10(a)1(A), ENHANCEMENT OF SPECIES PERMIT APPLICATION

for the

Reintroduction of Central Valley Spring-Run Chinook Salmon into the San Joaquin River

Submitted by the U.S. Fish and Wildlife Service

In Cooperation with:
National Marine Fisheries Service
U.S. Bureau of Reclamation
California Department of Fish and Game

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Contents

APPLICATION PURPOSE

This §*10(a)1(A), Enhancement of Species Permit Application for the Re-Introduction of Central Valley Spring-Run Chinook Salmon into the San Joaquin River* (application) proposes specific criteria, guidelines, and measures that the U.S. Fish and Wildlife Service (Service), and their sub-grantees will follow during the implementation of the proposed action. Due to capacity restrictions of the on-line component of the application process (through the National Marine Fisheries Service's (NMFS) Authorization and Permits for Protected Species site) this application should be considered the Service's full application and the information included on the on-line site as summarized sections.

USE OF THE DOCUMENT

This document is intended to be used within the interagency process as set in the Program Management Plan (PMP). This document provides the overall framework underlying the implementation process to be facilitated through the Fish Management Working Group (FMWG) and (ultimately to the permitting agencies) via the San Joaquin River Restoration Program (SJRRP). Additionally, this document is intended to be used in its entirety; meaning that the individual sections and appendices are not intended to stand alone. Using the document as a whole, rather than in part, provides the reader with the appropriate perspective in which to assess this application. We endeavored to provide the maximum amount of protection to federally listed species required under NMFS regulatory mandates, while also providing the greatest amount of flexibility to the Service in order to most effectively meet the Conservation Program goals. Finally, we expect further technical discussion and a refinement of specific components presented within this application—both through the upcoming National Environmental Policy Act (NEPA) process, and as explicitly proposed within the prescriptions of an annual adaptive process for program collection and reporting activities.

BACKGROUND

The SJRRP is an effort whose charge is to execute a legal settlement from the lawsuit, NRDC et al. v. Kirk Rodgers et al. In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and California's Central Valley Project Friant Division contractors. After more than 18 years of litigation, the Settling Parties reached a Stipulation of Settlement Agreement (Settlement). The Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved on October 23, 2006. The Settlement establishes two primary goals:

- Restoration Goal – To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River (SJR) downstream of Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- Water Management Goal – To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

To achieve the Restoration Goal, the Settlement calls for a combination of channel and structural modifications along the SJR downstream of Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of Chinook salmon, *Oncorhynchus tshawytscha*. In response to the Settlement, the implementing agencies, consisting of the Service and Bureau of Reclamation (Reclamation), NMFS, California Department of Fish and Game (CDFG), and California Department of Water Resources (DWR) organized a Program Management Team (PMT) and associated Work Groups to begin work implementing the Settlement. For additional information related to the Implementing Agency approach, the reader is referred to the PMP, available on the SJRRP Website at www.restoresjr.net

Paragraph 14 of the Settlement indicates that the Restoration Goal shall include the reintroduction of spring-run and fall-run Chinook salmon to the SJR between Friant Dam and the confluence of the Merced River. In addition, Paragraph 14 of the Settlement requires the Service to submit an ESA §10(a)1(A) permit application to the NMFS for the reintroduction of spring-run Chinook salmon. The San Joaquin River Restoration Settlement Act (SJRRS Act; Public Law 111-11) indicates that spring-run Chinook salmon shall be reintroduced into the SJR pursuant to §10(j) of the Endangered Species Act (ESA), provided that the Secretary of Commerce "finds that a permit for the reintroduction of California Central Valley spring-run Chinook salmon may be issued pursuant to §10(a)1(A) of the Endangered Species Act." This document fulfills the Paragraph 14 Settlement requirement that the Service submit a §10(a)1(A) enhancement of species permit application.

The Settlement specified the roles and responsibilities for a Restoration Administrator (RA) who is supported by a Technical Advisory Committee. The SJRRP management structure integrates these resources to obtain timely input on technical issues related to the Restoration Goal.

Organization of the San Joaquin River Restoration Program

As detailed in the PMP, the implementing agencies have organized into multi-agency technical work groups, including the FMWG, the Environmental Compliance and Permitting Working Group (ECPWG), the Water Management Working Group, and the Engineering and Design Working Group. These groups are responsible for developing and completing the technical work required to meet the Settlement Goals.

The FMWG is comprised of technical representatives from the Service, Reclamation, NMFS, DWR, and CDFG. This group is responsible for planning and coordinating efforts to implement the sections in the Settlement related to meeting the Restoration Goal. A subgroup of this larger body is the Genetics and Hatchery Management Group, who were primarily responsible for the technical planning phases of the donor stock rearing (as reflected in the draft HGMP) and compiled the Stock Selection Strategy document (that covers the rearing and management of adult donor stock collection and/or their progeny). Finally, the Reintroduction Strategy document details the elements of reintroduction and the management of fish and their progeny in the mainstem of the SJR. These three elements: 1) collection, 2) rearing, and 3) release and reintroduction; broadly define the initial components of the Conservation Program as covered in this permit application. Elements related to the adaptive management are mentioned and related to these reintroduction activities as the global over-arching framework, but this larger effort is contained within the fish management planning process (see upcoming Fisheries Management Plan).

Interface with Founding Interagency Technical Documents

The FMWG (and subgroups) collaborated on development of the three foundational documents that comprise the initial technical framework for the current project description within this application. These documents include: the Stock Selection Strategy; the Hatchery and Genetics Management Plan (HGMP) for the SJR; and the Reintroduction Strategies document. Upon final drafting, the documents are submitted to the SJRRP PMT for approval and final release.

At the time of this application, all three documents remain in draft form. They are attached in their most current state as supporting technical documents (reflect some of the deliberation and planning that formed the founding technical framework for this application). However, we intend that the content of the application submitted here is to serve as the official project description and effects analysis. We acknowledge that some discrepancies may exist between draft documents and our application. We have attempted to capture and highlight all of these items, but ask that the permitting agency consider the information provided within this current application our project description.

For purposes of this permit, the project description remains true to the content of the draft Stock Selection Strategy (dated May 2010) with the exception of three additional donor stock collection techniques (early spring-run Chinook Salmon from other Central Valley tributaries, juveniles from the Delta Juvenile Fish Monitoring Program (DJFMP), and salvaged juveniles from Tracy Fish Collection Facility and John Skinner Fish Protection Facility (Delta pumps). These activities were added (and included discussion between the Service and the interagency technical groups) to supplement project collections, as described below, during periods when primary donor stock streams may not provide sufficient numbers for project activities. Further, there was insufficient time and resources to finalize this document for consistency through the established document review and release protocol established by the implementing agencies.

The draft HGMP, dated September 2010, is awaiting edits and approval by CDFG, and is expected to be available for PMT review and public release imminently. We anticipate one more expedited round of revisions to capture the framework and specific elements of the application herein. We are aware, for example, that the figures in Table 1.2 of this draft document have been superseded by Table 1 of the application herein.

The draft Reintroduction Strategies document, dated September 2010, is currently incomplete and will be finalized within the FMWG, and publicly released through the official interagency review channels as soon as practically possible.

Studies mentioned in the various source planning documents are important aspects of the overall adaptive management planning process within the FMP component of the SJRRP. These will include monitoring that is essential for reporting requirements and meeting performance measures of this permitted activity; but also includes research and further investigations necessary to improve the performance of underlying methodology, or assist in improving the efficacy of implementation within the overall adaptive management framework. It is important to recognize the segregation of these activities within the programmatic framework. The Service is not in a position to prescribe duties to our partner agencies before they are collectively vetted and approved within the larger programmatic process (via the PMT).

Unless specifically prioritized and defined in this context within the current drafts of these documents, we do not explicitly intend to include studies listed in the various technical documents as part of the project description. Beyond the data required to implement the donor stock collection planning process, and the monitoring and reporting necessary to ascertain programmatic performance during management of the conservation stock at the Conservation Facility or the experimental stock during and following reintroduction, we do not intend this application to include all aspects of additional research or restoration monitoring. These are part of the larger Programmatic operations and the adaptive management of the experimental stock of spring-run Chinook and their habitat in the restored mainstem SJR, and should be captured in the further evolution of the fisheries management planning process.

INTRODUCTION

The Service, in accordance with the Settlement, is proposing to reintroduce Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*) to the San Joaquin River (SJR) upstream of the mouth of the Merced River in the Central Valley of California (Merced, Madera, and Fresno counties). The reintroduction is entitled the San Joaquin River Salmon Conservation and Research Program (Conservation Program).

The Central Valley spring-run Chinook salmon is listed as threatened under the Federal Endangered Species Act (ESA) and is listed as threatened under the California ESA (CESA). The Evolutionarily Significant Unit (ESU) includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California, including the Feather River, as well as the Feather River Hatchery spring-run Chinook salmon program

(NOAA 2005). Critical habitat was established on September 2, 2005, and became effective on January 2, 2006 (NOAA 2005a). In accordance with the SJRRS Act the fish reintroduced under the SJRRP would be considered an experimental population under §10(j) of the ESA.

Goals of the Conservation Program

The Public Draft *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (NMFS 2009a) describes both long term and short term strategies to achieve recovery of these populations. As part of the recovery strategy, the Plan incorporates viability at ESU and population levels of existing stocks, prioritizes currently occupied and unoccupied watersheds for reintroductions.

The SJR from Friant Dam to the Merced River Confluence (the Restoration Area) is prioritized as a primary focus for recovery for spring-run Chinook salmon in the Southern Sierra Nevada Diversity Group (NMFS 2009a). While reintroduction of spring-run Chinook salmon into the Restoration Area will meet the Settlement as stated above, an additional, goal of the program is to ultimately contribute to the recovery of spring-run Chinook salmon viability in the Central Valley by addressing this recovery priority.

Through annual supplementation into the SJR, plus the returns from past years, the Conservation Program's target for the experimental population of spring-run Chinook salmon is a minimum annual return of 500 adults by 2019.

Project Overview

The overall objective is to collect and reintroduce multiple life stages of spring-run Chinook salmon to develop a naturally-reproducing, self-sustaining population of spring-run Chinook salmon in the SJR. The intent is to capture varied and desired genetic and phenotypic characteristics of the fish, and therefore increase the likelihood that the reintroduction of spring-run Chinook salmon to the SJR would be successful.

Another clear objective within the proposed action is that these collections not have an adverse impact on the population viability of the ESU and/or the populations within each potential source stream. Finally, the reintroduction and management activities in the restored SJR should not adversely affect the experimental population and their progeny within the mainstem SJR, as to be consistent with the experimental stock conservation status as defined by NMFS in upcoming §10j experimental population rule.

Following recommendations of the RA and technical deliberation within the FMWG, we are proposing multiple strategies to implement the reintroduction—meaning greater than one reintroduction method at a time would be implemented to maximize learning opportunities and the potential for success. Given the goal of the SJRRP to achieve a naturally-reproducing and self-sustaining spring-run Chinook salmon population in the Restoration Area, several options have been considered.

The first option is to allow natural re-colonization following the time course of habitat restoration. However, allowing only natural re-colonization of the SJR is problematic for spring-run Chinook salmon, given the lack of geographically proximal populations.

Another option is translocation—moving fish directly from one stream for immediate release into the SJR. However, it is probable that the numbers of donor fish needed to support in-river reintroductions (translocation) is too high to be currently supported by any or all of the potential donor populations. So, although minimizing hatchery influence is genetically a desirable strategy, the translocation option must take into account the reality of population-level impacts to the donor streams (in this case, to a listed species).

Another option is the use of propagation facilities (hatcheries). Propagation facilities can generally be classified as supplementation facilities or conservation facilities. Traditional supplementation facility models have a low likelihood of achieving the restoration goals without detrimental genetic impacts to the reintroduced population. Conservation facility models emphasize not only producing desired numbers of fish for release, but also reducing genetic and ecological impacts of release on wild fish (Flagg and Nash, 1999). A key element within this strategy is therefore minimizing reliance on hatchery-reared fish.

Based upon the evaluation of different options above, the Service proposes for this Application a multiple strategy approach–comprising reintroduction of cultured fish (conservation stock) at different lifestages originally collected from natural production donor stocks (also at various lifestages) to various SJR locations; and reintroduction of donor stock (also at various lifestages) directly from donor streams into the SJR Restoration Area.

Project Location

The SJR from Friant Dam near the town of Friant, California, to the confluence of the Merced River is considered the Restoration Area for the purposes of the SJRRP.

SJR conditions including riparian vegetation, geomorphology, and channel morphology are highly variable throughout the Restoration Area. The Restoration Area, is about 153 miles long, and includes an extensive flood control bypass system (bypass system). See Figure 1 for visual representation of the project area. The bypass system consists of a series of dams, bifurcation structures, flood channels, levees, and portions of the main river channel; and is managed to maintain flood-conveyance capacity. The basic features of the bypass system include: Fresno Slough, also known as James Bypass, the Chowchilla Bypass and Bifurcation Structure, the Eastside and Mariposa Bypasses.

Sections of the 153 mile area are dry most of the year except during periods of agricultural or flood flows. The Restoration Area has been significantly altered by changes in land and water use over the past century. Several structures such as the Chowchilla Bypass, Mendota Dam, Sack Dam, Eastside Bypass, and many smaller private structures may impede fish movements through the system until the restoration of the SJR is completed.

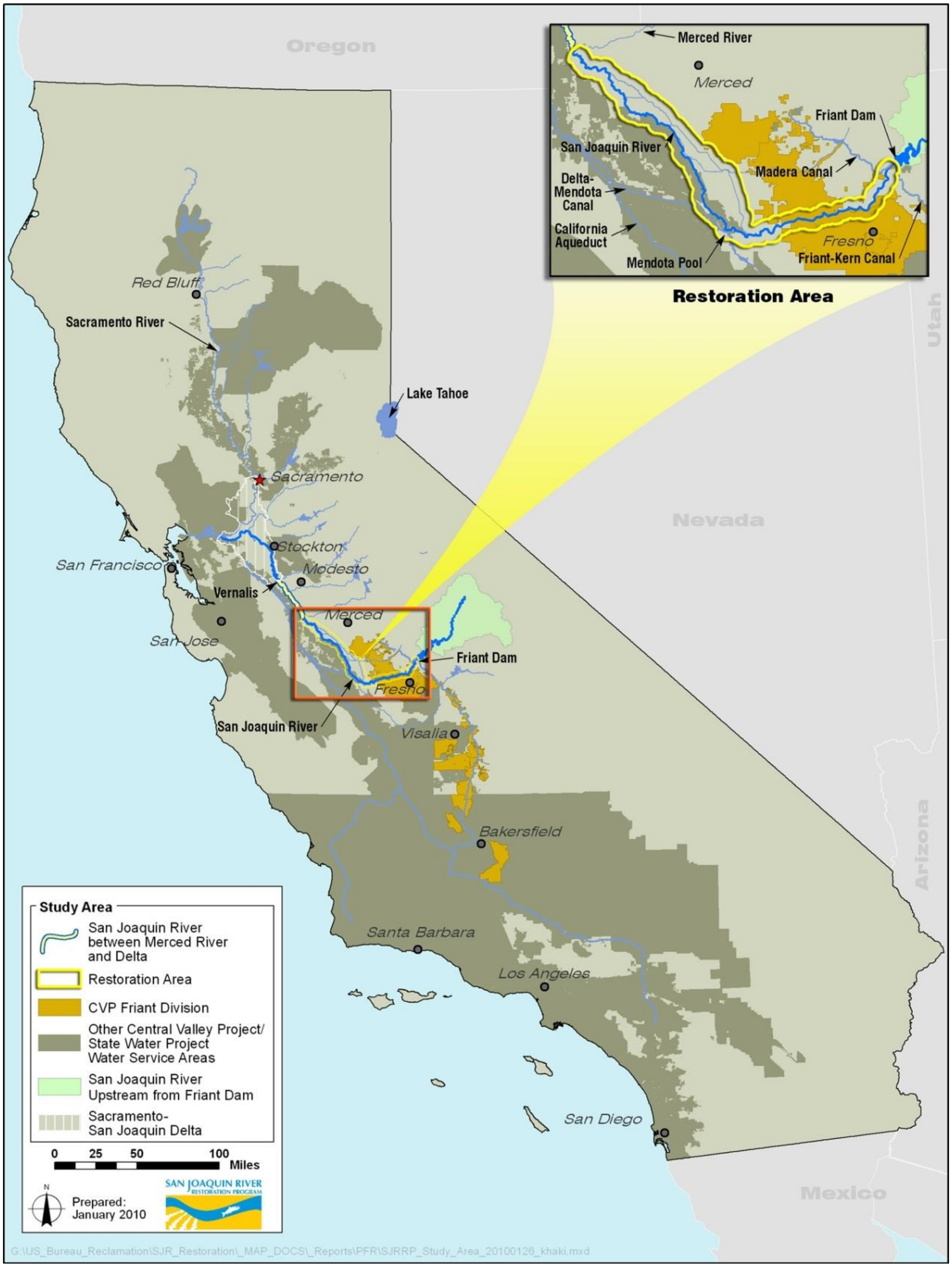


Figure 1. Project Location.

PROJECT DESCRIPTION

Through annual supplementation into the SJR, plus the returns from past years, the Conservation Program's target for the experimental population of spring-run Chinook salmon is a minimum annual return of 500 adults by 2019. Donor stock collection from three primary source populations (i.e. Feather River Hatchery (FRH; Yuba County), Butte Creek (Butte County), and the Deer/Mill Creek Complex (Tehama County) would begin as soon as April 30, 2012 (Figure 2).

This Application proposes to implement a multiple stock (multi-stock) donor selection strategy (where donor stock population conditions allow). The multi-stock approach includes incorporation of all *available* known Central Valley spring-run Chinook salmon stocks. The benefits associated with this multi-stock approach include: an increase in overall genetic diversity and reduction in inbreeding risk, and operational flexibility for collection opportunities.

In the event that circumstances indicate it is inadvisable to collect fish or eggs from the primary source populations, flexibility in donor stock collections will be required in order to reduce impacts to these primary source populations. In order to simultaneously maximize flexibility for opportunistic collections (and therefore program success), we are proposing to collect from all applicable life stages (i.e., eyed-eggs, juveniles and adults). Further, a suite of collection methods across life stages are proposed subject to permit approval and an adaptive process that includes assessment of current population conditions, habitat characteristics, fish distribution, and spawning phenology. This information, along with further data made available as knowledge from genetic studies, monitoring and method refinement (based in part as learning follows implementation of this study itself) will be critical to inform the specific details for future collections within refined stock selection strategies.

In order to facilitate reintroduction successfully into a river in the early phases of the project, it has been determined that on-site or off-site artificial propagation will likely be necessary to achieve restoration goals. The proposed conservation facility is based upon adaptive, multi-strategy concepts that are intended to support an eventual population with maximum genetic integrity that is functionally self-sustaining. In other words, the overall objective for this facility is focused on phasing out as soon as practicable.

First, a small-scale, interim facility is expected to begin operations fall 2010, (with fall-run Chinook salmon) to allow hatchery personnel to familiarize themselves with the rearing of juvenile Chinook in the new facilities. Introduction of spring-run would begin pending completion of this permitting process and, at the discretion of the permitting agency, may be based upon the successful completion of these initial fall-run trials.

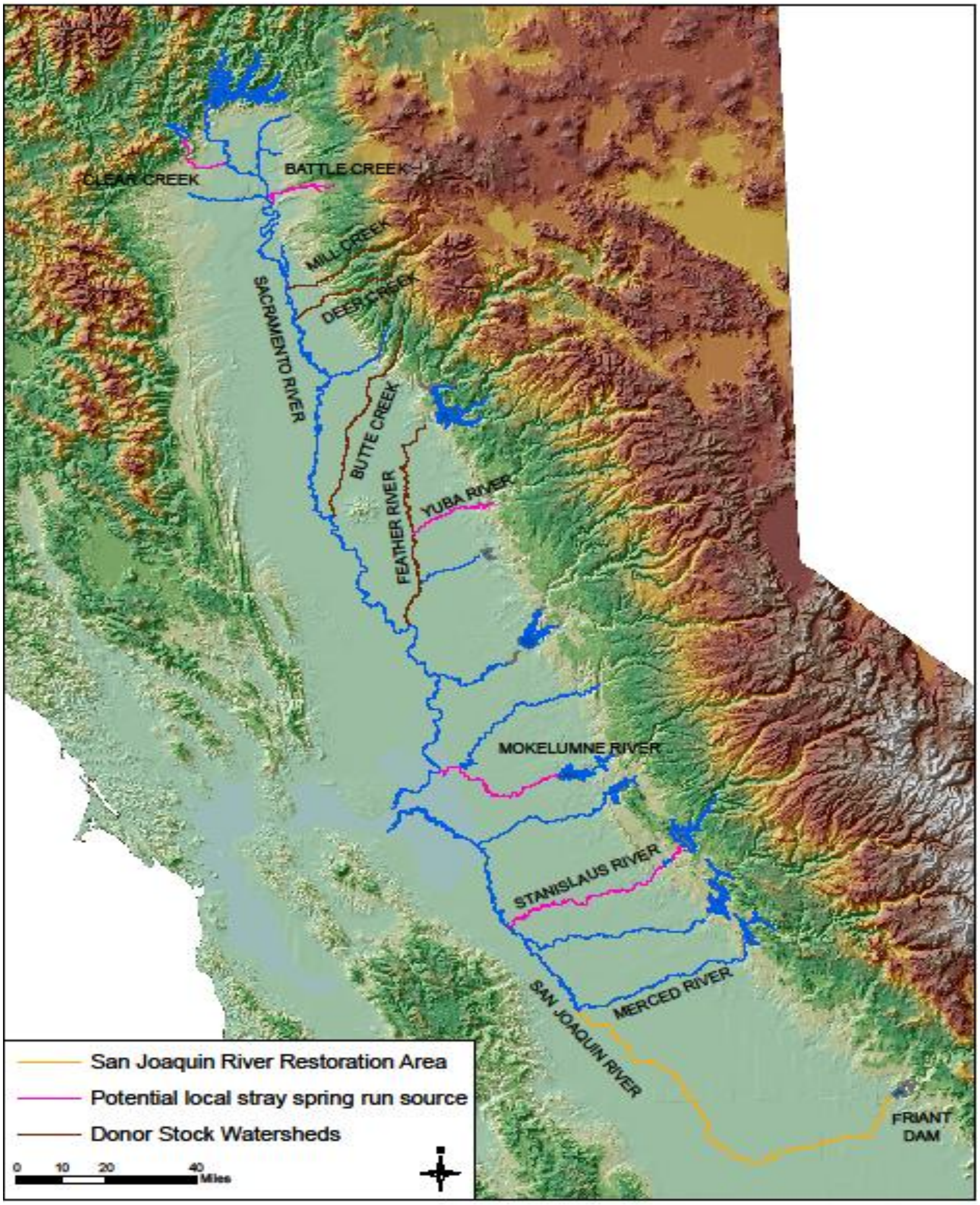


Figure 2. Donor Stock Watersheds.

Some rearing of eggs, fry, juveniles and smolts would occur at the interim facility located on the grounds of the CDFG San Joaquin Fish Hatchery (SJFH) until 2014, when the construction of the permanent Conservation Facility is expected to be completed on the SJFH property. Individuals may be brought into either facility relatively briefly and released; while others would be reared to adulthood. These adults would either be spawned upon reaching sexual maturity after 2-5 years, or be released to the river to spawn naturally.

The full scale Conservation Facility would be located along the SJR adjacent to the SJFH in Friant, California about 20 miles northeast of Fresno (Fresno County) and one mile downstream of Friant Dam. Salmon resulting from eggs and juveniles planted directly into the SJR should begin returning as adults in 2015. Likewise, initial Conservation Facility broodstock should reach adulthood by 2015. The adult offspring of these fish would be expected to return to the SJR and the Conservation Facility in 2019.

Donor stock would be gathered primarily as eggs or juveniles, in order to minimize the effects on the source populations while allowing for collection of enough fish to establish successful broodstock. Eggs and juveniles would be stocked directly in the SJR or reared at the interim facility located adjacent to the SJFH or a new conservation hatchery (i.e., the San Joaquin River Salmon Conservation and Research Facility [Conservation Facility]).

The capture of adults would be considered when conditions exist indicating that this activity is prudent and will not negatively affect the primary source populations. This is suggested by population viability criteria, for which a suggested approach is provided to the permitting agency in Appendix A.

Natural conditions may contribute to possible "rescue" events, where adults may also be targeted for collection. Examples of such conditions include: when adult migration is blocked by passage barriers (physical and non-physical); numbers of holding adults are too high for available holding habitat and/or spawning habitat; or when temperature conditions are prone to promote disease outbreaks. In these instances, it may be determined advantageous to "rescue" some of these adult fish, and it is assumed the costs to the population are negligible, or in some cases project activities may actually benefit the source population.

Should the collection of adults from primary source populations not be advisable, the Conservation Program would consider collecting early spring-running Chinook adults from other Central Valley streams and rivers in order to continue progress toward meeting the Restoration Goal. If evaluation of real time circumstances indicate that taking spring-running fish would not result in negative impacts to spring-run populations, these fish may be collected for use in the Conservation Program.

In the event that neither primary source populations nor spring-running fish are available to meet the needs of the Conservation Program, juvenile salmon captured in the Interagency Ecological Program (IEP) Delta Juvenile Fish Monitoring Program trawls or salvaged at the State and Federal Water Projects would be considered for collection. In both of these scenarios, evaluations would be performed to determine the original source of the fish and the appropriate ways to incorporate them into the Conservation Program. In all cases, the donor stock collection planning and implementation will be driven by interagency collaboration and based on real time information including: population status, Conservation Program status, geographic location, life stage(s) present, potential collection methods, run identification, and other pertinent information.

The Conservation Facility realistically may only expect limited transfers from any Central Valley spring-run Chinook salmon population, and will therefore initially depend on artificial propagation via a broodstock (by captive rearing) to attain sufficient fish numbers for reintroduction.

The proposed activities and methods are detailed further in Figure 3.

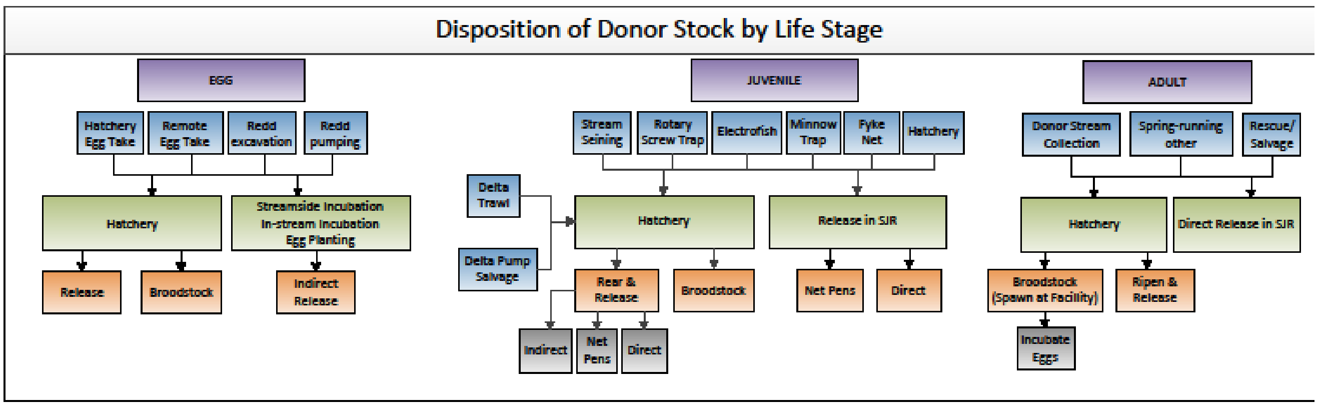


Figure 3. Life stage, collection methods and reintroduction pathways for donor stock.

Donor Stock Collection

The Conservation Program's target for the experimental population of spring-run Chinook salmon is a minimum annual return of 500 naturally-reproducing and self-sustaining adults by 2019. As discussed above, the Program is proposing a multi-strategy approach that incorporates both supplementation by a Conservation Facility (i.e., hatchery) and direct reintroductions (translocation), as donor stock is available.

To meet the goal, it is anticipated that 80 percent (400 of the 500 adult returns) will be supported through annual supplementation into the SJR from the Conservation Facility (or interim Facility in years 1-3; 2012-2014). The remaining 20 percent (100 of the 500 adult returns) would be provided via direct releases of eggs and juveniles from donor stock streams. Specifically, these include Butte, Deer and Mill Creeks and the Feather River Hatchery Facility as our primary source streams, though these collections will also be augmented opportunistically from other Central Valley tributaries. See Table 1 for the collection goals as outlined by collection sources, targeted life stages and methods of introduction. The number of years and/or seasons that collecting would occur is dependent on the propagation needs and available supply of donor stock, however we propose to begin collections April 30, 2012 and to continue through December 31, 2019.

In the short-term (Years 1-3), the goal would be to collect sufficient numbers of broodstock to provide a maximum of 100 unrelated gravid adult females and an equal number of fertile males for the Interim Facility. These 200 fish, produced from eggs and juveniles collected from donor streams, would be the first broodstock reared in the Interim Facility, and their offspring would be released to the SJR in sufficient numbers to support a return of 400 adults in following years.

Assuming the survival rates and enhanced rearing conditions in the Facility, it is anticipated that only 600 eggs or juveniles would be needed to produce 200 adults. In the long-term (Years 4-8; 2015-2019), based on the anticipated availability of the full Conservation Facility, the goal would be to propagate sufficient numbers of broodstock to provide 450 unrelated gravid adult females (and an equal number of fertile males) from each donor population, per year, for a minimum of 4 to 8 years.

Since the permanent Conservation Facility can accommodate a broodstock size of 900 (whereas the Interim Facility could house fewer adults), a greater number of donor stock could be collected and reared to adulthood. It is anticipated that annual collection of 2,700 eggs or juveniles would be adequate to produce 900 adults, whose progeny could be released to the SJR in sufficient numbers to meet or exceed the goal of 400 adult returns from supplementation (see 80 percent criterion above).

To meet the goal of the remaining 20 percent (100 of the 500 adult returns) through translocation and direct release, a greater number of eggs and juveniles would be needed from the donor sources (Butte, Deer and Mill creeks and the FRH), as survival rates are lower for naturally-reared fish than for those reared in an propagation facility.

Annual maximum potential collections for which the Service is seeking permission within a future §10j rule, by creek and lifestage, are reported in Table 1. Also listed are donor stock disposition (i.e., project activity or individual fate) and phasing within the programmatic timeline.

Derivation of the Donor Stock Numbers (in Table 1)

The survival rates of eggs to the fry stage for fall-run in the lower Tuolumne River have been estimated at 40 percent (EA 1992) when water temperatures are suitable for adult migration (<18ºC) and egg incubation (<13ºC). The survival rates for fry to the parr-smolt stage and parr-smolt stage to adult stage were calculated using USFWS AFRP data reports (USFWS AFRP 1996-2009) and analyzed by Alan Hubbard (UC Berkeley, Division of Biostatistics) and Carl Mesick (USFWS). The estimated mean percentage of fry that survive to the parr-smolt stage (≥56 mm FL) and migrate is about 5 percent, as suggested from rotary screw trap (RST) data on the Stanislaus River during dry and normal year spring flow releases (not flood control releases).

However, the estimate of 5 percent does not factor in the mortality of fry that may occur before the upstream RST, thus a range of 3-5 percent for the survival rate of fry to parr-smolt stage may be more suitable (C. Mesick, pers. comm. USFWS. 9/15/2010). Of these parr-smolt stage fish ($\geq$56 mm FL) that migrated from the Stanislaus River and returned to spawn, it has been estimated that escapement values are around 3.6 percent. However, the true estimate could be as low as 2.5 percent because of uncertainty in the estimated number of natural spawners (versus strays) in the Stanislaus River, thus a range of 2.5-3.6 percent would be appropriate (C. Mesick, pers. comm. USFWS. 9/15/2010). Although falling slightly beyond this range, Petrosky et al. (2001) calculated 1-5 percent for the transition from smolt to adult on the Snake River. However, the estimates for the Stanislaus River are probably more similar to the conditions and survival rates anticipated in the SJR.

Table 1. Anticipated assemblage to meet genetic and Conservation Program goals

Collection Source	Targeted Life Stage	Activity	Total Collection	Years
Butte, Deer and Mill creeks and Feather River Hatchery	Eggs or Juveniles	Conservation Facility	600	1-3
Butte, Deer and Mill creeks and Feather River Hatchery	Eggs or Juveniles	Conservation Facility	2,700	4-8
Butte, Deer and Mill creeks and Feather River Hatchery	Eggs, fry, or parr-smolts	Translocation to SJR	250,000[a] eggs, 100,000[b] fry or 4,000[c] parr-smolts	1-8
Butte, Deer and Mill creeks and Feather River Hatchery	Adults	Translocation to SJR	75 pairs	1-8
Other Central Valley Rivers	Adult Spring-running others	Translocation to SJR	opportunistic	1-8
All Central Valley Rivers	Adults	Remote site-egg take	50 pairs	1-8
Delta collection (trawls and salvage)	Juveniles	Conservation Facility	600	1-8

[a]Assumes a 40% survival rate from egg-to-fry, 4% from fry-to-smolt, and 2.5% from smolt-to-adult to produce 100 returning adults.
[b]Assumes a 4% survival rate from fry-to-smolt, and 2.5% from smolt-to-adult to produce 100 returning adults.
[c]Assumes a 2.5% survival rate from smolt-to-adult to produce 100 returning adults.

Based on the survival rates detailed above (i.e. calculated survival rates of egg-to-fry of 40 percent, fry-to-smolt of 4 percent, and smolt-to-returning adult of 2.5 percent) the number of eggs required to produce about 50 returning pairs (100 adults, assuming a 50 percent sex ratio) would be approximately 250,000 eggs in total. The number of fry required to produce the same number of adults would be approximately 100,000, while it would require 4,000 to produce the same number of smolts.

Through the propagation activities at the Conservation Facility, along with the direct releases via translocation, the Conservation Program goals should be achieved. However, additional sources for donor stock may be needed when circumstances indicate it is inadvisable to collect fish or eggs from the primary source populations. Flexibility in donor stock collections is required in order to reduce the effect to these primary source populations while still allowing the Program to meet its reintroduction objectives. Therefore, collections of juveniles and adults from additional sources are also proposed.

If adult spring-run returns are high in the primary donor streams (see *Appendix A* for an example of such calculations), there may be an opportunity to collect individuals for direct transplant into the SJR. These numbers would be limited to 150 adults. Secondly, if adult spring-running fish are counted in the weirs or hatchery facilities from other Central Valley streams, or future rescue events occur, these individuals could also be collected for direct release in the San Joaquin River. A key attribute of these non-primary donor stock sources is that collection would occur opportunistically. If available (i.e., if populations support collection), adults from any Central Valley stream may be collected and used for egg-take rather than direct release. These would be used to supplement the artificial propagation facility, but would be limited to 50 pairs. Lastly, if juvenile collection goals from the donor streams are not met, fish obtained by Delta trawling (through IEP Delta Juvenile Monitoring Program) or salvage of individuals from the Delta pump facilities may provide an additional source of donor stock (up to 600 individuals to supplement the interim Facility).

The figures in Table 1 are explicitly additive by donor group, such that the final collection figures (for each source grouping as they appear in the table) will never be exceeded Program-wide. For example, no greater than 600 eggs and/or juveniles will be collected from Butte Creek, Deer/Mill Creek Complex, and FRH (all combined) for the Conservation Facility. These collections will be conducted opportunistically, but under the larger guiding framework of a prioritization scheme that is outlined below.

Collection Method Prioritization

No specific decision on which life stage will be most preferred for collection can be made without annual review (incorporating considerations of donor population abundance, impact to donor stock individuals, captive facility status and needs, as well as the current relative value of each source and lifestage in meeting Program goals at the time of donor stock selection). However, for purposes of framing the application and the rationale that will be generally applied during the preparation of annual Donor Stock Collection Plans, the collection methods available within each life stage have been ranked according to the following conceptual framework.

We consider the following factors: physical availability of donor stock; ease of capture method and its associated impact to individuals (stress, injury, survival); benefits to the Conservation Program (numbers attainable, survivability, usefulness to captive rearing program); and potential impacts to donor populations. Effects to the donor populations are assessed based on: induced stress to non-targets, negative effects from habitat disturbance, absolute numbers taken from the donor populations, and the genetic implications for each method utilized (e.g., relatedness of captured individuals, operation of desired selection pressures on conservation and experimental stock, and retention of unique genetic qualities within the donor population).

A variety of collection methods and life stages would be used to ensure a diverse age structure and genetic stock to facilitate success. These are listed below and generally priority-ranked in Tables 2 and 3.

- Egg collection through redd excavation and/or redd pumping in Butte, Deer and Mill creeks;
- Egg and juvenile collections from FRH;
- Juvenile collection through stream seining or use of RSTs in Butte, Deer and Mill creeks, although electrofishing, minnow traps, or fyke nets may be used when appropriate;
- Utilization of the existing Delta Juvenile Fish Monitoring Program in the Sacramento-San Joaquin Delta to collect spring-run Chinook smolts;
- Adult collection from the Feather River at the FRH facility;
- Remote site egg-collection from adults captured in Butte, Deer, and Mill creeks;
- Adult collection for direct transfer into the SJR from Butte, Deer and Mill creeks; and,
- Collection of early-running adult spring-run Chinook salmon in other Central Valley rivers and streams (e.g., Stanislaus, Mokelumne or Yuba rivers or Battle or Clear creeks) for remote site egg collection or direct transfer into the SJR.

Table 2. Prioritization of Collection Methods for Spring Run Donor Stocks

Collection Method*	Collection Period	Priority	Priority Justification
Adults			
Hatchery	fall	high	fish available, can be selective
Traps in ladders and weirs	spring/summer	med/high	less handling stress than netting methods, stress from prolonged holding (can be reduced by releasing to hold/spawn naturally in SJR)
Seining (for in-river adults)	spring (holding) fall(spawning)	med	handling stress to targets, stress to non-targets, transport stress to SJR
Tangle nets (for in-river adults)	spring (holding) fall(spawning)	med	handling stress to targets, stress to non-targets, transport stress to SJR
Juveniles			
Rotary Screw Traps	year round	high	fish already subject to handling and available, collecting fry would minimize impacts to the population compared to smolts and yearling collections
Seining	year round	med/high	requires additional sampling/effective method, may cause abrasion
Hatchery	year round	med	fish already subject to handling and available
Minnow/fyke traps	year round	med	labor intensive, relatively low catch rate, additional sampling required
Electrofishing	year round	med/low	effective method in habitats not accessible by traps or nets, but concern over physical impact/survival
Salvage at the Federal and State Pumping Plants	year round	low	opportunistic only, considered high survival to this point
Delta Juvenile Fish Monitoring Program	year round	low	opportunistic only, take permits for DJFMP in place, high survival to this point
Eggs			
Hatchery egg takes	fall	high	can use multiple adults easily, readily available, low risk
In River Egg Collections (redd pumping/extraction)	fall	med/high	can collect multiple unrelated gametes by contacting multiple redds spatially and temporally, high survival of eggs extracted
Adult egg takes in the wild – active spawners	fall	med	need multiple adults, difficult to capture, potential for egg loss, stress to non-target spawner
Adult egg takes in the wild – from holding pools	spring	low	need multiple adults, extended holding period on site is risky (stress, vandalism, disease),stress non-targets, capture methods are high stress

* The determination of appropriate combination of life stages for collection will be based on annual review by an interagency team and includes considerations of population abundance of donor stocks, and captive facility needs.

Adults

Collection of adults from hatchery stocks ranks as a high priority due to ease of collection, and because fish can be selectively chosen to reduce relatedness (thereby reduce inbreeding depression risks). This action would occur in the fall as ripe (marked) adults enter hatcheries for spawning.

Adult collections from ladders and weirs rank as a medium/high priority. Ideally, collection of these adults would occur in the spring (when they first enter fresh water) rather than the fall. This is because females would be less likely to drop their (unripe) eggs, and early collection would be less stressful on the adults. This collection method is also preferred because there is less risk of injury during capture, since ladders and weir traps are typically of a bar-grate construction, and facilitate the use of purse cradles to transfer fish to holding tanks. While there is an increased risk of holding stress with green (unripe) fish, this factor can be reduced by transferring these fish directly into the SJR to encourage natural spawning.

Both netting methods for adult capture (seining and tangle nets) are given medium priority. While these are still very effective methods for capturing adults, there is a considerable amount of capture stress—which could lead to increased mortality, injury, abrasion, or premature egg release. Additionally, there is risk of stress to non-target individuals from disturbance in the holding pools during collection activities.

Juveniles

There are many juvenile collection methods anticipated for use. Collection at RSTs is preferred because of: high capture efficiency, low mortality risk, and ease of availability due to sourcing them from ongoing monitoring projects. Collection of fry using this method (rather than smolts or yearlings) would have less impact on the population due to low natural survival rates at the earlier life stages. Seining has a medium/high priority—although, like rotary screw trapping, it is an effective capture method, it involves a higher risk of injury and requires greater sampling effort and resources. Collection of juveniles in the hatchery is a medium priority—while these fish are readily available and already subject to handling, they are also subject to hatchery selection pressure, leading to reduced fitness.

Minnow and fyke traps are less likely to be used because they are labor intensive and often have low capture efficiency. Similarly, electro-fishing is not a highly recommended sampling method because, although it may be effective in swift water and other difficult to sample habitats, there is a significant risk of injury. Furthermore, electro-fishing is not species-specific and may harm non-targeted individuals. Collections from salvage operations and through the DJFMP are considered lower priorities since: they are not a consistent source of fish, they cannot provide large numbers of juveniles, and because the captured fish have survived to an advanced life stage and their collection may contribute towards a greater net population level effect. Additionally, their origins are unknown at the time of capture, and genetic testing would be required before it would be known what specific contribution to the broodstock they represent.

Eggs

Hatchery egg collections rank high due to their availability, and because selective sorting can be used to reduce relatedness and thus reduce outbreeding depression. In-river egg collections from redd pumping and redd extraction is considered a medium/high priority because: sampling multiple redds can ensure a low level of relatedness, spatial and temporal diversity could be obtained, and egg survival using these methods is expected to be high (Berijikian et al. Draft, Collins et al. 2000).

Egg collections using egg take from ripe (spawning) adults are of medium priority because it requires the collection of multiple adults to get unrelated gametes and there is potential for egg loss in the process (ripe females releasing eggs due to stress and handling). There is also risk of stress to non-target individuals during sampling activities.

The lowest priority is the collection of eggs from holding (unripe) adults. This method ranks low because adults would be captured early and then held until ripe. This extended holding period can lead to high mortality rates from stress and disease.

Site Specific Donor Stock Selection by Lifestage

Site specific conditions in each watershed, and of each donor stock, will play a key role in the annual determination of the appropriate life stage to collect. These factors are summarized in Table 3, and described in more detail below.

Table 3. Prioritization of Life Stages for Collection by Locality

Locality*	Season	Priority	Priority Justification
Butte Creek			
Adult	spring/fall	med	availability (salvage or rescue fish or high escapements)
Juvenile	year round	med	can use existing sampling to collect only spring-run from upper watershed
Egg	fall	high	least selection on gametes before transfer to SJ (allows selection to take place on SJ)
Feather River			
Adult	spring/fall	med	readily available, higher fecundity than captive broodstock, some transport stress
Juvenile	year round (hatchery only)	low	too much overlap of fall/spring run in river, only hatchery fish available
Egg	fall	high	readily available, can control/select relatedness, can collect at least vulnerable stage
Deer/Mill Creeks			
Adult	spring/fall	low	impact to donor populations too high
Juvenile	year round	high	current sampling can be used to attain fish, can collect across temporal range of population
Egg	fall	high	least impact to the source population, can collect lower number for captive rearing
Spring Running Other			
Adult	spring/fall	high	these adults contribute little to watershed specific populations, accessible
Juvenile	year round	low	typically not differentiated from local fall run stocks
Egg	fall	med/low	need hatchery practices to utilize this life stage (in river eggs typically mixed with fall run)

* The determination of appropriate combination of localities for collection will be based on annual review by an interagency team and include considerations of population abundance of donor stocks, and captive facility needs (see Donor Stock Annual Decision Process, below).

In some years, Butte Creek is habitat limited for adult spawning of spring run fish, and additionally a temperature barrier exists during certain flow conditions for some adults—precluding some returning fish from spawning successfully. For this reason, adult collection ("rescue") in Butte Creek has a medium priority. Excess fish could be captured and transferred directly to the SJR. The risk to the donor stock is minimal, as many of these fish would either not spawn successfully in Butte Creek, or would likely experience high egg mortality due to superimposition.

Juvenile collections are also ranked as medium because this life stage could be collected using currently ongoing monitoring, and spring-run could be selectively targeted in the upper watershed (beyond fall-run influence). Egg collections are considered the highest priority for Butte Creek conditions since collection at the egg stage would mean that the least amount of selection pressure would occur in Butte Creek, and fish from those eggs will be subject to SJR selection pressure for a longer period—therefore giving progeny a higher net fitness for the experimental population.

For the Feather River stock, eggs again are ranked high priority due to the issues of selection pressure. Additionally, they are readily available through the hatchery program at FRH and adults could be selectively paired to produce a high level of unrelatedness. Adults are a medium priority from FRH because they are readily available, and will more than likely be more fecund than fish produced at the Conservation Facility—although adult relocation to the SJR does provide some risk of transport losses. Currently, juvenile collections on the Feather River could only involve hatchery fish, due to the complete spatial overlap of spring and fall run on the river itself. Therefore, this option is considered a low priority due to the hatchery selection pressures that will have occurred on these fish. This situation could be ameliorated with the construction of separation weirs.

In the Deer/Mill Creek complex, adult collections are the lowest priority due to the current population status of these fish and the large numbers of gametes that would be removed from the population(s). Both juvenile and egg life stages are considered high priority. Juveniles because: current sampling can be used to collect fish, fish can be collected through time to ensure unique genetics are retained in the restored population, and there are locations with good separation of fall and spring run juveniles in these watersheds. Removal of eggs provide the least amount of impact to the source population based on life stage survival estimates, and fewer eggs can be collected for captive rearing to produce the same number of juveniles for the Conservation Program.

For supplemental adult collection from other streams, we have different rankings, by stream source. For fish in the Yuba, Mokelumne, Stanislaus rivers, and perhaps certain other tributaries where a few strays may appear, the adults are a high priority because these fish are dispersers, and not contributing to their natal watershed population. They are the most readily available life stage in these streams, since many of the streams into which they stray are also fall-run streams with no spatial separation of the two runs. Strays to Battle Creek may contribute to self-sustaining populations because there is access to the upper watershed, where they are probably segregated from fall-run, so these adults are lower prioritized. The same may be true of Clear

Creek if a segregation weir is installed. We propose to treat those populations separately, and rank these a low priority.

Eggs from these "other Central Valley tributaries" fish are medium/low priority due to the need of existing hatchery facilities for egg collection, and the need for extended holding in pens while fish ripen for on-site egg takes. However, if you presume that these fish can be held offsite (such as at the Conservation Facility), then the priority ranking for adult "other Central Valley tributaries" fish may be ranked higher. Juveniles from these fish are low priority because in most, if not all, cases these fish are indistinguishable in the river environment from fall-run, and in the hatchery will have been subjected to more hatchery selection than eggs.

Specific Collection Locations

Donor stock collections in Butte, Deer and Mill creeks would occur in known spring-run Chinook salmon spawning areas, which are upstream (i.e., separate) from fall-run Chinook salmon spawning areas. These include the following: in Butte Creek, from Quartz Bowl (river mile (RM) 60.8) downstream to the Honey Run covered bridge (RM 50.5); in Deer Creek, from Upper Falls along Highway 32 (RM 42.2) downstream to the confluence of Rock Creek (RM 19.2); and in Mill Creek from the Highway 36 bridge crossing (RM 44.4) downstream to Pape Place (RM 20.4). Collection from the Feather River would occur at the Feather River Hatchery.

Additional collection locations would include the Stanislaus River fish counting weir located at RM 31.4; the Mokelumne River Hatchery located at the base of Comanche Dam (RM 63), the Yuba River at Daguerre Point Dam (RM 11.4), the fish ladder on Battle Creek, and Clear Creek upstream of the segregation weir. Collections may also occur at the Delta pumps (Tracy Fish Collection Facility and the John Skinner Fish Protection Facility) located in the south delta and in the IEP Delta Juvenile Fish Monitoring Program trawls in the Sacramento River at Sacramento (RM 55) and Chipps Island (RM 18).

Collection Timing

The timing of donor stream collection will vary based on the life history stage being targeted for collection (Figure 4). Adults arrive at donor streams from March through June, hold in deep pools, and then spawn August through October (with peak spawning occurring in September). Therefore, collection of adults for direct transplant into the SJR could occur March through October and eggs taken directly from adults and fertilized on-site (either in the FRH or at remote site egg-take) or eggs could be collected when adults are ripe and actively spawning (August-October).

Collection of eggs through redd extraction (i.e., redd excavation or redd pumping) would be delayed by 20-30 days from the date of spawning to target eggs in the "eyed" stage, thus occurring any time from September through November. Unlike adults, juveniles and smolts are expected to be present year-round and could be collected any time of the year.

Collection Methods by Lifestage

Eggs

Eggs are preferred for collection because the ability to target genetically diverse individuals and collect spatial and temporal diversity is high, while the risk to the donor population remains low. Furthermore, collection at this life stage provides greater survival to adulthood in a controlled environment when compared to rearing in the wild, thereby reducing population level impacts.

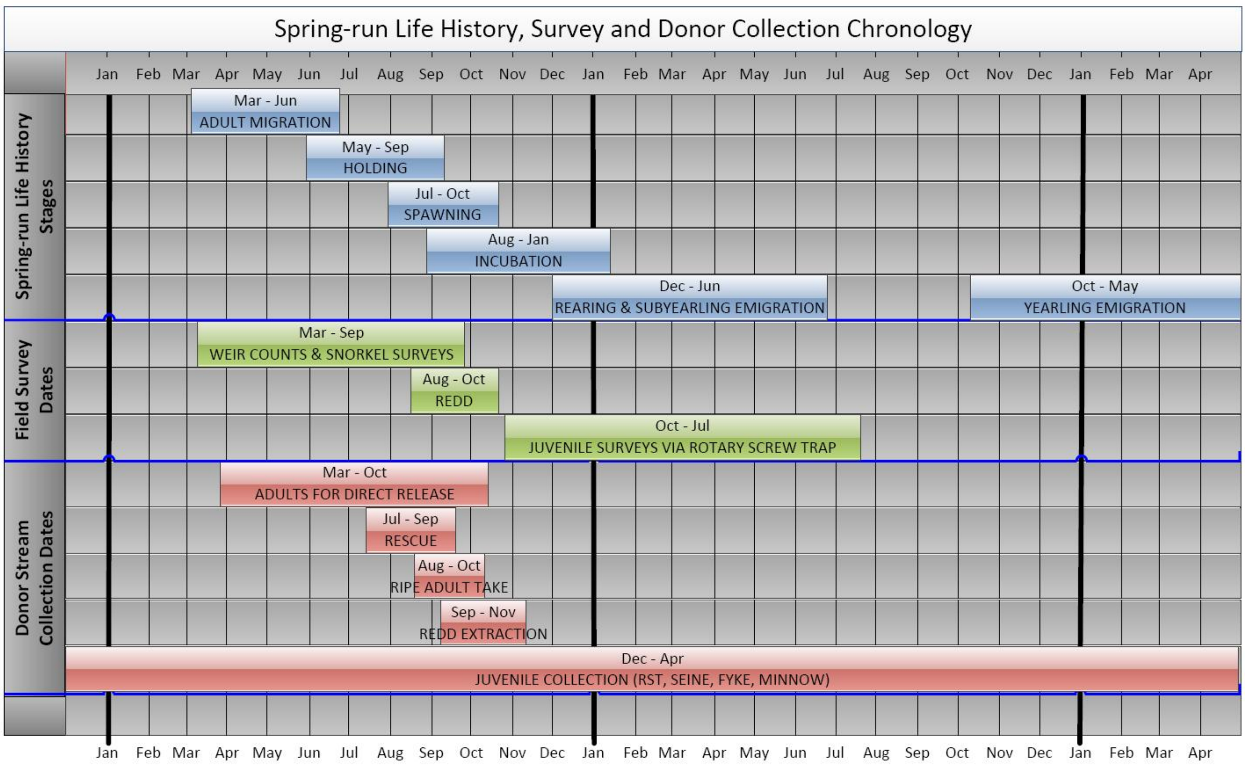


Figure 4. Life history of spring-run Chinook salmon and anticipated field survey dates and donor stream collections based on life stage.

Eggs would be obtained from the FRH (following adult collection), through excavation or pumping from redds in Butte, Deer and Mill creeks; or, in rare cases, through remote site egg-take from adults captured in Butte, Deer or Mill creeks.

Feather River Hatchery

The FRH offers a consistent source of eggs for the Conservation Program. Gametes would be taken from up to 50 males and 50 females during the normal hatchery spawning operation. The FRH Hatchery and Genetic Management Plan protocols (CDWR 2009) would be followed for the collection, fertilization and incubation of eggs at the FRH facility. After following the specific mating scheme outlined in the FRH HGMP (CDWR 2009), the eggs would be placed in incubation trays at the FRH, where they would remain until reaching the eyed stage (about 30 days). They would then either be relocated to the Conservation Facility for continued incubation (relocation) and rearing or translocated to the SJR for in-river incubation.

Redd Extraction

Redd extraction would involve the removal of individual eggs from redds, and would occur either through redd excavation or redd pumping on Butte, Deer and Mill creeks. Redds would be sampled at multiple locations within each reach and throughout the spawning season to provide spatial and temporal diversity. Ultimately, the total number of eggs collected would depend on redd availability, but the maximum number of redds from which eggs would be extracted would be limited to 10 percent of the total number of new redds counted during the weekly redd surveys.

Egg collection would be coordinated with redd surveys conducted by CDFG or the Anadromous Fish Restoration Program (AFRP) on Butte, Deer and Mill creeks. The surveys would be conducted by foot or kayak and would occur weekly for the duration of the spawning period (August-October). The redds would be marked and mapped following Gallagher et al. (2007). If the redd surveys do not occur often enough to provide adequate information, supplemental surveys could be conducted, but would target only spawning areas suitable for redd extraction activities (i.e., areas of shallower water and gentle velocities to facilitate obtaining eggs without loss).

The appropriate time of collection would be at the "eyed" stage of development. To identify embryos at this developmental stage, water temperatures would be monitored to estimate the Accumulated Temperature Units (ATUs) and used in conjunction with the timing of redd formation (from surveys) to estimate the onset of the eyed stage. The methods for redd excavation and redd pumping are described in detail below.

Redd Excavation

Redd excavation would consist of carefully hand-digging the tailspill of identified spring-run redds to obtain the live fertilized eggs. The eggs in the redds are expected to be covered by about 2 inches to 1.5 feet of spawning gravel (Evenson 2001), therefore gravel would be carefully removed from the tailspill until the appropriate depth is reached. The digging process would proceed slowly so that a clear view of the excavated area can be maintained. Snorkel gear would be used to get a clear underwater view of the excavated area (J. Hannon, USBR, and Pers. Comm. August 25, 2010). A fine mesh dipnet would be used to retrieve the eggs, where they would then be placed into a five gallon bucket of river water (maintained at or below the temperature of the river), and counted until the desired number of eggs is reached (≤50 eggs). Once the targeted number of eggs are removed from the redd, gravel would be carefully replaced and the pre-disturbance contour of the redd re-formed.

Redd Pumping

As described by Murdoch and Tonseth (2006), eggs would be collected from redds using a small portable backpack mounted water pump (Alaska Resource and Economic Development, Inc. (ARED), Wrangell, AK). An aluminum probe attached to the pump would be inserted into the redd gravels and pulsed (with an air-water mixture) to dislodge and eject the eggs from the gravel. An aluminum frame basket covered with 3.2 mm wire mesh and a 1.6 mm cloth net bag on the downstream side would collect the released eggs when placed over the portion of redd to be sampled. Each redd would be sampled carefully until the first egg was collected and the developmental stage verified (i.e., eyed-egg stage). Eyed-eggs would be removed from the collection net by hand or with a small dip net and placed into buckets. The eggs would be inventoried and buckets labeled with redd number and egg count. Buckets would then be placed in coolers on ice for transport to the Conservation Facility. Excess eggs would be re-injected into the redd using a hydraulic egg planter, or carefully returned to the redd by hand.

Remote Site Egg-T*ake*

Remote site egg-take involves the collection of spring-run adults from Butte, Deer and Mill creeks. Collection would only occur if other methods of reintroduction were determined to be insufficient to meet Conservation Program goals and would also require agreement among the Service, NMFS, and CDFG (including field staff familiar with the spring-run populations in the respective creeks). Adult collection would follow the tangle net protocols of Ashbrook et al. (2007).

A tangle net resembles a gill net in both design and deployment. Both consist of a float line and lead line, but the mesh size is smaller (2 inch diameter) in a tangle net, which prevents adults from becoming "gilled." Instead, adults (measuring 24 inches or more) swim into the net and become entangled, usually by catching a tooth or fin in the small mesh, and become further entangled as they try to escape.

A tangle net about 100 feet long by 6 feet high would be actively fished by either dragging the net through a holding pool (similar to seining) or passively fished by setting the net in the holding pool and corralling the adults into the net (using swimmers). The latter would be used when dragging the net is not feasible (e.g., when large snags or other obstructions are present in the pool). Sampling would ideally be conducted in water temperatures near 13 ºC, but would cease when temperatures exceed 16ºC.

Once adults become entangled, the individuals would be immediately removed, then placed in a large dipnet and examined for sex determination and ripeness. Sex would be determined based on body shape and size, and the presence of a kype (i.e., curved jaw) in males. Signs of ripeness would include the easy release of eggs or milt from the body. After examination, adults would be moved into a holding pen measuring 5 feet by 5 feet, constructed of plastic mesh (¼ inch) on a two by four frame and anchored in the holding pool. If a captured adult appears stressed (i.e., slow-moving and having difficulty maintaining an upright position), water would be run through its gills by moving back-and-forth in the water to increase gill oxygenation, until the condition of the fish improves.

Collection would occur until about 5 males and 5 females per holding pool are obtained. If more adults are captured, they would be released in the same holding pool but downstream from the immediate netting area, to minimize the likelihood of recapture. The adults retained for the Conservation Program would be placed in the holding pens until they become ripe. Once adults are ripe they would be spawned on-site using methods similar to those described for FRH, above. The collected eggs would be allowed to water harden for two hours and then be transported to the conservation facility for hatchery use or in-river planting.

An alternative method to capturing and holding pre-spawn adults would be to wait until they are ripe before capture. Females actively digging redds could be targeted for collection. This would reduce potential losses of fish in the holding pen while waiting for them to "ripen." This method would only be employed if the targeted female and associated male(s) were at least 50 feet away from other spawning fish to minimize the disturbance of the other fish. A seine may be used to capture the fish in this case if the redds are fairly shallow (i.e., in less than 3 feet of water).

Juveniles

Juvenile spring-run Chinook salmon would be primarily collected with stream seines and RST on Butte, Deer and Mill creeks; however, other methods that may be employed include: electrofishers, minnow traps, and fyke nets. If needed, juveniles may also be collected from the IEP Delta Juvenile Fish Monitoring Program trawls in the Sacramento-San Joaquin Delta, or from the Tracy Fish Collection Facility and John Skinner Fish Protection Facility (Delta pumps) located in the south delta, or juvenile hatchery production fish from the FRH may be collected.

When possible, collections of juvenile would occur in known spring-run Chinook salmon spawning areas that are upstream of the distribution of fall-run Chinook salmon, thus any juvenile salmon collected in these areas could be assumed to be a spring-run. However, the few exceptions would be collections at the existing CDFG RST sites in Butte, Deer and Mill creeks, the IEP Delta Juvenile Fish Monitoring Program's Kodiak and mid-water trawl sites in the Sacramento-San Joaquin Delta, and the salvage operations at the Delta pumps.

Processing

Once juveniles are collected (using the various methods described above), they would be placed in buckets outfitted with a battery-operated air bubbler to oxygenate the water. The water temperature would be continuously monitored and changed as needed. The processing of the juveniles would follow the protocols developed by the Service for the Comprehensive Assessment and Monitoring Program (CAMP; USFWS 2008). Juveniles to be processed would be placed into a bucket with anesthesia (MS-222 or Tricaine-S) in a dosage suitable to sedate the fish and minimize stress. The individuals would be removed from the bucket, examined for clips or marks that indicate they originated at a fish hatchery, classified by life stage (fry, parr, smolt or yearling) and measured. All tagging, marking and fin clipping for genetic analysis activities would occur only at the Conservation Facility and not in the field. After processing is completed, the anesthetized fish would be placed into a recovery bucket outfitted with an air bubbler, a small volume of PolyAqua, and allowed sufficient time to recover. Once they regain equilibrium, the processed juveniles would be placed into tanks for transport to the interim or Conservation Facility.

If the juveniles are captured in remote locations, they would be transported by backpack or by mule using fish pack cans (DFG, unpublished report 2003) to a vehicle transport staging location. The backpacks would be outfitted with battery-powered aerators. At the staging location, fish would be transferred to a 500-gallon transport tank and trailer. The tank would be filled with stream water immediately prior to transport using a portable, screened pump.

When necessary for isolating fish with particular phenotypic characteristics, individual groups of fish would be separated using small cages suspended within the transport tank. The transport water would be oxygenated using bottled oxygen with oxygen stones and impellor driven aerators. Dissolved oxygen levels would be monitored and maintained near saturation during transport. Transport water would be supplemented with sodium chloride to provide a physiologically isotonic concentration to minimize ionic disturbances. When possible, fish would be moved in and out of the transport truck using a water filled vessel (i.e., water to water transfer) and without netting to minimize stress and loss of slime.

Transport times would depend on the location but may be as long as 8 hours. Before transferring fish the water would be tempered to two degrees Celsius of the Conservation Facility, and prior to combining with fish at the Conservation Facility salmon would be quarantined for two weeks for appropriate prophylactic treatment and disease monitoring.

Seines

Stream seine nets hang vertically in the water and consist of a weighted line (lead line), float line and poles (brailles) on both ends that keep the net taut and open. The net is swept through pools and the fish are collected in the deep pocket in the center. Seines are most effective when used in relatively shallow water with few obstructions. Sites with irregular bottom topography, significant accumulations of debris or larger rocks, or dense stands of aquatic vegetation may not be suitable for seining due to net snagging or lifting. Seining has been recommended for collection of spring-run fish on Deer and Mill creeks by personnel with local expertise in collecting fish on these rivers (Colleen Harvey-Arrison, CDFG, Red Bluff, pers. Comm. April 28, 2010). Fish would be seined at multiple locations along each donor system to capture spatial diversity. The beach seining protocols of Hahn et al. (2007) would be used to collect juvenile salmon. The seines to be used would measure 30 to 300 feet in length with a mesh size of 1/8 to 3/8 inch and constructed of knotless-mesh nylon netting. Collection sites would be visually assessed to determine suitability for seining. The nets would be deployed by crews of two to eight people, depending on location, stream condition and stream contour.

Using brailles attached to each end of the net, the seine would be deployed by encircling fish and trapping them in the mesh pocket. The brailles would be angled and tensioned so that the lead line remains in front of the float line. Once the net is closed, the weighted bottom edge would be either pulled up on shore or lifted out of the water so that fish could be removed and transferred to buckets of water for processing. The various seine deployment strategies that may be used are described in Hahn et al. (2007). The particular method to be used will be determined by stream condition and contour. It is anticipated that the juvenile collections via seine would occur from January through July to avoid impacts to spawning adults and incubating eggs.

Rotary screw traps

A RST (E.G. Solutions®, Corvallis, OR) consists of a funnel-shaped cone that is screened with 3-millimeter diameter perforated plate and suspended above the water between floating pontoons. The cone rotates as water flows past the trap, guiding the fish moving downstream into a live box that is attached to the rear of the trap cone. Cone mouth diameter of the RSTs used on the donor creeks measure either 5 or 8 feet, depending on the channel width and water depth specific to each creek.

The RSTs would be installed at fixed locations and may continuously sample from October through July, although specific climatic events or flow regimes may preclude continuous trapping. Currently, juvenile spring-run Chinook salmon are being collected for abundance estimates using RSTs on Butte, Deer and Mill creeks as part of CDFG's fish monitoring program for the Central Valley. However, the downstream location of these RSTs may capture both fall- and spring-run Chinook salmon. Therefore, larger yearling spring-run fish from the CDFG RSTs would be targeted for The Conservation Program. Potentially, up to three additional RSTs would be installed in each creek as part of this project and operated in spring-run Chinook salmon spawning habitat upstream from where fall-run Chinook salmon would be found.

The RST protocols (USFWS 2008) would be used for the collection and processing of juvenile spring-run. The fish would be confined to the live box and checked at least twice per day. When water velocities or debris loads are relatively high, traps would be checked either every two hours or monitored continuously, depending on the stream conditions.

During each trap check, debris and fish inside the livebox would be retrieved using long-handled nets. Juveniles would be carefully separated from debris and piscivorous fish and placed in separate buckets of fresh water for processing as described above. After processing, juvenile spring-run Chinook salmon would be transported to the Conservation Facility; other fish would be released.

Electrofishing

Electrofishing transfers an electrical current through the water that stuns fish, causing them to lose equilibrium. This method of collection is widely used in stream, rivers, and lakes because of its high catch efficiency and versatility in different aquatic habitats. Electrofishing can be used in areas with hydrologic conditions that prevent other sampling methods and traps from being deployed. Backpack electrofishing gear is portable, so fish can be collected in areas that otherwise cannot be accessed by larger equipment.

Two backpack electrofishers and 30 sampling days per year would be used to collect juvenile salmonids in Butte, Deer and Mill creeks. Collections would occur from January through July to avoid impacts to spawning adults and incubating eggs. The protocol of Temple and Pearsons (2007) and NMFS (2000) Electrofishing Guidelines would be followed when collecting juveniles.

Prior to fish collection, water conductivity and temperature would be measured, and the backpack electrofisher would be adjusted to the conditions according to the manufacturer's recommendations to ensure capture effectiveness and prevent fish injury. Two or three people would work together on each electrofishing crew, with one operating the backpack electrofisher while the other(s) collect the stunned fish with dipnets. Electrofishing would be conducted in an upstream direction, with the netters positioned downstream from the electrofisher to facilitate fish capture. Stunned fish would quickly be removed from the water and placed in buckets of water for processing as described above.

Minnow traps

Minnow traps are small, torpedo-shaped cylinders (about 16 inches long with a 9-inch diameter) constructed of 1/4 galvanized steel mesh. They have 1-inch openings located at the apexes of inward-pointing cones at either end. Small fish are directed through the openings by the funnels and remain in the trap until removed. Minnow traps work well in a diversity of habitats that are difficult to access by boat, and are ideal for sampling in areas with high debris accumulations that make electrofishing and seining impractical. They can be deployed for varying amounts of time, up to 24 hours, but they generally have relatively low capture efficiency. The protocols outlined in Kane et al. (2000) would be followed.

Up to 20 minnow traps would be deployed in Butte, Deer and Mill creeks in suitable locations such as pools, glides, and eddies. They would have retrieval lines either tied off to a stationary object (e.g., a tree) or attached to a float. The traps would be baited with commercially available salmon eggs that are disinfected using a Betadyne solution of 1:100 for a minimum of 10 minutes. The minnow traps would be deployed from 30 minutes to 2 hours (depending on stream discharge, condition and water temperature), then slowly retrieved and examined for captured fish while partially submerged. Juvenile salmon would be carefully removed and placed in buckets of water for processing as described above; all other fish would be released.

Fyke nets

Fyke nets consist of cylindrical or cone-shaped netting bags mounted on steel rings or other rigid structures. They can have wings or leaders which guide the fish towards the entrance of the net.

These nets are fixed on the river bottom by anchors, ballast or stakes. When they are retrieved, fish are concentrated at the very end of the bag (cod end) which can be untied to remove the fish. Fyke nets have high catch efficiencies when deployed in deep water close to shore. As with minnow traps, this method could be useful for sampling juvenile spring-run Chinook salmon in headwater habitats on Deer and Mill creeks. Up to 60 sampling days may be required at each creek. Collections would occur from January through July and downstream of spawning habitat to avoid impacts to spawning adults and incubating eggs.

Protocols outlined in O'Neal (2007) would be followed. The fyke nets would be small and deployable by hand rather than by boat. The fyke nets would measure 3 feet in diameter, be covered with 1/4 inch delta mesh nylon netting stretched across a series of two rectangular steel frames and four steel hoops. Leaders and wings would measure about 25 feet long by 4 feet high. The nets would be set in shallow pools, less than 6 feet deep, and either set perpendicular to shore, or if 2 fyke nets are deployed together, parallel to shore (with the leads facing each other). Up to three fyke nets would be deployed in Butte, Deer and Mill creeks and allowed to soak for a maximum of 24 hours (if water temperatures are appropriate). The nets would be retrieved by hauling onto shore, with the cod end containing captured fish coming on shore last. The cod end of the net would be untied, and fish removed. Juvenile salmon would be placed in buckets of water for processing as described above; all other fish would be released.

Trawls

Trawls are net bags that are actively towed through the water by boat (in some cases, two boats). The mouth of a trawl is held open through the use of weighted "otter boards" which splay outward as the trawl is towed through the water. Fish enter the net through the mouth and are swept back to the rear of the net (cod end), which can be untied when the net is retrieved for fish removal. Juvenile spring-run Chinook salmon would be collected through the ongoing midwater and Kodiak trawl surveys that are conducted as part of the IEP Delta Juvenile Fish Monitoring Program.

Midwater trawl surveys are conducted in the Sacramento River at Sacramento (RM 55) to estimate the relative abundance and timing of Chinook salmon fry and smolts entering the Sacramento-San Joaquin Delta. Midwater trawling also occurs at Chipps Island (RM 18) to estimate the number of unmarked fish emigrating from the Delta and to recover marked smolts released in mark and recapture survival experiments. The midwater trawl used at Sacramento has a mouth opening that measures 6 by 15 feet, with a cod end mesh size of 1/4 inch, whereas the one used at Chipps Island is larger, and has a mouth opening that measures 15 by 30 feet, with a cod end mesh size of 1/4 inch. Operation requires a boat crew consisting of one boat operator and two deckhands. Ten, 20-minute trawls per day are conducted for 3 to 7 days per week from November through June.

The Kodiak or paired trawl requires two boats to pull the net. This net has a larger mouth opening than the midwater trawl nets, and thus is more efficient at catching larger juvenile Chinook salmon such as winter- and late-fall run fish. The Kodiak trawl replaces the midwater trawl for surveys at Sacramento and Chipps Island during the winter months. Kodiak trawl surveys also are conducted at Mossdale on the SJR (RM 54). The Kodiak trawl has a mouth opening that measures 6 by 25 feet, with a cod end mesh size of 1/8 inch. Operation requires two boat crews consisting of two boat operators and three deckhands.

Nets would be retrieved by hauling them onto the bow deck of the boat, with the cod end containing captured fish coming on board last. The cod end of the net would be untied, and fish placed in buckets of water for processing as described above. Chinook salmon determined by size to be spring-run Chinook salmon would be retained for transport to the Conservation Facility; all other fish would be released.

Juvenile salvage from Delta pumping facilities

The Tracy Fish Collection Facility and the John Skinner Fish Protection Facility located in the south delta entrain spring-run fish from the Sacramento River populations. Currently, spring-run fish are designated as spring-run based on their size in particular months and transported for release into the San Francisco Bay. Genetic samples are currently being collected on a subsample of fish salvaged at these facilities to ground-truth the size by month criteria for run designation by CDFG. Putative spring-run fish could be individually marked (or segregated) until genetic information can be confirmed. Fish genetically identified as spring-run fish would be collected for the Conservation Program.

Adults

Capture of adult spring-run Chinook salmon for remote-egg collection or translocation to the SJR for spawning may occur:

1) When the FRH has high return years (i.e., those that exceed the needs of the FRH spring-run Chinook salmon program). Chinook salmon returning to the FRH during the spring are floy-tagged to distinguish them from late-arriving fall-run fish, and released back into the Feather River for over-summer holding until the September spawning period. Adult fish would be collected during the spring tagging season, quarantined for disease purposes, and then transported to the SJR and released. Floy-tagged fish could be collected when they re-enter FRH in September and transferred to the SJR.

2) Collection of individuals from fish rescue operations in lower Butte, Deer and Mill creeks. In Butte Creek adults that are unable to continue migrating past a thermal barrier are collected from lower Butte Creek and transported farther upstream. In past years rescues have occurred in June and July. Rescue events also are possible on Deer and Mill creeks in response to catastrophic events such as major forest fires. As with the Feather River fish, some adults could be transported and released in the SJR. Both instances would provide the opportunity to collect adults that would be captured, handled, and transported anyway due to reasons other than the Conservation Program.

3) <u>Capture of adult spring-run Chinook salmon in Butte, Deer and Mill creeks for the purpose of remote site egg-take</u> (as described above under *egg collection*). This activity would occur only if other methods of reintroduction were determined to be insufficient to meet Conservation Program goals and would require agreement among Service, NMFS, and CDFG, including field staff familiar with the spring-run Chinook salmon populations on the respective creeks.

4) <u>Early-spring running Chinook (other tributaries).</u> Adults may be captured for remote egg take and either taken to the Conservation Facility or directly translocated to the SJR. This involves early spring-run Chinook salmon that appear in small numbers in various Central Valley tributaries (e.g., Stanislaus, Mokelumne, Yuba rivers; Battle and Clear creeks). There would be opportunity to capture these fish at the weirs, ladders and hatcheries, as applicable for each stream. Both adipose fin-clipped and nonadipose fin-clipped fish are proposed for collection.

In addition to having a larger effect on the donor stocks as compared to taking eggs or juveniles, adult methods of collection are expected to be associated with high stress levels and potential mortality of adults. Collection would follow the methods outlined under *Remote egg-take*, or involve collection at fish ladders, in-stream weirs or hatchery facilities.

Adult spring-run Chinook salmon would be transported using the same methods used for transporting juveniles described above. Adult fish would be transferred to and from transport tanks using in purse-style stretchers that hold both fish and water (e.g. water-to-water transfer). Direct netting of fish will be minimized to the greatest extent possible to reduce injury and fish stress.

Donor Stock Annual Decision Process

The decisions regarding donor stock selections—the timing, numbers, life stages, locations and methods—cannot be predicted *a priori* for each year during the duration of this permitted activity. In all cases, the donor stock collection planning and implementation will be driven by interagency collaboration and based on real time information including: population status, Conservation Program status, geographic location, life stage(s) present, potential collection methods, run identification, and other pertinent information.

Other considerations may arise through further monitoring and research, and these may influence future planning. These include: new understanding about genetics and movement of vagrant spawners, improved understanding regarding survivability of donor stock (by selected locations and methods) through implementation of collections during this project itself, and refined knowledge about run sizes to "other" tributaries.

In addition, we need to be sure about donor stock disposition with respect to hatchery operational status and/or habitat conditions in the mainstem SJR for reintroduced individuals. We recognize that conditions change, the hatchery is not completed, and the restoration has not begun.

From our analyses (see Appendix A), we cannot necessarily anticipate that NMFS will permit full collections of donor stock from all primary sources (the optimal numbers outlined in Table 1 of the Project Description) in every given year, over the duration of years intended to be covered by this activity. For these reasons, we are proposing a donor stock collection planning process that shall operate in real time, and be adaptive to population fluctuation and extant habitat conditions. This process may also be adaptive to favor collection methods that prove, during the course of project activities, to be preferable as methodology improves and the most effective and least disruptive techniques are identified.

The donor stock selection decision process would entail ongoing technical input from the interagency technical teams such as the FMWG. The implementing agencies would convene periodically during the course of the collection season to review data provided through the donor stock collection monitoring program, including: stream surveys, censuses at weirs, recent historic escapement figures, monitoring program data, Conservation Program needs, hatchery returns, etc. The team would also consider any updated numeric guidelines provided by NMFS to ascertain allowable collection limits with respect to current population trends (e.g., see Appendix A).

Upon reviewing the available information, the team will confer and make a formal recommendation to the Service SJRRP Program Manager for stock selection (including specific numbers and capture methods, by lifestage and stream segment) for that year. The Service's SJRRP Program Manager, or designated staff, will compile the information provided by the FMWG into an annual Donor Stock Collection Plan (DSC Plan) and submit it to NMFS and DFG in the form of a formal request.

NMFS will review this request from the Service for that season's collections as outlined within the DSC Plan. The plan and request shall include, at a minimum: a summary of the data evaluated by the team, notes from the group's deliberation from development to recommendations, and the Service's rationale underlying the conditions of the permit and the FMWG technical recommendation through the permitting guidelines established through the §10(j) ruling (e.g., Appendix A, or other) to compile a final request to NMFS.

NMFS will make a final determination on allowable collections and report back to the Service's SJRRP Program Manager to approve, deny, or amend the allowable collections in the donor stream segments as outlined in the Stock Selection Strategy for the duration of the applicable DSC Plan.

The FMWG will reconvene to discuss progress on the approved donor stock collection activities, and report back to the Service through the course of the collections. Available agency staff and/or consultants responsible for collection, transport, rearing, and release activities will compile information covering all project activities as outlined in this application. These reports would eventually comprise the annual tallies from the collections, monitoring, and rearing activities that shall be submitted to NMFS in an annual report of donor stock collection and hatchery operations.

Timing of the DSC Plans

Snorkel surveys, weir counts, and other acceptable methods (e.g., video monitoring at Clear Creek) would occur March through September. Adult collections from that spawning run may be permissible as soon as late spring in that spawning year; however, current-year spawning numbers would be needed to ascertain whether population conditions meet some threshold criteria for viability (e.g., the run sizes proposed within Appendix A) before collections commence.

Following the derivation based on the analyses in Lindley et al (2007) (see Appendix A), we propose herein that this threshold should be a spawning run (S) reflected by any single day snorkel survey exceeding 500 fish (or suggest using any other reliable method available for assessing spring-run spawning size). In other words, once such a survey is conducted during the spawning season, and if conditions within the generation (i.e., total population size including numbers from the past two seasons) sums to greater than 2,500 fish, then the FMWG through the Service may formally request adult collections via an interim DSC Plan.

On streams where they occur, redd surveys typically span August through October, while egg collections could potentially begin as soon as September. The same threshold rule should apply based on run size of adult return. The submitted DSC Plan for egg collections may be subsequent to an interim plan already submitted (i.e., based on further data or longer time to reach the threshold), or in the case of good population status and current-year returns, the first DSC Plan may be sufficient to function as an annual document. Timing will be dependent on run size and survey results. However, a DSC Plan, request from the Service, and response from NMFS will all be needed by September at the latest to successfully implement some of the collections that season. Approval for later collections could come on October 1.

Figure 5 details the annual survey process through a single collection calendar year and identifies the proposed DSC planning schedule based on the spawning phenology of the respective runs.

Conservation Stock Rearing

For the short-term (Years 1-3; 2012-2014), the goal of the Conservation Program would be to collect sufficient numbers of broodstock to provide a minimum of 50 and a maximum of 100 unrelated gravid adult females (and an equal number of fertile males) for the Conservation Facility. These 100-200 fish, produced from donor stock eggs and juveniles, would be the first broodstock reared in the interim facility and their offspring would be released to the SJR.

In the long-term (Years 4-8; 2015-2019), based on genetic considerations, the goal would be to propagate sufficient numbers of broodstock annually to provide a minimum of 150 and a maximum of 450 unrelated gravid adult females (and an equal number of fertile males) from each donor population, for a minimum of 4 to 8 years. The permanent Conservation Facility will be designed to accommodate the maximum broodstock size of 900 fish total.

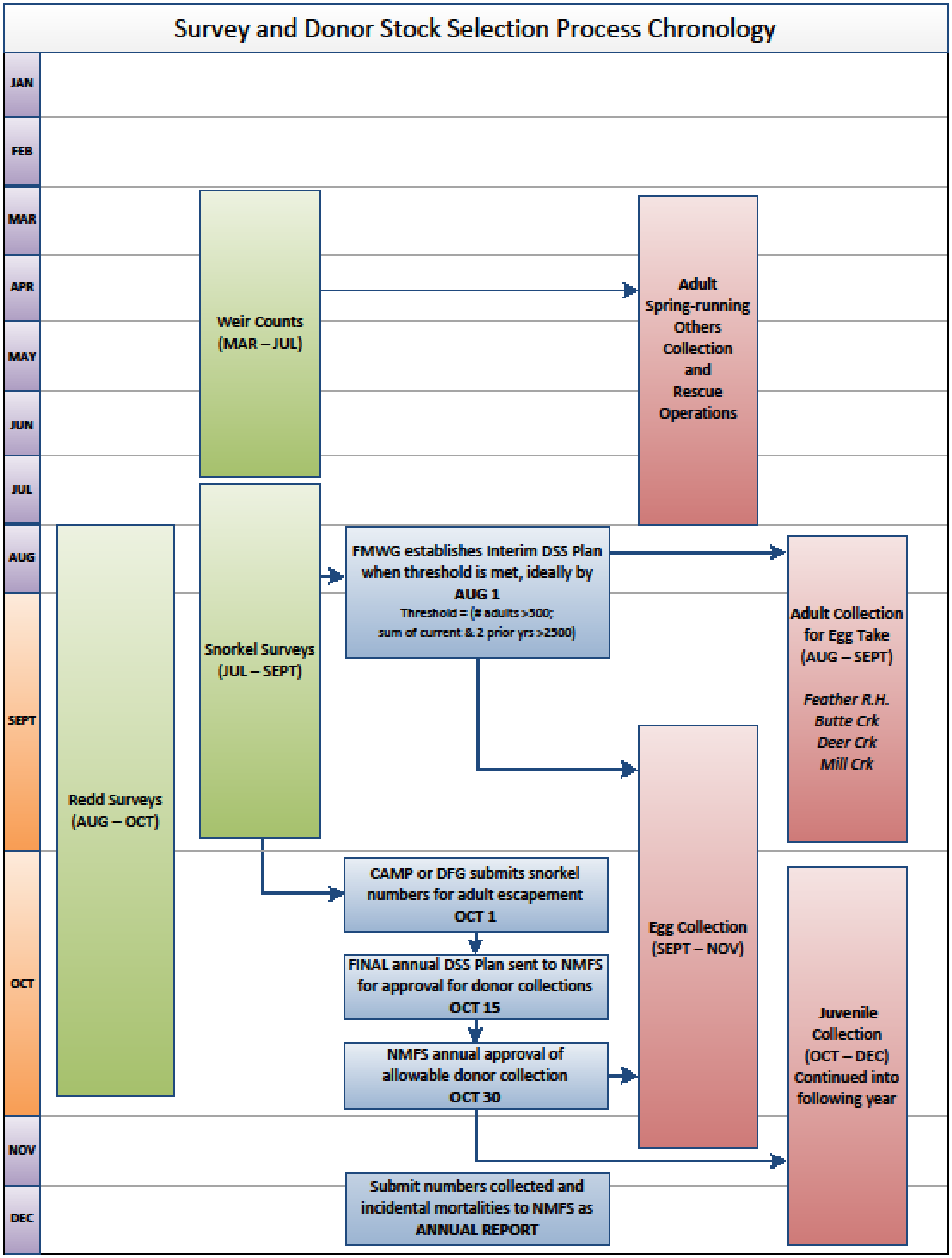


Figure 5. Survey dates and the corresponding donor stock selection process strategy.

Some of the source stock may be reared for a shorter period of time in the Conservation Facility and released directly to the SJR as eggs or juveniles, providing that habitat restoration activities have restored suitable conditions in the SJR. However, as salmon survival to adulthood in the wild is much reduced relative to hatcheries, additional eggs and juveniles would be required for direct release to the "wild."

Timing

Incubation and rearing operations would occur at an interim facility until 2014, at which time operations would transition to the full-scale Conservation Facility. Eggs and juveniles collected from donor streams would be transported to the Facility and reared under controlled hatchery conditions to sufficient age and size to improve their probability of survival to reproduction. Each year, a portion of this production would be withheld in the hatchery to provide the source for the next generation of broodstock. If adults are collected, they may be held for a brief time at the Conservation Facility for acclimation and disease prevention, before release into the river.

The first introductions from the hatchery-reared, adult broodstock are expected to occur in 2015. This is the preferred near-term strategy to attain numeric fish goals until such time that the Conservation Program completes habitat restoration to provide sufficient in-river survival rates. All hatchery juveniles would be adipose fin-clipped and coded wire tagged prior to release; therefore releases from the Conservation Facility would be 100 percent marked. The broodstock would be genotyped for parental-based tagging, and would be intraperitoneal, passive-integrated transponder (PIT) tagged for tracking and identification in the hatchery.

The Conservation Facility's physical design and operation are described are summarized below.

Conservation Facility Design and Operation

Water Source and Discharge

Water for the Conservation Facility would be supplied from Millerton Lake, located at the base of Friant Dam. The water supply would be micro-screened (with a minimum pore size of 80 microns to reduce pathogen loads) and aerated. The water supply (for egg incubation, hatching and early rearing) would be further treated with ultraviolet filtration. The existing CDFG SJFH uses the same water source, and has successfully hatched and raised trout at the site since 1955 due to favorable water temperature and water quality conditions.

The source water for the hatchery is a continuous 35 cubic foot per second (cfs) supply gravity-fed directly from Friant Dam. Prior to reaching the hatchery, the water passes through the Fishwater Release Hydropower Plant, which is owned by the Orange Cove Irrigation District. The flows are delivered to the power plant through two different pipelines: a 24-inch diameter pipeline from two Friant Dam penstocks, and a 30-inch diameter pipeline that takes water from the Friant Kern Canal penstock near the left dam abutment.

The temperature of the water in each pipeline varies throughout the year, and valves are used to control the flows to create favorable temperature conditions at the hatchery. Temperatures are typically maintained between 45-55ºF (7.2-12.8ºC) throughout the year, occasionally dipping as low as 42ºF (5.6ºC) or peaking as high as 58ºF (14.4ºC). Hatchery water and the adjacent river water is of the same origin and is fairly similar in quality and temperature; however, the temperatures of the hatchery water are moderated due to the ability to adjust water temperatures at the mixing valves located at the Fishwater Release Hydropower Plant.

The water flowing from the Hydropower Plant is delivered to a 44-inch diameter pipeline for delivery to the fish hatchery (about 1 mile from the dam). The pipeline has been calculated to have the capacity to convey an additional 30 cfs to the hatchery. Planning is currently in progress to convey a portion of the unused capacity to the Conservation Facility, therefore water flow is anticipated to be equally as reliable.

The Conservation Facility would have a separate discharge from the existing hatchery and would operate under an independent National Pollutant Discharge Elimination System (NPDES) permit. Effluent from the hatchery building and bottom drains from fish culture tanks would be directed via gravity flow to micro-screen drum filters. Filtered water would be directed to a common discharge point on the river. Sludge from drum filters would be directed to a drying pond for disposal. Existing settling ponds would be lined, refurbished, and used for additional effluent treatment as required.

Because of the high flow rates intended at the hatchery to provide sufficient flushing and to provide optimal conditions, temperature increase in the SJR from Conservation Facility effluent water is anticipated to be minimal and would remain within the guidelines provided by the Regional Water Quality Control Board.

Physical Infrastructure

The small-scale, interim facility would be located on the grounds of SJFH and be operational until the full-scale Conservation Facility is constructed. The interim facility holding tanks would include twelve 3-foot diameter circular tanks, three 6-foot diameter circular tanks, three 16-foot diameter circular tanks, and two 20-foot diameter circular tanks. It would be designed to spawn about 50-100 adult salmon annually. Interim facility incubators would include two, 12-tray vertical flow incubators (Marisource®, Fife, WA); two deep matrix incubators (ARED, Inc., Wrangell, Alaska); and one moist air Incubator (ARED, Inc., Wrangell, Alaska).

The full-scale Conservation Facility is anticipated to be operational in 2014, at which time both facilities would be integrated together. Additional facilities for the Conservation Facility would include three 20-foot diameter by 5-foot high circular tanks for holding, quarantine and acclimation of all wild fish entering the hatchery. Eight 12-tray vertical egg incubators would be obtained as well. A pre-engineered metal shell spawning shed, equipped with spawning tables, egg processing equipment and associated plumbing, would be installed.

Rearing facilities would be organized into three main areas: fry production, smolt production, and captive rearing. Fry production would occur in the main hatchery building and involve rearing fish from the unfed fry stage to about 3 grams each (in 72 small, circular culture tanks measuring 3 feet in diameter by 30 inches high with a volume of 106 gallons). Smolt production of fish from 3 grams to 7.5 grams, and yearling production from 7.5 grams to 75 grams, would occur outdoors in the exterior hatchery area. Twenty, 16-foot diameter tanks would be used for smolt production.

Captive rearing of fish for adult production from yearlings (75 grams) to adults (greater than 1 kilogram) also would occur outdoors in the exterior hatchery area using four banks of culture tanks, with one 30-foot tank and three 20-foot tanks in each bank. All outdoor tanks would be equipped with automatic feeders, include netted or solid-roof bird exclosures, and feature a flow-through water system. A 3-foot wide volitional release channel would be installed between fish culture tanks to be used both for volitional release and transporting fish to the adjacent spawning shed.

Operating Procedures

Spawning

All male and female broodstock would be examined weekly during the spawning season to determine readiness for spawning. Mating pairs would be determined according to molecular relatedness estimates, as described in the draft HGMP, with consideration given to increasing genetic diversity and effective population size, and decreasing inbreeding and outbreeding depression.

Eggs from the female would be divided into five groups and each group would be fertilized by a different male. Each male would be used with five different females. Fish to be spawned would be euthanized by pneumatic knife inserted into the spinal cord posterior to the head. The ventral wall of the abdominal cavity of each female Chinook salmon would be slit open and eggs allowed to freely flow into a metal spawning pan (Leitritz and Lewis 1976). Sperm from males would then be expressed into the pan by stroking the vent area.

The flaccid eggs would be put into incubation trays. Eggs and fry from each cross would be kept separately until the swim-up stage to allow for evaluation of the success of the cross. As available, and as governed by the recommendations of the hatchery and river monitoring technical teams, precocious males and jacks would be used to ensure representation of alternative life history strategies.

Egg incubation

Each vertical flow incubator (consisting of 12 trays) would be operated at the manufacturer’s recommended flow rate of 30-60 gallons per minute, depending on the loading density. Loading densities would not exceed 8,000 eggs per tray, although egg tray capacity is 10,000 eggs. Individual family lots would be segregated into three or four sections per egg tray using segregation dividers (providing segregation for up to 48 parental crosses). Opaque side panels would be added to the incubators to produce a darkened environment for incubation. All egg incubation would occur in darkened conditions.

Deep matrix incubators are hatch boxes that provide a substrate (i.e., plastic rings) for hatching to mimic in-river conditions by requiring "emergence." The units would be single pass through flow systems, and would be operated at the manufacturer's recommended flow rate. Each unit has a recommended loading rate of 200,000 salmon eggs.

Each egg tray would hold 2,700 eggs, with a total capacity of almost 600,000 eggs per unit. The unit would recirculate 40 gallons of filtered water, with 5 gallons of water replaced daily. Filtration would consist of 1 and 50 micron particle filters, a 10 micron carbon filter and ultraviolet sterilization.

Moist air incubation produces a fine mist for incubation to inhibit fungal growth. The moist air incubator would have 220 individual egg trays to allow isolation and tracking of individual parental crosses. The moist air unit would incubate green eggs through the eyed stage in a dark environment, after which the eggs would be transferred to deep matrix or vertical tray incubators for hatching.

The deep matrix incubators and the vertical tray incubators would utilize ambient water temperatures, anticipated to be between 45-55^{o}F. As the moist air incubator would allow for temperature control, hatching temperatures would be based on the objectives of the Conservation Program, and may include: mimicking SJR temperatures, slowing or speeding egg development, and/or utilizing temperature to produce thermal marks on otoliths. Dissolved oxygen levels would be maintained near saturation. Eggs would be monitored twice daily, and dead eggs would be removed. Siltation is not anticipated to be a problem because the water supply comes from Lake Millerton (i.e., the reservoir would allow sediments to settle out before reaching the hatchery intake).

Rearing

The rearing facility would utilize circular rearing tanks. Circular rearing tanks have been shown to have several advantages over plug-flow raceway designs, and are the design of choice for many salmon captive rearing programs. The benefits of circular tanks include the following:

- the ability to adjust water velocities to target optimal swimming speeds for salmonids, which has been shown to improve growth rates, feed efficiency, oxygen utilization, swimming performance and stamina, and to reduce aggression;
- the ability to self-clean, allowing improved water quality and minimizing human to fish contact;
- improved waste management characteristics;
- the ability to efficiently and evenly add supplemental oxygen; and
- easily modified for water recirculation, if needed.

Three-foot circular tanks (106 gallons) would be used for early feeding and for juvenile segregations, and would be monitored for early mortality. After about 2 weeks, family groups would be combined in larger circular holding tanks. Sixteen-foot circular tanks would be used for rearing fish up to age 2, and 20-foot tanks would be used for rearing fish from age 2 until maturity. During captivity, tank flushing rates would be less than one turnover per hour and the maximum allowable fish density index would be 0.15 $lb/ft^3/in$, as proposed by Banks (1994) and Ewing and Ewing (1995) for spring-run Chinook salmon.

The Conservation Facility would utilize high quality slow sinking salmon feed from a reputable fish feed manufacturer. Dietary protein and energy levels may vary in order to modulate fish growth rates according to The Conservation Program requirements. Feeding charts would be used to guide the number of feedings and feed amount per day (by percent body weight).

Live feeds and other natural feeds would be investigated, with the goal of mimicking natural conditions. Feed conversion efficiencies would vary depending on the feed type, feed rate, and the age of the fish. Automated feeders would be used and feeding regimes and timing would attempt to mimic natural conditions, particularly for smolt production.

Growth rates would be modulated by manipulating the feed rate and/or the energy density and protein content of the feed. Growth of captive reared fish would be modulated to minimize precocity. Growth during smolt production would be modulated to meet the Conservation Program goals for release size, release timing and strategies for avoiding possible impacts to the wild population.

Fish health would be monitored by CDFG pathologists. Treatment methods prescribed by fish pathologists for disease outbreaks and treatment protocols would be carried out by hatchery staff. Depending on the nature of an outbreak, treatment methods may vary. However, chemical treatments for external pathogens may include the use of salt, $KMnO_4$, formalin or hydrogen peroxide (as allowed by the hatchery discharge permit). Bacterial infections could include the use of oxytetracycline, florfenicol or other approved antibiotic.

All treatment would follow veterinary guidance and would be used and monitored according to NPDES wastewater discharge requirements. Diagnostic procedures for pathogen detection would follow American Fisheries Society professional standards, as described in the American Fisheries Society Bluebook (Thoesen 2007).

Tagging

The entire population of captive reared broodstock would be genotyped for parental based tagging. A small fin clip would be collected from spawned fish and either dried on blotter paper or stored in ethanol. In the lab, the fish would be genotyped, and this information stored in a parent database. When suspected offspring are sampled subsequently, they too would be genotyped, their parents located in the database and the stock and cohort of origin recorded.

All ESA-listed salmonids tissue samples would be preserved as voucher specimens and sent to: Salmonid Genetic Repository, Southwest Fisheries Science Center, 110 Shaffer Road, Santa Cruz, California 95060, (831) 420-3903, for Chinook salmon; Mr. Jonathan Nelson, California Department of Fish and Game, 830 S Street, Sacramento, California 95814, (916) 445-4506, for Central Valley steelhead and Chinook salmon. Preservation protocol would be confirmed with the appropriate contact person.

Broodstock reared at the Conservation Facility also would be PIT tagged after reaching a minimum length of 85 mm (Harvey 1987). Sterilized tags would be injected into the peritoneum using an implant gun or syringe-style implanter. PIT tags would be used for monitoring individual fish throughout captivity.

Prior to spawning, adult fish would be tagged intra-muscularly with Petersen disc tags for easy visual identification (Harvey 1987). The tag would consist of two plastic buttons that are held to the sides of the fish by a stainless steel pin passed through the muscle tissue beneath the dorsal fin. The discs would be colored or marked with letters or numbers. Adult fish would be anesthetized during all tagging activities using MS-222, CO_2, or Tricaine-S. The dosage of the anesthetics would be adjusted to avoid fish mortality.

All hatchery juveniles would be adipose fin clipped and coded wire tagged prior to release (Harvey 1987). Coded wire tags are small (less than 1 mm) lengths of wire implanted into the snout of each juvenile fish using specialized automated equipment. The tags (visually indicated by the removed adipose fin) would allow fish to be identified as belonging to a particular Conservation Facility cohort when it is either captured as an adult (commercial or sport fishery harvest), or when it returns to the SJR to spawn and the carcass is recovered. Some adipose fin clips would be used for additional genetic analysis.

Experimental Stock Release/Reintroduction

The third component of our proposed action includes the release of donor stock and/or conservation stock to the mainstem of the SJR.

The prospective elements of the §10(j) ruling include direction by the permitting agency to provide coverage for all collected donor stock (and their progeny) through to release into the SJR—at which time the §10(j) experimental designation is expected to be in effect. Therefore, we anticipate activities associated with release to be categorized into two broad categories.

1) <u>Fish Relocation</u>—fish (at different lifestages) will be available *from the Conservation Facility* and transported for either direct release and/or exposure and acclimation at in-stream facilities (incubators or cages) into different areas of the river (see Reintroduction Strategies document, and below); and

2) <u>Fish Translocation</u>—fish (at different lifestages) may be directly introduced *from a donor stream source* to the SJR. This is from riverine donor source (or associated holding facility) to riverine SJR habitat (including direct release and/or in-stream facilities).

In regulatory terms, fish relocation refers to transport of covered individuals from one facility to another, all under the proposed §10(a)1(A) provisions pursuant to this application. Fish translocation involves transport of fish for eventual direct release to the SJR. Reintroduction into in-stream or streamside facilities would entail either relocation or translocation (Figure 6), depending on the fish source. Upon completion of transfer to riverine habitat (direct release or in-stream facility), the experimental §10(j) designation would commence.

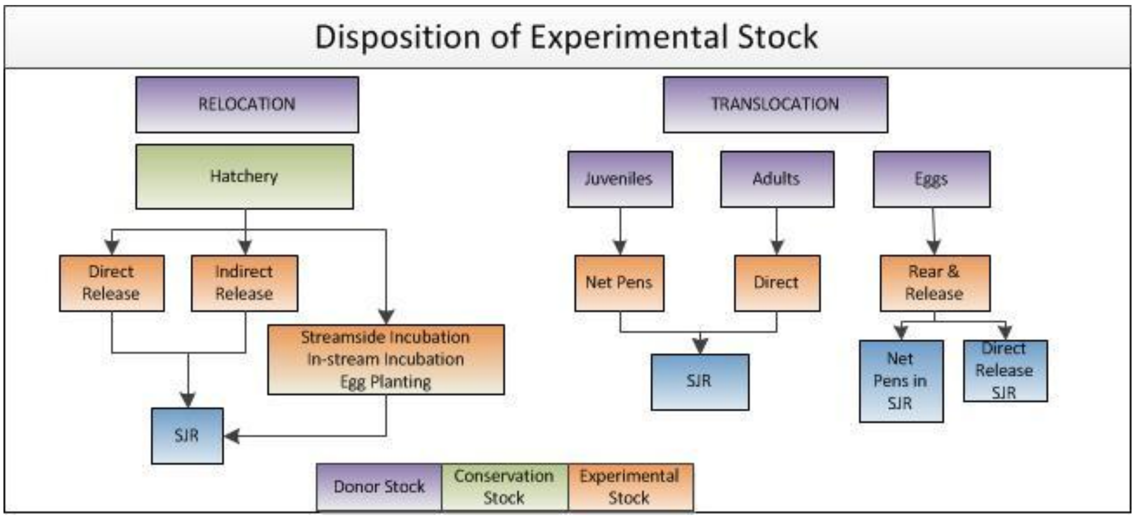


Figure 6. Life stage and reintroduction pathways for experimental stock.

Adaptive Management of the Reintroduction

The development and finalization of the Reintroduction Strategy document will guide future adaptive management methods for reintroduction of our donor source stock and progeny. The adaptive management process is discussed in the *2010 Draft Fisheries Management Plan* (SJRRP 2010), which shall be finalized and released by fall 2010. Adaptive management emphasizes "learning by doing," and ideally follows a technically rigorous process. That process includes: articulating what is known about the ecological dynamics of the system; predictive (quantitative, where possible) modeling to relate management actions to expected outcomes; monitoring, assessment and reporting of observed results; followed by successive reiterations of the entire process—revisiting our revised understanding through adaptive actions and further observations, etc.

A number of monitoring tools are necessary to evaluate the reintroduction strategies employed. Genetic evaluation and other methods will be used to evaluate the relative fitness and success of fish from the different stocks at various life stages following the reintroduction, and these evaluations will inform progress in the reintroduction effort. A monitoring framework that includes static sites, which will remain identical throughout the term of the SJRRP, for collecting biological data and a genetic samples (e.g., fin clips), would allow identification of individuals and their biological status (e.g. growth, weight, condition factor). This pedigree information and biological information can be combined with genetic study of adaptive traits to demonstrate selection for specific traits and local adaptation to the upper San Joaquin's environment.

Direct Releases

This activity is associated with transport of various lifestages (fish relocation and translocation) for direct reintroduction to the SJR. For all such transport activities (regardless of destination), proper protocol must be followed to minimize stress and mortality. Transport of spring-run Chinook salmon eggs, juveniles or adults from the Conservation Facility to the SJR for release/reintroduction would occur as described above for donor stock collections, by lifestage.

Transport water would be tempered to within 2^{o} C of the river location receiving the fish before transferring fish. When possible, fish would be moved in and out of the transport truck using a water filled vessel and without netting to minimize stress and loss of slime. In particular, fish would be transferred to and from transport tanks using "in-water" in purse-style stretchers that hold both fish and water (i.e., water-to-water transfer). Direct netting of fish would be minimized to the greatest extent possible to reduce injury and fish stress. When possible, releases would occur at night to minimize predation on juveniles. Juvenile and adult fish would be transported to the release site using the following general guidelines (Carmichael et al. 2001):

- reduce the number of stressors;
- reduce the severity of stressors;
- minimize the duration of stressors;
- minimize plasma ion disturbances; and
- minimize increases in metabolic rate.

Up to 250,000 spring-run Chinook salmon eggs per year may be reintroduced to the SJR, the source of which could be the Conservation Facility of directly from translocated fish collected in the donor streams. Upon arrival at the release site, eggs would be tempered to the receiving water by increasing the egg temperature 1ºC per hour until matching the receiving water temperature. Eggs then would be reintroduced to the SJR as described below using streamside incubators, instream incubation boxes, or egg injection into the gravel. Timing of egg releases would occur in direct correspondence to their period of collection from donor streams and availability from the Conservation Facility typically from August 20 through November 10.

Preferred release sites would be near the hatchery and predicted spawning ground; however, releases may occur much farther downstream to avoid migratory hazards and predator conditioning, and transport time may be as long as 2 hours.

SJR egg, juvenile, or adult spring-run Chinook salmon release locations may include, although are not limited to, the following locations:

- Conservation Facility, RM 254.2
- Lost Lake Park, RM 264.5
- Ball Ranch Access Point RM 262.2
- SJR Ecological Reserve, Willow Unit, RM 260.6
- Fort Washington Access Point, RM 257
- Vulcan Access Point/Rank Island RM 258.5
- Sycamore Island, RM 253.3
- Scout Island, RM 250
- Highway 99 Bridge Crossing, RM 243.2
- San Joaquin River Ecological Reserve, Millburn Unit, RM 247.2
- Bifurcation Structure Access Point, RM 216.1
- Mendota Pool Access Point, RM 205
- Sack Dam, RM 182
- Firebaugh, RM 195
- San Luis Wildlife Area, RM 147.2
- Highway 165 Bridge, RM 132.9
- Highway 140 Bridge, RM 125.1
- Hills Ferry Barrier, RM 118.2

Reintroduction Methods

Egg injection into the gravel

This method would involve injecting eyed eggs into the gravel using a hydraulic redd pump/egg injector (ARED, Inc., Wrangell, Alaska (http://www.ared.net)) to simulate incubation in a natural redd within the gravel. Egg injection would occur in areas of the river with suitable spawning habitat characterized by appropriate water depth, velocity, and substrate, and low sedimentation. Egg injection sites also would be selected to be adjacent to areas with appropriate water depth, velocity, and substrate, and cover characteristics to promote fry growth and survival. A simulated redd would be prepared by first inserting a water pump pipe into the gravel and pumping water through to remove fine material, as would occur with natural salmonid spawning, prior to egg injection. Fine sediments would be “pumped” out to improve permeability. About 50 eggs would then be poured into the open top of the pipe and pumped into the gravel along with the stream water from the pump. The site would then be left alone for the eggs to incubate and fry to emerge naturally. If the reintroduction of eggs would occur entirely using the hydraulic redd pump/egg injector, the activity would occur in about 4,000 locations.

Juvenile Releases

Juveniles are expected to be available for release into the SJR at various ages and sizes from the Conservation Facility. Juveniles may be released over the same temporal window as collection or availability occurs, or placed in temporary holding pens for imprinting and additionally for acclimation prior to release into the SJR. Release sites would be selected to provide appropriate water depth, velocity, substrate, and cover characteristics to promote juvenile growth and survival. The use of temporary holding pens would allow the juveniles to acclimate before release, and thereby reduce the risk of predation (Fisheries Foundation 2009). Holding pens would also allow for collecting juveniles from donor stocks over a period of time until a group of fish have been amassed for release in a series of groups. Juvenile salmon outmigrate in groups, which may reduce mortality due to predation. Temporarily holding juveniles and releasing them in a series of groups may more closely resemble natural densities experienced during rearing and outmigration and increase their survivorship.

Finally, if smolt-sized juveniles from the Sacramento River Basin, or elsewhere out of basin, are released in the Restoration Area, holding the fish in pens temporarily may increase the likelihood that they imprint on the SJR and return to the Restoration Area to spawn as adults. Juvenile salmon learn odors associated with their home stream before seaward migration and use these odor memories for homing as adults (Dittman 1995). Numerous studies from the Pacific Northwest point to the value in developing olfactory cues for juvenile salmonids released outside of their natal streams, to improve homing to the river of release (Slatick et al 1988).

Adult Releases

Adults would be released in the SJR into appropriate deep pools located near likely spawning areas. Timing of adult releases would occur in direct correspondence to their period of collection from donor streams and availability from the Conservation Facility (i.e., annually from March 1 through October 10).

Indirect Release

Streamside incubators

This method would entail using portable incubators erected alongside the SJR. The incubators would be Whitlock-Vibert (WV) boxes (Federation of Flyfishers, Livingston, Montana; www.fedflyfishers.org) contained in 5-gallon buckets or large tubs. The WV boxes would be plastic and measure 6 x 2 x 4 inches (http://www.kawanobooks.com/html/En/e083.html). Fifty eyed eggs would be placed in one of two chambers in the box. Once they hatch, fry would exit the egg chamber through slots and enter a rearing chamber. Fry would be released into the river immediately upon absorption of their yolk sac and swim through slots in the outer sides of the boxes. Release would occur volitionally onsite, or fry would be transported to specific locations for release. Release sites would be selected so as to provide appropriate water depth, velocity, and substrate, and cover characteristics to promote fry growth and survival. This method essentially involves piping a river water source, using gravity, through an incubator of incubating eggs. The water is piped into the bottom of the incubator and allowed to flow out the top. Sites would be selected to provide the best conditions to successfully incubate the eggs. If the re-introduction of eggs would occur entirely using streamside incubators, up to 8000 WV boxes may be required. These would be housed in 5-gallon buckets (2 WV boxes per bucket) or 534 large tubs (15 WV boxes per tub).

Instream incubators

This method would involve incubating freshly fertilized or eyed eggs contained in wire or plastic boxes directly in the stream gravel of the SJR. Incubators would be buried in the streambed in a likely spawning area with appropriate water depth, velocity, and substrate, and low sedimentation. Sites also would be selected adjacent to areas with appropriate water depth, velocity, and substrate, and cover characteristics to promote fry growth and survival. WV boxes may be used as described above, except that they would be buried in the stream gravel and fry would complete their swim through the stream gravel. Additionally, an incubator design described by Donaghy and Verspoor (2000) may be used. Their design is an about 7-inch square box that includes lidded trays for holding eggs, a basket for retaining the trays, and a lidded frame for securing the basket in the streambed. This incubator would accommodate 4,000 eggs, and as with the Whitlock-Vibert boxes, would allow eggs to mature within the streambed and the fry to emerge naturally. If the reintroduction of eggs would occur entirely using instream incubators, 8000 WV boxes or 100 incubators of the type described by Donaghy and Verspoor (2000) would be required.

Reintroduction Timeline

With the acceptance of the Settlement by the Court in October 2006, work immediately began on planning needed to implement the SJRRP consistent with the NEPA and the California Environmental Quality Act (CEQA). During the drafting of the Settlement, it was assumed that legislation would be quickly forthcoming. However, the legislation (SJRRS Act) was not signed until March 2009, which then authorized the implementation of the Settlement. As a result, progress on channel improvements has been delayed past that which was anticipated and scheduled within the context of the Settlement.

To fully achieve the Restoration Goal, a combination of channel and structural improvements along the SJR below Friant Dam and releases of additional water from Friant Dam to the confluence of the Merced River will be required. The near-term channel and structural improvements are outlined in Paragraph 11(a) of the Settlement. The near-term release of additional water from Friant Dam is outlined in Paragraph 15 of the Settlement. However, realizing that quality fish habitat must be present to optimize the success of the proposed action, the implementing agencies should weigh the current habitat conditions of the SJR in light of the Settlement timeline.

Settlement Paragraph 11(a), Phase 1 Improvements

Mendota Pool Bypass and Reach 2B Channel Improvements Project

- Creation of bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cfs from Reach 2B to Reach 3. (Requires completion of a structure capable of directing flow down the bypass and allowing deliveries of SJR water into Mendota Pool when necessary.)
- Channel capacity modifications (incorporating new floodplain and riparian habitat) to ensure conveyance of at least 4,500 cfs in reach 2B between Chowchilla Bifurcation Structure and new Mendota Pool bypass channel.

The actions described in Paragraph 11(a)(1) and 11(a)(2) have been combined because of their related functions, the project planning has begun and construction is estimated to start in 2013, and be completed in 2015.

Reach 4B, Eastside Bypass and Mariposa Bypass Low Flow Channel and Structural Improvements Project

- Modifications in SJR channel capacity, if necessary, to ensure 475 cfs through Reach 4B.
- Modifications at Reach 4B headgate on the SJR channel for fish passage and to enable flow routing of between 500 cfs and 4,500 cfs into Reach 4B.
- Sand Slough modifications to ensure fish passage.
- Modifications to structures in the Eastside and Mariposa Bypass channels to the extent needed to provide anadromous passage on an interim basis until completion of Phase 2 improvements.
- Modifications in the Eastside and Mariposa Bypass channels to establish a suitable low flow channel (if Secretary, in consultation with RA, determines necessary).

Work on combined projects 3, 4, 5, 8, and 9 began in September 2009; construction is anticipated to start in 2013 and be completed in 2015.

Arroyo Canal Fish Screen and Sack Dam Fish Passage Improvements Project

- Screening of Arroyo Canal water diversion upstream of Sack Dam to prevent entrainment of anadromous fish.
- Modifications at Sack Dam for fish passage.

Planning began in 2009, and construction is anticipated to start in 2012 and be completed in 2014.

Salt and Mud Slough Seasonal Barriers

- Modifications to enable deployment of seasonal barriers to prevent adult anadromous fish from entering false migration pathway in the area of Salt and Mud Sloughs.

Planning is anticipated to begin for this project in late 2010, with construction estimated to start and be completed in 2013.

Additional Actions Identified in the draft Fisheries Management Plan (SJRRP 2010)

- Minimize in-river harvest, unlawful take, and disturbance;
- Augment and clean gravel to improve spawning habitats;
- Construct settling basins to reduce sedimentation;
- Restore floodplain habitat;
- Create off-channel Chinook salmon rearing areas; and
- Increase invertebrate production.

Planning and construction timelines have not been established for these actions.

Interim Flows

Paragraph 15 of the Settlement calls for a program of Interim Flows that includes releases of additional water from Friant Dam to start no later than October 1, 2009, and continue until full Restoration Flows begin. The purpose of the Interim Flows is to collect relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture and reuse to facilitate the larger project planning.

Given the schedule for fish reintroduction outlined in the Settlement, the channel improvements and the biology of salmon, the following timeline is anticipated.

2012 – 2019

The initial phase encompasses direct in-river release, the Interim Facility, and the full scale Conservation Facility. In the Reintroduction and Interim population phases (Meade 2007, 2008), genetic pedigree analyses (parentage based tagging, Anderson and Garza 2005) and well-designed propagation experiments should be conducted to evaluate which reintroduction methods would have the greatest success in returning adult spawners. Monitoring of the effectiveness of artificial propagation and management actions on the demographics of the natural re-establishing populations is essential for adaptive management. This population will require monitoring during all periods of the restoration program to ensure that the planned level of segregation/integration of hatchery fish is occurring.

2019 - 2025

During the next phase, strategies with the greatest success should be continued. It is anticipated that SJR spring-run Chinook salmon returns will be high enough so collection of fish from source stocks will not be necessary. The Conservation Facility will also start ramping down hatchery operations during this phase.

2025 – 2040

It is anticipated that the Conservation Facility will be phased out during the beginning of this phase; however, the research component of the Conservation facility will be ongoing. The Conservation Facility may be brought back online in certain circumstances, such as but not limited to, during periods of low returns, low water year types, and rescue operations.

Trap and Haul

In the early years of the Conservation Program, it is anticipated that a number of major passage impediments will still be in place in the Restoration Area. In order to meet the Settlement mandated reintroduction date, Dec. 31, 2012, there may be a need to utilize trap and haul procedures to move reintroduced fish through the river system before eventual release downstream of Sack Dam. This would require moving juveniles downstream of structures, or unscreened diversions/bypasses, and may require moving returning adults upstream around passage barriers, including structural or biological barriers, (e.g., temperature or DO migration barriers). The locations of these impediments may vary both temporally and spatially as they are subject to river conditions and release flows, and thus would be determined at time of trapping.

For out migrating juveniles, the primary method may utilize holding pens as described above (in the *Donor Stock Release/Reintroduction, Juvenile Releases section*). Holding pens serve to both acclimate fish, and also allow imprinting. If moving them significant distances, then fish would be put into pens in more than one location in the river, to increase the likelihood that they are able to imprint successfully. It is anticipated that both the holding pens and the trap and haul may be used in conjunction.

Fish would be collected from the holding pens in the SJR using and transferred to a 500-gallon transport tank and trailer. The tank would be filled with stream water immediately prior to transport using a portable, screened pump. The transport water would be oxygenated using bottled oxygen with oxygen stones and impellor driven aerators. Dissolved oxygen levels would be monitored and maintained near saturation during transport. Transport water would be supplemented with sodium chloride to provide a physiologically isotonic concentration to minimize ionic disturbances. When possible, fish would be moved in and out of the transport truck using a water filled vessel (i.e., water to water transfer) and without netting to minimize stress and loss of slime. Transport times may be as long as 4 hours. Water would be tempered to two degrees Celsius of the receiving water at the predetermined release location before transferring fish.

The same general guidelines used to minimize impacts during the collection and relocation or translocation of fish from the donor and conservation stocks to the Conservation Facility and/or SJR can be utilized to minimize impacts of Trap and Haul Procedures.

It is anticipated that a number of major passage impediments will still be in place in the Restoration Area in the first years of the reintroduction. Likewise, returning adults would encounter these structural and biological barriers and would also require collection and transport upstream, thus encountering similar stressors and adverse effects as the adults collected in the donor streams. Early reintroductions would be maintained in cages and under the control of agency personnel during movement (which may include sequential *in-situ* residence periods along the stream course at locations chosen to test survival and provide limited selection pressure specific to the SJR, while imprinting the smolts).

EFFECTS ANALYSIS AND PROPOSED CONSERVATION MEASURES

Donor Stock Collection

Individual-level effects

The life-history stage selected for broodstock from the Feather River, Butte, Deer and Mill creeks would vary based on several factors, including: the status of each donor population, the potential impact to the donor population for the particular choice of lifestage and method utilized, the accessibility of each life-stage, stipulations of collection permits, and guidance from the adaptive management process. Final collection targets would depend on broodstock availability and guidance from the NMFS through the annual donor stock collection planning process.

Egg Collection

Redd extraction via pumping and excavation

Eggs would be collected from redds through redd pumping and redd excavation. Redd extraction can cause disturbance to eggs and has the potential to damage or induce "shock" to an embryo, which could result in mortality (Thedinga et al. 2005). The developmental age of the embryo largely determines the likelihood of "shock" and the risk of mortality from this collection method. The stage of development is a factor of Accumulated Temperature Units (ATU in ºC), and after 200 ATU Chinook salmon eggs are very resistant to "shock" and less likely to experience lethal effects from disturbance (ADFG 2010). The reduced "shock" sensitivity roughly coincides with the eyed-egg developmental stage, about 25 days post-spawn at 10ºC (Billard and Jensen 1996).

To minimize the risk of "shock" and mortality to embryos, egg collection is not anticipated until 20 to 30 days after spawning, when embryos are in the eyed-egg stage, but prior to the hatching stage, which occurs at about 530 ATU (Billard and Jensen 1996). Water temperatures would be monitored to calculate ATU values and assess the stage of embryo development. Spawning surveys would be conducted weekly by foot and kayak to mark redds and estimate the date of spawning. These measures would enable egg collection activities to occur during the desired stage of development to maximize survival of the eggs removed and those left to incubate in the redd. Furthermore, if pre-eyed or post-hatch individuals are seen during collection, the sampling efforts would cease until the proper developmental stages are present. To minimize the effects of redd surveying, personnel would walk along stream banks when possible and skirt the redds when walking in-stream.

Smith and Wampler (1995) speculated that redd sampling may destroy the interstitial redd structure, which could deleteriously alter the flow of oxygenated water through the egg pockets, predispose redds to scour during high river flows and make displaced eggs more vulnerable to predation. To minimize the likelihood of these effects, sampling would begin at the most downstream point of the tail spill and progress systematically upstream, as necessary (Murdoch and Tonseth 2006). This method would ensure that disturbance to redds would be confined to the furthest downstream portion of the redd, decreasing the probability of direct effects from personnel (i.e. stepping on egg pockets) or the sampling process (e.g., changing the hydraulics of the redd) (Murdoch and Tonseth 2006). To reduce the vulnerability of eggs to predation, an egg planter would be used to reposition ejected eggs.

Redd superimposition (later spawning individuals creating a new redd directly over an existing redd) may occur in the stream reaches selected for egg collection. This poses a potential problem for collection efforts, as less developed embryos could be disturbed during the collection of older, eyed-eggs in the redd below. Although redd disturbance from superimposition does occur naturally in streams and can lead to mortality of the embryos in the underlying redd (Groot and Margolis 1991), precautions would be taken to avoid such disturbances and adverse effects induced by the proposed collection methods. Spawning surveys would be conducted weekly to mark redds, estimate the date of spawning, and note any newly superimposed redds. Locations would be avoided where superimposition has been recorded in the surveys, and new locations selected. If pre-eyed eggs are observed during collection, efforts would cease and new sites would be selected.

Feather River Hatchery egg collection

Adult spring-run Chinook salmon would be spawned onsite at the FRH and the resulting fertilized eggs would be retained as broodstock. This collection technique would require the sacrifice of adult salmon and the artificial incubation of the fertilized eggs.

After fertilization, the eggs are unlikely to be disturbed until the eyed-egg stage when they would be addled (bounced) to separate the live and dead eggs. It is unlikely that the jostling of the embryos could elicit a “shock” response because the embryos are fairly resistant to jostling by this stage of development (Billard and Jensen 1996, ADFG 2010). The protocols set forth in the Hatchery and Genetic Management Plan for Feather River Hatchery spring-run Chinook salmon (Cavallo et al. 2009) would be followed to minimize any additional adverse effects.

To reduce disease and egg mortality, iodine would be flushed through the incubators on a daily basis. During times that increased mortality may be anticipated, fish health would be monitored by CDFG Fish Health Laboratory personnel and diagnostic procedures for pathogen detection would follow American Fisheries Society professional standards as described in Thoesen (1994). Appropriate treatments would be recommended or prescribed by a CDFG Fish Pathologist/Veterinarian and follow-up examinations would be performed as needed (Cavallo et al. 2009). The use of these protocols has resulted in a 72 percent survival to hatching rate, with survival rates reaching 85 percent in recent years (Cavallo et al. 2009).

Juvenile Collection

Stream seining

Stream seining activities have the potential to cause stress, injury, or mortality to juvenile Chinook salmon. The presence of sampling gear and personnel in-stream can cause disturbance to juveniles at the collection site, and the attempted collection of individuals with a seine may elicit stress, including stress for escaped juveniles. The brief acute stress experienced by individuals eluding capture may be similar to the effects experienced during predator escape, and although the disturbance may temporarily cause elevated cortisol levels (Weber et al. 2002), the effect is most likely transitory if no further disturbance occurs. The stress response can be greater for captured juveniles, as multiple and prolonged stresses from the capture, hauling, and handling can be cumulative (Weber et al. 2002, Kelsch and Shields 1996). Such stress-related effects can lead to reduced capacity for activity, and difficulty with osmoregulation in the short-term; and reduced disease resistance, decreased growth, and decreased reproductive capacity in the long-term (Kelsch and Shields 1996, Weber et al. 2002). However, these effects are directly related to the severity and duration of the stressors (Barton 2002). Maule et al. (1998) found that physiological conditions of juveniles were impaired during the first 24 hours after collection, but a period of 12-48 hours was adequate for recovery from collection stress. Although the collection method was different (dip-basket rather than seine), it is likely that a similar recovery time may be required.

In addition to the induction of stress, the hauling and handling of the individuals can cause adverse effects; such as the removal of beneficial mucous lining, scale loss, or damage to fins, which in turn could decrease immune response and predispose fish to disease (Gadomski et al. 1994, NMFS 2003). Although physical damage to juveniles is possible during collection, the stress associated with the injury may subside after 12 hours (Gadomski et al. 1994).

To minimize the adverse effects to juveniles, optimal handling methods and protocols would be implemented and follow methods outlined in Hahn et al. (2007). Disturbance stress would be minimized by preparing gear onshore rather than in-stream and by reducing the number of personnel in the water during collection. To decrease the stress and injury associated with collecting and hauling juveniles, the seine net would remain in the water where fish can swim freely prior to processing and handling. Debris and large cobbles would be avoided when possible during collection; and such hazards, if encountered, would be removed from the net prior to landing to avoid crushing or impinging juveniles.

Rotary screw traps

RSTs have the potential to cause stress and injury to juveniles from overcrowding in the live box, as well as possible injury or death from debris buildup. Fish captured in the live box also are vulnerable to in-trap predation by other fish and mammals if the traps are not emptied on a frequent basis (NMFS 2003). The effects of stress and physical injury are similar to those that may be induced during stream seining, and recovery from the stressors and the stress associated with injury could subside over a short period of time (Gadomski et al. 1994), but is dependent on the severity and duration of these stressors (Barton 2002). Additional stress or physical damage is possible during the removal and handling of juveniles from the live box. These effects can be minimized by following the proper netting techniques and collection protocols found in USFWS (2008) *Draft Rotary Screw Trap Protocol for Estimating Production of Juvenile Chinook Salmon* developed for the CAMP, which suggests that the live box be checked a minimum of twice per day, or more (as needed) based on stream conditions (during periods of increased stream discharge and high debris loading).

Electrofishing

NMFS (2003) states that electrofishing as a method of capture can result in a variety of effects ranging from simple harassment and injury to mortality. Electrofishing can also result in trauma to fish from stress, but it is frequently unrecognized because the fish often appear normal upon release. Recovery from this stress can take up to several days, and during this time the fish are more vulnerable to predation, and less able to compete for resources. Stress related deaths can also occur within minutes or hours of release, with respiratory failure usually the cause. In addition to stress, there is a risk of injury, of which there are two major types: hemorrhages in soft tissues and fractures in hard tissues (Reynolds 1996). NMFS (2003) states that the waveforms produced by the electrofisher largely determine the likelihood of these injuries.

Continuous direct current or low-frequency (30 Hz) pulsed direct current have been recommended for electrofishing (Fredenberg 1992, Snyder 1992, Snyder 1995, Dalbey et al. 1996) because reduced spinal injury rates occur with these waveforms (Fredenberg 1992, McMichael 1993, Sharber et al. 1994, Dalbey et al. 1996). The age or stage of development of the target species also affects the likelihood of injury. The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish intercept a smaller head-to-tail potential than larger fish (Sharber and Carothers 1988) and may therefore be subject to lower injury rates (Hollender and Carline 1994, Dalbey et al. 1996, Thompson et al. 1997).

To minimize the adverse effects to juveniles during collection, all electrofishing would be conducted by field crew personnel trained and experienced with electrofishing techniques. Collection would follow the guidelines set forth by NOAA Fisheries (2000) titled *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act.* To further reduce stress and injury, fish would be removed from the electrical field quickly before coming in contact with the electrode, and the voltage would be adjusted to the minimum necessary for collection. Field crew personnel would constantly monitor the condition of the fish being collected and would change or terminate collection efforts when signs of injury, mortality, or other indications of fish stress appear.

Passive sampling (fyke nets and minnow traps)

NMFS (2003) states that fish captured with fyke nets and minnow traps are less stressed than fish captured with entanglement gears. However, the use of these nets can cause abrasion to fish from the shaking of fish down into the collection end prior to removal. Fish caught in traps could experience stress, injury or death from overcrowding or debris buildup if the traps are not emptied on a regular basis (NMFS 2003). Fish caught in traps are vulnerable to in-trap predation by other fish that are able to enter the trap (NMFS 2003). Captured fish may also experience temperature stress if the traps are placed in non-shaded areas or not checked frequently.

To reduce the likelihood of adverse effects of passively trapping juveniles, the nets and traps would be checked twice per day, or more, if needed based on stream conditions (during periods of increased stream discharge and high debris loading). This would greatly minimize the in-trap predation, temperature stress and possible injury from debris buildup. Similar to stream seining, optimal handling methods and protocols would be implemented to reduce removal and handling stress and minimize injury to juveniles (Kane et al. 2000).

Delta collection (trawls and Delta pumps)

Juveniles collected in the Kodiak and midwater trawls, or entrained in the Delta pumps, would be placed into holding tanks. The effects of stress and physical injury are similar to those that may be induced during rotary screw trapping, and include stress and possible injury from removal, handling and processing. Once collected, genetic samples would be taken from potential spring-run juveniles, and could induce further stress and injury depending on the handling time and amount of tissue removed. To reduce the likelihood of adverse effects, optimal handling methods and protocols would be implemented; juveniles would be anesthetized during tissue sampling and given time to recover before being transported to the Conservation Facility.

Processing of juveniles

Measuring, weighing and additional processing activities would require netting, removal and handling of the juveniles. Such activities could induce stress or result in the removal of beneficial mucous lining, scale loss, or cause damage to fins (Gadomski et al. 1994, NMFS 2003). To minimize the likelihood of such effects, anesthesia would be administered to juveniles during such activities. Dosage and administration would follow the protocols outlined for each collection method. All processed fish would be allowed to recover before being transported.

Although physical damage may occur during collection, handling and processing, the stress associated with the injury may subside after 12 hours (Gadomski et al. 1994).

Adult Collection

Feather River Hatchery

For effects, see *Egg Collection* section, *Feather River Hatchery egg collection* subsection above.

Rescue/salvage operations

Although stranded fish rescue operations are considered a possible broodstock collection method, it is not considered a preferred method. The holding and transporting of adults can result in high mortality, especially for adults already under heavy environmental stress (e.g., high water temperatures, low dissolved oxygen concentrations). The adults collected under these conditions may not be ripe and may require extended holding times, causing further stress and probable mortality. The Interagency Fish Rescue Strategy (2009b) developed by NMFS, Service, and CDFG considers fish rescue efforts a last resort. It remains unclear what the long-term survival benefits are and what the consequences could be for translocating rescued fish (e.g., disease, competition and genetic concerns). If collection via salvage operations is used, the effects could be minimized by spawning ripe fish on-site, which may reduce the mortality associated with excessive handling and transport (see *Donor Rearing: Individual-level effects* section, *streamside incubation* and *on-site egg-take* subsections for effects of these specific actions).

Tangle Nets

If the adult escapement for the donor streams is larger than expected, adult collection from Butte, Deer and Mill creeks may be a possibility. If this collection method is employed, tangle nets would be used to collect adults. A major benefit of tangle nets over gill nets is that fish captured are not "gilled", but rather snagged by their teeth, which greatly minimizes the stress and injury to the fish because they continue to respire while in the net (Ashbrook et al. 2007). However, the use of these nets can still elicit a stress response. To minimize such an effect, optimal handling methods would be followed using Ashbrook et al. (2007).

An additional concern with this collection method is that it may capture adults that are unripe. This would require the holding or the transport of unripe adults until ripe, which may cause further stress and possible mortality. If this sampling technique is used, the effects could be minimized by spawning ripe fish on-site, or holding adults on-site until ripe, thus reducing the mortality associated with excessive handling and transport.

Spring-running others

Other Central Valley tributaries (e.g, the Mokelumne, Stanislaus and Yuba Rivers; and Battle and Clear creeks) may receive spring-running others which could be used as broodstock for the Conservation Program. Similar to adult collection at the Feather River Hatchery, the adults may experience stress and injury from handling and processing. To reduce the adverse effects of capture, optimal handling methods would be followed and specific transport protocols would be implemented (see *Transportation effects* section, *Adults* subsection).

Transport effects

Eggs

Possible adverse effects to the collected eggs could occur in the transport process, including ionic and respiratory disturbance of the egg membrane, the spread of disease to other eggs, injury due to jostling, or death if the membrane is ruptured or punctured (ADFG 2010, Thedinga et al. 2005). To minimize these effects, eggs would be placed in a specialized shipping container to reduce excessive movement and limit damage to the egg membrane. An iodine bath would be administered during transport to disinfect eggs and to limit the spread of disease to other embryos. The eggs would also be disinfected again upon arrival to the rearing facility.

Juveniles

The transfer and holding of fish could cause adverse effects to juveniles including, stress, injury and mortality. Juveniles can easily become stressed if the ionic balance, pH, dissolved oxygen concentration, or the water temperature in the transfer tank differs greatly from the source water (NMFS 2003). Also, a high stocking density of juvenile salmonids could elicit a stress response (increased cortisol levels) in individual fish, leading to reduced fitness, vulnerability to additional stressors, and possible mortality (Barton et al. 1980).

To minimize the potential effects of transporting juveniles, transfer protocols would be followed that would monitor and maintain dissolved oxygen and isotonic water concentrations, temper the water temperature to with two degrees Celsius of the receiving facility, and maintain an appropriate stocking density. The maximum allowable density index would be 0.15 lb/ft^3/in as proposed by Banks (1994) Ewing and Ewing (1995) for spring-run Chinook salmon.

Adults

Adult spring-run Chinook salmon would be transported using the same methods used for transporting juveniles described above. Adult fish would be transferred to and from transport tanks using “in-water” in purse-style stretchers that hold both fish and water (e.g. water-to-water transfer). Direct netting of fish will be minimized to the greatest extent possible to reduce injury and fish stress.

Ecosystem (Indirect) Effects

Stream disturbance

In-stream activities, such as, standing and walking in the stream and dragging nets along the streambed can dislodge gravels, displace benthic macroinvertebrates, scrape algae off rocks and send pulses of sediment downstream. These effects could temporarily modify the foodweb, and thus have an indirect effect on the juveniles feeding in these reaches. However, the effect is probably temporary and may mimic the natural disturbance that already occurs in salmon spawning streams. Honea and Gara (2009) found that changes to the aquatic macroinvertebrate community following redd construction was substantial and resulted in lower biomass and density of invertebrates, but they concluded that macroinvertebrates in spawning streams may be well adapted to this seasonal disturbance, as their high reproductive rates and mobility allow them to quickly recover from frequent disturbances. Although human disturbance to the stream substrate would occur during the collection of broodstock, it is not likely to have long-term indirect effects on Chinook salmon in the donor streams. To minimize any impact that may occur, stream disturbance (via walking, standing or net dragging) would happen only when necessary and by as few individuals as possible.

Marine derived nutrients and carbon availability

It is widely accepted that marine derived nutrients (via adult salmon carcasses) are vital for the growth of juvenile salmonids (Bilby et al. 1998, Bilby et al. 1996). Removal of broodstock from donor streams may limit the number of returning adults and thus decrease the availability of marine derived nutrients and carbon in the stream system. However, the broodstock collected from the donor streams would be limited to a number that would not have an adverse impact on the population (see *Donor Stock Collection: Population level effects* section). There should be virtually no impact of broodstock collection on the marine derived nutrients or carbon availability in the donor stream systems.

Population Level Effects

Up to three federally-listed populations would be directly affected by the Conservation Program. The three potential source populations that may be directly affected include the three largest stocks of spring-run Chinook salmon in the Central Valley: the Feather River, Butte Creek, and Deer/Mill Creek Complex.

The implementation of the proposed activities, as described (see *Description of the Proposed Action*), would be within prescribed limits by the Decision Matrix approach, and therefore have no direct adverse effects to any of the donor stock populations. Donor stocks may benefit by the establishment of another population of spring-run Chinook salmon (extension of range); provision of future possible source stock to help bolster the population of any of the donor sources in the future; a possible refugial population in case of large-scale geographic catastrophe in the northern tributaries; and, in some cases, reduction of crossing with fall-run through management practices implemented as part of this activity.

The donor populations would be monitored per ongoing programs (see above) and the collection of spring-run Chinook salmon for reintroduction in the Conservation Program would be determined and authorized according to the results of the monitoring and through continuing discussion between the implementing agencies. At no time would the collection exceed a level that has been determined to be a threshold beyond which the potential for additive loss to the donor population is likely to occur (see Decision Matrix, *Appendix A*).

Adults collected as rescued individuals would have no effect on the donor source population, as that individual by virtue of having been designated for rescue would have been determined to no longer be a part of the effective population of that donor source population.

A seasonal census would be used to determine the number of returning adult spring-run salmon to each of the potential donor sources. The results of these surveys would be reported to NMFS, and based on that information the allowed quota for collection for that year would be set including methods to be used, numbers, and life-stages that could be collected from each potential donor source (see *Appendix A*). Any year in which it is determined that a donor population cannot sustain removal of any portion of its population, a moratorium would be placed on collection from that population until it has been determined that the population is once again able to sustain collection activity.

For detailed descriptions of methods and protocols that would be implemented during the collection of donor stocks see the *Donor Stock Collections* in the *Project Description* section above. For a proposed metric for threshold and limits for collection from donor stock sources see Appendix A.

Conservation Stock Rearing

Individual-Level Effects

Incubation and rearing operations would occur at an interim facility until 2014, at which time operations would transition to the full-scale Conservation Facility. All activities and minimization measures mentioned in the subsections below would be implemented at both the interim and full-scale Conservation Facilities.

Egg and juvenile introduction into the facility

It is possible that various pathogens from the donor stocks could be introduced to the rearing facility and cause disease in the other introduced stocks. To minimize this risk, the facility would implement specific fish health maintenance and sanitation procedures similar to those used at the Feather River Hatchery (Cavallo et al. 2009). The procedures would differ based on the developmental stage of the fish. The wild-collected eggs brought into the facility would be disinfected with 10-minute bath treatment using a solution containing 100 parts per million (ppm) of free iodine, and the juveniles would undergo a two-week quarantine period. During this quarantine, they would be screened for the presence of specific pathogens and treated with an eight-hour oxytetracycline bath and a three day course of a 170 ppm formalin drip.

Incubation

After disinfection, eggs would be placed in incubation trays, which may jostle the eggs and elicit a "shock" response (see *Redd extraction* subsection for specific effects). Depending on the source of the eggs, they may enter the facility as water-hardened eggs (several hours post-fertilization) from the FRH or as eyed-eggs (about 30 days post-fertilization) from Butte, Deer or Mill creeks.

If eggs are water-hardened they have not reached their most sensitive stage (gastrulation) and remain slightly resistant to disturbance and "shock" (Jensen and Alderdice 1983). Similarly, the jostling or heavy movement of eggs in the eyed-stage is unlikely to result in mortality, as the embryos are fairly resistant to disturbance by this stage of development (Billard and Jensen 1996, ADFG 2010). However, care would be taken to ensure that the eggs are moved only when necessary and would follow the FRH HGMP (CDWR 2009).

Once hatched, eggs incubated in the deep matrix boxes would volitionally swim from the incubator into a holding tank, whereas the eggs in the vertical tray incubators would require hand transfer into a holding tank. The latter would require further handling, which could elicit stress or induce injury (NMFS 2003). The adverse effects of handling would be minimized by using water-to-water transfer rather than direct netting to reduce injury and stress, and further minimized by following the FRH HGMP protocols (CDWR 2009). Once fish enter the holding tanks, they would remain there for the duration of their rearing.

Rearing

Juveniles would either be reared from eggs or directly introduced to the facility as juvenile broodstock. Donor stock juveniles would be transported from the transport trucks into the holding tanks. The potential adverse effects to the juveniles during the transfer process are similar for the fry (see *Incubation* subsection above), and the effects would be minimized following the same protocols.

The biggest threat to the broodstock in the rearing facilities is exposure to diseases and other pathogens. To minimize the likelihood of infections, all fish would be monitored by CDFG pathologists, and treatment methods and protocols prescribed for disease outbreaks would be implemented.

Depending on the cause of an outbreak, treatment methods may vary. Chemical treatments for external pathogens may include the use of salt, $KMnO_4$, formalin or hydrogen peroxide, and bacterial infections may require the use of oxytetracycline, florfenicol or other approved antibiotics. All treatment would follow veterinary guidance. Sanitation procedures would be implemented, and include the following:

- All cleaning equipment and nets would be disinfected in iodine-based disinfectant prior to use and separate cleaning instruments would be kept for each culture tank.
- Routine pathology health assessments would be carried out to maintain the health of all hatchery stocks. Fish would be monitored daily for behavior and physical abnormalities. Fish exhibiting abnormal behavior would be screened for pathogens. Sick fish would be promptly examined by the California Department of Fish and Game State Fish Health Lab.
- Feeding practices would be continuously monitored to avoid uneaten feed at the bottom of the rearing tanks and feed would be stored according to manufacturer recommendations to avoid fish health problems related to mycotoxins and rancidity, and feed would be used within the time recommended by the manufacturer.
- Water flushing rate would be maintained at a minimum of one turnover per hour and rotational water velocities would be elevated daily to improve water quality and tank sanitation.
- Sidewall viewing windows would be installed on all large tanks for increased fish health and tank sanitation monitoring.
- Dead or dying fish would be removed promptly from each rearing tank and necropsied. Dying fish would be humanely euthanized immediately after removal from rearing tank.
- The water supply would be micro-screened with a minimum pore size of 80 microns to reduce pathogen loads, and the water supply for early rearing would be further treated with ultraviolet filtration.
- Weekly prophylactic salt flushes would be administered throughout the duration of captive broodstock holding.

A high stocking density of juveniles could elicit a stress response (increased cortisol levels) in individual fish, leading to reduced fitness, lower growth rates, a vulnerability to additional stressors and possible mortality (Barton et al. 1980). To minimize density induced effects, the maximum-allowable-density index would be 0.15 $lb/ft^3/in$, as proposed by Ewing and Ewing (1995) and Banks (1994) for spring-run Chinook salmon.

Human-induced disturbance could also invoke a stress response in rearing juveniles. To reduce the likelihood of this effect, human-fish contact would be minimized and culture tanks would be cleaned no more than once per month, unless required by sanitary conditions. Additionally, flushing rates would be maintained at a minimum of one turnover per hour to reduce stress and disease potential. The tanks would be designed with the ability to self-clean, allowing improved water quality and minimized human to fish contact.

To avoid any adverse effects of water quality on the fish, specific parameters would be monitored. Dissolved oxygen levels would be generally maintained between 80-100 percent saturation and not allowed to drop below 70 percent saturation. Studies indicate the benefits of high dissolved oxygen levels in fish culture (Westers 2001). Both total suspended solids (Timmons and Ebeling 2007) and carbon dioxide levels would be maintained at or below 10 mg/L (Piper et al. 1982).

There is growing concern that reared fish could exhibit hatchery induced selection due to rearing conditions. The use of natural rearing methods is a relatively new phenomenon (Flagg and Nash 1999), but the Conservation Program would institute natural rearing techniques to provide the most promise for increasing the reproductive fitness of fish for the Conservation Program. The methods to be employed include the following:

- Promote development of body camouflage coloration in juvenile fish by creating more natural environments in hatchery rearing vessels, for example, overhead cover, and in-stream structures and substrates.
- Condition young fish to orient to the bottom rather than the surface of the rearing vessel by using appropriately positioned feed delivery systems.
- Exercise young fish by altering water-flow velocities in rearing vessels to enhance their ability to escape predators (the ability to adjust water velocities to target optimal swimming speeds for salmonids has been shown to improve growth rates, feed efficiency, oxygen utilization, swimming performance and stamina, and to reduce aggression).

Tagging, marking, measuring of juveniles during rearing

Reared juveniles would be measured and weighed, marked with adipose fin-clips, Coded Wire Tags (CWT) and PIT tags. All measuring and marking activities would require netting, removal and handling. Such activities could induce stress or result in the removal of beneficial mucous lining, scale loss, or cause damage to fins (Gadomski et al. 1994, NMFS 2003). To minimize the likelihood of such effects, anesthesia would be administered to juveniles during measuring and weighing activities and PIT tag implantation. Dosage and administration would follow protocols outlined in the FRH HGMP (CDWR 2009). An automated system that is quick and efficient would be used for adipose-fin clipping and CWT implantation. All processed fish would be allowed to recover before returning to the rearing tanks. Although physical damage from tag implementation is likely, the stress associated with the injury may subside after 12 hours (Gadomski et al. 1994).

Alternative Incubation Methods

If the interim facility or Conservation Facility is unable to house additional donor stock eggs from collected adults, or it is not appropriate to do so, alternative methods to facility incubation are proposed. In such cases, in-stream incubator boxes, streamside incubators, or egg planting options would be utilized (see *Donor Stock Release/Reintroduction section, Eggs subsection* for specific details).

Instream incubation boxes

The instream incubation box method involves incubating eggs in flow-through containers buried in the stream bed. There is a risk that the appropriate water temperature and velocity in the stream could be too high and cause egg damage or mortality. In some cases, the boxes may fill with fine sediment, which could suffocate incubating eggs. However, this is largely dependent on the specific stream conditions, and instream incubation boxes would not be used where sedimentation poses a risk. As in natural redds, there is also increased risk of disease and fungus outbreaks. Whitlock-Vibert slotted boxes would likely be used, which would facilitate the examination and removal of dead eggs to minimize the likelihood of pathogen outbreaks.

Streamside incubators

Streamside incubators would be erected along the stream banks and filled with freshly fertilized or eyed eggs. Similar to instream incubation, there is a risk that the stream water temperature could be too high or water quality could be poor and cause egg damage or mortality. However, there is little risk of sedimentation because the box would be placed on the bank rather than in-river. Vandalism and tampering could occur, so placement of the boxes in less accessible areas would generally be required.

Egg planting

Eggs would be injected into suitable spawning habitat to simulate natural incubation. The process of injecting the eggs into the gravels may cause damage or “shock” to the embryo. For eggs injected into the gravels, fine sediments may limit permeability and suffocate eggs. Similar to other stream incubation methods, temperature and water quality are concerns. However, these would be natural conditions and could not be altered. To minimize the likelihood of these effects, egg injection would not occur until the eggs were fairly resistant to “shock” (at the eyed egg stage), and the gravels would be thoroughly “pumped” with an injector to remove the fine sediments before egg planting. Risk of vandalism and tampering would be low because the planted redds are rather inconspicuous.

Population-Level Effects

Survival Rates

Although there is inherent risk and likelihood of mortality associated with hatchery rearing, the survival rates are significantly higher in a rearing facility than under natural conditions. Following the FRH HGMP (CDWR 2009), the FRH has had a 72 percent survival to hatching rate for their facility, with survival rates reaching 85 percent in recent years. Survival rates under natural conditions usually do not exceed 40 percent (EA 1992). The use of instream incubation, streamside incubation and egg planting may result in higher survival rates as well, but no research has been conducted to date.

Catastrophic Events

There is inherent risk of catastrophic events or disasters occurring during rearing facility operations, and such events could have devastating consequences for the broodstock. Such events could range from water shortages to electrical outages.

Water deliveries have been very reliable in the existing adjacent trout hatchery which receives water from the same major supply line as the interim and Conservation facilities. In the past 55 years, there was one major interruption to water flow that occurred in 1992 when a work crew accidentally ruptured the main line. For the Conservation Program's facilities, the water delivery system would be gravity fed, thereby reducing risk of interruption to flow by eliminating the use of electric pumps that are susceptible to failure by power outages. In addition, each tank would contain a water monitoring and alarm system that would alert culturists to low dissolved oxygen levels, interruption to water flow, high or low water temperatures, or high or low water levels. The monitoring system would be integrated with a backup oxygen system that would trigger a solenoid for the supply of gaseous oxygen from compressed oxygen cylinders in the event of low oxygen conditions.

Flooding occurred at least once in recent history, when in 1997 the trout hatchery raceways were inundated by floodwater due to high river flows. At that time, many fish from the trout hatchery escaped to the adjacent SJR. In the event of future flooding, it is likely that fish from both facilities would again be released to the river. In a case such as this, it is unlikely that it would result in 100 percent mortality (since fish would be able to escape to the SJR), but depending on the time of occurrence and stage of development, fish may be less likely to survive in the mainstem river. Measures would be taken to prevent fish loss during a flood event by netting the tops of fish tanks.

Experimental Stock

The goal of the Conservation Facility is to restore naturally reproducing, viable spring and fall-run Chinook salmon populations, and so its success is marked by the ability to ultimately phase out hatchery production of fish. This will reduce the negative influences that continued hatchery supplementation can have on the re-established spring- and fall run Chinook salmon populations. Modification of spring- or fall-run Chinook salmon hatchery production should be determined by an adaptive management approach given the likely uncertainty of initial restoration phases. Genetic accommodation of the natural population, quantitative natural population targets (e.g. N_e, census size, genetic diversity), and other community and ecosystem indicators of reintroduction success will be derived and periodically evaluated to phase out hatchery production. Hatchery production phase out is further detailed in the HGMP (Appendix 9.4). Additionally, uncertainties such as local habitat change, climate change, and others, should be given consideration in phase out determinations.

Density-dependent mechanisms contribute to predator avoidance, feeding behavior, migration patterns, and survival in juvenile salmonids, so care needs to be taken to translocate enough individuals to minimize alteration of natural behaviors and to achieve a detectable level of adult returns from the effort.

Individual-Level Effects

Transport to San Joaquin River

Several life stages of fish would either be transported from the Interim or Conservation Facilities or transported directly from donor streams to the SJR. Disease transmission could occur since equipment would be shared from these different sources. To minimize the introduction of pathogens, transport tanks, containers and equipment would be disinfected with an iodophore prior to use and between sources.

The transport of various life stages has different risks and effects. Possible adverse effects to eggs include: ionic and respiratory disturbance of the egg membrane, injury due to jostling, or death if the membrane is ruptured or punctured (ADFG 2010, Thedinga et al. 2005). To minimize these effects, eggs would be placed in a specialized shipping container to reduce excessive movement and limit damage to the egg membrane. The eggs would not be transported until they are fairly resistant to "shock," at the eyed-egg stage. For juveniles, the transferring process could cause stress, injury and mortality.

Juveniles can easily become stressed if the ionic balance, pH, dissolved oxygen concentration or the water temperature in the transfer tank differs greatly from the source water (NMFS 2003). Also, a high stocking density of juvenile salmonids could elicit a stress response (increased cortisol levels) in individual fish, leading to reduced fitness, vulnerability to additional stressors and possible mortality (Barton et al. 1980). To minimize the potential effects of transporting of juveniles, transfer protocols would be followed that would monitor and maintain dissolved oxygen and isotonic water concentrations, temper the water temperature to within two degrees Celsius of the receiving stream, and maintain an appropriate stocking density.

In rare instances, adults may be transported from the rearing facilities or from the donor streams for stocking in the SJR. Similar to effects of transport on juveniles, adults could easily become stressed, incur injury or possibly die from a combination of these conditions. The effects would be minimized in a similar manner, water quality and temperatures would be maintained and the stocking density would not exceed 0.15 lb/ft^3/in as proposed by Banks (1994) and Ewing and Ewing (1995) for spring-run Chinook salmon.

Effects of Release

The reintroduction of fish collected from spring-run donor populations for direct release into the San Joaquin in the near-term has some challenges. Specifically, river restoration projects are not anticipated to be completed until 2016, yet salmon reintroduction would begin in 2012.

Eggs would be introduced into the SJR either in in-stream or streamside incubation boxes or by egg planting in the river gravels. Juveniles could be either directly released or placed in temporary holding cages for imprinting prior to release. Adults, if used, would be directly released and consist of collected fish from rescue operations or from the rearing facility.

Eggs

The effects of incubating eggs outside of the rearing facility are discussed in *Donor Stock Rearing: Individual-level effects* section, *Alternative rearing methods* subsection. There are few ways to minimize the effects, as they are largely affected by stream conditions. However, acclimation stress could be minimized, and eggs would be tempered to the receiving water by increasing the egg temperature 1 ºC per hour until matching the receiving water temperature.

Incubating in-stream or streamside would allow for imprinting opportunities and information on egg survival in the SJR, which would inform decisions for future stocking and provide estimates of survival during natural spawning events.

Juveniles

Direct release of juveniles collected from donor stocks into the SJR could be achieved on the same schedule as they are collected. This would simulate the same temporal distribution of rearing and outmigration observed by the donor source. Holding pens could be used for one to two hours to allow the fish to acclimate prior to release to reduce the risk of predation (Fisheries Foundation 2009). Additionally, holding pens could be used to cue fish to different reaches of the river by simulating downstream migration. Slatik et al (1995) showed sequential exposure imprinting techniques that significantly improved homing to release location. Since all passage improvements to the river may not be complete by the time reintroduction is mandated, this staggered holding pen approach may be one option to move fish through the river system and move them around passage impediments while improving imprinting. One disadvantage may be releasing too few fish at a given time, disrupting densities and schooling behaviors. The transportation and release of fish as they are collected on a daily or weekly basis also increases the frequency and logistics in transporting and releasing fish to the SJR.

An alternative to direct release into the SJR is to temporarily hold juveniles in a net pen with recirculating SJR water to assist with imprinting, acclimation, and natural schooling behaviors. Quinn et al (1989) linked homing to changes in thyroid hormone levels during smoltification and the onset of migration in salmonids. The temporary use of holding pens may provide time during the smolting process for fish to imprint on the SJR and maximize their likelihood of successfully navigating back to their reintroduced location to spawn. Smolt survival studies with juvenile salmon from the Feather River and Merced River hatcheries that released smolts with coded-wire-tags near Mossdale and Dos Reis in the SJR Delta indicate that the out-of-basin juvenile salmon returned at low rates to the San Joaquin Basin compared to the Merced River Hatchery smolts. Only a mean of 37% of the FRH smolts returned to the San Joaquin Basin from 1995 to 2000 compared to 83% of the Merced River Hatchery smolts from 1998 to 2000 (DFG CWT database, methods described in Mesick et al. 2009). Smolts released at Mossdale probably only spent about 2 days before they encountered Sacramento River flows via the Mokelumne River.

It is possible that by holding Sacramento Basin juveniles in pens in the Restoration Area for several days, imprinting and adult returns to the Restoration would be improved. In addition, keeping juveniles in holding pens for at least one to two hours allows the fish to acclimate prior to release and reduces the risk of predation (Fisheries Foundation 2009). The use of temporary holding cages would also allow collection of juveniles from donor stocks over a period of time until a group of fish have been amassed and released together. Juvenile salmon outmigrate in groups, which are thought to occur primarily to reduce mortality due to predation. Temporarily holding fish and releasing them in a series of groups may therefore more closely resemble the densities experienced during rearing and outmigration and increase their survivorship.

Adults

The introduction of adults into the SJR may induce heavy stress to these individuals, especially if environmental conditions are not optimal (e.g., high water temperatures, low dissolved oxygen concentrations). Adults may have stress-induced mortality from excessive handling and transport and from the stress of acclimation. The effects could be minimized by slow acclimation in the holding tank and reducing the transport and handling times.

Instream conditions

Restoration of the mainstem of the SJR is anticipated to begin several years following the introduction of fish. Before restoration is completed, the in-stream conditions may limit the growth potential and the survival rates of the introduced eggs and juveniles.

The water temperature modeling has not been completed, but it is likely that in the summer months the stream temperatures may reach lethal limits, especially with the lack of a riparian zone to shade the stream. If adequate pools and in-stream cover is available, they could serve as refugia from the high summer temperatures. However, it is unknown how many pools may be available. The flows during these warmer months may also be limited and are based on the releases from Friant Dam. If the flows are inadequate, they would create limiting reaches that are impassible by both adults migrating upstream and juveniles emigrating downstream. The limited flows may also create low dissolved oxygen concentration conditions which would also be problematic for juveniles.

Food availability is another concern in the SJR. However, the flows are anticipated to be rather high during the winter and spring months which would result in inundation of floodplain habitat; a rich source of food for juvenile salmonids, but it is unclear if the seasonal spates (flood pulses) would inundate these floodplains for long enough to supply this food source.

Additionally, there are concerns about contaminant levels in the river reaches slated for reintroduction. For example, pesticides in return drains or selenium and other subsurface drainwater constituents from Mud Slough (north) via the Grasslands Bypass Project (GBP) releases. Significant spikes of selenium concentrations have been observed at Hills Ferry (approximately mile 118) on the SJR. Recent GBP monthly monitoring reports documented elevated selenium concentrations at the Hills Ferry sampling station H for 6 months from August 2009 through January 2010.

Elevated concentrations of selenium in the SJR from sources including the GBP will likely be problematic to efforts to restore salmon runs to the upper SJR ecosystem through the SJRRP. Rivers and sloughs that carry agricultural drainwater have been found to concentrate selenium in invertebrates, small (prey) fish, and larger predatory fish. Selenium concentrations in the food-chain of these impacted waters have often reached levels that could kill a substantial proportion of young salmon (Beckon *et al*. 2008) if the salmon, on their downstream migration, are exposed to those selenium-laden food items for long enough for the salmon themselves to bioaccumulate selenium to toxic levels.

Saiki et al. (1991) documented that juvenile salmonids are present in the lower SJR for periods of time that are sufficient for them to accumulate selenium to levels that could cause mortality. Based on existing water quality data for selenium in specific reaches of the SJR, Beckon and Maurer (2008) concluded that there remains a substantial ongoing risk to migrating juvenile Chinook salmon and steelhead in the SJR.

These initial environmental conditions could be problematic for the survival of eggs and juveniles in the early years, but these effects would be minimized by the intense restoration work anticipated several years after the introductions begin. The restoration efforts would establish floodplain habitats, create in-stream cover, provide shaded streamside riparian habitat, and minimize the limiting reaches. These stream and habitat alterations would greatly increase areas of refugia, minimize stranding, reduce fluctuating water temperatures and provide floodplain food sources; all of which would greatly increase the likelihood of survival in the early life stages.

Spring-run Chinook salmon are required, per the Settlement to be reintroduced into the Restoration Area by December 31, 2012, which is prior to the completion of the first and second phases of channel and habitat improvements. The first phase of channel and habitat improvements is scheduled to be completed by December 31, 2013. These improvements include: (1) creating a bypass channel around Mendota Pool; (2) modifying channels in Reaches 2B and 4B to increase flow capacity; (3) modifying Eastside and Mariposa bypasses to create a low-flow channel; (4) modifying Reach 4B headgate and Sand Slough control structures to provide fish passage and convey flows up to 4,500 cfs into Reach 4B; (5) installing screens at the Arroyo Canal Water Diversion; (6) providing fish passage at Sack Dam; (7) modifying Eastside Bypass structures and Mariposa Bypass structures to provide fish passage; and (8) installing seasonal barriers at Salt and Mud sloughs (SJRRP 2010), are scheduled to be completed by December 31, 2013.

Before the Phase 1 and Phase 2 improvements have been made, fish passage barriers, entrainment, and in-stream conditions likely will limit the survival of eggs and juvenile fish, particularly in the reaches that are upstream from the planned improvement sites. It is anticipated that the FMWG will consider the level of completion for the planned channel and habitat improvements when determining the best location, timing, and number of fish and/or eggs to be reintroduced into the Restoration Area. In addition, monitoring will be conducted to determine whether passage is blocked by inadequate flow or unimproved flow control structures. If these targeted studies indicate that fish passage is impaired, trap-and-haul operations would be implemented to move the salmon to suitable habitats (SJRRP 2010).

These Phase 2 improvements include: (1) restoration of Chinook salmon spawning habitat; (2) actions to minimize in-river harvest, unlawful take, and disturbance, and (3) targeted studies of potential problems (e.g., entrainment at Chowchilla Bifurcation Structure and impacts of in-river mining pits), are scheduled for completion in December 31, 2016 (SJRRP 2010).

Trap and haul

It is anticipated that a number of major passage impediments will still be in place in the Restoration Area in the first years of the reintroduction. Likewise, returning adults would encounter these structural and biological barriers and would also require collection and transport upstream, thus encountering similar stressors and adverse effects as the adults collected in the donor streams. Early reintroductions would be maintained in cages and under the control of agency personnel during movement (which may include sequential *in-situ* residence periods along the stream course at locations chosen to test survival and provide limited selection pressure specific to the SJR, while imprinting the smolts).

The transport of juveniles and adults would follow optimal handling protocols to minimize the adverse impacts of these actions. The transport water would be oxygenated using bottled oxygen with aerators, and dissolved oxygen levels would be monitored and maintained near saturation during transport. When possible, fish would be moved in and out of the transport truck using a water filled vessel (i.e., water to water transfer) and without netting to minimize stress and loss of mucous lining. Adult fish would be transferred to and from transport tanks using in purse-style stretchers that hold both fish and water (i.e., water-to-water transfer).

Ecosystem (Indirect) Effects

Marine derived nutrients and carbon availability

The reintroduction of Chinook salmon to the SJR will likely result in adults returning and carcass deposition. It is widely accepted that marine derived nutrients (via adult salmon carcasses) are vital for the growth of juvenile salmonids (Bilby et al. 1998, Bilby et al. 1996). Bilby et al. (1998) found increased densities, body weight and improved condition factor of juvenile salmonids in stream reaches where salmon carcasses were added. Therefore, the presence of carcasses in the SJR would increase the availability of marine derived nutrients and carbon in the stream system and thus have a positive effect on rearing juveniles, possibly increasing the weight and condition factor of the fish, which may positively influence their survival rates.

Introduction of invasive species or pathogens

Reintroduction efforts could increase the potential for invasive species, such as New Zealand mud snail (*Potamopyrgus antipodarum*) and freshwater asian clam (*Corbicula fluminea)* to be transferred from one stream system to another (for a full list of potential non-target species, which could be transferred see Appendix D). Transfer of invasive species could occur in a number of ways, including nets and other equipment which has not been appropriately decontaminated prior to being used.

Population-Level Effects

The reintroduced spring-run Chinook salmon (i.e., experimental stock) in the mainstem SJR would also be a population affected by the proposed action. This stock does not yet exist, so no detailed review is possible at this time, but it is reasonable to anticipate a number of likely affects to the population as it is established in the upper SJR.

Predation

The initial reintroduced spring-run Chinook salmon will likely benefit from a period of depressed predation because of current conditions within the SJR. The periodic reduction and elimination of flow in some reaches of the restored mainstem of the SJR should limit the establishment of large piscivore predators within those reaches. This would likely be a temporary situation, and would not extend beyond those reaches that have until recently been without consistent flows of water. In addition, fish that are ultimately released culminating any trap and haul effort would be released at a number of different locations overtime to limit the establishment of large piscivore predators within the areas of release.

Habitat condition

Portions of the Upper SJR above its confluence with the Merced River have not had water flowing within the channel on a consistent basis since the construction of Friant Dam. As a result of lack of consistent river flows in the upper SJR, many habitat components generally accepted as necessary for salmon rearing are missing, or much reduced. These missing or reduced habitat features include, but are not limited to: a limited prey base, instream refugia, shaded streamside habitat, consistent water temperatures below 21^{o}C, floodplain foraging, and adequate dissolved oxygen levels.

Current construction schedules preclude full restoration of the habitat prior to the reintroduction of spring-run Chinook salmon to the upper SJR, and habitat that is currently being restored will not have had time to fully mature– therefore resources for juvenile salmon will be limited. This has the potential to create greater competition between individuals for the limited resources that will be available. However, these effects would be minimized as restoration is completed and restored habitat matures.

The upper SJR has been, and will continue within the foreseeable future to be, greatly influenced by the surrounding agriculture. A certain amount of agricultural waste water will likely influence the water chemistry of the SJR during the time that salmon are occupying the river. This agricultural runoff may adversely affect the salmon while they are exposed. However, the Central Valley Regional Water Quality Control Board has adopted several relevant Total Maximum Daily Loads (TMDLs) for many of the various chemical constituents (CVRWQCB 1996, 2002, 2010), which may limit the degree of salmonid exposure in the watershed.

Central Valley Evolutionarily Significant Unit (ESU) Effects

It is anticipated that the Conservation Program would expand the range and distribution of the ESU with the addition of a self-sustaining natural SJR population. The addition of these fish would increase the number of key populations within the ESU that could buffer the risk of extinction from environmental fluctuations, stochastic events and human, land– and water– use impacts.

Outmigration Effects

The reintroduced salmon occupying the lower reaches of the SJR, where populations of salmon of the San Joaquin/Sacramento River system are currently present, will experience the same effects as those already existing populations. This includes effects in the lower SJR, the Sacramento/San Joaquin Delta, San Francisco Bay and the marine habitat off the central coast of California.

Critical Habitat

The final ruling for Central Valley spring-run Chinook salmon critical habitat was published February 2, 2005 (50 **CFR** Part 226), and includes much of the Sacramento River Valley, its tributaries and the Sacramento-San Joaquin River Delta. The collection of donor stock for the proposed action will take place on Mill Creek, Deer Creek and Butte Creek, all of which are within critical habitat units and sub-areas. The locations proposed for reintroduction of fish are not within critical habitat. Central Valley Chinook salmon critical habitat is also considered critical habitat for Central Valley steelhead (*O. mykiss*).

Mill Creek and Deer creeks flow through two different critical habitat units, the *Tehama Hydrologic Unit* (5504) and the *Eastern Tehama Hydrologic Unit* (5509). The activities associated with the proposed action will take place within two sub-areas of the *Eastern Tehama Hydrologic Unit*, the *Deer Creek Hydrologic Sub-area 550920* and the *Upper Mill Creek Hydrologic Sub-area 550942*.

Butte Creek flows through the *Colusa Basin Hydrologic Unit* (5520) and *Butte Creek Hydrologic Unit* (5521), all activities associated with the proposed action will be within the latter unit and will be within the *Upper Little Chico Hydrologic Sub-area* 552130.

The proposed action, as described, will not destroy or adversely modify any designated critical habitat.

Essential Fish Habitat

Essential Fish Habitat (EFH) is defined by NMFS as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. "Necessary" means habitat required to support a sustainable fishery and a healthy ecosystem. "Spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The proposed effort would not have adverse effects on any Chinook salmon EFH.

Evolutionarily Significant Unit

An evolutionarily significant unit, or ESU, of Pacific salmon is considered to be a "distinct population segment" and thus a "species" under the Endangered Species Act. There are established two criteria for ESUs: 1) the population must show substantial reproductive isolation; and 2) there must be an important component of the evolutionary legacy of the species as a whole.

STATUS OF THE SPECIES

General Life History of Chinook Salmon

Chinook salmon exhibit two generalized freshwater life history types (Healey 1991). "Stream-type" Chinook salmon, enter freshwater months before spawning and reside in freshwater for a year or more following emergence, whereas "Ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over-summering by adults and/or juveniles.

Chinook salmon typically mature between 2 and 6 years of age (Myers et al. 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes. Runs are designated on the basis of adult migration timing. However, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and the actual time of spawning (Myers et al. 1998). Both winter-run and spring-run tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. Fall-run enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38ºF to 56ºF (Bell 1991, CDFG 1998). Boles (1988) recommends water temperatures below 65ºF for adult Chinook salmon migration, and Lindley et al. (2004) report that adult migration is blocked when temperatures reach 70ºF, and that fish can become stressed as temperatures approach 70ºF.

Information on the migration rates of adult Chinook salmon in freshwater is scant and primarily comes from the Columbia River basin, where information regarding migration behavior is needed to assess the effects of dams on travel times and passage (Matter and Sanford 2003). Keefer et al. (2004) found migration rates of Chinook salmon ranging from about 10 kilometers (km) per day to greater than 35 km per day and to be primarily correlated with date, and secondarily with discharge, year, and reach, in the Columbia River basin. Matter and Sanford (2003) documented migration rates of adult Chinook salmon ranging from 29 to 32 km per day in the Snake River. Adult Chinook salmon inserted with sonic tags and tracked throughout the Delta and lower Sacramento and San Joaquin rivers were observed exhibiting substantial upstream and downstream movement in a random fashion, for several days at a time, while migrating upstream (CALFED 2001). Adult salmonids migrating upstream are assumed to make greater use of pool and mid-channel habitat than channel margins (Stillwater Sciences 2004), particularly larger salmon such as Chinook salmon, as described by Hughes (2004). Adults are thought to exhibit crepuscular behavior during their upstream migrations, meaning that they are primarily active during twilight hours. Recent hydroacoustic monitoring conducted by LGL

Environmental Research Associates showed peak upstream movement of adult spring-run in lower Mill Creek, a tributary to the Sacramento River, occurring in the 4-hour period before sunrise and again after sunset.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. The upper preferred water temperature for spawning Chinook salmon is 55ºF to 57ºF (Chambers 1956, Smith 1973, Bjornn and Reiser 1991, and Snider 2001).

Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1995) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. The optimal water temperature for egg incubation ranges from 41ºF to 56ºF [44ºF to 54ºF (Rich 1997), 46ºF to 56ºF (NMFS 1997), and 41ºF to 55.4ºF (Moyle 2002)]. A significant reduction in egg viability occurs at water temperatures above 57.5ºF and total embryo mortality can occur at temperatures above 62ºF (NMFS 1997). Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 61ºF and 37ºF, respectively, when the incubation temperature was held constant. As water temperatures increase, the rate of embryo malformations also increases, as well as the susceptibility to fungus and bacterial infestations. The length of development for Chinook salmon embryos is dependent on the ambient water temperature surrounding the egg pocket in the redd. Colder water necessitates longer development times as metabolic processes are slowed. Within the appropriate water temperature range for embryo incubation, embryos hatch in 40 to 60 days, and the alevins (yolk-sac fry) remain in the gravel for an additional 4 to 6 weeks before emerging from the gravel.

During the 4 to 6 week period when alevins remain in the gravel, they utilize their yolk-sac to nourish their bodies. As their yolk-sac is depleted, fry begin to emerge from the gravel to begin exogenous feeding in their natal stream. Fry typically range from 25 mm to 40 mm at this stage. Upon emergence, fry swim or are displaced downstream (Healey 1991). The post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on zooplankton, small insects, and other micro-crustaceans. Some fry may take up residence in their natal stream for several weeks to a year or more, while others are displaced downstream by the stream's current. Once started downstream, fry may continue downstream to the estuary and rear, or may take up residence in river reaches farther downstream for a period of time ranging from weeks to a year (Healey 1991).

Fry then seek nearshore habitats containing riparian vegetation and associated substrates important for providing aquatic and terrestrial invertebrates, predator avoidance, and slower velocities for resting (NMFS 1996). The benefits of shallow water habitats for salmonid rearing have been found to be more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer et al. 2001).

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures (Healey 1991). Catches of juvenile salmon in the Sacramento River near West Sacramento exhibited larger-sized juveniles captured in the main channel and smaller-sized fry along the margins (USFWS 1997). When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Migration cues, such as increasing turbidity from runoff, increased flows, changes in day length, or intraspecific competition from other fish in their natal streams, may spur outmigration of juveniles when they have reached the appropriate stage of maturation (Kjelson et al. 1982, Brandes and McLain 2001).

As fish begin their emigration, they are displaced by the river's current downstream of their natal reaches. Similar to adult movement, juvenile salmonid downstream movement is crepuscular. The daily migration of juveniles passing Red Bluff Diversion Dam (RBDD) is highest in the 4-hour period prior to sunrise (Martin et al. 2001). Juvenile Chinook salmon migration rates vary considerably, presumably depending on the physiological stage of the juvenile and hydrologic conditions. Kjelson et al. (1982) found Chinook salmon fry to travel as fast as 30 km per day in the Sacramento River, and Sommer et al. (2001) found travel rates ranging from about 0.5 miles up to more than 6 miles per day in the Yolo Bypass. As Chinook salmon begin the smoltification stage, they prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (Healey 1980, Levy and Northcote 1981).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, SJR, the Delta, and their tributaries (Maslin et al. 1997, Snider 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960, Dunford 1975, Meyer 1979, Healey 1980). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982, Sommer et al. 2001, MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer et al. 2001). Optimal water temperatures for the growth of juvenile Chinook salmon in the Delta are between 54ºF to 57ºF (Brett 1952). In Suisun and San Pablo Bays, water temperatures reach 54ºF by February in a typical year. Other portions of the Delta (i.e., South Delta and Central Delta) can reach 70ºF by February in a dry year. However, cooler temperatures are usually the norm until after the spring-runoff has ended.

Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levings 1982, Levy and Northcote 1982, Levings et al. 1986, Healey 1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle et al. (1989) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson et al. (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper 3 meters of the water column. Available data indicate that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MacFarlane and Norton 2001). Based on the mainly ocean-type life history observed (i.e., fall-run Chinook salmon), MacFarlane and Norton (2001) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry.

Central Valley Spring-Run Chinook Salmon ESU

Historically, spring-run occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit Rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). Because of alterations to the system, the upper SJR, from Friant Dam downstream to the confluence with the Merced River, no longer supports spring-run Chinook salmon. The last documented run of spring-run Chinook salmon in the upper SJR, consisting of only 36 individuals, was observed in 1950 (Warner 1991). Since the 1950s, the remaining Chinook salmon in the San Joaquin basin consist only of fall-run populations found in major tributaries to the lower SJR.

Spring-run exhibit a stream-type life history

Adults enter freshwater in the spring, hold over the summer, spawn in the fall, and the juveniles typically spend a year or more in freshwater before emigrating. Adult spring-run leave the ocean to begin their upstream migration in late January and early February (CDFG 1998) and enter the Sacramento River between March and September, primarily in May and June (table 4-4; Yoshiyama et al. 1998, Moyle 2002). Lindley et al. (2007) indicate adult spring-run enter tributaries from the Sacramento River primarily between mid April and mid June. Typically, spring-run utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature (Yoshiyama et al. 1998). Reclamation reports that spring-run holding in upper watershed locations prefer water temperatures below 60ºF, although salmon can tolerate temperatures up to 65ºF before they experience an increased susceptibility to disease.

Spring-run spawning occurs between September and October depending on water temperatures. Between 56 and 87 percent of adult spring-run that enter the Sacramento River basin to spawn are 3 years old (Calkins et al. 1940, Fisher 1994).

Spring-run fry emerge from the gravel from November to March (Moyle 2002) and the emigration timing is highly variable, as they may migrate downstream as young-of-the-year (YOY) or as juveniles or yearlings. The modal size of fry migrants at about 40 mm between December and April in Mill, Butte, and Deer creeks reflects a prolonged emergence of fry from the gravel (Lindley et al. 2007). Studies in Butte Creek (Ward et al. 2002, 2003; McReynolds et al. 2005) found the majority of spring-run migrants to be fry occurring primarily from December through February; and that these movements appeared to be influenced by flow. Small numbers of spring-run remained in Butte Creek to rear and migrated as yearlings later in the spring. Juvenile emigration patterns in Mill and Deer creeks are very similar to patterns observed in Butte Creek, with the exception that Mill and Deer Creek juveniles typically exhibit a later YOY migration and an earlier yearling migration (Lindley et al. 2007).

Once juveniles emerge from the gravel, they seek areas of shallow water and low velocities while they finish absorbing the yolk sac and transition to exogenous feeding (Moyle 2002). Many also will disperse downstream during high-flow events. As is the case in other salmonids, there is a shift in microhabitat use by juveniles to deeper, faster water as they grow larger. Microhabitat use can be influenced by the presence of predators, which can force fish to select areas of heavy cover and suppress foraging in open areas (Moyle 2002). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of the YOY fish outmigrating through the lower Sacramento River and Delta during this period (CDFG 1998). Spring-run juveniles have been observed rearing in the lower reaches of non-natal tributaries and intermittent streams in the Sacramento Valley during the winter months (Maslin et al. 1997, Snider 2001). Peak movement of juvenile spring-run in the Sacramento River at Knights Landing occurs in December, and again in March and April. However, juveniles also are observed between November and the end of May (Snider and Titus 2000). Based on the available information, the emigration timing of spring-run appears highly variable (CDFG 1998). Some fish may begin emigrating soon after emergence from the gravel, whereas others over summer and emigrate as yearlings with the onset of intense fall storms (CDFG 1998).

Historically, spring-run were the second most abundant salmon run in the Central Valley (CDFG 1998). The Central Valley drainage as a whole is estimated to have supported spring-run runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the SJR alone (Fry 1961). Construction of other low elevation dams in the foothills of the Sierras on the American, Mokelumne, Stanislaus, Tuolumne, and Merced Rivers extirpated spring-run from these watersheds. Naturally-spawning populations of spring-run currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998).

On the Feather River, significant numbers of spring-run, as identified by run timing, return to the FRFH. From 1986 to 2007, the average number of spring-run returning to the FRFH was 3,992, compared to an average of 12,888 spring-run returning to the entire Sacramento River Basin. However, CWT information from these hatchery returns indicates substantial introgression has occurred between spring-run and fall-run populations within the Feather River system due to hatchery practices. Because Chinook salmon have not always been temporally separated in the hatchery, spring-run and fall-run have been spawned together, thus compromising the genetic integrity of the spring-run and early fall-run stocks. The number of naturally spawning spring-run Chinook salmon in the Feather River has been estimated only periodically since the 1960s, with estimates ranging from 2 fish in 1978 to 2,908 in 1964. However, the genetic integrity of this population is questionable because of the significant temporal and spatial overlap between spawning populations of spring-run and fall-run (Good et al. 2005). For the reasons discussed above, and the importance of genetic diversity as one of the VSP parameters, the Feather River spring-run population numbers are not included in the following discussion of ESU abundance.

The spring-run ESU has displayed broad fluctuations in adult abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (CDFG 2007, PFMC 2002, 2004, CDFG 2004, Yoshiyama 1998, GrandTab 2006). Sacramento River tributary populations in Mill, Deer, and Butte creeks are probably the best trend indicators for the spring-run ESU as a whole because these streams contain the primary independent populations within the ESU. Escapement numbers are dominated by Butte Creek returns, which have averaged over 7,000 fish between 1995 and 2007. During this same period, adult returns on Mill Creek have averaged 778 fish, and 1,463 fish on Deer Creek. Although recent trends are positive, annual abundance estimates display a high level of fluctuation, and the overall number of spring-run remains well below estimates of historic abundance. Additionally, in 2002 and 2003, mean water temperatures in Butte Creek exceeded 21ºC for 10 or more days in July (Williams 2006). These persistent high water temperatures, coupled with high fish densities, precipitated an outbreak of columnaris disease (*Flexibacter columnaris*) and ichthyophthiriasis (*Ichthyophthirius multifiis*) in the adult spring-run over-summering in Butte Creek. In 2002, this contributed to the pre-spawning mortality of about 20 to 30 percent of the adults. In 2003, about 65 percent of the adults succumbed, resulting in a loss of an estimated 11,231 adult spring-run in Butte Creek.

The Butte, Deer, and Mill Creek populations of spring-run are in the Northern Sierra Nevada diversity group. Lindley et al. (2007) indicated that spring-run populations in Butte and Deer creeks had a low risk of extinction in Butte and Deer Creek, according to their PVA model and the other population viability criteria (i.e., population size, population decline, catastrophic events, and hatchery influence). The Mill Creek population of spring-run Chinook salmon is at moderate extinction risk according to the PVA model, but appears to satisfy the other viability criteria for low-risk status. However, the spring-run ESU fails to meet the "representation and redundancy rule," since the Northern Sierra Nevada is the only diversity group in the spring-run ESU that contains demonstrably viable populations out of at least 3 diversity groups that historically contained them. Independent populations of spring-run only occur within the Northern Sierra Nevada diversity group. The Northwestern California diversity group contains a few ephemeral populations of spring-run that are likely dependent on the Northern Sierra Nevada populations for their continued existence. The spring-run populations that historically occurred in the Basalt and Porous Lava, and Southern Sierra Nevada, diversity groups have been extirpated. Over the long term, the three remaining independent populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run populations in the Deer, Mill, and Butte Creek watersheds due to their close proximity to each other. One large event could eliminate all three populations.

The Central Valley Project Improvement Act (CVPIA), implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From the CVPIA arose several programs that have benefited listed salmonids: the Anadromous Fish Restoration Program (AFRP), the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for spring-run by maintaining or increasing instream flows in Butte and Mill creeks and the SJR at critical times.

For spring-run, the construction of high dams for hydropower, flood control, and water supply resulted in the loss of vast amounts of upstream habitat (i.e., about 80 percent, or a minimum linear estimate of over 1,000 stream miles), and often resulted in precipitous declines in affected salmonid populations. For example, the completion of Friant Dam in 1947 has been linked with the extirpation of spring-run in the SJR upstream of the Merced River within just a few years. The reduced populations that remain below Central Valley dams are forced to spawn in lower elevation tailwater habitats of the mainstem rivers and tributaries that were previously not used for this purpose. This habitat is entirely dependent on managing reservoir releases to maintain cool water temperatures suitable for spawning, and/or rearing of salmonids. This requirement has been difficult to achieve in all water year types and for all life stages of affected salmonid species. Spring-run have also been negatively affected by the production of hatchery fish associated with the mitigation for the habitat lost to dam construction (e.g., from genetic impacts, increased competition, exposure to novel diseases, etc.).

Land-use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes, such as: alteration of natural flow regimes; installation of bank revetment; and building structures such as dams, bridges, water diversions, piers, and wharves, often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, ocean productivity, and drought conditions provide added stressors to listed salmonid populations. In contrast, various ecosystem restoration activities have contributed to improved conditions for listed salmonids (e.g., various fish screens). However, some important restoration activities (e.g., Battle Creek Restoration Project) have not yet been implemented and benefits to listed salmonids from the EWA have been less than anticipated.

Current natural production estimates, relative to historic baselines and AFRP production targets for spring-run Chinook are presented in Table 5 and Figure 1. These are derived from the Comprehensive Assessment and Monitoring Program (CAMP); Assessment of Anadromous Fish Production in the Central Valley of California between 1992 and 2008 (2009).

Table 4. Summary statistics of the average natural production of spring-run of adult Chinook salmon from the Central Valley, 1967-2008. (CAMP, 2009)

Chinook salmon group	**1967-1991 average production**	**1992-2008 average production**	**AFRP fish production target**	**Percent change in average production 1967-1991 vs. 1992-2008**
Spring-run	34,374	15,446	68,000	- 55%

Figure 7. Estimated natural production of adult spring-run Chinook salmon from the Central Valley, 1992-2008. Annual estimates reflect the combined contributions from Butte Creek, Deer Creek, Mill Creek, and the Sacramento River mainstem. The AFRP spring-run Chinook salmon production target is 68,000 Chinook salmon, and the 1967-1991 baseline average is 34,374 Chinook salmon. (CAMP, 2009)

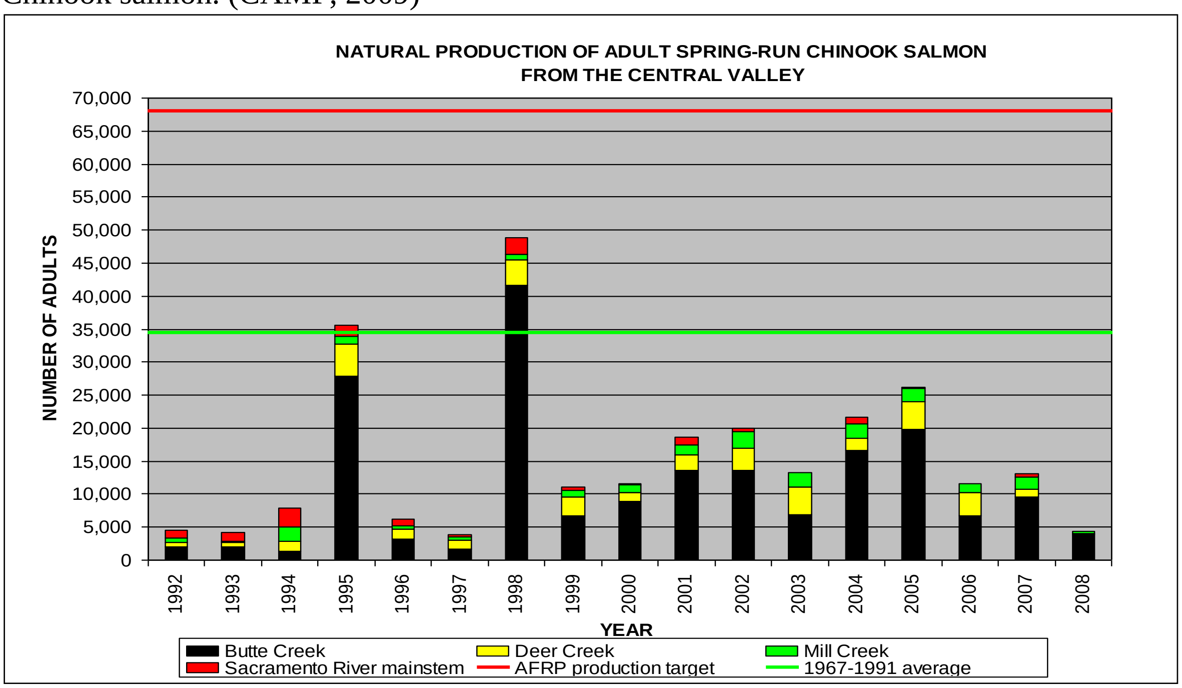


Table 5. Overall assessment of changes in natural production of spring-run adult Chinook salmon from the Central Valley, 1967-2008.; ** P values <0.05 reflect a statistically significant change (CAMP, 2009).

Watershed/Run	Number of years the AFRP production target was exceeded /number of years monitoring occurred since 1991	Change in average production between the 1967-1991 and 1992-2008 time periods
Butte Creek spring-run	14/17	+ 976%**
Deer Creek spring-run	0/17	- 29%
Mill Creek spring-run	0/17	- 40%
Sacramento River spring-run	0/16	- 97%**

The graphs in Figures 2 - 4 show the watershed's AFRP production target, estimated annual natural production of Chinook salmon between 1992 and 2008, and average natural production of Chinook salmon between 1967 and 1991. (CAMP, 2009). Table 6, identifies the percent changes over that time and the number of years in which AFRP goals were exceeded.

Figure 8. Estimated natural production of adult Chinook salmon from Butte Creek, 1992-2008.

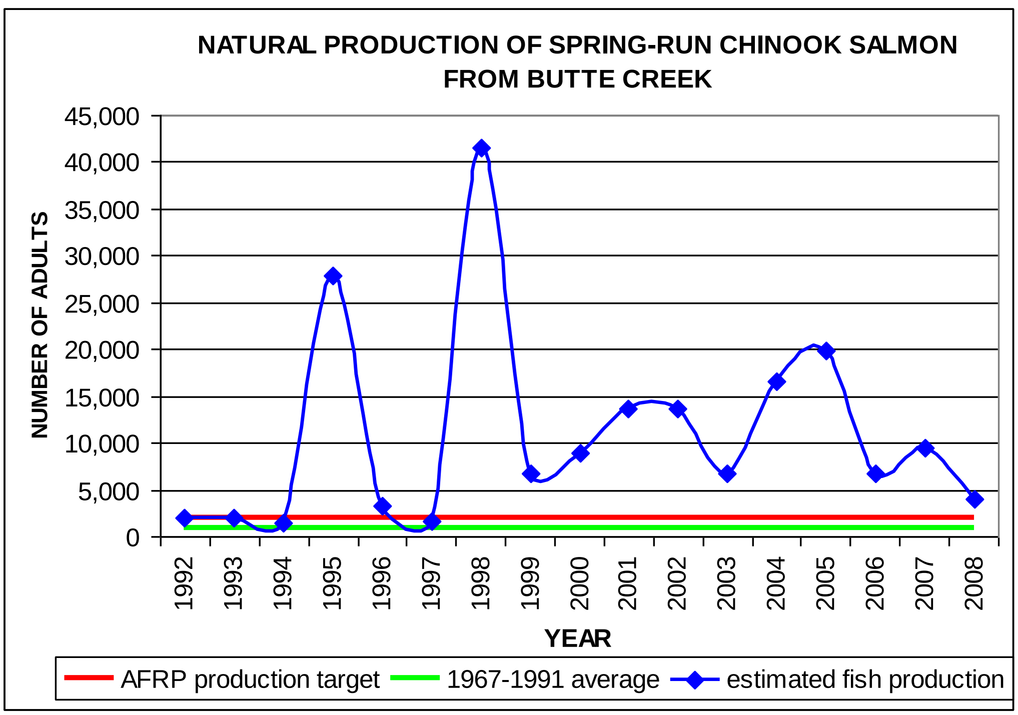


Figure 9. Estimated natural production of adult Chinook salmon from Deer Creek, 1992-2008.

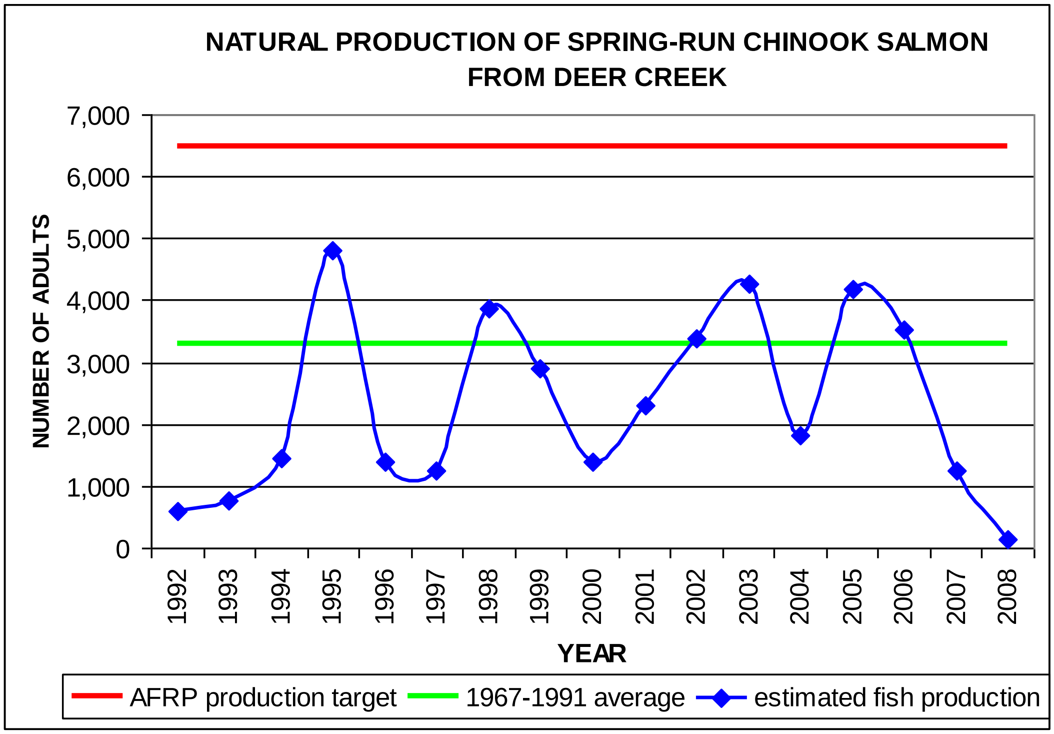
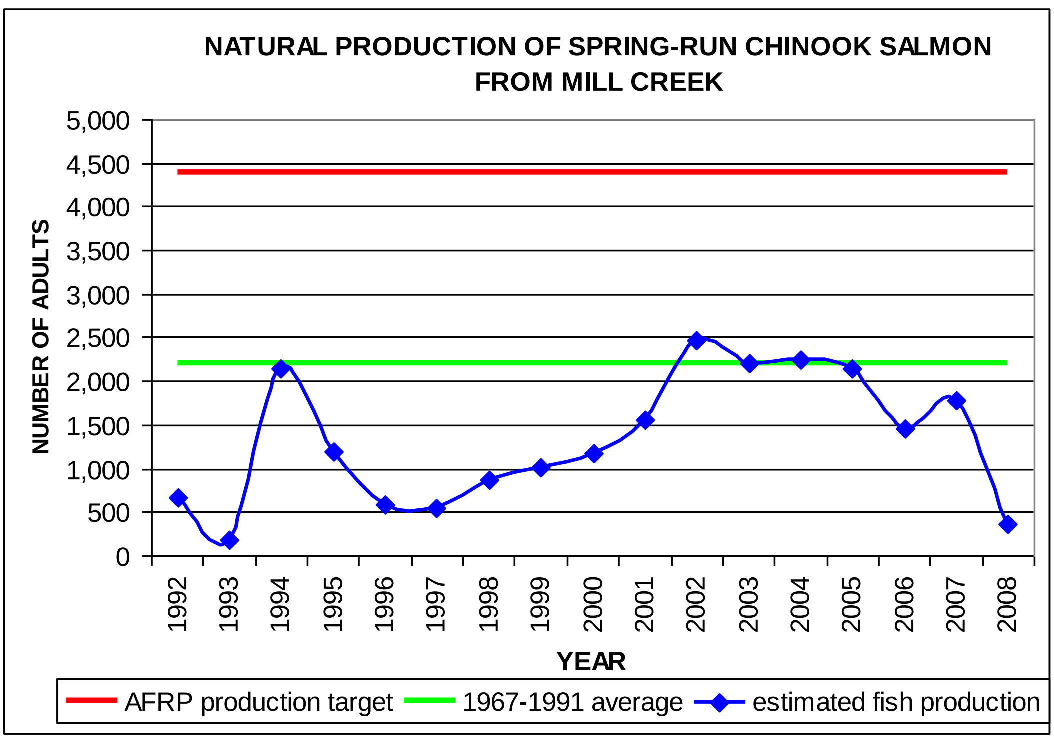


Figure 10. Estimated natural production of adult Chinook salmon from Mill Creek, 1992-2008.



All Central Valley spring-run Chinook salmon ESU are federally-listed as threatened, and of the potential donor stocks considered, only one (Butte Creek) has exceeded the AFRP goal (CAMP 2009), but this may be a result of anomalously low population numbers used for the 1967 through 1991 mean baseline. The three genotypic spring-run donor sources (Butte, Deer, and Mill creeks) have all shown declines since 2005 (CAMP 2009).

TAKE

For purposes of defining the relevant project activities, we are segregating affected individuals (or populations) into three distinct categories—mirroring the associated project phases: Donor Stock, Conservation Stock, and Experimental Stock.

Donor Stock refers to the individuals actually collected from their native (or currently resident) stream source. In permit terms, we reference these numbers to their donor population. All fish collected and managed as part of this proposed activity will be recognized as conservation stock for the entire duration while in the possession of the responsible parties for each specified activity. For example, transport during relocation and translocation, and during residence in the Conservation Facility (during the pre-emergence phase for eggs). Once fish are introduced to the SJR proper (at the moment that fish are no longer in possession of the responsible personnel during direct release activities), these fish transition to experimental stock, under the anticipated §10J designation. All eggs located streamside or in-stream are all considered part of the experimental stock, though they technically remain in the possession of responsible entities.

The proposed action would result in both direct and incidental take to the donor stock populations and losses to the conservation stock. Donor stock direct take consists of all collections (one for one numeric debits to the donor population). Donor stock (population) incidental take consists of effects to the remnant populations from collection activities. Transport and rearing activities also involve mortality to the conservation stock incidental to the Conservation program activity.

Direct Take of Donor Stock

Direct take would result from the capture of donor stock and the removal of the donor stock from the donor stream. Direct take would affect those fish or eggs that were captured or collected. Those numbers would vary year to year depending on the allowable quotas set for each year's collection (see Appendix A).

Incidental Take to Donor Population from Collection

Incidental take to the donor populatin would be considered that associated with collection activities and would include harassing, injuring, or killing any spring-run Chinook salmon during the permitted collection activities. Incidental direct take would include any take that occurred during the actual collection or capture activities, e.g., any mortality or injury that may occur to individual fish during the capture process or eggs during collection (see Effects Analysis for a description of possible causes). Incidental indirect take would also result from the collection activities, but would occur at a later time as a result of the proposed activity (e.g., the failure of redds due to disturbances to the stream bed caused by capture activities, or fungal infection caused by removal of protective slime), and will by definition be unobserved.

The Service anticipates that tangible numeric figures for indirect take during donor stock collection activities would be difficult to fully account. Take that occurred in streams during capture and collection activities would likely be obscured from detection by disturbance of the streambed substrate. Fish that were injured or killed would likely be carried downstream and may not be detected. During capture attempts fish may evade capture and be lost and suffer subsequent, unknown mortality due to injury or stress caused by the capture attempt. The small size of eggs and juvenile fish inherently make detection difficult.

All take incidental to the activities covered under this permit will be avoided and minimized based on the mitigation measures outlined in the Project Description and Effects Analysis, above. In the case that this unquantifiable negative impact to population viability is deemed of more than a significant magnitude by the permitting agency, we suggest that this take be accounted for in the form of a safety margin applied to the protectiveness criteria within the Decision Matrix process. For example, if redd pumping is considered a significant population level effect to remnant eggs within the affected redds, the 15% value proposed in Appendix A could be expanded with a 5% or 10% (or whatever appropriate value) buffer.

Methods and assumptions used to derive Conservation and Experimental Stock potential loss estimates provided in Appendix B.

Conservation Stock Losses and Facility Performance Measures

Losses at the Conservation facility are anticipated to be within acceptable standards for facilities of this nature (e.g., in line with other facilities within the system currently in operation). We have projected mortalities for various activities associated with the management and rearing of the conservation stock. Appendix B presents a wChipprst case scenario for various project activities. The program will maintain performance standards deemed necessary by the permitting agency for mortality rates of captured donor stock and brood stock of a species under the current conservation status (threatened under the ESA).

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APPENDIX A—DECISION MATRIX

As outlined in the Donor Stock Collection Annual Decision Process section of the Project Description, Donor Stock Collection Plans (DSC Plan) will be prepared by the FMWG in coordination with the Service that shall be officially provided to NMFS before collection activities will be allowed within each season or collection window. This process will function in real-time and adapt to natural and population conditions, using the best professional judgment of the FMWG and subject to guidance provided herein, and review and approval by the permitting agencies. The fundamental objective of this process is to adaptively manage annual collections within a context that assures no detrimental effects to the viability of each donor stream population. Secondarily, this plan and process will ensure that specific collection locations and methods will follow best available practices to minimize take within the umbrella of the Collection Program.

The DSC Plan will be submitted to NMFS and DFG prior to permitting specific collection activities on the timelines discussed in the Project Description; however, total numbers shall never exceed the figures expressed within the Donor Stock Collection section (Table 1 of the Project Description). All collections (numbers, locations, methods, mortality rates) will be reported to NMFS annually as described in the reporting section of this Application.

It has been determined through the course of pre-consultation with NMFS that final evaluation criteria and guidance will be forthcoming in the form of take guidelines to be formulated through their Science Center. Given the timeline of the permitting process, the Service is able to reference this guiding document as the foundational basis to ensure that donor stock collections will not have a negative effect on the source populations in any given stream. However, the complete details of this decision matrix are not currently available. Regardless of the ultimate models used to ascertain appropriate risk thresholds, the process itself must be adaptive to function within the current population context.

Nevertheless, we provide herein some basic guidelines following the results from Lindley et al. (2007) that are intended to place our proposed donor stock collections (a decision matrix to frame the DSC planning) within a population viability context. We attempt below to provide example calculations, as well as use recent data in order to place the numbers outlined in the project description above within a context relevant to the current baseline. These are meant as an example, and not necessarily to constrain or direct any further work conducted by NMFS. This process is also adaptive to incorporate improved and updated analyses that will serve as the guiding framework underpinning the adaptive process serving future DSC Plans and subsequent official requests from Service to NMFS and CDFG.

There are three classes of spring-run Chinook salmon targeted for collection in this Application. These include: 1) genetically-isolated strains of unrelated pairs from the natural-origin source stocks (Butte, Deer, and Mill creeks), 2) genetically "mixed" strains from FRH, and 3) strays to other Central Valley tributaries (FRH and Butte Creek most likely origins). The three streams containing genetically-preferred natural production are intended to contribute individuals at all lifestages. Deer Creek and Mill Creek (Deer/Mill complex) are considered genetically a single population (Michelle Workman, USFWS, pers comm. 9/18/2010), although in this example we will follow GrandTab (2010) and AFRP (CAMP 2009), and treat them as individual source populations. Adults may also be collected from the hatchery augmented run at Feather River and from various sources where "strays" may be available throughout the Central Valley.

For each system, it is necessary to choose a metric upon which to base permissible collection limits. These may be different metrics as dictated by the unique physical or biological characteristics of each stream (or alternatively, different degrees of certainty attached to available real-time abundance estimates). We anticipate the updated criteria and guidance forthcoming through the further consultation with NMFS will sufficiently deal with these qualitative differences in the donor stock streams, if appropriate.

As an initial framework for this document, we propose a tiered decision approach that incorporates an already established benchmark (extinction risk). We then offer a methodology that is derived from the Lindley et al (2007) work within the context of the current trends evidenced by existing monitoring programs. These guidelines are meant to serve as an interim analytical framework underpinning the FMWG evaluation process as recommendations from that group are interpreted by the Service prior to official requests from the permitting agencies within the DSC Plans.

Service Proposed Decision Matrix

As a placeholder within this decision matrix, until such time the updated viability benchmarks are made available to the FMWG, we propose herein the following criterion for planning within the DSC process.

Our approach is based on the specific work within Lindley et al. (2007). This analysis concluded that an effective population size (N_e) of greater than 500 individuals (N_e/N = 0.2) or a total population size per generation (N) greater than or equal to 2,500 individuals (N = the mean run size x average generation time) is at low risk of extinction (Lindley et al., 2007). N is derived from the population count from available census methods; for example, the escapement numbers given by GrandTab (2009). The average run size ($\hat{S}_t$) is computed as the mean of up to the three most recent generations (Lindley et al. 2007). To be consistent with Lindley, we will use a generation time of three years herein.

Table 1 Escapement (S) Numbers Used for Calculating Population Decline (Growth Rate) [a]				
Year	**Butte Creek**	**Deer Creek**	**Mill Creek**	**Feather River Hatchery**
2000	4,118	637	544	3,657
2001	9,605	1,622	1,100	4,135
2002	8,785	2,185	1,594	4,189
2003	4,398	2,759	1,426	8,662
2004	7,390	804	998	4,212
2005	10,625	2,239	1,150	1,774
2006	4,579	2,432	1,002	2,061
2007	4,943	644	920	2,674
2008	3,935	140	362	1,624
2009	2,059	213	220	989
[a] Escapement numbers from GrandTab 3/9/2010				

The criteria used by Lindley et al. (2007) are modified from Allendorf et al. (1997) and correspond to risks of extinction within the specified time horizon. The "low" risk category in Lindley et al. (2007) is defined by various criteria, including <5% extinction risk from population viability analysis (PVA) within 100 years; but includes, 1) the population size parameters previously described ($N \geq 2{,}500$), along with 2) no apparent or probable population decline, 3) no apparent catastrophes occurring within the last 10 years, and 4) low hatchery influence. Lindley et al. (2007) provides quantitative metrics that may be calculated from observed returns to determine these risk levels in any given year.

The three streams in which natural production of spring-run Chinook salmon are proposed for donor stock collection (Butte, Mill, Deer creeks), and the Feather River Hatchery collections are treated equally in this example, though we recognize that the permitting agency may wish to apply a different criterion to the FRH population. For this example, all primary donor source streams would have the harvest metric based on the Lindley et al. (2007) benchmark ($N \geq 2{,}500$), and include the decline and catastrophe criteria from the same analysis. For purposes of discerning a trend, the population growth rate (% per year over the most recent ten year period) would be calculated using the method described in Table 2 of Lindley et al. (2007).

The specific decision guideline within this interim matrix is that fish should only be collected from a donor stream if the donor stream spring-run meets the <5 percent risk of extinction within 100 years according to a population viability analysis. All of the following criteria must be met for the donor population to be at a low (<5%) risk of extinction:

1. The population (N) ≥2,500, and that ($S_{t-2} + S_{t-1} + S_t$) = 2,500 and that $S_t \geq 500$ (Lindley et al. 2007). We are assuming a mean generation (g) of three years, following Lindley et al. (2007), and;

2. The population is not declining. Population growth (or decline) rate is estimated from the slope of the natural logarithm of spawners (S) versus time for the most recent 10 years of spawner count data (slope of $\ln(S_t)$ v. time x 100). The population decline criteria has two components, a downward trend in abundance and a critical run size of greater than 500 spawners (Lindley et al. 2007; Allendorf et al. 1997). A "High Risk" of extinction would be a decline within the last two generations to annual run size ≤ 500 spawners, or run size ≥ 500 but declining at ≥ 10% per year. A "Moderate Risk" of extinction entails a run size that has declined to ≤ 500, but is now stable (<10% decline per year; Lindley et al. 2007), and;

3. There is no catastrophe occurring within the last 10 years. A catastrophe is a singular event with an identifiable cause and only negative immediate consequences. Examples would include disease outbreaks, toxic spills, volcanic eruptions, extended droughts (i.e., low instream flow releases), and unusually poor ocean productivity as occurred in 2005 and 2006 (Lindley et al. 2009). A "High Risk" situation is created by a 90 percent decline in population size over one generation. A "Moderate Risk" event is one that is smaller (< 90% decline) but biologically significant, such as a year-class failure (Lindley et al. 2007). Catastrophe (c) is calculated as a percent (100 x (1-min(N_t+g/N_t)), and;

4. Hatchery influence is low (0.5 – 5 percent). A population can be considered "low risk" if up to 5 percent of the naturally spawning fish are of hatchery origin, if the hatchery fish are from a hatchery using "best management practices" using broodstock derived from the wild population.

If all of the above criteria are met, then the total approved numbers for collection will be scaled to no greater than 15 percent of the run (S_t) (USFWS 2008), which may be collected until such time that the projected "optimal" genetic collection figures (as described in *Project Description*) are met; although, not at any time to exceed an amount that would reduce the instream run size to less than 500.

Applying the Lindley Criteria to the Current Empirical Data

Using Lindley's criteria for decline, we conducted a linear regression of year versus natural log (spawner count) to determine the decline rate (Table 2), and found that Deer Creek, Mill Creek and the FRH populations are all currently in decline above 10 percent (Table 2). Two of the three natural production donor streams (Deer Creek and Mill Creek) have had runs of less than 500 spawners (S) in the most recent two years (2008 and 2009) that data has been available (GrandTab 2010). For this metric, the Deer Creek, Mill Creek, and the FRH runs appear to be at high extinction risk within the Lindley et al. (2007) criterion, and until the run size is ≥ 500 and the rate of decline is less than 10 percent, these would not be eligible for collection, regardless of the status of the other criteria below.

Table 2 Population Growth (Decline) Rates (Based on Lindley et al. 2007)	
Donor Streams	**Percent Growth (10 years) from years 2000 through 2009**
Butte Creek	-9.02%
Deer Creek	-19.68%
Mill Creek	-11.87%
Feather River Hatchery	-15.59%

The hatchery influence of Deer Creek, Mill Creek and Butte Creek are all considered very low (Lindley et al. 2007). The Feather River population would be an exception under this criterion, because the population available for collection is predominantly hatchery spawned and is considered by NMFS a part of the spring-run ESU (**CFR,** Vol. 70. No. 123, June 28, 2005).

We have not developed nor run a predictive model to forecast the probability of meeting donor stock targets in future years within the current proposed framework. Application of these proposed criteria within the Donor Stock Collection planning process, as indicated above, would direct donor stock collections in our 2009 spawning year example to the Butte Creek system. We therefore carry forward this example to further define a possible decision approach for use by the FMWG within the DSC decision process.

Available Numbers for Donor Stock Collection using the Decision Matrix

Using the most recent escapement numbers from Butte Creek (S = 2,059 for 2009) the following example illustrates the potential collection for different life stages that would be available for collection. Our calculations are based on the survival rates (transition probabilities) provided in the *Project Description* and the criteria proposed above. We can therefore calculate the numbers of different life stages that would be available for collection from the run. Assuming our donor stream meets the viability criteria following the appropriate decision methodology, Table 4 presents an example calculation for deriving desired collection numbers by life stage.

Table 4 Potential Collection Example for Butte Creek	
Total Adults in Run (S)	2,059[a]
Population (N = total escapement over 3 years)	10,937[a]
Number of fish available for collection at 15% rate [S(0.15)] maintaining instream run $\geq$ 500)	309 (15% of 2,059)
[a] Based on most recent GrandTab escapement numbers (GrandTab 2010).	

Decision Matrix Modifier Based on Spawning Habitat Saturation

Unique to Butte Creek is the amount of data that has been collected as to the spawning habitat capacity of the waterway. At flows of 75 cubic feet per second (cfs) above Centerville Powerhouse and 120 cfs below Centerville Powerhouse in September, there are 144,132 square feet of spawning habitat for spring-run Chinook salmon in Butte Creek (USFWS 2003).

Assuming a redd size of 62 square feet (Williams 2001), this would equate to sufficient capacity for 2,325 redds. Assuming a mean of 2.5 spawning adults per redd, a maximum spawning habitat capacity for 5812.5 returning adult spring-run Chinook salmon is available in Butte Creek without superimposition. A run size greater than 5812 spawning adults would exceed the stream's spawning habitat capacity and superimposition would be expected to occur. In addition, upstream of Centerville Powerhouse the spawning habitat capacity is only 344 redds, or 860 spawning adults. Numbers above 860 spawning adults would potentially result in significant superimposition in that stretch of the stream. The stretch below Centerville Powerhouse has the spawning capacity of 1,981 redds, or a spawning population of 4952.5 adults.

We consider the data sufficient, and the best science available to date, to suggest that the Butte Creek system is habitat-saturated by spawning area availability during certain flow and abundance conditions. The population is therefore, in part, driven by habitat limitation, and superimposition reduces the effective contribution of each individual to the next generation. In these instances, all adults above the spawning habitat capacity of the two sections of the stream should be considered potential for collection as the take of these surplus adults would be under compensatory density-dependence and their removal should not affect the annual production within Butte Creek. Such modifiers to the Lindley et al. (2007) abundance and growth rate criteria above may be considered by the FMWG within the Decision process, as warranted by available data and the professional judgment of the group, recommendation by the Service, and final determination by NMFS.

Collections by Lifestage (Adult Standard Units)

A final concept that is proposed as part of this application and methodology is to place all donor stock collections (numbers by lifestage) into *adult standard units*. This calculation is required to conceptually link the proposed viability metrics above (basing on spawning class as adults) to permitted take for collections of their progeny as eyed-eggs or juveniles. Basically, we propose a weighting of population value for each lifestage collected. This provides a coefficient to count (in base adult units) against project collections.

Using the transition probability (percent survival) data presented in the Donor Stock Collection section of the Project Description, we are able to calculate weighting coefficients, or estimate the relative population level contribution (or loss) associated with the removal of any given lifestage from the extant population. This metric only accounts for direct take (i.e., does not include incidental take from project related activities). It also does not presume density-dependent effects and any compensatory response following collection (i.e., that an individual loss to the population is carried through to the returning year class in proportion to our underlying survival estimate stepwise calculations). These calculations are presented below in Table 5, along with associated numbers (by lifestage) that would be permissible collection thresholds using the conceptual framework as outlined.

Table 5 The numbers of eyed eggs, fry, and juveniles associated with the parental spawning class, and the weighting coefficients used to derive these proposed figures.

Number of females [(*S**0.15)/2]	154.5[a]
Number of eggs available for collection	648,900[b] (0.00048)[e]
Number of fry produced by eggs	259,560[c] (0.0012)[e]
Number of juveniles available for collection	12,978[d] (0.024)[e]

[a] Assuming half of spawners are female
[a] Assuming that each female produces 4,200 eggs (CDFG 2008; CDFG 1998a).
[c] 40% average survival rate of eggs to fry (EA 1992)
[d] 5% survival rate for fry to juveniles (C. Mesick, pers. comm., USFWS. 9/15/2010).
[e] Weighted value of spawner (*N*(0.01)/x).

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APPENDIX B – DIRECT AND INCIDENTAL TAKE

The tables presented below represent the maximum direct take that may occur during all activities required for donor stock collection. Again, these represent population level losses to the donor source populations.

Additionally, we have provided loss estimates that the permitting agency may use for reference purposes associated with the conservation stock (capture, transport and rearing) and experimental stock reintroduction phases of the Conservation Program. Conservation stock losses will involve both losses to the donor stock individuals while in possession of the collecting party (from collection and transport during relocation or translocation), and losses to their progeny during Conservation Facility operation. Experimental stock losses involve losses to individuals following reintroduction and/or placement of the individuals at stream-side or in-stream facilities (i.e., infrastructure other than the Conservation Facility).

Collection - Direct Take of Donor Stock

Donor Stock Contributions

As described in the *Project Description*, donor stock individuals will be collected from three primary sources (FRH, Butte Creek, and Deer/Mill Creek complex), and opportunistically from other sources). Individuals of varying life stages will be collected from the donor sources and used for conservation stock rearing, remote-site egg collection, or direct transplant into the SJR (translocation). Tables 1 and 2 below summarize the maximum direct take that will result from donor stock collections (numbers are for all streams combined).

Table 1. Direct Take From Donor Stock Collections: Year 1-3		
Life Stage	**Use of Individuals**	**Maximum Direct Take***
Egg or Juvenile	Conservation Facility	600
Eggs	Translocation to SJR	250,000
Fry	Translocation to SJR	100,000
Parr-smolt	Translocation to SJR	4,000
Adult	Remote-Site Egg Take (Cons. Fac.)	100
Adult	Translocation to SJR	150

Table 2. Direct Take From Donor Stock Collections: Year 4-8		
Life Stage	**Use of Individuals**	**Maximum Direct Take***
Egg or Juvenile	Conservation Facility	2,700
Eggs	Translocation to SJR	250,000
Fry	Translocation to SJR	100,000
Parr-smolt	Translocation to SJR	4,000
Adult	Remote-Site Egg Take (Cons. Fac.)	100
Adult	Translocation to SJR	150

* Maximum direct take determined by maximum targeted harvest values indicated in the *Project Description.*

Donor Stock - Potential Mortality to Broodstock

As noted in the *Project Description*, a large proportion of SJR releases will be derived from progeny (broodstock) reared from egg and juvenile lifestages following donor stock collections. This is especially the case during the early years (1-3) of project activities. These donor stock individuals will need to be transported and added to the broodstock rearing operations at the Conservation Facility.

Egg and Juvenile—Collection of Conservation Facility Donor Stock

Using empirical data from a literature search (see Table 10), maximum potential mortality associated with collection, handling and transport was determined for each life stage. Maximum losses were calculated using maximum targeted harvest values for donor stock collection (i.e., best-case collection scenario) as specified in the *Project Description*, and assuming worst possible case conservation stock management (i.e., highest loss rates from the literature, or using best professional judgment).

Short-term collections (Years 1-3) target a maximum of 600 eggs or juveniles for contribution to brood stock. Activities associated with this include capture, handling, and transport following the methods described in the *Donor Stock Collection* section of the *Project Description*. Based on targeted collection numbers, a maximum potential loss to the conservation stock of up to 178 eggs or up to 24 juveniles was determined (Table 3). Collection mortality was calculated assuming all individuals will be captured using the method with the highest anticipated mortality rate. Maximum potential loss was derived by adding the collection mortality to the anticipated mortality resulting from handling and transportation of individuals to the Conservation Facility.

Using the same collection assumptions and long-term (Years 4-8) maximum collection targets of 2700 eggs or juveniles, maximum potential losses to the conservation stock of up to 796 eggs or up to 108 juveniles were determined (Table 4). Estimated loss values represent the maximum take that may occur if all individuals are collected using the method with the highest associated mortality, making these values a worst-case scenario. However, collection methods have been prioritized based on ease of sampling and risk of mortality (*Donor Stock Collection* Tables 2 & 3), so realized losses should be lower during the actual implementation of the project.

Table 3. Egg/Juvenile Donor Stock Collection - Potential Mortality: Years 1-3*				
*600 individuals targeted for harvest (based on Project Description, Table 1).				
Life Stage	**Maximum Targeted Harvest**	**Collection Method/Activity**	**% Mortality**	**Individuals Lost**
Egg	600	Feather River Hatchery	28%	168
		Redd pumping	2%	12
		Redd excavation	2%	12
		Adult collection (streamside)	25%	150
		Handling	1%	5
		Transport to Conservation Facility	1%	5
			Max. Potential Mortality	178**
Juvenile	600	RST	1.6%	10
		Seining	1%	6
		Fyke Net/Minnow Trap	1.6%	10
		Feather River Hatchery	1.6%	10
		Electrofishing	1%	6
		Salvage at State and Federal Pumping Plants	2%	12
		DJFMP ops (IEP trawls)	2%	12
		Handling	1%	6
		Transport to Conservation Facility	1%	6
			Max. Potential Mortality	24**

Table 4. Egg/Juvenile Donor Stock Collection - Potential Mortality: Years 4-8*				
*2700 individuals targeted for harvest (based on Project Despcription, Table 1).				
Life Stage	**Maximum Targeted Harvest**	**Collection Method**	**% Mortality**	**Take**
Egg	2700	Feather River Hatchery	28%	756
		Redd pumping	2%	54
		Redd excavation	2%	54
		Adult collection (streamside	25%	675
		Handling	1%	20
		Transport to Conservation Facility	1%	20
			Max. Potential Mortality	796**
Juvenile	2700	RST	1.6%	44
		Seining	1%	27
		Fyke Net/Minnow Trap	1.6%	44
		Feather River Hatchery	1.6%	44
		Electrofishing	1%	27
		Salvage at State and Federal Pumping Plants	2%	54
		DJFMP ops (IEP trawls)	2%	54
		Handling	1%	27
		Transport to Conservation Facility	1%	27
			Max. Potential Mortality	108**

** Maximum potential mortality is loss associated with collection in addition to losses from handling and transportation to the Conservation Facility.

Rearing–Potential Losses to Conservation Stock

Rearing Eggs and Juveniles

Progeny mortality was calculated for rearing the collected donor stock individuals to adults at the Conservation Facility. These values were calculated using incidental mortality risk data (Table 10) and the collection targets laid out in the *Project Description* – 600 eggs or juveniles in the short-term (Years 1-3), and 2700 eggs or juveniles in the long-term (Years 4-8). Based on collection targets and mortality data for each step in the rearing process, the maximum short-term loss to the Conservation Stock (as progeny mortality) will be between 441 (192 eggs; 249 juveniles) and 366 (all juveniles) individuals per year (Table 5). Maximum long-term loss will be between 1984 (864 eggs; 1120 juveniles) and 1647 (all juveniles) individuals per year (Table 6).

The *Project Description* indicates that the short-term and long-term collection targets (600 and 2700, respectively) are totals that may be made up of a mixture of eggs and juveniles. Given the potential combination of life stages collected from the donor stock, the losses during rearing will likely also be a combination of eggs and juveniles.

Table 5. Potential Progeny Mortality from Rearing Activites: Years 1-3

Life Stage Collected	Collection Target	Activity	% Mortality	Individuals Lost	Remaining Individuals
Egg	600	Eyed-Egg to Fingerling	32%	192	408
		Fingerling to Smolt	22%	90	318
		Smolt to Adult	50%	159	159
				Total Progeny Mortality = 441 (192 eggs; 249 juveniles)	
Juvenile	600	Fingerling to Smolt	22%	132	468
		Smolt to Adult	50%	234	234
				Total Progeny Mortality = 366 (juveniles)	

Table 6. Potential Progeny Mortality from Rearing Activites: Years 4-8

Life Stage Collected	Collection Target	Activity	% Mortality	Individuals Lost	Remaining Individuals
Egg	2700	Eyed-Egg to Fingerling	32%	864	1,836
		Fingerling to Smolt	22%	404	1,432
		Smolt to Adult	50%	716	716
				Total Progeny Mortality = 1984 (864 eggs; 1120 juveniles)	
Juvenile	2700	Fingerling to Smolt	22%	594	2,106
		Smolt to Adult	50%	1053	1,053
				Total Progeny Mortality = 1647 (juveniles)	

Translocation to SJR–Potential Losses (of Donor Stock)

Capture and Transport of Donor Stock Eggs and Juveniles

Maximum potential loss was calculated for activities required for direct release of eggs and juveniles into the SJR. Estimates of loss were calculated using mortality rates from Table 10, and the targeted number of eggs and juveniles to be collected each year for direct translocation, as specified in the *Project Description* – 250,000 eggs, 100,000 fry or 4,000 smolts per year (Table 7). Handling and transport procedures have an associated mortality of less than one percent. In these cases, one percent mortality was assigned to that activity to create a more conservative estimate of loss. Based on collection targets and available mortality data, a maximum loss to the conservation stock of up to 73,582 eggs, up to 3951 fry, or up to 159 smolts was estimated, assuming all individuals are collected via the method with the highest anticipated mortality.

Table 7. Egg, Fry and Smolt Collection/Translocation - Potential Mortality: Years 1-8*				
*based on collection of 250,000 eggs, 100,000 fry or 4,000 smolts (see Project Description, Table 1).				
Life Stage	**Individuals Collected for Translocation to SJR**	**Collection Method/Activty**	**% Mortality**	**Individuals Lost**
Egg	250,000	Feather River Hatchery	28%	70,000**
		Redd pumping	2%	5000
		Redd excavation	2%	5000
		Adult collection (streamside)	25%	62500
		Handling	1%	1800
		Transport	1%	1782
			Max. Potential Mortality**	**73,582 eggs**
Fry	100,000	RST	1.6%	1600
		Seining	1%	1000
		Fyke Net/Minnow Trap	1.6%	1600
		Feather River Hatchery	1.6%	1600
		Electrofishing	1%	1000
		Salvage at State and Federal Pumping Plants	2%	2000**
		DJFMP ops (IEP trawls)	2%	2000**
		Handling	1%	980
		Transport	1%	971
			Max. Potential Mortality**	**3951 fry**
Smolt	4,000	RST	1.6%	64
		Seining	1%	40
		Fyke Net/Minnow Trap	1.6%	64
		Feather River Hatchery	1.6%	64
		Electrofishing	1%	40
		Salvage at State and Federal Pumping Plants	2%	80**
		DJFMP ops (IEP trawls)	2%	80**
		Handling	1%	40
		Transport	1%	39
			Max. Potential Mortality**	**159 smolts**

** Maximum potential mortality is the loss associated with collection in addition to losses associated with handling and transporting individuals to SJR.

Capture and Transport of Donor Stock Adults

A total of 150 adults per year (75 males, 75 females) are targeted for removal from donor streams for direct transplant into the SJR, resulting in a maximum potential loss of 38 individuals from the Conservation stock assuming all adults must be collected using the method with the highest mortality (Table 8). As mentioned previously, the maximum loss estimate represents loss that would occur if all individuals are collected using the method with the highest associated mortality plus losses associated with handling and transport of adults to the release site.

Table 8. Adult Collection/Translocation: Potential Mortality, Years 1-8*					
* 50 males and 50 females targeted for removal (based on Project Description, Table 3).					
Life Stage	**Sex**	**Collection Target**	**Collection Method**	**% Mortality**	**Individuals Lost**
Adult	Male	75	Seine	8%	6
			Tangle net	21.4%	17
			Stray/salvage and rescue ops	8%	6
Adult	Female	75	Seine	8%	6
			Tangle net	21.4%	17
			Stray/salvage and rescue ops	8%	6
			Handling	1%	2
			Transportation	1%	2
					Max Potential Mortality = 38**

** Maximum potential mortality is the loss associated with collection in addition to losses associated with handling and transporting individuals to SJR.

Reintroduction– Projected Mortality of Experimental Stock

Maximum losses were determined for experimental stock reintroduction of 250,000 eggs, 100,000 fry or 4,000 smolts (Table 9). Using mortality estimates, a projected loss of up to 150,000 eggs and up to 99,640 juveniles is anticipated following the release of 250,000 eggs. Losses resulting from the release of 100,000 fry would be 99,640 juveniles. Releasing 4000 smolts would result in a loss of up to 3940 juveniles.

As indicated in Table 7 above, there will likely be some loss to the conservation stock during collection and handling/transport activities, resulting in less than the maximum target number being released. However, loss estimates were based on releasing the maximum number of individuals to obtain the maximum potential loss that may occur.

Table 9. Experimental Stock (Egg, Fry and Smolt Release) - Potential Mortality: Years 1-8				
Life Stage to be Released	**Target for release**	**Activity**	**% Mortality**	**Incidental Take**
Egg	250,000	Egg Survival to Fry	60%	150,000 (eggs)
		Fry Survival to Smolt	96%	96,000 (juveniles)
		Smolt Survival to Adult	98.5%	3640 (juveniles)
			Total Take:	249,640 (150,000 eggs; 99,640 juveniles)
Fry	100,000	Fry Survival to Smolt	96%	96,000 (juveniles)
		Smolt Survival to Adult	98.5%	3640 (juveniles)
			Total Take:	99,640 (juveniles)
Smolt	4,000	Smolt Survival to Adult	98.5%	3940 (juveniles)

Table 10: Incidental Mortality Risk

Incidental Mortaity Risk Table					
Process	Life Stage	**Method/Activity**	**Incidential Mortality Risk**	**Reference**	**Comments**
Donor Stock Collection	Egg	Redd Pumping	2%	Collins et al. 2000; Thedinga et al. 2005	2% shock-induced mortality when 100% eyed eggs present (pink salmon).
		Redd Excavation	2%	none	Assuming impacts of redd excavation are similar to redd pumping.
		FRH Collection From Adults	28%	Cavallo et al. 2009	Recent mortality has been as low as 15%.
		Stream-Side Collection From Adults	25%	Barnes et al. 1999	70 - 76.3% survival with stream-side fertalization and 1 h water hardening (inland chinook salmon).
	Juvenile	RTS	1.6%	Montgomery et al. 2007	Merced River RTS data.
		Seine	1%	Achord et al. 1996	Collection mortality was less than 1%.
		Fyke Net	1.6%	none	Using RTS mortality data since all are passive sampling techniques.
		Minnow Trap	1.6%	none	Using RTS mortality data since all are passive sampling techniques.
		FRH	1%	Sharpe et al. 1998; Schreck et al. 2006	Collection increased stress, but no mortality (Shapre et al. 1998). Post release survival of barged spring-summer run chinook on Lower Columbia near 100% (Schreck et al. 2006)
		Electrofishing	1%	McMichael et al. 1998	2% injury reported. Assumed less than 1% mortality
		Salvage at State/Federal Pumping Facilities	2%	NMFS, 2009	Mortality estimates based on survival rates for collection, handling, transport and release of entrained fish.
		IEP Trawling	2%	none	Assuming additional handling/transport impacts will be similar to collection of entrained fish at pumping facilities.
	Adult	Seine	8%	Garman and McReynolds et al. 2009	Mortality data from 2008 spring-run chinook stranding and rescue event on Butte Creek.
		Tangle Net	21.4%	Vander Haegan et al. 2002	Mortality rate based on percentage of fish that died before release. Jacks made up large portion of killed fish.
		Stray/Salvage and Rescue Operations	8%	Garman and McReynolds et al. 2009	Mortality data from 2008 spring-run chinook stranding and rescue event on Butte Creek.
		Transport	< 1%	Carl Mesick pers. comm. (9/14/10)	Winter-run chinook trap and haul data from USFWS Red Bluff office.
		Quarantine	5.2%	Carl Mesick pers. comm. (9/14/10)	Winter-run chinook trap and haul data from USFWS Red Bluff office.
Conservation Stock Rearing	Egg	Rearing to Eyed-Stage	28%	Cavallo et al. 2009	Data from 2009 Feather River Hatchery HGMP report.
	Juvenile	Rearing: Eyed Egg to Finglerling	32%	Cavallo et al. 2009	Data from 2009 Feather River Hatchery HGMP report.
		Rearing: Fingerling to Smolt	22%	Cavallo et al. 2009	Data from 2009 Feather River Hatchery HGMP report.
	Juvenile	Tagging - CWT	< 1%	Sharpe et al. 1998	No mortality reported for juvenile spring-run chinook following anesthetization, fin clipping and CWT.
		Tagging - PIT	< 1%	Achord et al. 1996	Direct and 24-h post-tag mortalilty were less than 1%.
		Fin Clipping	< 1%	Sharpe et al. 1998	No mortality reported for juvenile spring-run chinook following anesthetization, fin clipping and CWT.
		Handling	< 1%	Sharpe et al. 1998	No mortality reported for juvenile spring-run chinook following anesthetization, fin clipping and CWT.
		Transport	< 1%	Schreck et al. 2006	Post release survival of barged spring-summer run chinook on Lower Columbia near 100%
Experimental Stock	Egg	Egg Survival to Fry	60%	Carl Mesick pers. comm. (9/15/10)	40% egg survival to fry (Stanislaus River data)
	Juvenile	Fry Survival to Smolt	97%	Carl Mesick pers. comm. (9/15/10)	3-5% survival to smolt on the Stanislaus River. Mortallity risk determined by assuming low end Stanislaus survival.
		Smolt survival to Adult	97.5%	Carl Mesick pers. comm. (9/15/10)	2.5-3.6% survival to adult on Stanislaus River. Mortality risk determined by assuming low end Stanislaus survival.

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PERSONAL COMMUNICATIONS: Incidental Mortality Risk Table

Carl Mesick, 9/14/10: Summary of trap and haul methods form winter-run Chinook, Word document included in 9/14/10 email.

Carl Mesick, 9/15/10: Juvenile salmon survival rates in 9/15/10 email.

APPENDIX C- DONOR STOCK COLLECTION PLANNING FRAMEWORK

By necessity, this application has introduced a programmatic framework requiring formal requests (initiated to NMFS by the Service) prior to approving annual collection activities. The decisions regarding donor stock selections—their timing, total numbers, selected life stages, collection locations and methods—cannot be predicted *a priori* for each year during the duration of this permitted activity. The donor stock collection planning process would entail ongoing technical input from the interagency technical teams such as the FMWG, and include a forthcoming decision matrix approach (e.g., as in Appendix A above) to determine appropriate numeric thresholds.

The implementing agencies would convene periodically during the course of the spawning season to review data provided through the donor stock collection monitoring program, including: stream surveys, censuses at weirs, recent historic escapement figures, monitoring program data, Conservation Program needs, hatchery returns, etc. These will be weighed in light of the various prioritization criteria as discussed in the *Donor Stock Collection* section of the *Project Description*, but also include guidance from NMFS through their participation on the interagency technical planning and regulatory teams.

Upon reviewing the available information, the team will confer and make a formal recommendation to the Service's SJRRP Program Manager for stock collection (including specific numbers and capture methods, by lifestage and stream segment) for that year. The Service's SJRRP Program Manager, or designated staff, will compile the information provided by the FMWG into an annual DSC Plan and submit it to NMFS in the form of a formal request.

NMFS would review this request from the Service for that season's collections as outlined within the DSC Plan. The plan and request shall include, at a minimum: a summary of the data evaluated by the team, notes from the group's deliberation from development to recommendations, and the Service's rationale underlying the conditions of the permit and the FMWG technical recommendation through the permitting guidelines established through the §10(j) ruling (e.g., Appendix A, or other) to compile a final request to NMFS. NMFS will make a final determination on allowable collections and report back to the Service's SJRRP Fish Program Manager to approve, deny, or amend the allowable collections in the donor stream segments as outlined in the Stock Selection Strategy for the duration of the applicable DSC Plan.

The FMWG will reconvene to discuss progress on the approved donor stock collection activities, and report back to the Service through the course of the collections. Available agency staff and/or consultants responsible for collection, transport, rearing, and release activities will compile information covering all project activities as outlined in this application. These reports would eventually comprise the annual tallies from the collections, monitoring, and rearing activities that shall be submitted to NMFS in an annual report of donor stock collection and hatchery operations.

Example Donor Stock Collection Plan (Permit Year 1)

Let us presume this is year 1 of the Project, 2012. We present herein an example of the type of request that NMFS could expect for donor stock collection, within the framework of the Donor Stock Collection adaptive planning process and Decision Matrix above. It must be stressed that this example is intended to present the format in which the permitting agency may expect to see specific future requests. It is not explicitly part of the project description itself.

NOTE: *We have tried to anticipate the river conditions, and the status of the Conservation Facility, as best we can project at this time. We have provided fish return numbers that, while plausible within current trends, are nevertheless fictitious. The reader should not confuse the example plan within this appendix with the tangible numbers requested above in Table 1 of the Donor Stock Collection section of the Project Description. However, this example does fit within the breadth of that plan (i.e., will never exceed annual collection limits from any one donor source), follows the example population viability analysis presented in Appendix A, and is consistent with the type of report and detail we anticipate NMFS will receive during the implementation of the current project activity over the first 8 collection years.*

Data Reviewed

Data from the past decade (Grandtab) appear in Table 1, below. N for the generation from all currently monitored source populations are >5,000 for Butte Creek, <2,500 for Deer and Mill Creeks combined, and >5,000 for FRH.

Table 1 Escapement (*S*) Numbers Used for the Donor Stock Collection Decision Process[a]

Year	Butte Creek	Deer Creek	Mill Creek	Feather River Hatchery
2002	8,785	2,185	1,594	4,189
2003	4,398	2,759	1,426	8,662
2004	7,390	804	998	4,212
2005	10,625	2,239	1,150	1,774
2006	4,579	2,432	1,002	2,061
2007	4,943	644	920	2,674
2008	3,935	140	362	1,624
2009	2,059	213	220	822
2010	1,230	330	444	1,657
2011	2,899	410	407	2,135
2012 (tentative)	924 to date	299 to date	606 to date	1217 to date

[a] Escapement numbers from GrandTab 3/9/2010 (through 2009); ***Other numbers are fictitious.***

Current estimates based on available survey data indicate run sizes of >1,000 for Butte Creek, >1,000 for both Deer/Mill Creeks, and >1,500 at FRH. Vaki Riverwatcher counters, operating from April through August, report >800 returns at the Yuba River Daguerre Point Dam, and >20 spring-run at the Stanislaus Weir, respectively. Based on hatchery encounters at Mokelumne Fish Hatchery, we observed 48 ad-clipped adults (28 male and 20 female); and 7 non-ad-clipped individuals (2 female, 5 male). All were marked for identification, ad-clipped for genetic testing, and released awaiting fall return.

FMWG Discussion Notes

The river conditions are as follows: the preliminary water supply forecast is that the water year index will be a Normal Dry Year Type, which provides a total of 364,617 acre-feet of water with base flows of 350 cfs and a pulse flow of 700 cfs from November 1 to 10. None of the structural or channel improvements have been implemented. There is no flow connectivity below Sack Dam in Reach 3 (RM 182) through Reach 4B (RM135.8) during base flow releases.

It was mentioned that the goal for donor stock collection is to mirror the natural populations' genetic diversity as closely as possible. Ideally, this would be done by reintroducing a total of at least 1,200 spawners from each source population (CDFG, 2010). If possible, the spawners should be collected over a four-year generation (300 spawners per year) with equal proportions of males and females and roughly equal family sizes (CDFG, 2010). The broodstock should also be taken at the same level from all source populations used in the reintroduction (CDFG, 2010).

Taking a larger or smaller number from one population may reduce some of the benefits of using multiple sources for broodstock. If this is not possible because one of the three populations cannot support removal of a significant number of fish, the Conservation Facility may compensate by drawing natural fish from that population for a longer period than from the other sources, which will increase the diversity captured from that population.

Returns for this year are (so far) below the 2011 runs, but above the Decision Matrix criteria for viability for Butte Creek and the FRH. The Deer/Mill complex has run sizes below the generational threshold of 2,500 fish, and so we should not recommend collections there. FRH returns are increasing year over year, if modestly.

Given these considerations, it does not seem prudent to initiate larger-scale translocations with the current state of the restored SJR in reaches 1-4B. Survival of reintroduced stock is expected to be low, and the numbers required from donor stock would exceed available fish to responsibly manage and conserve the donor source populations. We currently prefer to utilize collections in 2012 to build the broodstock at the Conservation Facility for larger-scale introductions, before attempting substantial direct translocations. Further, we desire to gain a better understanding of conditions within the river during this initial phase of project activities. Studies are critical for improving our understanding of habitat suitability, and can be designed to also meet the needs of the SJRRP.

FMWG Recommendation

Based upon the consideration of the restoration goals, the current population status in the donor streams (as above), the successful operation of the Conservation Facility in their rearing activities at the interim facility on fall run Chinook salmon (see DFG Conservation Facility

Annual Performance Report to SJRRP, June 2012), we believe the facility will perform to acceptable performance standards (see USFWS, Sep 2010) to warrant initiating broodstock development and rearing. Desired collections for this year are listed in Table 2.

We recommend the Conservation Program focus on building the broodstock for the Conservation Facility as the highest priority in this early phase. We also recommend at least 2,000 juveniles (and perhaps eggs) for translocation to in-stream cages to look at survival rates for this rearing strategy. The cages will be moved downstream at appropriate intervals for imprinting, and finally individuals will be released in Reach 5 below Sack Dam with acoustic tags to track their movement and success. The details of this study are outlined in the Reintroduction Strategies document (USFWS, 2011).

Service Request

For the spawning year beginning Spring 2012, the Service hereby requests the following: 200 eyed eggs to be pumped from no more than 10 redds at Butte Creek this year for relocation to the Conservation Facility; 1 pair of adult fish from the Mokelumne River Hatchery for relocation and spawning at the Conservation Facility; 200 fertilized eggs from the FRH for relocation to the Conservation Facility to go toward rearing broodstock; and 1,000 smolt from the FRH for the cage survival/imprinting study and release below Sack Dam (and telemetry study). This number for survival and imprinting studies will be augmented with an equal or greater number of juveniles from the Conservation Facility (progeny of the Mokelumne River Hatchery adults).

We are not requesting early spring running individuals from Clear or Battle Creek, or any other Central Valley streams at this time. Our request is detailed in Table 2, below.

Table 2. Target donor stock levels for SJRRP 2012 and Fish identified for Reintroduction.

Source Stock	Age	Targeted Collection	Disposition
Butte Creek	Eyed eggs	200	Relocate to Conservation Facility
Feather River Hatchery	Fertile Eggs	200	Relocate to Conservation Facility
Feather River Hatchery	Juvenile-smolt	1,000	Translocation to SJR (cages) for survival and imprinting studies
Mokelumne River Hatchery	Adult	2 (1 pair)	Up to 100 eggs to be used as broodstock at the Conservation Facility and the remainder for SJR egg and smolt survival and imprinting studies
Conservation Stock			**River Reintroduction**

MRH Progeny from CF	Juvenile-smolt	1000	Caged study for survival/movement

References

CDFG, Jun 2012. San Joaquin River Salmon Conservation Facility Annual Performance Report to SJRRP, June 2012.

CDFG, 2010. Hatchery and Genetic Management Plan for the San Joaquin River Salmon Conservation and Research Program.

USFWS, 2011. Reintroduction Strategies Document for the Reintroduction of Central Valley Spring-Run Chinook Salmon into the San Joaquin River.

USFWS, Sep 2010. §10(a)1(A), Enhancement of Species Permit Application for the Reintroduction of Central Valley Spring-Run Chinook Salmon into the San Joaquin River.

APPENDIX D- Invasive Species

Non-Targets That May Potentially Be Moved/Introduced
Vertebrates: Non-indigenous fish (20 species), bull frog (*Rana catesbeiana*), northern water snake (*Nerodia sipedon*), and red-eared slider turtle (*Trachemys scripta*).
Invertebrates: New Zealand mudsnail (*Polamophyrgus antipodarum*), zebra mussel (*Dreissena polymorpha*), quagga mussels (*Dreissena bugensis*), and freshwater asian clam (*Corbicula fluminea*), crawdads *Procambarus clarkii* and *Orconectes rusticus*, mitten crab (*Eriocheir sinensis*), Siberian prawn (*Exopalaemon modestus*), exotic zooplankton spp.
Plants: Aquatic: Canadian waterweed (*Elodea canadensis and E. nuttallii*), Brazilian waterweed (*Egeria densa*), curly pondweed (*Potamogeton crispis*), hydrilla or waterthyme (*Hydrilla verticillata*), water hyacinth (*Eichhornia crassipes*), Eurasian watermilfoil or parrot's feather (*Myriophyllum* spicatum), floating primrose-willow or water primrose (*Ludwigia spp.*), lens-podded white-top (*Cardaria* chalepensis) and harmful algae such as *Didymosphenia geminata*. Terrestrial: yellow starthistle (*Centaurea solstitialis*), Himalayan blackberry (*Rubus discolor*), tree-of-heaven (*Ailanthus altissima*), perennial pepperweed (*Lepidium latifolium*), yellow flag iris (*Iris pseudacorus*), Scotch broom (*Cytisus scoparius*), Spanish broom (*Spartium junceum*), pampas grass (*Cortaderia selloana*), medusa-head (*Taeniatherum caput-medusae*), leafy spurge (*Euphoribia esula*), black locust (*Robinia pseudoacacia*), purple loosestrife (*Lythrum salicaria*), giant arundo (*Arundo donax*), salt cedar or tamarisk (*Tamarix spp.*), Italian thistle (*Carduus pycnocephalus*), Canada thistle (*Cirsium arvense*), tansy ragwort (*Senecio jacobaea*), spotted knapweed (*Centaurea maculosa*) and red sesbania (*Sesbania punicea*).
Other Biologics (pathogens, parasites, etc.): Various fish diseases and parasites including but not limited to: furunculosis (*Aeromonas salmonicida*), *Ambiphyra*, *Ceratomyxa shasta*, *Dactylogyridiasis spp.*, *Epistylis*, columnaris (*Flavobacterium columnare*), *gyrodactylus spp.*, *Hexamita spp*., costia (*Ichthyobodo spp*.), (*Ichthyophthirius multifiliis*), anchor worm (*Lernea* spp.) whirling disease (*Myxobolus cerebralis*), *Nanophyetus salmincola*, *Pseudomonas spp.*, bacterial kidney disease (*Renibacterium salmoninarum*), rosette agent (*Sphaerothecum destruens*), *Trichodina*, cestodes, enteric redmouth disease (*Yersinia ruckeri*), various fungi, and infectious hematopoietic necrosis virus (IHNV)

DEFINITIONS AND ACRONYMS

Adult Standard Units: As proposed within Appendix A for use within this Program, the equivalent of direct take based on survivability (empirical rates) to the adult lifestage. One adult fish equals one adult standard unit. However, due to mortality as eggs transition to emerging fry, outmigrating smolt, rearing subadults, and finally returning adults; a single adult is represented by ~2,080 eggs.

AFRP: Anadromous Fish Recovery Plan; The Central Valley Project Improvement Act (CVPIA) directed the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams. The program is known as the Anadromous Fish Restoration Program (AFRP).

CDFG: California Department of Fish and Game

Conservation Stock: Any individual Chinook salmon, at any life stage which is physically in the possession of the salmon reintroduction team, (i.e. the fish has been collected from donor stock and is being transported to a hatchery or for direct release into the San Joaquin River, or is being held within a hatchery facility for rearing or for use as broodstock).

Direct Release: The release of any fish from any source directly into the San Joaquin River Restoration area.

Donor Stock: Includes any individual Chinook salmon collected at any life stage, from any particular donor source stream (can be Battle, Clear, Butte, Deer or Mill creek; the Stanislaus, Mokelumne, Feather or Yuba rivers; or any other potential opportunistic "rescue" source).

DSC Plan: Donor Stock Collection Plan; The proposed formal request made to NMFS via the Service for annual donor stock collections.

Broodstock: Fish derived directly from Donor Stock which are raised to maturity from eggs, juveniles or unripe adults, and reared at the Conservation Facility. Offspring from the broodstock would eventually be released to the San Joaquin River.

ECPMG: Environmental Compliance and Permitting Working Group

ESA: Endangered Species Act. The law is administered by the Interior Department's U.S. Fish and Wildlife Service and the Commerce Department's National Marine Fisheries Service.

ESU: Evolutionarily Significant Unit: A sub-portion of a species that is defined by substantial reproductive isolation from other conspecific units, and represents an important component of the evolutionary legacy of the species.

Experimental Population: A geographically described group of reintroduced plants or animals that is isolated from other existing populations of the species. For the purposes of the SJRRP, any spring run Chinook salmon released into the San Joaquin River restoration area is anticipated to be considered part of the experimental population.

Experimental Stock: Any group of salmon upon release into the San Joaquin River Restoration Project area is identified as experimental stock. These can be from Donor Stock (for translocations) or Conservation Stock (if transported or indirectly released from the hatchery)

FMP: Fisheries Management Plan

FMWG: Fish Management Working Group

FRH: Feather River Hatchery

GrandTab: A compilation of sources estimating the late-fall, winter, spring, and fall-run Chinook salmon populations for streams surveyed. Estimates are based on counts of fish entering hatcheries and migrating past dams, carcass surveys, live fish counts, and ground and aerial redd counts. Estimates are provided by the California Department of Fish and Game, the US Fish and Wildlife Service, the California Department of Water Resources, the East Bay Municipal Utilities District, the Pacific Gas and Electric Company, and the Fisheries Foundation of California.

HGMP: Hatchery and Genetics Management Plan

IEP: The Interagency Ecological Program; a consortium of nine State and Federal agencies, has been monitoring aquatic organisms and water quality in the San Francisco estuary since about 1970.

Indirect Release: Refers to the release of fish from any rearing facility or structure into the San Joaquin River Restoration area. This may include the use of instream incubators like Whitlock-Vibert boxes.

NMFS: United States Department of Commerce, National Marine Fisheries Service.

PMP: (SJRRP) Program Management Plan

PMT: (SJRRP) Program Management Team

RA: (SJRRP) Restoration Administrator

Relocation: Any transport of Conservation Stock where the source and destination locations are fully protected pursuant to §7 of the ESA.

Reintroduction: Re-establishing a population or species to an area previously occupied by the species.

RST: Rotary Screw Trap

SJRRP: San Joaquin River Restoration Program

Take: A regulatory term within the ESA, as defined to mean: harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.

Translocation: The transport of Donor Stock directly to a release site within the San Joaquin River Restoration area.

Service: United States Department of the Interior, Fish and Wildlife Service