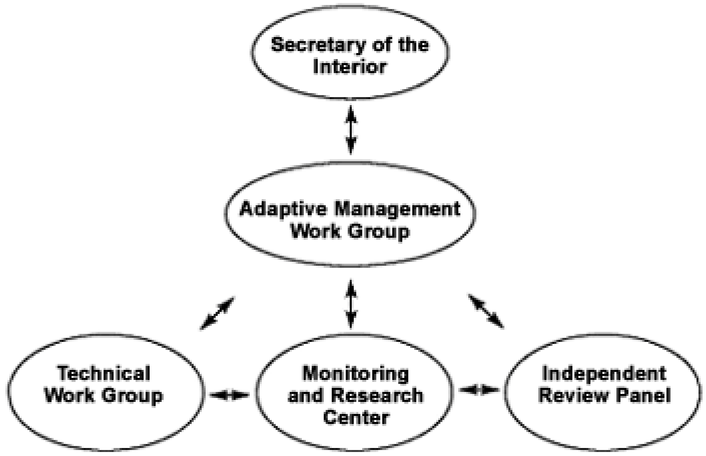

Figure 3b-1: Example from the Glen Canyon Adaptive Management Program

- All program activities and tools should be integrated and managed as one overarching anadromous fish restoration program.
- Increase high-level science staffing for the integrated program to include appropriate skill sets that support adaptive management. Involve scientists of this quality particularly in an umbrella group directly responsible for developing, overseeing and adapting the program's conceptual framework and monitoring and evaluation and adaptive management efforts.
- Employ a standing independent scientific review panel to provide advice on major program questions, to review proposed expenditures, and to review the reported results of implementation activities. Examples include the CALFED Science Panel and the panels that are part of the Columbia River Basin Fish and Wildlife Program, the Independent Scientific Advisory Board (ISAB) and the Independent Scientific Review Panel (ISRP).
- Base budget allocations on sound science, consistent with the revised program framework and CVPIA statutory purposes.
- Take responsibility at the highest level for integrating the work of the CVPIA with the other programs addressing the ecosystem problems of the Sacramento and San Joaquin rivers and Delta.

Section 3c: Improve Implementation by Making Full Use of CVPIA Authorities

One of the panel's difficulties in evaluating the effectiveness of planning and implementation by the agencies is the lack of any systematic methods by which the agencies are able to evaluate and compare the potential benefits to be gained by addressing different limiting factors. In Sections 3a and 3b above, we recommend ways in which the agencies might improve both the science-based foundation and framework for the CVPIA anadromous fish program and then the organization and management of the program. If the agencies revise the conceptual foundation and framework for the program as described above, they will have a better method for estimating the potential environmental and biological benefits that could accrue from different proposed actions. They will also have a better basis for evaluating whether implemented actions or sets of actions are resulting in the types of change hypothesized. In our opinion, over the long run, this will help improve the effectiveness of actions implemented.

Turning to CVPIA implementation itself, we also conclude that the agencies underutilized the authorities granted in the CVPIA to tackle some of the biggest problems in the system, especially concerning water management and the adverse effects of export pumping. First, critical actions that are explicitly called out in the CVPIA have not been given high priority for implementation. This is especially true with regard to solving all mortality issues associated with the export of water at the Tracy Pumping Plant and Fish Collection Facility. In addition, the agencies appear to have interpreted their CVPIA authorities too narrowly in certain cases and underutilized others, especially with regard to water management and project operations. This has reduced the agencies' ability to take effective action on a critical constraint to the natural production of anadromous fish. And the problem may begin with a too narrow and compartmentalized approach to the program mission, management and implementation.

We recommend that the agencies take a fresh and comprehensive look at their CVPIA authorities and their manner of implementation. Such a reform is consistent with our recommendation that the agencies rethink the conceptual foundation and framework for the program and overhaul program organization and management.

Implement Critical CVPIA Improvements

As noted in Part 2, the agencies correctly recognized a number of serious impediments to the survival and productivity of salmon and steelhead in the Central Valley and have taken effective action to address these impediments, actions that will be effective in making freshwater conditions better for salmon and steelhead and contribute in the long run to improved natural production. These actions include installing and operating the Shasta Temperature Control Device, passage improvements at Red Bluff Diversion Dam, and screen and passage improvements at the Sacramento River diversions for the Glen-Colusa Irrigation District and Anderson-Cottonwood Irrigation District.

However, there are just as many serious impediments to the survival and productivity of salmon and steelhead in the valley that the agencies have not effectively addressed. For example, the operation of the Tracy Pumping Plant and Fish Collection Facility is a serious mortality source for salmon and steelhead (and for Delta smelt). All aspects of the pump operations have significant adverse impacts on salmon and steelhead, from the way juveniles are drawn to the pumps and away from the natural migration routes out through the Delta, to predation and other mortality factors in the channels leading to the pumps, to high mortalities at the out-dated louvers screening the pumps, to even higher mortalities likely during the archaic "salvage" collection and transport operation at the pumps, to predation mortality at the point of re-release, and finally to the overall adverse effects on salmon survival and productivity from regulating and diverting that much of the natural Delta outflow. Data on direct and indirect juvenile mortality is uncertain but likely to be high, and may run as high as 50% for spring-run chinook and steelhead, and possibly 75% for winter-run chinook.[4]

Section 3406(b)(4) directly obligates the agencies to develop and implement a program to mitigate for fishery impacts associated with operations of the Tracy Pumping Plant. Even without that provision the agencies must have as a highest priority addressing and solving the fundamental Tracy facility problem, if they are to operate the CVP to meet their obligations under the federal ESA, Section 3406(b), and to have any chance to increase significantly the natural production of anadromous fish in the system under Section 3406(b)(1). In ongoing ESA litigation, the federal court has concluded that the operation of the pump facilities continues to cause appreciable, irreparable harm, constantly making conditions worse for already non-viable populations.

No significant progress has been made since 1992 in solving this fundamental constraint. We recognize the magnitude of the changes needed to solve the problem. But if the CVPIA missions are truly to be successful as set forth by Congress, it will be improvements of this magnitude that acknowledge the seriousness of the effort and provide the opportunity to achieve a successful long-term rebuilding of anadromous fish populations. We understand that a number of solutions are being studied in other fora, including in the ESA regulatory context and in the CALFED, Delta Vision and Bay Delta Conservation Plan processes. The fact that these discussions are taking place largely outside the context of the on-going CVPIA anadromous fish program is itself an indictment of the lack of seriousness of the latter effort, which instead should be the linchpin in these discussions. We suspect from all the information we have seen that improving conditions for anadromous fish to a level sufficient to meet the CVPIA and ESA obligations will require both a significant reduction in the amount of water pumped out of the system *and* substantial investments throughout the Delta to install effective barriers that reduce entrainment and keep the juveniles in well-flowing channels to the sea. In other words, it is unlikely there is a solution that restores natural anadromous

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[4] *See, e.g.,* the summary of information from the OCAP Biological Opinions and other sources cited in the May, July and October 2008 decisions of the federal court for the Eastern District of California in *Pacific Coast Federation of Fishermen's Associations v. Gutierrez* (Case No. 1:06-CV-00245) (salmon and steelhead) and the May and December 2007 decisions in *Natural Resources Defense Council v. Kempthorne* (Case No. 1:05-CV-1207) (Delta smelt).

salmonid runs while also allowing the region to continue to enjoy *all* the benefits it receives from current pumping levels and water regulation (and even increase the amount of pumping, as contemplated). We recognize we may be wrong about the ultimate solution – that is the purpose of the conceptual model analysis described above – but an increase in the magnitude of investments to address the problems seems likely in any event.

The Final Restoration Plan identified the Delta as the highest priority for CVPIA action, a priority statement the agencies have failed to implement effectively. For example, the agencies investigated the possibility of constructing a new fish screen and collection facility, but decided that budget constraints prevented consideration. For another example, the agencies identified 23 actions to improve the "salvage efficiency" of the Tracy facility, but completed only 10, few of which go to the heart of the systemic problem. Finally, Reclamation appears to have underutilized its authority to change pumping operations to address these problems, ceding for now those decisions to the federal courts. The agencies should use the revised conceptual foundation and the reorganized program framework recommended above to reassess the seriousness of the problems in the Delta.

The agencies may likely respond that the financial resources available have not been adequate to address this critical CVP constraint. An inadequate level of funds has been made worse by fluctuations and declines in CVPIA funding, further exacerbated by pressure from water contractors to begin *reducing* Restoration Fund payments, despite the lack of real progress in meeting the natural production or ESA goals of the CVPIA. See Appendix C6 for additional detail on CVPIA funding. Work should begin now on developing a stable source of adequate funding for this program. The agencies should work hard to persuade Reclamation's water delivery customers, their political allies, and the relevant appropriations committees that it is better for them to partner with Reclamation in a more serious effort at restoration in the Central Valley as the price of doing business. The alternative is to have the same result forced on them in a less palatable way and well out of their control through ESA regulatory actions and court injunctions. As an example, the Bonneville Power Administration and its power sales customers have recently increased funding in the Pacific Northwest, taking control of their destiny as partners with certain states and tribes in recently executed 10-year implementation agreements with adequate budgets for the Columbia River Basin Fish and Wildlife Program[5]. If the agencies find themselves truly unable to address effectively the serious constraints to salmon and steelhead in the Delta (or elsewhere), for financial, political or legal reasons, the agencies need to be honest and clear about this point, and reopen discussions with Congress and the region about a different set of ecosystem goals and the methods to achieve those goals.

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[5] *See* 2008 Columbia Basin Fish Accords at http://www.salmonrecovery.gov/Biological_Opinions/FCRPS/2008_biop/ColumbiaBasinFishAccords.cfm, associated with the 2008 FCRPS Biological Opinion at http://www.salmonrecovery.gov/Biological_Opinions/FCRPS/2008_biop/index.cfm; proposed program funding levels in and after FY2010 for Bonneville Power Administration, http://www.bpa.gov/corporate/Finance/IBR/IPR/Final_7_31_FY_2010_11_Draft_Report.pdf.

The lack of resources is not the only problem, however. The agencies must improve how funds are allocated to priority needs with the greatest potential for success at a system level, through the mechanisms described earlier in this section. And the agencies have *operational* authorities at their disposal under the CVPIA that seem underutilized, as discussed further below. The focus here has been on the effects of export pumping in the Delta. But there are other serious mortality sources, especially lower in the system, that are a clear focus of the CVPIA legislation and yet have not been effectively addressed, such as the need to implement a program to mitigate for fishery impacts resulting from operations of the Contra Costa Canal Pumping Plant No. 1, Section 3406(b)(5).

Critical actions that are explicitly called out in the CVPIA have not been given high priority or sufficient resources for implementation, especially in the Delta. CVPIA goals will not be met without implementing critical actions authorized in the CVPIA and increasing funding to address major system impediments.

Exploit Underutilized Powers in the CVPIA

There are a number of examples throughout CVPIA implementation where the agencies fail to exploit the full powers granted in the Act. This is especially true with regard to water management and project operations. An excellent example of the agencies' constrained approach to their authorities is how the agencies have implemented Section 3406(b)(2). This provision directs Reclamation to

> "dedicate and manage annually 800,000 acre-feet of Central Valley Project yield for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help meet such obligations as may be legally imposed upon the Central Valley Project under state or federal law following the date of enactment of this title, including but not limited to additional obligations under the federal Endangered Species Act."

When viewed in combination with the broad directive in Section 3406(b)(1)(B) to "modify Central Valley Project operations to provide flows of suitable quality, quantity, and timing to protect all life stages of anadromous fish," for which the 800 kaf is one explicit tool, the panel expected to find that implementation of 3406(b)(2) had occurred in this way: The agencies identify 800 kaf of dedicated storage in the system – essentially, a water volume budget – and then consistent with an identified system-wide flow regime to improve conditions for anadromous fish, Reclamation would release this stored water in requested amounts at the call of the fish managers and then protect that amount of altered flow through the rivers, through the Delta, and into the bay.

We were flabbergasted to learn this is not how the agencies implement this provision. The agencies have not identified a system-wide flow regime and set of system flow objectives. Worse, Reclamation does not dedicate and manage 800 kaf of water from headwaters storage through the Delta. Instead, Reclamation releases approximately *400* kaf from CVP storage each year, aimed at supporting the needs of particular life stages at particular locations. These augmented amounts are then *diverted out of the system* at a later point. The 800 kaf accounting then includes approximately 400 kaf realized in pump restrictions in the Delta. This approach seems fundamentally at odds with the intent and language of the legislation.[6] It is symptomatic of a program focused on local upstream watershed factors and not on the Delta and especially not on the problem at the system scale.

As with other aspects of the CVPIA anadromous fish program, the agencies need to rethink completely their water management authorities. Current implementation seems to begin with the disparate set of authorized actions, especially with the narrow approach to the dedicated 800 kaf, using a restricted focus on the benefits of dedicated water at the watershed level, and focused on the "doubling goal". A different way will begin with the conceptual foundation described above, and revise the anadromous fish restoration plan to identify a system-wide flow regime and flow objectives at various points in the system estimated to be of suitable quality, quantity and timing for all life stages of anadromous fish, from spawning, emergence and rearing, to juvenile outmigration, to conditions for returning adults. The agencies should also identify the runoff volumes and operational actions necessary at a coordinated system level to achieve these objectives. It is especially important to specify the flow regime in the lower river and through the Delta that is necessary for the biological requirements of anadromous fish.

In the AFRP Final Restoration Plan and in a separate IFIM program, the agencies have identified and worked to implement a set of instream flow targets for particular watersheds for particular life-stage conditions. Success in meeting these targets has been varied; the greatest discrepancy between target and actual conditions appears to be in the Stanislaus River. Useful efforts include the Vernalis Adaptive Management Plan, an attempt to meet flow objectives in the San Joaquin River. Also, the agencies manage Shasta and Whiskeytown releases to try to meet temperature standards set for the Sacramento River. The panel is not disparaging these efforts. But these should be elements of a comprehensive system-level effort to describe a set of desired hydrographs for the rivers as a whole for varying runoff conditions, describing the flow conditions anadromous fish need to achieve recovery under ESA and yield significant increases in productivity and abundance.

[6] We recognize that there has been a significant amount of policy development and litigation regarding implementation of Section 3406(b)(2). And thus we understand that the way in which Reclamation has implemented Section 3406(b)(2) may survive under the deferential canons of judicial review. But surely this is neither the only way nor the best way to understand and implement a provision calling for a dedicated 800 kaf of project yield to benefit salmon and steelhead, either in legal terns or, more importantly, in terms of what is best for the fish.

Thus, the agencies should design a flow regime, implemented through system operations, that functions at both the system level and at the watershed level, carries from the headwaters through the Delta into the Bay, and is cognizant of all life stages. Moreover, the focus of this flow regime should not be just on how water volumes might contribute to the "doubling goal." Section 3406 of the CVPIA describes a set of interrelated objectives to improve Central Valley fish and wildlife, fish and wildlife habitat, water quality, and ecosystem conditions, not just the doubling goal. For just two of many examples, Section 3406(b) tells Interior to operate the CVP to meet all obligations under federal and state law, including the requirements of the Endangered Species Act and the State Water Resources Control Board, and Section 3406(c) directs the agencies to develop a comprehensive plan to address fish, wildlife, and habitat concerns on the San Joaquin River, including streamflow and water quality improvements needed to reestablish and sustain naturally reproducing anadromous fisheries from Friant Dam to the Delta. The agencies' response has been to segment these programs into independent efforts. Instead, the agencies should use the conceptual framework approach described in Section 3a to design, and then Reclamation should implement, a coordinated effort at water management and project operations to produce a flow regime that meets all these objectives consistent with the intent of Section 3406. See Appendix C1 for further discussion about redesigning the program conceptual framework to take into account the broad set of interrelated objectives in the CVPIA.

This is an integrated river system, an integrated Central Valley Project, and a set of missions best integrated through an ecosystem restoration approach. Developing and implementing a disparate set of activities and programs to manage different water and different operations for these different purposes within an integrated river system is ineffective and inefficient. We recognize that some authorities and actions relate only to certain CVPIA objectives, but that is a management and accounting task within an integrated flow regime in an integrated CVPIA program, not an excuse for not having an integrated water management program.

Once the agencies describe the desired system flow conditions, the final step should be to look across the array of authorities and actions that can be used over time until these flow conditions are achieved and to use them as a coordinated and integrative set of tools until the desired environmental conditions are achieved:

- Manage a dedicated 800 kaf to this end under Section 3406(b)(2) – a true 800 kaf identified upriver and protected through the system, including preservation of that dedicated 800 kaf through the Delta.
- To add to the 800 kaf, Reclamation should continue an aggressive, coordinated program under Section 3406(b)(3) to "acquir[e] a water supply to supplement" the 800 kaf and eventually achieve the identified system flow conditions, an approach that will also mean Reclamation will be operating the CVP in an equitable way for fish and wildlife comparable to the other project purposes. This section directs Reclamation to use an array of tools and actions to obtain that water and dedicate it to the necessary environmental conditions for fish and wildlife, including "improvements in or modifications

of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land." Reclamation could be far more aggressive in demand side management –water conservation, land fallowing, and the like – under this section and Section 3408(i) to identify and dedicate to ecosystem needs additional volumes of water. It may be that particular circumstances mean that certain amounts of this additional water may be protected instream only through certain river reaches or for particular local needs. If so, this simply means Reclamation has more work to do to obtain and manage other water to meet the needed flow conditions defined for the system as a whole.

- Additional elements of this effort to manage the system toward the identified desired flow regime include: continual reevaluation of existing operational criteria in order to maintain minimum carryover storage at Sacramento River and Trinity River reservoirs to protect and restore the anadromous fish of the Sacramento River (and Trinity River), Section 3406(b)(19); identify and implement short pulses of increased water flows to increase the survival of migrating anadromous fish moving into and through the Sacramento-San Joaquin Delta and Central Valley rivers and streams, Section 3406(b)(8); and at the same time, eliminate to the extent possible losses of anadromous fish due to flow fluctuations caused by the operation of any Central Valley Project storage or re-regulating facility, Section 3406(b)(9).
- At bottom, Reclamation has the authority to operate the projects to meet at least the most serious environmental needs of anadromous fish, especially to meet ESA and water quality requirements imposed under federal and state law. E.g., Sections 3406(b) ("immediately . . . operate the Central Valley Project to meet all obligations under state and federal law, including but not limited to the federal Endangered Species Act and all decisions of the California State Water Resources Control Board establishing conditions on applicable licenses and permits for the project"), 3406(b)(7) ("meet flow standards and objectives and diversion limits set forth in all laws and judicial decisions that apply to Central Valley Project facilities"). This is certainly how the federal courts understand Reclamation's authority under the CVPIA, forming the basis for injunctive relief including orders to cease pumping out of the Delta to protect listed species and to meet state-mandated water quality conditions, with CVP water delivery contracts subject to these conditions.[7] The panel understands the agencies' reluctance simply to reduce pumping or make other unilateral operational changes, and we recognize that to be sustained in the long run these changes will need to be developed in collaboration with the other beneficiaries of the system in an equitable fashion and emphasizing all the tools described above. That does not mean the agencies should ignore using their authority to change project operations to produce flow conditions necessary to allow for the survival and recovery of

[7] *See, e.g., Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, Case No. 1:06-CV-00245 (E.D. Cal.), Findings of Fact and Conclusions of Law (July 2008), at 9-10.

> native anadromous fish in the system. It is clear that if Reclamation does not begin to use these authorities in a responsible and equitable manner, the courts will order it to do so.

The effect from the agencies' reluctance to implement their authorities in a robust manner consistent with the CVPIA mission is, not surprisingly, most noticeable in the Delta. We do not know to what degree a more normative flow regime is necessary through the Delta to support the recovery of anadromous fish. That is for the agencies to determine as they revise the conceptual framework for the program. But it is near certain that it is far different from how the agencies have implemented the CVPIA since 1992. As noted more than once above, the Final Restoration Plan designated the Delta as the highest priority area for CVPIA implementation. Yet the agencies have not used their water management and project operations authority to address effectively what they themselves identified as highest priority for action.

This section has focused on the serious constraint to the natural production of anadromous fish presented by altered flow regimes, and on the panel's perspective that the agencies are underutilizing the water management and project operation authorities that would allow them to tackle that problem. Another serious impediment, described above in Part 2, is the fact that most of the historic productive spawning habitat for listed spring-run and winter-run chinook and steelhead lies behind tributary dams, which are permanent barriers lacking fish passage facilities. It seems unlikely that these populations can be restored without providing access to at least some of that unutilized habitat. But even as the CVPIA program has worked to remove small barriers in various streams, it has largely ignored this larger system problem. Thus, it appears that under the CVPIA, managers may not have explored the feasibility of providing passage above current blockages, or about the biological potential if passage is provided. As the agencies redesign the conceptual foundation and program framework, they will need to investigate the feasibility, benefits, costs and risks of investing in passage to spawning and rearing habitat upstream of the dams.

Anadromous fish programs in other parts of the west are indeed investigating the feasibility of reintroducing anadromous fish above permanent barriers. For example, the Willamette River in Oregon resembles many of the Central Valley streams, in the sense that high headwaters dams in the Willamette and its Santiam tributary block access to most of the historic higher altitude habitat for spring-run chinook and steelhead, both listed under the ESA. After years of unsuccessful efforts to transform habitat below the dams to benefit these fish, the new Willamette Biological Opinion (July 2008) incorporated passage measures for the first time as necessary to avoid jeopardy and begin moving towards recovery.[8] The CVPIA agencies do not have the authority to remove the major CVP and similar dam blockages, but they certainly have the authority, in Sections 3406(b)(1), (b)(1)(a), (e)(3), (e)(6) and (g), to investigate this matter, model the potential, and seek to implement passage actions if the potential justifies action.

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[8] See http://www.nwr.noaa.gov/Salmon-Hydropower/Willamette-Basin/Willamette-BO.cfm.

We believe the agencies interpret their CVPIA authorities too narrowly in certain cases and have underutilized others, reducing the agencies' ability to take effective action on critical constraints to the natural production of anadromous fish. Instead, the agencies need to exploit underutilized powers in the CVPIA, especially with regard to water management and project operation; identify a system-wide flow regime and flow objectives at various points in the system that represents flows of suitable quality, quantity and timing for all life stages of anadromous fish; and use all the tools at the agencies' disposal in the CVPIA to alter how water is managed and the system is operated to support the identified flow regime and flow objectives.

The agencies' underutilization of their authorities is related to their compartmentalized approach to the program mission and management. The agencies need to implement actions consistent with the revised conceptual foundation and framework to meet the interrelated set of objectives in the CVPIA related to Central Valley fish and wildlife, fish and wildlife habitat, water quality, and improved ecosystem conditions.

Section 3d: Improve Collaboration With all Related Programs in the Central Valley

The CVPIA anadromous fish program is not the only program or activity in the Central Valley, or even within the agencies, attempting to improve fish populations, fish and wildlife habitat, and ecosystem conditions in general in the Sacramento and San Joaquin rivers. The ability of the CVPIA program to achieve its goals will be affected by actions implemented by entities outside the control of the CVPIA agencies, as well as by natural processes beyond anyone's control (e.g., climate change).

Some of these missions and actions complement the CVPIA program. The work of the CALFED program, for example, continues to overlap with the CVPIA program. As the CVPIA agencies revise the conceptual foundation and program framework for the CVPIA program, they need to coordinate directly with and help to lead the multi-agency CALFED effort (to the extent it is still vital) and account for those activities within the framework. This is also true for other efforts in the basin trying to tackle the same problems and integrate an ecosystem management paradigm into the broad set of human needs and activities in the Central Valley.

Ongoing activities within the agencies must be made to complement the CVPIA program. The most obvious example is that any effort by the CVPIA to address effectively the problems in the Delta and with the Delta pumps will founder if the State Water Project does not make similar reforms with regard to the pumping in the same location. The federal and state agencies must use the OCAP coordination and the Section 7 consultation process to bring these activities together in a compatible way. But such an effort will be successful only if it is also embedded in the revised conceptual foundation and program framework of ecosystem management described above. It would seem that the CVPIA program and personnel should be central to the OCAP Section 7 consultation, and the agencies' efforts to satisfy the requirements of ESA, one of the central directives of the CVPIA. Yet the panel received no information on the involvement of the CVPIA program or personnel in the ESA consultation effort, in the determination of the biological requirements for these species from an ESA perspective to avoid jeopardy, or in the determination of what actions the agencies should be taking to meet ESA.

Other activities in the Central Valley related to fish may be in conflict with or undermine what the agencies are trying to accomplish in the CVPIA. We do not presume that the goals and objectives embraced by many of these programs are entirely compatible. For example, the operation of hatchery facilities and inconsistent marking of hatchery populations will continue to confound the CVPIA agencies' ability to generate accurate estimates of natural production. The primary performance goal for the CVPIA will be hard to measure in any meaningful manner if this is not solved. In another example, programs that encourage population increases and thus fishing opportunities for exotic predatory species such as striped bass (e.g., California Fish and Game and the CVPIA itself) clearly conflict with CVPIA and ESA mandates to protect and rebuild depressed stocks of native salmonids (notwithstanding the panel's recognition that the CVPIA is internally inconsistent in this regard).

Notably absent is a regional vision or goal that could assist in guiding and integrating the various fishery and water resource programs. The Panel views this as a shortcoming that limits the ability of the CVPIA to achieve its stated goals. The CVPIA agencies must put a high priority on integrating these considerations into its revised program framework and conceptual foundation to better understand how the range of actions outside its control (human and natural) affect its ability to improve conditions for its focal species. The agencies need to coordinate closely with these other entities at a high level in the CVPIA program to try to bring the programs into line as much as possible, and take an active leadership role in this coordination effort around an ecosystem management foundation.

Part 4. Major Recommendations

We have summarized the panel recommendations below.

Improve the Program's Science-Based Framework

We recommend the agencies develop an integrated science-based framework for the CVPIA anadromous fish program incorporating an ecological risk assessment/adaptive ecosystem management approach with the following elements[9]:

- A program vision, which describes what the program is trying to accomplish with regard to fish and wildlife, in the context of other desired benefits from the rivers;
- A conceptual foundation linking management action and biological response in support of the program vision. Explicitly link ecosystem processes and salmonid production from direct hypothesis-driven observations and data collection. Incorporate exogenous factors into the conceptual model;
- A systematic quantitative analysis of limiting factors to estimate and prioritize potential gains and risks from different actions and types of environmental change, including the use of appropriate models;
- Develop and implement an integrated multi-agency data management system to allow for the storage, maintenance and use of data collected during the monitoring programs;
- A focused program framework and analyses at both the system and basin levels;
- Use statistically sound sampling designs to accompany a standard set of monitoring protocols, i.e., which responses need to measured or estimated and how that is to be accomplished;
- Use monitoring data to test hypotheses that will form the basis for management actions within a scientifically valid adaptive management program and adjust management actions and goals accordingly.

Reorganize Program Structure and Management

We recommend the Department of Interior change the structure of the program so that one decision-maker implements a unified program with an overarching framework of integrated goals and objectives grounded in the conceptual foundation discussed above and supported by the suite of specific activities managed as one program. This would include the following elements:

9 Recommendations are based on Harwell and Gentile et al. *See* Appendix C1. Also Williams, et al., 2007, Adaptive Management: The U.S. Department of the Interior Technical Guide, Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C. 1-411-31760-2

- Elevate the program in Reclamation and the Department of Interior. This means active involvement at the Assistant Secretary level within Interior with fundamental responsibility to ensure success of the program. In Reclamation itself, the Program Manager must sit at a sufficiently high level of responsibility to effectively implement the program across both the Bureau and Service. This would replace the co-lead concept. We understand there are several examples of programs within the Department of Interior with this structure, such as the Central Utah Completion Act and the Glen Canyon Adaptive Management Program. The figure below illustrates the management structure of the Glen Canyon program. This program is further described in Appendix C5.
- All program activities and tools should be integrated and managed as one overarching anadromous fish restoration program.
- Increase high-level science staffing for the integrated program to include appropriate skill sets that support adaptive management. Involve scientists of this quality particularly in an umbrella group directly responsible for developing, overseeing and adapting the program's conceptual framework and monitoring and evaluation and adaptive management efforts.
- Employ a standing independent scientific review panel to provide advice on major program questions, to review proposed expenditures, and to review the reported results of implementation activities. Examples include the CALFED Science Panel and the panels that are part of the Columbia River Basin Fish and Wildlife Program, the Independent Scientific Advisory Board (ISAB) and the Independent Scientific Review Panel (ISRP).
- Base budget allocations on sound science, consistent with the revised program framework and CVPIA statutory purposes.
- Take responsibility at the highest level for integrating the work of the CVPIA with the other programs addressing the ecosystem problems of the Sacramento and San Joaquin rivers and Delta.

Improve Implementation by Making Full Use of CVPIA Authorities

We recommend that the agencies reconsider how they understand and use their CVPIA authorities and rethink program implementation consistent with the recommended conceptual foundation and program framework.

- Implement actions consistent with the revised conceptual foundation and framework for program described above, in an attempt to improve ecosystem conditions to meet a broader and interrelated set of CVPIA goals than the agencies have integrated into the program so far.

- Implement critical actions authorized in the CVPIA to address major system impediments, especially in the Delta, even if expensive and difficult to achieve.
- Increase funding for flow restoration, habitat improvements, and monitoring as part of an adaptive management framework.
- Exploit underutilized powers in the CVPIA, especially with regard to water management and project operation.
  - Based on the conceptual foundation described above, identify a system-wide flow regime and flow objectives at various points in the system that represent flows of suitable quality, quantity and timing for all life stages of anadromous fish, from spawning, emergence and rearing, to juvenile outmigration, to conditions for returning adults. Identify the runoff volumes and operational actions necessary at a coordinated system level to achieve these objectives.
  - Implement Section 3406(b)(2) so as to dedicate and protect 800 kaf of water from headwaters storage through the Delta consistent with the above.
  - Then, use the other tools at the agencies' disposal in the CVPIA to alter how water is managed and the system is operated to support the flow regime and flow objectives described above and contribute to meeting an overlapping set of objectives in the CVPIA related to Central Valley fish and wildlife, fish and wildlife habitat, water quality, and improved ecosystem conditions.

Improve Collaboration with All Related Programs in the Central Valley

Recognize that the CVPIA cannot be successful in isolation from other activities within the region.

- The CVPIA agencies must put a high priority on integrating a range of actions and effects outside their control into a revised program framework and conceptual foundation to better understand their ability to improve conditions for focal species.
- Take responsibility at the highest level for integrating the work of the CVPIA with the other programs addressing the ecosystem problems of the Sacramento and San Joaquin rivers and Delta.

APPENDIX A: *Critical Questions and Panel Responses*

Assessing the Potential of Different Programs to Contribute to Doubling of Anadromous Fish Populations

1. Of the 26 CVPIA fisheries program activities that affect Central Valley anadromous fish populations (see attached list of program activities), which CVPIA tools have been most effective in increasing populations?
At the program level, data necessary to assess this are either absent or have not been collected in a consistent and statistically rigorous way.

2. Which anadromous fisheries program activities have the greatest ability to contribute to doubling fish populations? What recommendations do you have for programs to maximize their impact in these areas?
Based on the panel's assessment, the fisheries program activities lack an overarching and systematic approach to habitat and ecosystem function necessary to understand and accommodate the interrelatedness of actions. Instead, the program appears to consider the individual tools within the CVPIA as discrete activities rather than interconnected actions that change the dynamics of the system. Programs designed to increase flow, remove barriers, improve water quality, and reduce predation appear to have the greatest ability to improve anadromous fish populations in the near term. However in the long term, the synergies among the tools can also be considered but only when implemented in concert with other activities designed to restore ecosystem function.

The panel suggests the use of a conceptual model as employed in adaptive management to integrate the programs and to take advantage of possible synergies. This more holistic approach appears to have been used in Butte Creek. The panel recommends the use of an ecological risk assessment approach (Williams, 2007, Gentile et al 2001) to manage and reduce uncertainties.

3. Are the scope and scale of current program actions sufficient to achieve fish doubling? If not, what would be needed to achieve the goal?
No. Clearly the scope and scale is insufficient because the populations have not doubled and, in fact, most appear to have decreased.

First, recognize that the doubling goal may not be correctly defined, may not be achievable in certain cases, and even if achieved in other cases, may not result in restored natural production of anadromous fish sufficient to recover the runs. In Section 3a, we discuss the problems associated with the doubling goal itself and describe an alternative view based on system restoration and resulting biological responses. Using the ecosystem risk assessment approach, analyze what is possible and what magnitude of system change would be needed to restore and sustain anadromous fish production to the levels needed. Then, the program needs to use all of the authorities available to it to realize this change, as described in Section 3c.

Responding to Limiting Factors

4. How should CVPIA account for and address exogenous factors as it evaluates progress and plans for future restoration actions?
Exogenous factors should be considered in an ecosystem risk assessment decision making context and should be built into the conceptual model to account for them and their influence.

5. How well have the CVPIA anadromous fisheries programs identified and addressed the most important limiting factors within and across the watersheds for the different anadromous fish populations? Are there additional limiting factors that need to be considered?
Exogenous factors aside, many limiting factors specific to individual watersheds were identified in the AFRP but were not prioritized using a quantitative method either within the watershed or system-wide. Therefore, the contribution toward the doubling goal by reducing the effects of the limiting factor within and across watersheds remains unknown. The panel suggests the program managers adopt an analytical framework such as STELLA modeling on the system level and/or an EDT "micro" analysis at the watershed level to prioritize actions.

There may be additional limiting factors that have not been identified. For example, the panel did not see the prey base for juvenile salmonids identified as a potential limiting factor. The panel recommends revisiting the list of limiting factors during development of the conceptual model.

Setting Priorities for Programs and Restoration Actions

6. Have the anadromous fisheries programs individually and collectively established overarching program plans and priorities to guide them towards achieving the fisheries goals articulated in the provisions of the Act? What recommendations do you have for the program going forward?
No. Although there are plans for each "b" program, they are not integrated across the CVPIA program but instead are largely about, and for a specific "b" program. While the AFRP Final Restoration Plan was developed, it has not been implemented as conceived. Also, the level of planning for each of the "b" programs seems to vary considerably. Collectively, the CVPIA Program neither integrates actions nor monitoring results across "b" programs.

Detailed recommendations are included in this report.

7. Have the CVPIA anadromous fisheries programs been effective in establishing and following near-term priorities that guide restoration actions? What recommendations do you have for the program going forward?
No. See responses to questions above.

Detailed recommendations are included in this report.

Learning from Actions and Investments

8. How well have the CVPIA anadromous fisheries programs monitored anadromous fisheries resources and restoration actions and used the data collected to inform future actions and decisions? Can this process be improved?
The CVPIA program does not use basic principles of adaptive management at a program level. Consequently, the CVPIA program does not realize the many benefits of an adaptive approach to resource management described in Williams (2007) and Gentile (2004). Within the "b" programs, principles of adaptive management are not consistently applied, although some watersheds (e.g., Butte Creek) appear to use adaptive management techniques more than others.

Yes. The panel recommends that CVPIA managers adopt adaptive management principles as described in Williams et al. (2007) and Gentile (2004). These principles are summarized in Section 3a of the report.

9. In addition to measurements of the fish populations, what other goals or metrics could be used to measure accomplishments?
The anadromous fish doubling goal cannot be achieved without restoring natural function and process to critical system components. Therefore, metrics that capture ecosystem function should supplement metrics that measure progress towards the doubling goal.

10. What organizational or program management changes could be made to reduce program costs and/or to improve program performance, efficiencies, and effectiveness?
The panel recommends major changes to program structure and management described in Section 3b.

APPENDIX B: *Panel Biographies*

Fisheries Independent Review Panelists

Ken Cummins, Ph.D.

Ken Cummins received his undergraduate degree in Biology from Lawrence University, and from the University of Michigan, Ann Arbor both his masters in Fisheries and doctorate in Zoology/Limnology. Since 1999 he has served as Senior Advisory Scientist, with the California Cooperative Fishery Research Unit and as Adjunct Professor with the Fisheries Department, Humboldt State University, Arcata CA. His areas of professional expertise are in stream/river/wetland ecosystem structure and function; general aquatic ecosystem theory with emphasis on land-water interactions, especially sources and fates of organic matter from the riparian zone; functional analysis of freshwater and estuarine invertebrates and factors that regulate their growth and mortality.

Christopher Furey, J.D.

Christopher Furey is a policy analyst at the Bonneville Power Administration (BPA) with a focus on environment, fish, and wildlife issues. Mr. Furey is the BPA lead and project manager for the Columbia Basin Water Transactions Program and associated riparian easement pilot projects implemented in cooperation with the National Fish and Wildlife Foundation and the Northwest Power and Conservation Council. Mr. Furey represents BPA on the Federal Habitat Team and is involved with hydrosystem mitigation activities as part of the Biological Opinion and Integrated Program Planning Team for the Federal Columbia River Power System (FCRPS). Mr. Furey has a Bachelor of Science degree in Environmental Studies-Biology from the University of Southern California and a Juris Doctorate from Lewis and Clark Law School.

Albert Giorgi, Ph.D.

Albert Giorgi received his bachelor and masters degrees in biology at Humboldt State University and his doctorate in fisheries science from the University of Washington. He has worked in both the public and private sectors. He initially worked for NOAA as a research scientist for eleven years, and then began private consulting in 1990. He is now the president and a senior scientist at Bioanalysts, Inc. He has been conducting research on salmonid resources Pacific Northwest since 1982. He specializes in issues regarding salmon ecology, fish passage, migratory behavior, and biological effects associated with water management strategies and the emplacement and operation of dams. His research methods include the use of radio telemetry, acoustic tags and PIT-tag technology. His projects have been staged primarily in the Columbia and Snake River basins, but also include the Klamath, Clark Fork, and McKenzie river systems. In addition to his research activities, Dr. Giorgi acts as a technical analyst and advisor to public agencies and private firms. He has conducted projects for: the Bonneville Power Administration; The National Research Council; CALFED; Northwest Power and Conservation Council;

U.S. Army Corps of Engineers; Chelan, Douglas, and Grant County Public Utility Districts, and PacifiCorp. Dr. Giorgi regularly teams with structural and hydraulic engineers in the design and evaluation of fishways and fish bypass systems on rivers throughout the west.

Steve Lindley, Ph.D.

Steve Lindley is an ecologist at the NMFS lab in Santa Cruz, CA, where he leads the Landscape Ecology Team. He has a doctorate from Duke University and a BA from UC Santa Barbara. He has been active in providing scientific advice to those managing anadromous fish under the Endangered Species Act, and his research interests include landscape, ecosystem, and population ecology of aquatic organisms, statistical and numerical modeling, time series analysis, stable isotopes, telemetry, and mark-recapture. He has published over 30 articles in the peer-reviewed literature.

John Nestler, Ph.D.

John Nestler received an undergraduate degree in Biology from Valdosta State College, an M.S. in Zoology from University of Georgia, and a Ph.D. in Zoology from Clemson University. He is currently a member of the Cognitive Ecology and Ecohydraulics Team, U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS. Prior to this position, Dr. Nestler was Director, Environmental Modeling and System-wide Assessment Center, ERDC, from 2004-2007. He also holds the following scientific positions: Associate Adjunct Professor, Department of Civil and Environmental Engineering, University of Iowa; Honorary Professor, University of Birmingham, UK; Assistant Adjunct Professor, University of Georgia; Editorial Board, River Research and Applications, and Co-Director of the Tropical Environmental Research Center, University of Puerto Rico, Mayaguez, Puerto Rico. Dr. Nestler has made contributions to environmental flow determination methods, hydrologic methods for predicting cumulative impact on wetlands, techniques for predicting effects of turbine passage on fishes, and developed improved methods for fish protection and passage at dams. The primary focus of his research interests is to couple together into a single, seamless system, the tools used by engineers with the tools used by ecologists. Most recently, Dr. Nestler led the coupling of fish movement and population models to engineering water quality and CFD models. He developed tools to allow engineering models to support simulation of higher trophic level organisms such as fish and shellfish. He is active in issues involving coastal and river environmental sustainability, coastal and river large-scale ecosystem restoration, fish passage, fish movement analysis and forecasting, advanced habitat modeling methods, and Eulerian-Lagrangian-agent modeling methods. He has well over 100 professional publications and is inventor or co-inventor on 10 patents.

John Shurts, J.D., Ph.D.

John Shurts is the General Counsel for the Northwest Power and Conservation Council. The Council is an interstate compact agency based in Portland, Oregon, that develops and oversees a regional power plan for the Pacific Northwest and a fish and wildlife protection and mitigation program for the Columbia Basin. Dr. Shurts also has a Ph.D. degree in American History from the University of Oregon, with an emphasis on environmental and legal history, and is the author of a book on the origin and development of Indian reserved water rights published by the University of Oklahoma Press as Indian Reserved Water Rights: The Winters Doctrine in its Social and Legal Context, 1880s-1930s. He is also an adjunct professor at the Portland State University and the University of Portland (and has been at the law school at Lewis and Clark), teaching courses in environmental, water, energy, and natural resources law and policy.

APPENDIX C1: *Ecological Risk Assessment/Ecosystem Management Example and Further Considerations*

In Section 3a, we recommend that the agencies employ what is called the ecological risk assessment and ecosystem management paradigm (e.g., Harwell 1997, Harwell et al. 1999a and 1999b, Gentile et al. 2001). The approach will provide both a conceptual foundation for the program and a way to build an integrated program framework on that foundation. This Appendix:

- provides an example as to how this approach has been applied in the Everglades;
- discusses how the approach might be applied by the CVPIA to the problems in the Central Valley;
- emphasizes that the re-conceptualized program should target a broad set of interrelated CVPIA goal and objectives, not just the doubling goal; and
- provides additional considerations with regard to monitoring and evaluation consistent with the new approach.

Everglades example

Gentile et al. 2001 provides an example of how the approach has been applied to restoration efforts in the Everglades in south Florida. The overarching science-based vision in the Everglades has been to return the area to a sustainable state by recreating the major physical and ecological processes active in the historic, pre-drainage period. The participants in the process translated this general goal into more detailed and spatially explicit objectives for various ecosystem components. An extensive stakeholder effort also developed a list of social, economic and political goals for this south Florida area. Figure C1-1 illustrates the first part of the analytical relationships or model for this south Florida effort, identifying the primary human activities and their environmental effects. One important outcome of this effort was that it showed that most of the endpoints of interest were influenced by water demand and disposal, helping to guide managers in focusing their efforts on diminishing the actions that feed into this system effect, while showing that other actions have relatively little impact on the key endpoints.

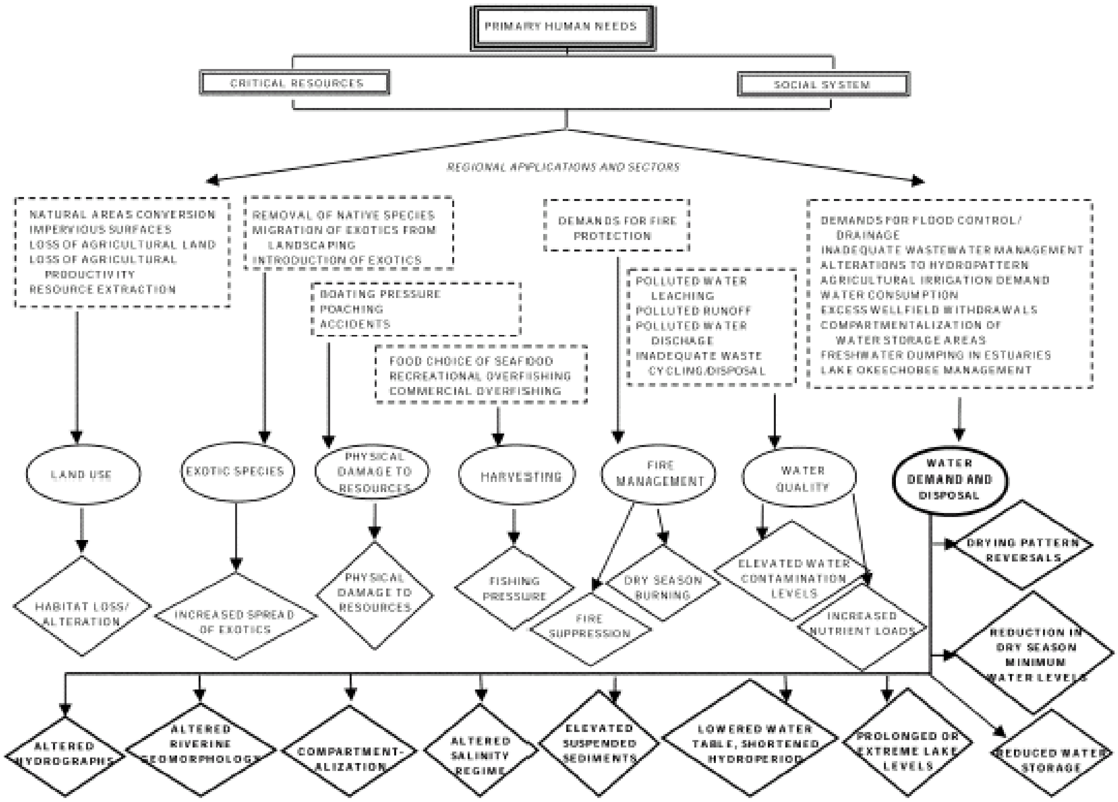

Figure C1-1. Conceptual model for the anthropomorphic component of the south Florida ecosystem. The drivers (in boxes) are the primary human needs. These drivers create stressors (in dashed boxes) on the ecosystem. These stressors in turn create system effects (in ovals), such as water demand. The system effects have various endpoints (diamonds) that can be measured and that have impacts on biota.

The endpoints flowing out of this first analytical effort – the environmental conditions resulting from the human activities – become the driving factors for the second analytical effort, the biological analysis. Many of the endpoints of the first part of the analysis (the physical attributes of the system) can serve as performance indices to be monitored as part of the program. This is because changes in these physical attributes of the habitat affect the biological response of the focal species. Gentile et al. (2001) provide several of the biological models for south Florida; Figure C1-2 below showing the model for the population of panthers. The panther model, when combined with the environmental model, illustrates how human activities and needs affect panthers in various ways, especially by impacts on the habitat conditions important for the survival of deer, a major prey item for panthers. It also identifies things to measure to manage panthers, including not only panther abundance, but also deer abundance, deer habitat quality and quantity, contaminant loads, age distribution of panthers, etc.

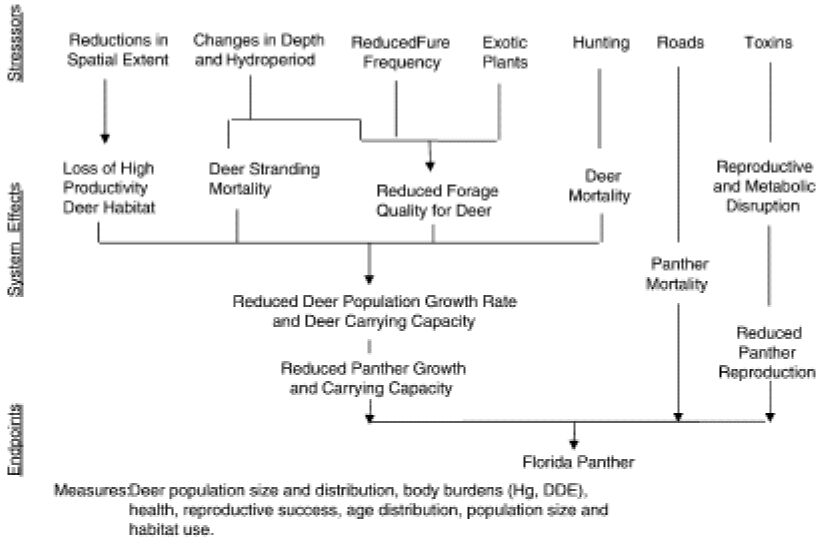

Figure C1-2. Conceptual model of the Florida panther population. From Gentile et al. 2001.

Attributes of such a conceptual foundation and program framework for the Central Valley

Using an approach of this type, an integrated array of habitat attributes and biological responses could serve as useful performance indices for the CVPIA anadromous fish program. These intermediate responses are more directly linked to the management actions, and in our view are more informative, than estimates of natural production via adult returns. We saw examples of this approach within some watersheds, but not explicitly, and not at all at the program or system level.

The CVPIA fisheries program has some elements of an ecological risk assessment and ecosystem management approach, *sensu* Harwell, but it has not been assembled into a cohesive conceptual foundation and system-wide program framework. As discussed above, the doubling goal is overly simplistic and other goals need to be developed for other endpoints, such as hydrographs, river geomorphology, and other ecosystem habitat attributes for the focal species of anadromous salmon and steelhead and sturgeon. The monitoring and evaluation program then needs to be connected to these desired endpoints, with explicit and detailed conceptual models developed that characterize the state of knowledge about the social and biological systems. In other words, a strategy needs to be developed to effectively link science and environmental decision-making. The teams putting together the Working Paper and the Final Restoration Plan did some of this hard work; what remains to do is place the knowledge represented by those documents into formal conceptual models and program goals at a system level and then organize the various actions around these models and goals.

It is beyond the scope of this review to develop the conceptual foundation further for the Central Valley, but we do note certain elements that ought to be part of the program framework and included in any models to be developed.

Describing the current condition in the Central Valley begins with the variety of human land and water uses affecting the valley's riverine ecosystem. These include agricultural and municipal water supplies, water storage, flood control, municipal and agricultural wastewater disposal, non-point source water quality effects from agricultural activities, hydropower, mining, recreational activities (e.g., sport fishing, pleasure boating), commercial harvest in river and in the ocean, hatchery production, the introduction of exotic species, and possibly more. Drought cycles, ocean mechanisms and other environmental variation also affect these ecosystem characteristics and should be considered in a risk-informed decision-making framework. Environmental characteristics that are important for anadromous fish that have been altered include altered hydrographs and hydrodynamics, altered riverine geomorphology, loss of shallow water rearing habitats and spawning habitat, degraded water quality, spread of exotic species, creation of predation hotspots, and altered energy flows in benthic, pelagic and terrestrial food webs leading to fish. All of these would be useful (but not necessarily practical) things to monitor for evaluating the general status of the system and for guiding the CVPIA fisheries programs; one important decision for the program, once this framework is in place, is to decide on the key physical, chemical, and biological characteristics to monitor for change.

From the perspective of this conceptual model approach, then, the actions implemented through the CVPIA program are aimed at changing the current condition by diminishing or mitigating some of the system effects caused by the other human activities, thereby aiming to improve the condition of key environmental characteristics for the focal species. The program should be explicit about the changes targeted or needed in the physical habitat attributes, the estimated *amount* of change both needed and possible, the expected time frame for this change, the reasons the agencies expect the proposed actions to result in this environmental change, and which attributes and which relationships to monitor. One other point -- the fact that the CVPIA program is unlikely to be able address all of the critical system effects suggests to us that the CVPIA will be unlikely to achieve its goals without help from other programs, co-managers and stakeholders – the program framework needs to be explicit about this point as well.

In terms of the biological response desired or expected from the changes in the environmental conditions, the agencies ought to create an overarching biological model for the entire ecosystem, including the ocean, for the focal species. For one thing, this would allow not just the system effects within the basin but also the out-of-basin or extraneous effects (e.g., variations in ocean conditions, climate change) to be accounted and planned for. Presumably the agencies would also find it necessary to create more detailed models in sub-units of the entire system for important populations, such as spring-run chinook in Clear Creek and steelhead in the American River.

For the biological models, the inputs are the environmental conditions resulting from the combination of natural and human-caused effects, both CVP-related and other. Natural effects would include ocean and terrestrial climate variations and climate change, food web interactions among native species, etc. System conditions to be simulated should include reduced productive capacity due to habitat truncation, degradation and disconnection; reduced survival due to predation by native and introduced species and modulated by in-river structures and altered hydrodynamics, elevated temperatures and entrainment; reduced growth due to altered food web, reduced quantity of rearing habitats, and toxicant exposures. The endpoints are the population characteristics of the focal species or population. Appropriate measures for a spring-run chinook population, for example, should include not just adult abundance but also, critically, spatial distribution of various life stages, expressions of yearling and sub-yearling migrant life history type, and smolt production, addressing the viability factors for salmon identified by McElhany et al. 2000. The framework and model analysis should be explicit not just about the endpoint population characteristics, but also about the *relationship between* changes in environmental characteristics and the biological response, in terms of timing, magnitude and explanation.

By developing a program framework of this type and engaging in this conceptual and quantitative exercise, we believe the agencies will be able to expand the compartmentalized and localized limiting factors approach used so far into a more cohesive and interrelated set of actions analyzed at the system and basin level. The resulting analytical effort would clearly illustrate and make honest the complexity of the problem of operating the CVP in a way that also allows for a doubling of natural production of anadromous fish. It would expose the many linkages between human needs and fish populations, suggest where restoration actions should be focused and what types of actions would be most effective, and identify what parameters of the system should be monitored to reduce uncertainties and risks. In particular, the linkages between program goals, program actions, environmental responses, and biological responses would be made explicit and based on hypotheses that predict outcomes. By comparing these predictions with observations collected by monitoring programs, the effectiveness of actions can be judged and progress towards goals can be measured. Even if the doubling goal is not met in the desired timeline, it should be possible demonstrate that progress has been made by focusing on other performance measures, especially improvements in critical environmental conditions and key population characteristics such as productivity. Examples of the key elements to measure and a strategy for organizing information about the elements and interactions between them are shown in Young et al (2002). Furthermore, managers and the public at large should have a better understanding of why the doubling goal has not been reached and reevaluate the goal in light of real costs to attain it.

The suite of conceptual relationships models identified above will provide at first only qualitative guidance on which actions are most likely to be effective. It is possible to further develop such conceptual models into quantitative models (statistical or mechanistic) that can be used to predict the magnitude of responses to proposed actions and to estimate the relative importance of various stressors. Some examples include the

Ecosystem Diagnosis and Treatment model (Lestelle et al. 1996), STELLA-based ecosystem models (Costanza and Gottlieb 1998), the All-H model being used in the Columbia River basin, and a freshwater-marine model approach developed by NOAA and applied to Skagit River salmon populations (Greene et al. 2005). We are aware that some of these models are going to be or have been used for ad hoc analyses in parts of the valley, such as the projected use of the EDT for modeling in the southern San Joaquin noted above and the recent use of a STELLA approach by the same contractor for a project assessing different planning scenarios at Old River Barrier and effects in the Delta. Information about the use of these tools did not come to the panel from the CVPIA personnel, who may not even be aware of their use. As the information base improves, it may be feasible and worthwhile to use some of these tools to develop models specifically for the Central Valley and the CVPIA anadromous fish program as a whole.

The broader CVPIA context for the program

As the agencies redesign the conceptual foundation and integrated framework for the CVPIA anadromous fish program, they should consider how broad the program goals should be for the program, given the sweep of the CVPIA. The agencies have implemented the CVPIA anadromous fish program under our review as if (1) the only real goal or mandate in the legislation with regard to anadromous fish is to double natural production numbers; (2) the tools to achieve this mission must be organized as a set of disconnected discrete implementation programs, read narrowly and in relation only to this goal; and (3) similarly, the anadromous fish doubling mission (in just part of the valley) should be understood, planned and implemented distinct from the other missions Congress gave to the agencies in the CVPIA, missions that collectively call for the Department of Interior to implement the CVPIA and operate the Central Valley Project so as to improve environmental conditions for anadromous fish and other fish and wildlife and for other reasons throughout the Sacramento/San Joaquin rivers.

This is not the only way to understand the legislation and implement the authorities granted, even with regard to anadromous fish, especially if the agencies are to plan and implement a program consistent with the ecosystem management foundation described above. Rather than beginning with the doubling goal for some fish in some sub-section of the valley as the organizing principle, the agencies should begin with a view of an integrated mission, in a broader, more comprehensive and integrated context, and then construct an integrated fish and wildlife program to match.

In redesigning the program framework, the agencies' starting place should be the set of explicit purposes that Congress articulated for adopting the CVPIA and then the interrelated set of missions Congress gave to the agencies to realize these purposes. As stated in CVPIA Section 3402, the purposes include:

- Protecting, restoring, and enhancing fish, wildlife, and associated habitats in the Central Valley and Trinity river basins
- Addressing impacts of the Central Valley Project on fish, wildlife and associated habitats

- Contributing to the efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta
- Increasing the water-related benefits provided by the Central Valley Project through expanded use of voluntary water transfers and improved water conservation
- Achieving a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife.

Congress gave the agencies not one mission, and not a set of distinct and disconnected missions, but instead a set of *overlapping* missions or goals – with corresponding and overlapping authorities -- to fulfill these purposes, *especially* when viewed from an ecosystem management foundation. This has been illustrated in Section 3c, simply by listing all the goals in the CVPIA that the Interior Department is to achieve by the way the agencies manage water and project operations. The CVPIA's overlapping ecosystem restoration assignment to the agencies includes not just a program to double natural production of anadromous fish, but also to meet all federal and state ESA, water quality and other legal obligations; to treat fish and wildlife restoration as an equivalent priority with other project purposes; to mitigate for fish and wildlife losses incurred as a result of the development and operation of the CVP; address other adverse environmental impacts of the CVP not specifically enumerated in the course of implementing the anadromous fish program; develop a comprehensive plan to address fish, wildlife, and habitat concerns on the San Joaquin River, "including but not limited to the streamflow, channel, riparian habitat, and water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fisheries from Friant Dam to its confluence with the San Francisco Bay/Sacramento-San Joaquin Delta Estuary"; and provide water of suitable quality to maintain and improve wetland habitat areas in wildlife refuges and other management areas.

The point is that all these missions and authorities may be distinct in some senses, but they also overlap and interconnect, both legally and, more important, physically. The agencies do not make naturally producing fish. What they can affect is the freshwater and estuarine habitat, the interconnected environmental conditions of the Central Valley streams – and *all* of these authorities and obligations are directed at that same point. It will make more sense to integrate these missions and activities in some fashion in an ecosystem program framework, as activities related to all these missions will have system effects on environmental characteristics to anadromous fish.

Additional considerations with regard to monitoring and evaluation consistent with this conceptual foundation and program framework

The previous discussion highlighted how monitoring and evaluation ought to flow from this conceptual foundation and the integrated program framework built on top of that foundation. The analytical work should identify changes in the key environmental attributes and population responses desired, and hypothesize whether, how, and in what magnitude the actions might result in these changes. It is never practical or cost effective to monitor all relevant attributes and relationships at the location of each action or set of actions. But a well conceived and executed framework and analytical effort should allow the agencies to identify the key or representative attributes, characteristics, and functions to monitor and evaluate at the watershed and especially at the system level. Additional considerations with regard to monitoring and evaluation follow here:

The motivation for conducting particular M&E activities is ultimately driven by management needs and questions. Large-scale, complex environmental restoration and water management programs like the CVPIA have moved towards adaptive environmental assessment and management approach based upon the conceptual foundation and program framework discussed above, especially for focusing its work on monitoring and evaluation. The adaptive environmental assessment and management approach (or AEAM) is an efficient way to make decisions in an environment characterized by high uncertainty, where errant decisions may result in irreversible, negative results. The Department of the Interior (2007) consolidated expertise on Adaptive Management and provided guidance on how to integrate the approach into Departmental actions. In a high-uncertainty and high-risk setting, programs are executed often in experimental, closely monitored steps. Iteratively collected monitoring data are regularly assessed to adjust and guide future steps so that a program progresses in efficient, measured steps without incurring the risk of irreversible, catastrophic failure or crossing an environmental threshold that restricts future management actions.

Assuring achievement of program-level goals and objectives requires an AEAM plan (Harwell et al. 2002) as part of the integrated program framework described above, with (1) a program vision, (2) a set of broad guiding principles, (3) a comprehensive set of goals and objectives, (4) a conceptual model of ecosystem structure and dynamics of sufficient detail that many of the uncertainties that threaten successful execution of the program can be identified, (5) a data collection and data assessment plan that includes monitoring, acquisition of data collected by other programs, and evaluation of existing data, which can efficiently identify and resolve problems before they jeopardize achievement of program-level goals and objectives, and (6) an information or knowledge management system that includes a suite of decision analysis tools that allow decision-makers to understand the risks and trade-offs among different program-level decisions.

The Review Panel could not identify a system-wide plan for conducting monitoring and evaluation activities that would ensure that a standard and sufficiently broad suite of physical and biological indicators (performance measures) is consistently used across watersheds. For the most part indices of naturally produced adult salmonids were the only performance measure regularly reported in most watersheds. Just measuring adult returns is inadequate to assess effectiveness of restoration actions. There are many exogenous factors beyond the control of the agencies act in concert to affect survival through to returning adults. The Panel recommends that additional performance indices should be tracked that are more proximal (temporally and spatially) to the actual actions, such as indices of juvenile production (now estimated in some but not all watersheds) and indicators of needed environmental change (little collected currently beyond flow and temperature data in certain reaches). This and other indices like it could be valuable in ascertaining the effectiveness of collective actions in a watershed in a more immediate manner, and ensure that cross-watershed comparisons can be conducted, so long as the analytical models can show a hypothesized relationship between these indices of environmental and biological performance and ultimate goals. An example of a robust and comprehensive monitoring and evaluation program occurs in the Columbia River Basin. We provide you information on this program in Appendix C3.

An important consideration is that a significant amount of monitoring activity is accomplished by agencies and organizations not part of the CVPIA program. Relevant information may simply not be available to CVPIA decision-makers, or may not be in compatible formats. The agencies need to develop a mechanism that allows for the compatible collection and use of all information germane to the program, regardless of origin. The information system described here should collect, house, integrate, and summarize the data collected as part of the CVPIA monitoring activities in a manner that allows the agencies to query and analyze available data as necessary for planning and decision-making. And this program component should also have the responsibility of developing links to the monitoring data of other regional programs of relevance. We recommend a process be established whereby working staff from all agencies and organizations within and outside of the CVPIA program is encouraged to report scientific findings or assessments produced from analyzing monitoring data in an agreed-upon compatible format and data portal. Knowledge about ecological response to management actions gained through monitoring, which currently appears to largely reside with individuals and/or outside agencies, could then be actively managed at the CVPIA program level and be readily available to inform appropriate decision-making.

One consistent theme in this report is that adult measures of abundance measures should be subordinate to measurements (monitoring) of stream/river ecosystem attributes. If actions were focused on achieving and maintaining healthy ecosystem conditions, with monitoring to track progress, the overall benefit to salmonids would be better served. Ecosystem attributes should be easier to measure than the doubling of salmonid production, at both the watershed and CVPIA scale. Moreover, program activities directly affect ecosystem attributes and not adult salmon returns. The relationship between general ecosystem performance and salmonid production can be derived from direct hypothesis-driven observations and data collection.

Ecosystem measurements can be made directly and integrated over space (watersheds or the basin) and time (daily, seasonal, annual). Important attributes to monitor, especially flow related, have been mentioned above. Attributes less commonly considered but quite revealing of ecosystem conditions include carbon or energy budgets, nutrient spiraling, and the relative balance between autotrophy and heterotrophy (see reviews in Allan and Castillo 2007). The latter may be the best overall measure for capturing watershed ecosystem characteristics and conditions, indicating as it does whether the energy to drive the stream food webs is derived from aquatic plant growth in the stream or from terrestrial plant growth in the riparian area that borders the stream.

APPENDIX C2: *Understanding the Entire Picture: Gravel Augmentation*

One of the highlighted activities of the CVPIA program is the addition of gravel to river reaches below dams that block flow and the movement of gravel. Gravel augmentation is the CVPIA program in a microcosm, illustrating how the agencies implement the CVPIA and the limits and weaknesses in that effort.

Gravel addition is a tool that has been used widely in CVPIA program stream reaches. Gravel augmentation is its own "b" in certain watersheds, implemented and managed as a separate program. That is, Section 3406(b)(13) calls on Interior to "develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Upper Sacramento River from Keswick Dam to Red Bluff Diversion Dam and in the American and Stanislaus Rivers downstream from the Nimbus and Goodwin Dams, respectively." Gravel augmentation also takes place in a number of the other watersheds as one of the main activities funded and implemented under Section 3406 (b1, in part of the Anadromous Fish Restoration Program. Under these programs, gravel is being added on a regular basis in the upper Sacramento River, Clear Creek, American River, Stanislaus River, Tuolumne River, and elsewhere.

It was not clear to the panel whether the different and separately managed gravel "programs," even as they are placing gravel in similarly situated watersheds, coordinate and communicate to any significant degree. And although there may be many stream reaches in the CVPIA program area where lack of spawning and rearing gravel is a factor potentially limiting salmonid production, there is a lack of a unified effort to understand the potential and address the problem across watersheds and at the whole program scale.

From what we can tell, the choice of reaches into which to place the gravel, and the choice of effects of the gravel addition that are measured, have been made by best professional judgment, and not by any hypothesis-driven, statistically valid methodology. We saw no analyses of the *extent* to which a lack of spawning gravel is a significant constraint in a particular area, and no analysis of the biological potential to be gained by placing gravel in the river. Nor did we see the agencies identify any indices or measurements of change in stream conditions and habitat functions expected to result or resulting from gravel additions. These factors severely limit the conclusions that can be derived from the actions.

The panel recommends that coordination and cooperation be a prerequisite across all locations where gravel is being introduced. This level of collaboration should involve assessments of potential change to be gained, experimental design, implementation, and monitoring, an approach that would be profitable for all limiting factor action. The first steps of any action to address a limiting factor should be collaborative development of the conceptual model followed by hypothesis generation. An example of an organization of actions that could lead to an integrated, statistically valid development and evaluation of gravel additions is shown in Fig. C2-1. A unified approach to limiting factor remedial actions, including the use of a separate team that could address gravel bed issues across all watersheds and river reaches, or agreement among all parties to follow standardized protocols, is needed if there is ever to be an integrated evaluation of success of these actions at the program level. In an action such as gravel addition, which needs to be repeated annually for the foreseeable future, an adaptive management approach is critical. Each year's results should be analyzed and used to reformulate procedures for the next year as warranted.

Questions remain about the effects of gravel addition at the reach scale on the goal of increasing salmonid production. Without careful monitoring and fish tagging before and after gravel addition, there is no way to verify whether the observed fish represent new spawning at the watershed scale, or merely a redistribution of the existing population. For example, the panel learned that gravel addition in the Stanislaus is resulting in physical habitat changes and spawning at those sites, but no detectable increase in juvenile production measured lower in the river. Of course, three or four or more years of monitoring may be required to resolve the issue. It is likely that the measurement to be made to determine the success of the action is not spawners alone, but rather the effect on smolts per spawner output at the watershed scale. In addition, more work needs to be done to document the effect of gravel additions on the stream/river benthic macroinvertebrates, especially those taxa most likely to provide food for rearing juvenile salmonids. The size composition of the gravel used in augmentation has been selected to correspond to published literature on the optimal sizes for salmonid spawning. But the optimal gravel size composition for salmonid spawning is unlikely to correspond to the optimal size for macroinvertebrate habitat. It seems clear that hypothesis driven experiments, with appropriate monitoring of both treatment and control reaches, are needed to resolve the true efficacy of gravel augmentation. Once such an experimental approach has set the necessary parameters for gravel additions, the scale of the coverage of these actions should be re-evaluated.

Given the very extensive loss of gravel supplies imposed by the many dams in the CVPIA program area, and the need to annually replenish additions, we question whether the present scale of operations is likely to be sufficient to illicit any statistically significant response in salmonid production at a single watershed level, let alone at the CVPIA program scale. In any event, more needs to be done through analyzes of the potential, through monitoring of key attributes, for the gravel program to be effective.

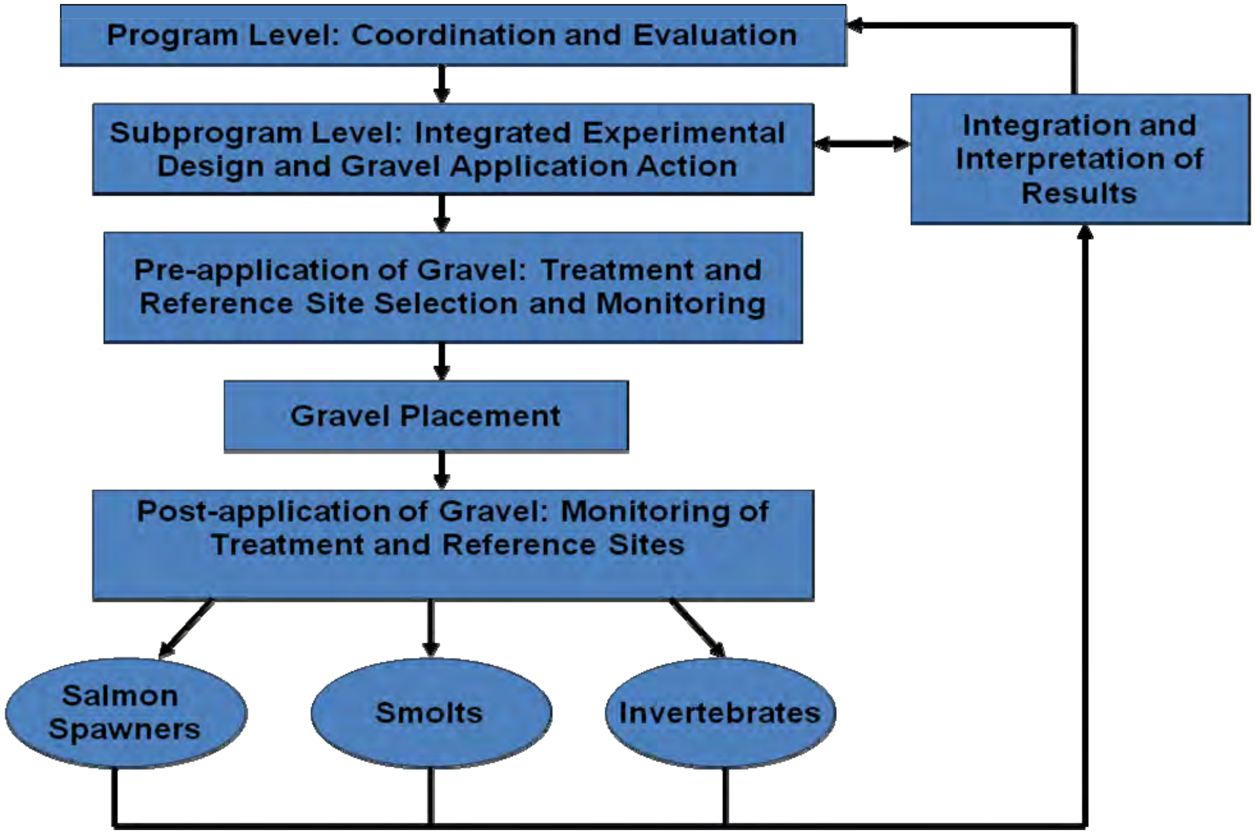

Fig. C2-1. Flow chart of an integrated program for developing, executing, and evaluating a limiting factor action, using gravel augmentation as an example. Coordination and standardization of effort is at the sub-program (watershed) level and overall integration is at the program level.

APPENDIX C3: *Columbia River Monitoring and Evaluation Example*

Other regional programs have grappled with establishing meaningful and comprehensive monitoring and evaluation efforts developed along these lines. The Columbia River Basin Fish and Wildlife Program funded by the Bonneville Power Administration has been attempting for nearly a decade to improve M&E associated with both system improvements and tributary habitat restoration actions. A relatively new method for this latter purpose has come out of recent collaborative efforts in the Columbia working with Tracy Hillman, a method both for estimating the potential of tributary habitat actions to affect population productivity and survival and for monitoring and evaluating actions in a tributary. One focus of the Hillman work has been in the reach of the mainstem Columbia called the "upper" Columbia by NOAA Fisheries, as while it is below Grand Coulee, it is the uppermost extent of salmon and steelhead left in the system, an area that includes four watersheds, the Okanogan, Entiat, Methow and Wenatchee. An excerpt from the analytical and M&E plan Hillman developed in collaboration with other regional interests describes the need and purpose:

> "Managers often implement actions within tributary streams to improve the status of fish populations and their habitats. Until recently, there was little incentive to monitor such actions to see if they met their desired effects. In cases where actions were monitored, investigators often used inappropriate experimental designs, resulting in failures to assess effects of habitat improvements on fish (Bayley 2002; Currens 2002). Now, however, many programs require that funded actions include valid monitoring efforts, coordinated indicators and measurements to reduce duplication, and a process for standardized reporting and strategic planning. Within the Upper Columbia Basin, several different organizations, including federal, state, tribal, local, and private entities, currently implement tributary actions and conduct monitoring studies. Because of different goals and objectives, different entities use different monitoring approaches and protocols. In some cases, different entities are measuring the same (or similar) things in the same streams with little coordination or awareness of each other's efforts. The Upper Columbia Regional Technical Team (RTT) is aware of this problem and desires a monitoring strategy or plan that reduces redundancy, increases efficiency, and meets the goals and objectives of the various entities."

This Upper Columbia monitoring and evaluation plan then prescribes standardized protocols for conducting watershed level M&E, consistent with an ecosystem management approach described above. After two years of testing the strategy in the Wenatchee subbasin and drawing upon information gathered from the Okanogan Basin Monitoring and Evaluation Program (OBMEP), the Aquatic and Riparian Effectiveness Monitoring Plan (AREMP), the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), the Washington Salmon Recovery Funding Board (SRFB), and the Collaborative System wide Monitoring and Evaluation Project (CSMEP), the agencies refined the plan in several important ways. Keys among these have been redefining the sampling framework, revising habitat measuring protocols, and updating biological protocols. Statistical and sampling designs were prescribed. The Upper Columbia M&E plan in its current form is as comprehensive, specific and cutting edge as anything available today. The issues there are similar to those in the Central Valley, where M&E efforts are dispersed across a number of watersheds. We point to the Upper Columbia Basin plan as at least one useful model for rationalizing M&E associated with a revised program framework and conceptual foundation for the CVPIA.

APPENDIX C4: *Information System Example*

We expected a program of the size and complexity of the CVPIA program to have an integrated information system. We did not observe the presence of such a system, but did observe the symptoms of lack of one. That is, program decisions are made by program participant and stakeholder encounter groups. It is unclear how their decisions relate back to collected data at a program level (and even at a project level for some activities). We consistently observe data incompatibilities among different watershed and activities as each data collection effort is designed primarily to meet the immediate needs of the data collector, based on local information needs, assumptions, or equipment selection and calibration protocols.

Information systems are regularly used by agencies that must maintain or evaluate data collected from disparate sources over wide spatial and temporal domains, including the EPA, Water Resources Division of the USGS, and the Corps of Engineers (e.g., see the ISCHEM agreement). In addition, information systems are a major feature of the observatory programs of the National Science Foundation (e.g., OOI, CUAHSI, CLEANER, WATERS, NEON) because they are seen as critical to advance science-based decision-making over large spatial domains conducted under an adaptive management framework. The structure of information systems is based on the specific needs of the user group or program that the system supports, but generally an enabling information system has the following general features:

- A central database management system featuring multiple redundancies where data are archived and made accessible to program participants. Program participants can maintain their own copies of data sets if they have the necessary computer infrastructure, but in all cases the official data are considered to reside on the central database management system.
- A web portal featuring different levels of access (from public to restricted depending upon knowledge management needs) established by the program managers). After participating in the initial set-up of the system, program participants can be relieved of data archiving and formatting responsibilities and focus on data collection and interpretation.
- Links to other relevant programs and databases ensure that all pertinent information collected in the region is available to all program participants.
- Uniform format for all status and trends monitoring data to ease the challenge of integrating and assimilating data collected over a large spatial domain for summarization and upward reporting.
- Different optional data formats for studies that describe specific processes or address specific hypotheses to encourage uniformity in data collection and reporting.
- Libraries of program products, commonly used tools, and supporting supplemental material.

- A query (expert) system with simple analysis and summary capability to analyze status and trends monitoring data by program participants.
- A graphical user interface to graph information or display it in an intuitive and compelling format to support decision-making and foster cooperation, collaboration, and data sharing among watersheds at coordination meetings.
- A relatively simple modeling system that can be used for sensitivity and risk analysis to guide program decision-making.
- More sophisticated modeling tools that can be used to estimate the consequences of global climate change or normal hydrologic variability on different restoration strategies. This last point is critical because salmon restoration made at marginal habitats during good years may be at the expense of species survival under suboptimum hydrologic or climate conditions.

APPENDIX C5: *Additional Discussion on Management Structure and The Glen Canyon Example*

Program organizational structure reflects the philosophy used by the implementing agency to meet their mission responsibilities. Not surprisingly, the structure of the CVPIA program reflects the organizational philosophy of a water resources agency with a mission to conserve and distribute water to regional users as opposed to an agency charged with system-level natural resource conservation and protection. Attributes of the two contrasting philosophies are generally described in Table C5-1. The CVPIA program appears to be more aligned with a "command and control" than an ecological risk assessment (i.e., adaptive management) organizational structure.

Management structures typically fall between one of two extremes, a line (or vertical) management structure typical of military organizations or water resources agencies versus a flat (or horizontal) management structure typical of university departments. Vertical corporate structures are ideal for managing authority, funding, and project delivery but do adapt or respond efficiently to new information. Elements of the organization that collect information or execute the program must communicate upwards through long "stove-pipes" where information may be modified, delayed, or eliminated at each hierarchy within the organization before they can engage other elements of the organization that collect information. A horizontal corporate structure has the contrasting blend of strengths and weaknesses. That is, it functions well to encourage scientific discovery and collaboration across disciplines because those parts of the organization that collect and process information can directly engage one another. Agencies engaged in an ecological risk assessment approach must learn from monitoring data to update and improve the effectiveness of their actions. Therefore, agencies engaged in an ecological risk assessment approach must exhibit a strong horizontal integrating capability to learn, to share learning to increase agency knowledge, and to archive knowledge so that it is not lost as staff retire or transfer.

Some panelists expected to see an intermediate structure comprised of both vertical and horizontal elements in the CVPIA program. The vertical components of the structure would ensure the timely execution of the program, account for expenditure of funds, be responsible for efficient upward reporting of program status and progress, and deal with basic issues associated with personnel and asset management. The expected intermediate structure would also include a strong horizontal integrating capability to bring together the different disciplines and program elements and to perform outreach to allied programs within the region. The horizontal component of the structure would insure that the scientific information collected by the different components of the program would be efficiently integrated and made available to program-level decision-makers as well as link to the monitoring and assessment elements of allied programs. This outreach to allied programs would ensure that all relevant data collected in the region contributes to better decision-making. Working together, the horizontal and vertical components would ensure successful program execution.

Instead, the two agencies exhibit a vertical organizational structure based on the "b"s and not along scientific or program-level goals and objectives and there are no organizational elements assigned for program integration, knowledge management, or any other activity associated with the effective execution of an ecological risk assessment approach. This type of organization is not efficient at horizontal integration because the elements of the program that collect information are corporately far removed both from each other and from the program-level decision-makers by the stove pipe structure of the program. There appears to be no means of horizontal integration required to achieve program level goals and objectives. The panel was unable to detect a mechanism that CVPIA program management can use to require working staff to report scientific findings or provide assessment produced by analyzing monitoring data so that information can be managed at the program level or ecological risk assessment approach could be effectively executed.

The lack of supporting executive or management layers above the CVPIA program managers indicates that CVPIA program management does not have an organizational management structure through which they can enforce program discipline. That is, there are no lines of communication or authority above the CVPIA program that reach to the regional directors of either agency or to the Department of the Interior. The CVPIA program cannot be efficiently executed without clear lines of communication and authority to the executive levels of both agencies, and as recommended, to Department of Interior.

The organization of the CVPIA program should be both strengthened and made more horizontal. There are currently several examples of management structures within the Department of Interior that achieve these goals such as the Central Utah Completion Act Program and the Glen Canyon Adaptive Management Program. The following describes the organizational structure for the latter.

The Glen Canyon Adaptive Management Program was designed to comply with the Grand Canyon Protection Act (Act) of 1992 (Public Law 102-575). The EIS prepared on the operation of Glen Canyon Dam proposed a process of "adaptive management." Including the formation of a federal advisory committee. A Transition Work Group (TWG) was formed to operate until such time as a federal advisory committee could be formed, and a record of decision (ROD) signed by the Secretary of the Interior to initiate a process of "management" (operating criteria for unbiased scientific research and data collection) whereby the effects of dam operations on downstream resources would be assessed.

The Secretary of Interior signed the ROD in October 1996, and in January 1997, Interior Secretary Babbitt signed a Notice of Establishment of the Glen Canyon Adaptive Management Work Group (AMWG), a federal advisory committee. The Adaptive Management Program is administered through a senior Department of the Interior official and facilitated through the AMWG, which is organized as a federal advisory committee and chaired by the Interior official. The Technical Work Group (TWG) is a subcommittee of the AMWG and is chaired by one of the TWG committee members.

The responsibilities of the TWG are to develop criteria and standards for monitoring and research programs; provide periodic review and updates; develop resource management questions for the design of monitoring and research by the Monitoring and Research Center, and provide information, as necessary, for preparing reports, as required for the AMWG. An Independent Review Panel provides scientific oversight and outside perspectives on the monitoring and research programs.

All of the elements are now in place for an effective, credible adaptive management effort. The AMWG is the key; the TWG provides detailed guidance on issues and objectives; the Science Center conducts the research and monitoring needed to evaluate operations; and the independent review panel provides the outside review necessary to firmly ground the effort in science. The figure included in the text generally describes the organization of the Glen Canyon Adaptive Management program. Further information on the Glen Canyon Adaptive Management Program can be found at the website: http://www.usbr.gov/uc/rm/amp/index.html.

Table C5-1: Attributes of command and control versus ecosystem-based approaches to river management (modified from Brierley and Fryirs, 2008).

Theme	Command and Control Approach	Ecosystem-Based Approach
Goals/Aims	5. Outcome-driven, goal oriented 6. Single purpose, discipline-bound (engineering focus), reductionist 7. Perceives problems as technical solutions, emphasizing the desire for certainty in outcomes	– Emphasizes processes and outcomes, means and ends – Multi-objective, holistic, cross-disciplinary – Perceives problems as symptomatic of wider socioeconomic, cultural, and biophysical considerations
Perceptions	8. Creates simple and predictable water management systems, viewing rivers as conduits with which to maximize the conveyance of water, sediments, and environmental waste products through uniform, stable, hydraulically smooth (homogenous) channels 9. Stabilizes, trains, or improves rivers 10. Views human activities as separate from ecosystems	– Restores natural variability in river structure, recognizing that many channels are naturally messy, irregular, and rough, while other areas may have no channel (e.g., wetlands or discontinuous watercourses) – Explicitly recognizes inherent complexity and uncertainties, emphasizing concerns for dynamic, and evolving ecosystems – Views people as part of ecosystems
Scientific Approach	11. Applies deterministic, cause-and-effect science using engineering principles (fluid mechanics and hydraulics). Uses experimental procedures performed under controlled sets of conditions 12. Generates and applies general theories and principles	– Applies probabilistic reasoning, recognizing that ecosystems are emergent and nonlinear not amenable to reductionist explanations – Frames system-specific knowledge in relation to generalized principles
Institutional Framework	13. Top-down, politically driven approach designed and enforced by government agencies	– Bottom-up approach, applying participatory frameworks integrating managerial, stakeholder, researcher, and community perspectives
Management Approach	14. Applies prescriptive (cookbook) approaches to river repair 15. Site-specific or reach-scale applications, typically framed in the quest for stability over decadal timeframes 16. Construction focus, with high level of intervention. Often embellished under labels such as 'environmentally sympathetic', 'soft', 'sensitive', or 'ecologically sound' engineering practices	– Promotes flexible, system approaches to ecosystem management – Catchment-framed rehabilitation programs recognizing the range of natural variability over centuries or millennia – Considers a continuum of interventions, including conservation programs, the 'do nothing' option, and strategic interventions that strive to enhance recovery. Minimizes the use of 'hard' engineering to protection of key infrastructure and assets
Approach to Prioritization	17. Reactive. Focuses attention upon sites of greatest societal alarm, typically located in the most degraded reaches. Such strategies may accentuate damage or transfer problems elsewhere. 18. Typically considers only a part of the problem, commonly addressing symptoms rather than underlying causes of degradation	– Proactive, conservation-first approach that strategically targets reaches with high recovery potential. Uses 'whole of system' thinking to prioritize actions, recognizing system connectivity and the potential for lagged, off-site responses. – Addresses causes rather than symptoms of degradation
Auditing and Monitoring	19. Limited accountability 20. Monitoring is externalized, with maintenance divorced from design	– Long-term commitment – Monitoring is internalized and maintenance as a core activity

APPENDIX C6: *Additional Discussion of CVPIA Funding*

The distribution of funds reflects historical priorities within the CVPIA Program. Some of the funding of the CVPIA program is tied to the ability of the CVP system to deliver water to contract users. Therefore, there is an implicit connection between performance of the CVP and the execution of the CVPIA that reinforces the institutional culture associated with a “command and control” management perspective that is partly determined by funding allocation across the program tools (i.e., the “b”s) so that understanding the funding process is paramount to grasp the present structure of the program.

In the period from 1993-2007, CVPIA program obligations exceeded $930 million to implement activities in Section 3406 and 3408 consistent with the act’s purposes. The primary funding source categories include the Restoration Fund ($589 million), Water and Related Activities ($269 million), State Trust and Restoration Fund donations ($73 million), and Bay-Delta fund portion ($2 million). Payments to the Restoration Fund from water and power contractors are a primary source of support for many section 3406 activities. Other sources to support CVPIA activities include federal appropriations and expenditures by the Bureau of Reclamation and U.S. Fish and Wildlife Service, as well as state and other cost-share.

Section 3407d and section 3404 require payments from CVPIA water users to the Restoration Fund. The Restoration Fund is primarily supported by annual payments from water and power contractors of up to $30 million per year on a three-year rolling average apart from Federal reimbursements. If the $30 million in payments for the Restoration Fund is not obtained, additional payments from CVPIA water users cannot exceed $6 per acre-foot of delivered agricultural water and $12 per acre-foot of delivered municipal and industrial water. Water transferred to non-CVPIA entities may be assessed a $25 per acre-foot charge to be used for the Restoration Fund. Ultimately, up to $50 million per year can be appropriated from the Restoration Fund for CVPIA activities, but such limits are also constrained by Restoration Fund collections. If the appropriations under the Restoration Fund do not equal $50 million per year on a three-year rolling average basis, the Secretary of Interior may increase charges to provide sufficient collections, subject to statutory caps.

Section 3407 also allows the $50 million per year Restoration Fund to be reduced to $35 million if the fish, wildlife, and restoration components of the act under section 3406 are completed. Section 3407 would also reduce the mitigation and restoration payment by Central Valley Project water and power users from $30 million per year to $15 million per year. Given the panel’s analysis of all the section 3406 activities and the state of their completion, it does not appear that the Restoration Fund would be reduced under these section 2407 provisions anytime in the near future.

Some constraints do exist on Restoration Fund appropriations. Not less than 67 percent of the funds made available to the Restoration Fund are authorized to be appropriated by the Secretary of Interior to carry out the habitat restoration, improvement, and acquisition (from willing sellers) provisions of the CVPIA. This includes activities such as Water Acquisition, Anadromous Fish Restoration Program and the Trinity River Restoration Program. Not more than 33 percent of the funds made available to the Restoration Fund may be used for activities in 3406 (b)(4)-(6), (10)-(18), and (20)-(22). These activities primarily include structural activities for the pumping plants, diversion dams, and fish screens specified in the CVPIA although some other activities such as comprehensive monitoring and increasing spawning gravels are included in the 33 percent cap.

The funds for the CVPIA are distributed across many actions, including over 35 different activities under section 3406 and 3408. For the 1993-2008 period, the activities receiving the most funding included the Anadromous Fish Restoration Program 3406 (b)(1), Water Acquisition 3406 (b)(3), Shasta Temperature Control Device 3406 (b)(6), Red Bluff Diversion Dam 3406 (b)(10), Coleman Fish Hatchery 3406 (b)(11), GCID Hamilton City Pump Plant 3406 (b)(20), Anadromous Fish Screen Program 3406 (b)(21), and Trinity River Restoration 3406 (b)(23). In 2008, the CVPIA funding focused on the Water Acquisition Program 3406 (b)(3), the Anadromous Fish Restoration Program 3406 (b)(1), and Anadromous Fish Screens 3406 (b)(21) with the Bureau of Reclamation providing the greatest share of funding. As many of the structural investments have been completed, CVPIA program managers increased funding to the habitat restoration and water acquisition actions.

Grouping of historical costs shows that anadromous fish structural components accounted for 47% of overall obligations ($440 M), anadromous fish habitat modification for 20% ($192 M), refuges and waterfowl for 21% ($201 M), other fish and wildlife costs for 7% ($69 M), studies and models for 2% ($22 M), and monitoring for only 1% ($9 M). The Bureau of Reclamation and USFWS have considerable discretion in allocating funds to CVPIA activities. Agency personnel consider factors such as fixed funding costs for current operations and historical priorities, the extent activities have been completed, and the ripeness and capability to implement new actions when making funding obligations to particular section 3406 and 3408 line item activities.

Funding for the CVPIA initially increased from its inception, but annual funding has shown a recent decreasing trend. In 1996, annual obligations totaled more than $78 million, a significant increase from the $28 million average from 1993-1995. Annual expenditures peaked at $82 million in 1998, and have not exceeded $74 million since 2002. The last few years have shown a decline in obligations, from $72 million in 2005, to less than $70 million in 2006, to $64 million in 2007, to an estimated $59 million in 2008. If the CVPIA is to achieve fish improvement goals, the trend of decreased investment in its actions to improve fish conditions creates a challenge.

The CVPIA managers are encouraged to expand relationships with non-governmental organizations like the National Fish and Wildlife Foundation, Ducks Unlimited, and the Nature Conservancy in partnerships for water and land acquisition (e.g., Butte Creek efforts). To increase funding to water conservation actions under 3407(I), the CVPIA could leverage state water conservation funds and contractor contributions. Other legislation such as the Farm Bill offers potential to cost-share on complementary activities, such as on riparian and floodplain buffers through the Farm Bill's Conservation Reserve Enhancement Program (CREP) and other agricultural incentive programs. By leveraging other funding sources, including state, local, and non-governmental organizations, the CVPIA has the potential to more fully address key limiting factors such as water quality, water quantity, predation, and habitat availability.

APPENDIX D: *References*

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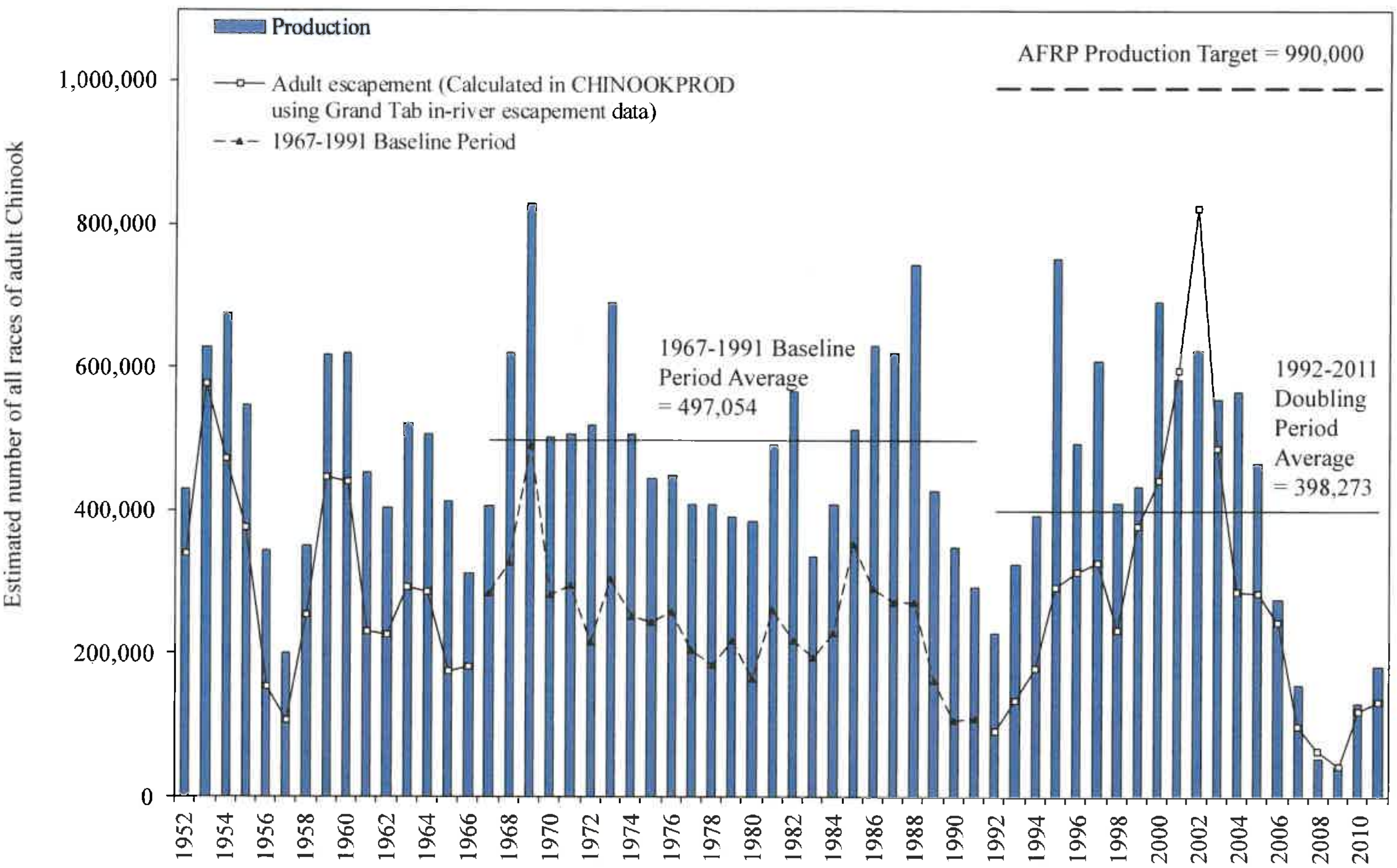

Figure 1. Estimated yearly natural production and in-river escapement of all races of adult Chinook Salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are calculated in CHINOOKPROD using numbers from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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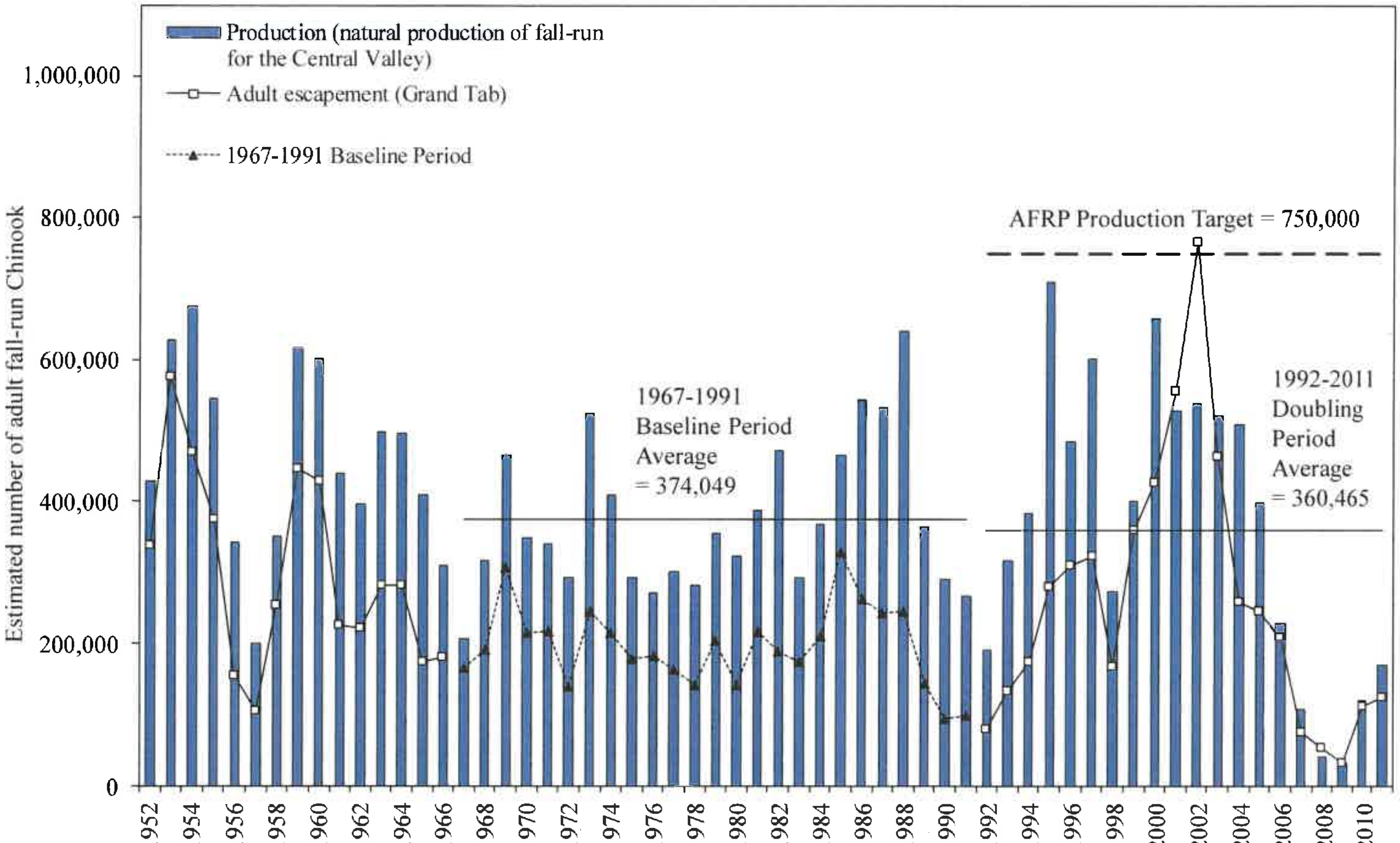

Figure 2. Estimated yearly natural production and in-river escapement of adult fall-run Chinook salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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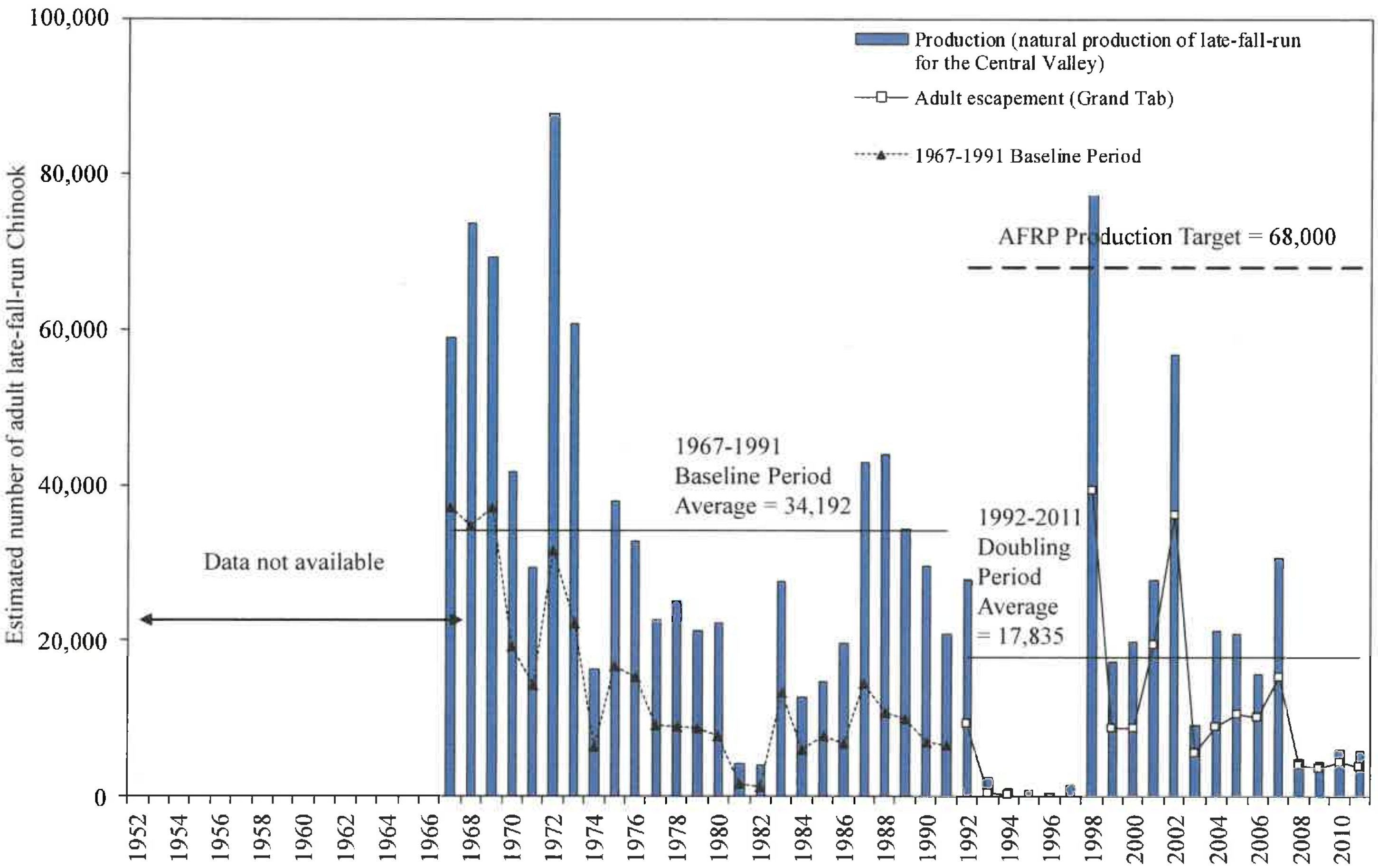

Figure 3. Estimated yearly adult natural production, and in-river adult escapements of late-fall-run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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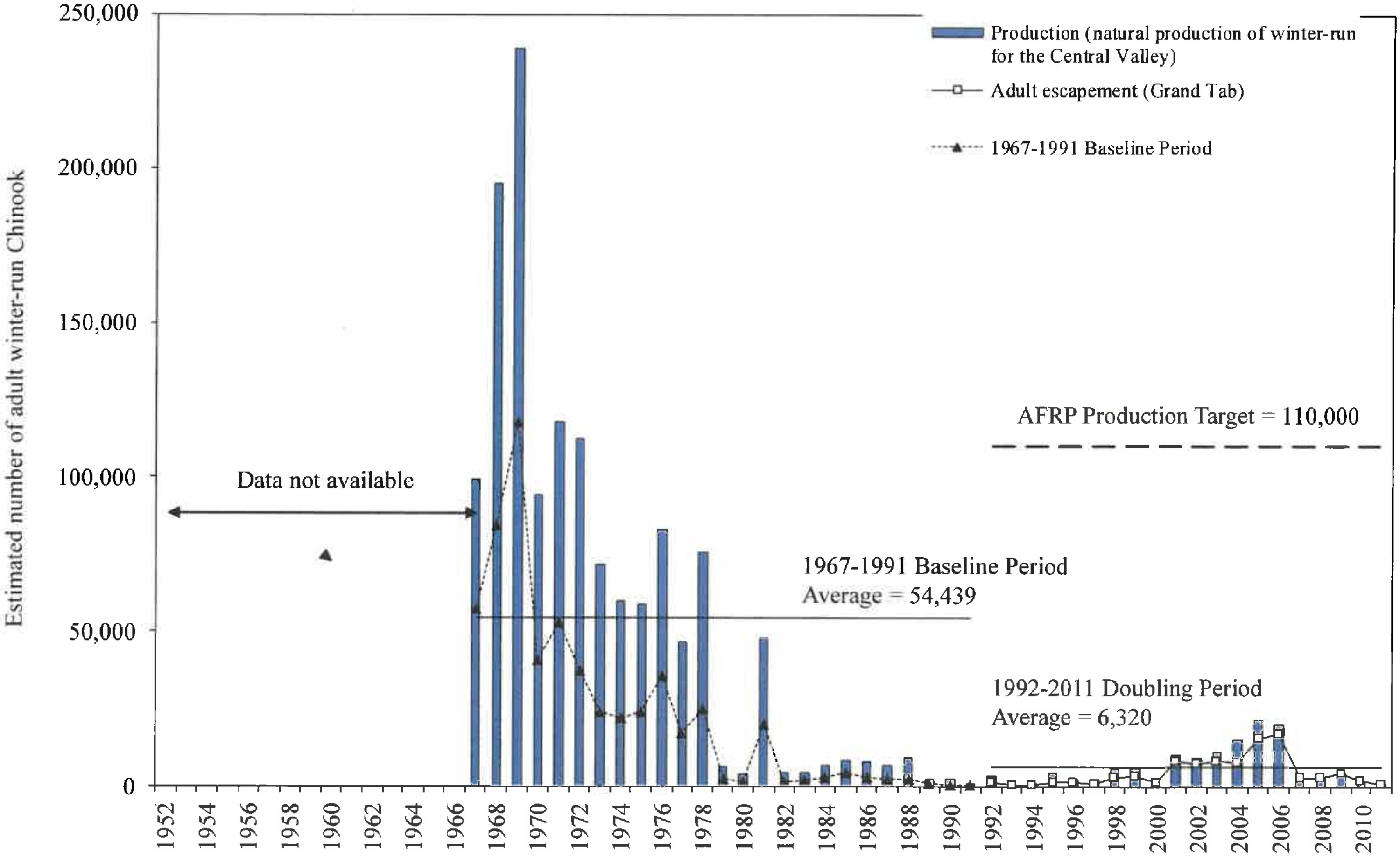

Figure 4. Estimated yearly adult natural production, and in river adult escapements of winter-run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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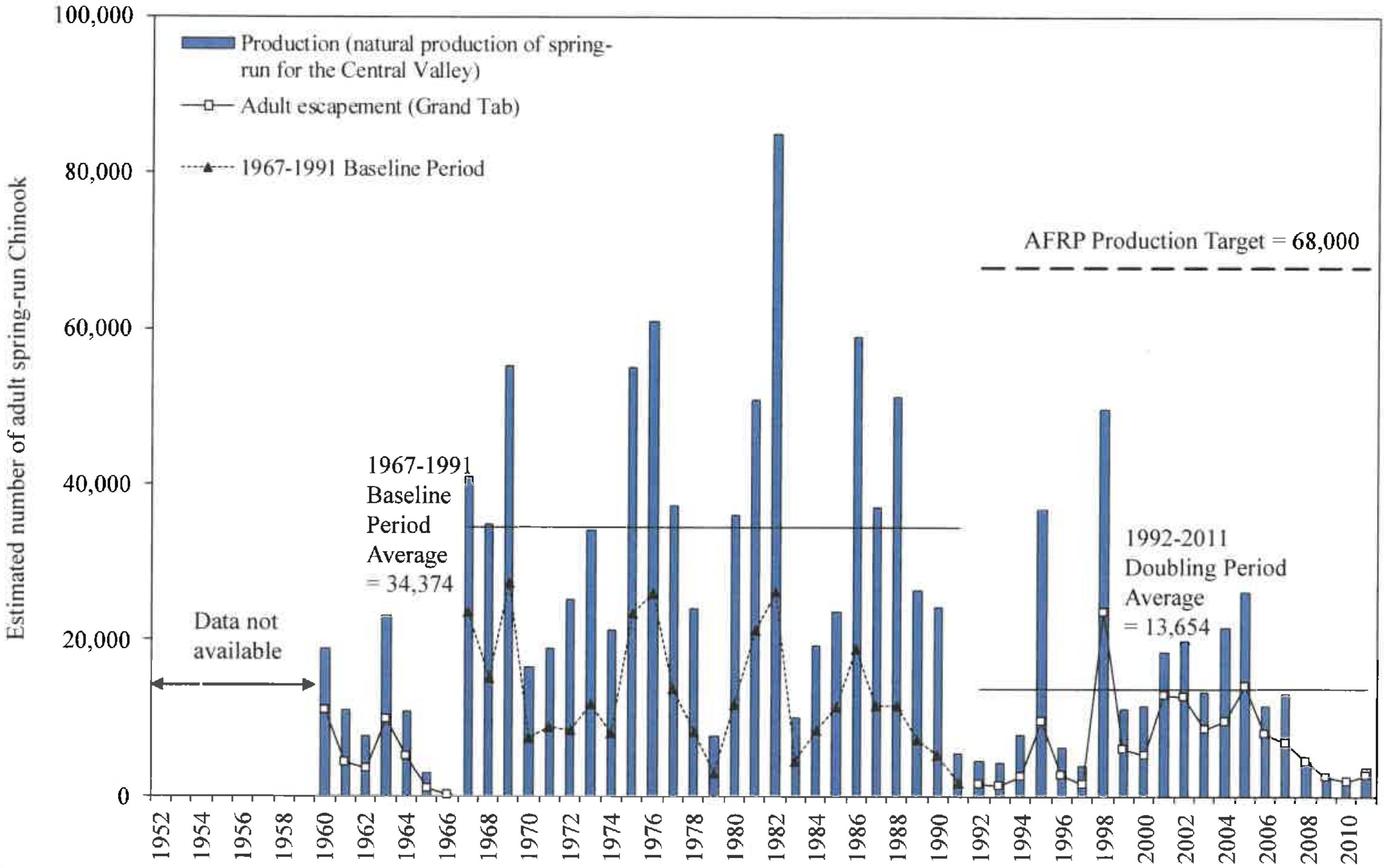

Figure 5. Estimated yearly adult natural production, and in-river adult escapements of spring-run Chinook salmon in the Central Valley rivers and streams. 1960 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period number are from Mills and Fisher (CDFG, 1994).

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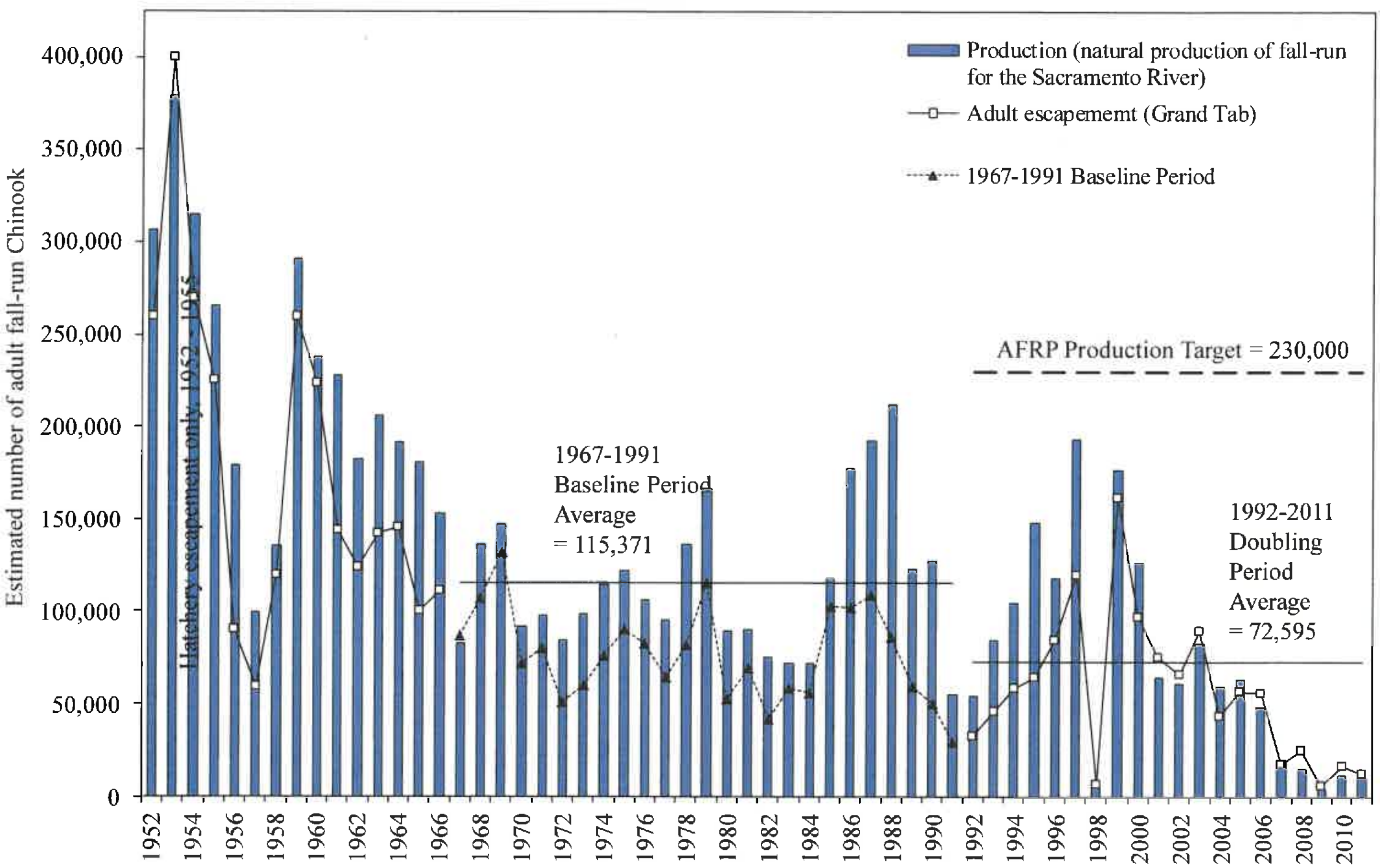

Figure 6. Estimated yearly adult natural production, and in-river adult escapements for the entire mainstem Sacramento River fall-run Chinook salmon. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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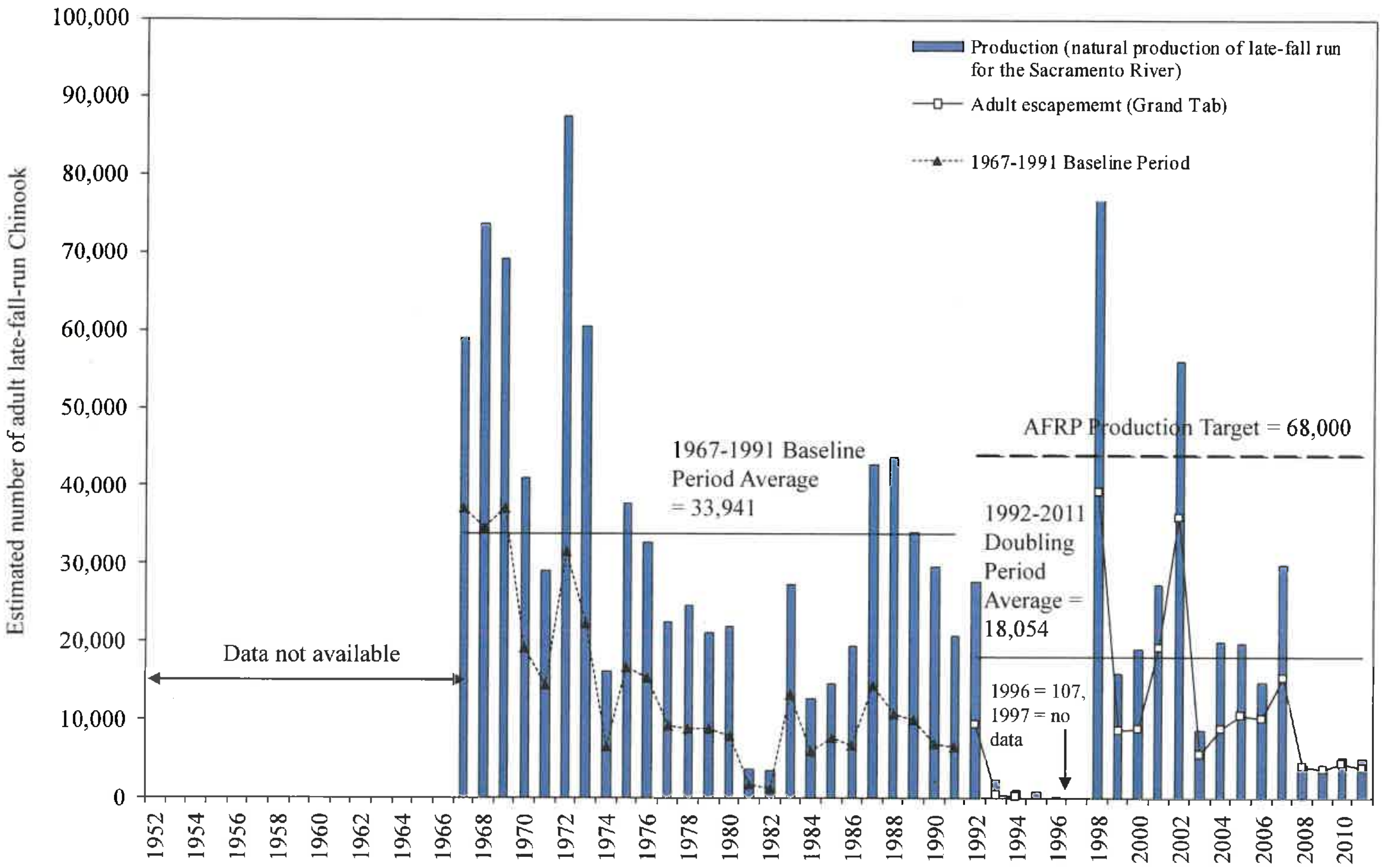

Figure 7. Estimated yearly adult natural production, and in-river adult escapements for above RBDD mainstem Sacramento River late-fall-run Chinook salmon. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994). Note that the doubling goal in the Final Restoration Plan is not double the 1967 – 1991 arithmetic mean as calculated in CHINOOKPROD.

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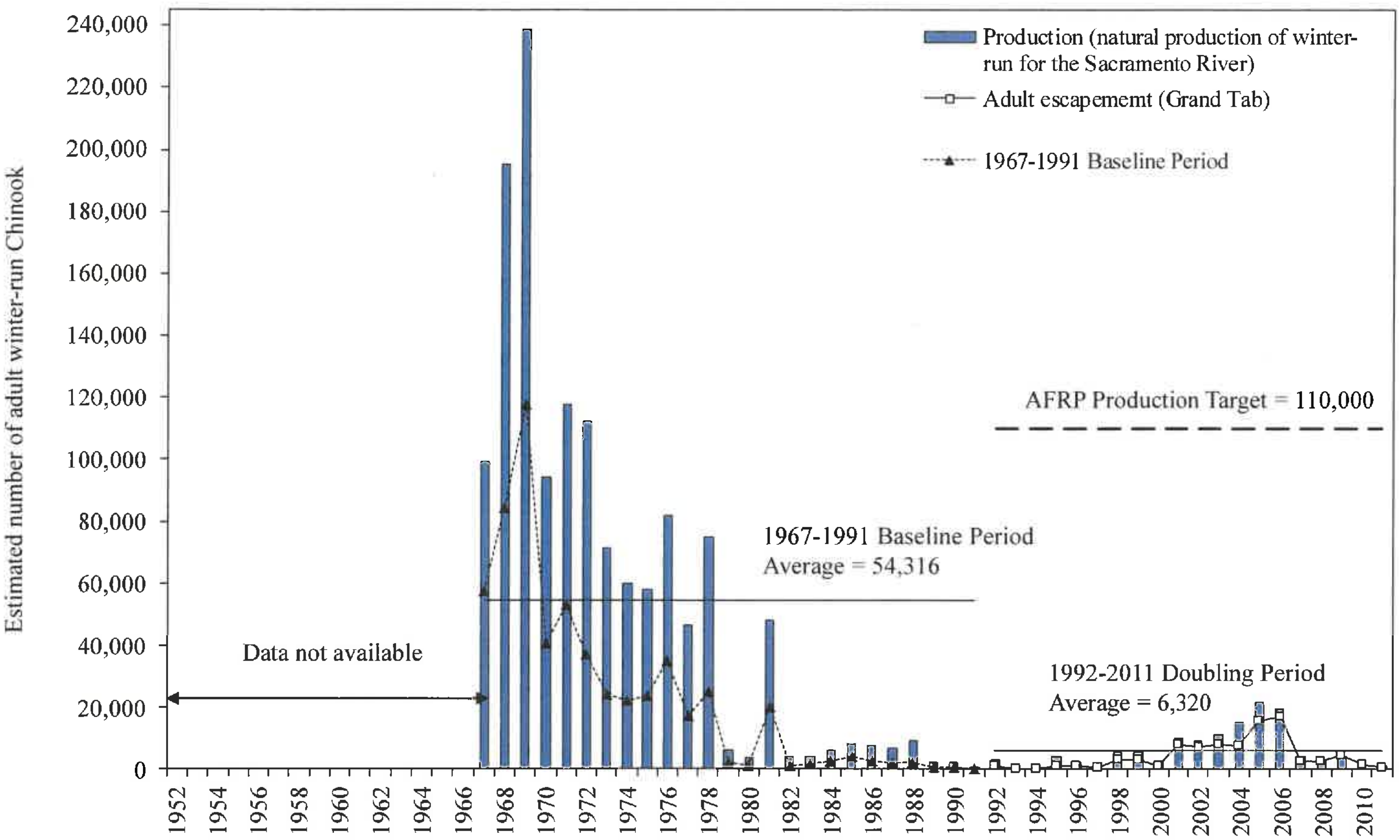

Figure 8. Estimated yearly adult natural production, and in river adult escapements for above RBDD mainstem Sacramento River winter-run Chinook salmon. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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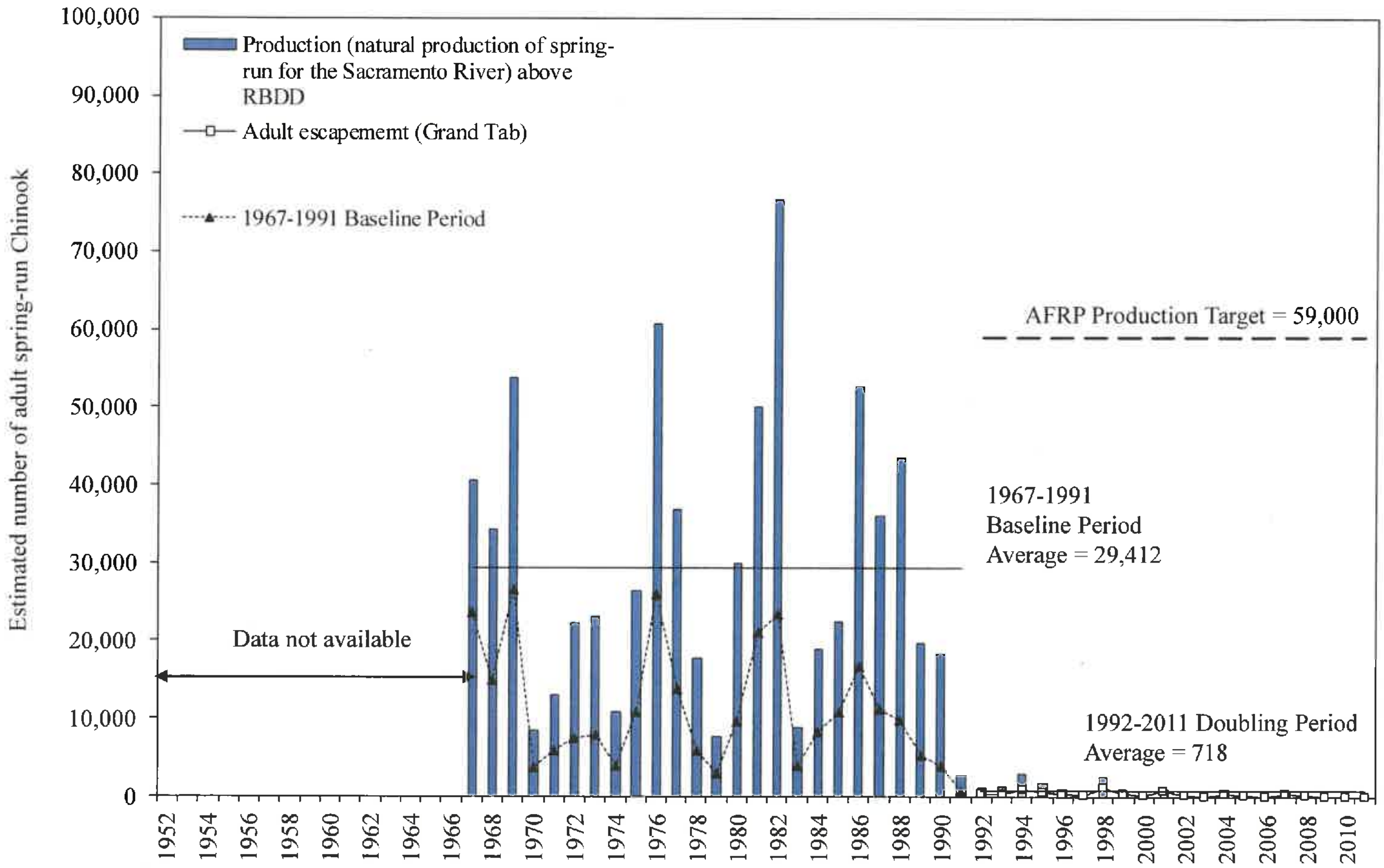

Figure 9. Estimated yearly adult natural production, and in river adult escapements for above RBDD mainstem Sacramento River spring-run Chinook salmon. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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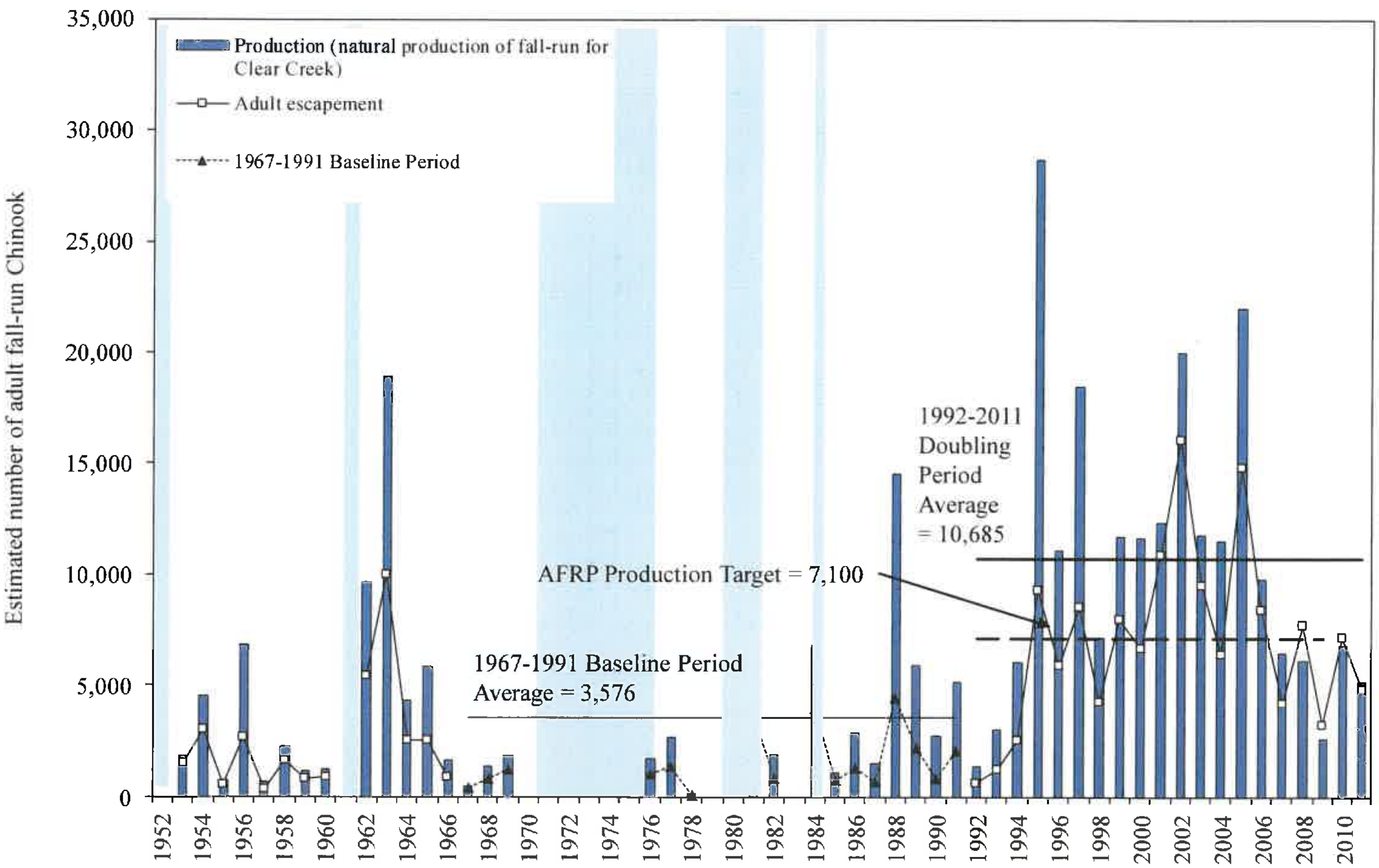

Figure 10. Estimated yearly adult natural production, and in river adult escapements of Clear Creek fall-run Chinook salmon. ▭ = data was not available for 1952, 1961, 1970-1975, 1979, 1980, 1983. 1953 – 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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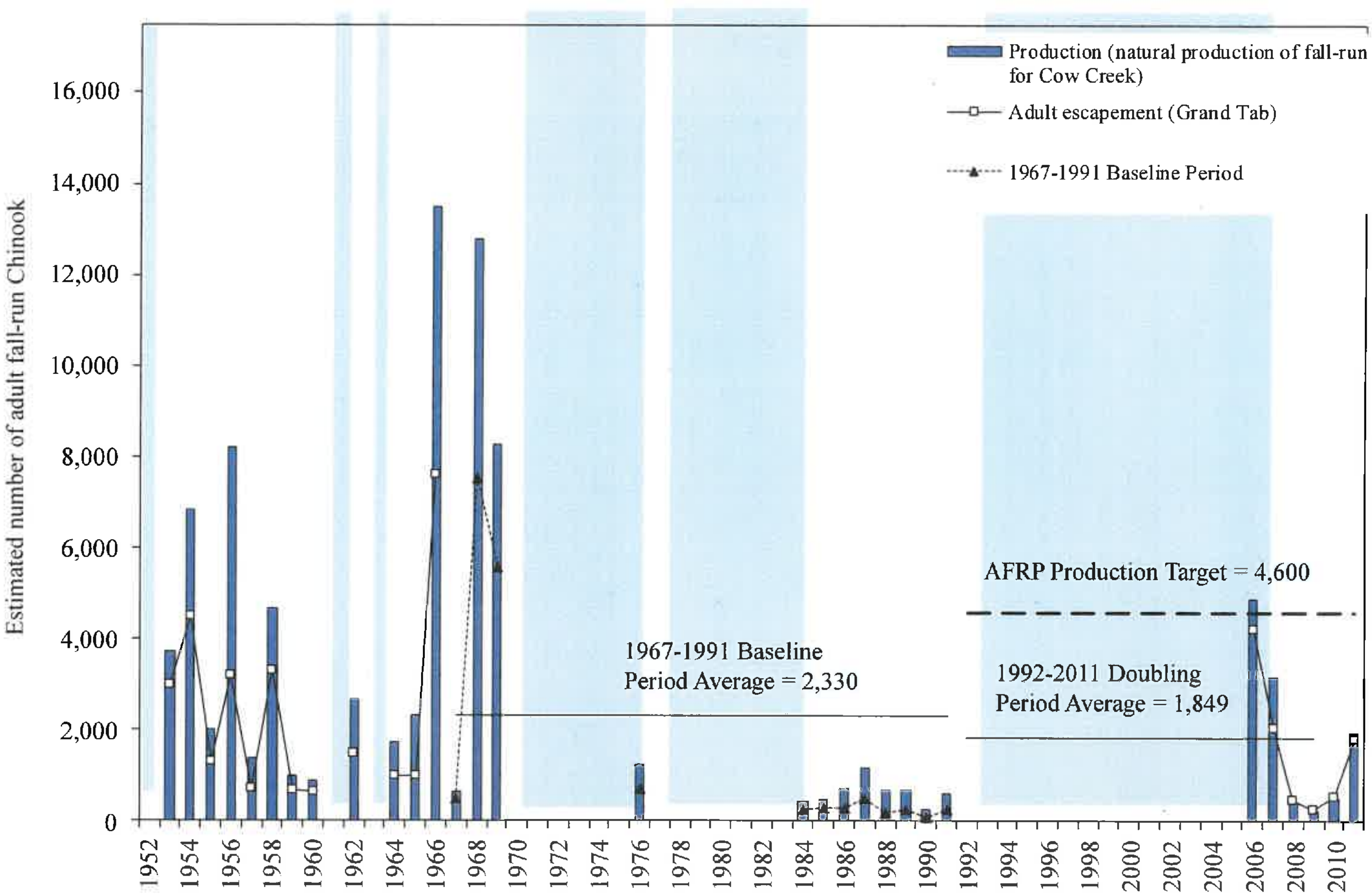

Figure 11. Estimated yearly natural production, and in river escapements of Cow Creek adult fall-run Chinook salmon. ▭ = data was not available for 1952, 1961, 1963, 1970 - 1975, 1977 - 1983, and 1992 - 2011. 1952 – 1966 and 1992 - 2009 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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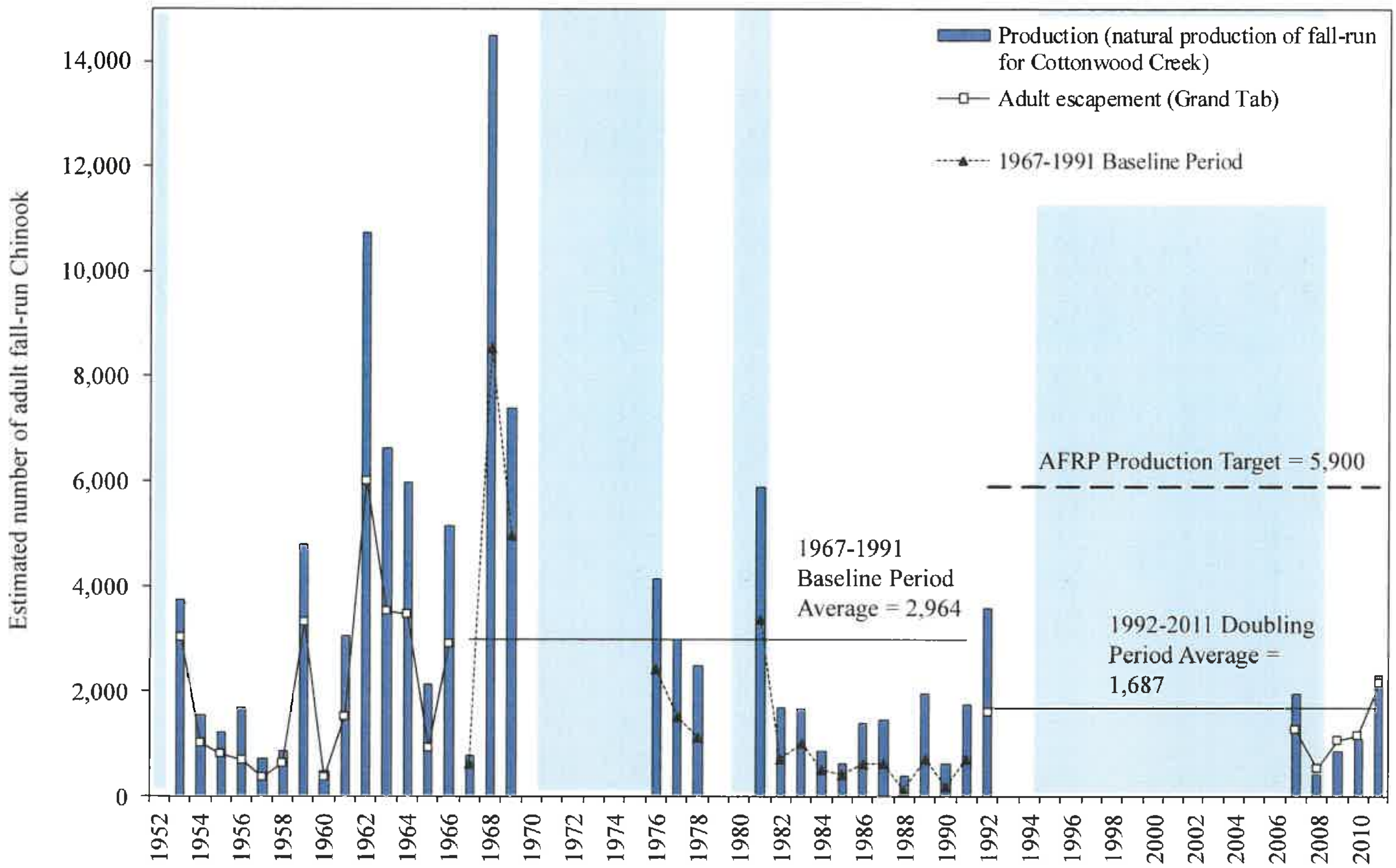

Figure 12. Estimated yearly adult natural production, and in river adult escapements of Cottonwood Creek fall-run Chinook salmon. ▭ = data was not available for 1952, 1970 - 1975, 1979 - 1980 and 1993 - 2005. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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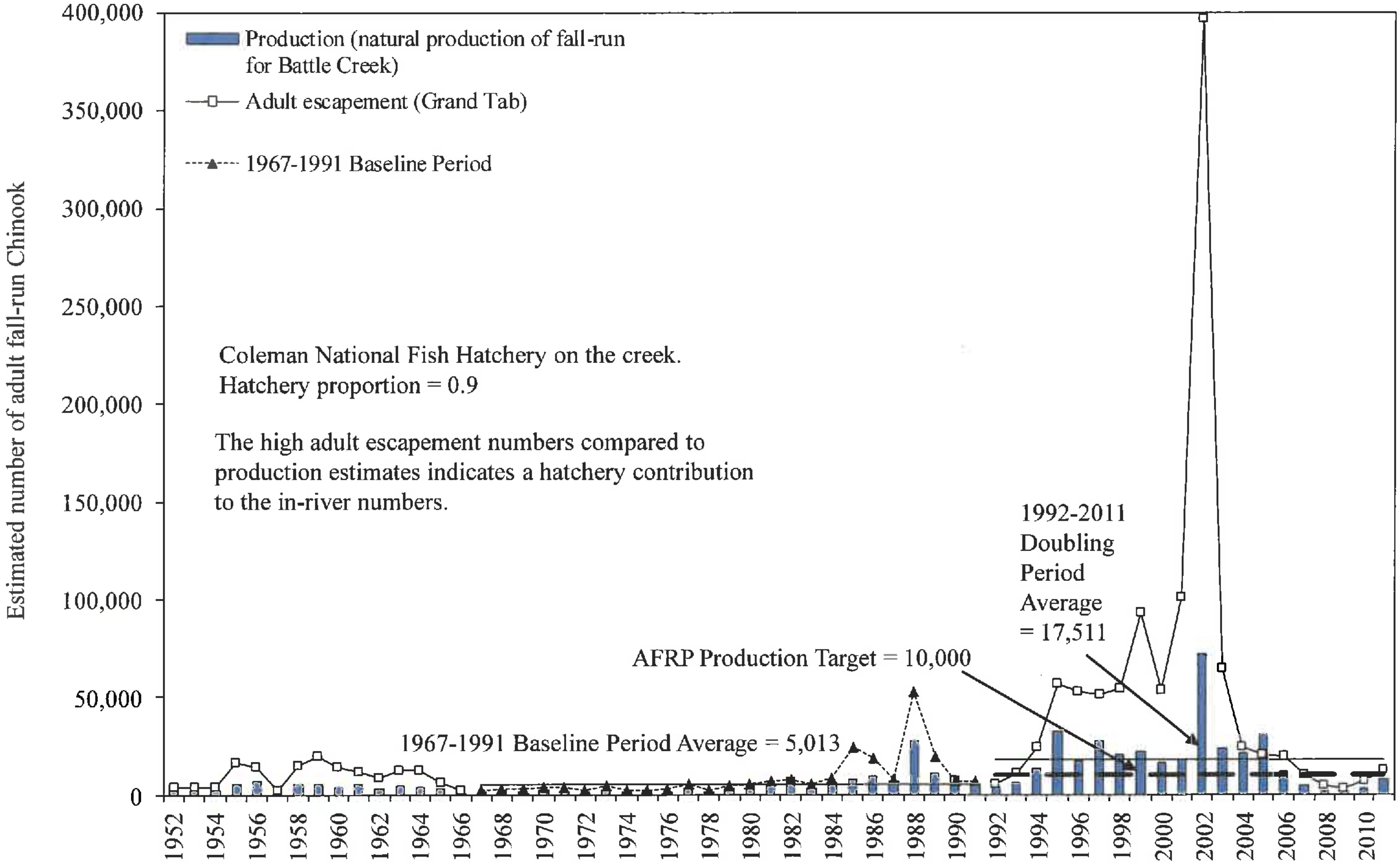

Figure 13. Estimated yearly natural production, and in river escapements of Battle Creek adult fall-run Chinook salmon. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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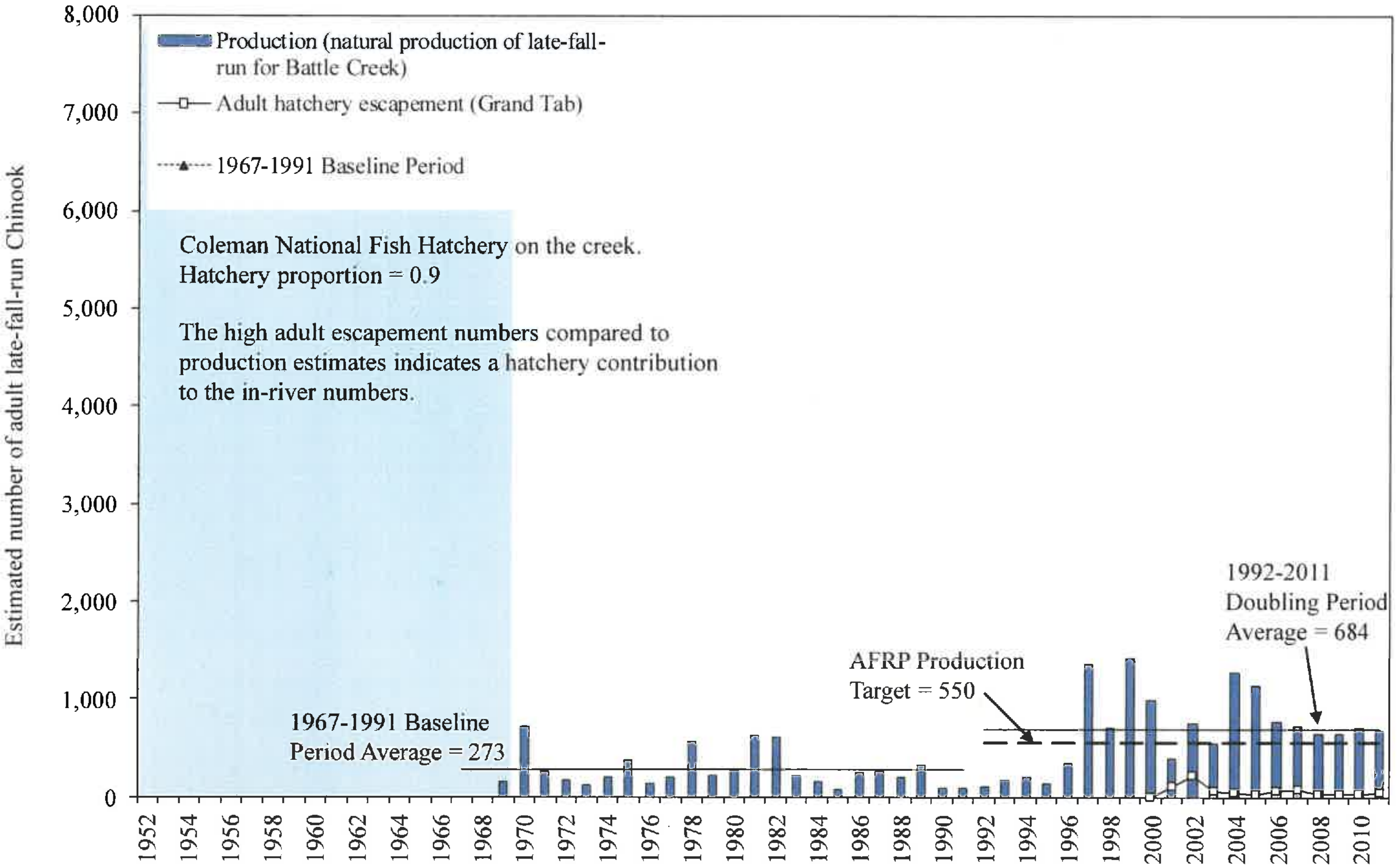

Figure 14. Estimated yearly natural production calculated from hatchery returns (in river returns were available starting in 2000), and hatchery returns of Battle Creek adult late-fall-run Chinook salmon. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). ▭ = data was not available for 1952-1968. 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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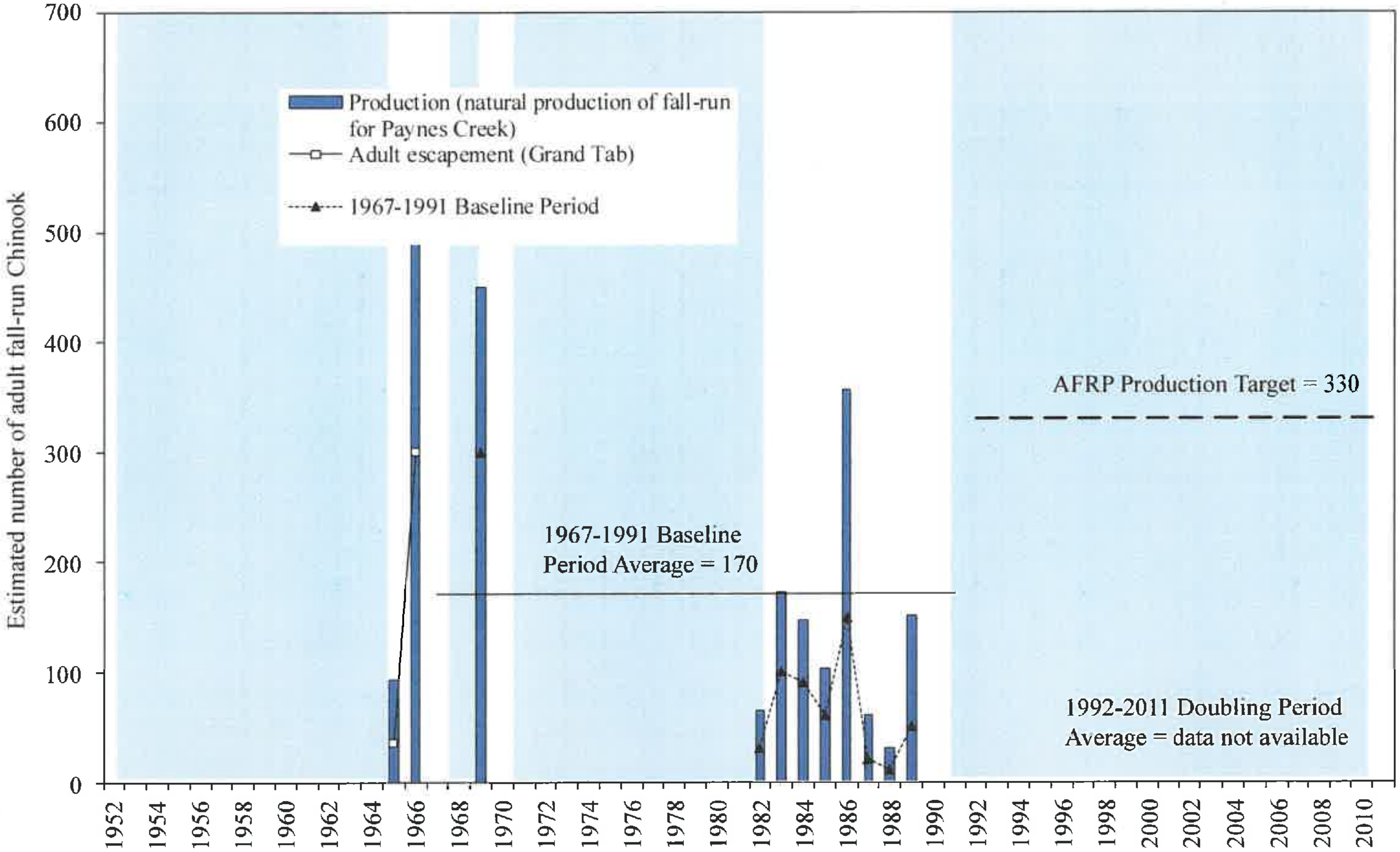

Figure 15. Estimated yearly natural production, and in river escapements of Paynes Creek adult fall-run Chinook salmon. ▭ = data was not available for 1952 - 1964, 1967 - 1968, 1970 - 1981, and 1990 - 2009. 1965-1966 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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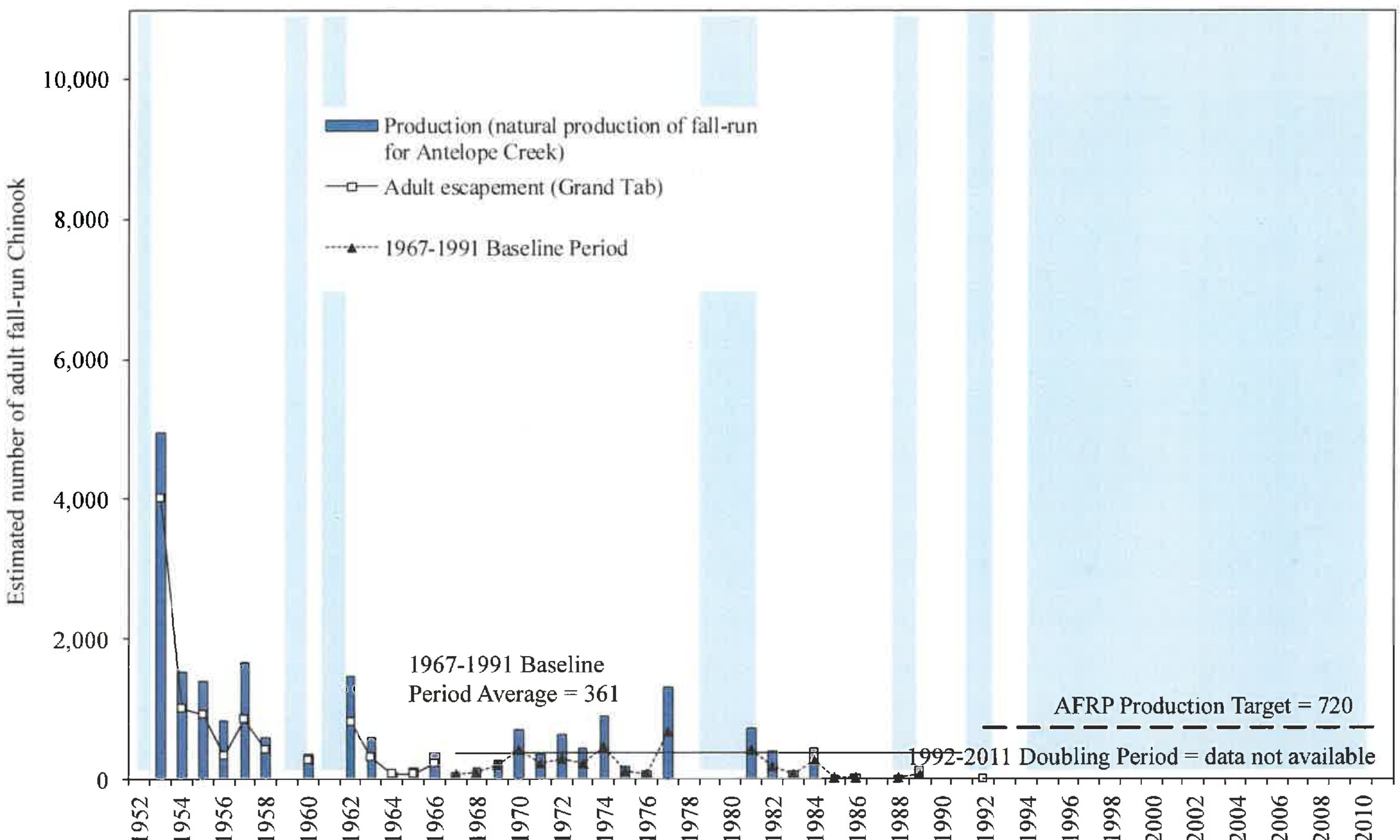

Figure 16. Estimated yearly natural production, and in river escapements of Antelope Creek adult fall-run Chinook salmon. ▭ = data was not available for 1952, 1959, 1961, 1978 - 1980, 1987, 1990, 1991, and 1993 - 2009. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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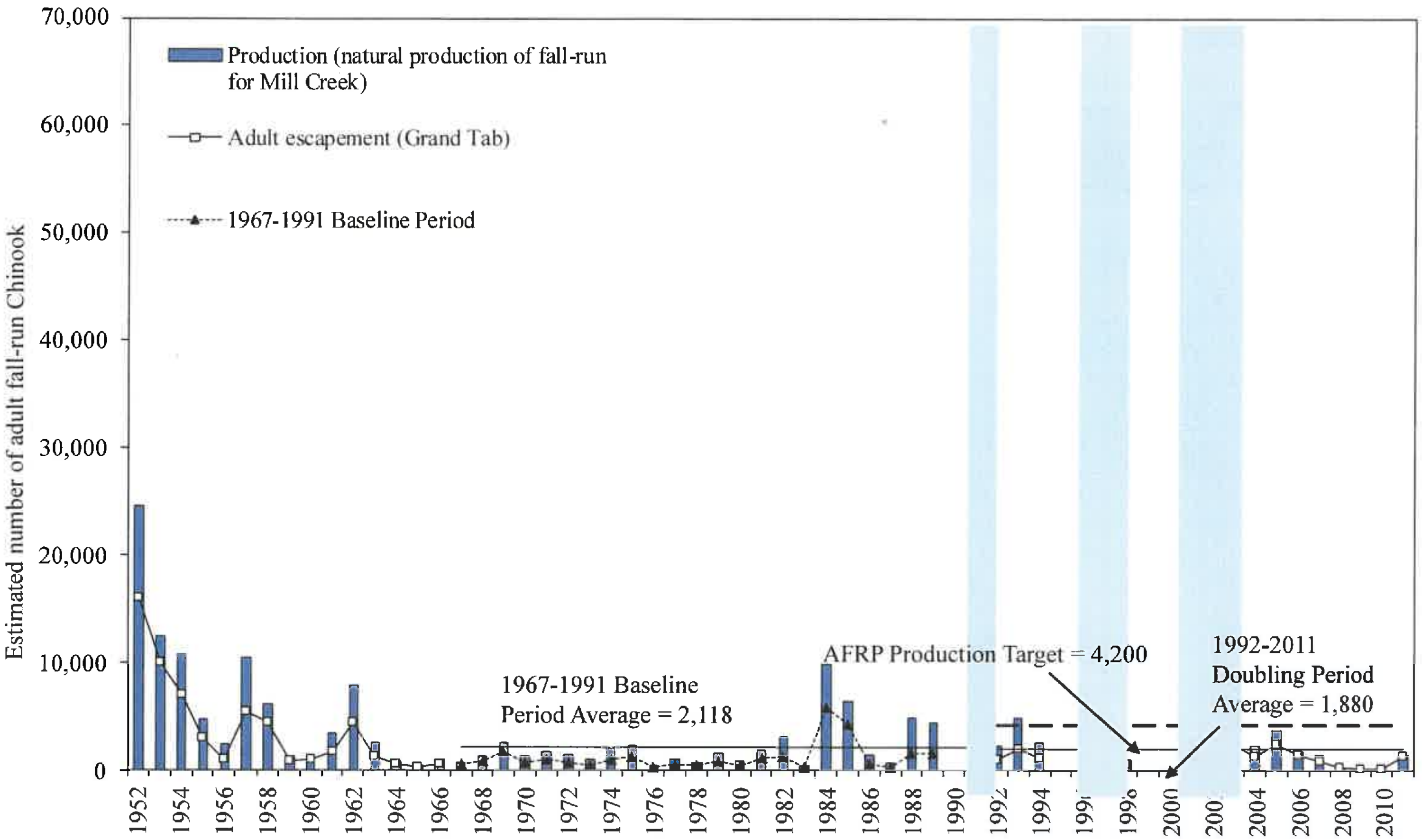

Figure 17. Estimated yearly natural production, and in river escapements of Mill Creek adult fall-run Chinook salmon. ▭ = data was not available for 1990, 1995 - 1996, and 1999 - 2001. 1952 -1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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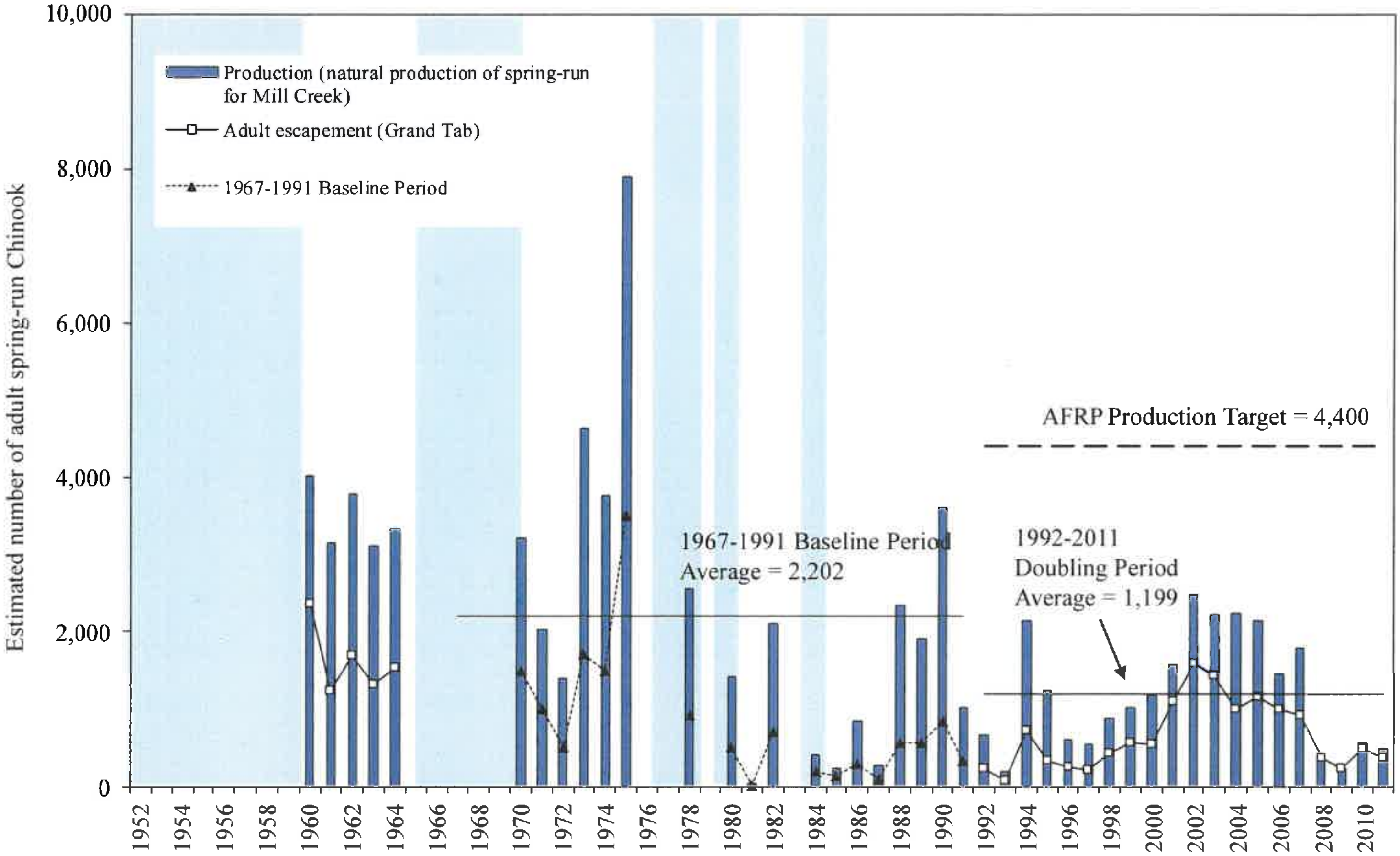

Figure 18. Estimated yearly natural production, and in river escapements of Mill Creek adult spring-run Chinook salmon. ▭ = data was not available for 1952 - 1959, 1965 - 1969, 1976, 1977, 1979, and 1983. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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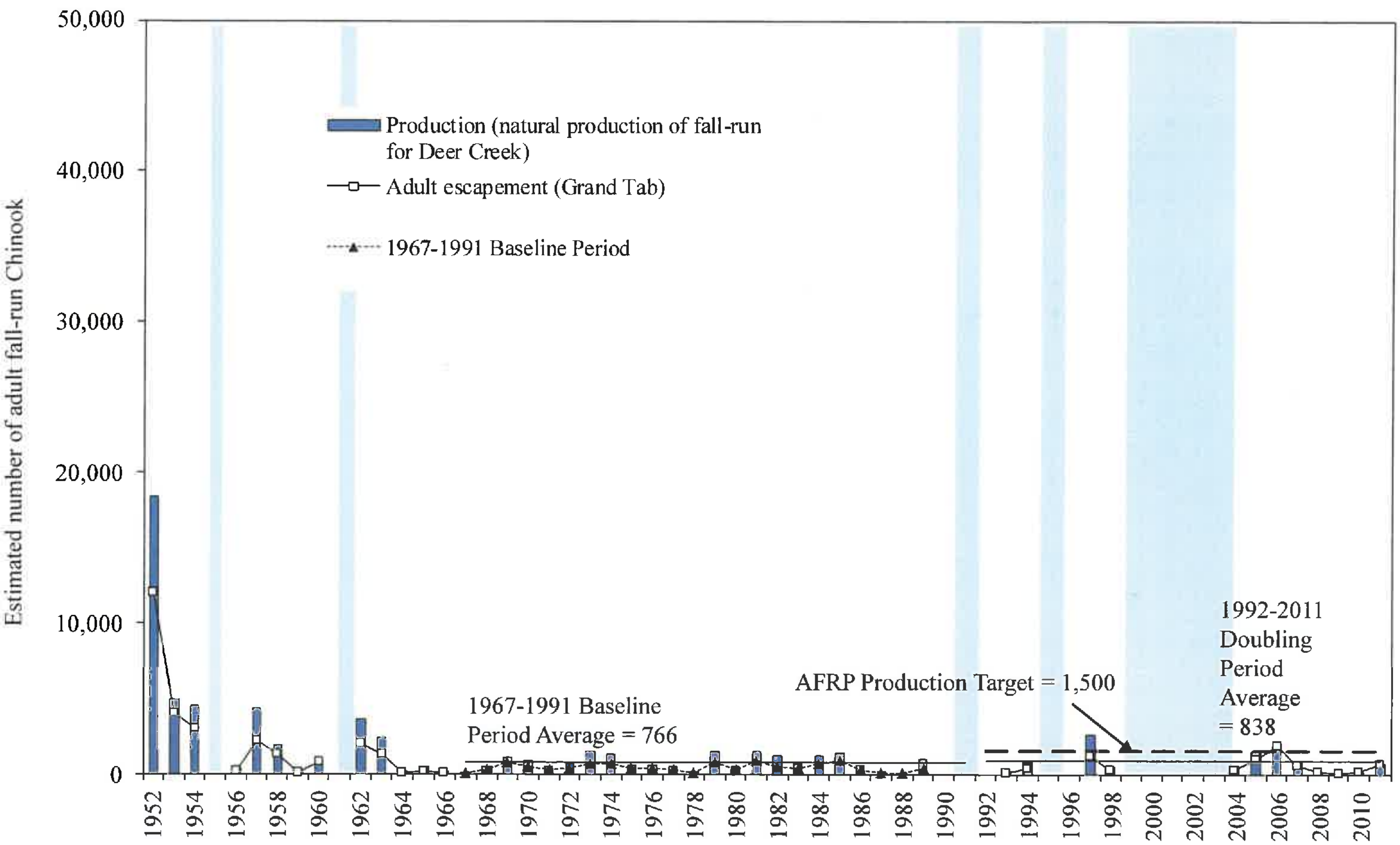

Figure 19. Estimated yearly natural production, and in river escapements of Deer Creek adult fall-run Chinook salmon. ▭ = data was not available for 1955, 1961, 1990 - 1992, 1995, 1996, and 1999 - 2003. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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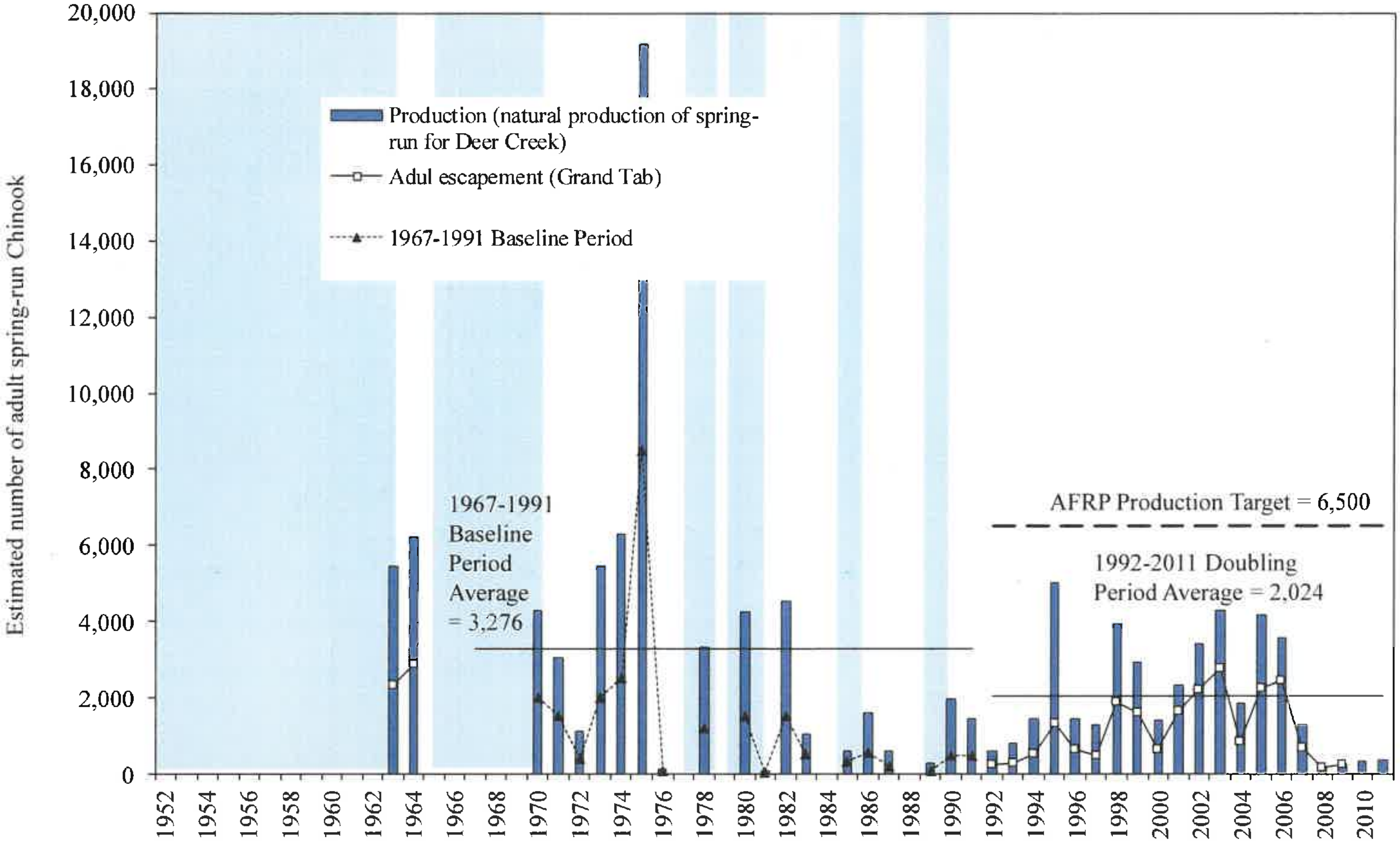

Figure 20. Estimated yearly natural production, and in river escapements of Deer Creek adult spring-run Chinook salmon. ▭ = data was not available for 1952 - 1962, 1965 - 1969, 1977, 1979, 1984, and 1988. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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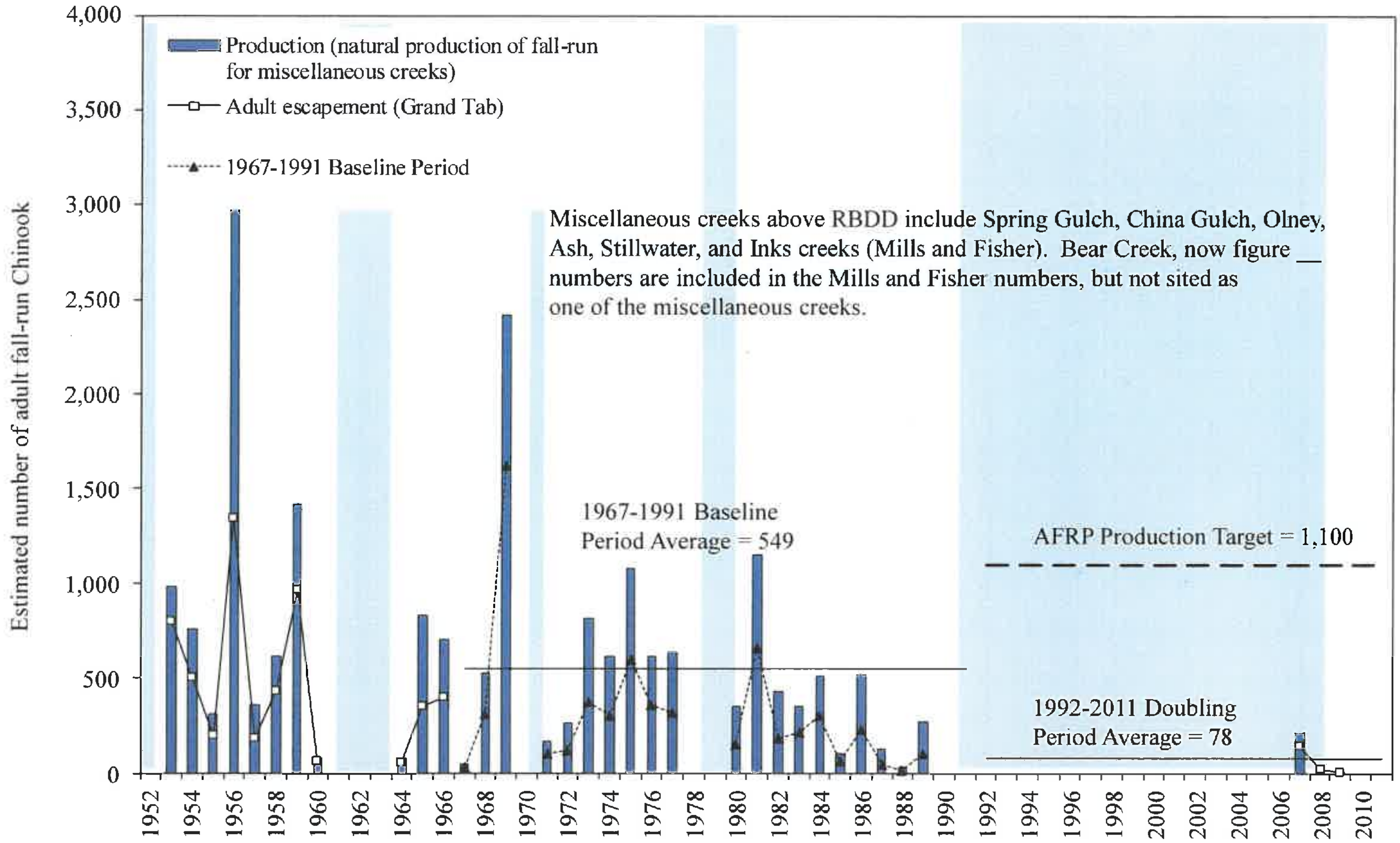

Figure 21. Estimated yearly natural production of miscellaneous creeks adult fall-run Chinook salmon above RBDD. ▭ = data was not available for 1952 -1955, 1963 – 1968 and 1970 – 2006. 1952 – 1966 and 1992 - 2011 2009 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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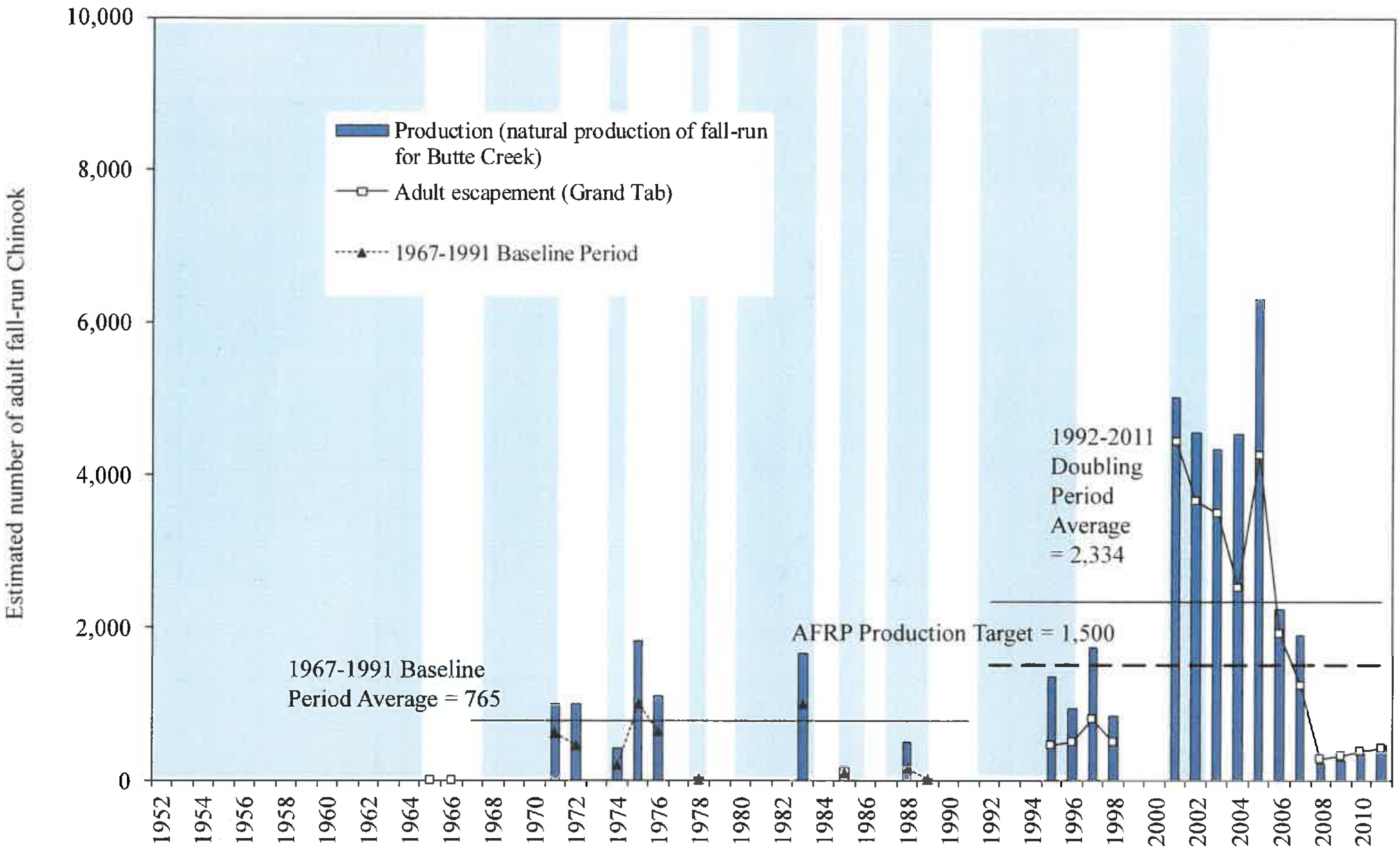

Figure 22. Estimated yearly natural production, and in river escapements of Butte Creek adult fall-run Chinook salmon. ▭ = data was not available for 1952 - 1964, 1967 - 1970, 1973, 1977, 1979 - 1982, 1984, 1986,1987, 1990 -1994, and 1999 - 2001. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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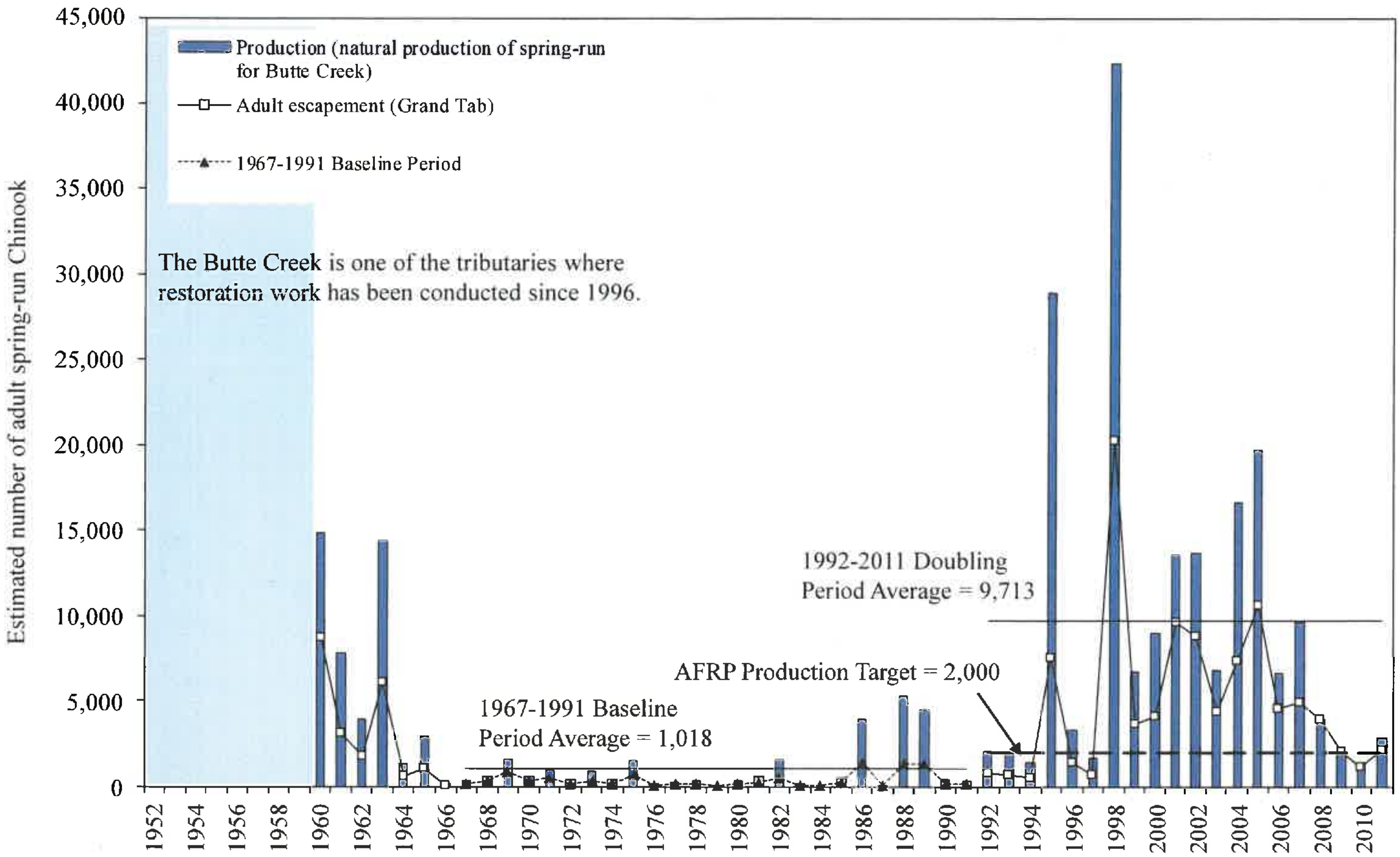

Figure 23. Estimated yearly natural production, and in river escapements of Butte Creek adult spring-run Chinook salmon. 1952- 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). ▭data was not available for 1952 - 1959. 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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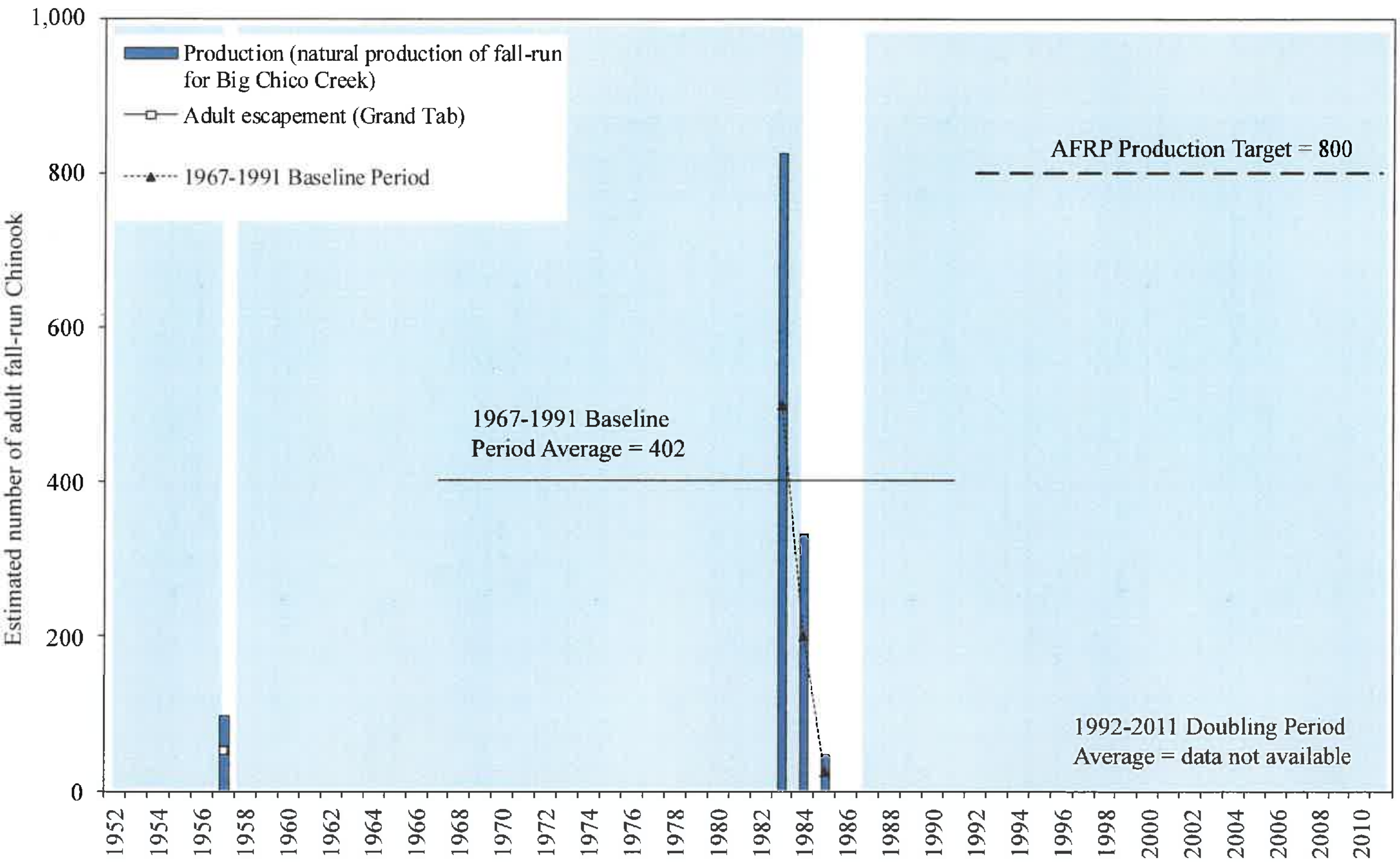

Figure 24. Estimated yearly natural production, and in river escapements of Big Chico Creek adult fall-run Chinook salmon. ▭ = data was not available for 1952 - 1956, 1958 - 1982, and 1986 - 2005. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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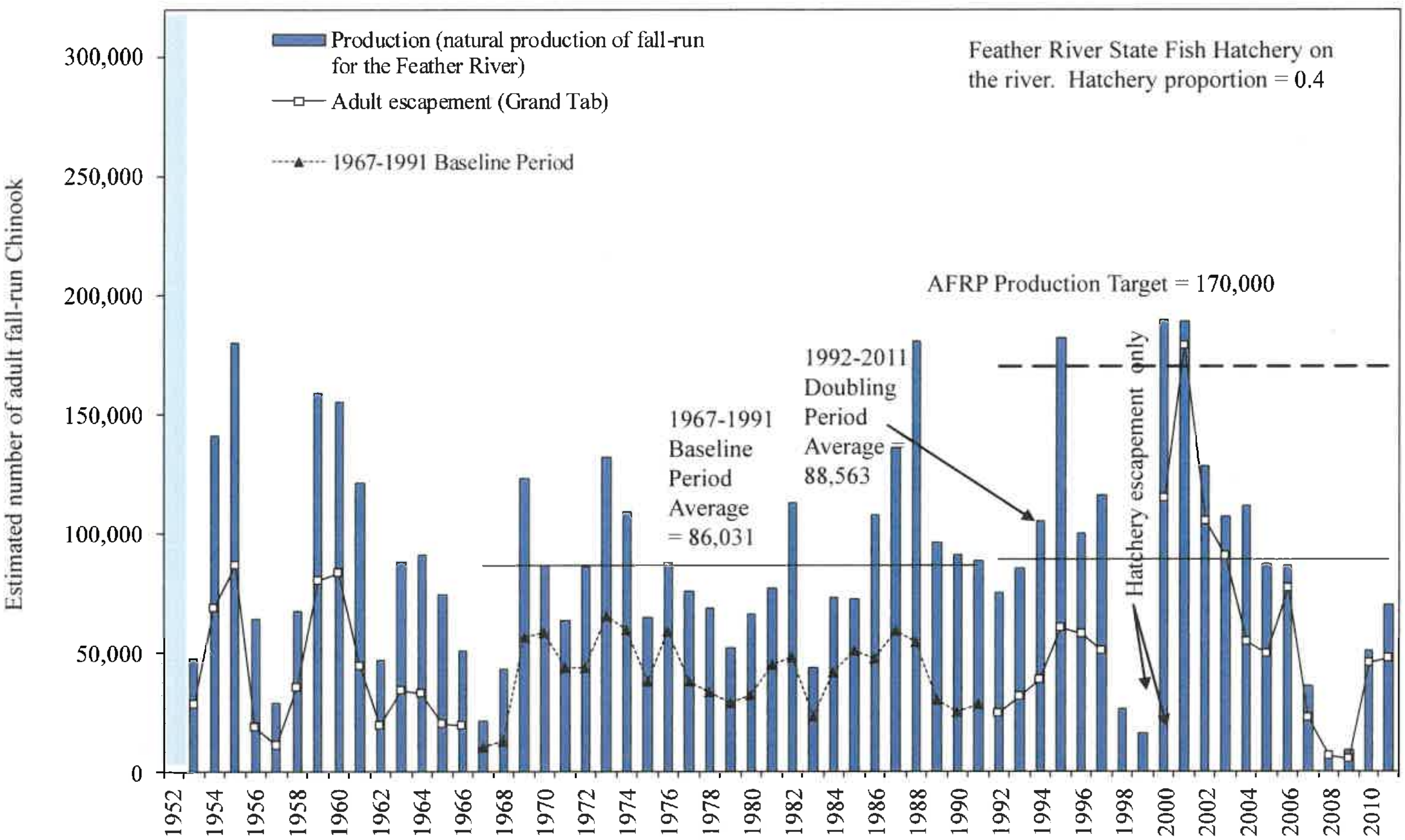

Figure 25. Estimated yearly natural production, and in river escapements of Feather River adult fall-run Chinook salmon. In-river escapements were not available for 1998 and 1999. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994). Starting in 2005 only fall-run returns are used for hatchery escapement.

2-1-13

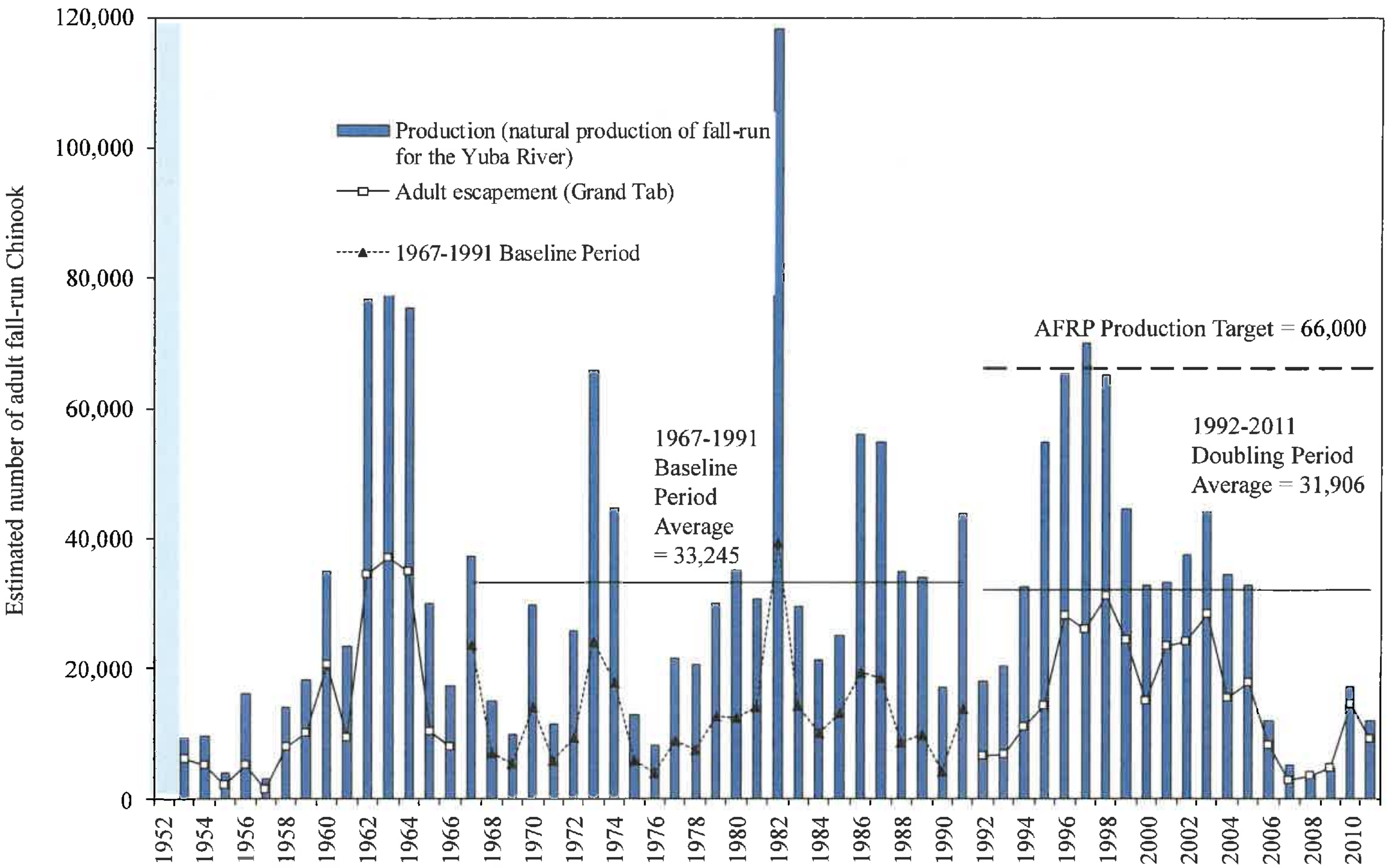

Figure 26. Estimated yearly natural production, and in river escapements of Yuba River adult fall-run Chinook salmon. 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994). 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). ▭ data was not available for 1952.

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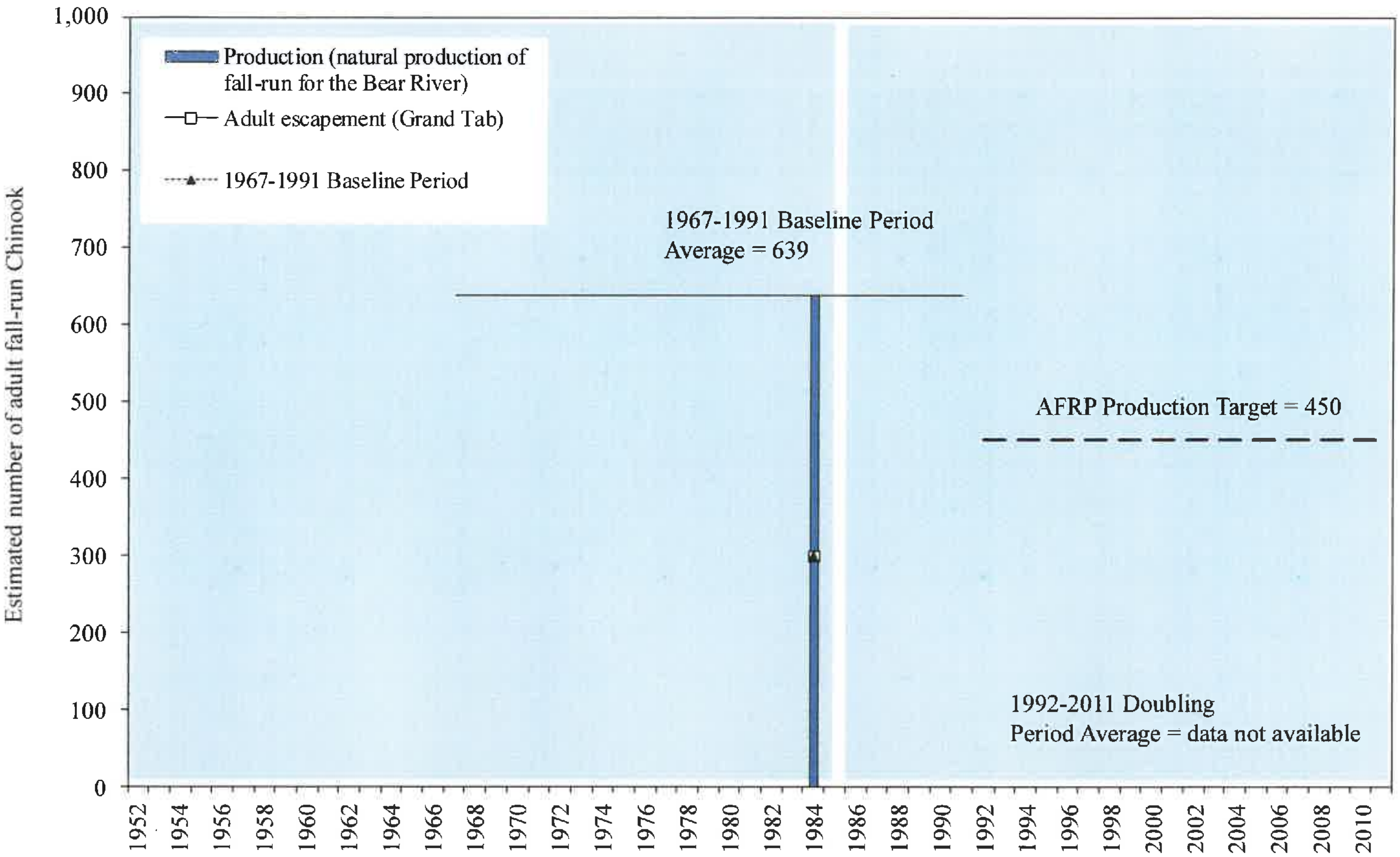

Figure 27. Estimated yearly natural production, and in river escapements of Bear River adult fall-run Chinook salmon. ▭ = data was not available for 1952 - 1983, and 1985 – 2009. Numbers are from CDFG Grand Tab (Apr 24, 2012).

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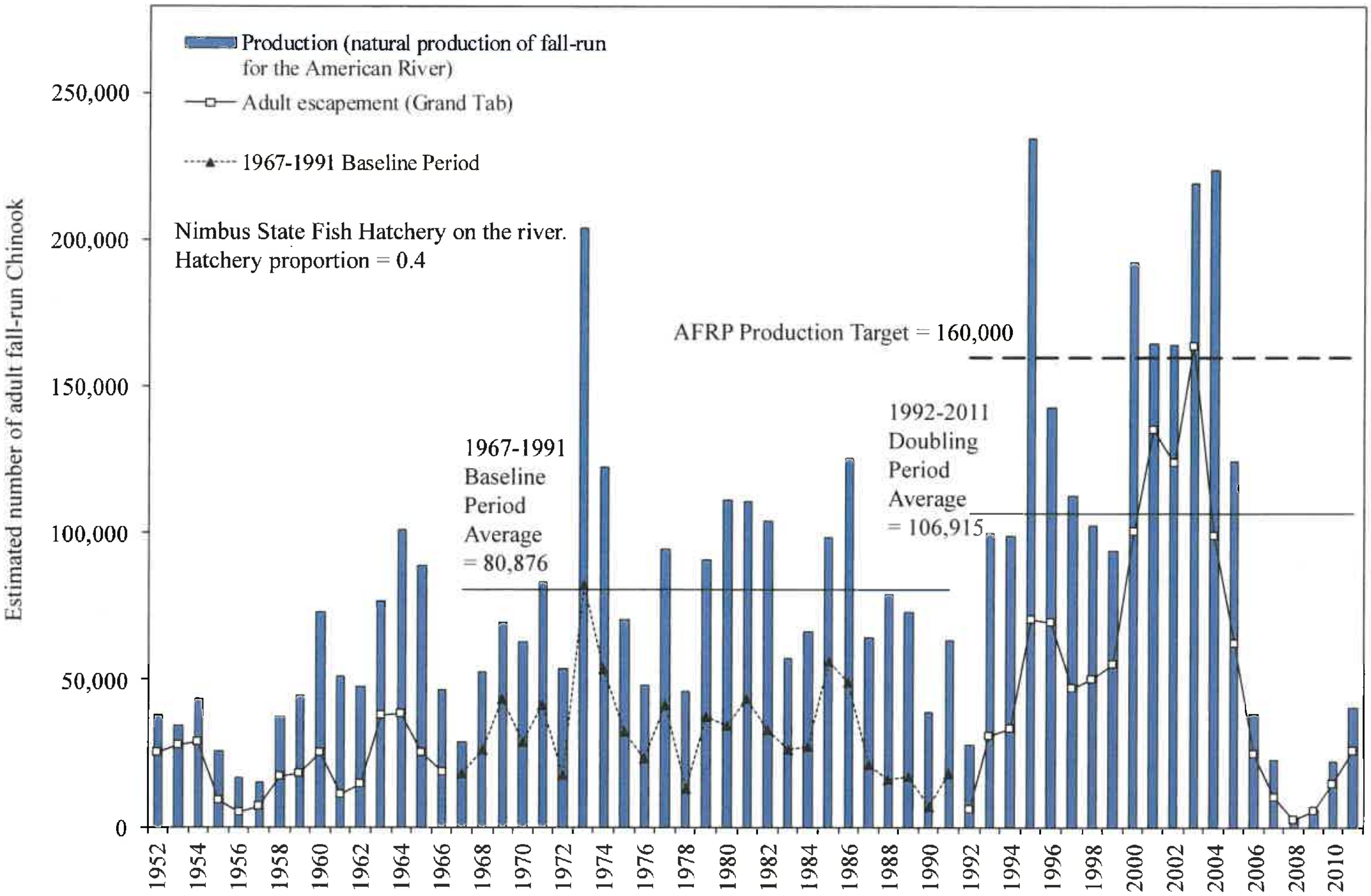

Figure 28. Estimated yearly natural production, and in river escapements of American River adult fall-run Chinook salmon. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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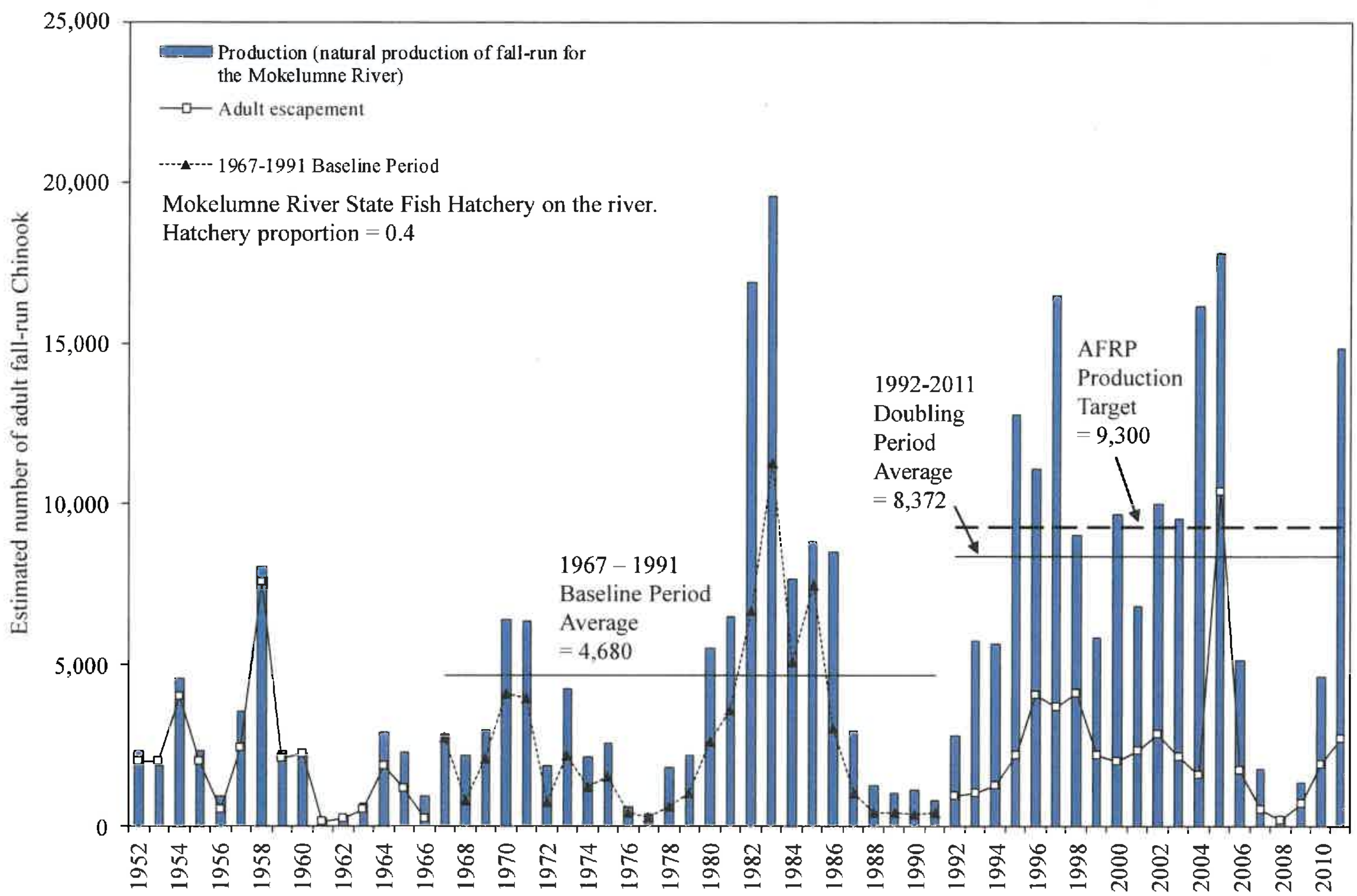

Figure 29. Estimated yearly natural production, and in river escapements of Mokelumne River adult fall-run Chinook salmon. In river escapement numbers were not available for 2001. 1952 – 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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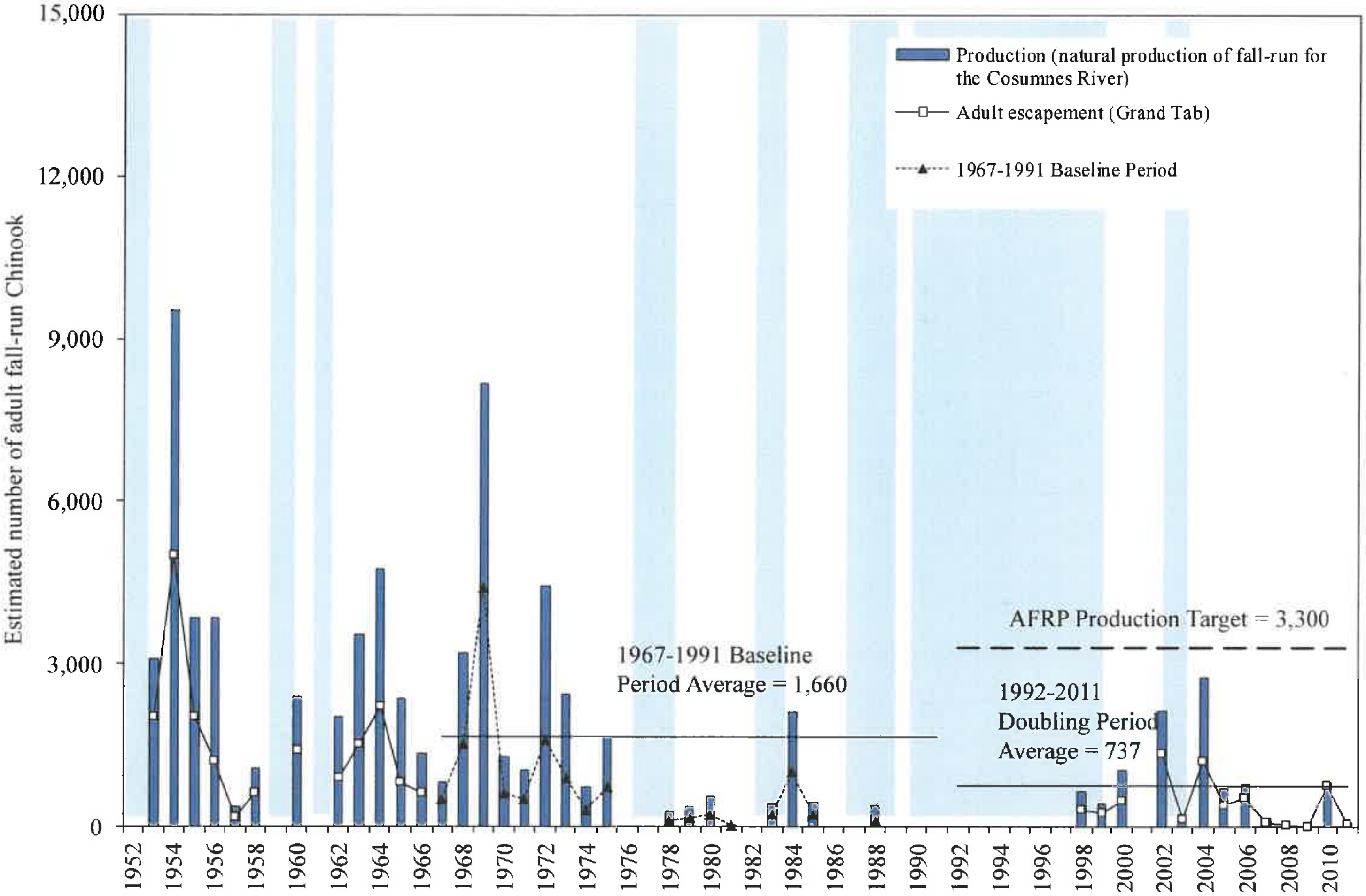

Figure 30. Estimated yearly natural production, and in river escapements of Cosumnes River adult fall-run Chinook salmon. ▭ = data was not available for 1952, 1959, 1961, 1976-1977, 1982, 1986, 1987, 1989 - 1997, and 1999 - 2006. 1952-1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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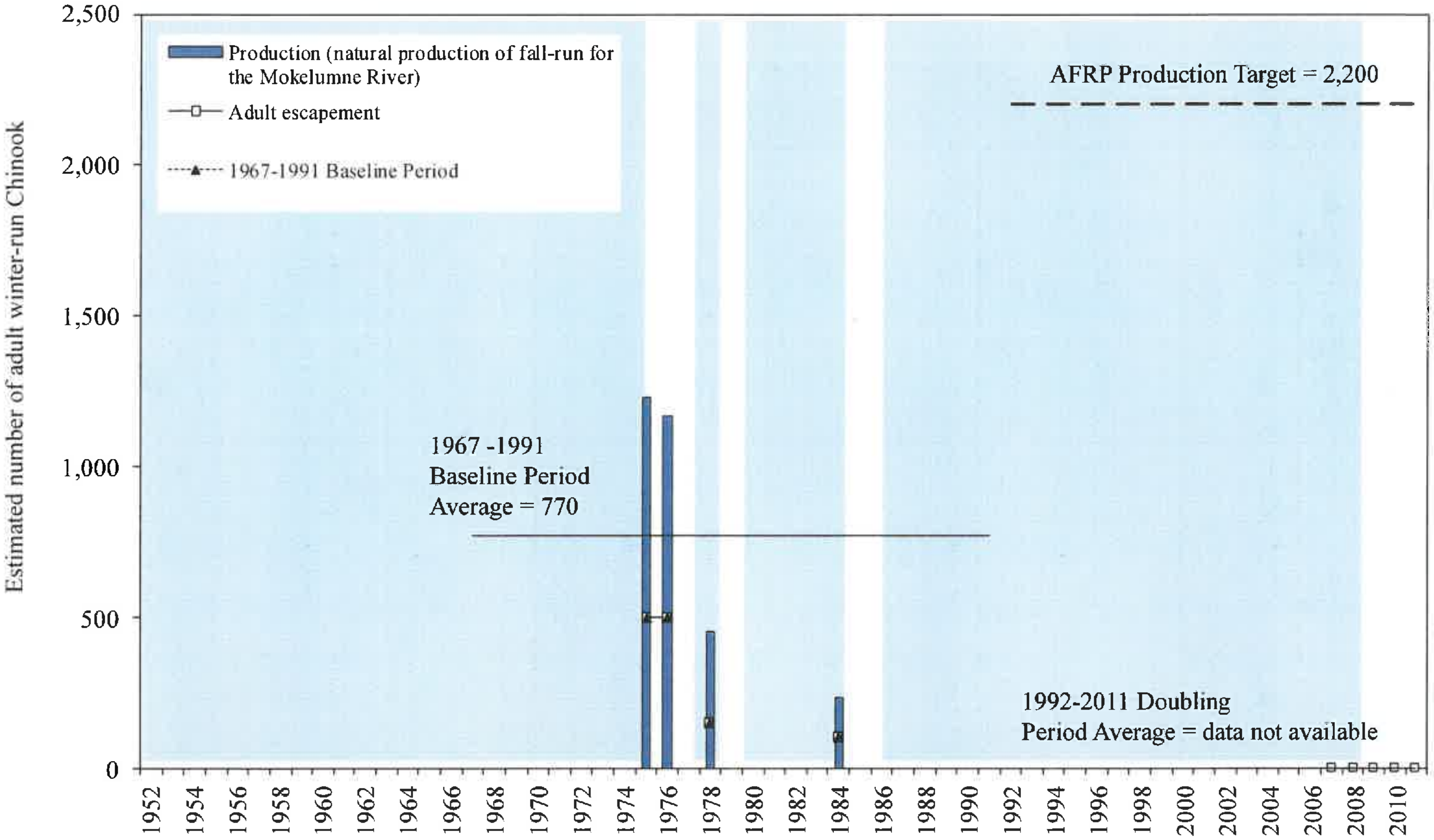

Figure 31. Estimated yearly natural production of Calaveras River adult winter-run Chinook salmon. ▭ = data was not available for 1952 - 1974, 1977, 1979 – 1983, and 1985 - 2005. 1952 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers from Mills and Fisher (CDFG, 1994) were not available.

2-1-13

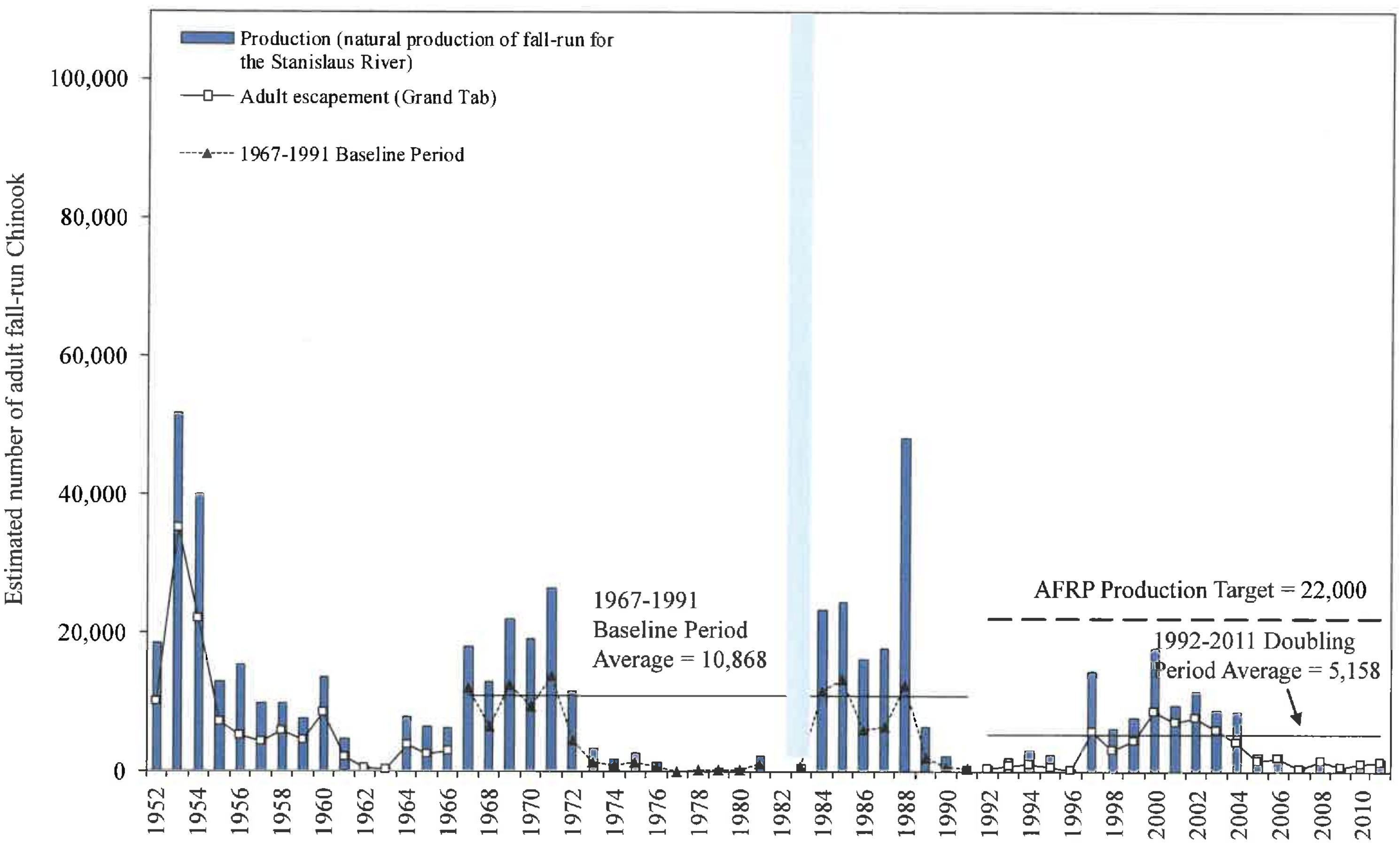

Figure 32. Estimated yearly natural production, and in river escapements of Stanislaus River adult fall-run Chinook salmon. 1952 – 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994). ▭ = data was not available for 1982.

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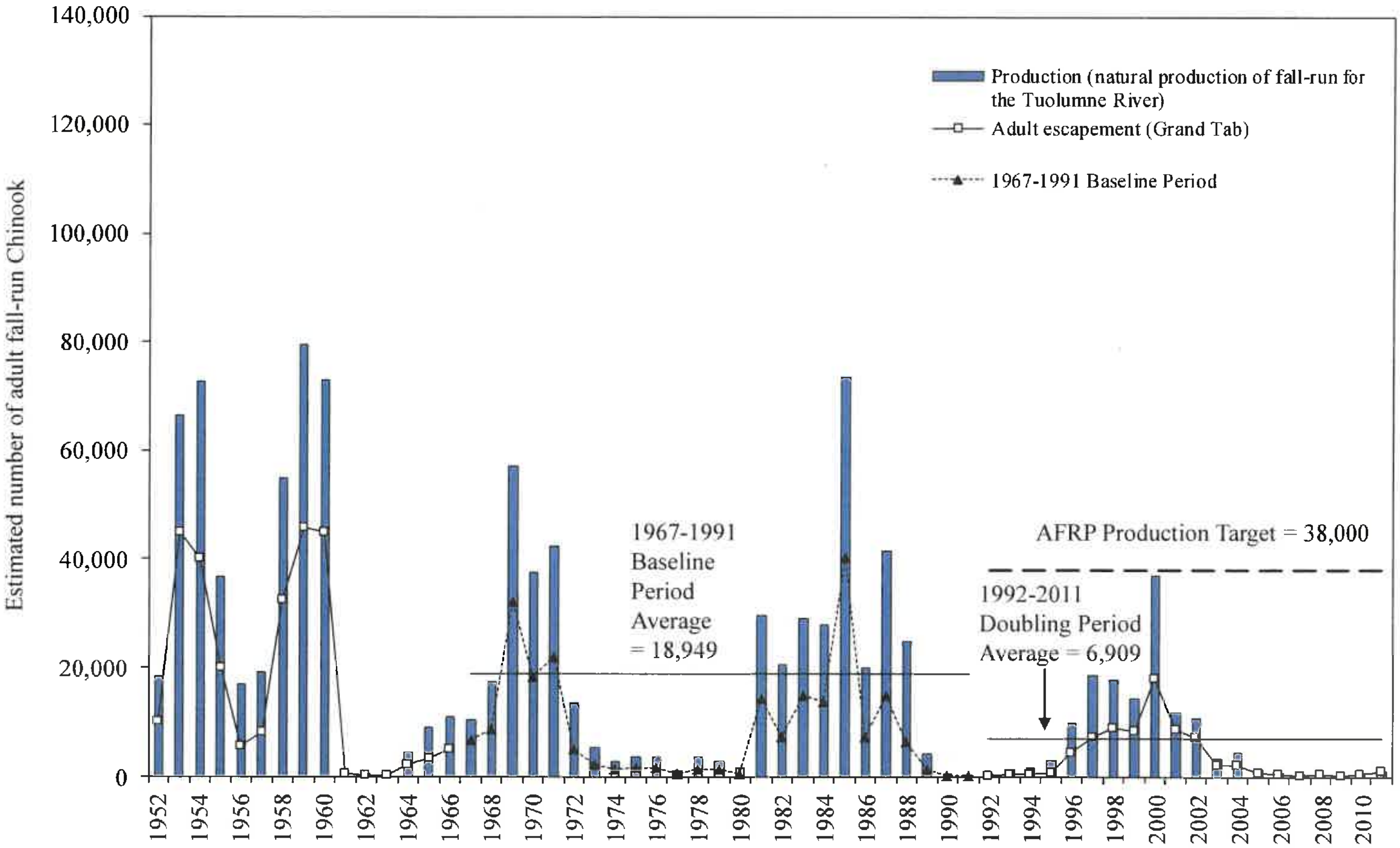

Figure 33. Estimated yearly natural production, and in river escapements of Tuolumne River adult fall-run Chinook salmon. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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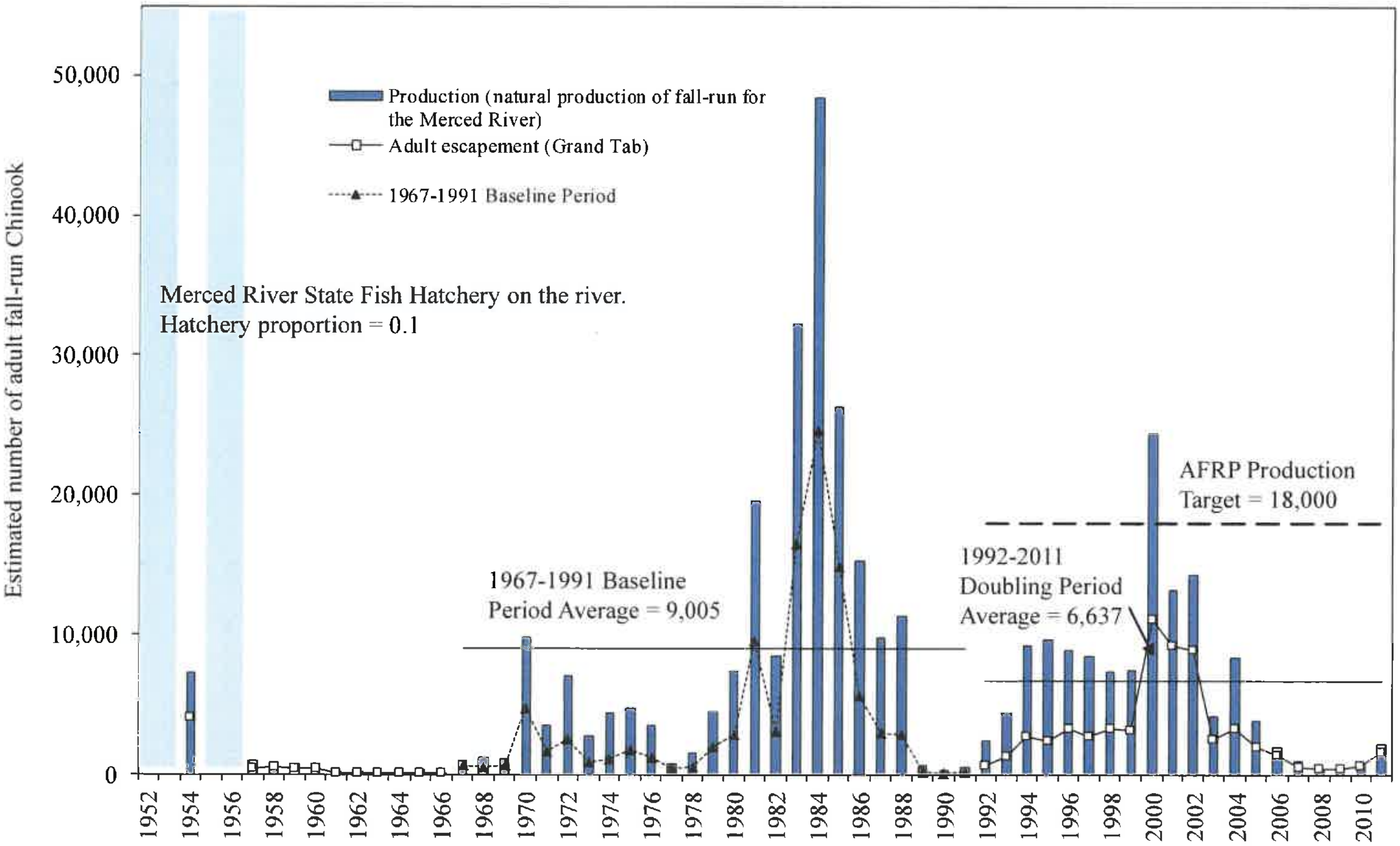

Figure 34. Estimated yearly natural production, and in river escapements of Merced River adult fall-run Chinook salmon. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). ▭ data was not available for 1952 - 1953, and 1955 - 1956. 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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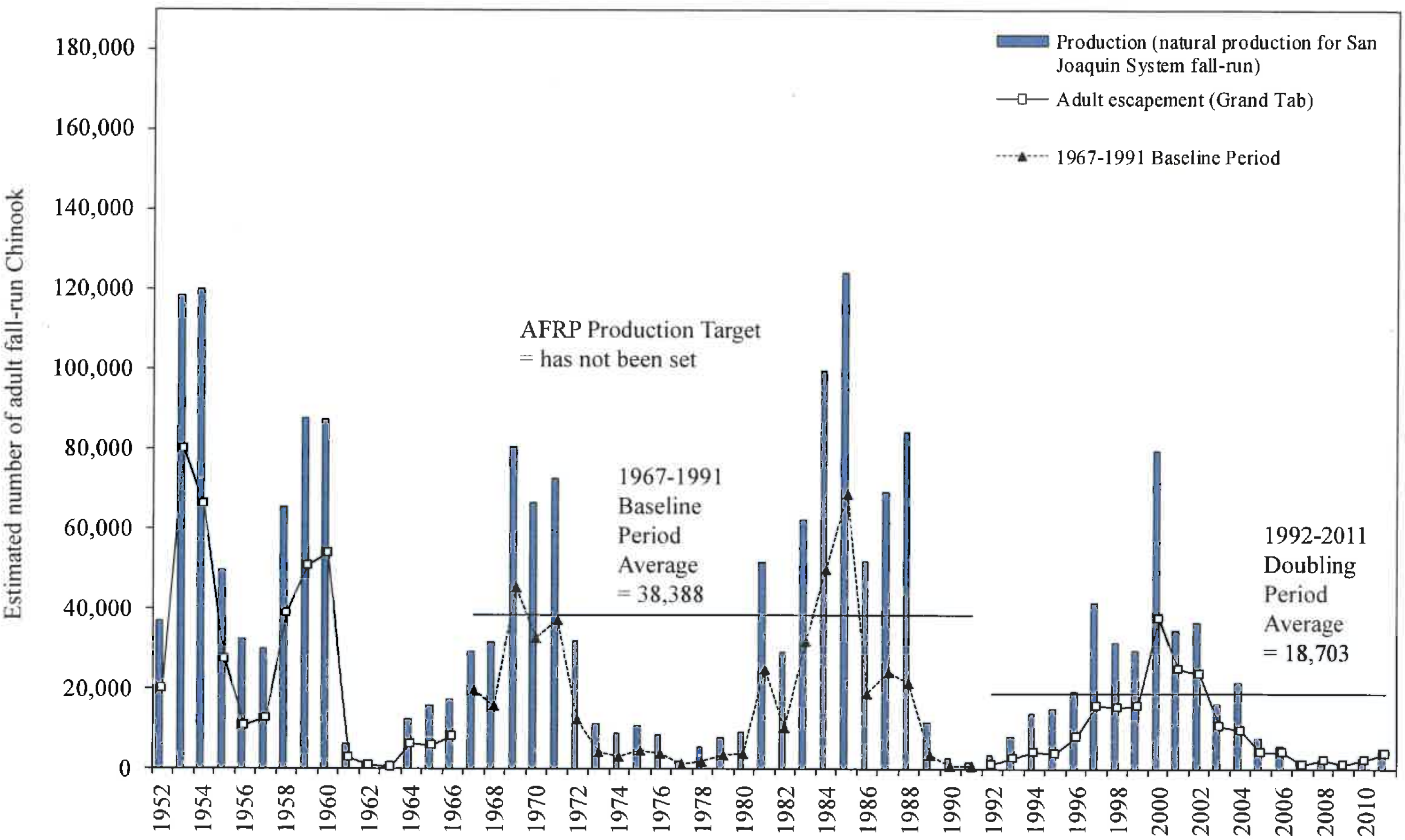

Figure 35. Estimated yearly natural production, and in river escapements of San Joaquin System adult fall-run Chinook salmon. The San Joaquin System is the sum of the Stanislaus, Tuolumne, and Merced Rivers. 1952 - 1966, and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

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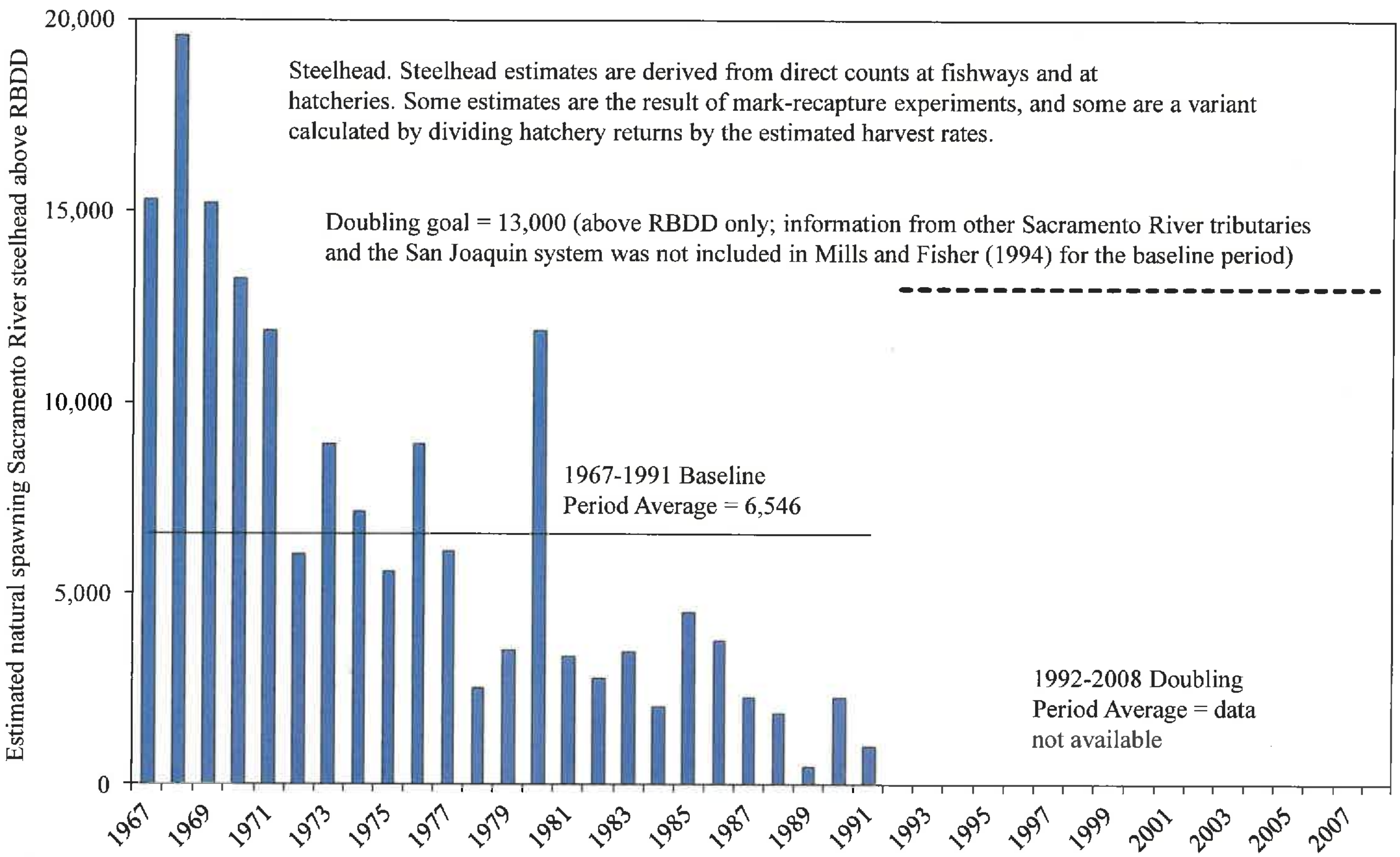

Figure 36. Estimated yearly number of natural spawning of steelhead on the Sacramento River, upstream of the RBDD (Mills and Fisher, 1994). Data for 1992-2008 is from CDFG, Red Bluff. 2008 sampling was curtailed in June due to high water temperatures.