United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Sacramento Field Office
2800 Cottage Way, E-1803
Sacramento, California 95825-1846

TAKE PRIDE IN AMERICA

BL

431

In Reply Refer To:
1-1-94-F-70

March 6, 1995

Memorandum

To: Regional Director, U.S. Bureau of Reclamation
Sacramento, California

From: Field Supervisor, Ecological Services
Sacramento Field Office, Sacramento, California (ES)

Subject: Formal Consultation and Conference on Effects of Long-term Operation of the Central Valley Project and State Water Project on the Threatened Delta Smelt, Delta Smelt Critical Habitat, and Proposed Threatened Sacramento Splittail

This responds to your request of September 6, 1994, for formal consultation with the U.S. Fish and Wildlife Service (Service) pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (Act), on the effects of the long-term operation of the Central Valley Project (CVP) and State Water Project (SWP) on the delta smelt (*Hypomesus transpacificus*). The delta smelt was federally listed as a threatened species on March 5, 1993 (Service 1993a). Included with this request for formal consultation was a biological assessment entitled: *Effects of the Central Valley Project (CVP) and State Water Project (SWP) on Delta Smelt and Sacramento Splittail*, prepared by the California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation)(DWR and Reclamation 1994).

This biological opinion addresses effects of the long-term combined operations of the CVP and SWP on the delta smelt. On January 6, 1994, a proposed rule to list the Sacramento splittail (*Pogonichthys macrolepidotus*) as a threatened species (Service 1994b) was published in the Federal Register. On December 19, 1994, a final rule designating critical habitat for the delta smelt was published (Service 1994c). This biological opinion also incorporates a conference opinion prepared pursuant to 50 CFR §402.10, which addresses combined project effects on the proposed threatened Sacramento splittail and a biological opinion on delta smelt critical habitat. Should the Sacramento splittail listing action be finalized as proposed, the Service intends to adopt the conference opinion as the biological opinion for combined project effects. When the conference opinion is adopted in this manner, it will satisfy Reclamation's consultation requirements. This biological opinion does not address all of the interrelated and interdependent effects of the CVP and SWP action. Effects of CVP and SWP operations on the endangered bald eagle (*Haliaeetus leucocephalus*), endangered California clapper rail (*Rallus longirostris obsoletus*), and endangered salt mouse harvest mouse (*Reithrodontomy raviventris*) have been addressed in another biological opinion (Service 1993b). Effects of the CVP in the Friant Division service area were also addressed in a separate biological opinion (Service 1991a). The Service

has issued several other biological opinions pertaining to the CVP (Service 1993c, 1994d). A biological opinion has also been issued by the Service to EPA regarding Bay-Delta water quality standards. In a memorandum dated April 8, 1993, Reclamation agreed to consult with the Service on other federally listed endangered and threatened species in CVP service areas. Effects of the CVP and SWP on the threatened giant garter snake (*Thamnophis gigas*) are being addressed in a separate consultation (Service 1994c).

Table of Contents

CONCURRENT PROPOSED ACTIONS

The Service will issue a final determination regarding listing the Sacramento splittail as a threatened species.

EPA has promulgated water quality standards for the Sacramento and San Joaquin river estuary (Estuary) that place the 2 parts per thousand (ppt) isohaline (defined as X2) at Roe Island, Chipps Island, and the Sacramento and San Joaquin river confluence at Collinsville (Confluence) for varying numbers of days dependent on a previous months flow index occurring from February 1 through June 30. The State of California and the Federal government have agreed to a set of Bay-Delta standards that are currently in draft form. In a statement of principles entitled, *Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government* (Principles for Agreement), there is a Preamble that summarizes the intent of the agreement. This Preamble states: "In order to provide ecosystem protection for the Bay-Delta Estuary, representatives of the State and Federal governments and urban agricultural and environmental interests agree to the implementation of a Bay-Delta protection plan through the State Water Resources Control Board (SWRCB) consistent with the following principles (attached). These principles describe changes to the California Urban Water Agency and Agricultural Water Users (CUWA and AG) proposal as the base case for Bay-Delta protections, which are intended to be in force for three years, at which time they may be revised". Reinitiation of consultation will occur as a result of any revisions that result in substantial changes to the proposed action. On December 15, 1994, the SWRCB published a draft Water Quality Control Plan (draft WQCP). In addition to the water quality objectives for agriculture, municipal and industrial users, the draft WQCP contained objectives described in the CUWA/AG proposal as modified by the Principles for Agreement. Since December 15, a process has been taking place which has resulted in clarification, correction, and elaboration of portions

of the Bay-Delta standards contained in the draft WQCP. Parties to the Principles for Agreement have met to discuss interpretation and implementation of the draft WQCP as guided by the Principles for Agreement. As a result, the SWRCB has issued an errata sheet amending the draft WQCP. This project description is intended to be consistent with the consensus of the parties to the Principles for Agreement, the interpretation of its criteria and conditions as they apply to the CVP and SWP operations. Various objectives contained in the draft WQCP provide outflows that will transport larval delta smelt to suitable rearing habitat in Suisun Bay and will maintain that habitat under conditions which are not influenced by Federal and State pumps. For the purposes of this opinion, Suisun Bay is defined as the area bounded by the Confluence to the east and Carquinez Straits to the west.

On December 21, 1994, Reclamation and DWR sent a letter advising the Service of their intent to voluntarily comply with the objectives outlined in the CUWA/AG proposal and Principles for Agreement. Implementation of the draft SWRCB standards was initiated on December 23, 1994, by the CVP and SWP upon receiving a concurrence from the Service and National Marine Fisheries Service. Full implementation of these standards will occur when components have been apportioned to the various SWRCB water rights holders through the water rights process.

Consideration of any future biological opinions based on new or re-initiated consultation will recognize three major initiatives that will shape the dynamics of future estuarine conditions for delta smelt. First, in accordance with a Framework Agreement (1994) between the Governor's Water Policy Council of the State of California (Council) and the Service, National Marine Fisheries Service (NMFS), EPA, and Reclamation (collectively known as "Club Fed"), the SWRCB has drafted water quality standards that will be finalized in 1995. This will occur while water right proceedings are under way to allocate responsibility among water right holders in the Bay-Delta watershed. Second, section 7(a)(1) of the Act imposes an affirmative obligation on Federal agencies to carry out programs for the conservation (recovery) of listed species. With the January 6, 1995, Federal Register notice of availability of the draft Delta Native Fishes Recovery Plan (Service 1994e), the Service expects that participating and affected local, State, and Federal agencies will fulfill their responsibilities by assisting in the completion of tasks and objectives in the Recovery Plan. Third, and related to number two above, the scheduled renewal or reopening of water contracts and licenses (such as, reopened or expired Federal Energy Regulatory Commission (FERC) licenses, expired CVP water contracts) will provide an additional opportunity under section 7(a)(1) and 7(a)(2) of the Act to implement Recovery Plan objectives and meet EPA's or SWRCB's water quality standards. Collectively, these initiatives will result in a phased improvement to habitat requirements for the delta smelt and Sacramento splittail. Accordingly, the Service anticipates that adverse modification or destruction of critical habitat will be avoided by the CVP and SWP through implementation of the above described initiatives.

CVP AND SWP PROPOSED ACTION

The following sources of information were used to develop this biological opinion: (1) the biological assessment transmitted with the request for formal consultation; (2) discussions with Reclamation, DWR, EPA, and the California Department of Fish and Game (DFG) at several informal meetings; (3) references cited in this biological opinion; (4) miscellaneous materials provided by Reclamation, DWR, EPA, and DFG during the consultation process; (5) the SWRCB's draft Water Quality Control Plan for the San Francisco Bay and

Sacramento-San Joaquin Delta Estuary (draft WQCP) and including errata sheets and further clarifications achieved through meetings of the Principles for Agreement participants; (6) the Principles for Agreement; and (7) unpublished information in Service files.

BIOLOGICAL OPINION

It is our biological and conference opinion that the proposed long-term combined CVP and SWP operations as modified by the winter-run biological opinion, the Principles for Agreement and the draft WQCP are not likely to jeopardize the continued existence of the threatened delta smelt and the proposed threatened Sacramento splittail, or adversely modify critical habitat for the delta smelt.

DESCRIPTION OF THE PROPOSED ACTION

The proposed action is the operation of the CVP and SWP. A detailed description of facilities and historic and proposed operations of CVP and SWP are described in DWR and Reclamation (1994). The proposed operations have been further modified by the objectives outlined in the Principles for Agreement and the SWRCB draft WQCP with exceptions noted in the following section. The proposed operations also include those actions that implement management decisions agreed upon in the August 2, 1994, Framework Agreement (Fourteen-Agency 1994). Additional information on CVP and SWP facilities and operations can be found in Reclamation (1992), DWR and Reclamation (1993), NMFS (1993), and Service (1993b).

Elements of the Draft WQCP not included in the Proposed Operations

Certain elements of the draft WQCP are not controllable by the CVP and SWP, thus, have not been incorporated into the proposed operations. These elements include specific water quality objectives such as: (1) the dissolved oxygen standard in the San Joaquin River near Stockton; (2) the salinity standard at Prisoner's Point; (3) the high-tide salinity standards for the Suisun Marsh interior; (4) export area salinity standard for export agriculture; and (5) the salinity standards for southern Delta agriculture.

SWRCB Water Rights Decision 1485 and the NMFS Biological Opinion of February 12, 1993

The SWRCB Water Rights Decision 1485 (D-1485) and the reasonable and prudent alternative and incidental take statement terms and conditions from the NMFS biological opinion of February 12, 1993, were part of the projects' environmental baseline. On December 23, 1994, flow and operational elements of the Principles for Agreement and draft WQCP were implemented by the CVP and SWP. These standards replace D-1485 and many aspects of the NMFS biological opinion. Those aspects of the NMFS biological opinion that are unchanged remain part of the projects' environmental baseline. The QWEST requirements in the NMFS opinion and in the Service's February 4, 1994, biological opinion project description have been converted to export/inflow ratios to give equivalent protection for winter-run chinook salmon and delta smelt.

Central Valley Project and State Water Project

Two major interbasin water delivery systems, the CVP and the SWP, divert water from the southern portion of the Sacramento River/San Joaquin River delta (Delta) (Figure 1). Both projects include major reservoirs north of the

Delta, and both transport water released from storage to areas south and west of the Delta.

The CVP is composed of some 20 reservoirs with a combined storage capacity of about 11 million acre-feet (AF), eight power plants and two pumping/power-generating plants with a maximum capacity of about two million kilowatts, and about 500 miles of major canals and aqueducts (Figure 1). These various facilities are generally operated in coordination as a single project. Authorized project purposes include flood control and navigation; provision of water for irrigation and domestic uses; fish and wildlife protection, restoration, and enhancement; and power generation. However, not all facilities are operated to meet each of these purposes. Flood control is not an authorized purpose of the CVP's Trinity River Division, for example. The primary purpose of the Federal CVP is to provide water for irrigation throughout California's Central Valley. Recent legislation included in the Central Valley Project Improvement Act (CVPIA) has modified this purpose through section 3402 to include fish and wildlife mitigation, protection, and restoration, as purposes equal in priority to irrigation and domestic uses, and fish and wildlife enhancement as a purpose equal in priority to power generation.

Figure 1 shows major features of the CVP including Shasta and Keswick dams and Shasta Reservoir on the Sacramento River; Trinity and Lewiston dams and Clair Engle Reservoir on the Trinity River; Folsom and Nimbus dams and Folsom Reservoir on the American River; New Melones Dam and Reservoir on the Stanislaus River; Friant Dam and Millerton Reservoir on the San Joaquin River; the Tracy Pumping Plant; the Contra Costa Canal; and the Delta-Mendota, Friant-Kern, and Madera canals in the San Joaquin Valley. Other features including San Luis Reservoir, O'Neill Forebay, and a portion of the California Aqueduct (San Luis Canal) are joint facilities also owned by the SWP. The Delta facilities and project operations will be described in greater detail below.

The SWP stores and distributes water for agricultural, municipal, and industrial uses in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. Other project functions include flood control, water quality maintenance, power generation, recreation, and fish and wildlife enhancement. Figure 1 shows major features of the SWP including Oroville Dam and Reservoir, and Thermolito Dam and Afterbay on the Feather River; the North and South Bay aqueducts; the Harvey O. Banks Delta Pumping Plant and Clifton Court Forebay near Tracy; the California Aqueduct, which runs south from the Delta through the San Joaquin Valley and into southern California; and Pyramid, Perris, and Castaic reservoirs along the California Aqueduct.

Water Transfers

Water Transfers that are relevant to this opinion are those transfers where a water right holder within the Delta watershed undertakes actions to make water available for transfer generally south of the Delta. Transfers requiring export from the Delta are done at times when pumping capacity at the Federal and State pumping plants is available to move the water. Reclamation and DWR will work to facilitate transfers in accordance with the Principles for Agreement and this biological opinion.

Scope of CVPIA Actions in Proposed Operations

The proposed operation of the CVP includes potential actions under CVPIA. These include the dedication and annual management of up to 800 TAF of CVP yield. A process of identifying, managing, and accounting for CVP yield so dedicated under section 3406(b)(2) is still being defined. Reclamation's Project Impact Statement for CVPIA has identified a range of possible options for meeting the fish and wildlife requirements of CVPIA using the 800 TAF of CVP yield. The differences in the options are defined by the way in which the 800 TAF of dedicated CVP yield is used to meet fish and wildlife needs. The 800 TAF may be used to meet Act and Clean Water Act requirements. Supplemental water aquired from other water rights holders would meet the remaining fish and wildlife needs under CVPIA. Another alternative may be the use of the 800 TAF for meeting other statutory purposes with no water used for meeting requirements of the Act or Clean Water Act.

Management of 800 TAF of CVP Yield Under the CVPIA:

To date, management of the 800 TAF of CVP Yield under the CVPIA has consisted of the following:

(1) Springtime pulse flows in the Stanislaus River, and in the lower San Joaquin River.

(2) Springtime restrictions on Delta pumping and closure of the Delta Cross Channel gates.

(3) Spawning and rearing flow improvements in the mainstem Sacramento, lower American, and Stanislaus rivers in fall and early winter.

(4) Carryover storage of a portion of the dedicated yield in New Melones Reservoir as a contingency against future drought-induced reductions.

Delta Facilities

The CVP and SWP use the Sacramento River and channels in the Delta to transport water to export pumping plants in the south Delta (Figure 2a). The CVP's Tracy Pumping Plant, about five miles north of Tracy, consists of six pumps including one rated at 800 cubic feet per second (cfs), two at 850 cfs, and three at 950 cfs. Maximum sustained pumping capacity is about 4,600 cfs, the nominal capacity of the Delta-Mendota Canal at the pumping plant. The Tracy Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles long. At the head of the intake channel, louver screens that are part of the Tracy Fish Protection Facility and effective on targeted species, intercept fish which are then collected and transported by tanker truck to release sites away from the pumps.

Other CVP facilities in the Delta include the Delta Cross Channel and the Contra Costa Canal (Figure 2a). The Delta Cross Channel is a gated diversion channel in the Sacramento River near Walnut Grove and Snodgrass Slough. When the gates are open, water is diverted from the Sacramento River through natural channels of the lower Mokelumne and San Joaquin rivers toward the pumping plants in the south Delta. The Contra Costa Canal originates at Rock Slough, about four miles southeast of Oakley, and terminates after 47.7 miles at Martinez Reservoir. Historically, diversions at the unscreened Rock Slough facility (Contra Costa Canal Pumping Plant No. 1) have ranged from about 50 to

250 cfs. The canal and associated facilities are part of the CVP, but are operated and maintained by the Contra Costa Water District (CCWD).

The SWP's Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant), in the south Delta, about 12 miles northwest of Tracy, consists of 11 pumps, including two rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity (Figure 2a). Water is pumped into the California Aqueduct, which has a nominal capacity of 10,300 cfs at Banks Pumping Plant. A one-mile, open intake channel conveys water to the Banks Pumping Plant from Clifton Court Forebay, a 31,000 AF reservoir which provides storage for off-peak pumping and moderates the effect of the pumps on the fluctuation of flow in adjacent Delta channels. Water enters Clifton Court Forebay and then passes through John E. Skinner Fish Protective Facility (Skinner Fish Facility), which intercepts fish that would otherwise be entrained into the pumps and California Aqueduct. As at the Tracy Fish Facility, fish captured at the Skinner Fish Facility are relocated elsewhere in the Delta.

Other DWR facilities in and near the Delta include the North Bay Aqueduct (NBA), the Suisun Marsh Salinity Control Structure (SMSCS), Roaring River diversion, and several temporary barriers in the south Delta.

The NBA allows the SWP to meet project entitlements in Napa and Solano counties with ultimate scheduled deliveries expected to be 67,000 AF annually. The intake for the NBA is on Barker Slough and maximum pumping capacity is about 175 cfs with daily pumping rates ranging between 0 and 90 cfs.

The NBA was also utilized in 1994 to meet salinity objectives in the western Suisun Marsh. Water pumped at Barker Slough was released to Cordelia Forebay into Green Valley Creek. The augmented flow from the creek proved to be an effective means of lowering channel salinity in various sloughs in the northwest portions of the marsh. Need for releases will be dependent upon compliance with regulatory requirements, local hydrology, and future water quality objectives.

The SMSCS spans Montezuma Slough near Collinsville. Operation of the structure restricts the upstream movement of salty water from Suisun Bay during flood tide while allowing the normal flow of freshwater from the Sacramento River during ebb tides. This action changes the effects of upstream diversions by the CVP and SWP and other small agricultural diversions, and decreases salinities in Suisun Marsh where water is diverted onto private lands and lands owned by DFG.

The Roaring River diversion and distribution system intake is the largest diversion point on Montezuma Slough in Suisun Marsh. The intake consists of eight 60-inch culverts just to the north of the original Roaring River confluence with Montezuma Slough. Operation and screening of this intake is described in more detail below.

DWR's existing South Delta Temporary Barriers Project consists of seasonal installation and removal of temporary rock barriers at three locations in the south Delta. Barrier location and operation of these barriers is described in more detail below. DWR will be consulting on a fourth temporary barrier in Grantline Canal.

Operations of Delta Facilities

This section summarizes information on CVP and SWP operations that is presented in greater detail in DWR and Reclamation (1994).

Delta Export Facilities. The Delta acts as a conduit for natural river flows and reservoir storage to the CVP and SWP facilities in the south Delta which export water to the projects' service areas (Figure 2a). The Contra Costa Canal and the NBA supply water to users in the northwestern San Francisco Bay and Napa Valley areas, while the Banks and Tracy pumping plants are operated to meet demands in the San Joaquin Valley, southern California, and southwestern San Francisco Bay area. CVP and SWP Delta export operations are constrained by regulatory decisions and permits, laws, water service contracts and negotiated agreements. Examples include: the SWRCB D-1485 (soon to be replaced by the actions taken by the SWRCB), a U.S. Army Corps of Engineers (Corps) Federal/State letter of operational constraints for the Banks Pumping Plant, the Coordinated Operation Agreement (COA) between the CVP and SWP of 1986, the NMFS biological opinion on the effects of the projects on the threatened winter-run chinook salmon, and the Service's 1994 biological opinion on the effects of the projects on delta smelt. Additional constraints result from section 3406(b)(2) of the CVPIA which dedicates annually 600,000 to 800,000 AF (600 to 800 TAF) of CVP yield for fish, wildlife and habitat restoration purposes. Refuges are allocated level II water through CVPIA. Additional level IV water may also be acquired.

Operations of the Tracy and Banks pumping plants are closely coordinated with each other and with operations of the joint CVP and SWP San Luis Reservoir. A typical annual cycle of Delta operations begins in August or September, when storage in San Luis Reservoir is typically at its lowest level following peak spring and summer water demand in the project service areas. At this time, demand for irrigation water begins to decline, and export capacity in the Delta is increasingly devoted to refilling San Luis Reservoir. During the fall, the CVP and SWP largely transfer water stored north of the Delta (from Shasta, Clair Engle, Folsom, and Oroville reservoirs) to San Luis Reservoir; during the winter, the Tracy and Banks Pumping Plants export a combination of uncontrolled natural river flows and upstream reservoir releases for storage in San Luis Reservoir.

In past years, export pumping has continued at or near maximum allowable rates from August through April, or until the San Luis Reservoir was full. The Tracy Pumping Plant is usually operated at or near its maximum rate of 4,600 cfs, except when restrictions are imposed by water right or endangered species requirements. Average daily diversions at the Banks Pumping Plant are generally limited to 6,680 cfs, as set forth by Corps requirements (dated October 13, 1981). However, from mid-December to mid-March, diversions at the Banks Pumping Plant may be increased by one-third of the flow of the San Joaquin River (as measured at Vernalis), if discharge from the San Joaquin River exceeds 1,000 cfs. The maximum potential diversion rate at the Banks Pumping Plant during this period is 10,300 cfs, the nominal capacity of the California Aqueduct.

In December through March, maximum export rates are generally required to capture uncontrolled runoff in the Delta to fill San Luis Reservoir.

Entitlement water deliveries to SWP contractors are also maintained during these periods. Contractor delivery patterns peak during spring and summer and are satisfied by direct diversions from the Delta in conjunction with releases from San Luis Reservoir and SWP reservoirs in Southern California. At times, unused Delta pumping capacity would be available to move additional water for direct delivery, ground water recharge, pre-irrigation, or into storage south of the Delta for future use.

Allocation of water supplies for a given year is based on four variables:

(1) Forecast water supplies based on the Sacramento River Index (SRI), which is the sum of measured runoff at four locations (Sacramento River near Red Bluff, Feather River inflow to Lake Oroville, Yuba River at Smartville, and American River inflow to Folsom Lake);

(2) amount of carry-over storage in Oroville and San Luis reservoirs;

(3) projected requirement for end-of-year carryover storage; and

(4) Delta regulatory requirements.

These criteria are meant to ensure that sufficient water is carried over in storage to protect Delta water quality the next year, to meet fishery requirements, and to provide emergency storage of a portion of the dedicated yield in New Melones Reservoir as a contingency against future drought-induced reductions.

Beginning each year in December, initial allocations of entitlement deliveries are determined based on the four criteria. Allocations are updated monthly until May, and more often if storms result in a significant increase in the Sacramento River Index.

Clifton Court Forebay. Clifton Court Forebay is a 31 TAF regulating reservoir at the intake to the California Aqueduct. Inflows to the forebay are controlled by radial gates and are generally operated during high tide to reduce approach velocities and prevent scour in adjacent channels. The forebay is operated to minimize water level fluctuation in the intake by taking water in through the gates at high tide and closing the gates at low tide. When the gates are open at high tide, inflow can be as high as 15,000 cfs for a short time, decreasing as water levels inside and outside the forebay reach equilibrium. This flow corresponds to a velocity of about two feet per second in the primary intake channel.

Tracy and Banks Fish Protection Facilities. Both of these facilities use behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks before transport by truck to release sites within the Delta. The louvers are operated to achieve water approach velocities for striped bass of about one foot per second, and for salmon of about three feet per second. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks used to transport fish to release sites contain an eight ppt salt solution to reduce stress. The SWP maintains two permanent release site facilities: at Horseshoe Bend on the Sacramento River, and on Sherman Island at Curtis Landing on the San Joaquin River. The CVP uses two release sites: one on the Sacramento River near Horseshoe Bend, and the other on the San Joaquin River immediately upstream of the Antioch Bridge.

The COA between Reclamation and DWR became effective in November 1986. The agreement defines the rights and responsibilities of the CVP and SWP regarding Sacramento Valley and Delta water needs. The CVP and SWP are obligated to ensure that water is available for specific uses identified by the agreement. When water must be withdrawn from storage to meet Sacramento Valley and Delta needs, 75 percent of the responsibility is borne by the CVP and 25 percent by the SWP. The agreement also provides that, when unstored water is available for export, 55 percent of the sum of CVP and SWP stored water and the unstored export water is allocated to the CVP and 45 percent is allocated to the SWP.

Some of the operational restrictions imposed by past NMFS and Service biological opinions were not addressed by the COA. Specifically, the agreement did not address sharing of responsibilities for meeting either the QWEST standard or the take limitations at the export pumping facilities. As a result, in 1993, the CVP and SWP were not operated in strict accordance with the COA. Instead, Reclamation and DWR by mutual agreement apportioned the available water supply and responsibility for meeting Delta standards between the two projects.

Delta Cross Channel. Reclamation operates the Delta Cross Channel to augment the transfer of water from the Sacramento River to the southern Delta and the export facilities at the Banks and Tracy pumping plants (Figure 2a). Flows into the Delta Cross Channel from the Sacramento River are controlled by two 60-foot by 30-foot radial gates. From April 16 through May 31, at the request of DFG the gates have been closed to avoid diverting striped bass when Delta outflow was estimated to exceed 12,000 cfs. However, during several years, with concurrence of DFG, Reclamation kept the gates closed for most of the April 16 to May 31 period. New criteria have superseded the above.

To reduce scour in the channels on the downstream side of the gate, and to reduce potential flood flows that might occur from diverting water from the Sacramento River through the Mokelumne River system, the gates are also closed when flows in the Sacramento River, at Sacramento, reach 25,000 to 30,000 cfs on a sustained basis. Sometimes during short duration flows at high rates, the gates have remained open.

At times, closing the gates can exacerbate the net reverse flow problem in the western San Joaquin River, causing salinity in the central and southern Delta to increase.

The reasonable and prudent alternatives in the February 12, 1993, NMFS biological opinion for winter-run chinook salmon require closure of the Delta Cross Channel gates from February 1 through April 30 to avoid diversions of downstream-migrating juvenile salmon.

Suisun Marsh Salinity Control Structure. The SMSCS is about two miles northwest of the eastern end of Montezuma Slough, near Collinsville. The SMSCS spans Montezuma Slough, a width of 465 feet. In addition to permanent barriers adjacent to each levee, the structure consists of the following components (from east to west): (1) a flashboard module, which provides a 66-foot wide maintenance channel through the structure (the flashboards can be removed if emergency work is required downstream of the gates, but removal requires a large, barge-mounted crane); (2) a radial gate module, 159 feet across, containing three radial gates, each 36 feet wide; and (3) a boat-lock module, 20 feet across, which is operated when the flashboards are in place. An acoustic velocity meter is located about 300 feet upstream (south) of the gates to measure water velocity in Montezuma Slough. Water level recorders on both sides of the structure allow operators to determine the difference in water level above and below the gates. The three radial gates open and close automatically, using the water level and velocity data.

Operation of the SMSCS restricts the upstream flow of salty water from Suisun Bay during flood tides while allowing the normal flow of freshwater from the Sacramento River during ebb tides.

During full operation, the gates open and close twice each tidal day. Flows past the gates vary from no flow when the gates are closed to several thousand cfs with all three gates open; the net flow through the gates is about 1,800

cfs when averaged over one tidal day. Typically in summer, when the gates are not operating and the flashboards are removed, the natural net flow in Montezuma Slough is low, and often in the upstream direction from Grizzly Bay toward Collinsville.

In spring 1992, the NMFS biological opinion for winter-run chinook salmon significantly changed operation of the SMSCS from what previously occurred in critically dry years. The gates were closed from March 1 through March 27, with full gate operations beginning March 27. Individual landowners along Montezuma Slough agreed not to divert water through their unscreened diversions until May 1 so that full gate operations might occur.

Roaring River Distribution System. The Roaring River diversion and distribution system intake has a 40-acre intake pond, constructed west of the new intake culverts, that supplies water to Roaring River Slough. Flows through the culverts into the pond are controlled by motorized slide gates on the Montezuma Slough side and flap gates on the pond side. The motorized gates are adjusted depending on tide levels, diversions from Roaring River Slough, and the season. A manually-operated flap gate that allows drainage back into Montezuma Slough for flood protection is located at the confluence with Roaring River Slough. DWR owns and operates this drain gate to ensure that the Roaring River levees are not compromised during extremely high tides.

Water is diverted into the Roaring River intake pond on high tides to raise the water surface elevation in Roaring River Slough above the adjacent marshlands. Wetlands south and north of Roaring River Slough receive water from the slough as needed. The pond is used to supplement the water supply in Roaring River Slough.

The intake to Roaring River Slough is screened to prevent entrainment of fish larger than about 25 mm. DWR designed and installed the screens using DFG criteria. Reclamation and DWR provide routine screen maintenance. The screen is a stationary, vertical screen constructed of continuous slot, stainless steel wedge wire. All screens have 3/32-inch slot openings with a design approach velocity of 0.5 foot per second, based on an average peak tidal condition (19-year mean higher high tide) and projected peak delivery schedule. Flow through the fish screen is controlled by motorized slide gates on each culvert.

North Bay Aqueduct Intake at Barker Slough. The SWP uses the NBA intake at Barker Slough to meet project entitlements in Napa and Solano counties (Figure 2a). Ultimate scheduled deliveries are expected to be about 67 TAF annually. Maximum pumping capacity is about 175 cfs (pipeline capacity). Daily pumping rates have ranged between 0 and 90 cfs. Average annual pumping rate is 35 cfs. Water use in the NBA service area is increasing as the human population grows in Napa and Solano counties. Current demands result in pumping less than 65 cfs until April.

The Barker Slough intake has a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch designed to exclude fish 25 mm or larger from being diverted and an approach velocity of 0.5 feet per second. The screens are routinely cleaned to prevent excessive head loss, which can result in increased localized approach velocities.

South Delta Temporary Barriers. The existing South Delta Temporary Barriers Project consists of installation and removal of temporary rock barriers at the following locations: (1) Middle River near Victoria Canal, about 0.5 miles

south of the confluence of Middle River, Trapper Slough, and North Canal; (2) Old River near Tracy, about 0.5 miles east of the Delta-Mendota Canal intake; and (3) the head of Old River near San Joaquin River, about 0.1 miles west of the confluence of the two rivers. The barriers on Middle and Old rivers near Tracy are tidal control facilities designed to improve water quality for irrigation and increase water levels in south Delta channels during irrigation season. Until June 1, installation of these barriers is permitted only if the barrier at the head of Old River is in place. The barrier at the head of Old River is designed to improve conditions in the San Joaquin River during the migration of fall-run chinook salmon. If the temporary barriers accomplish their purpose and have minimal negative environmental impacts, DWR proposes to replace them with permanent structures (e.g., radial gates), that would be operated seasonally. Installation of the barrier at the head of Old River during the fall is permitted by the Corps from 1968 until 1997. Until 1995, it will also be permitted to reduce the number of outmigrant smolts entering Old River and subsequently exposed to the CVP and SWP intakes. In 1993, the barriers on the Middle River and the Old River near Tracy were permitted to be in place between June 1 and September 30 on an annual basis until 1995. DWR will submit a request to the Corps to permit installation of the barriers according to the original schedule presented in Figure 23 of DWR and Reclamation (1993). Any future installation of the temporary barriers project beyond that currently permitted shall require further section 7 compliance.

Contra Costa Canal. The Contra Costa Canal, owned by Reclamation and operated by CCWD, originates at Rock Slough, about four miles southeast of Oakley. Water for irrigation, municipal, and industrial uses is lifted 127 feet by a series of four pumping plants. The 47.7-mile canal terminates in Martinez Reservoir. Two short canals, Clayton and Ygnacio, are integrated into the system. The initial diversion capacity of 350 cfs gradually decreases to 22 cfs at the terminus. Historically, pumping has ranged from about 50 to 250 cfs, and varies seasonally.

Service's 1993 Biological Opinion (Service 1993e). The 1993 biological opinion on the effects of CVP and SWP operations on the delta smelt established part of the baseline conditions from May 26, 1993, to February 15, 1994.

Mitigation measures proposed by Reclamation and DWR to the Service (1993e) that were implemented to benefit the delta smelt included: (1) no reverse flow in the western Delta, based on the 14-day running average of the QWEST index, from May 1 through June 30; (2) the flow in the western Delta shall exceed negative 1,000 cfs from July 1 through July 31, and negative 2,000 cfs from December 1 through January 31; (3) springtime pulse flows were required from both the Sacramento and San Joaquin rivers to help transport larval delta smelt through the Delta and into Suisun Bay; (4) for Sacramento River at Freeport, Rio Vista, and Chipps Island, minimum daily flows were set for March through August and December through February 15; (5) CVP and SWP reduced combined Delta exports at Tracy and Banks to a daily average of not more than 1,500 cfs during the period April 26 through May 16, or coincident with the arrival of the San Joaquin pulse flows in the Delta; (6) for combined Delta pumping at Tracy, Banks and Contra Costa, the 14-day running average export rate was set from April through July; and (7) the CVP and SWP were operated to maintain the salinity regime in eastern Suisun Bay to provide a 14-day running average electro-conductivity (EC) of 3 mmhos per centimeter (mmhos/cm) at Mallard Slough from May 1 to June 30.

In 1993, Reclamation and DWR had agreed to study and monitor effects of operations and facilities on the delta smelt. The Interagency Ecological

Study Program (now the Interagency Ecological Program or IEP) was also conducting monitoring and studies in the Delta that addressed most of the effects of the 1993 proposed CVP and SWP operations which included the winter-run chinook salmon biological opinion modifications. The following studies and monitoring were done by Reclamation and DWR as part of 1993 CVP and SWP proposed operations: (1) Information was obtained on the estimated average daily position of X2, the average net daily Delta outflow of the Sacramento River at Chipps Island, and the average daily QWEST value for the San Joaquin River, and surveys were conducted for adult and larval delta smelt in the vicinity of X2; (2) studies were done to determine more effective fish salvage procedures at the CVP and SWP fish protection facilities; (3) the past operation of SMSCS was analyzed; (4) studies were continued to better quantify the population of delta smelt and determine the location of spawning areas; and (5) studies were conducted to address ways of minimizing diversion of adult and larval fish within the Delta, including screening requirements.

The reasonable and prudent measures in the May 26, 1993, biological opinion provided: (1) improved salvage operations at Tracy and Skinner Fish Protection Facilities; (2) decreased pumping at the Barker Slough intake; (3) decreased pumping at the Tracy and Banks pumping plants and use of a 400-fish take limit that was modified on June 30, 1993, to a 14-day running average of 400 delta smelt; and (4) QWEST requirements that reduced delta smelt juvenile and adult losses.

Service's 1994 Biological Opinion (Service 1994d). This jeopardy opinion imposed constraints on operations of the projects from February 4, 1994, through February 15, 1995. The reasonable and prudent alternative required: (1) habitat and transport flows which consisted of placement of X2 downstream of the Confluence, and Delta outflows with Sacramento and San Joaquin base flows; (2) San Joaquin River flows for 30 days triggered by the presence of delta smelt; (3) actions to deal with the presence of delta smelt upstream of the Confluence in July-August; and (4) investigations of the effects of the SMSCS. The reasonable and prudent measures to minimize the effects of incidental take of delta smelt included: (1) improve salvage operations at the Tracy and Skinner Fish Facilities; (2) minimize take at the Tracy and Skinner Fish Facilities; (3) minimize take at the NBA diversion on Barker Slough; (4) minimize take at the Roaring River diversion in Montezuma Slough; and (5) minimize take at CCWD Rock and Mallard slough diversions. The terms and conditions implementing these reasonable and prudent measures included: (1) addition of a new, fully functional release site near the Rio Vista Bridge; (2) a monthly take limit at the CVP and SWP pumping plants; (3) limited diversions at the Barker Slough intake; (4) a change in approach velocity at the Roaring River diversion; and (5) minimization of delta smelt take at the unscreened Rock and Mallard slough diversions. In addition, within the project description for the 1994 biological opinion, the protective measures for winter-run chinook salmon through QWEST requirements also provided biological benefits to delta smelt. In fact, the foundation of the delta smelt biological opinion was built on NMFS's February 4, 1993, winter-run chinook salmon biological opinion.

The CVP and SWP have proposed modifying long-term operations to benefit delta smelt, delta smelt critical habitat, and the proposed Sacramento splittail. The beneficial modifications deal with: (1) habitat and transport flows; (2) San Joaquin River flows; (3) presence of delta smelt upstream of the Confluence in July-August as a result of a late spawning period; (4) the SMSCS; and (5) NBA diversion at Barker Slough and Prospect Island. These components minimize project effects on the delta smelt and critical habitat for the delta smelt (and the proposed threatened Sacramento splittail) through

various biologically justifiable methods: (1) habitat and transport flows act to move delta smelt larvae and juveniles in the Sacramento and San Joaquin drainages to rearing habitat in Suisun Bay away from the influence of the Federal and State pumping plants, and maintain that habitat in a suitable geographic location; (2) San Joaquin River flows supplement these flows in April and May and move delta smelt larvae and juveniles on this side of the Delta to rearing habitat in Suisun Bay; (3) when delta smelt spawn late in July-August, and larvae and juveniles remain upstream because required flows have occurred earlier, provisions for supplementary flows are necessary to move fish to rearing habitat in Suisun Bay; (4) the SMSCS operations are modified to allow free movement of delta smelt into and out of Montezuma Slough; and (5) the NBA diversion is modified to limit entrainment when delta smelt larvae are present.

PRINCIPLES FOR AGREEMENT AND DRAFT WQCP

On December 23, 1994, the CVP and SWP began operations in accordance with the CUWA/AG proposed standards as modified by the Principles for Agreement. The CUWA/AG proposal, as modified by the Principles for Agreement, is embodied in the draft SWRCB WQCP (with errata). These documents contain elements beneficial to delta smelt, delta smelt critical habitat, and the proposed Sacramento splittail. The California Water Policy Council and Federal Ecosystem Directorate together, as CALFED will decide how these elements may be implemented to benefit these species.

The "CALFED Process"

The "CALFED Process" is an element of the draft WQCP and the Principles for Agreement and consists of the following process:

(a) Initial deliberations and decisions occur in the "Ops Group". The "Ops Group", or CVP/SWP Operations-Endangered Species Coordination Group, is defined in Exhibit B of the Framework Agreement and consists of representatives of the Service, Reclamation, NMFS, EPA, DWR, and SWRCB. The Ops Group exchanges information and facilitates coordination of water project operations with requirements of the delta smelt and winter-run biological opinions, Federal and State water quality standards, and the CVPIA.

Issues that may be presented within the Ops Group include:

(1) review of project operations;

(2) review of operating parameters in biological opinions;

(3) review of fish distribution and fish population levels;

(4) review of status of endangered species take;

(5) discussion of strategies for implementation of fishery protections to resolve conflicts between operations, water quality requirements, and fishery needs in the Estuary and its watershed;

(6) coordination of the winter-run salmon monitoring and operations and management work groups with the delta smelt management and work groups and with IEP;

(7) discussion of strategies for implementation of Estuary standards;

(8) review and comment on the annual CVPIA water allocation and on other CVPIA activities related to the Estuary such as the Anadromous Fish Restoration Program; and

(9) cooperation with the IEP and others to determine factors affecting Delta habitat and health of fisheries, and to identify appropriate corrective measures for the CVP and SWP.

Ops Group deliberations shall be conducted in consultation with water user, environmental and fishery representatives. Briefings shall periodically be provided to the Governor's Water Policy Council, Club Fed, and other interested groups. The Delta Smelt Working Group, defined in the Reporting Requirements below, will provide technical information to the Ops Group.

(b) If the Ops Group disagrees on a particular issue, or if an Ops Group action requires additional water that it is believed cannot be made up within existing requirements, the issue will be decided by CALFED.

(c) If CALFED cannot reach agreement, and if the issue involves listed species, a final decision will be made by the appropriate listing agency. Other issues not involving the Endangered Species Act will be decided by the appropriate regulatory or resources management agency.

The following water quality standards and operational constraints contain biological benefits:

(a) Delta outflow-- Table 1 shows the minimum monthly average Net Delta Outflow index.

Table 1. Minimum monthly average Net Delta Outflow Index (cfs)

Water Year Type*	Time Period**	Outflow (cfs)
All	January	4,500***
All	February-June	****
Wet, Above Normal	July	8,000
Below Normal	July	6,500
Dry	July	5,000
Critical	July	4,000
Wet, Above and Below Normal	August	4,000
Dry	August	3,500
Critical	August	3,000
All	September	3,000
Wet, Above and Below Normal, Dry	October	4,000
Critical	October	3,000
Wet, Above and Below Normal, Dry	November-December	4,500
Critical	November-December	3,500

*The Sacramento Valley 40-30-30 water year hydrologic classification index at the 50 percent exceedance level applies.

**For the May-January objectives, if the value is less than or equal to 5,000 cfs, the 7-day running average shall not be less than 1,000 cfs below the value; if the value is greater than 5,000 cfs, the 7-day running average shall not be less than 80 percent of the value.

***The objective is increased to 6,000 cfs if the best available estimate of December's Eight River Index (ERI or 8RI) is greater than 800 TAF. The ERI is defined as the sum of the unimpaired runoff as published in the DWR Bulletin 120 for the following locations: Sacramento River flow at Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River flow at Smartville; American River, total inflow to Folsom Reservoir; Stanislaus River, total inflow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total inflow to Exchequer Reservoir; and San Joaquin River, total inflow to Millerton Lake.

****The minimum daily Net Delta Outflow Index shall be 7,100 cfs for this period, calculated as a 3-day running average. This requirement is also met if either the daily average or 14-day running average EC at the Confluence is less than or equal to 2.64 mmhos/cm (Collinsville, station C2). Determination of compliance with an objective expressed as a running average begins on the last day of the averaging period. If the objective is not met on the last day of the averaging period, all days in the averaging period are considered out of compliance. The above standard for March may be relaxed upon the recommendation of the Ops Group (defined above) established under the Framework Agreement, if the best available estimate of the ERI for February is less than 500 TAF. Disputes will be resolved by the CALFED policy group. The above standard does not apply in May and June if the best available estimate of the May Sacramento River Index for the water year is less than 8,100 TAF at the 90 percent exceedance level. Under this circumstance, a minimum 14-day running average flow of 4,000 cfs is required in May and June.

(b) X2 protection measures-- X2 protection shall be based on Footnote 11 for Table 3 on page 23 of the draft WQCP with errata with the following adjustments: Chipps Island requirement in February will be zero days when the ERI in January is less than 800 TAF and 28 days when it is greater than 1,000 TAF with linear interpolation between 800 and 1,000 TAF. The requirement at the confluence shall be 150 days, except when the best available estimate of the May 1, 90 percent exceedance Sacramento River Index is less than 8,100 TAF, the maximum outflows for May and June shall be 4,000 cfs, with all other flow requirements removed. When the February index falls below 500 TAF, the requirement of March will be reviewed by the Ops Group defined above. Additional refinements, which will involve no further water costs above those which are required for this paragraph may be subsequently made (however some water costs associated with other sections of this Project Description may be above those required for this paragraph).

Table 2 shows the number of days when maximum daily average EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago.

Number of days when maximum daily average EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago-- The number of days that an EC of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago is determined by the Previous Months ERI (PMI). The number of days from February through June at different PMI is described in Footnote 11 for Table 3 on page

TABLE 2.

Number of Days When Maximum Daily Average Electrical Conductivity of 2.64 mmhos/cm Must Be Maintained at Specified Location [a]

PMI [b] (TAF)	Chipps Island (Chipps Island Station D10)					PMI [b] (TAF)	Port Chicago (continuous recorder at Port Chicago)					PMI [b] (TAF)	Port Chicago (continuous recorder at Port Chicago)				
	FEB	MAR	APR	MAY	JUN		FEB	MAR	APR	MAY	JUN		FEB	MAR	APR	MAY	JUN
≤ 500	0	0	0	0	0	0	0	0	0	0	0	5250	27	29	25	26	6
750	0	0	0	0	0	250	1	0	0	0	0	5500	27	29	26	28	9
1000	28[c]	12	2	0	0	500	4	1	0	0	0	5750	27	29	27	28	13
1250	28	31	6	0	0	750	8	2	0	0	0	6000	27	29	27	29	16
1500	28	31	13	0	0	1000	12	4	0	0	0	6250	27	30	27	29	19
1750	28	31	20	0	0	1250	15	6	1	0	0	6500	27	30	28	30	22
2000	28	31	25	1	0	1500	18	9	1	0	0	6750	27	30	28	30	24
2250	28	31	27	3	0	1750	20	12	2	0	0	7000	27	30	28	30	26
2500	28	31	29	11	1	2000	21	15	4	0	0	7250	27	30	28	30	27
2750	28	31	29	20	2	2250	22	17	5	1	0	7500	27	30	29	30	28
3000	28	31	30	27	4	2500	23	19	8	1	0	7750	27	30	29	31	28
3250	28	31	30	29	8	2750	24	21	10	2	0	8000	27	30	29	31	29
3500	28	31	30	30	13	3000	25	23	12	4	0	8250	28	30	29	31	29
3750	28	31	30	31	18	3250	25	24	14	6	0	8500	28	30	29	31	29
4000	28	31	30	31	23	3500	25	25	16	9	0	8750	28	30	29	31	30
4250	28	31	30	31	25	3750	26	26	18	12	0	9000	28	30	29	31	30
4500	28	31	30	31	27	4000	26	27	20	15	0	9250	28	30	29	31	30
4750	28	31	30	31	28	4250	26	27	21	18	1	9500	28	31	29	31	30
5000	28	31	30	31	29	4500	26	28	23	21	2	9750	28	31	29	31	30
5250	28	31	30	31	29	4750	27	28	24	23	3	10000	28	31	30	31	30
≥ 5500	28	31	30	31	30	5000	27	28	25	25	4	> 10000	28	31	30	31	30

[a] The requirement for number of days the maximum daily average electrical conductivity (EC) of 2.64 mmhos per centimeter (mmhos/cm) must be maintained at Chipps Island and Port Chicago can also be met with maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflows of 11,400 cfs and 29,200 cfs, respectively.

[b] PMI is the previous month's Eight River Index. (Refer to Footnote 10 for Table 3 for a description of the Eight River Index.) Intermediate PMI values are determined by linear interpolation

[c] When the PMI is between 800 TAF and 1000 TAF, the number of days the maximum daily average EC of 2.64 mmhos/cm (or maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflow of 11,400 cfs) must be maintained at Chipps Island in February is determined by linear interpolation between 0 and 28 days.

23 of the draft WQCP with errata. The requirement can also be met with maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflows of 11,400 cfs and 29,000 cfs, for Chipps Island and Port Chicago, respectively. When the PMI is between 800 TAF, the number of the maximum daily average EC of 2.64 mmhos/cm (or maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflow of 11,400 cfs) must be maintained at Chipps Island in February is determined by linear interpolation between 0 and 28 days. The Port Chicago standard applies only in months when the average EC at Port Chicago during the 14 days immediately prior to the first day of the month are equal to or less than 2.64 mmhos/cm.

(c) San Joaquin River protection measures-- Not later than three years following the adoption of this plan, the SWRCB shall assign responsibility for the following flows, together with other measures in the watershed sufficient to meet all criteria in the San Joaquin River at Vernalis among the water right holders in the watershed. During this three-year period, Reclamation shall provide these flows. Table 3 shows these flows, which are interim flows and will be reevaluated as to timing and magnitude within the next three years.

Table 3. San Joaquin River flows

Year Type*	February-June flows (cfs)**	April-May pulse flows (cfs)***
Critical	710 or 1,140	3,110 or 3,540
Dry	1,420 or 2,280	4,020 or 4,880
Below Normal	1,420 or 2,280	4,620 or 5,480
Above Normal	2,130 or 3,420	5,730 or 7,020
Wet	2,130 or 3,420	7,330 or 8,620

*San Joaquin Valley 60-20-20 water year classification index at the 75 percent exceedance level applies (see Other Operation Changes section below concerning use of 90 percent exceedance).

**higher flows provided when the standard requires the positioning of X2 west of Chipps Island.

***A Vernalis flow for October of 1,000 cfs is provided with up to an additional 28 TAF pulse and attraction flow during all water year types. The pulse flow will be scheduled by the Ops Group defined above. The additional 28 TAF is not required in a critical year following a critical year.

(d) Delta Cross Channel Gate Closure-- During the period November to January, the Delta Cross Channel will be closed a maximum of 45 days. The timing and duration of the closures will be determined by the Ops Group. During the period May 21 through June 15, the Delta Cross Channel may be rotated closed four consecutive days each week, excluding weekends.

(e) Combined export rate* limits-- In all water year types, during the April and May, 30-day pulse flow interval, maximum combined export rate is 1,500 cfs or 100 percent 3-day running average of San Joaquin River flow at Vernalis, whichever is greater (see below, Other Operational Changes section, for additional San Joaquin River requirements). Variations to this maximum combined export rate are authorized subject to the "CALFED Process" defined above. In all water year types, from February-June, maximum combined export

rate is 35 percent of Delta inflow diverted** and from July-January, 65 percent of Delta inflow diverted. This may be changed by the Ops Group, as defined by the flexibility clause.

*Combined export rate for this objective is defined as the Clifton Court Forebay inflow rate (minus actual Byron-Bethany Irrigation District diversions form Clifton Court Forebay) and the export rate of the Tracy pumping plant.

**Percent of delta inflow diverted is defined on page 22 of the draft Water Quality standards. The export rate for this calculation is defined as a 3-day running average. The 14-day averaging period for Delta inflow is reduced to a 3-day period when the CVP or SWP is making storage withdrawals for export. The percent Delta inflow diverted values can be varied either up or down. Variations are authorized if agreed to by the Ops Group defined above.

> February protections-- If the best available estimate of the January ERI is less than or equal to 1.0 MAF, the export limit for February is 45 percent of Delta inflow diverted. If the best available estimate of the January ERI is between 1.0 MAF and 1.5 MAF, the export ratios for February will be adjusted by the Ops Group defined above within the range of 35 percent to 45 percent. Disputes within the Ops Group will be resolved by CALFED as described in the "CALFED Process" above. If the best available estimate of the January ERI is greater than 1.5 MAF, the February export limit is 35 percent of Delta inflow diverted.
>
> March through June protections-- During March through June, exports shall be no greater than 35 percent of Delta inflow, subject to the flexibility provisions described below.
>
> July through January-- During July through January, exports shall be no greater than 65 percent of Delta inflow, subject to the flexibility provisions described below. The criteria will be developed by the Ops Group.

(f) Daily export limits-- Daily export limits shall be based on the average Delta inflow over the preceding three days, when CVP or SWP is making storage withdrawals for exports (as defined in the Coordinated Operations Agreement), or 14 days under all other conditions.

(g) Operational flexibility-- Decisions to exercise operational flexibility under the Ops Group process may increase or decrease water supplies in any month and must be based on best available biological data to ensure biological protection and be consistent with requirements for delta smelt, delta smelt critical habitat, winter-run salmon, and proposed Sacramento splittail.

(h) All CVP water provided pursuant to these principle's shall be credited toward the CVP obligation under CVPIA Section 3406(b)(2) to provide 800 TAF of project yield for specified purposes.

(i) Brackish tidal marshes of Suisun Bay protections-- Water quality conditions sufficient to support a natural gradient in species composition and wildlife habitat characteristic of a brackish marsh throughout all elevations of the tidal marshes bordering Suisun Bay shall be maintained. Water quality conditions shall be maintained to prevent the loss of diversity.

Other Operational Changes Made to Benefit Delta Smelt, Delta Smelt Critical Habitat, and the Proposed Sacramento Splittail

(1) Starting gate-- If the best estimate of the Eight River Index is more than 900 TAF in January, the daily average or 14-day running average electrical conductivity at Collinsville (station C2) shall attain 2.64 mmhos/cm or less between February 1 and February 14 for at least one day. If the Eight River Index is between 650 TAF and 900 TAF in January, the operations coordination group established by the Framework Agreement shall decide if the daily average or 14-day running average electrical conductivity at Collinsville (station C2) shall attain 2.64 mmhos/cm for at least one day between February 1 and February 14. Disputes will be resolved by the CALFED policy group described above.

At the discretion of the Ops Group, the starting gate requirement may also be met by a minimum daily Delta 3-day running average outflow of 7,100 cfs, if the January Eight River Index is between 650 and 900 TAF.

(2) San Joaquin River pulse flow-- The operating criteria listed above specifies that during the April and May 30-day pulse flow period, combined CVP and SWP exports may be the greater of 1,500 cfs or 100 percent of the Vernalis flow. Reclamation will pursue acquisition of additional flow (acquired flow) to provide San Joaquin flows at Vernalis during the April and May 30-day pulse in excess of those exported by the CVP and SWP. Any such acquired flows will be identified as being in excess of those attributable to CVP releases, unregulated accretions or unstorable flows. Through the CALFED process and other associated discussions, Reclamation and DWR will encourage measures that will minimize the diversion of acquired flows during the 30-day pulse flow period. An Operations Plan shall be submitted to the Service by April 1 of each year describing Reclamation's and DWR's Delta operations and forecasted San Joaquin River flows during the April and May 30-day pulse flow. The objective of this Operations Plan is to provide a flow at Vernalis that exceeds CVP plus SWP export by an amount equal to 50 percent of the identified pulse flow associated with the most recently available forecasted San Joaquin 60/20/20 Index (at 90 percent of exceedance).* In an effort to accomplish this goal, Reclamation and DWR will also consider re-allocation within the Principles for Agreement or other means to provide Vernalis flows or Delta exports consistent with this objective.

*Two examples of possible Operations Plans that meet the stated objective:

(a) "Above Normal" San Joaquin Index with X2 requirement west of Chipps Island--
Base flow = 5,400 cfs (Reclamation will identify base flow in Operations Plan)
CVP+SWP export = 5,400 cfs (equal to 100 percent of base flow)
Identified pulse flow = 7,020 cfs
Acquired flow objective = 3,510 cfs (equal to 50 percent of identified pulse flow)
Total flow objective at Vernalis = 8,910 cfs (base flow plus acquired flow)

(b) "Critical" San Joaquin Index with X2 requirement at the Confluence--
Base flow = 1,400 cfs
CVP+SWP export = 1,500 cfs (greater of 1,500 cfs or base flow)
Identified pulse flow = 3,110 cfs

Acquired flow objective = 1,555 cfs (equal to 50 percent of identified pulse flow)
Total flow at Vernalis = 3,055 cfs (1,500 cfs export plus acquired flow)

(3) San Joaquin River exceedance forecast-- A 90 percent exceedance forecast shall be used to determine required San Joaquin River flows.

(4) North Bay Aqueduct Diversion at Barker Slough and Prospect Island:

(a) When monitoring at Barker Slough indicates the presence of delta smelt larvae (under 20 mm), diversions from Barker Slough shall be reduced to a 5-day running average rate of 65 cfs not to exceed a 75 cfs daily average for any day, for a minimum of 5 days, and when monitoring shows no delta smelt are present. Presence is defined as a weighted average of one or more larval delta smelt sampled at Barker Slough stations 720, 720a (between stations 720 and 721), and 721 during a single sampling day. Barker Slough monitoring stations shall be weighted as follows:

station 720-- 20 percent
station 720a (between stations 720 and 721)-- 30 percent
station 721-- 50 percent

If replicate samples are taken, the count used at each monitoring station shall be the average of all replicate samples taken at the monitoring station.

The averaging period for the 65 cfs shall begin 24 hours after the presence of delta smelt is detected. The Service shall be notified within 24 hours when diversions are reduced due to the presence of delta smelt juveniles and larvae and when diversions are subsequently increased due to the absence of delta smelt juveniles and larvae.

(b) A monitoring plan will be developed and submitted to the Service to provide baseline information to allow an estimation of delta smelt numbers and distribution in the Barker/Lindsey/Cache Slough-Prospect Island area. If this monitoring shows increases in delta smelt numbers and distribution when Prospect Island has become operational as a shallow-water habitat, the Working Group will meet and make a recommendation to the Service to amend 4(a) above.

SPECIES ACCOUNT/ENVIRONMENTAL BASELINE

Species Account

Delta smelt. Please refer to Service (1993a, 1993e, 1994d) and DWR and Reclamation (1994) for additional information on the biology and ecology of the delta smelt. Delta smelt are a slender-bodied fish with a steely blue sheen on the sides and seem almost translucent (Moyle 1976). The delta smelt, which has a lifespan of one year, has an average length of 60 to 70 mm (about 2 to 3 inches) and is endemic to Suisun Bay upstream of San Francisco Bay through the Delta in Contra Costa, Sacramento, San Joaquin, and Solano counties, California. Historically, the delta smelt is thought to have occurred from Suisun Bay upstream to at least the city of Sacramento on the Sacramento River and Mossdale on the San Joaquin River (Moyle *et al.* 1992,

Sweetnam and Stevens 1993). The delta smelt is an euryhaline species (tolerant of a wide salinity range) that spawns in fresh water and has been collected from estuarine waters up to 14 ppt salinity (Moyle *et al.* 1992). For a large part of its annual life span, this species is associated with the freshwater edge of the mixing zone (saltwater-freshwater interface), where the salinity is approximately 2 ppt (Ganssle 1966, Moyle *et al.* 1992, Sweetnam and Stevens 1993).

The delta smelt is adapted to living in the highly productive Estuary where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment, the historical Estuary probably offered relatively constant suitable habitat conditions for delta smelt, because they could move upstream or downstream with the mixing zone (Moyle, pers. comm., 1993). The final rule to list the delta smelt as threatened describes in detail the factors that have contributed to this species' decline (Service 1993a).

Shortly before spawning, adult delta smelt migrate upstream from the brackish-water habitat associated with the mixing zone to disperse widely into river channels and tidally-influenced backwater sloughs (Radtke 1966, Moyle 1976, Wang 1991). Migrating adults with nearly mature eggs were taken at the CVP's Tracy Pumping Plant from late December 1990 to April 1991 (Wang 1991).

Delta smelt spawn in shallow, fresh, or slightly brackish water upstream of the mixing zone (Wang 1991). Most spawning occurs in tidally-influenced backwater sloughs and channel edgewaters (Moyle 1976; Wang 1986, 1991; Moyle *et al.* 1992). Although delta smelt spawning behavior has not been observed in the wild (Moyle *et al.* 1992), the adhesive, demersal eggs are thought to attach to substrates such as cattails, tules, tree roots, and submerged branches (Moyle 1976, Wang 1991). As delta smelt eggs descend through the water column, the outside adhesive layer of the chorion folds back and attaches to the substrate (Wang 1986).

Spawning locations appear to vary widely from year to year (DWR and Reclamation 1993). Sampling of larval delta smelt in the Delta suggests spawning has occurred in the Sacramento River, Barker, Lindsey, Cache, Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs, in the San Joaquin River off Bradford Island including Fisherman's Cut, False River along the shore zone between Frank's and Webb tracts, and possibly other areas (Dale Sweetnam, DFG, pers. comm.; Wang 1991). Delta smelt also may spawn north of Suisun Bay in Montezuma and Suisun sloughs and their tributaries (Lesa Meng, Service, pers. comm.; Sweetnam, DFG, pers. comm.).

The spawning season varies from year to year and may occur from late winter (December) to early summer (July). Moyle (1976) collected gravid adults from December to April, although ripe delta smelt were most common in February and March. In 1989 and 1990, Wang (1991) estimated that spawning had taken place from mid-February to late June or early July, with peak spawning occurring in late April and early May. A recent study of delta smelt eggs and larvae (Wang and Brown 1994 as cited in DWR and Reclamation 1994) confirmed that spawning may occur from February through June, with a peak in April and May. Spawning has been reported to occur at about 7° to 15° C. Initial results from a University of California at Davis (UCD) study (Cech and Swanson 1993 as cited in DWR and Reclamation 1994) indicate that although delta smelt tolerate a wide range of temperatures (<8° C to >25° C), warmer water temperatures restrict their distribution more than colder water temperatures.

Female delta smelt mature at 55-70 mm and fecundity ranges from 1,247 to 2,590 eggs for females 59 to 70 mm standard length (corrected range from Moyle *et al.* 1992). No relationship between fecundity and length has been observed (Moyle *et al.* 1992). Laboratory observations indicate that delta smelt are broadcast spawners that spawn in a current, usually at night, distributing their eggs over a local area (Lindberg 1992 and Mager 1993 as cited in DWR and Reclamation 1994). The eggs form an adhesive foot that appears to stick to most surfaces. Eggs attach singly to the substrate, and few eggs were found on vertical plants or the sides of a culture tank (Lindberg 1993 as cited in DWR and Reclamation 1994).

Delta smelt eggs hatched in 9 to 14 days at temperatures from 13° to 16° C during laboratory observations in 1992 (Mager 1992 as cited in Sweetnam and Stevens 1993). In this study, larvae began feeding on phytoplankton on day four, rotifers on day six, and *Artemia* nauplii at day 14. In laboratory studies, yolk-sac fry were found to be positively phototaxic, swimming to the lightest corner of the incubator, and negatively buoyant, actively swimming to the surface. The post-yolk-sac fry were more evenly distributed throughout the water column (Lindberg 1992 as cited in DWR and Reclamation 1994). After hatching, larvae and juveniles move downstream toward the mixing zone where they are retained by the vertical circulation of fresh and salt waters (Stevens *et al.* 1990).

The pelagic larvae and juveniles feed on zooplankton. At larval stages, gut samples indicate that the diet consists of harpacticoid copepods, calanoid copepods, and copepod nauplii (Stevens *et al.* 1990). As delta smelt grow larger, the primary dietary objects are calanoid copepods. In 1974 samples, *Eurytemera affinis* was the primary prey item with mysid shrimp *Neomysis mercedis* second (Stevens *et al.* 1990). In 1988 and 1991 samples, *Pseudodiaptomus forbesi*, an exotic copepod first observed in the Estuary in 1987, was the dominant prey item (Stevens *et al.* 1990; Moyle *et al.* 1992; Moyle unpub. data). Other prey items observed in gut samples include: another exotic copepod, *Sinocalanus doerii* (Moyle *et al.* 1992); the amphipod, *Corophium spp.*; and the cladocerans *Bosmina spp.* and *Daphnia spp.* (Stevens *et al.* 1990). When the mixing zone is located in Suisun Bay where there is extensive shallow-water habitat within the euphotic zone (depths less than four meters), high densities of phytoplankton and zooplankton may accumulate (Arthur and Ball 1978, 1979, 1980). In general, estuaries are among the most productive ecosystems in the world (Goldman and Horne 1993). Estuarine environments produce an abundance of fish as a result of plentiful food and shallow, productive habitat.

When X2 is contained within Suisun Bay and when adequate transport and behavioral flows from both the Sacramento and San Joaquin rivers have allowed downstream movement, young delta smelt are dispersed more widely throughout a large expanse of shallow-water and marsh habitat than when X2 is upstream in the deeper Delta channels. Dispersion in areas downstream from Collinsville reduces delta smelt susceptibility to entrainment in Delta water diversions and exposure to contaminants, and distributes juvenile delta smelt among the extensive, protective, and highly productive shoal regions of Suisun Bay. Jassby (1993) has reported that increased abundance and survival of organisms from a variety of trophic levels and a variety of life-history stages was observed when entrapment zone position was in Suisun Bay. In contrast, when located upstream, the mixing zone becomes confined in the deeper river channels that are smaller in total surface area, contain fewer shoal areas, have higher levels of contaminants, and are less productive.

Swimming tests done on delta smelt indicate that 28 percent do not show rheotaxic or current orienting behavior (Swanson *et al.* 1994a). Delta smelt orienting to currents showed sustained swimming speeds for 10 minutes of >1.2 feet per second (fps) to <0.5 fps. Small delta smelt swam faster than larger fish. On average, delta smelt can swim approximately 0.33 fps for 10 minutes. Delta smelt can sustain swimming for a least six hours at velocities of 0.33 fps. In laboratory tests (Swanson *et al.* 1994a) at low velocities, delta smelt swim with an intermittent tailbeat or "stroke and glide" swimming. As delta smelt are forced to swim faster, both tailbeat frequency and the number of tailbeats per glide seem to increase until fish are forced to stroke continuously. The "transition speed" between "stroke and glide" swimming and continuous stroking appears stressful to fish, occurs at about 0.5 fps for 2-3 cm juveniles and 0.2-0.33 fps 6-10 cm adults, and may result in impingement.

Delta Smelt Critical Habitat. Please refer to Service (1994d) and DWR and Reclamation (1994) for additional information on the delta smelt critical habitat. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR §424.12(b)). The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

(1) space for individual and population growth, and for normal behavior;

(2) food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) cover or shelter;

(4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and

(5) generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

In designating critical habitat, the Service identified the following primary constituent elements essential to the conservation of the delta smelt: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration. Critical habitat for delta smelt is contained within Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Figure 2b).

Spawning habitat. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay (Figure 2b). The spawning season varies from year to year and may start as early as December and extend until July.

Larval and juvenile transport. Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay and to ensure that rearing habitat is maintained in Suisun Bay (Figure 2b). To ensure this, X2 must be located westward of the Confluence during the period when larvae or juveniles are being transported, according to historical

salinity conditions (Figure 2c). Habitat conditions suitable for transport of larvae and juveniles may be required as early as February 1 and as late as August 31.

Rearing habitat. An area extending eastward from Carquinez Straits, including Suisun, Grizzly, and Honker bays, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat (Figure 2b). Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when historical salinity conditions are implemented. Protection of rearing habitat conditions may be required from the beginning of February to the end of August.

Adult migration. Adequate flow and suitable water quality must be maintained to attract migrating adults in the Sacramento and San Joaquin river channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries (Figure 2b). These areas also must be protected from physical disturbance and flow disruption during migratory periods.

The Service's 1993 and 1994 biological opinions provided for larval and juvenile transport flows, rearing habitat, and protection from entrainment for upstream migrating adults (Service 1993e, 1994d).

Sacramento Splittail. Please refer to Service (1994b) and DWR and Reclamation (1994) for additional information on the biology and ecology of the Sacramento splittail. The Sacramento splittail is a large cyprinid that can reach greater than 12 inches in length (Moyle 1976). Adults are characterized by an elongated body, distinct nuchal hump, and a small blunt head with barbels usually present at the corners of the slightly subterminal mouth. This species can be distinguished from other minnows in the Central Valley of California by the enlarged dorsal lobe of the caudal fin. Sacramento splittail are a dull, silvery-gold on the sides and olive-grey dorsally. During the spawning season, the pectoral, pelvic and caudal fins are tinged with an orange-red color. Males develop small white nuptial tubercles on the head.

Sacramento splittail are endemic to California's Central Valley where they were once widely distributed in lakes and rivers (Moyle 1976). Historically, Sacramento splittail were found as far north as Redding on the Sacramento River and as far south as the site of Friant Dam on the San Joaquin River (Rutter 1908). Rutter (1908) also found Sacramento splittail as far upstream as the current Oroville Dam site on the Feather River and Folsom Dam site on the American River. Anglers in Sacramento reported catches of 50 or more Sacramento splittail per day prior to damming of these rivers (Caywood 1974). Sacramento splittail were common in San Pablo Bay and Carquinez Strait following high winter flows up until about 1985 (Messersmith 1966, Moyle 1976, and Wang 1986 as cited in DWR and Reclamation 1994).

In recent times, dams and diversions have increasingly prevented upstream access to large rivers and the species is restricted to a small portion of its former range (Moyle and Yoshiyama 1989). Sacramento splittail enter the lower reaches of the Feather (Jones and Stokes 1993) and American rivers (Charles Hanson, State Water Contractors, in litt., 1993) on occasion, but the species is now largely confined to the Delta, Suisun Bay, and Suisun Marsh (Service 1994b). Stream surveys in the San Joaquin Valley reported observations of

Sacramento splittail in the San Joaquin River below the mouth of the Merced River and upstream of the confluence of the Tuolumne River (Saiki 1984 as cited in DWR and Reclamation 1994).

Sacramento splittail are long-lived, frequently reaching five to seven years of age. Generally, females are highly fecund, producing over 100,000 eggs each year (Daniels and Moyle 1983 as cited in DWR and Reclamation 1994). Daniels and Moyle measured fecundity of 20 females 175 mm standard length or larger collected from January through March in Suisun Marsh and found from 17,500 to 266,000 ova per female. Populations fluctuate annually depending on spawning success. Spawning success is highly correlated with freshwater outflow and the availability of shallow-water habitat with submersed, aquatic vegetation (Daniels and Moyle 1983). Sacramento splittail usually reach sexual maturity by the end of their second year at a size of 180 to 200 mm. There is some variability in the reproductive period since older fish reproduce before younger individuals (Caywood 1974). The largest recorded Sacramento splittail have measured between 380 and 400 mm (Caywood 1974, Daniels and Moyle 1983 as cited in DWR and Reclamation 1994). Fecundity increases with length and weight of females.

Adults migrate into fresh water in late fall and early winter prior to spawning. The onset of spawning is associated with rising temperature, lengthening photoperiod, seasonal runoff, and possibly endogenous factors from the months of March through May, although there are records of spawning from late January to early July (Wang 1986). Spawning occurs in water temperatures from 9° to 20° C over flooded vegetation in tidal freshwater and euryhaline habitats of estuarine marshes and sloughs and slow-moving reaches of large rivers. The eggs are adhesive or become adhesive soon after contacting water (Caywood 1974, and Bailey, University of California at Davis, pers. comm. 1994 as cited in DWR and Reclamation 1994). Larvae remain in shallow, weedy areas close to spawning sites and move into deeper water as they mature (Wang 1986). Mature splittail eggs are 1.3 to 1.6 mm diameter with a smooth, transparent, thick, chorion (Wang 1986). Under laboratory conditions, fertilized eggs incubated in fresh water at 19° C start to hatch in about 96 hours. Asynchronous hatching of egg batches from single females has been observed in preliminary culturing tests. Eggs laid *en masse* were first to begin hatching, apparently due to higher concentrations of hatching enzymes released from adjacent eggs. Larvae are 7.0-8.0 mm total length when they complete yolk-sac absorption and become free swimming (Daniels and Moyle 1983; Wang 1986).

Sacramento splittail are benthic foragers that feed on opossum shrimp, although detrital material makes up a large percentage of their stomach contents (Daniels and Moyle 1983). Earthworms, clams, insect larvae, and other invertebrates are also found in the diet. Predators include striped bass and other piscivores. Sacramento splittail are sometimes used as bait for striped bass and are sometimes caught for human consumption.

Sacramento splittail can tolerate salinities as high as 10 to 18 ppt (Moyle 1976, Moyle and Yoshiyama 1992). Sacramento splittail are found throughout the Delta (Turner 1966), Suisun Bay, and Suisun and Napa marshes. They migrate upstream from brackish areas to spawn in freshwater. Because they require flooded vegetation for spawning and rearing, Sacramento splittail are frequently found in areas subject to flooding.

The 1985 to 1992 decline in Sacramento splittail abundance (Figure 3) is concurrent with hydrologic changes to the Estuary. These changes include increases in water diversions during the spawning period from January through July. Diversions, dams and reduced outflow, coupled with severe drought

years, introduced aquatic species, and loss of wetlands and shallow-water habitat (DFG 1992) have reduced the species' capacity to reverse its decline.

Environmental Baseline

Delta smelt. Until February 15, 1995, the existing environmental baseline included CVP and SWP operations as modified by the requirements of SWRCB's draft WQCP, the February 12, 1993, winter-run chinook salmon biological opinion issued by the NMFS, and the February 4, 1994, delta smelt biological opinion issued by the Service (1994d). The Service's 1993 opinion addressed effects of the CVP and SWP from May 26, 1993, to February 15, 1994, and was superseded by the 1994 biological opinion which addresses the period from February 4, 1994, to February 15, 1995. Included in the 1994 CVP and SWP project operations were reasonable and prudent alternatives to benefit the delta smelt. Reclamation and DWR (1994) have not included these reasonable and prudent alternatives in the long-term CVP and SWP project operations. Therefore, after February 15, 1995, the environmental baseline for the delta smelt will consist of draft WQCP conditions as modified only by requirements of NMFS's 1993 winter-run chinook salmon biological opinion.

The delta smelt is adapted to living in the highly productive Estuary where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment, the historical Estuary probably offered relatively consistent spring transport flows that moved delta smelt juveniles and larvae downstream to the mixing zone (Peter Moyle, UCD, pers. comm.). Since the 1850's, however, the amount and extent of suitable habitat for the delta smelt has declined dramatically. The advent in 1853, of hydraulic mining in the Sacramento and San Joaquin rivers, led to increased siltation and alteration of the circulation patterns of the Estuary (Nichols *et al.* 1986, Monroe and Kelly 1992). The reclamation of Merritt Island for agricultural purposes, in the same year, marked the beginning of the present-day cumulative loss of 94 percent of the Estuary's tidal marshes (Nichols *et al.* 1986, Monroe and Kelly 1992).

In addition to the degradation and loss of estuarine habitat, the delta smelt has been increasingly subject to entrainment, upstream or reverse flows of waters in the Delta and San Joaquin River, and constriction of low salinity habitat to deep-water river channels of the interior Delta (Moyle *et al.* 1992). These adverse conditions are primarily a result of drought and the steadily increasing proportion of river flow being diverted from the Delta by the CVP and SWP (Monroe and Kelly 1992). Figure 4a shows the relationship between the portion of the delta smelt abundance west of the Delta as sampled in the summer townet survey and the natural logarithm of Delta outflow from 1959 to 1988 (DWR and Reclamation 1994). This relationship indicates that the percent of the summer townet index increased dramatically when outflow was between 34,000 and 48,000 cfs placing X2 between Chipps and Roe islands. Placement of X2 at Chipps and Roe islands would duplicate these favorable conditions of distribution into Suisun Bay.

Operations of the CVP began in 1940. The SWP began delivering water in 1968. However, the proportion of fresh water being diverted has increased since 1983, and has remained at extremely high levels ever since (Moyle *et al.* 1992). The high proportion of fresh water exported has exacerbated the already harsh environmental conditions experienced by the delta smelt during the last six drought years. The relationship between expanded salvage of juvenile delta smelt at the Skinner Fish Facility and total Delta outflow is shown in Figure 4b (DWR and Reclamation 1994). This relationship indicates that if delta smelt have been moved downstream past the Confluence by

outflows, that salvage decreases. This relationship has broken down in recent years (S. Ford, DWR, pers. comm.), possibly due to Delta Cross Channel gate closures imposed by the NMFS biological opinion. As an example of delta smelt response to favorable placement of X2, low salinity habitat was pushed downstream of Roe Island at the beginning of 1993 due to above normal precipitation and resulting outflows plus implementation of measures contained in the delta smelt 1993 biological opinion. By late 1993, however, low salinity habitat moved back upstream as inflow decreased and water exports increased. The fall midwater trawl index showed an increase in delta smelt abundance concurrent with the more favorable placement of low salinity habitat in early 1993. In May and June, 1993, salvage of delta smelt at the Skinner Fish Facility was high at 15,901 and 6,187 individuals, respectively demonstrating the breakdown in the relationship between increased outflow and decreased salvage. Therefore, placement of X2 at Chipps and Roe islands as evidenced by 1993 hydrology is important in maintaining delta smelt distribution and abundance but does not guarantee low salvage at the Federal and State facilities.

The results of seven surveys (Figure 5a) currently done by the IESP (now IEP) corroborate the dramatic decline in delta smelt attributable to baseline conditions prior to May 26, 1993. Existing baseline conditions provide sufficient Delta outflows from February 1 through June 30 to transport larval and juvenile delta smelt out of the "zone of influence" of the pumps, and provide them low salinity, productive rearing habitat (Figures 4a,4b). This zone of influence has been delineated by DWR's Particle Tracking Model and expands or contracts with CVP and SWP combined pumping increases or decreases (DWR and Reclamation 1993). With the effects of tidal movement contributing additional movement, the influence of the pumps may entrain larvae and juveniles as far west as the Confluence. Placement of X2 downstream of the Confluence, Chipps and Roe islands provides delta smelt with protection from entrainment, and low salinity, productive rearing habitat that, when combined with adequate transport and behavioral flows from the Sacramento and San Joaquin rivers, increases both smelt abundance and distribution.

The seven abundance indices used to record trends in the status of the delta smelt showed that this species was consistently at low population levels in ten years prior to 1993 (Stevens *et al.* 1990) (Figure 5a). These same indices also show a pronounced decline from historical levels of abundance (Stevens *et al.* 1990). The summer townet abundance index is thought to be one of the more representative indices because data have been collected over a wide geographic area (from San Pablo Bay upstream through most of the Delta) for the longest period of time (since 1959). Figure 6a shows the distribution of summer townet sampling sites. The summer townet abundance index measures the abundance and distribution of juvenile delta smelt and provides data on the recruitment potential of the species.. Except for three years since 1983 (1986, 1993, and 1994), this index has remained at consistently lower levels than experienced previously (Figure 6b). As indicated in Figure 2c, these consistently lower levels correlate with the 1983 to 1992 mean location of X2 upstream of the Confluence, Chipps and Roe islands.

The second longest running survey (since 1967), the fall midwater trawl survey, measures the abundance and distribution of late juveniles and adult delta smelt in a large geographic area (San Pablo Bay upstream to Rio Vista on the Sacramento River and Stockton on the San Joaquin River, Figure 7a)(Stevens *et al.* 1990). The fall midwater trawl provides an indication of the abundance of the adult population just prior to upstream spawning migration. Figure 7b shows that until recently, except for 1991, this index has declined irregularly over the past 20 years. Since 1983, the delta smelt population

has exhibited more low fall midwater trawl abundance indices, for more consecutive years, than previously recorded. The 1994 value of 101.2 is a continuation of this trend (Figure 7b). This occurred despite the high 1994 summer townet index. Losses of delta smelt at the CVP and SWP pumps shown in Figure 8 and losses due to other CVP and SWP operations are thought to be part of the reason for these declines (Figures 4a,4b). Minimal placement of X2 at the Confluence maintains delta smelt downstream of the influence of the pumps for 50 percent of the time with tidal influence.

Analysis of salinity preferences using fall midwater trawl data indicate that delta smelt distribution peaks upstream of the mixing zone (Obrebski 1993 as cited in DWR and Reclamation 1994). Delta smelt distribution is fairly broad, particularly in years when abundance levels are high (DWR and Reclamation 1994). In late 1993 extending to July of 1994, delta smelt were found in Suisun Bay, downstream of X2. Samples from Suisun Bay showing high concentrations of *Eurytemera affinis* suggest that food availability may also influence smelt distribution. Herbold (1994 as cited in DWR and Reclamation 1994), was able to demonstrate a correlation between abundance and X2 position (Figure 9). This correlation showed maximum increases in abundance occurring when X2 was between Roe Island and Middle Ground Shoals. Placement of X2 at Roe Island would promote these increases in abundance with tidal effects moving X2 upstream to Chipps Island 50 percent of the time and downstream into Grizzley Bay 50 percent of the time. DWR and Reclamation (1994) concluded that the location of X2 may be a "necessary but not sufficient condition" for a high abundance index, but that other factors determine whether or not that opportunity is realized. Entrainment of upstream migrating adults at the Federal and State pumps, lack of San Joaquin River transport flows, and other adverse environmental effects also affect the abundance index.

Export Pumping, Reverse Flows, and Entrainment. Existing baseline conditions provide the necessary positive riverine flows and estuarine outflows to transport delta smelt larvae downstream to suitable rearing habitat outside the influence of the Federal and State pumping plants. When the total Delta diversion rates are high, the lower San Joaquin, Old, and Middle rivers, and other Delta channels, have a net upstream (*i.e.*, reverse or negative) flow. Out-migrating larval and juvenile fish of many species, including delta smelt, become entrained in these flows and are displaced upstream into the south Delta. The Federal Tracy Pumping Plant can export water at rates up to 4,600 cfs. The State operated Banks Pumping Plant generally exports water at rates up to 6,400 cfs. At times, an additional 3,900 cfs of San Joaquin River flow can be diverted through the use of four newly installed pumps. Pumping from Barker Slough, a delta smelt spawning area, through the North Bay Aqueduct has averaged at least 36,000 AF in 1990 and 1991 (with flows of about 50 cfs). Pumping from Rock Slough into the Contra Costa Canal adds another 250 cfs diversion. In addition, local private water right holders divert 3,000 to 4,000 cfs during the peak irrigation season from about 1,800 diversions throughout the Delta. Fish are lost at these diversions, at CVP and SWP diversions (Figure 8), and also as a result of predation by striped bass and other predators.

In recent years, the number of days of reverse San Joaquin River flow which enhances transport of fish to the pumps has increased, particularly during the January to July spawning months for delta smelt (Moyle *et al.* 1992). However, DWR and Reclamation (1994) did not find a significant statistical relationship between reverse flow and various measurements of delta smelt abundance. Nonetheless, all size classes of delta smelt are lost from the Estuary when they are entrained at the water project intakes in the south Delta (Sweetnam and Stevens 1993). In January 1993, during upstream spawning migration, 3,086

delta smelt adults were salvaged at the Skinner Fish Facility. Average monthly numbers of delta smelt adults and juveniles salvaged at the Skinner Fish Facility from 1980 to 1992, are as follows:

January (2,354 individuals), February (1,422), March (765), April (676), May (1,413), June (7,884), July (4,309), August (1,041), September (111), October (85), November (142), and December (943).

Salvaged delta smelt probably do not survive because of stress due to handling and trucking (Sweetnam and Stevens 1993). Survival of delta smelt retained at the SWP's Byron growout facility was reported to be 0 percent in 1989 out of a total 2,590 fish (Odenweller 1990). To estimate losses due to screen effects, salvage numbers would have to be multiplied by a factor that varies with length of the fish (as delta smelt increase in length, screen efficiency increases). Other sources of losses that would need to be accounted for in a multiplying factor are predation and handling losses. Preliminary delta smelt morphometric and swimming efficiency information and some behavioral information are available (Swanson *et al.* 1994a) and a recommendation has been made that an appropriate delta smelt approach velocity is 0.2 fps. There are no data on predation rates on delta smelt or any closely related species. None of the data discussed above reflect losses of larvae, which are too small to be screened or salvaged.

Table 4 shows monthly salvage figures (expressed in numbers of individuals) for delta smelt at CVP and SWP fish facilities since the issuance of the 1994 delta smelt biological opinion.

Table 4. Expanded numbers for delta smelt salvage at CVP and SWP fish facilities from February through August, 1994.

MONTH	CVP	SWP
February	120	54
March	108	61
April	728	217
May	16,776	15,361
June	3,720	5,141
July	12	1,592
August	0	0
Total	21,464	22,426
Combined Total		43,890

Salvage data from the CVP and SWP show that dry year effects are generally greater than wet year effects (DWR and Reclamation 1994). A shift in delta smelt distribution toward the export facilities in dry years is thought to be responsible for this trend.

Delta smelt larvae are also entrained at the Federal and State facilities. This entrainment has been estimated using larval fish sampling gear.

Table 5. Estimated entrainment of delta smelt larvae in the SWP and CVP from 1989-1992 (Reclamation and DWR 1994).

	Central Valley Project	State Water Project
Year	Estimated Entrainment	Estimated Entrainment
1989	136,191	442,922
1990	348,745	582,501
1991	16,901*	24,085*
1992	645,496	554,407

*No sampling done from April 17th to May 27th, 1991

February 4, 1994, Biological Opinion on Effects of CVP and SWP on Delta Smelt. The 1994 delta smelt biological opinion established part of the baseline conditions for this consultation to include the period from February 4, 1994, to February 15, 1995. (See Service (1994d) for information concerning the reasonable and prudent alternative and reasonable and prudent measures contained within that jeopardy opinion.)

The results of monitoring activities indicate that implementation of the reasonable and prudent alternative may have moved some delta smelt downstream of the Delta during the February through May period, and that 6,800 cfs flows were helpful in maintaining delta smelt in a downstream location (DWR and Reclamation 1994). Outflow averaged more than 12,000 cfs in March and more than 7,000 cfs in April and May. However, delta smelt did not migrate west until June, after outflow had dropped to about 4,000 cfs. The majority of the fish that migrated in June probably were responding to additional cues.

The combined 14-day running average take limit of 755 for CVP and SWP salvage facilities was exceeded on the following dates: May 23--787; May 24--809; May 26--861; May 27--1,128; May 28--1,187; May 29--1,335; May 30--1,433; May 31--1,410; and June 1--779. The daily combined salvage during this period ranged from 248 to 4,616 delta smelt with an average of 919 fish. The average combined salvage for the last 10 days of May was 1,833 fish/day.

Figure 7b shows the 1994 fall midwater trawl index value of 101.2. These values are similar to the 1985 value 109.2. These data indicate that the 1994 fall midwater trawl index value is the lowest in the last 20 years.

Conclusion

As stated previously, operations agreed to in Service (1993e, 1994d) were each in effect for only one year and Reclamation and DWR have included similar delta smelt mitigation measures and measures outlined in the Principles of Agreement and draft SWRCB Water Quality Plan in the proposed long-term operation of the CVP and SWP.

Delta Smelt Critical Habitat. Adverse modification or destruction of critical habitat may be analyzed based on the implementation of the reasonable and prudent alternatives in the Service's May 26, 1993, or February 4, 1994, biological opinions, and NMFS's 1992 and 1993 biological opinions for winter-run.

Critical habitat has been affected by diversions that have shifted the position of X2 upstream. This shift has caused a decreased abundance of delta smelt (Figure 7b). Existing baseline conditions and implementation of the Service's 1993 and 1994 biological opinions provide a substantial part of the necessary positive riverine flows and estuarine outflows to transport delta smelt larvae downstream to suitable rearing habitat in Suisun Bay outside the influence of the Federal and State pumping plants. Additional flows have been provided through the draft WQCP to transport and maintain delta smelt larvae and juveniles in rearing habitat between Chipps and Roe islands. This geographic location is most suitable for distribution and production of delta smelt (Figure 9).

Sacramento Splittail. Figure 3 shows the decline of the Sacramento splittail over the past 10 years using fall midwater trawl data. The results of eight independent surveys (Figure 5b) currently done by the IESP (now IEP) corroborate the dramatic decline in Sacramento splittail attributable to baseline conditions. Of these eight surveys, only the beach sein survey does not show declining abundances over the past 10 years, but no sampling occurred in five of these years (1986-1990). This decline is due to hydrologic changes in the Estuary. These changes include increases in water diversions during the spawning period of January through July. Most of the factors that caused delta smelt to decline have also caused the decline of this species. Diversions, dams and reduced outflow, coupled with severe drought years, introduced aquatic species such as the Asiatic clam (Nichols *et al.* 1990), and loss of wetlands and shallow-water habitat (DFG 1992) appear to have perpetuated the species' decline.

Table 2 shows monthly salvage figures for Sacramento splittail at CVP and SWP fish facilities since the issuance of the 1994 delta smelt biological opinion.

Table 6. Expanded numbers for Sacramento splittail salvage at CVP and SWP fish facilities from February through August, 1994.

MONTH	CVP	SWP
February	228	55
March	196	28
April	36	0
May	132	72
June	2,088	73
July	336	18
August	0	0
Total	3,016	246
Combined Total		3,262

EFFECTS OF THE PROPOSED ACTION

Please refer to the Service (1993e, 1994d) and DWR and Reclamation (1993, 1994) for more information on the effects of the CVP and SWP on the delta smelt. The Service's 1993 biological opinion addressed effects for the period from May 26, 1993, to February 4, 1994, and the 1994 biological opinion addressed effects for the period from February 4, 1994, to February 15, 1995. Post-February 4, 1994, conditions contributed to an increase in abundance of delta smelt as indicated by the 1994 summer townet survey (Figure 6b). However, preliminary results of the 1994 fall midwater trawl survey (Figure 7b) indicate that this years' drought conditions coupled with other adverse conditions have continued the decline of this species. The proposed action

should provide beneficial conditions for delta smelt, delta smelt critical habitat, and Sacramento splittail.

Habitat and Transport Flows

Proposed operations of the CVP and SWP provide adequate flows to transport delta smelt away from the influence of the pumps and provide productive, low-salinity rearing habitat in Suisun Bay. Flows for these purposes are needed from February to the end of June during most years. Because delta smelt are weak swimmers as larvae, they are passively transported with flows. Therefore, during the larval phases, flows of sufficient magnitude and duration are needed to transport and disperse delta smelt from the Delta to Suisun Bay. Bruce Herbold (EPA, pers. comm., 1994) has found a positive correlation between Delta outflow and delta smelt abundance as measured by the fall midwater trawl index when X2 is between Middle Ground Shoals and Roe Island (Figure 9). These data indicate that placement of X2 downstream of Chipps Island may be beneficial to recruitment. Historical placement of X2 is shown in Figure 2c.

To ensure adult distribution, transport of delta smelt larvae is necessary during the months of February to the end of June, and sometimes as late as August, from the area where they hatch to shallow, productive rearing or nursery habitat in Suisun Bay. Adequate Sacramento and San Joaquin river flow is necessary to provide this transport to Suisun Bay. The specific geographic area important for larval transport is confined to waters contained within the Delta, Suisun Bay, and Montezuma Slough and its tributaries. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year depending upon when peak spawning occurs.

Maintenance of X2 in Suisun Bay is necessary to provide delta smelt larvae and juveniles with a shallow, protective, food-rich environment in which to mature to adulthood. After hatching, larvae are transported downstream toward the mixing zone. After the first 15 days, the pelagic larvae and juveniles feed on zooplankton. When the mixing zone is located in a broad geographic area with extensive shallow-water habitat within the euphotic zone (depths less than 4 meters), high densities of phytoplankton and zooplankton are produced (Arthur and Ball 1978, 1979, 1980), and larval and juvenile fish (including delta smelt) grow rapidly (Moyle *et al.* 1992, Sweetnam and Stevens 1993). When the mixing zone is contained within Suisun Bay, young delta smelt are dispersed widely throughout a large expanse of shallow-water and marsh habitat. Dispersion in shallow regions protects delta smelt from large predators and increases the likelihood of their survival to adulthood. In contrast, when located upstream, the mixing zone becomes confined to the deep river channels which are smaller in total surface area, have swifter, more turbulent water currents and lack high zooplankton productivity (Moyle *et al.* 1992).

Placement of X2 in Suisun Bay also serves to protect larval, juvenile, and adult delta smelt from entrainment in the CVP and SWP pumps as well as from agricultural diversions. The western limits of the "zone of influence" of the pumps is 10 to 20 km upstream of the Federal and State pumping plants (DWR and Reclamation 1993). However, tidal influence near the Confluence moves delta smelt larvae and juveniles into the "zone of influence", upstream of Collinsville. Flows that move X2 downstream of Collinsville, such as the Chipps Island flows in the proposed EPA water quality standards, are needed to move delta smelt away from this zone of influence. When delta smelt are moved into this zone, they are subjected to increased entrainment from both State

and Federal pumps and agricultural diversions. Salvage of juvenile delta smelt is inversely related to Delta outflow (DWR and Reclamation 1994)(Figure 4b). The SWP historically salvages more delta smelt than the CVP (D. Sweetnam, DFG, pers. comm., 1994), possibly because it pumps more water from the Sacramento River where many delta smelt spawn. Based on analyses for the SWP, there appears to be a substantial increase in entrainment when outflow levels drop below about 10,000 cfs (DWR and Reclamation 1994). This relationship has broken down over the past two years, possibly because of Delta Cross Channel gate closure. The CVP and SWP operations, as proposed, should contribute to reversing the decline of the delta smelt.

San Joaquin River Transport Flows

Proposed operations of the CVP and SWP provide for a base flow from the San Joaquin River when monthly flow is less than the following: about 11,000 cfs from August to April; 6,000 cfs in May and June; and 9,200 cfs in July (Burke, Reclamation, pers comm., 1994). There is also a pulse flow in April and May to move delta smelt larvae spawned on the San Joaquin River to suitable rearing habitat in Suisun Bay. Prior to agricultural diversions and the construction of the CVP and SWP, fresh water flowed down the San Joaquin River, and attracted spawning delta smelt to its fresh water channel edges and tributary sloughs. Also, due to Delta hydrology, delta smelt larvae and juveniles from other areas concentrate in the central Delta on the San Joaquin side as happened in 1994. However, San Joaquin River water, downstream of Sack Dam, now contains contaminants that enter the system from agricultural drains. This contaminated water likely adversely affects delta smelt and its food organisms as has been observed for juvenile chinook salmon and striped bass (Saiki *et al.* 1992). The proposed operations provide high quality water down the San Joaquin River to maintain transport and attractant flows and dilute and minimize the adverse effects associated with contaminants. Additional sources of water potentially available to provide San Joaquin River outflow include "temporary water supplies". Temporary water supplies are those made possible as a result of an unusually large water supply not otherwise storable for project purposes, or infrequent and otherwise unmanaged flood flows of short duration. Under temporary contracts that do not exceed one year, these flows can be made available for agricultural purposes to lands without regard to the acreage limitation and full-cost provisions of Federal Reclamation law. By proposing to use this type of water for instream purposes, and agricultural and municipal purposes, the proposed project will make available San Joaquin River flows.

Presence of Delta Smelt Upstream of the Confluence in July-August
In years when peak spawning occurs late in the year, the proposed operations may provide flows to move delta smelt larvae and juveniles in July and August to suitable rearing habitat in Suisun Bay. Operation of the CVP and SWP pumping plants in the summer months are particularly harmful to delta smelt. This is especially true when delta smelt spawn late and are not well distributed. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River, including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat.

The proposed operations may provide additional "pulse" flows when delta smelt spawn late in the season or when the summer townet survey indicates that delta smelt are not distributed widely throughout the Delta. Therefore, in years when the delta smelt numbers are low and distribution poor and larvae and

juveniles are especially vulnerable to entrainment, a mechanism is proposed to protect delta smelt.

Suisun Marsh Salinity Control Structure

When the SMSCS is in operation, the flashboards and radial gates impair free movement of delta smelt into or out of Montezuma Slough. The twice daily closure of radial gates may slow the movement of the delta smelt out of Montezuma Slough, and may increase the likelihood of entrainment due to private and State-owned diversions, and predation due to the presence of predators such as striped bass near the structure. Suisun Marsh is an important area that allows wide geographic distribution of delta smelt.

Entrainment and Predation at the Pumps, Barker Slough and Roaring River Diversion

The proposed action includes curtailments in pumping to mitigate for entrainment at the pumping plants. As was mentioned previously, DWR's Particle Tracking Model indicates that the export pumps have a "zone of influence" in the interior Delta from which a large percentage of modeled particles were entrained (DWR and Reclamation 1993). When delta smelt are in or near the interior Delta, losses from entrainment will increase. Furthermore, reverse flows, which are a consequence of pumping, move delta smelt into the "zone of influence", thus decreasing their distribution and increasing the likelihood of entrainment. During December through March, delta smelt adults migrate upstream from Suisun Bay and into the lower Sacramento and San Joaquin rivers to spawn. This is the most important life-stage in determining the abundance of the following year's recruitment (Herbold, EPA, pers. comm.). Losses of these adults occur when CVP and SWP pumping entrains these fish as they migrate upstream into the influence of the pumps. In all water-year types, these adult spawners must have protection from entrainment. Larval and juvenile delta smelt migrate downstream from the Delta to Suisun Bay from February through June. Larvae float passively downstream with flows and are easily entrained when in the influence of the pumping plants. In wet, above normal, and below normal water-years, abundance of larvae may be relatively high compared to dry and critically dry years when more protection is necessary. The average yearly estimated larval entrainment at the CVP and SWP Delta facilities for 1989 through 1993 was 590,200 larvae with a range of 41,000 larvae in 1991 to 1,199,000 larvae in 1992 for the combined facilities; however, sampling was not done during critical periods in 1991 and 1993 due to boat breakdown, consequently these numbers may be low (DWR and Reclamation 1994). Larval sampling at south and central Delta sites indicates that the months when entrainment occurs are February through June (DWR and Reclamation 1994). In most of the wetter years, spawning is earlier and juveniles that survive to July and August are important to recruitment for the next year class. Delta smelt spawn in July and August in some of the dryer years. Larvae and juveniles produced by this late spawning are susceptible to entrainment at a time when diversions are high in the Delta. The summer townet survey indicates the abundance of this life-stage during July (Figure 6b). Summer townet indices of about 14 to 19 would be a conservative range for delta smelt. This represents the range between the mean for wet, above normal, and below normal water-years from 1959 to 1993 (14.39) and the mean for all water-year types from 1959 to 1982 (19.5)(Figure 6b). If flows or behavioral cues have resulted in movement to Suisun Bay and subsequent flows have maintained larvae and juveniles in Suisun Bay, entrainment is least likely in September through November.

Predation occurs concurrent with entrainment because striped bass and other predator fish accumulate at the pumping plants and other diversions where delta smelt are drawn due to the influence of the pumps. The high flows and turbulence associated with these diversions disorient fish making them highly susceptible to predation (Coulston, DFG, pers. comm.).

CVP and SWP have not proposed changing operations at the salvage facilities to increase survival of salvaged delta smelt. Current practices at the salvage facilities result in substantial losses of delta smelt. Louvering is targeted at salmon and striped bass and may not be effective for delta smelt and Sacramento splittail. Newly proposed fish release sites may be appropriate for various life-stages of the delta smelt and the Sacramento splittail and may remove the potential for additional predation of these species at the point of release. Predation in Clifton Court Forebay is a significant source of fish mortality.

The proposed CVP and SWP actions include reducing diversions from Barker Slough during the delta smelt spawning interval. Adult delta smelt spawn in Barker Slough from February through August. This spawning area is thought to be one of the most important in the Delta (Sweetnam, DFG, pers. comm.). DWR has proposed additional diversions from Barker Slough through the North Bay Aqueduct during the spawning period. Entrainment of delta smelt larvae at the Barker Slough intake in 1993 and 1994 is estimated to have been 8,289 and 22,489 individuals, respectively (DWR and Reclamation 1994). The proposed CVP and SWP actions do not include changing approach velocities at the Roaring River Diversion screen in Montezuma Slough. Larval delta smelt were collected at three stations in Montezuma Slough during special purse seine sampling from June 7 through 9, 1994. Estimates of delta smelt abundance for this period were 1.37, 1.37, and 54.11 delta smelt/AF, respectively (DWR and Reclamation 1994). The abundance estimate of 54.11 delta smelt/ AF was derived from sampling near the Roaring River Diversion. Because Montezuma Slough represents a key location where distribution of delta smelt reduces the risk of extinction of the species (Draft Delta Native Fishes Recovery Plan, Service 1994e), losses should be minimized to below five delta smelt/AF. The Roaring River Diversion in Montezuma Slough is screened using DFG requirements for salmon. This requirement does not fully address delta smelt needs. Both of these diversions attract predators that add to losses of delta smelt.

The proposed CVP and SWP actions do not include reducing diversions from Rock Slough during the delta smelt spawning interval. Contra Costa Canal carries 50 to 250 cfs taken from an unscreened intake at Rock Slough in Old River. Because delta smelt adults are in this area, lack of screening creates potential for entrainment. Large spawning areas for delta smelt lie just north of the intake at Twitchell Island. The unscreened intake at Rock Slough is responsible for losses that have been estimated at about 7,300 delta smelt larvae for 1992 and 13,000 larvae for 1993 (Spaar 1988 as cited in DWR and Reclamation 1994). In 1992, delta smelt larvae were entrained at 7.91 larvae/AF in March and 8.68 larvae/AF in April. In 1993, delta smelt larvae were entrained at 4.89 larvae/AF in March and 6.36 larvae/AF in April. These estimates may not be representative of actual entrainment because of the location of the sampling sites and tidal influences at these sites (DWR and Reclamation 1994); therefore, entrainment rates may actually be higher than those reported above. The affected delta smelt are most likely killed. Predatory fish reside near the Rock Slough intake and add to the loss of delta smelt.

Delta Smelt Critical Habitat

Because one of the most important existing requirements identified in Service (1994d) was the maintenance of X2 in Suisun Bay to provide rearing habitat for juvenile delta smelt, effects of CVP and SWP operations on critical habitat are similar to those that affect the continued existence of the species. As described above, proposed operations will minimize high diversion and export rates of surface water inflows, in combination with upstream water storage management practices and operations, that will move X2 downstream of the Confluence during the late winter through early summer months, and will not adversely modify or destroy proposed critical habitat for the delta smelt.

Sacramento Splittail

Sacramento splittail young-of-the-year and adults also are entrained by the Federal and State pumping plants. The largest losses at the pumping plants occur in wet years when thousands of splittail young are lost during the spring months. High levels of wet-year recruitment are important to sustain splittail populations during drought years and to reverse the long-term decline of this species. The Sacramento splittail is found at the Rock Slough intake (P. Coulston, DFG, pers. comm.) and is susceptible to entrainment at the Contra Costa diversion. Proposed CVP and SWP operations provide adequate flows for splittail spawning and rearing habitat or transport flows to move young downstream.

BIOLOGICAL JUSTIFICATION OF ACTIONS TAKEN

Below are the biological justifications of actions taken to benefit delta smelt, delta smelt critical habitat, and the proposed Sacramento splittail:

Sacramento and San Joaquin river flows are essential to transporting and maintaining the delta smelt in suitable rearing habitat downstream of the Confluence, and at Chipps and Roe islands. The confluence of the Sacramento-San Joaquin Rivers, marked by Collinsville, defines the western limits of the "zone of influence" of the pumps (USFWS 1993b; DWR and Reclamation 1993). Delta outflows of 7,100 cfs are sufficient to transport or provide behavioral cues to delta smelt larvae and juveniles to move them to Collinsville. Delta outflows of about 11,400 cfs are necessary to transport or provide behavioral cues to larvae and juveniles for movement to the shallow, productive rearing habitat in the Suisun Bay region. Smaller or reverse Delta outflows maintain larvae and juveniles upstream in the deep-water channel regions of the Sacramento and San Joaquin rivers. Therefore, placement of the 2 ppt isohaline between Collinsville (by providing Delta outflows of 6,800 cfs), Chipps Island, and Roe Island (by providing outflows of 11,400 or 29,000 cfs flows, respectively) would be the minimum outflows that will be provided to keep young delta smelt from being entrained in in-Delta diversions and export pumps and allow some periods of dispersal (through tidal flux and transport flows) into the safe, productive rearing habitat of Suisun Bay. The PMI scale allows a smooth transition to occur from month to month as the forecast for water-year type is updated. The two or three ways to comply with the X2 positioning flows, 11,400 cfs, and 29,000 cfs flow requirements, identified above, were determined by CUWA/AG. These compliance measures allow operational flexibility while maintaining the transport and habitat outflows. As spawning success of Sacramento splittail is highly correlated with freshwater outflow and the availability of shallow-water habitat with submersed, aquatic vegetation (Daniels and Moyle 1983), these flows should also benefit this species.

When X2 is contained within Suisun Bay and when adequate transport and behavioral flows from both the Sacramento and San Joaquin rivers have allowed downstream movement, young delta smelt are dispersed more widely throughout a large expanse of shallow-water and marsh habitat than when X2 is upstream in the deeper Delta channels. Dispersion in areas downstream from Collinsville reduces their susceptibility to entrainment in Delta water diversions and exposure to contaminants and distributes juvenile delta smelt among the extensive, protective, and highly productive shoal regions of Suisun Bay. In contrast, when located upstream, the mixing zone becomes confined in the deeper river channels that are smaller in total surface area, contain fewer shoal areas, have higher levels of contaminants, and are less productive.

By initially using salinity to measure compliance with the positioning requirement, X2 is placed at or downstream of the Confluence. Delta smelt are moved out of the influence of the CVP and SWP pumps with this placement of X2, and when 11,400 cfs or 29,000 cfs flows are provided for the minimum number of days, rearing habitat is moved to a location that historically has correlated with delta smelt abundance (Figures 4a, 9). Placement of X2 at Roe Island would promote these increases in abundance with tidal effects moving X2 upstream to Chipps Island 50 percent of the time and downstream into Grizzley Bay 50 percent of the time. DWR and Reclamation (1994) concluded that the location of X2 may be a "necessary but not sufficient condition" for a high abundance index, but that other factors determine whether or not that opportunity is realized. Entrainment of upstream migrating adults at the Federal and State pumps and other adverse environmental effects may also affect the abundance index (Figure 4b).

It is beneficial for delta smelt larvae to be transported during the months of February to the end of June from the area where they hatch to shallow, productive rearing or nursery habitat in Suisun Bay. Adequate river flow is necessary to provide this transport to Suisun Bay. The specific geographic area important for larval transport is confined to waters contained within the Delta, Suisun Bay, and Montezuma Slough and its tributaries.

The specific season when habitat conditions identified above are important for successful larval transport varies from year to year depending upon when peak spawning occurs. Peak occurrence of larvae may occur as late as July or August. Base flows and pulse flows that transport and provide behavioral cues for delta smelt larvae and juveniles from February through June may not be adequate for larval peaks in July or August. Therefore, additional actions that move larvae and juveniles to Suisun Bay will be necessary during late spawning episodes. Without these additional actions, it is possible that a majority of a year class of young delta smelt could be lost as a result of one catastrophic event (*e.g.*, reverse flows causing extremely high entrainment in the southern and central Delta or a contaminant pulse). In annual species like the delta smelt, such a catastrophic event could result in extinction.

The proposed long-term operation of the CVP and SWP provides for minimum base flows down the San Joaquin River, other than those required from New Melones Reservoir to meet salinity standards in the south Delta. The San Joaquin River and tributary sloughs are delta smelt spawning habitat that require a pulse flow during April and May to move and provide behavioral cues for larvae and juvenile transport toward Suisun Bay. Additionally, delta smelt from the Sacramento River side move to the central Delta. Here they are vulnerable to entrainment at the Federal and State pumping plants and so need transport and behavioral flows to move them to Suisun Bay. This occurred in May, 1994, and combined salvage levels rose above the incidental take limit. Because of the relative scarcity of water available from the San Joaquin River drainage, base

flows may not be adequate in some years to transport larvae and juveniles out of the San Joaquin River and tributary sloughs and central Delta toward Suisun Bay. Thus, this pulse flow is an important mechanism to move delta smelt from the San Joaquin River and its tributaries and the central Delta to suitable rearing habitat west of the Confluence.

Montezuma Slough in the Suisun Marsh has been identified as a key area for distribution of delta smelt. Larval delta smelt were collected at three stations in Montezuma Slough during special purse seine sampling from June 7 through 9, 1994. Estimates of delta smelt abundance for this period were 1.37, 1.37, and 54.11 delta smelt/AF, respectively (DWR and Reclamation 1994). The abundance estimate of 54.11 delta smelt/ AF was derived from sampling near the Roaring River Diversion. Because Montezuma Slough represents a key location where distribution of delta smelt reduces the risk of extinction of the species (Draft Delta Native Fishes Recovery Plan, Service 1994e), losses should be minimized. Minimal operation of the SMSCS is important to allow delta smelt access into and out of Montezuma Slough.

Barker Slough has been identified as a spawning area for delta smelt. Adult delta smelt spawn in Barker Slough from February through August. This spawning area is thought to be one of the most important in the Delta (Sweetnam, DFG, pers. comm.). DWR has proposed additional diversions from Barker Slough through the North Bay Aqueduct during the spawning period. Entrainment of delta smelt larvae at the Barker Slough intake in 1993 and 1994 is estimated to have been 8,289 and 22,489 individuals, respectively (DWR and Reclamation 1994). The rate of delta smelt larvae entrained at the NBA diversion has been estimated to range from 37 to 1,700 larvae/day using 1993-94 data (DWR and Reclamation 1994). Curtailment of the NBA rate of diversion is the only method of decreasing this entrainment.

Prospect Island is a Federal project to create a shallow-water habitat in the Delta by breaching levees. Prospect Island is located about four miles from the Barker Slough Pumping Plant of the NBA. One reason for designing Prospect Island as shallow-water habitat is to create habitat for delta smelt and other native fish and allow increases in numbers and distribution.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions affecting listed species and their critical habitat that are reasonably certain to occur in the area considered in this biological opinion. Future Federal actions not related to this proposed action are not considered in determining the cumulative effects, but are subject to separate consultation requirements pursuant to section 7 of the Act.

Cumulative effects on the delta smelt or its proposed critical habitat include any continuing or future diversions of water that may entrain adult or larval fish or that may decrease outflows incrementally, thus shifting upstream the position of the delta smelt's preferred habitat. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay contribute to these cumulative effects. These diversions also include municipal and industrial uses, as well as providing water for power plants. The Pacific Gas and Electric Company (PG+E) power plant intakes are screened, but these screens are ineffective on larval fish. In 1978-1979, more than 50 million and 16 million smelt larvae (delta and longfin smelt) were estimated to have been entrained at PG+E's Pittsburg and Contra Costa power plants, respectively (PG+E 1981a, 1981b). Also, estimates of impingement of larger delta smelt

juveniles and adults on the power plant screens were 11,000 at Pittsburg and 6,400 at Contra Costa.

State or local levee maintenance and channel dredging activities also destroy or adversely modify critical habitat by disturbing spawning or rearing habitat. Delta smelt adults seek shallow, tidally-influenced, fresh water (*i.e.*, less than 2 ppt salinity) backwater sloughs and edgewaters for spawning. To assure egg hatching and larval viability, spawning areas also must provide suitable water quality (*i.e.*, low concentrations of contaminants) and substrates for egg attachment (*e.g.*, submerged tree roots, branches, and emergent vegetation). Suitable water quality must be provided by addressing point sources of contaminants so that maturation is not impaired by pollutant concentrations. Levee maintenance and channel dredging disturbs spawning and rearing habitat, and resuspends contaminants into these waters.

Of the entities with water storage greater than 100,000 AF, Reclamation represents 40.6% of Delta water, 42.8% of Sacramento River water, and 37.7% of San Joaquin River water, respectively. DWR represents 17.4 percent of Delta water, 29 percent of Sacramento River water, and has no storage for San Joaquin River water. Therefore, the non-Federal entities (excluding DWR) represent 42.0 percent of Delta water, 28.2% of Sacramento River water, and 62.3% of San Joaquin River water, respectively, of those with storage greater than 100,000 AF. Collectively, these non-Federal entities (excluding DWR whose activities were analyzed as part of the proposed Federal action) contribute to the existing baseline by removing water and thus decreasing Delta outflows. However, the draft WQCP provides flows and export curtailments that, to a large extent, counteract these effects.

Although the cumulative effects of non-Federal entities substantially contribute to the environmental baseline and project effects, other effects also contribute. These additional effects include point and non-point source chemical contaminant discharges. These contaminants include selenium and numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for delta smelt and Sacramento splittail, these contaminants may adversely affect delta smelt and Sacramento splittail reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants used as substrates for adhesive egg attachment are lost due to toxic substances.

CONCLUSION

The proposed action provides Delta outflow resulting in transport and habitat flows for the delta smelt and the Sacramento splittail. Delta outflow must have both Sacramento and San Joaquin river base flows to adequately transport and provide behavioral cues to larvae and juveniles, and to ensure appropriate rearing conditions in Suisun Bay. The proposed project includes operations that result in delta smelt and Sacramento splittail moving to areas downstream of the Sacramento-San Joaquin confluence which decreases the vulnerability of these species to entrainment, predation, and contaminants.

The proposed action will help to reverse the decline of delta smelt and Sacramento splittail populations (through increase in reproduction, numbers, and distribution) which occurred during the 20 years before 1993, and will appreciably increase the likelihood of their recovery. The survival and recovery of these species can be ensured by the continuation of these proposed operations.

After reviewing the current status of the delta smelt and the Sacramento splittail, the environmental baseline, the effects of the proposed CVP and SWP operations and the cumulative effects, it is the Service's biological opinion that the CVP and SWP operations, as proposed, are not likely to jeopardize the continued existence of the delta smelt and the proposed threatened Sacramento splittail, or result in the destruction or adverse modification of proposed critical habitat for the delta smelt. Implementation of the Framework Agreement, the Principles for Agreement, and the SWRCB's implementation of the draft WQCP are key components of the types of actions that are necessary to conserve these species.

INCIDENTAL TAKE

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by Reclamation or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of Reclamation's action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary and must be implemented by Reclamation so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

The Service has developed the following incidental take statement. The Service anticipates that operations of the CVP and SWP will result in the take (by killing) of delta smelt (see Table 4). This take includes that incurred by salvage activities, predation associated with physical structures, and losses due to diversions. Adults, juveniles, and larvae are present in the south Delta from January through July. Larvae and juvenile delta smelt are flushed to the eastern Suisun Bay by outflows during this interval and removed from the influence of most direct project effects through June 30. With implementation of the reasonable and prudent measures described below, the incidental take of all delta smelt lost due to salvage activities, predation, and diversions and occurring as a result of water exports by the long-term CVP and SWP operations described above will not be considered a prohibited taking.

The Service anticipates that operating the Tracy and Skinner Fish Facilities will result in the take and loss of delta smelt. Additionally, take is expected at the Barker Slough intake on the NBA and the Rock Slough intake with the Contra Costa Canal. Take is also expected through studies done to

determine screening criteria and improve delta smelt handling techniques. Quantifying this take is difficult due to the lack of multiplying factors for sampled delta smelt to expand numbers to actual losses. Take as a result of all ongoing fishery monitoring conducted by IEP needed to implement this biological opinion including the summer townet survey, fall midwater trawl survey, the Barker Slough survey, and studies done to determine screening and handling criteria and techniques is allowed. Any surveys of listed species done by non-DFG entities must obtain a scientific collecting permit through the Portland Regional Office at 503-231-6243 (FAX 503-231-6243) or initiate a section 7 or section 10 consultation for direct taking.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impact of take of the delta smelt:

(1) Improve salvage operations at the Tracy and Skinner Fish Protection Facilities during the spawning period.

(2) Minimize take at the Tracy and Skinner Fish Protection Facilities.

(3) Minimize take at the North Bay Aqueduct intake on Barker Slough during the spawning period.

(4) Minimize take at the Roaring River Diversion in Montezuma Slough.

(5) Minimize take at CCWD diversions.

(6) Minimize take by monitoring abundance and distribution of delta smelt.

(7) Minimize take at the Suisun Marsh Salinity Control Structure.

In order to be exempt from the prohibitions of section 9 of the Act, Reclamation and DWR must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary:

(1) Between December 1 and March 30, truckloads of salvaged fish from the CVP and SWP salvage facilities shall be transported to a new release site whenever the number of adult delta smelt observed in any salvage count preceding a truckload exceeds 0.5 adult delta smelt per count minute. The threshold abundance value (0.5 adult delta smelt) triggering this action may be adjusted by the Working Group if it is apparent that too few or too many loads are being transported to the new release site. Delta smelt handling techniques developed by Swanson *et al.* 1994b shall be modified for use at the salvage facilities. The Service understands that these handling techniques are continually being improved and that all aspects of these techniques may not be appropriate for use at the fish salvage facilities. Therefore, Reclamation and DWR shall submit a plan to the Service to modify all aspects of the Swanson *et al.* 1994b handling techniques that are appropriate for the fish salvage facilities and a plan to update these techniques as future improvements occur within one year of finalization of this opinion. Salt shall be added to maintain an 8 ppt salinity in transport water for trucking delta smelt during this period, and this requirement shall be modified to increase survival consistent with the Swanson *et al.* 1994b modifications. At the Tracy and Skinner Fish Protection Facilities, if delta smelt are present in samples pulled for fish counts at a facility, delta smelt shall not be held at that facility more than 8 hours before beginning transport to a release site.

Biological Justification: Past operations of the salvage facilities have resulted in substantial losses of delta smelt due to use of handling techniques not appropriate to a delicate fish, lack of prophylactic treatment of hauling water, and delays in hauling fish to release sites.

(2) (a) If the 14-day running average of the combined salvage of delta smelt juveniles and adults at the Federal and State salvage facilities is 400 or more, then Reclamation and DWR will consider actions to: (1) determine the significance of the increase in salvage; (2) develop and recommend to the Service additional monitoring to identify population distribution and the potential for adverse impacts on delta smelt; and (3) develop recommendations for appropriate actions that can be taken by Reclamation and DWR and submit these actions to the Working Group, defined in the Reporting Requirements below, for discussion. If appropriate, these recommendations may be submitted to the Ops Group defined in the Principles for Agreement.

Biological Justification: The appearance of delta smelt at the salvage facilities correlates with upstream migrating adults, downstream migrating juveniles and larvae, the leading edge of neap tides (Lloyd Hess, Reclamation, pers. comm.), and the magnitude of export pumping. Spikes in salvage numbers occur as a result of the interaction of these factors. At the Western Division American Fisheries Society Meeting in July 1993, a relationship was demonstrated between combined Federal and State pumping at or below 2,000 cfs and a decrease in salvage rates of delta smelt (Reclamation 1993). Combined 1980-1992 pumping for the Federal and State Facilities was graphed against 1980-1992 combined salvage data. The 2,000 cfs combined pumping value mentioned above intersected with the combined salvage at a value of 400. In the Service's May 26, 1993, delta smelt biological opinion, 400 was used as an incidental take limit. Thus, 400 is a biologically and operationally valid threshold value. Since numbers of salvaged delta smelt could be expanded by a factor representing losses due to screen efficiency, predation, and handling, it is also a conservative threshold value. It is recognized that a brief increase in salvage above a 14-day running average of 400 fish may not be a significant impact on delta smelt. Surveys that provide information on distribution and abundance allow a determination to be made on the significance of the impact.

(b) CVP and SWP shall use table at the CVP and SWP fish salvage facilities on a monthly basis. If reasonable operation of the CVP and SWP cannot satisfy this requirement, the Working Group (defined in the Reporting Requirements section below) shall meet to develop alternative actions.

Biological Justification: The incidental take was developed using the highest 25 percent of historical salvage from 1980 through 1992. The 1980 to 1992 period was selected as representing the period when the delta smelt was declining when compared to post-project historical conditions and when identification of delta smelt was consistently accurate. The values were developed based on water year classification, not calendar year. The draft WQCP provides flows to place X2 at the Confluence, Chipps Island, and Port Chicago. Biologically, it is more beneficial to the delta smelt if transport and habitat flows are provided that allow increased distribution and abundance in Suisun Bay, away from the influence of the Federal and State pumps. Thus, these numbers are not likely to be salvaged at the Federal and State facilities because the above alternative will change the Delta dynamics and decrease entrainment at the Federal and State pumps.

Table 7. Monthly average delta smelt salvage at the Federal and State Fish Facilities from 1980 to 1992 by water year type. Numbers are total allowable incidental take for each month by water year type, with 90 percent exceedance forecasts used to update water-year classifications monthly.

	Above Normal	Below Normal
Months	Top 25% of Years	Top 25% of Years
January	5,397	13,354
February	7,188	10,910
March	6,979	5,368
April	2,378	12,345
May	9,769	55,277
June	10,709	47,245
July	9,617	35,550
August	4,818	25,889
September	1,329	1,978
October	11,990	6,440
November	3,330	2,001
December	733	8,052

(3) Monthly average of daily density for incidental take of delta smelt larvae at the Barker Slough diversion shall be the following:

January[1]	15 larvae/AF
February	15 larvae/AF
March	15 larvae/AF
April	20 larvae/AF
May	15 larvae/AF
June	15 larvae/AF
July	15 larvae/AF

[1]The rounded-off values are taken from a December 7, 1994, letter from the Solano County Water Agency faxed to the Sacramento Field Office. This letter provided numbers that reflect 1994 larval densities that update the biological assessment (DWR and Reclamation 1994).

Biological Justification: These values were in place when pumping was curtailed through the 1993 delta smelt biological opinion. Thus, these values represent a year when delta smelt were spawning in Lindsey Slough in high numbers resulting from favorable conditions of high outflow and the protective measures under the 1994 biological opinion. They represent a biologically appropriate limit when combined with pumping curtailment.

(4) Reclamation and DWR shall maintain approach velocities at the Roaring River Diversion to 0.2 feet per second when delta smelt are present, unless and until new information on a more appropriate approach velocity becomes available. From September through November, an approach velocity of 0.5 fps for 4-6 weeks may be substituted for the above requirement upon approval by the Service. Any changes to these approach velocities shall be approved by the Service before they are implemented.

Biological Justification: Current approach velocity recommendations for delta smelt are 0.2 feet per second (Swanson et al. 1994a).

(5) To minimize take of delta smelt in the unscreened Rock Slough intake, monitoring information described in the Reporting Requirements below shall be used to determine reduction in diversion of water at the Rock Slough and Mallard Slough intakes. The intent is to minimize take of delta smelt adults, juveniles, or larvae that are exposed to pumping and diversion-related losses during the spawning and rearing period from January 1 through August 31. Notification of proposed diversion reduction to reduce take of delta smelt shall be submitted to the Service for approval and submitted in the twice monthly report mentioned above.

Biological Justification: The Service has issued a biological opinion on Los Vaqueros Project (Service 1993c) that contained an analysis of the effects of the Rock Slough and Mallard Slough intakes. The above condition was developed in this opinion to minimize the effects of project diversions on delta smelt.

(6) (a) If ongoing monitoring indicates that the flows specified in the Principles for Agreement and draft WQCP are not sufficient to maintain rearing habitat for delta smelt away from the southern and central Delta, then the Working Group, defined in the Reporting Requirements below, will convene and make a recommendation to the Ops Group defined above. The Ops Group shall then recommend an appropriate action to the Service within 10 days to protect delta smelt, delta smelt critical habitat, and the proposed Sacramento splittail. Based on these recommendations, Reclamation and DWR will reinitiate section 7 consultation, or submit to the Service for approval prior to implementation, recommendations for project changes to protect the delta smelt consistent with the Principles for Agreement, the draft WQCP, and the Framework Agreement.

(b) If the summer townet survey shows that delta smelt are not found distributed in 3 out of 7 Suisun Bay stations 405-519 and 4 out of 8 Montezuma Slough/Sacramento River stations 513-707 and/or delta smelt larval surveys provide evidence that delta smelt have spawned late (*i.e.* an average of 1 or more larvae collected at current (1994) sampling sites during one sampling interval in July or August), then Reclamation and DWR shall recommend that the Service convene the Working Group that will subsequently make a recommendation to the Ops Group defined above. The Ops Group shall then recommend an appropriate action to the Service within 10 days of the results of the townet or larval surveys being available that minimizes entrainment of delta smelt and maximizes downstream movement of fish away from the pumps. The Service shall make the final determination necessary for protection of delta smelt.

Biological Justification: Monitoring may indicate conditions resulting from implementation of the Principles for Agreement and draft WQCP that have not adequately addressed biological needs of the delta smelt. This may result from several conditions including delta smelt spawning late in the season. Appropriate actions may be necessary to respond to these conditions.

(7) DWR shall operate the Suisun Marsh Salinity Control Structure only as required to meet the standards contained within the SWRCB's draft WQCP. When not operating, the gates shall remain in the raised position.

Biological Justification: Suisun Marsh including Montezuma Slough is a vital area for delta smelt distribution. Distribution of delta smelt within Suisun Marsh substantially reduces the risk of extinction according to the Delta Native Fishes Recovery Plan (Service 1994e).

REPORTING REQUIREMENTS

Reclamation and DWR shall require all contractors, constituent farmers and salvage operation personnel at the State and Federal fish screens to report immediately any information about take or suspected take of delta smelt (and Sacramento splittail should this species be listed). Reclamation/DWR shall immediately notify the Service within 1 working day of any such information. Notification must include the date, time, and precise location of the incident and specimen, and any other pertinent information. The Service contact persons are Robert Pine and Matt Vandenberg at (916) 979-2725. Any killed specimens that have been taken shall be properly preserved in accordance with the Natural History Museum of Los Angeles County policy of assessioning (10% formalin in quart jar or freezing). Information concerning how the fish was taken, length of the interval between death and preservation, the water temperature and outflow/tide conditions, and any other relevant information shall be written on 100% rag content paper and included in the container with the specimen. This preserved specimen shall be delivered to the Service's Division of Law Enforcement at 2800 Cottage Way, Sacramento, California 95825-1846 (telephone 916-979-2987).

When delta smelt are present, salvage information from the State and Federal fish protection facilities shall be faxed (916-979-2723) to the Service on Monday of each week or when the 14-day running average of combined salvage is at 400 or above. If the 14-day running average of combined salvage is at 400 or above, Reclamation and DWR shall notify the Service within 48-hours about the proposed action to be taken to reduce salvage numbers.

Larval sampling shall be done at Barker Slough stations 720 and 721, and a new station established between these two stations (720a). Barker Slough sampling data shall be FAXed to the Service weekly. The Service shall be notified within 48 hours when diversions are reduced at Barker Slough due to the presence of delta smelt juveniles and larvae, and when diversions are subsequently increased due to the absence of delta smelt juveniles and larvae. Numbers of Sacramento splittail sampled shall also be included in these reports. Flow reports from the Barker Slough intake in North Bay Aqueduct shall be submitted weekly to the Service by FAX at (916) 979-2723.

All Rock Slough studies initiated in the February 4, 1994, delta smelt biological opinion shall be continued and the reporting requirements shall be the same.

The location of X2 in relation to Roe Island, Chipps Island, and Collinsville shall be monitored and related to the Delta 14-day running mean outflow, and

DFG surveys that determine delta smelt abundance. Fax (916-979-2725) maps to the Service showing X2 location, Delta 14-day running mean outflow, 14-day running average salvage at CVP and SWP pumps, and the latest DFG survey information immediately when survey information is available in the following months: June, July, September, October, November, and December or once a month in other months.

Establishment of a Working Group and Ops Group

The Service, NMFS, Reclamation, EPA, DWR, SWRCB, and DFG shall identify participants from each agency that will form two separate committees, a Ops Group defined in Exhibit B of the Framework Agreement and a Working Group. The purpose of the Ops Group shall be to recommend appropriate actions to the Service within a 7-day timeframe, assist in coordinating agency actions and resolving management conflicts, and to protect the delta smelt and other Federal and State listed endangered and threatened species. The purpose of the Working Group is to resolve biological and technical issues raised by this biological opinion and to develop recommendations for consideration of the Management Group. The Service shall convene the Working Group on a regular basis and will consider requests from agency participants at other times. The Ops Group shall meet as necessary as recommended by the Service, Reclamation, and DWR.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species and the ecosystems upon which they depend. Conservation recommendations are Service suggestions regarding discretionary agency activities to promote the recovery of listed species. Therefore, the Service recommends the following additional actions to promote the recovery of federally listed species and their habitats:

(1) Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop a program for threatened and endangered species that allows acquisition and management of areas used as spawning habitat, such as backwater sloughs and shallow channel edges, to prevent destruction and adverse effects caused by in-Delta project activities.

(2) Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop baseline information (i.e., proposed operations plus February 12, 1993, winter-run chinook salmon biological opinion) on project effects on currently unlisted species including longfin smelt, Sacramento splittail, and green sturgeon to prepare for compliance with the Act as new species become listed.

(3) Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop an ecosystem-centered analysis of the Bay-Delta to promote understanding of the interrelated effects of operating the Federal and State water projects.

(4) Reclamation and DWR should develop salinity standards for the Suisun Marsh that reflect the historical fresh to salt water gradient from east to west, and north to south within the marsh.

CONCLUSION

This concludes the consultation and the conference for the proposed action. You may ask the Service to confirm the conference opinion as a biological opinion issued through formal consultation if the Sacramento splittail is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during conference, the Service may confirm the conference opinion as the biological opinion on the project and no further section 7 consultation may be necessary.

As required by 50 CFR §402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an adverse effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take ceases to have the protective coverage of section 7(o)(2) of the Act.

If you have any questions regarding this biological opinion, please contact Robert Pine at the Sacramento Field Office at (916) 979-2725.

cc: ARD-ES, Portland, OR
Dale Sweetnam, DFG, Bay-Delta Special Water Projects Division, Stockton, CA
Bruce Herbold, U.S. EPA, San Francisco, CA
Roger Guinee, CVPIA Division
Mike Fris, Corps Branch
Jean Elder, Federal Projects, Bay-Delta Branch

LITERATURE CITED

Arthur, J. F., H. F. N. Wong, M. D. Ball, and L. J. Hess 1991. 1990 Striped bass egg and larvae management studies San Francisco Bay-Delta Estuary. Evaluation of potential striped bass management scenarios by use of a numerical salt transport model. U.S. Department of the Interior Bureau of Reclamation, Mid-Pacific Region. 11 pages plus maps.

Arthur, J.F. and M.D. Ball 1980. The significance of the entrapment zone location to the phytoplankton standing crop in the San Francisco Bay-Delta Estuary. U.S. Dept. Interior, Water and Power Resources Service.

Arthur, J.F. and M.D. Ball 1979. Factors influencing the entrapment of suspended material in the San Francisco Bay-Delta Estuary. Pages 143-174 in T.J. Conomos, editor. Pacific Division, Amer. Assoc. Advance. Sci., San Francisco, California.

Arthur, J.F. and M.D. Ball 1978. Entrapment of suspended materials in the San Francisco Bay-Delta Estuary. U.S. Dept. Interior, Bureau of Reclamation, Sacramento, California.

California Department of Fish and Game 1992. Impact of water management on splittail in the Sacramento-San Joaquin estuary. State Water Resources Control Board Hearing for setting interim standards for the Delta. WRINT-DFG-Exhibit 5. 7 pp.

Carlton, J. T., J. K. Thompson, L. E. Schemel, and F. H. Nichols 1990. Remarkable invasion of San Francisco Bay (California, USA) by the asian clam Potamocorbula amurensis. I. Introduction and dispersal. Mar. Ecol. Prog. Ser. 66:81-94.

Caywood, M.L. 1974. Contributions to the Life History of the Splittail Pogonichthys macrolepidotus (Ayres). M.S. Thesis, California State U., Sacramento. 77 pp.

Daniels, R.A. and P.B. Moyle 1983. Life history of splittail (Cyprinidae: *Pogonichthys macrolepidotus*) in the Sacramento-San Joaquin estuary. Fishery Bulletin 84-3:647-654.

Department of Water Resources and U.S. Bureau of Reclamation, Mid-Pacific Region 1993. Effects of the Central Valley Project and State Water Project on delta smelt. 134 pp.

Department of Water Resources and U.S. Bureau of Reclamation, Mid-Pacific Region 1994. Effects of the Central Valley Project and State Water Project on delta smelt and Sacramento splittail. 230 pp.

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco 1991. Distribution and abundances of fishes and invertebrates in west coast estuaries, Volume 2: Species life histories summaries. ELMR Rep. No. 8. NOS/NOAA Strategic Environmental Assessment Division, Rockville, Maryland. 329 pp.

Environmental Protection Agency 1993. Water quality standards for surface waters of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California. January 6, 1994. Fed. Reg. 59(4):810-852.

Fourteen-Agency 1994. Framework Agreement between the Governor's Water Policy Council of the State of California and the federal Ecosystem Directorate. 5 pp. plus Exhibits.

Ganssle, D. 1966. Fishes and decapods of San Pablo and Suisun bays. Pp.64-94 in D.W. Kelley, ed.: Ecological studies of the Sacramento-San Joaquin estuary, Part 1. Calif. Dept. Fish and Game, Fish Bulletin No. 133.

Goldman, C.R. and A.J. Horne 1983. Limnology. McGraw-Hill Book Company, New York, New York.

Jassby, A.D. 1993. Isohaline position as a habitat indicator for estuarine resources: San Francisco Bay Estuary. Pages B1-B2 *in* Managing freshwater discharge to the San Francisco Bay/Sacramento-San Joaquin Estuary: The scientific basis for an estuarine standard. San Francisco Bay Estuary Project Report.

Jones and Stokes Assoc., Inc. 1993. Sutter Bypass Fisheries Technical Memorandum II: Potential Entrapment of Juvenile Chinook Salmon in the Proposed Gravel Mining Pond. May 27, 1993. (JSA 91-272). Prepared for Teichert Aggregates, Sacramento. 31 pp.

Kano, R. M. 1990. Occurrence and abundance of predator fish in Clifton Court Forebay, California. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary. Tech. Rept. 24, FF/BIO-IATR/90-24.

Kimmerer, W. 1992. An evaluation of existing data in the entrapment zone of the San Francisco Bay estuary. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary. Tech. Rept. 33. 49 pages.

McAllister, D.E. 1963. A revision of the smelt family, Osmeridae. Bull.Natl. Mus. Canada 191:53 pp.

Messersmith, J.D. 1966. Fishes collected in Carquinez Straight in 1961-1962. Pages 57-62 *in*: D.W. Kelly, editor. Ecological Studies of the Sacramento-San Joaquin Estuary, Part 1. Dept. Fish and Game, Fisheries Bulletin 133.

Miller, D.J. and R.N. Lea 1972. Guide to the coastal fishes of California. Calif. Department of Fish and Game. Bull. 157:235 pp.

Monroe, M.W. and J. Kelly 1992. State of the estuary: A report on conditions and problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. San Francisco Estuary Project, Oakland, California.

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley, California. 405 pp.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Trans. Am. Fish. Soc. 121:67-77.

Moyle, P.B., J.J. Smith, R.A. Daniels, and D.M. Baltz 1982. Distribution and ecology of stream fishes of the Sacramento-San Joaquin Drainage System, California: a review. Univ. Calif. Publ. Zool. 115:225-256.

Moyle, P.B. and R. M. Yoshiyama 1992. Fishes, aquatic diversity management areas, and endangered species: A plan to protect California's native aquatic biota. Draft report prepared for California Policy Seminar, University of California, Berkeley, California. July 1992. 196 pp.

National Marine Fisheries Service 1993. Biological opinion for the operation of the Federal Central Valley Project and the California State Water Project. February 12, 1993. 81 pages plus attachments.

Nichols, F.H., J.E. Cloern, S.N. Luoma, and D.H. Peterson 1986. The modification of an estuary. Science 231:567-573.

Odenweller, D. 1990. Delta Fish Facilities Study. Chapter 8 *in* P.L. Herrgesell, (compiler), 1989 Annual Report, Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Sacramento, California.

Pacific Gas and Electric Company 1981a. Contra Costa Power Plant cooling water intake structures 31(b) demonstration. PG+E, San Francisco, California.

Pacific Gas and Electric Company 1981b. Pittsburg Power Plant cooling water structures 316(b) demonstration. PG+E, San Francisco, California.

Pimm, S. L., H. L. Jones, and J. Diamond 1988. On the risk of extinction. American Naturalist 132:757-785.

Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta. Pp. 115 - 119 in J. L. Turner and D. W. Kelley, eds.: Ecological studies of the Sacramento-San Joaquin estuary, Part 2. California Department of Fish and Game Fish Bulletin No. 136.

Rutter, C. 1908. The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. Bulletin of U.S. Bureau of Fisheries 27(637):103-152.

Saiki, M. K., M. R. Jennings, and R. H. Wiedmeyer 1992. Toxicity of agricultural subsurface drainwater from the San Joaquin Valley, California, to juvenile chinook salmon and striped bass. Trans. Am. Fish. Soc. 121:78-93.

Stevens, D.E. and L.W. Miller 1983. Effects of river flow on abundance of young chinook salmon, American shad, longfin smelt, and delta smelt in the Sacramento-San Joaquin river system. North American Journal of Fisheries Management 3:425-437.

Stevens, D. E., S. W. Miller, and B. C. Bolster 1990. Report to the Fish and Game Commission: A status review of the delta smelt (*Hypomesus transpacificus*) in California. California Department of Fish and Game Candidate Species Status Rept. 90-2. 149 pages.

Swanson, C., P. Young, J.J. Cech, Jr. 1994a. Delta smelt swimming performance and behavior in a laboratory flume: Preliminary results. A Focussed Progress Report to the California Department of Water Resources. 11 pages plus figures.

Swanson, C., R. Mager, J.J. Cech, Jr., and S.I. Doroshov 1994b. Use of salts, anesthetics and polymers to minimize handling and transport mortality in delta smelt (*Hypomesus transpacificus*). High Performance Fish, Proceedings of the International Fish Physiology Symposium, Vancouver, Canada. 445-448.

Sweetnam, D.A. and D.E. Stevens 1993. Report to the Fish and Game Commission: A status review of the delta smelt (*Hypomesus transpacificus*) in California. Candidate Species Status Report 93-DS. 98 pages plus appendices.

Turner, J.L. and D.W. Kelley 1966. Ecological studies of the Sacramento-San Joaquin Delta. Cal. Dept. Fish and Game Bull. 136.

U.S. Bureau of Reclamation 1992. Biological assessment for U.S. Bureau of Reclamation long-term Central Valley Project operations criteria and plan. October 1992. U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, California.

U.S. Fish and Wildlife Service 1991a. Formal consultation on the Friant Division contract renewals, Central Valley, California. October 15, 1991. 47 pages + appendices.

U.S. Fish and Wildlife Service 1991b. Endangered and threatened wildlife and plants; Proposed threatened status for the delta smelt. October 3, 1991. Fed. Reg. 56(192):50075-50083.

U.S. Fish and Wildlife Service 1993a. Endangered and threatened wildlife and plants; Determination of threatened status for the delta smelt. March 5, 1993. Fed. Reg. 58(42):12854-12864.

U.S. Fish and Wildlife Service 1993b. Formal Endangered Species Act consultation on effects of implementing long-term operational criteria and plan for Central Valley Project reservoirs. February 12, 1993. 13 pages.

U.S. Fish and Wildlife Service 1993c. Formal consultation on effects of the proposed Los Vaqueros Reservoir Project on delta smelt, Contra Costa County, California. July 26, 1993. 23 pages with figures.

U.S. Fish and Wildlife Service 1993d. Formal consultation on Central Valley Project Operations Criteria and Plan for 1993: Effects on delta smelt. May 26, 1993. 37 pages with figures.

U.S. Fish and Wildlife Service 1994a. Endangered and threatened wildlife and plants; Proposed determination of threatened status for the Sacramento splittail. January 6, 1994. Fed. Reg. 862-869.

U.S. Fish and Wildlife Service 1994b. Endangered and threatened wildlife and plants; Critical habitat determination for the delta smelt. December 19, 1994. Fed. Reg. 65256-65279.

U.S. Fish and Wildlife Service 1994c. Draft Biological Opinion on Interim Contract Renewals for the Central Valley Project. Sacramento Field

Office, California.

U.S. Fish and Wildlife Service 1994d. Formal consultation on the 1994 operation of the Central Valley Project and State Water Project: Effects on delta smelt. 34 pages, plus figures.

U.S. Fish and Wildlife Service 1994e. Technical/Agency Draft Sacramento-San Joaquin Delta Native Fishes Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: A guide to the early life histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Tech. Rept. 9.

Wang, J.C.S. 1991. Early life stages and early life history of the delta smelt, Hypomesus transpacificus, in the Sacramento-San Joaquin estuary, with comparison of early life stages of the longfin smelt, Spirinchus thaleichthys. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary. Tech. Rept. 28.

Personal Communications

Cech, J., C. Swanson, P. Young, Department of Wildlife and Fisheries Biology, University of California, Davis, Davis, California 95616

Coulston, P., Department of Fish and Game, Bay-Delta and Special Water Projects Division, 4001 N. Wilson Way, Stockton, California 95205-2424

Herbold, B., Environmental Protection Agency, 1235 Mission Street, San Francisco, California 94103

Moyle, P.B., University of California, Davis, Davis, California 95616.

Sweetnam, D., Department of Fish and Game, Bay-Delta and Special Water Projects Division, 4001 N. Wilson Way, Stockton, CA 95205-2424.

Tillman, T., Department of Fish and Game, Bay-Delta and Special Water Projects Division, 4001 N. Wilson Way, Stockton, CA 95205-2424.

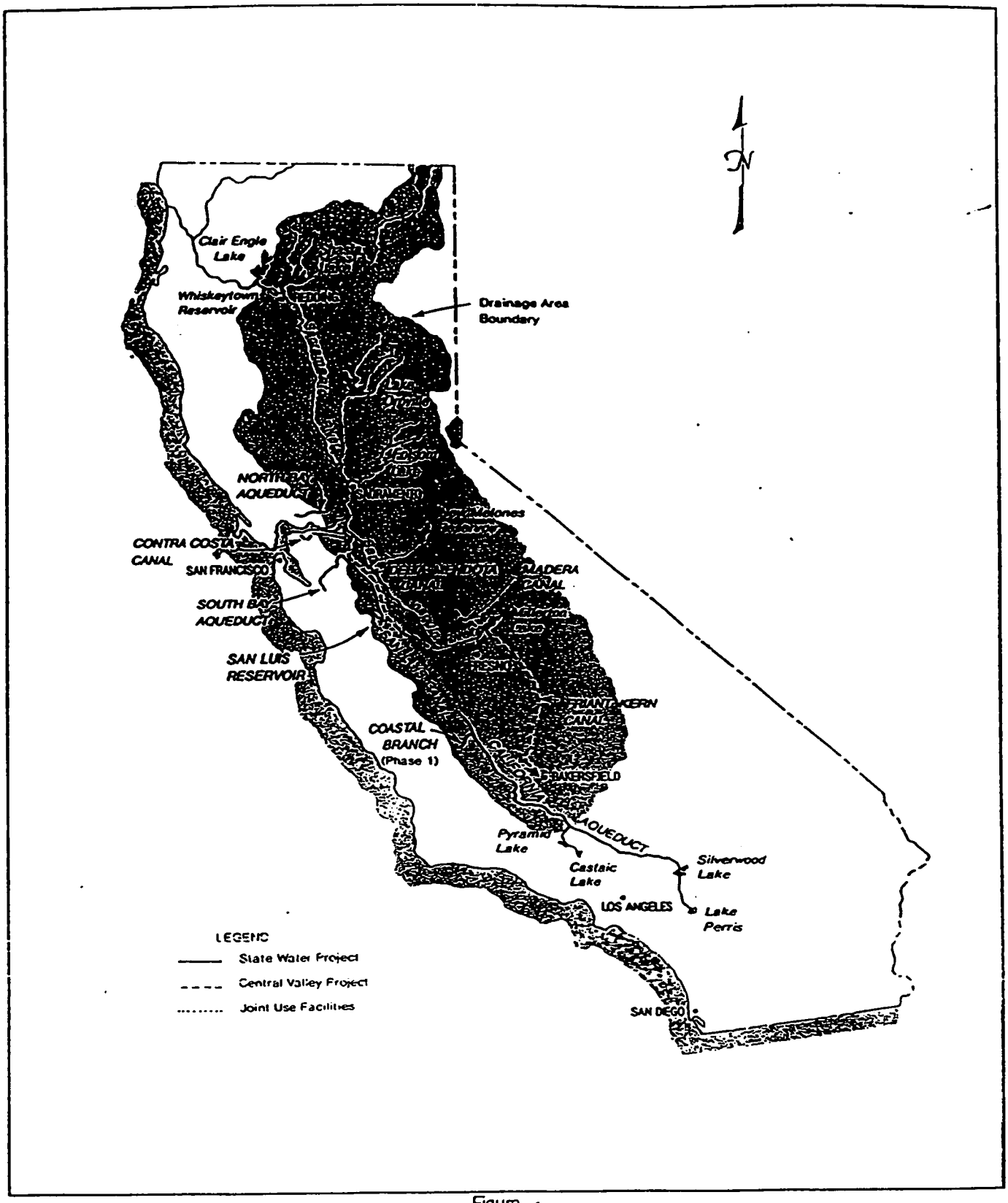


Figure 1.
MAJOR FEATURES OF THE CENTRAL VALLEY PROJECT AND STATE WATER PROJECT

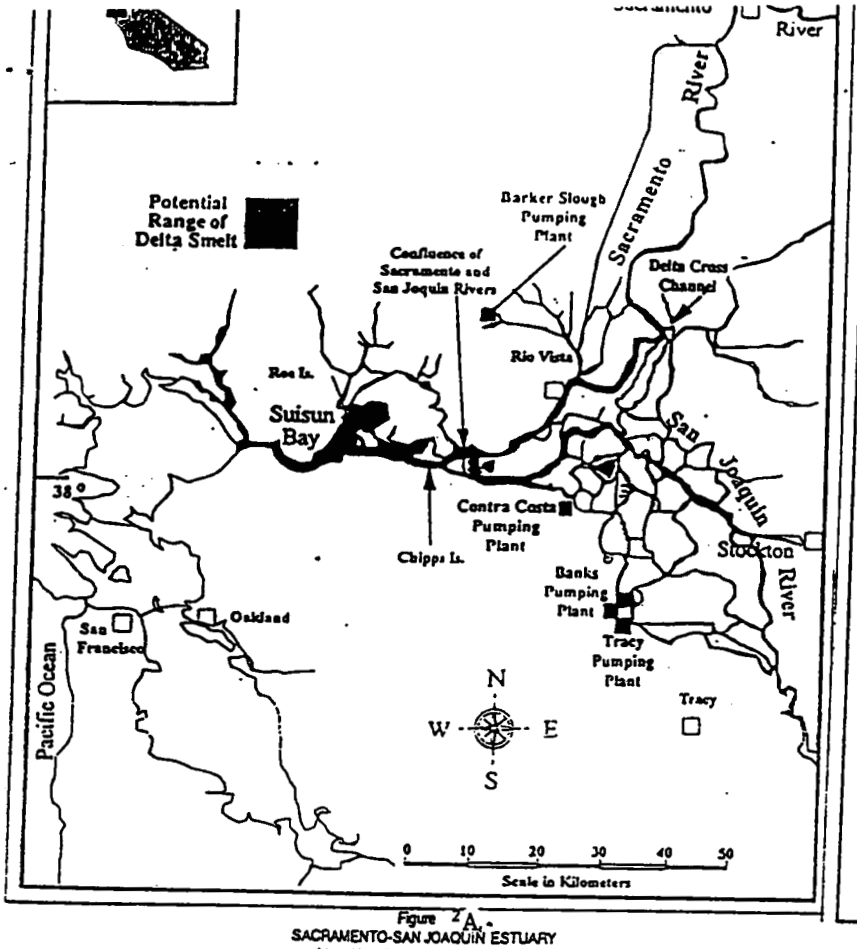


Figure 2a.
SACRAMENTO-SAN JOAQUIN ESTUARY
Adapted from Sweetnam and Stevens 1993.

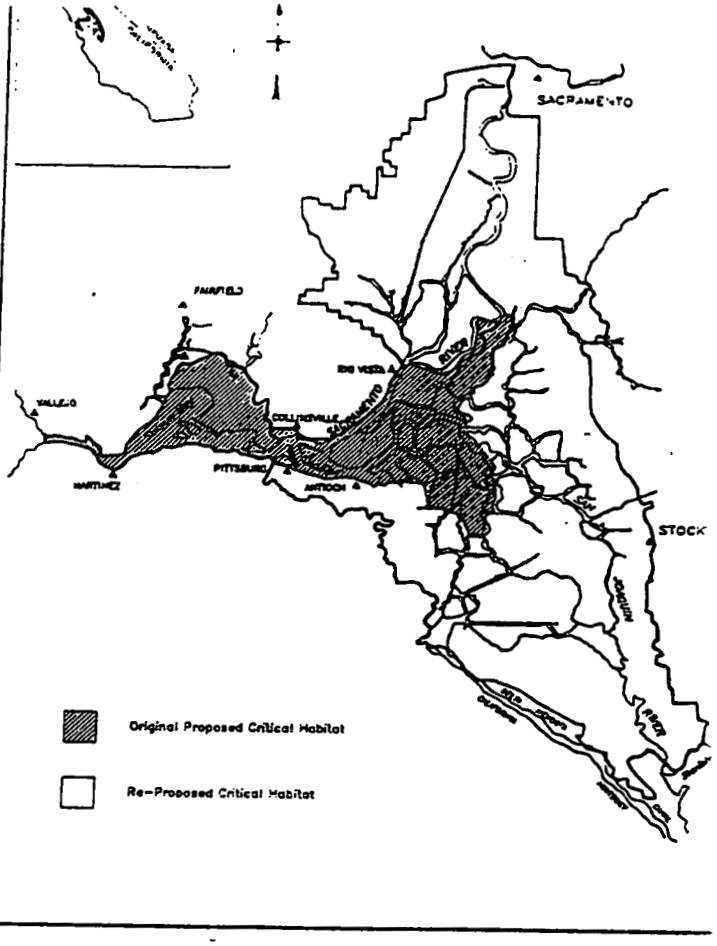


Figure 2b.

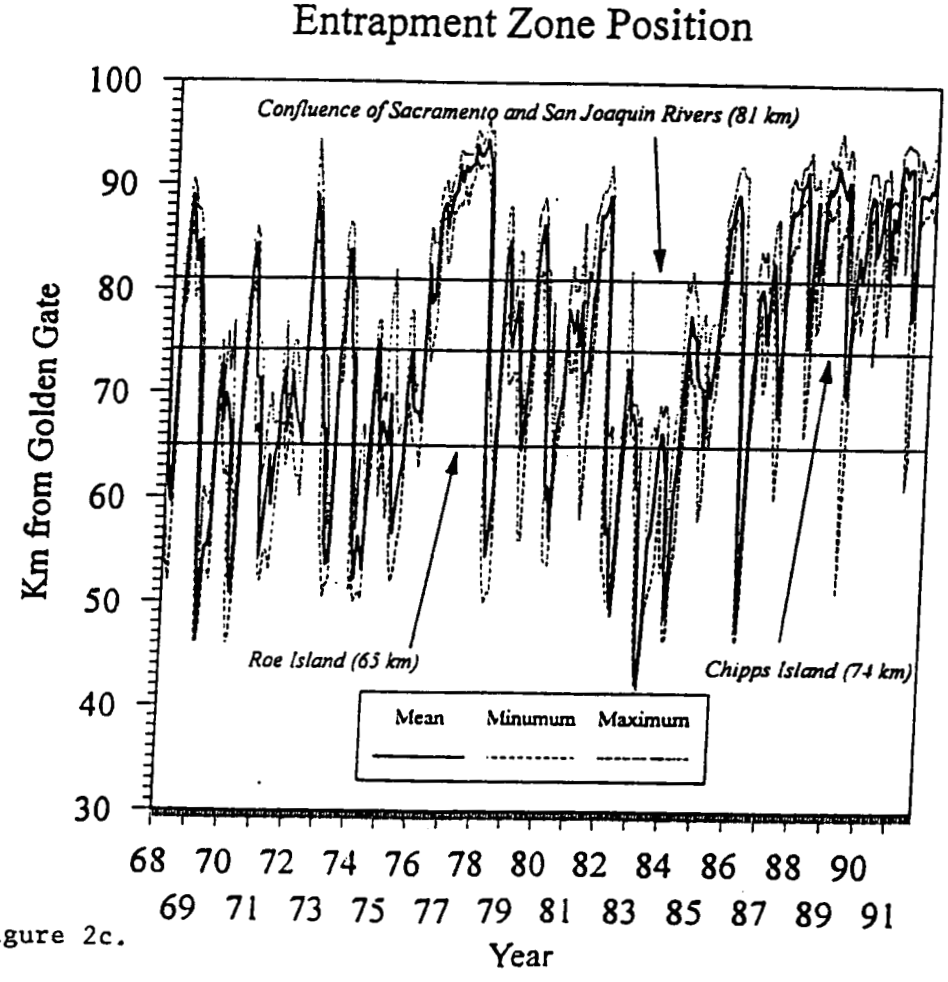
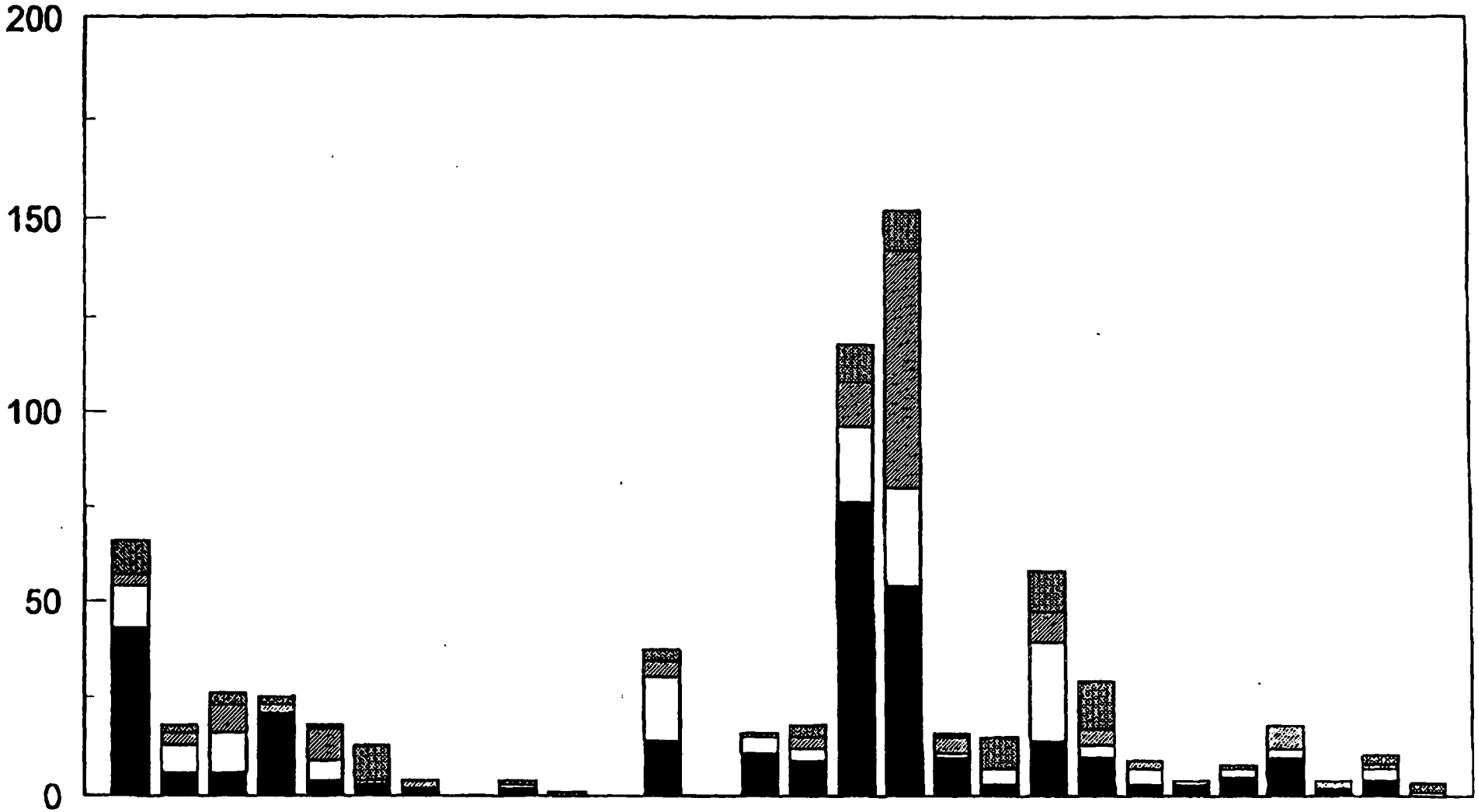


Figure 2c.

Figure 3.

Splittail Fall Midwater Trawl Abundance Index



Year	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Sep	43.0	6.0	6.0	21.0	4.0	3.0	2.0		2.0	0.0	0.0	14.0		11.0	9.0	76.0	54.0	10.0	3.0	14.0	10.0	3.0	3.0	5.0	10.0	2.0	4.2	0.0
Oct	11.0	7.0	10.0	0.0	5.0	0.0	0.0		1.0	0.0	0.0	16.0		4.0	3.0	20.0	26.0	1.0	4.0	25.0	3.0	4.0	1.0	2.0	2.0	0.0	2.8	1.0
Nov	3.0	3.0	7.0	2.0	8.0	1.0	2.0		0.0	1.0	0.0	4.0		1.0	3.0	12.0	62.0	4.0	0.0	8.0	4.0	2.0	0.0	1.0	6.0	2.0	1.2	0.0
Dec	9.0	2.0	3.0	2.0	1.0	9.0	0.0		1.0	0.0	0.0	3.0		0.0	3.0	10.0	10.0	1.0	8.0	11.0	12.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4
ANNUAL	66.0	18.0	26.0	25.0	18.0	13.0	4.0	0.0	4.0	1.0	0.0	37.0	0.0	16.0	18.0	118.0	152.0	16.0	15.0	58.0	29.0	9.0	4.0	8.0	18.0	4.0	10.6	3.4

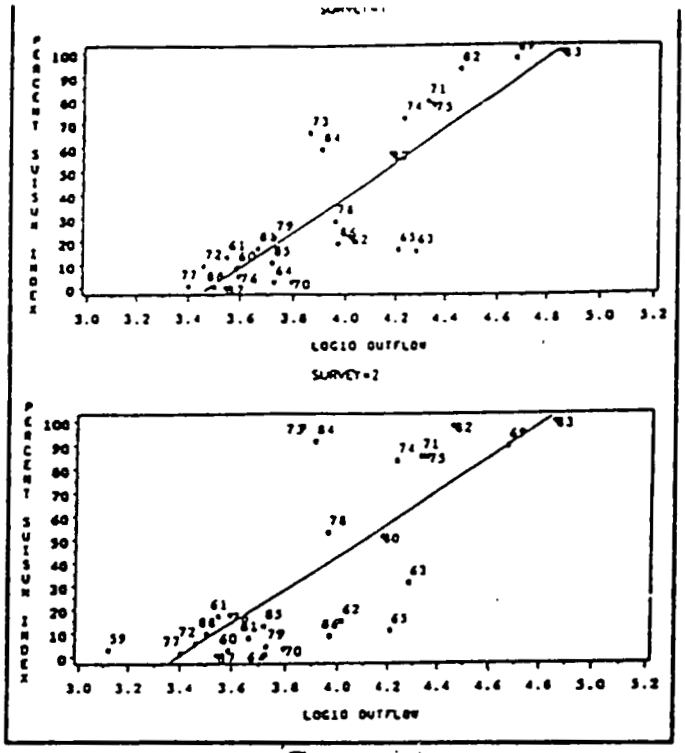


Figure 4a.
RELATIONSHIP BETWEEN THE PORTION OF DELTA SMELT POPULATION WEST OF THE DELTA AND LOG DELTA OUTFLOW DURING THE SURVEY MONTH FOR SUMMER TOW-NET SURVEY, 1959 TO 1988

For arcsine transformed percentages, $r^2 = 0.74$ for survey 1 and $r^2 = 0.55$ for survey 2.

Source: Sweetnam and Stevens 1993.

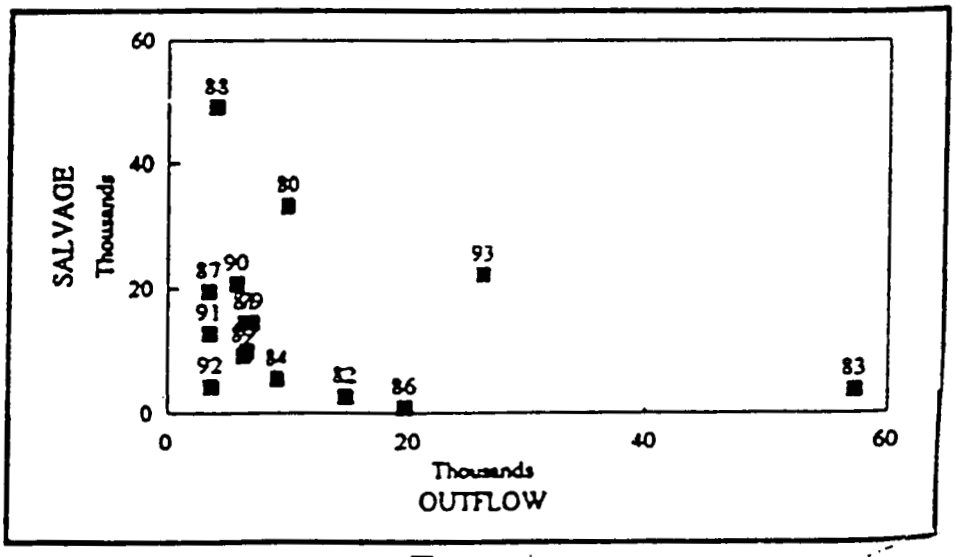


Figure 4b.
RELATIONSHIP BETWEEN EXPANDED SALVAGE OF JUVENILE DELTA SMELT AT SKINNER FISH FACILITY AND TOTAL DELTA OUTFLOW, 1979-1993

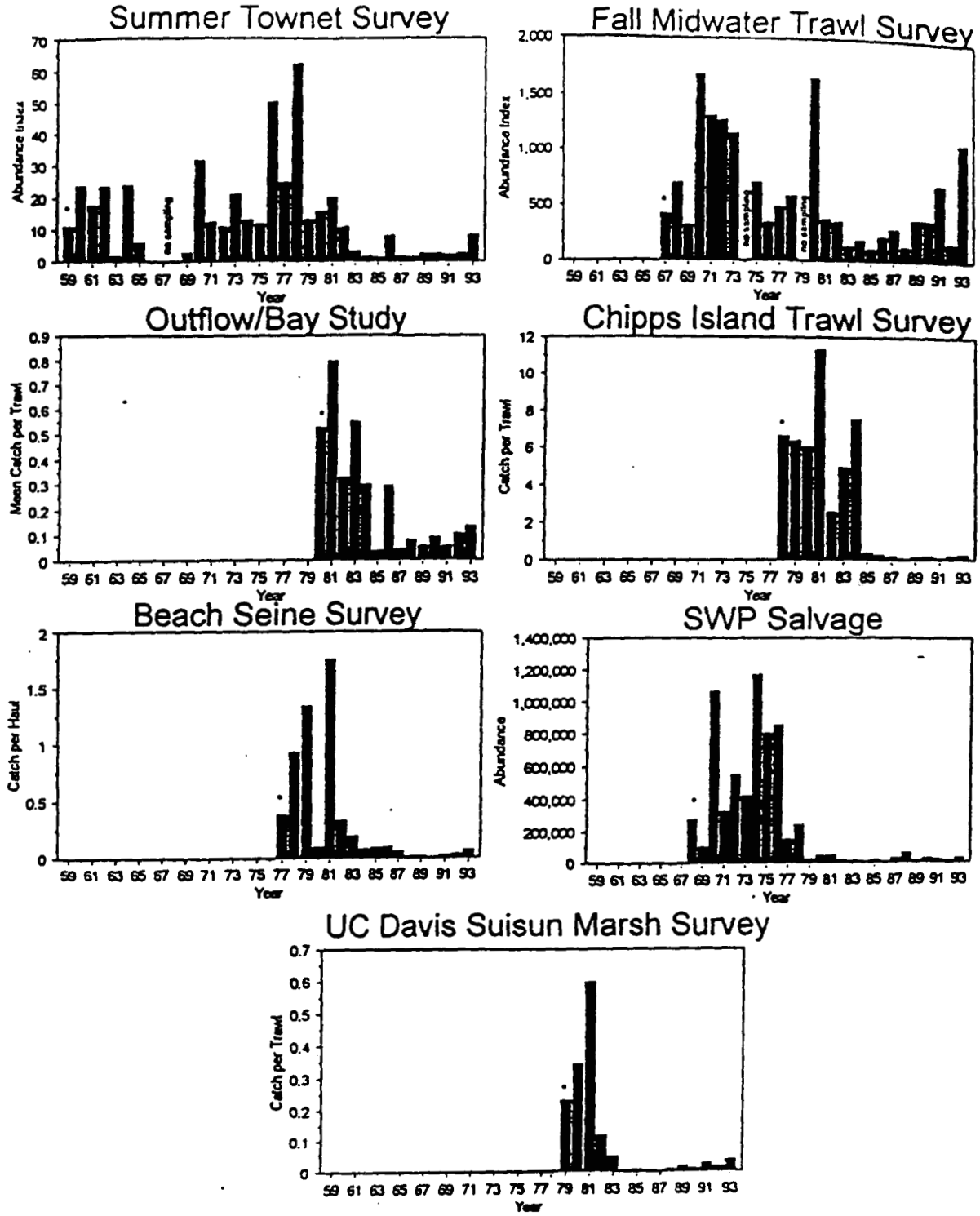


Figure 5.a

TRENDS IN DELTA SMELT POPULATIONS, AS INDEXED BY SEVEN INDEPENDENT SURVEYS

Note that not all surveys were conducted in all years shown.

Source: Department of Fish and Game, updated from Stevens *et al* 1990.

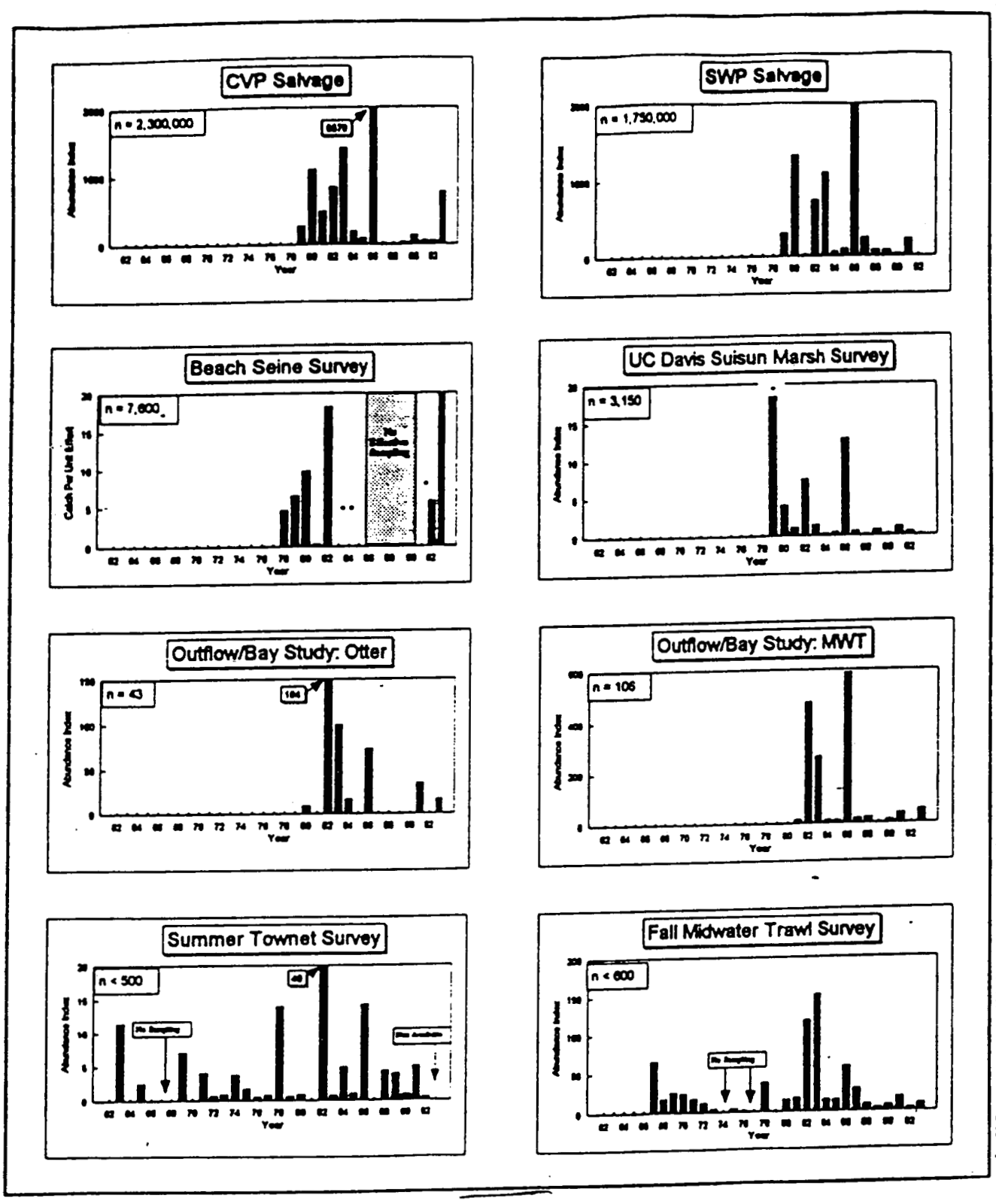


FIGURE 5b. Trends in Young-of-the-Year Splittail Abundance, as Indexed by Eight Independent Surveys

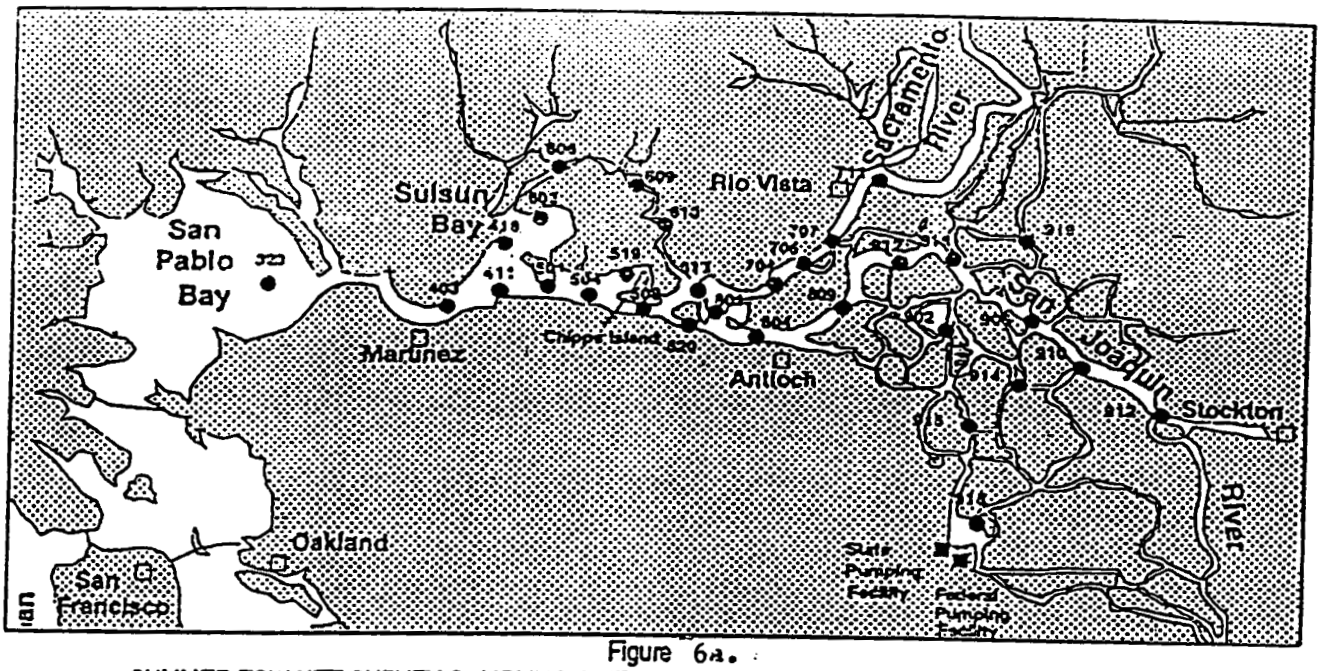


Figure 6a.

SUMMER TOW-NET SURVEY SAMPLING SITES IN THE SACRAMENTO-SAN JOAQUIN ESTUARY

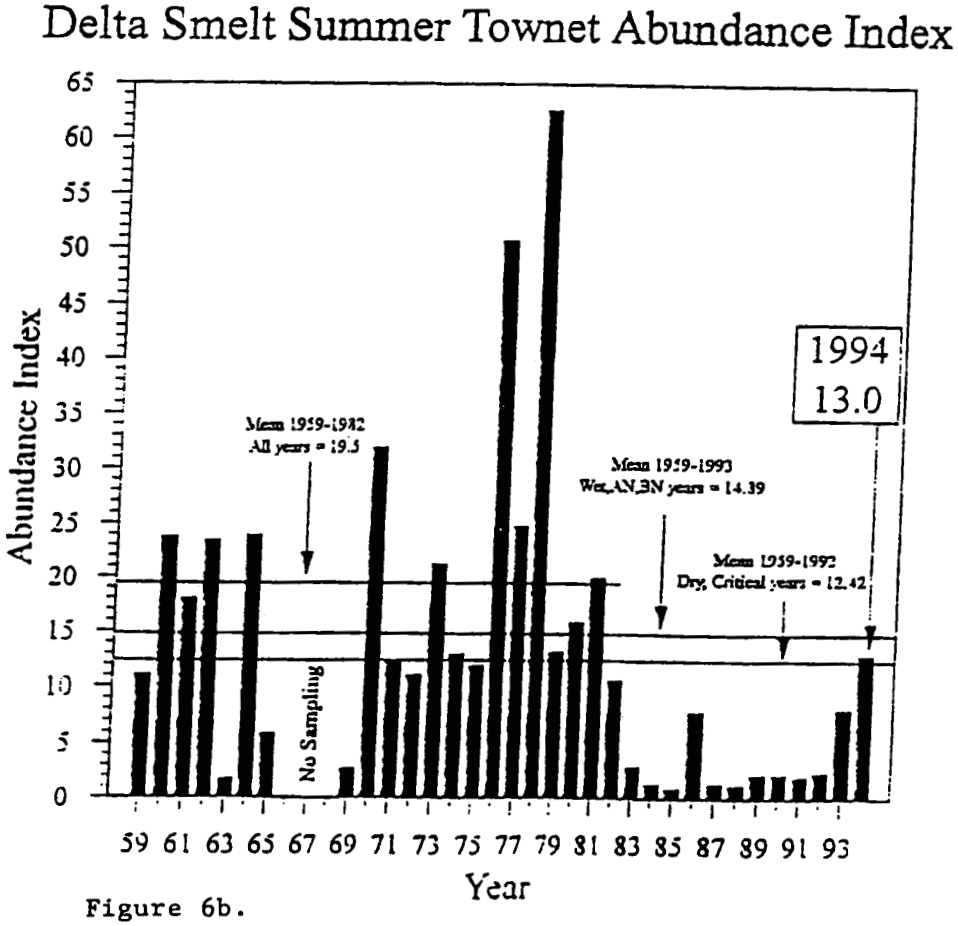


Figure 6b.

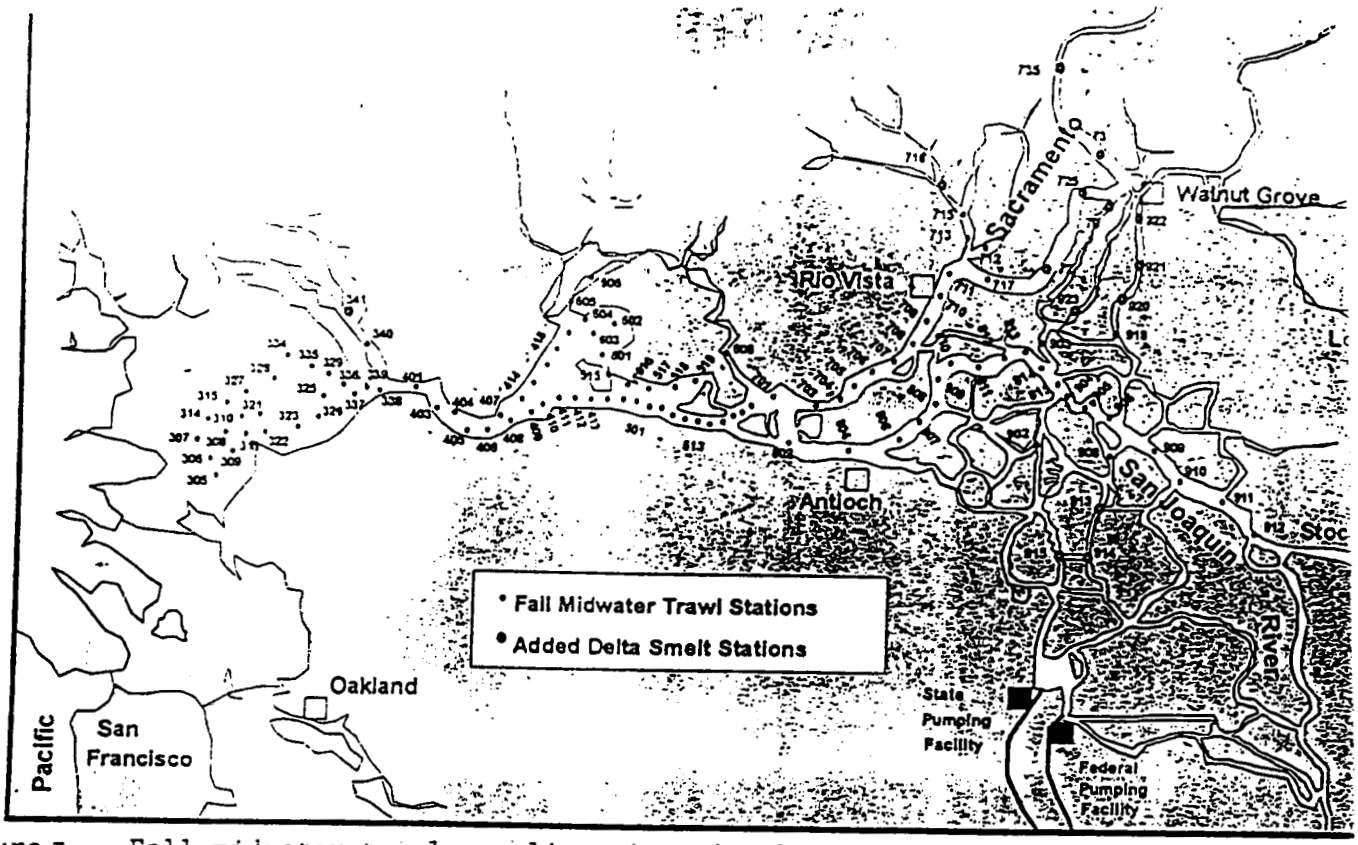
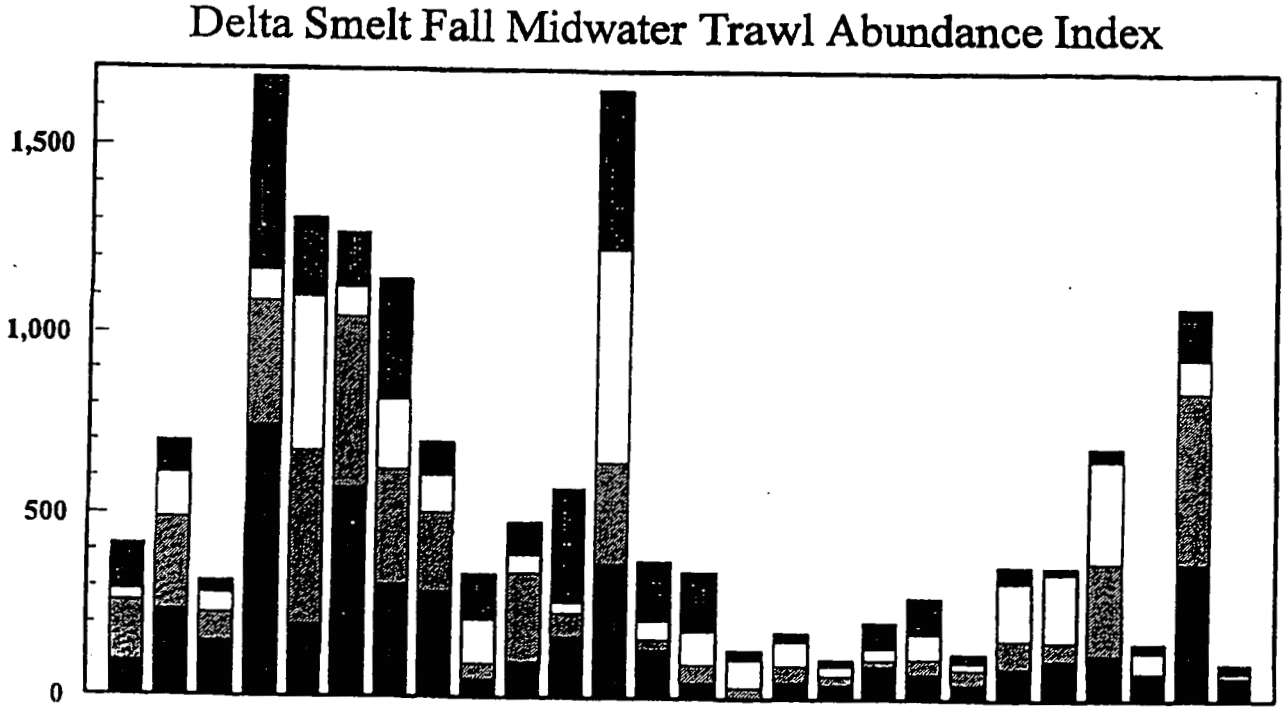


Figure 7a. Fall midwater trawl sampling sites in the Sacramento-San Joaquin Estuary.



Year	67	68	69	70	71	72	73	75	76	77	78	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Sept	93.4	234.7	149.8	741.8	597.4	571.6	307.9	280.5	48.8	97.5	166.9	368.8	132.4	44.8	2.1	47.0	40.7	92.1	71.0	41.6	88.1	100.5	125.9	71.5	374.6	84.0
Oct	165.2	253.4	78.8	340.0	472.1	472.0	312.4	213.7	42.2	242.5	84.7	273.7	27.3	47.4	28.0	43.7	23.8	15.1	39.6	40.7	74.7	49.7	249.2	3.5	470.0	11.8
Nov	31.1	119.9	55.3	83.1	427.7	91.1	198.2	102.3	120.9	51.7	31.1	566.2	54.2	91.8	77.9	68.6	28.0	33.8	69.5	19.1	157.9	187.6	278.0	57.5	94.4	8.6
Dec	125.2	88.7	33.7	509.9	207.7	142.3	327.4	91.3	125.0	87.8	308.9	422.9	181.1	162.0	24.3	24.2	16.9	70.9	100.1	24.8	45.5	16.8	35.0	24.3	138.4	17.8
Annual	414.9	696.7	315.6	1,677.8	1,305.9	1,267.0	1,145.9	687.8	337.9	479.5	571.6	1,651.4	375.0	346.0	132.3	183.5	109.2	211.9	280.2	126.2	366.2	353.4	689.1	156.8	1,078.4	101.2

Figure 7b. Fall midwater trawl index showing decline from 1981 to 1992. Note increases in 1991 and 1993.

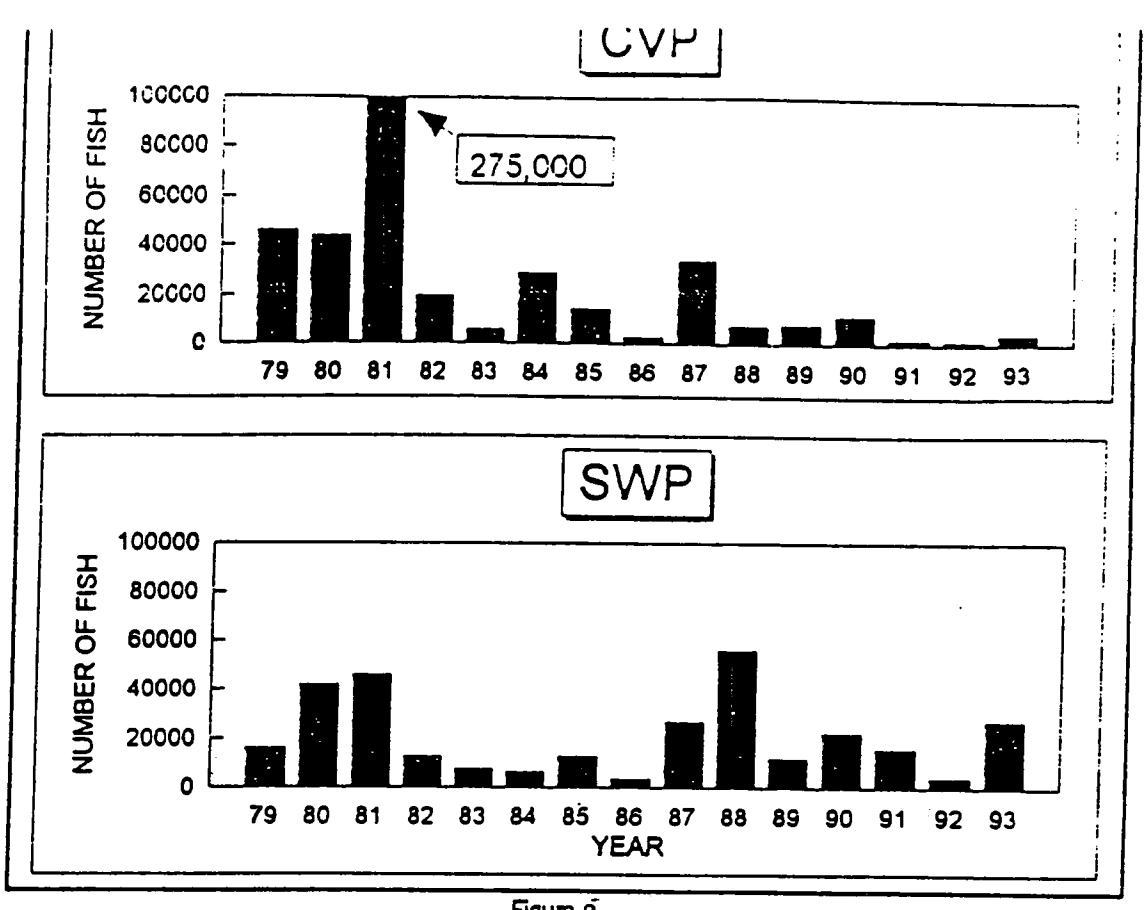


Figure 8.
ANNUAL SALVAGE ESTIMATES FOR DELTA SMELT AT THE CVP AND SWP FISH FACILITIES
Data before 1979 are not included because of identification problems described in the text.

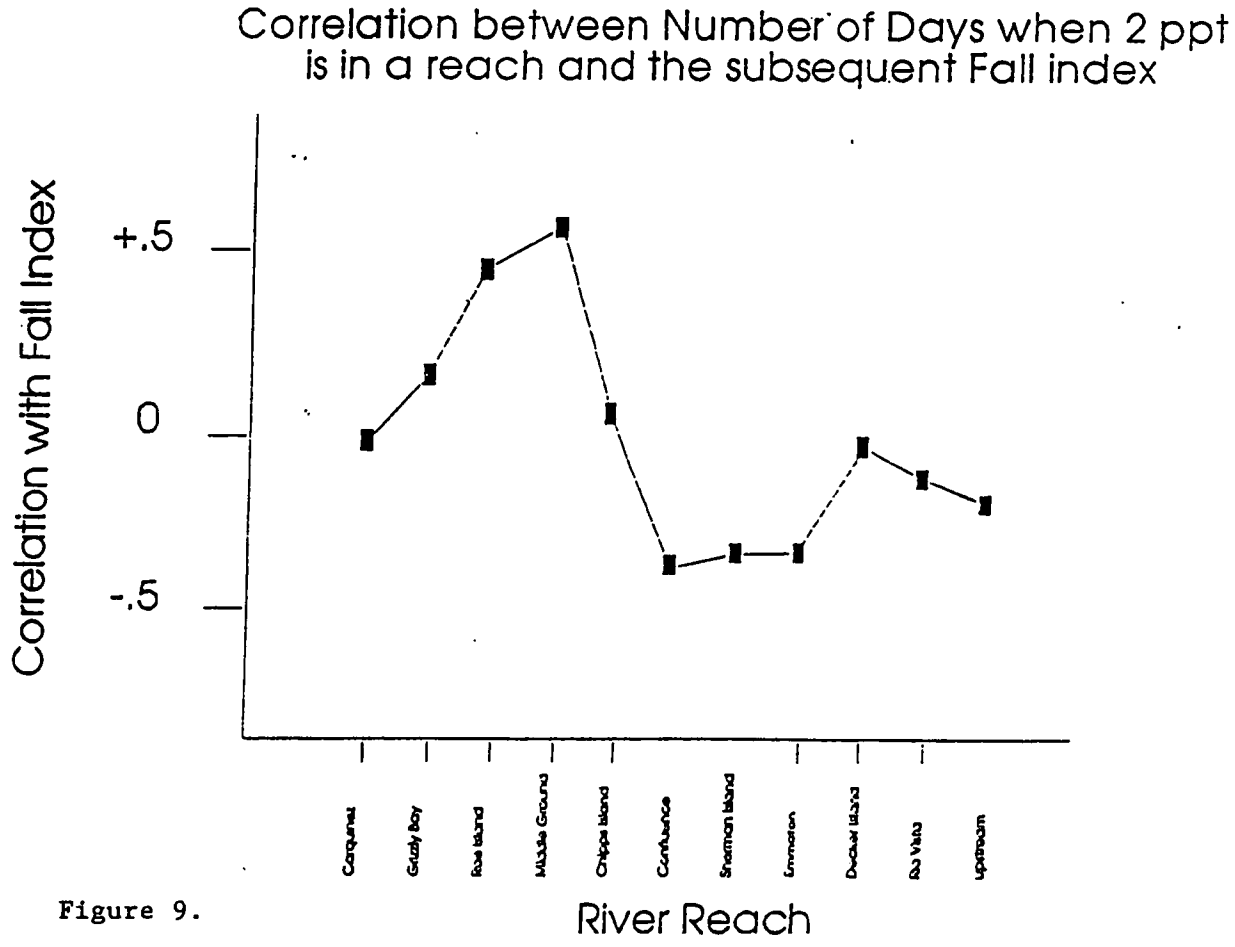


Figure 9.

December 15, 1994

Attachment A

PRINCIPLES FOR AGREEMENT ON BAY-DELTA STANDARDS BETWEEN THE STATE OF CALIFORNIA AND THE FEDERAL GOVERNMENT

Preamble

In order to provide ecosystem protection for the Bay-Delta Estuary, representatives of the State and Federal governments and urban, agricultural and environmental interests agree to the implementation of a Bay-Delta protection plan through the California State Water Resources Control Board (SWRCB) consistent with the following principles. These Principles describe changes to the California Urban Water Agency/Agricultural Water Users (CUWA/AG) proposal as the base case for Bay-Delta protections, which are intended to be in force for three years, at which time they may be revised.

Water Quality Standards and Operational Constraints

1. February Protections: Subject to the flexibility provisions described below, the exports during February shall be no greater than 35% of Delta inflow in years when the January Eight River Index is greater than 1.5 million acre feet (MAF). If this index is less than 1 MAF, the allowable exports will be 45% of Delta inflow. If this index is between 1 and 1.5 MAF, operational decisions will be made by the California Water Policy Council and Federal Ecosystem Directorate (CALFED) Coordination Group (Ops Group) as set forth in the Exhibit B of the Framework Agreement of June 1994. (The CALFED process is described in Attachment A.)

2. March through June Protections: During March through June, exports shall be no greater than 35% of Delta inflow, subject to the flexibility provisions described below.

3. July through January: During July through January exports shall be no greater than 65% of Delta inflow, subject to the flexibility provisions described below. Criteria for exercising this flexibility will be developed by the Ops Group.

4. X-2 Protection Measures: X-2 protection shall be based on the CUWA/AG proposal with the following adjustment. The Chipps Island requirement in February will be zero days when the Eight River Index in January is less than 0.8 MAF and 28 days when it is greater than 1.0 MAF with linear interpolation between 0.8 and 1.0 MAF. The requirement at the confluence shall be 150 days, except that when the May 1 90% forecast of the Sacramento River Index is less than 8.1 MAF, the maximum outflows for May and June shall be 4,000 cfs, with all other flow requirements removed. When the February index falls below 0.5 MAF, the requirement for March will be reviewed by the Ops Group. Additional refinements, which will involve no further water costs above those which are required for this paragraph may subsequently be made.

5. San Joaquin River Protection Measures: The protection measures will consist of the narrative standard and implementation provisions agreed to on December 12, 1994 (Attachment B). In addition, export limits during the April/May 30-day pulse flow period will be consistent with the CUWA/AG proposal. The parties agree to take immediate actions, as appropriate, to resolve the biological concerns related to the removal of the barrier and to provide adequate transport of fisheries consistent with the CALFED process

identified in Attachment C. If biological problems arise before the solution(s) can be implemented, resolution of these concerns shall be made within CALFED.

6. Additional Modifications to CUWA/AG Proposal: Daily export limits shall be based on the average Delta inflow over the preceding three days under balanced conditions as defined in the Coordinated Operation Agreement or fourteen days under unbalanced conditions.

During the period November to January, the Delta Cross Channel will be closed a maximum of 45 days. The timing and duration of the closures will be determined by the Ops Group.

During the period May 21 through June 15, the Delta Cross Channel may be rotated closed four days and open three days, including the weekend.

ESA FLEXIBILITY

1. No Additional Water Cost: Compliance with the take provisions of the biological opinions under the Federal Endangered Species Act (ESA) is intended to result in no additional loss of water supply annually within the limits of the water quality and operational requirements of these Principles. To implement this principle, the Ops Group will develop operational flexibility through adjustment of export limits.

2. Real Time Monitoring: To the maximum extent possible, real time monitoring will be used to make decisions regarding operational flexibility. CALFED commits to aggressively develop more reliable mechanisms for real time monitoring.

3. Additional Study Programs: CALFED commits to aggressively pursue study programs to develop information allowing better decisions to be made about managing the Estuary and its watershed.

4. Operational Flexibility: Decisions to exercise operational flexibility under the Ops Group process may increase or decrease water supplies in any month and must be based on best available data to ensure biological protection and be consistent with the Federal and State Endangered Species Acts.

5. Dispute Resolution: Any disputes within the Ops Group will be resolved by CALFED, as set forth in Attachment A.

CATEGORY III -- NON FLOW FACTORS

1. Principles: Implementation of Category III principles will be consistent with the principles set forth in Attachment C.

2. Financial Commitment: The water user community agrees to make available by February 15, 1995, an initial financial commitment of $10 million annually for the three years of these interim standards to fund Category III activities. Metropolitan Water District of Southern California (MWD) will guarantee this commitment. Subsequent financial agreements relative to Category III will credit this early commitment of funds to MWD's obligation.

INSTITUTIONAL AGREEMENTS

1. EPA Standards: Consistent with the Framework Agreement, EPA commits to withdraw Federal standards pursuant to the Clean Water Act when the SWRCB adopts a final plan consistent with these Principles.

2. Endangered Species Act

a. Limitation To Aquatic Species: These Principles apply only to aquatic species affected in the Bay-Delta Estuary.

b. Impacts of Additional Listings: This Plan, in conjunction with other Federal and State efforts, is intended to provide habitat protection sufficient for currently listed threatened and endangered species and to create conditions in the Bay-Delta Estuary that avoid the need for any additional listings during the next three years. To the extent that due to unforeseen circumstances in the Estuary, or to factors not addressed in the Plan, additional listings may be required, it is understood that protection of these species shall result in no additional water cost relative to the Bay-Delta protections embodied in the Plan and will, to the maximum extent possible, use the flexibility provided within Section 4(d) of the ESA. Additional water needs will be provided by the Federal government on a willing seller basis financed by Federal funds, not through additional regulatory re-allocations of water within the Bay-Delta.

c. Other Endangered Species Issues: To the extent consistent with the requirements of Federal and State ESAs, all other actions related to this Plan required to

implement the Acts as they affect the Bay-Delta, including but not limited to future biological opinions, incidental take statements, recovery plans, listing decisions and critical habitat designations, are intended to conform to these Principles, and decisions regarding ESA implementation will be made utilizing the CALFED process.

3. Central Valley Project Credits. All CVP water provided pursuant to these Principles shall be credited toward the CVP obligation under Section 3406 (b) (2) of the Central Valley Project Improvement Act to provide 800,000 acre feet of project yield for specified purposes.

4. Immediate Implementation:

a. Biological Opinions: It is agreed that there will be an immediate reconsultation on the biological opinions currently governing project operations with appropriate modifications by the end of 1994, to the extent practicable, to conform with the requirements of these Principles.

b. State Implementation: Consistent with the Framework Agreement, the SWRCB will finalize the Plan and immediately thereafter initiate water right proceedings to implement the adopted Plan. In implementing the Plan, the SWRCB will act in compliance with all provisions of law which may be applicable, including, but not limited to, the water rights priority system and the statutory protections for areas of origin.

STATE OF CALIFORNIA

Douglas B. Wheeler
Secretary, California Resources Agency

James M. Strock
Secretary for Environmental Protection
California Environmental Protection Agency

UNITED STATES OF AMERICA

Bruce Babbitt
Secretary of the Interior

Ronald H. Brown
Secretary of Commerce

Carol M. Browner
Administrator
Environmental Protection Agency

INTERESTED PARTIES

Walter J. Bishop
Contra Costa Water District
By: Greg Gartrell

Gary Bobker
The Bay Institute

Stephen K. Hall
Association of California
Water Agencies

John Krautkraemer
Environmental Defense Fund

Anson K. Moran
California Urban Water Agencies

Daniel G. Nelson
San Luis-Delta Mendota Water Authority

David R. Schuster
Kern County Water Agency and
Tulare Lake Water
Storage District

John R. Wodraska
Metropolitan Water District
of Southern California

INTERESTED PARTIES

David Fullerton
Natural Heritage Institute

Richard Golb
Northern California Water Association

Attachment A

The "CALFED process" referred to herein consists of the following steps:

Initial deliberations and decisions occur in the "Ops Group." "Ops Group" deliberations shall be conducted in consultation with water user, environmental and fishery representatives.

If the Ops Group disagrees on a particular issue, or if an Ops Group action requires additional water that it is believed cannot be made up within existing requirements, the issue will be decided by CALFED.

If CALFED cannot reach agreement, and if the issue involves listed species, a final decision will be made by the appropriate listing agency. Other issues not involving ESA will be decided by the appropriate regulatory or resources management agency.

Attachment B

Narrative Criteria for Chinook Salmon on the Sacramento and San Joaquin Rivers

Water quality conditions shall be maintained, together with other measures in the watershed, sufficient to achieve a doubling of production of chinook salmon, consistent with the mandates of State and Federal law.

Implementation Measures - San Joaquin River System

1. Not later than three years following adoption of this Plan, the SWRCB shall assign responsibility for the following flows, together with other measures in the watershed sufficient to meet the narrative criteria, in the San Joaquin River at Vernalis among the water right holders in the watershed. During this three-year period, the Bureau of Reclamation shall provide these flows, in accordance with the biological opinion for Delta smelt. These flows are interim flows and will be reevaluated as to timing and magnitude (up or down) within the next 3 years.

	Feb-June Flows (cfs)*	April-May pulse flows (cfs)*
C	710-1140	3110-3540
D	1420-2280	4020-4880
BN	1420-2280	4620-5480
AN	2130-3420	5730-7020
W	2130-3420	7330-8620

*higher flows provided when the 2 ppt isohaline (x2) is west of Chipps Island.

2. Install a barrier at the head of Old River during the April-May pulse flows.

3. During the 3-year period, decisions by the Federal Energy Regulatory Commission (FERC) or other regulatory orders may increase the contribution from other upstream water users into the Estuary. These additional flows will benefit the Delta resources. These flows will be recognized by ClubFED in its calculation of flows available to the Delta and be considered by the SWRCB in its assignment of responsibility among the water rights holders in the watershed during its water rights proceeding.

The SWRCB will initiate a water rights proceeding to assign responsibility for meeting these flow requirements. Actions of the NMFS and FWS in the FERC proceedings will be in furtherance of their authority and responsibility under the ESA. Such actions shall not be intended to assume the responsibility of the SWRCB to assign responsibility for meeting water quality standards in the Delta.

Sacramento River System - Additional Measures

Close the Delta Cross Channel gates from February-May 20, and during half of the period from May 20-June 15.

Attachment C

PRINCIPLES FOR IMPLEMENTATION OF CATEGORY III

The State and Federal governments and agricultural, urban and environmental interests are committed to the implementation and financing of "Category III" measures as an essential part of a comprehensive ecosystem protection plan for the Bay-Delta Estuary.

To achieve this objective we agree to the following principles:

1) Level of funding:

Category III activities are expected to require a financial commitment estimated to be $60 million a year.

2) Sources of funds:

It is anticipated that new sources of funds will be required to adequately finance Category III activities. A process for evaluating existing funding and possible reprioritization will be used to finance a portion of Category III activities. Additional funds will be secured through a combination of Federal and State appropriations, user fees, and other sources as required.

3) Monitoring:

It is further agreed that monitoring is a high priority in addition to the Category III elements, and has a high priority for separate funding.

4) Unscreened Diversions:

It is agreed that the highest priority Category III activity for funding is the screening of currently unscreened diversion points in the Bay-Delta watershed. An evaluation of the benefits of a screening program for listed species will be conducted immediately and used to improve listed species survival no later than during the 95/96 water year.

5) Consensus Process:

CUWA/Ag will work with CALFED and environmental interests in an open process to determine precise priorities and financial commitments for the implementation of all Category III elements. The CUWA/AG work plan currently being developed will be revised consistent with these Principles.

6) Deadline:

This process will be under the sponsorship or CUWA/AG, which commits to an open and collaborative approach involving CALFED and the environmental community. It is agreed that detailed implementation for these Principles will be finalized before publication of the final SWRCB standards, which is currently planned by March 31, 1995.