Chapter 5. Fisheries

This chapter updates the 1995 DEIR/EIS assessment of Delta Wetlands Project effects on fish species. The 1995 DEIR/EIS assessment focused on the project's effects on chinook salmon *(Oncorhynchus tshawytscha)*, steelhead *(O. mykiss)*, striped bass *(Morone saxatalis)*, American shad *(Alosa sapidissima)*, delta smelt *(Hypomesus transpacificus)*, splittail *(Pogonichthys macrolepidotus)*, and longfin smelt *(Spirinchus thaleichthys)*, all representative fish species that reside in the Delta, Suisun Bay, and San Francisco Bay for at least part of their lives. It examined project effects on habitat conditions that support these species and on factors that affect the species' abundance and distribution. The effects of Delta Wetlands Project facilities and operations on changes in Delta flows, water quality, local habitat conditions, and entrainment of fish in diversions were analyzed using simulations of project operations, data on fish habitat conditions, and information about the distribution and timing of fish life stages in the Delta.

After the 1995 DEIR/EIS was released, DFG, USFWS, and NMFS issued no-jeopardy biological opinions on Delta Wetlands Project effects on listed species (Appendices C, D, and E). The findings of no jeopardy for fish species are based on the inclusion of the FOC terms agreed to by Delta Wetlands during ESA consultation and the implementation of additional RPMs described in the biological opinions. By incorporating the FOC into proposed project operations, Delta Wetlands has modified the proposed project specifically to avoid or reduce effects on fish. As a result, conditions for fish under the project operations evaluated in this REIR/EIS will be improved from those conditions described in the 1995 DEIR/EIS analysis. With the FOC and RPMs in place, the significant impacts on fish habitat and populations identified in the 1995 analysis are reduced to a less-than-significant level.

FOCUS OF THE REVISED DRAFT EIR/EIS ANALYSIS

The terms of the FOC and the RPMs in the state and federal biological opinions address many of the concerns expressed in comments on the 1995 DEIR/EIS. The evaluation of project effects on fish species has been updated in this REIR/EIS to show how application of these measures will reduce project effects from those identified in the 1995 DEIR/EIS. The chapter also:

- discusses listings of fish species that have occurred since 1995 and the relevance of the 1995 DEIR/EIS analysis and the completed state and federal ESA consultations to assessment of project effects on those species, and

- evaluates the following information in response to concerns stakeholders expressed at the water right hearing or in comments on the 1995 DEIR/EIS:
  - new DFG data on spring-run chinook salmon and use of these data in the chinook salmon mortality model,
  - new EBMUD data on Mokelumne River chinook salmon, and
  - information regarding potential increases in predation with the construction of Delta Wetlands boat docks and other facilities.

Summary of Issues Addressed in This Chapter

The REIR/EIS analysis of fisheries addresses the following questions:

- How do the final terms of the federal and state biological opinions affect the analysis of fishery impacts and mitigation measures presented in the 1995 DEIR/EIS?
- How does incorporation of new data on spring-run chinook salmon affect the conclusions related to salmon mortality presented in the 1995 DEIR/EIS?
- Will Delta Wetlands Project operations significantly affect Mokelumne River anadromous fish, including outmigrating juvenile salmon, rearing juveniles, outmigrating hatchery-released fall yearlings, and returning adults?
- Will the Delta Wetlands Project's proposed boat docks and intake/discharge facilities affect predation in Delta waterways?

Definition of Terms

The following are definitions of key terms as they are used in this chapter:

- *Anadromous Species:* Fishes that mature in marine waters and migrate to fresh water to spawn.
- *Endangered Species:* Any plant or animal species or subspecies whose survival is threatened with extinction and that is included in the federal or state list of endangered species.

- *Entrainment:* The process in which fish are drawn into water diversion facilities along with water drawn from a channel or other water body by siphons and/or pumps. Entrainment loss includes all fish not salvaged (i.e., eggs, larvae, juveniles, and adults that pass through the fish screens, are impinged on the fish screens, or are eaten by predators).

- *Evolutionarily Significant Unit (ESU):* A distinctive group of Pacific salmon or steelhead.

- *Riprap:* A stone covering used to protect soil or surfaces from erosion by water or the elements.

- *Smolt:* A juvenile fish that has undergone physiological change enabling it to survive in saltwater.

- *Spawning:* Laying of eggs, especially by fish.

- *Take:* A term used in Section 9 of the federal ESA that includes harassment of and harm to a species, entrainment, directly and indirectly caused mortality, and actions that adversely modify or destroy habitat.

- *Threatened Species:* A species that is likely to become endangered in the foreseeable future and is included in the federal or state list of threatened species.

CHANGES IN THE PROPOSED PROJECT: FINAL OPERATIONS CRITERIA AND BIOLOGICAL OPINIONS

Since release of the 1995 DEIR/EIS, USACE and SWRCB have consulted with USFWS, NMFS, and DFG on potential effects of the Delta Wetlands Project on fish species listed or proposed for listing under the federal and state ESAs. During the consultation process, the SWRCB, USACE, and the project proponent worked with the resource agencies to revise the project to reduce or avoid adverse effects on fish species. The FOC measures are the result of that effort. The consultations also resulted in no-jeopardy biological opinions from USFWS and NMFS under the federal ESA and a no-jeopardy biological opinion from DFG under the state ESA. To minimize the impacts of incidental taking of fish species, the opinions include RPMs for the project. The FOC and RPMs also provide adequate protection to prevent significant impacts on nonlisted fish species (e.g., striped bass, American shad).

The FOC and RPMs change the conditions under which the Delta Wetlands Project could operate; these measures or criteria are more restrictive than the operations analyzed in the 1995 DEIR/EIS, so fisheries effects would be further reduced. The following section summarizes the changes in project operations that would result from the FOC and measures included in the federal and state biological opinions.

Final Operations Criteria

The FOC terms were developed in response to anticipated impacts of the proposed project, as analyzed in the 1995 DEIR/EIS, on fish species protected under the state and federal ESAs. To avoid or minimize the Delta Wetlands Project's effects on Delta fish populations and habitat, the FOC terms primarily revise the timing and magnitude of allowable diversions for storage and discharges for export or outflow. These restrictions are summarized in Table 2-2. Delta Wetlands also agreed to implement the following measures as part of the FOC:

- Meet design criteria for fish screens of 0.2 feet per second (fps) approach velocity.
- Conserve in perpetuity 200 acres of shallow-water rearing and spawning habitat.
- Contribute $100 per year for boat-wake-erosion mitigation for each boat berth constructed beyond preproject conditions.
- Mitigate on a 3:1 basis for the loss of aquatic habitat to construction activities.
- Minimize and avoid adverse effects of discharge through changes in water temperature.
- Minimize and avoid adverse effects of discharge through changes in dissolved oxygen.
- Compensate for incidental entrainment losses of striped bass, American shad, delta smelt, splittail, and longfin smelt from January through March and June through August (no diversions are permitted in April and May).
- Limit in-water construction to June through November.
- Implement a fish monitoring program that includes:
  - in-channel monitoring during diversions from December through August,
  - on-island monitoring during diversions,
  - monitoring during discharge for export from April through August,
  - reporting,
  - sample handling protocol,
  - coordination with IEP monitoring, and
  - a monitoring technical advisory committee.

The full text of the FOC is included in Appendix B.

Reasonable and Prudent Measures in the Biological Opinions

In their biological opinions for the protection of delta smelt and winter-run chinook salmon, DFG, NMFS, and USFWS specified RPMs that supplement the FOC measures agreed to by Delta Wetlands. These measures are nondiscretionary. Delta Wetlands is required to implement them. Therefore, the measures are included here as modifications to proposed project operations or as additional requirements for mitigating project effects on these listed species.

California Department of Fish and Game Biological Opinion

DFG issued a revised biological opinion in August 1998 regarding effects of the Delta Wetlands Project on state-listed species (California Department of Fish and Game 1998). The full text of the biological opinion is included in Appendix C. Following is a summary of the RPMs in the DFG biological opinion for the protection of delta smelt and winter-run chinook salmon. (The numbers refer to the original numbering in the biological opinion; missing numbers are for measures that pertain to the protection of terrestrial plant and wildlife species and requirements for communicating information to DFG.)

1.0 Delta Wetlands diversion to storage in March is limited by QWEST. (As mentioned in Table 2-2 and in Chapter 3, this is a calculated flow parameter representing net flow between the central Delta and the western Delta.)

2.0 Delta Wetlands will establish an environmental water fund to be controlled by DFG; the amount deposited into the fund will be based on the amount of project diversions from October through March and the amount of project discharge.

4.0 Aquatic habitat development measures will be implemented to offset impacts of moving X2 upstream from February through June.

6.0 Aquatic species monitoring will be implemented to minimize adverse impacts of take.

12.0 Fish screens will comply with DFG's fish screen policy.

15.0 Employee orientation on sensitive-species protection will be provided.

16.0 DFG will be notified of dead, injured, and entrapped state-listed species.

17.0 Compliance inspections will be conducted weekly during construction, assessing Delta Wetlands' compliance with the measures of DFG's biological opinion; compliance will be reported and confirmed.

18.0 Delta Wetlands will allow DFG access to the project site.

19.0 In lieu of monitoring for the entrainment of eggs, larvae, and fry as described in FOC measure 7, Delta Wetlands will provide funds to DFG based on the amount of water diverted to storage from January through March and from June through August. These funds will compensate for incidental entrainment.

20.0 Delta Wetlands will establish an aquatic habitat restoration fund.

National Marine Fisheries Service Biological Opinion

NMFS issued a biological opinion on Delta Wetlands Project effects on winter-run chinook salmon in May 1997 (National Marine Fisheries Service 1997). The full text of the biological opinion is included in Appendix D. The following is a summary of the RPMs specified by NMFS:

1. Properly designed fish screens will be used to reduce entrainment and predation during Delta Wetlands diversion operations.

2. Degradation of Delta habitat during construction, operation, and maintenance activities will be reduced.

3. Appropriate sampling and processing procedures will be used to reduce impacts on juvenile winter-run chinook salmon from discharge monitoring activities.

4. Delta Wetlands operations and daily Delta hydrologic conditions will be monitored.

U.S. Fish and Wildlife Service Biological Opinion

USFWS issued a biological opinion on Delta Wetlands Project effects on delta smelt in May 1997 (U.S. Fish and Wildlife Service 1997). The full text of the biological opinion is included in Appendix E. The following is a summary of the RPMs specified by USFWS:

1. Immersed plants will be avoided when riprap is placed and when recreation facilities and diversion and discharge structures are built.

2. Submersed aquatic plants will be avoided when riprap is placed and during all in-water work associated with constructing project facilities; in-water work will be limited to June through November.

3. The FOC and a fish monitoring program will be implemented.

An analysis of Delta Wetlands Project impacts under the FOC and RPMs developed during ESA consultation is presented below under "Environmental Consequences".

AFFECTED ENVIRONMENT: RELEVANT OR NEW INFORMATION

The fishery resources chapter (Chapter 3F) and appendices (Appendices F1 and F2) in the 1995 DEIR/EIS describe the life histories of Delta fish species and factors affecting their population abundance. Refer to those sections for an overview of Delta fish and their habitats. Since the 1995 DEIR/EIS was released, some additional fish species have been listed as threatened or endangered under the federal and state ESAs; these listings are described below. Also, the lead agencies have received additional information about chinook salmon survival and abundance. DFG has provided these data for spring-run chinook salmon throughout the Delta, and EBMUD has provided data for fall-run chinook salmon in the Mokelumne River. A literature review regarding enhanced feeding activity by predator species associated with boat docks and other in-water structures was also completed to address the comments received on the 1995 DEIR/EIS and during the water right hearing.

New Species Listings and Endangered Species Act Consultation Status

Additional Species Listed under the California and Federal Endangered Species Acts

Since the release of the 1995 DEIR/EIS, three additional species of fish that occur in the Delta have been listed as threatened under the federal ESA. These new listings are:

- Central Valley steelhead ESU (63 FR 11481, March 9, 1998),
- splittail (64 FR 5963, February 8, 1999), and
- Central Valley spring-run chinook salmon ESU (64 FR 50394, September 16, 1999).

Spring-run chinook salmon was also listed as threatened under the California ESA on February 5, 1999. In addition, the Delta has been designated critical habitat for steelhead and spring-run chinook salmon under the federal ESA (65 FR 7764, February 16, 2000).

Status of Consultation

The 1995 DEIR/EIS fully addressed potential effects of the Delta Wetlands Project on splittail and steelhead. In addition, because these species were proposed for listing at the time, the biological assessment prepared for the Delta Wetlands Project (Appendix F2 in the 1995 DEIR/EIS) analyzed project effects on splittail and steelhead.

The final biological opinion of "no jeopardy" received from NMFS on winter-run chinook salmon (Appendix D) also contained a "conference opinion" for the Central Valley ESU steelhead. (Similar to a biological opinion for listed species, a conference opinion is applicable to species proposed for listing.) This conference opinion found that the Delta Wetlands Project would not

jeopardize the continued existence of steelhead. USACE has requested that NMFS formally adopt the conference opinion as its biological opinion on steelhead for the Delta Wetlands Project.

Similarly, the final biological opinion of "no jeopardy" received from USFWS on delta smelt (Appendix E) included a conference opinion for splittail, which found that the Delta Wetlands Project would not jeopardize the continued existence of splittail. USFWS has formally adopted the conference opinion as its biological opinion on splittail for the Delta Wetlands Project (Appendix E). Therefore, no additional consultation is needed to address Delta Wetlands Project effects on splittail.

To address potential project effects on Central Valley ESU spring-run chinook salmon, USACE has requested consultation with NMFS pursuant to Section 7 of the federal ESA. The project's FOC and other measures to be implemented as RPMs under the federal and California ESA biological opinions for the other species cover the period when spring-run chinook salmon occur in the Delta and, therefore, would minimize adverse effects of the project on spring-run chinook salmon as well. USACE has requested concurrence with this conclusion from NMFS and has also inquired whether any additional information or analysis may be required to complete consultation on spring-run chinook salmon.

Similarly, Delta Wetlands will request concurrence directly from DFG regarding the assertion that the FOC and RPMs from the existing biological opinions adequately address potential project effects on spring-run chinook salmon pursuant to Section 2081 of the California Fish and Game Code. The California ESA biological opinion assessed Delta Wetlands' impacts on spring-run chinook salmon, and the RPMs were indicated as minimizing adverse impacts of the incidental taking of spring-run chinook salmon. DFG will indicate whether additional information or analysis is required to complete consultation pursuant to the California ESA.

New California Department of Fish and Game Data on Spring-Run Chinook Salmon

On August 13, 1999, DFG gave the lead agencies new information about juvenile spring-run chinook salmon occurrence in the Delta (Wernette pers. comm.). The extent of occurrence of juvenile spring-run chinook salmon assumed in the 1995 DEIR/EIS assessment generally corresponds to the extent of occurrence in the information provided by DFG (Table 5-1).

DFG also furnished new information about the assumed survival of spring-run chinook salmon during migration through the Delta (Wernette pers. comm.). The survival information was incorporated into the chinook salmon mortality model as described below under "Environmental Consequences".

East Bay Municipal Utility District Data on Mokelumne River Chinook Salmon

During the water right hearing and the review period for the 1995 DEIR/EIS, EBMUD commented that the 1995 DEIR/EIS did not adequately address Delta Wetlands Project effects on Mokelumne River anadromous fish (i.e., fall-run chinook salmon and steelhead). The impact of Delta Wetlands diversions on juvenile chinook salmon originating from the Mokelumne River was considered significant in the 1995 DEIR/EIS and mitigation was identified.

In response to EBMUD's comment, the lead agencies asked EBMUD to provide data about tracking and movement of Mokelumne River fish, including timing data for juvenile migration. EBMUD provided raw data in spreadsheet and database files, including tables of summary statistics and summary histograms (Miyamoto pers. comm.). The data provided include adult spawning escapement for 1993-1998 (Table 5-2), juvenile outmigration for 1994-1999 (Table 5-3), and coded wire tag data for 1991-1998. This information was used in the revised assessment of Delta Wetlands Project effects on Mokelumne River chinook salmon described below under "Environmental Consequences".

Delta Wetlands Project Facilities and Fish Predation

A literature search was completed to update information presented in the 1995 DEIR/EIS about predation, including potential effects of boat docks and intake/discharge facilities on prey species vulnerability and predator species success. As described below, this information has been used to augment the discussion of potential effects of the project on predation presented in the 1995 DEIR/EIS.

IMPACT ASSESSMENT METHODOLOGY

Assessment of Delta Wetlands Project effects on Delta fish species and their habitat involves predicting fish and habitat responses to changes in Delta conditions that could result from project operations. The 1995 DEIR/EIS impact assessment used a variety of methods, including:

- Delta Wetlands Project operation modeling that determined changes in Delta flows (see Chapter 3, "Water Supply and Operations");
- water quality modeling that determined changes in Delta salinity and assessed other factors that could affect fish species and the amount of estuarine habitat available to them (see Chapter 4, "Water Quality");

- an entrainment index that was used to represent changes in potential entrainment of fish at the Delta Wetlands diversion facilities and the SWP and CVP pumping plants; and

- a salmon smolt survival model (mortality index) that was modified from the model developed by USFWS (Kjelson et al. 1989).

These methods were also used in the ESA consultation process; the results of the ESA consultation were the basis for the changes in the project described by the FOC and the RPMs.

For the analysis presented below, Delta Wetlands Project operations modeling was used to determine changes in Delta flows under the FOC and RPMs (see Chapter 3, "Water Supply and Operations"). The following summarizes the contents of this analysis:

- Because the FOC and RPMs improve conditions for fish, the project's effects as identified in the 1995 DEIR/EIS are compared with effects under the FOC and RPMs.

- Potential effects of the Delta Wetlands Project on spring-run chinook salmon are assessed using the new data provided by DFG on spring-run occurrence and using USFWS's recently modified salmon smolt survival model.

- Impacts on Mokelumne River fall-run chinook salmon are reassessed, considering recent data provided by EBMUD.

- Based on additional literature review, the potential impacts of new Delta Wetlands Project boat docks and other facilities on predator-prey interactions in the Delta are assessed in greater detail than in the 1995 DEIR/EIS.

The significance thresholds are the same as those used in the 1995 DEIR/EIS.

ENVIRONMENTAL CONSEQUENCES

Delta Wetlands Project Impacts under the Final Operations Criteria and Implementation of Reasonable and Prudent Measures

The FOC and RPMs developed during ESA consultation have been incorporated into the proposed Delta Wetlands Project assessed in this REIR/EIS. The revised Delta Wetlands operations and RPMs reduce project impacts on fish identified in the 1995 DEIR/EIS to less-than-significant levels, fulfilling the need for mitigation measures proposed in that document. Table 5-5 summarizes the impacts on fish species and habitat identified in the 1995 DEIR/EIS. It also discusses how the FOC and RPMs reduce those impacts to less-than-significant levels and supersede the mitigation measures previously recommended.

Project Impacts on Spring-Run Chinook Salmon

As shown in Figure 5-1, the occurrence of spring-run chinook salmon overlaps with the occurrence of winter- and fall-run juveniles. Spring-run yearlings occur in the Delta primarily from October through January; the timing of occurrence depends on flow and water temperature conditions (Table 5-1). Young-of-year juvenile spring-run chinook salmon may occur in the Delta from December through June, depending primarily on two factors—flow conditions that cause early-life-stage chinook salmon to move downstream and the growth of juveniles to smolt size. Analysis of effects on juvenile winter-run and fall-run chinook salmon in the 1995 DEIR/EIS covered the time periods identified for spring-run yearlings and young-of-year juveniles. The occurrence data provided by DFG are more specific than the assumptions used in the 1995 DEIR/EIS but do not alter the conclusion reached in the 1995 DEIR/EIS.

DFG also provided new information about assumed survival of spring-run chinook salmon through the Delta. USFWS has used this information to modify the relationship (i.e., slope) between migration pathway and survival in the USFWS salmon smolt survival model (mortality index). With this modification, the same model can be used to assess effects on late fall-, spring-, and winter-run chinook salmon. The modified slope was based on results of survival experiments carried out by USFWS during the months of December and January (Wernette pers. comm.) (the years of data collection were not specified in the DFG information). For assessment of Delta Wetlands Project effects on spring-run chinook salmon, the slope for the reach 2 relationship (central Delta) was changed from 0.000043 (fall-run relationship) to 0.000054 (spring-run relationship).

The USFWS model states that index values are not estimates of absolute survival and should be used only as tools to aid in evaluating the relative impacts associated with additional pumping. DFG concurs with this approach (Wernette pers. comm.). Therefore, as in the 1995 DEIR/EIS analysis, the model was used in this REIR/EIS analysis to assess impacts based on the changes in the mortality index between without-project and with-project conditions.

Using the assumed spring-run relationship in place of the assumed fall-run relationship does not affect conclusions about project effects reported in the 1995 DEIR/EIS. When both relationships were applied to export conditions under an assumed constant water temperature of 55°F, the timing and magnitude of effects on the fish with and without the Delta Wetlands Project were similar (Figure 5-2). The effects illustrated in Figure 5-2 for both the fall- and spring-run relationships are worst-case scenarios; they assume a constant effect of Delta Wetlands diversion and CVP-SWP export, including export of Delta Wetlands discharge, regardless of water source and net channel flow conditions. These factors were considered in the assessment for the 1995 DEIR/EIS.

The revised analysis identifies Delta Wetlands Project effects on survival during the same years indicated in the 1995 simulation, although the magnitude of the effects varies slightly when the new data are used. The direction of change in response to exports, Delta Wetlands operations, and water temperature remains the same. Delta Wetlands Project effects found in this revised analysis of the spring run are consistent with conclusions reached in the 1995 DEIR/EIS, which were based on earlier USFWS data. Although flow changes resulting from Delta Wetlands diversions and discharges could indirectly cause spring-run chinook salmon mortality to increase, this potential

increase would be less than significant. Relative to effects described in the 1995 DEIR/EIS, these impacts will be reduced with implementation of the FOC terms and RPMs from the biological opinions for delta smelt and winter-run chinook salmon.

For Sacramento River fish, the USFWS model assumes that increased mortality attributable to export occurs in the central Delta. Closure of the DCC gates reduces exposure of Sacramento River fish to export effects. The Delta Wetlands Project does not affect operations of the DCC or the proportion of flow drawn through the DCC and Georgiana Slough. Additionally, the FOC terms require reductions in Delta Wetlands diversions if the DCC gates are closed for fishery protection (from November through January).

The effects of water temperature are a primary factor in the survival of juvenile chinook salmon during migration through the Delta. The Delta Wetlands Project also does not affect water temperature in the Sacramento River or in the central Delta when it diverts water to storage. The FOC will minimize effects of Delta Wetlands Project discharge on water temperature, and effects will be limited to locations in channels near the discharge facilities. FOC terms require that project operations not cause a change in receiving water temperature greater than 7°C; they also prohibit channel temperature increases greater than 1°C where channel temperatures are 13° to 25°C, and increases greater than 0.5°C where channel temperatures are more than 25°C (see Appendix B).

Project Impacts on Mokelumne River Chinook Salmon

For the 1995 DEIR/EIS, a mortality index was developed for chinook salmon that originate in the Sacramento River, but not specifically for chinook salmon in the Mokelumne River. The impact assessment assumed that all juveniles originating in the Mokelumne River and adults returning to the Mokelumne River would be affected by Delta exports and Delta Wetlands Project diversions. The impact of such diversions on juvenile chinook salmon originating in the Mokelumne River was considered significant in the 1995 DEIR/EIS and mitigation was identified (Table 5-5).

When submitting data on salmon occurrence and survival, EBMUD did not identify any relationships between Delta channel flows (or Delta diversions) and adult migration or juvenile survival. Survival of adult and juvenile chinook salmon in the Mokelumne River does not appear to be affected by net flows in Delta channels.

The evaluations of project effects on migrating adults, juvenile outmigration, and flows from the Mokelumne River are described below.

Adult Spawning Migration

EBMUD indicated that release of Delta Wetlands Project water in August and September could confuse returning adult Mokelumne River salmon seeking cues from the river. The number of adults migrating past Woodbridge Dam daily was compiled to estimate the completion dates of

50% and 90% of the run (Table 5-2). The data were compared with the timing assumed for adult fall-run chinook salmon in Figure 5-1, which duplicates Figure 3F-1 from the draft EIR/EIS. In Figure 5-1 and in the data provided by EBMUD, most adult chinook salmon enter the Mokelumne River from September through December, with peak migration in October and November.

EBMUD did not identify, and analysis of the data provided did not show, a relationship between net Delta channel flow (QWEST) and adult migration to the Mokelumne River. Although Delta channel flows varied substantially, the new information indicated minimal variability in the 50% and 90% completion dates for adult chinook salmon migration into the Mokelumne River from 1993 through 1998. For example, average QWEST in October 1993 was -2,359 cfs and was 161 cfs in October 1994. The dates of 50% and 90% completion of annual migration past Woodbridge Dam, however, varied by only a few days between 1993 and 1994 (Table 5-2). Similarly, the dates of annual migration past Woodbridge Dam during 1994 and 1995 were similar even though QWEST in August averaged -1,780 cfs in 1994 and 1,948 cfs in 1995.

A negative QWEST indicates that very little Mokelumne River water will exit the Delta as outflow and that most of the Mokelumne River water will be present in the water mass moving toward the CVP and SWP export pumps. A negative QWEST (e.g., in October 1993 and August 1994) does not appear to have affected the timing of adult migration in the Mokelumne River when compared to years when QWEST was positive (e.g., October 1994 and August 1995).

Another indicator that adults could be confused by the presence of Mokelumne River water in the central and south Delta channels would be straying to other rivers. However, the coded wire tag data provided by EBMUD showed that regardless of their origin (i.e., Nimbus Fish Hatchery), more than 90% of juvenile chinook salmon released in the Mokelumne River returned as adults to the Mokelumne River. The data also indicated that 60% to 100% of the juvenile chinook salmon produced in the Mokelumne River or at the Mokelumne River fish hatchery returned to the Mokelumne River as adults regardless of release location. The coded wire tag data indicate that if straying occurs, juveniles originating from other rivers and released in various Delta locations are most likely to stray as returning adults.

Delta Wetlands discharge and diversion could change the amount of Mokelumne River water present in channels south of the San Joaquin River; however, the available data do not indicate that such changes would affect migration of adult chinook salmon. (See also "Effect of the Delta Wetlands Project on the Concentration of Mokelumne River Water in the Central and South Delta" below.)

Juvenile Outmigration

The EBMUD data on juvenile outmigration indicated that during wet years (water years 1995 through 1999), most annual production of juvenile chinook salmon passes Woodbridge Dam before March (Table 5-3). According to EBMUD, up to 70% of the entire annual production of juvenile chinook salmon would pass Woodbridge Dam as fry (Miyamoto pers. comm.). A similar pattern of outmigration has been noted in other systems. The high abundance of fall-run fry in the Delta before March coincides with high flows (U.S. Fish and Wildlife Service 1994).

EBMUD and USFWS have indicated concern about the entrainment of fry in Delta diversions after high flows. The available salvage data for the CVP and SWP, however, show that peak entrainment of juvenile chinook salmon occurs during April and May (Figure 5-3). It is likely that fry and young juvenile chinook salmon rear in the lower portion of rivers and in the Delta channels receiving the river discharge until they reach smolt size (i.e., a level of maturity that allows movement to the ocean). Smolt-sized salmon move past Chipps Island primarily from April through June (U.S. Fish and Wildlife Service 1994) and are salvaged at the CVP and SWP fish protection facilities primarily during April and May (Figure 5-3).

EBMUD also provided raw data on recovery (capture) of Mokelumne River juvenile chinook salmon marked with coded wire tags. EBMUD did not identify any relationship between net Delta channel flow, export, and entrainment in Delta diversions. The number of tagged fish salvaged at the CVP and SWP fish protection facilities appears to be related to the number and size of fish released: the larger the number and bigger the fish released, the larger the number recovered. In general, the number of fish recovered at the fish protection facilities was small, usually 1 or 2 fish and less than 0.02% of the number released, and was highly variable, ranging from none to as many as 27 fish out of 10,000 to 100,000 released. Because of the relatively high occurrence of zero recoveries and the variability of release dates, number of fish released, release locations, and size at release, the EBMUD data cannot be used to develop accurate relationships between facility operations and entrainment.

The available information does not indicate that Delta Wetlands operations, with the FOC and RPMs in place, would have significant adverse effects on juvenile chinook salmon that originate in the Mokelumne River and rear in the Delta from January through March. The data provided by EBMUD on the recovery of tagged juveniles did not include data on fish released during January through March. They also did not provide information on relationships between flow or diversion and entrainment at the CVP and SWP export facilities. SWP and CVP salvage data indicate that the months of highest entrainment of juveniles are April and May. The FOC terms specify that Delta Wetlands diversions would be limited by several factors during January through March and would not be allowed during April and May. Details of the applicable FOC restrictions are provided under "Summary of the Evaluation of Delta Wetlands Project Effects on Mokelumne River Chinook Salmon" below. (See also the following section, "Effect of the Delta Wetlands Project on the Concentration of Mokelumne River Water in the Central and South Delta".)

Effect of the Delta Wetlands Project on the Concentration of Mokelumne River Water in the Central and South Delta

EBMUD was concerned that discharge of Delta Wetlands Project water could confuse returning adult and juvenile chinook salmon during upstream and downstream migration. A worst-case assessment of the origin of central and south Delta water was completed, based on simulated Delta water supply and operations (Chapter 3). This assessment assumed that:

- tidal flows would not dilute the proportion of Mokelumne River water drawn into the central and south Delta,

- Delta Wetlands discharge would retain the Mokelumne River characteristics over the storage period, and

- Delta Wetlands discharge would mix completely in the central Delta and would not be drawn toward the export pumps. (This is a very conservative assumption for Bacon Island discharge, the only discharge for exports allowed during January through June.)

The results shown in Table 5-4 and Figure 5-4 indicate that the Delta Wetlands Project would have a minimal effect on the proportion of Mokelumne River water moving through the central and south Delta. In most years the Delta Wetlands discharge would have proportionately less Mokelumne River water than the channel receiving the discharge. Project operations, therefore, may reduce slightly the proportion of Mokelumne River water present, but the effect on chinook salmon is likely to be negligible. In addition, under normal operating circumstances, Delta Wetlands would infrequently release water in the winter months (see Table 3-15 in Chapter 3), further reducing the probability that the project would affect Mokelumne River salmon.

Summary of the Evaluation of Delta Wetlands Project Effects on Mokelumne River Chinook Salmon

The EBMUD data do not provide evidence that Delta Wetlands Project operations would significantly affect adult chinook salmon migration to the Mokelumne River. The 1995 DEIR/EIS identified project effects on juveniles originating in the Mokelumne River as a significant impact. With implementation of the FOC and RPMs described in the state and federal biological opinions, impacts on chinook salmon, including those originating in the Mokelumne River, would be less than significant. The FOC that would minimize adverse effects on juvenile chinook salmon from the Mokelumne River include the following (see Appendix B for details):

- Total annual export of Delta Wetlands stored water would be limited to 250,000 af; therefore, the amount of diversion and discharge that could occur in any one year would be restricted.

- The volume of Delta Wetlands diversions and potential effects on Delta channel flow conditions would be limited by:

  - the maximum X2 value (corresponding to a minimum Delta outflow);
  - the maximum allowable change in X2 value;
  - the March QWEST criteria;
  - the percentage of Delta surplus, Delta outflow, and San Joaquin River inflow; and
  - criteria during DCC closures for fish protection.

- Webb Tract would not be allowed to discharge to export during January through June, which includes the period of juvenile chinook salmon migration.

- The volume of Delta Wetlands discharges to export and potential effects on Delta channel flows would be limited to a percentage of unused export capacity.

- Fish screens would be designed to meet a 0.2-fps approach velocity, avoiding direct diversion effects on juvenile chinook salmon.

Effects of Delta Wetlands Project Facilities on Fish Predation

Numerous boat docks and fishing piers are found in the Delta region (see Chapter 3J of the 1995 DEIR/EIS, "Affected Environment and Environmental Consequences—Recreational and Visual Resources"). Docks and piers are present at more than 100 marinas, approximately 23 public recreation facilities that provide boat launching and fishing access, and several private waterfowl hunting clubs. Three of the four Delta Wetlands Project islands (Bacon Island, Webb Tract, and Bouldin Island) do not currently have public recreational boat docks (they do, however, have a limited number of private docks and ramps). The fourth project island, Holland Tract, supports two marinas, one with 335 berths and one with 21 berths. The Delta Wetlands Project may include construction of up to 40 new floating boat docks with as many as 30 berths each. Delta Wetlands may construct fewer and smaller facilities but is proposing the maximum amount, which necessitates worst-case environmental analysis. Also, pilings and other structures would be constructed as part of the siphon and pump facilities on Bacon Island and Webb Tract.

The presence of natural or artificial cover (e.g., trees, rootwads, brush piles, or aquatic plants) in water bodies is well known to attract relatively high concentrations of fish (Johnson and Stein 1979). Food may be more abundant in areas with cover (Johnson et al. 1988). Cover can disrupt streamflow patterns and therefore provide fish with refuges from elevated water velocities associated with high flows (Shirvell 1990). By providing small protected spaces and a diversity of space sizes, cover can effectively reduce predation risk for small fish and can ameliorate competitive interactions (Savino and Stein 1982, Bugert et al. 1991).

Installation of boat docks would not be expected to affect fish predator-prey interactions significantly. Pilings and shade associated with boat docks or fishing piers may be used as cover by both predator and prey fish. However, these structurally simple forms of cover attract fish species much less than more complex forms such as brush piles or aquatic plants (Savino and Stein 1982, Gotceitas and Colgan 1987, Lynch and Johnson 1989).

The construction of new boat docks and other facilities on the Delta Wetlands islands is not expected to increase the vulnerability of juvenile chinook salmon or other species to predation. Comprehensive data about predator-prey interactions involving juvenile salmonids and other species in the Delta are unavailable (U.S. Bureau of Reclamation 1983, Interagency Ecological Program 1995). However, juvenile chinook salmon and other species are known to be vulnerable to predators at locations such as Red Bluff Diversion Dam, Clifton Court Forebay, and release sites for fish salvaged from the SWP and CVP facilities (Hall 1980, Pickard et al. 1982, U.S. Bureau of Reclamation 1983). These facilities and release sites attract relatively high concentrations of juvenile salmonids and other fish species that may be substantially disoriented by turbulence and

handling associated with diversion, flow constriction, bypasses, and trucking. The high concentration of disoriented fish could create exceptional predator habitat by increasing prey availability. Boat docks, however, would not divert water or constrict flows and would not cause conditions expected to disorient fish.

The additional information reviewed for this REIR/EIS evaluation does not provide evidence that predation would increase because of the presence of boat docks and other Delta Wetlands Project facilities or change the 1995 DEIR/EIS conclusion that effects of project facilities on fish predation would be less than significant.

Cumulative Impacts

When added to other past, present, and reasonably foreseeable future actions, effects of the Delta Wetlands Project would not be expected to increase cumulative impacts on fish and fish habitat relative to existing conditions. With implementation of the AFRP under the CVPIA, the Ecosystem Restoration Program under CALFED, and other ongoing programs, fish habitat conditions in and upstream of the Delta are expected to improve for chinook salmon and other species. The FOC terms for the Delta Wetlands Project avoid and minimize project effects on Delta fish and their habitat (Table 2-2). The FOC terms include compensatory measures that potentially improve and increase fish habitat, such as conservation of 200 acres of shallow-water rearing and spawning habitat, habitat replacement at a 3:1 ratio, setting aside of environmental water, and contribution of funds for DFG fish and habitat management (i.e., $100 per year per additional boat berth, compensation for incidental entrainment losses, establishment of aquatic habitat conservation and environmental water funds).

Impact Evaluation of Project Alternatives from the 1995 Draft EIR/EIS

Alternatives 1 and 2 described in the 1995 DEIR/EIS represented two scenarios for Delta Wetlands' proposed project, which differed only in terms of allowable discharges of stored water. The biological assessment for Delta Wetlands Project effects on fish species was based on project operations under the proposed project as described for Alternative 2, which would have the maximum amount of discharge pumping and the maximum effect on fisheries associated with discharges under the proposed project. The FOC and RPMs were developed through ESA consultation based on estimated project effects under Alternative 2 operations; as described above, application of the FOC and RPMs would improve conditions for fish in comparison with conditions described in the evaluation of project effects presented in the 1995 DEIR/EIS. Similarly, application of the FOC and RPMs under Alternative 1 operations would improve conditions for fish.

Alternative 3, the four-reservoir-island alternative, has not changed since the 1995 DEIR/EIS was published. The FOC and biological opinion terms were developed for the two-reservoir-island operations and are not applicable to a four-reservoir-island alternative. There is no change to the conclusions of the environmental impact analysis presented in the 1995 DEIR/EIS for Alternative 3.

Table 5-1. Comparison of Juvenile Spring-Run Chinook Salmon Occurrence in the Delta Assumed in the 1995 DEIR/EIS and Provided by DFG in August 1999

	Potential Occurrence in the Delta as a Proportion of Annual Production			
	1995 DEIR/EIS		DFG	
Month	Yearlings	Young-of-Year	Yearlings	Young-of-Year
October	X[a]			
November	X[a]		0.37	
December	X[a]	<0.26	0.42	0.01
January	X[a]	0.26-0.50	0.13	0.06
February		>0.50	0.05	0.17
March		0.26-0.50	0.03	0.28
April		<0.26		0.25
May		<0.26		0.16
June		<0.26		0.07

[a] The proportion in the Delta was not estimated, but occurrence was assumed during the months indicated.

Sources: Jones & Stokes Associates 1995, Wernette pers. comm.

C-062844

Table 5-2. Dates of Annual Adult Chinook Salmon Migration Past Woodbridge Dam

Year	Date of Percentage of Annual Migration Past Woodbridge Dam	
	50%	90%
1993	November 2	November 20
1994	November 7	November 26
1995	October 28	November 23
1996	October 31	November 20
1997	November 7	November 22
1998	November 3	November 23

Source: Miyamoto pers. comm.

C-062845

Table 5-3. Dates of Annual Juvenile Chinook Salmon Migration Past Woodbridge Dam

Year	Date of Percentage of Annual Migration Past Woodbridge Dam	
	50%	90%
1994	May 4	May 24
1995	March 6	June 3
1996	March 4	June 6
1997	February 22	May 30
1998	February 4	May 16
1999	February 19	May 14

Source: Miyamoto pers. comm.

C-062846

Table 5-4. Frequency with which Concentrations of Mokelumne River Water in the South Delta Would Exceed the Percentages Given for Each Month,1922-1991 Simulation

	Mokelumne River Water Concentration in the South Delta without the Delta Wetlands Project (%)											
Frequency (%)	October	November	December	January	February	March	April	May	June	July	August	September
0	15	48	55	51	63	51	54	41	26	16	16	12
10	8	10	28	38	38	33	28	25	14	5	8	7
20	5	7	13	25	31	28	27	23	8	5	5	5
30	4	6	10	14	24	21	25	21	7	4	5	4
40	3	5	7	11	20	18	22	20	6	4	5	4
50	2	4	5	7	15	16	21	17	5	3	4	4
60	2	3	4	5	11	14	19	15	5	3	4	4
70	2	2	3	5	9	12	16	13	5	3	3	3
80	1	2	3	3	6	7	15	12	5	3	3	3
90	1	1	2	2	3	3	12	11	5	3	3	3
100	0	0	0	0	0	0	0	0	0	0	2	1

	Mokelumne River Water Concentration in the South Delta with Delta Wetlands Project Diversions (%)											
Frequency (%)	October	November	December	January	February	March	April	May	June	July	August	September
0	15	48	55	51	63	51	54	41	26	16	16	12
10	7	8	26	38	37	33	28	25	14	5	8	7
20	4	6	11	25	30	28	27	23	8	5	5	5
30	4	5	9	12	24	21	25	21	7	4	5	4
40	3	5	7	9	18	18	22	20	6	4	5	4
50	2	4	5	7	15	16	21	17	5	3	4	4
60	2	3	4	5	11	14	19	15	5	3	4	4
70	2	2	3	4	9	11	16	13	5	3	3	3
80	1	2	3	3	6	7	15	12	5	3	3	3
90	1	1	2	2	2	3	12	11	5	3	3	2
100	0	0	0	0	0	0	0	0	0	0	2	1

	Mokelumne River Water Concentration in the South Delta with Delta Wetlands Project Diversions and Discharge (%)											
Frequency (%)	October	November	December	January	February	March	April	May	June	July	August	September
0	15	48	55	51	63	51	54	38	26	15	16	12
10	7	8	26	38	37	33	28	24	14	6	8	7
20	4	6	11	25	30	28	27	22	7	5	5	5
30	4	5	9	12	22	22	26	21	7	4	5	4
40	3	5	7	9	18	18	22	19	5	3	5	4
50	2	4	5	7	12	16	20	17	5	3	4	4
60	2	3	4	5	10	14	19	15	5	3	4	4
70	2	2	3	5	8	10	16	13	5	3	3	3
80	1	2	3	3	6	6	15	12	5	3	3	3
90	1	1	2	2	2	3	11	10	4	3	3	2
100	0	0	0	0	0	0	0	0	0	0	2	1

Table 5-5. Comparison between Delta Wetlands Project Impacts on Fisheries in the 1995 DEIR/EIS and in the 2000 REIR/EIS

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
CHAPTER 3F. FISHERY RESOURCES	
Impact F-1: Alteration of Habitat (S) • **Mitigation Measure F-1**: Implement Fish Habitat Management Actions (LTS)	**Alteration of Habitat.** The impact would be less than significant based on inclusion of the following project elements identified in the California and federal Endangered Species Act (ESA) biological opinions (see final operations criteria [FOC] in Appendix B): - Conserve in perpetuity 200 acres of shallow-water rearing and spawning habitat. - Contribute $100 per year per additional boat berth for boat-wake-erosion mitigation. - Mitigate on a 3:1 basis for aquatic habitat lost to construction activities. - Limit in-water construction to June through November. (LTS) The project elements would minimize and avoid, where feasible, effects on habitat and would replace lost habitat. The following reasonable and prudent measures (RPMs) will further reduce Delta Wetlands Project impacts: *DFG Biological Opinion* - Provide employee orientation on sensitive-species protection. - Report and confirm compliance with construction guidelines. - Allow DFG personnel access to the project site. - Establish an aquatic habitat restoration fund. *NMFS Biological Opinion* - Complete project construction and maintenance in a manner that does not degrade Delta habitat. (Continued on next page)

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

Table 5-5. Continued

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
	(Continued from previous page) *USFWS Biological Opinion* - Avoid areas of immersed plants while riprap is placed and diversion and discharge structures are built. - Avoid areas of submersed plants while riprap is placed and diversion and discharge structures are built; limit in-water work to June through November.
Impact F-2: Increase in Temperature-Related Mortality of Juvenile Chinook Salmon (S) • **Mitigation Measure F-2**: Monitor the Water Temperature of Delta Wetlands Discharges and Reduce Delta Wetlands Discharges to Avoid Producing Any Increase in Channel Temperature Greater than 1°F (LTS)	**Increase in Temperature-Related Mortality of Juvenile Chinook Salmon.** The impact would be less than significant based on inclusion of the following project elements identified in the California and federal ESA biological opinions (see FOC and RPMs in Appendices B, C, D, and E). (LTS) - Minimize and avoid adverse effects of discharge through changes in water temperature: • when the temperature differential between the discharge and receiving water is greater than 20°F, there shall be no discharge; • when channel water temperature is 55°F or higher and is less than 66°F, it shall not increase by more than 4°F; • when channel water temperature is 66°F or higher and is less than 77°F, it shall not increase by more than 2°F; • when channel water temperature is 77°F or higher, it shall not increase by more than 1°F; and • Delta Wetlands shall develop and implement water temperature monitoring.

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

C-062849

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
Impact F-3: Potential Increase in Accidental Spills of Fuel and Other Materials (LTS) • No mitigation is required.	**Potential Increase in Accidental Spills of Fuel and Other Materials.** The impact would be less than significant and would be further minimized by inclusion of the following project elements identified in the California and federal ESA biological opinions: (LTS) - Conserve in perpetuity 200 acres of shallow-water rearing and spawning habitat. - Contribute $100 per year per additional boat berth for boat-wake-erosion mitigation. - Mitigate on a 3:1 basis for aquatic habitat lost to construction activities.
Impact F-4: Potential Increase in the Mortality of Chinook Salmon Resulting from the Indirect Effects of Delta Wetlands Project Diversions and Discharges on Flows (S) • **Mitigation Measure F-3:** Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Changes in Cross-Delta Flow Conditions during Peak Outmigration of Mokelumne and San Joaquin River Chinook Salmon (LTS) **Impact F-5**: Reduction in Downstream Transport and Increase in Entrainment Loss of Striped Bass Eggs and Larvae, Delta Smelt Larvae, and Longfin Smelt Larvae (S)	**Potential Impacts on Chinook Salmon, Striped Bass, Delta Smelt, Longfin Smelt, American Shad, and Other Species.** Interrelated operations criteria address Impacts F-4, F-5, F-6, F-7, and F-8. The impacts would be less than significant based on inclusion of the following project elements identified in the California and federal ESA biological opinions (see FOC and RPMs in Appendices B, C, D, and E). The impacts reduced or avoided are indicated for each operations criterion by the impact number in parenthesis. (LTS) Total Export Criteria: - Annual export of Delta Wetlands stored water will not exceed 250,000 acre-feet (af). This criterion limits the maximum operation effect that could occur in any given year, constraining impacts F-4 through F-8. Diversion Criteria: - Maximum X2 value limits start of Delta Wetlands diversion, September through November (F-4, F-6, F-7, F-8)

(Continued on next page)

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

C-062850

Table 5-5. Continued

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
• **Mitigation Measure F-4**: Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Adverse Transport Effects on Striped Bass, Delta Smelt, and Longfin Smelt (LTS) **Impact F-6**: Change in Area of Optimal Salinity Habitat (LTS) • No mitigation is required. **Impact F-7**: Increase in Entrainment Loss of Juvenile Striped Bass and Delta Smelt (S) • **Mitigation Measure F-5**: Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Entrainment of Juvenile Striped Bass and Delta Smelt (LTS) **Impact F-8**: Increase in Entrainment Loss of Juvenile American Shad and Other Species (LTS) • No mitigation is required.	Diversion Criteria (continued from previous page): - Maximum X2 value limits magnitude of Delta Wetlands diversion, September through March (all impacts) - Delta Wetlands diversion is limited by a maximum allowable change in X2, October through March (all impacts) - Delta Wetlands diversion to storage is limited by QWEST in March (see California ESA biological opinion) (F-4, F-5, F-6, F-7) - No water is diverted, April and May (F-4, F-5, F-6, F-8) - If the delta smelt fall midwater trawl (FMWT) index is less than 239, no diversion from February 15 through June (F-4, F-5, F-6, F-8) - Diversions are limited to a percentage of Delta surplus, year round (all impacts) - Diversions are limited to a percentage of Delta outflow, year round (all impacts) - Diversions are limited to a percentage of San Joaquin River inflow, December through March (all impacts) - Diversions are reduced when monitoring detects presence of delta smelt, December through August (all impacts) - Diversions are limited if the Delta Cross Channel is closed for fish protection, November through January (F-4, F-6, F-7, F-8) (Continued on next page)

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS

(Continued from previous page)

Discharge Criteria:

- Bacon Island discharge for export is limited to 50% of San Joaquin River inflow, April through June (F-4, F-5, F-8)

- Webb Tract discharge for export is prohibited, January through June (F-4, F-5, F-7, F-8)

- Discharge for export or rediversion from habitat islands is prohibited (Bouldin Island, Holland Tract), all year (F-4, F-5, F-7, F-8)

- Discharge is limited to a percentage of available unused export capacity, February through July (F-4, F-5, F-7, F-8)

- Environmental water will be set aside and provided as a percentage of discharge, February through June (F-5, F-6, F-8)

- Discharge is reduced when monitoring detects presence of delta smelt, April through August (F-4, F-5, F-8)

Other Criteria:

- Meet design criteria for fish screens: 0.2 fps approach velocity (F-7, F-8)

- Conserve in perpetuity 200 acres of shallow-water rearing and spawning habitat (F-6)

- Compensate for incidental entrainment losses, January through March and June through August (F-7, F-8)

- Implement a fish monitoring program (all impacts)

(Continued on next page)

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

Table 5-5. Continued

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
	(Continued from previous page) California ESA RPMs: - Delta Wetlands will provide an environmental water fund based on diversions from October through March and discharge (all impacts) - Aquatic habitat development measures will be implemented to offset impacts of moving X2 upstream from February through June (F-6)
Cumulative Impacts	
Impact F-17: Alteration of Habitat under Cumulative Conditions (LTS) • No mitigation is required.	**Alteration of Habitat under Cumulative Conditions.** Similar to the descriptions provided above, Delta Wetlands Project cumulative impacts on fish populations and habitats would be less under the FOC and biological opinion measures than the impacts described in the 1995 DEIR/EIS. The FOC and other measures reduce the Delta Wetlands Project's contribution to cumulative adverse conditions in the Delta. The significance findings made above for the project's direct and indirect impacts are applicable to the related cumulative impact. (LTS) See above discussion under Impact F-1 (page 1).
Impact F-18: Potential Increase in Accidental Spills of Fuel and Other Materials under Cumulative Conditions (LTS) • No mitigation is required.	See above discussion under Impact F-3 (page 3).

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

Table 5-5. Continued

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
Impact F-19: Potential Increase in the Mortality of Chinook Salmon Resulting from the Indirect Effects of Delta Wetlands Project Diversions and Discharges on Flows under Cumulative Conditions (S) • **Mitigation Measure F-3:** Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Changes in Cross-Delta Flow Conditions during Peak Outmigration of Mokelumne and San Joaquin River Chinook Salmon (LTS)	See above discussion under Impacts F-4 through F-8 (beginning on page 3).
Impact F-20: Reduction in Downstream Transport and Increase in Entrainment Loss of Striped Bass Eggs and Larvae, Delta Smelt Larvae, and Longfin Smelt Larvae under Cumulative Conditions (S) • **Mitigation Measure F-4:** Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Adverse Transport Effects on Striped Bass, Delta Smelt, and Longfin Smelt (LTS)	See above discussion under Impacts F-4 through F-8 (beginning on page 3).
Impact F-21: Change in Area of Optimal Salinity Habitat under Cumulative Conditions (LTS) • No mitigation is required.	See above discussion under Impacts F-4 through F-8 (beginning on page 3).

Note: S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.

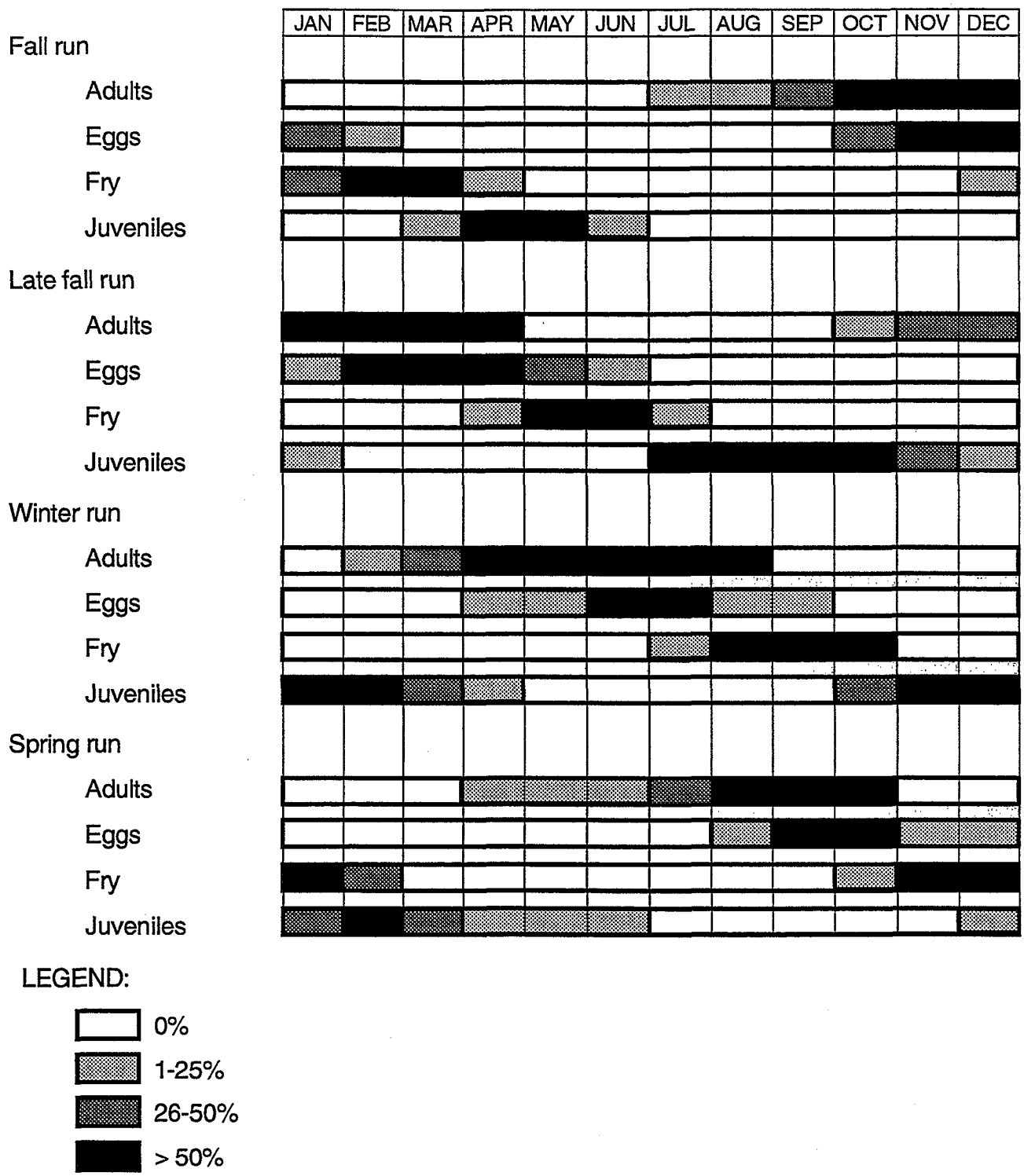
C-062854

Table 5-5. Continued

Impacts and Mitigation Measures of 1995 DEIR/EIS Alternatives 1 and 2	Differences between 1995 DEIR/EIS and 2000 REIR/EIS
Impact F-22: Increase in Entrainment Loss of Juvenile Striped Bass and Delta Smelt under Cumulative Conditions (S) • **Mitigation Measure F-5:** Operate the Delta Wetlands Project under Operations Objectives that Would Minimize Entrainment of Juvenile Striped Bass and Delta Smelt (LTS)	See above discussion under Impacts F-4 through F-8 (beginning on page 3).
Impact F-23: Increase in Entrainment Loss of Juvenile American Shad and Other Species under Cumulative Conditions (LTS) • No mitigation is required.	See above discussion under Impacts F-4 through F-8 (beginning on page 3).

Notes: Impacts F-9 through F-16 of the 1995 DEIR/EIS describe impacts of Alternative 3, the four-reservoir island alternative. There is no change to the assessment of Alternative 3; therefore, the impacts and mitigation measures have not changed.

S = Significant; SU = Significant and unavoidable; LTS = Less than significant; B = Beneficial.



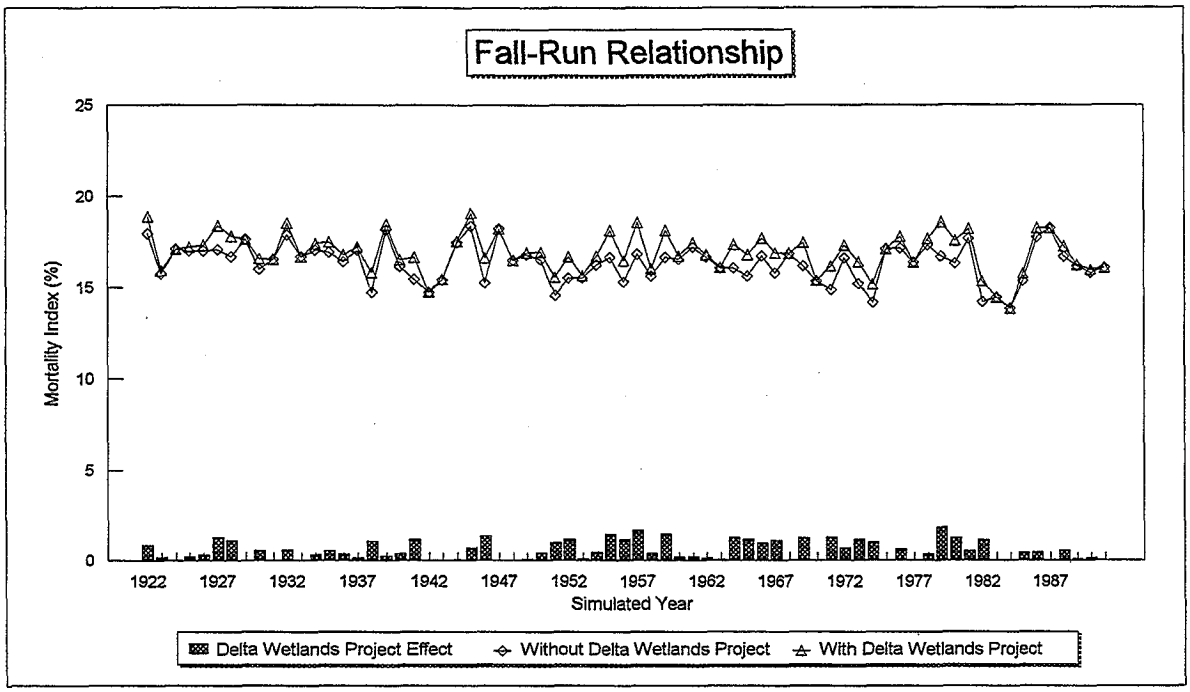
Note: Designations for adults represent the percentage of the spawning population that has arrived on the spawning grounds by the month shown. Designations for eggs, fry, and juveniles represent the percentage of the year's brood present during each month.

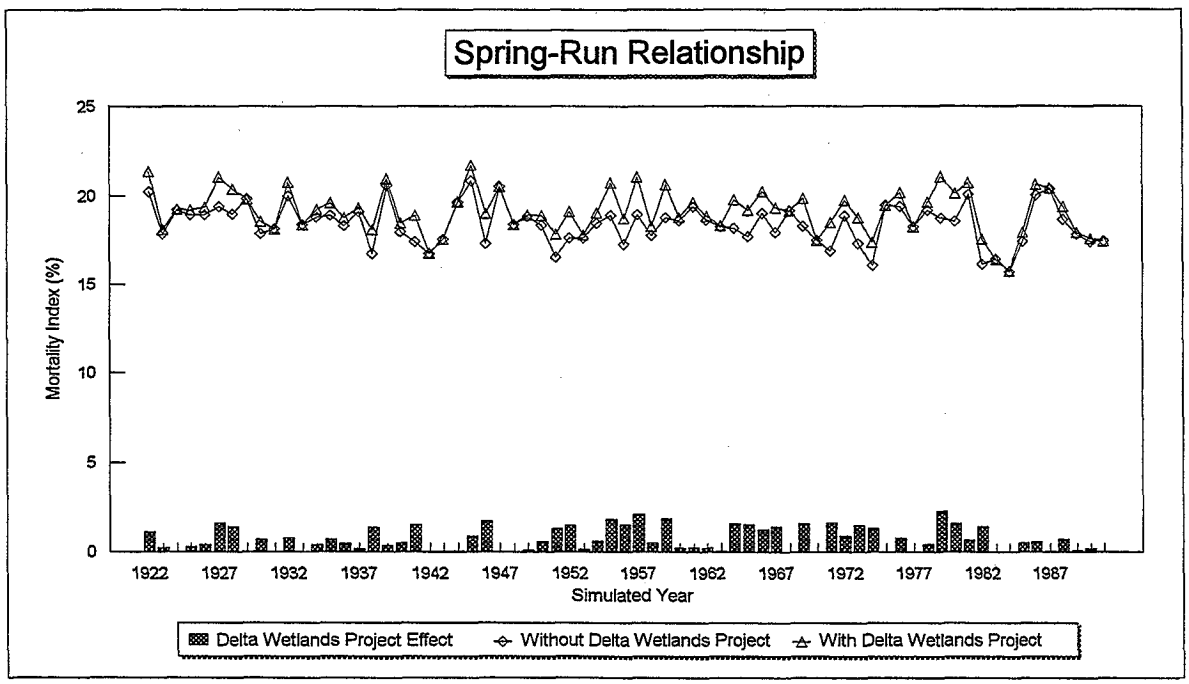
Jones & Stokes

Figure 5-1
Occurrence of Chinook Salmon by Life Stage in the Sacramento River Basin

C—062856

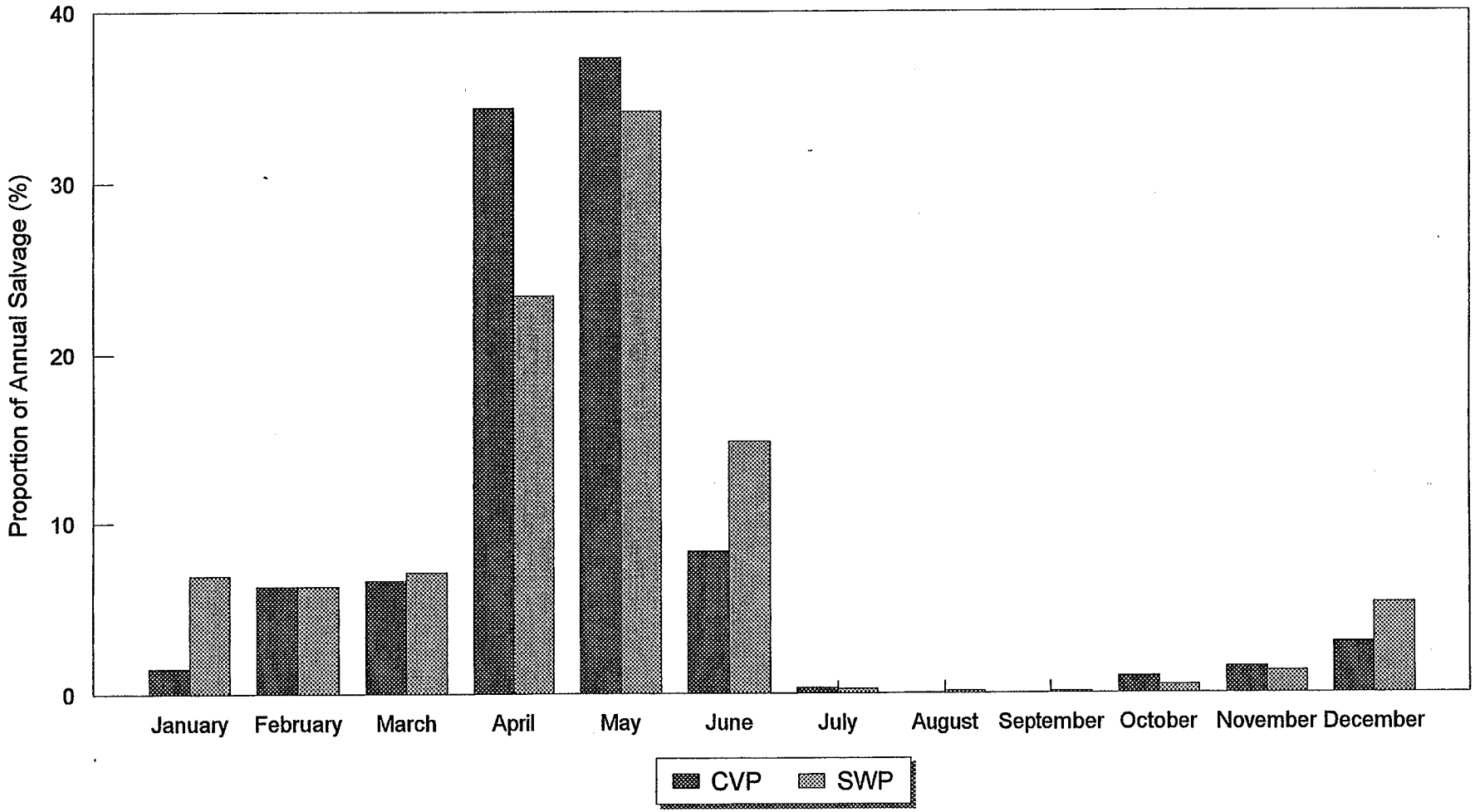
C-062856





Jones & Stokes

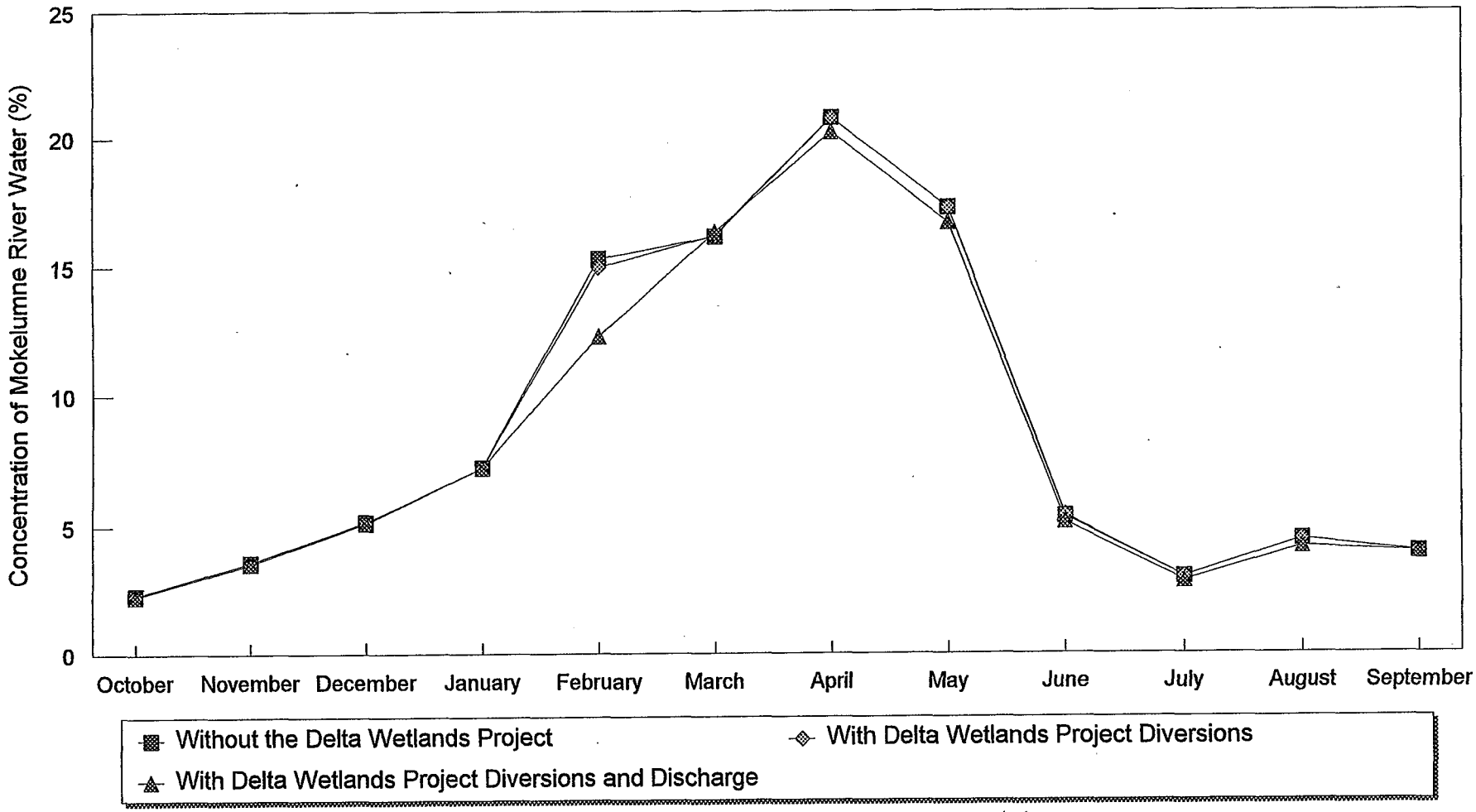
Figure 5-2
Comparison of the Fall-Run Relationship to the Spring-Run Relationship for Assessment of Delta Wetlands Project Effects on Survival of Juvenile Spring-Run Chinook Salmon



Source: California Department of Fish and Game Salvage Data 1980-1994, Stockton, CA.

Jones & Stokes

Figure 5-3
Proportion of Annual Salvage of Juvenile Chinook Salmon by Month for the CVP and SWP Fish Protection Facilities



Jones & Stokes

Figure 5-4
Median Concentration of Mokelumne River Water in the South Delta with and without Delta Wetlands Project Operations