

Summary Report on the Transactions of the Smelt Working Group in Water Year 2018

Prepared by the San Francisco Bay-Delta Fish and Wildlife Office  
U.S. Fish and Wildlife Service, Sacramento, California  
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## Acronyms and Abbreviations

BDFWO	Bay-Delta Fish and Wildlife Office
BiOp	Central Valley Project/State Water Project Long-term Operations Biological Opinion
Board	State Water Resources Control Board
CDEC	California Data Exchange Center
cfs	cubic feet per second
CVP	Central Valley Project
DAT	Data Assessment Team
DFW	California Department of Fish and Wildlife
DWR	California Department of Water Resources
ESA	Endangered Species Act
FMWT	Fall Mid-Water Trawl
IEP	Interagency Ecological Program
ITL	Incidental Take Limit
NMFS	National Marine Fisheries Service
OMR	Old and Middle River Flow (combined, in cubic feet per second)
Project(s)	Central Valley Project and State Water Project
Reclamation	U.S. Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
Service	U.S. Fish and Wildlife Service
SKT	Spring Kodiak Trawl Survey
SLS	Smelt Larva Survey
STNS	Summer Towntnet Survey
SWG	Smelt Working Group
SWP	State Water Project
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WIIN Act	Water Infrastructure Improvements for the Nation Act
WOMT	Water Operations Management Team
WY	Water Year (October 1 – September 30)
X2	Distance from Golden Gate Bridge to the two parts per thousand isohaline

Cover photo credit: Steve Martarano, U. S. Fish and Wildlife Service

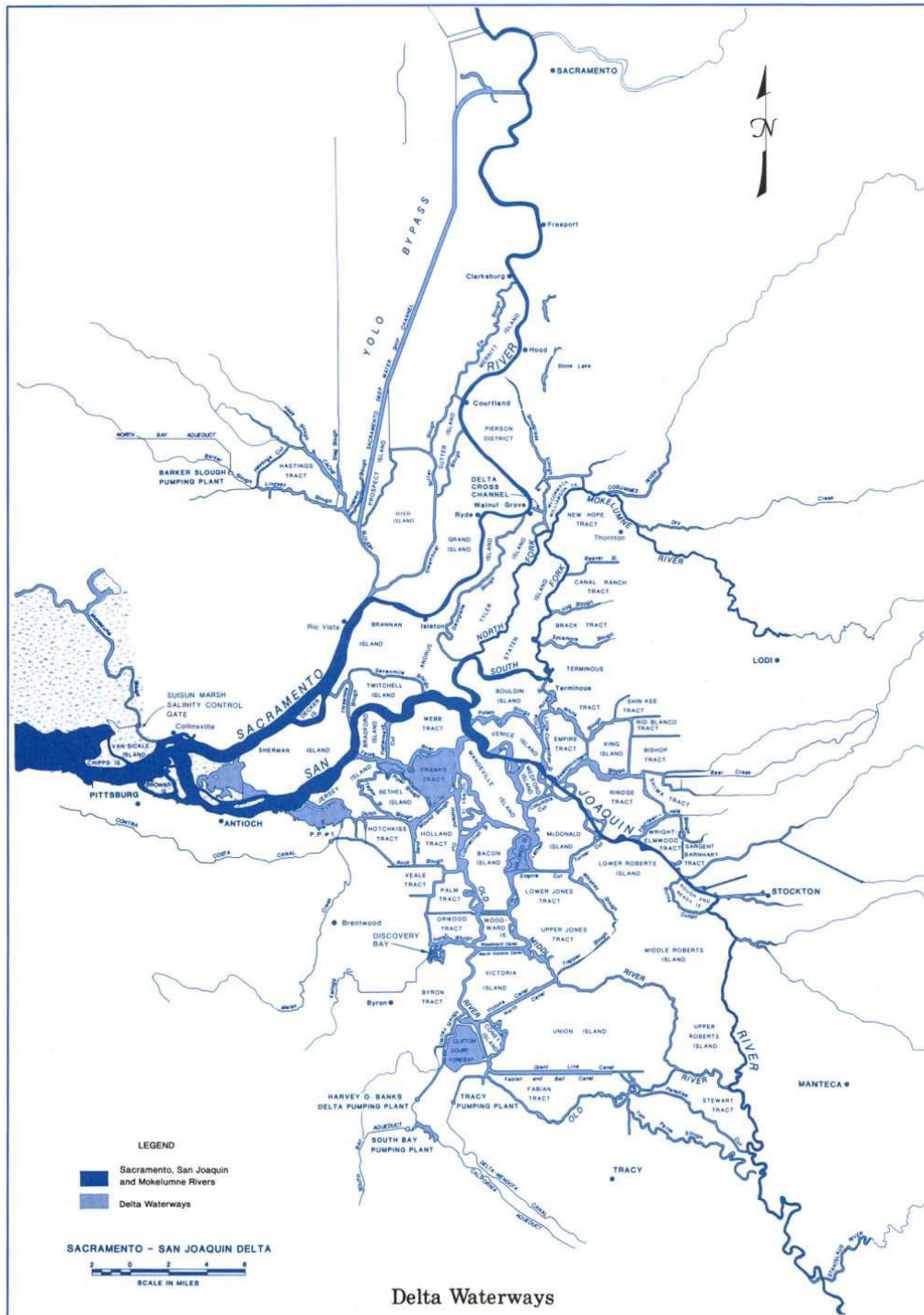


Figure 1. Map of the Sacramento-San Joaquin Delta

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- Attachment 2. February 22, 2013 memo describing corrected IT statement
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## **Introduction**

The San Francisco Bay-Delta Fish and Wildlife Office (BDFWO) has prepared this report to summarize the implementation of the water operations related sections of U.S. Fish and Wildlife Service's (Service) 2008 biological opinion on the Central Valley Project (CVP) and State Water Project (SWP) Long-term Operations (BiOp) in Water Year (WY) 2018. In addition to background information pertinent to implementation of the BiOp, this report provides a summary of the transactions of the Smelt Working Group (SWG) during WY 2018. The SWG is a technical team that evaluates meteorologic, hydrodynamic and biological information relevant to the entrainment risk of Delta Smelt (*Hypomesus transpacificus*) and Longfin Smelt (*Spirinchus thaleichthys*). The group uses that information to develop recommendations for consideration by the Service during implementation of the BiOp's Reasonable and Prudent Alternative (RPA) actions.

## **Chapter 1. Background**

### *1.1 Consultation Background*

The Federal Endangered Species Act (ESA) is primarily administered by the National Marine Fisheries Service (NMFS) and the Service. A biological opinion is the product of an interagency formal consultation under section 7 of the ESA, which provides that "each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat..."

In the December 2008 BiOp to the U.S. Bureau of Reclamation (Reclamation), the Service determined that the coordinated operations of the CVP and SWP, as proposed, would likely jeopardize the continued existence of the Delta Smelt and adversely modify its critical habitat. The BiOp identified three factors that affect the population resilience and long-term viability of Delta Smelt: 1) direct mortality associated with entrainment of pre-spawning adult Delta Smelt by CVP/SWP operations; 2) direct mortality of larval and early juvenile Delta Smelt associated with entrainment by CVP/SWP operations; and 3) indirect mortality and reduced fitness through reductions to and degradation of Delta habitats by CVP/SWP operations, with the fall as a particular concern (BiOp, p 325). The risk of entrainment increases with increased net reverse flows on the Old and Middle rivers (OMR), which are affected by Project export pumping. Reverse OMR flows are a proximal cause of entrainment; the position of the two-parts-per-thousand isohaline (termed "X2" and measured as kilometers from the Golden Gate Bridge) is a distal cause of entrainment. The upstream nature of the Delta Smelt winter spawning migration has the potential to bring Delta Smelt closer to the hydrologic influence of CVP/SWP operations from their summer rearing habitat in Suisun Bay. Because adults are poor swimmers, flows are a major factor in determining the distribution of Delta Smelt and their progeny. Depending on the population distribution, strong reverse OMR flows have the potential to entrain large numbers of Delta Smelt during the vulnerable migration and spawning period.

The Service's BiOp for Delta Smelt includes five RPA components to protect all Delta Smelt life stages and minimize impacts to critical habitat. The components affecting CVP and SWP operations that are implemented considering recommendations of the SWG are Components 1 and 2 (Table 1). Component 1, which consists of two Actions (1 and 2), protects adult Delta Smelt by reducing OMR flows to a range of -1,250 to -5,000 cubic feet per second (cfs) at times when the fish are most vulnerable to entrainment at Project diversions, which can occur as early as December and continue until spawning has begun. Component 2, which has a single Action (3), protects larval and juvenile Delta Smelt by reducing OMR flows to a range of -1,250 to -5,000 cfs at times when these life stages are vulnerable to entrainment. Component 2 is implemented from the onset of spawning to June 30, or when the water temperature at Clifton Court Forebay reaches 25° Celsius for three consecutive days, whichever occurs first. Components 1 and 2 are implemented through an adaptive decision process described in the BiOp. More specific information about the implementation of Actions 1 through 3 can be found in Chapter 2: Summary of SWG Discussion and Advice.

Table 1. Component 1 (Actions 1 and 2) and Component 2 (Action 3) of the BiOp’s RPA

		<b>Objective</b>	<b>Trigger</b>	<b>Timing</b>	<b>OMR Flows</b>
<b>Component 1</b>	<b>Action 1 (a)</b>	A fixed duration action to protect pre-spawning adult Delta Smelt from entrainment during the first flush and to provide advantageous hydrodynamic conditions early in the migration period.	SWG may recommend a start date	Dec 1 to Dec 20	-2,000 cfs
	<b>Action 1 (b)</b>		Turbidity or Salvage	Dec 20 to Action 2	
	<b>Action 2</b>	An action implemented using an adaptive process to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions	The end of Action 1 or (if Action 1 is not triggered), the SWG may recommend a start date	Immediately following Action 1	-1250 to -5000 cfs
<b>Component 2</b>	<b>Action 3</b>	Minimize the number of larval Delta Smelt entrained at the facilities by managing hydrodynamics in the central Delta flow levels pumping rates spanning a time sufficient for protection of larval Delta Smelt. The action is adaptive and flexible within appropriate constraints	Temperature or Onset of Spawning	Upon meeting trigger criteria	

*1.2 Adaptive Decision Process*

Real-time decision making to assist fishery management is a process that promotes flexible decision making to allow for adjustments as new data are collected, and as outcomes from management actions and other events become better understood. The adaptive decision process provides a way to implement the fish protection Actions in the NMFS and Service BiOps in real-time to minimize impacts to water deliveries. In addition, decisions regarding CVP and SWP operations to avoid and minimize adverse effects on listed species must consider factors that include public health, safety, water supply reliability, and water quality.

To facilitate these water operations decisions, the Project agencies and the Service, NMFS, and the California Department of Fish and Wildlife (DFW) have developed and refined a process to collect data, disseminate information, develop recommendations, make decisions, and provide transparency. This process consists of three types of groups that meet on a recurring basis. Management teams (e.g. the Water Operations Management Team [WOMT]) are made up of management staff from Reclamation, DWR, the Service, NMFS, DFW, the U.S. Environmental Protection Agency (USEPA) and the State Water Resources Control Board. Information teams (e.g. the Data Assessment Team [DAT] and the Delta Conditions Team [DCT]) gather and disseminate information among agencies and stakeholders. Fisheries and Operations Technical Teams (e.g. SWG) are made up of technical staff from state and Federal agencies. These teams review the most up-to-date information on fish status and Delta conditions, and develop recommendations that fishery agencies' management can use to determine what specific actions to take to protect listed species. In WY 2018, a regular Directors' Meeting was held to discuss water management decisions. Decisions on water operations were often coordinated at the directors' level, rather than through the WOMT process.

The process to identify actions for protection of listed species varies to some degree among species but follows this general outline: a Fisheries or Operations Technical Team compiles and assesses current information regarding species, such as stages of reproductive development, geographic distribution, relative abundance, and physical habitat conditions. The team provides a recommendation to the agency having the statutory obligation to enforce protection of the species in question. The agency's staff and management review the recommendation, and in cooperation with Reclamation and DWR, use it as a basis for developing a protective action to minimize adverse effects to listed species by the Projects. The fishery agency with the statutory authority makes the final determination on the specific protective action. The outcomes of any protective actions that are implemented are monitored and documented, and this information informs future recommended actions (BiOp, pp 27-29).

In 2016, Congress enacted the Water Infrastructure Improvements for the Nation Act (WIIN Act). Among other things, the Act provides for increased exports during storm events when criteria in the Act are met. As this legislative mandate is outside the process provided for in the BiOp, the Service did not seek advice from the SWG on potential implementation of the storm provisions of the WIIN Act.

### *1.3 Smelt Working Group*

The SWG is one of several fisheries technical teams that provide guidance and recommendations on resource management issues in the Central Valley. The SWG currently consists of representatives from the Service, NMFS, DFW, DWR, and Reclamation. The Service facilitates the group, and members are assigned by each participating agency.



The SWG evaluates meteorologic, hydrodynamic and biological information regarding Delta Smelt and develops recommendations for consideration by the Service. Since the Longfin Smelt became a California candidate species in 2008, the SWG has also developed recommendations for DFW to minimize adverse effects to Longfin Smelt. The SWG meets regularly from December through June, which is historically when Delta Smelt salvage has occurred. The SWG will also convene to review Longfin Smelt entrainment risk at the request of DFW (BiOp, pp 30-31).

When the data indicate that smelt may be at risk of entrainment, the SWG may recommend OMR flows to the Service that fall within the range specified in the RPA. Since 2015, the SWG has used the SWG Framework for Providing Advice to the Service (Attachment 1) if conditions are appropriate, as reflected in the meeting notes. The Service’s staff and managers review the recommendation and, if warranted, use it to develop a determination for modification of water operations that will minimize adverse effects caused by Project operations. This adaptive process continues throughout the winter and spring until smelt are no longer vulnerable to entrainment. SWG meeting notes are made public on the BDFWO website at <https://www.fws.gov/sfbaydelta/cvp-swp/SmeltWorkingGroup.htm>.

*1.4 Delta Smelt Monitoring Data*

Most research and monitoring activities in the Bay-Delta are coordinated through the Interagency Ecological Program (IEP). The IEP is led by state and Federal agencies, but also includes university and private partners. There are four monitoring programs that are implemented each year that the SWG relies most heavily upon, as well as two other additional surveys (Figure 2).

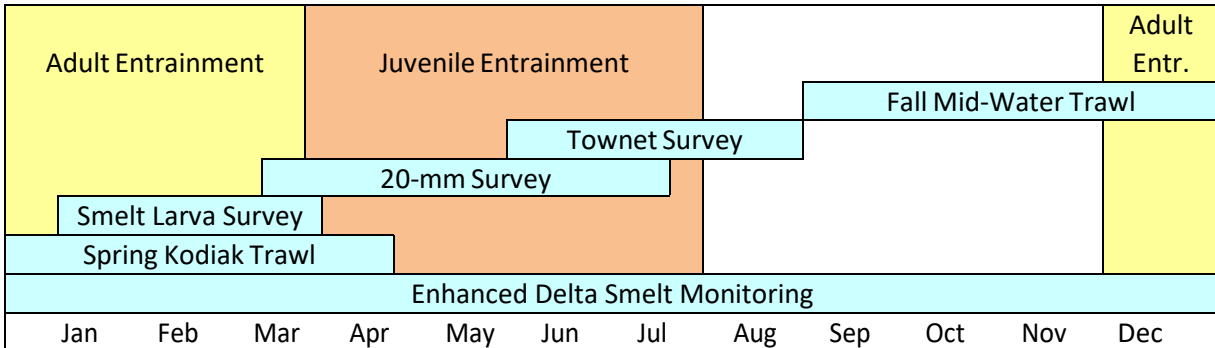


Figure 2. Approximate timetable of the surveys used to assess relative abundance and distribution of Delta Smelt

The Fall Mid-Water Trawl (FMWT) and the Summer Townet Survey (STNS) are the two longest-running IEP fish monitoring programs that are used to index Delta Smelt abundance. Two more recent surveys, the 20-mm survey and the Spring Kodiak Trawl (SKT) survey, were specifically designed to sample Delta Smelt relative abundance and distribution. Each of these four sampling programs targets a different life stage and collectively, they encompass the entire life cycle and a large majority of the species' distribution. Data from two additional surveys, the Smelt Larva Survey (SLS) and the Enhanced Delta Smelt Monitoring (EDSM) were also distributed and considered by the SWG. Data from the FMWT (September – December) are used to calculate a relative index of abundance, which is used in the BiOp to calculate incidental take for the Projects. Data from the SKT (January – May) are used to monitor distribution and spawning readiness of adults, data that factor heavily into SWG entrainment risk discussions. Data from the 20-mm survey (March – June) are used to monitor the distribution and relative abundance of post-larval Delta Smelt. Along with data from the Longfin Smelt-focused SLS, 20-mm data factor heavily into SWG entrainment risk discussions for larvae and small juveniles of both smelt species. Data from the STNS (June – August) are used to monitor the distribution and relative abundance of juvenile Delta Smelt. The EDSM program began in 2016 and was established to provide estimates of absolute abundance and real-time distribution for Delta Smelt using intensive year-round sampling. EDSM data was distributed to the SWG with the understanding that the program's sampling design would be subject to modification and review by the Service.

During the time that SWG had convened in WY 2018, the EDSM program was out in the field weekly from December 2017 to March 2018 using Kodiak trawling gear appropriate for adult recruitment. The program often encountered weeks in which no Delta Smelt were detected and overall catch numbers remained low, with 19 adult Delta Smelt caught in the 4-month window (December – March) for historical peak migration and spawning. While the SWG reviewed EDSM data on a weekly basis, the low catch numbers made it difficult to produce a stable estimate of abundance throughout the winter season. During this time, abundance estimates ranged from approximately 1,000 individuals to 38,000 individuals, depending on weekly catch. The SWG did not rely heavily on these estimates to inform their recommendations to the Service. In April and May, the EDSM program went on hiatus in order to investigate possible improvements in sampling design and other program aspects based on the recommendations from the Long-Term Operations Biological Opinions Biennial Science Review's Independent Review Panel.

Both the state and Federal water Projects utilize behavioral-barrier fish screens designed to route fish away from export water and into a fish salvage facility where they are collected, counted, and trucked to a release site in the Delta. The salvage process was designed for young Chinook Salmon and Striped Bass; Delta Smelt that enter the facility are thought to not survive the release process and are counted as mortality. The fish salvage facilities report Delta Smelt and Longfin Smelt salvage to the Service and publish the data on a public website. (BiOp, pp 143-145, <http://www.usbr.gov/mp/cvo/>). The Service and DFW use the salvage data as indices of entrainment and as part of their incidental take calculations.

## **Chapter 2. Summary of SWG Discussion and Advice in WY 2018**

The SWG began distributing data and holding regular meetings beginning December 4, 2017; the last meeting was on June 18, 2018. At least one representative from each agency was able to participate on most calls.

Weekly discussion topics included fish salvage at the Projects' fish salvage facilities, DFW and Service biological field surveys, Delta hydrodynamics, current and anticipated weather, turbidity distribution, expected Project operations for the coming week, status of NMFS biological opinion actions, and risk of entrainment for Delta Smelt and Longfin Smelt. Periodic discussion topics included applicable sections of the Service BiOp for Delta Smelt, updates regarding EDSM, historical survey results, historical Delta flow conditions, water quality requirements, Delta turbidity modeling results, and the status of temporary barriers in the Delta.

Several topics were frequently discussed at SWG meetings in WY 2018. Some are briefly summarized here; a full description can be found online within the SWG notes (<https://www.fws.gov/sfbaydelta/cvp-swp/SmeltWorkingGroup.htm>).

As described in Section 1.3, the SWG provides advice to the Service on the risk of entrainment to Delta Smelt. In WY 2018, members regularly discussed the ongoing difficulty of assessing risk given the impact of near record low relative abundance of Delta Smelt on the ability to assess the species' true distribution. This issue was regularly mentioned at SWG meetings and was often reflected in their advice to the Service.

In assessing the risk of entrainment, which is tied directly to species distribution, SWG also discussed the low reliability of the salvage data, which is also linked to Delta Smelt abundance (salvage was rare). Although there was no fixed SWG position, there was a general perception that the salvage data may not have been as reliable an indicator of Delta Smelt entrainment in WY 2018 as these data were in past years when abundance was higher.

### *2.1 Component 1: Adult Entrainment*

#### *Adult Incidental Take*

The adult Delta Smelt incidental take authorized in the BiOp is based on historical salvage from the Projects scaled to the FMWT index to account for the influence of fish abundance (BiOp, pp 285-288). The FMWT index for Delta Smelt for 2017, which applies to WY 2018, was 2. Therefore, using the equation in the BiOp with the corrections described in both the February 22, 2013, and December 23, 2015 Service memos (Attachment 2 and Attachment 3), authorized incidental take for adult Delta Smelt in WY 2018 was identified in the January 4, 2018 Service memo as 16 fish for both Projects; the Concern Level was 12 fish (Attachment 4). During WY 2018, one salvage event occurred on March 9, 2018 in which four adult delta smelt were salvaged at the Tracy Fish Collection Facility. No other Delta Smelt were salvaged after this date at either facility. The cumulative salvage for the year was four Delta Smelt, or 25% of the authorized incidental take.

### *Action 1*

Adult Delta Smelt entrainment generally occurs when pre-spawning fish enter the southern Delta following the first winter pulse of precipitation in the watershed. This event is usually characterized by the first substantial flow increase of the winter and is generally coincident with an increase in turbidity, also referred to as “first flush”. Flow and turbidity are believed to serve as cues for adult Delta Smelt migration.

Action 1 requires OMR flow be managed to no more negative than -2,000 cfs for 14 days. This decrease in reverse OMR flow results in the draw of little to no Sacramento River water into the central and southern Delta and typically allows some portion of the San Joaquin River flow to reach the Sacramento-San Joaquin river confluence. Action 1 is intended to decrease the risk of entrainment of pre-spawning adult Delta Smelt by limiting the draw of Sacramento River water into Old and Middle rivers during a time of rapid fish movement. Additionally, Action 1 is intended to decrease the risk of entrainment of larval and juvenile Delta Smelt later in the season by allowing environmental cues to encourage more individuals to spawn in locations where larval entrainment risk is very low.

In WY 2018, the SWG monitored turbidity and Delta flows as indicators of the occurrence of the first winter pulse flow in an effort to assess adult Delta Smelt entrainment risk. The SWG also monitored salvage and SKT and EDSM survey results as indicators of relative species abundance and distribution (given the limitation to this data discussed previously). Conditions in December remained relatively dry with minor precipitation events occurring in early winter. On January 1, Action 4.2.3 of the NMFS BiOp began, limiting OMR flow to be no more negative than -5,000 cfs for salmonid protections. Due to consensus that risk to Delta Smelt remained low during this time, the SWG did not recommend implementation of Action 1 of the Service’s BiOp.

### *Action 2*

Action 2 encompasses the period when OMR prescriptions (-1,250 to -5,000 cfs) for adult Delta Smelt are required to protect parental stock until the approximate onset of reproduction; however, such controls may be relaxed if the main pulse of fish migration has already occurred and adults are maintaining position near selected spawning areas. Action 2 may also be needed to extend protections, consistent with Action 1, in years when the spawning migration period is longer or due to changing environmental conditions. Because conditions are highly variable both between and within years, the SWG monitors environmental conditions including turbidity, flow, and water temperature, as well as relative fish abundance, distribution and spawning readiness (which is monitored by the SKT), and salvage at the export facilities, to assess the risk of entrainment. Additionally, Action 2 and its associated flow protections may be temporarily suspended if the 3-day flow average is greater than or equal to 90,000 cfs in the Sacramento River at Rio Vista and 10,000 cfs in the San Joaquin River at Vernalis. Action 2 comes back into effect after the flow conditions have abated. The RPA describes a variety of potential recommendations, according to the assessed level of risk (BiOp, pp 354-356).

Action 2 does not have any environmental or calendar-based triggers associated with the start of implementation. Due to continuing moderate flow conditions in mid-January, risk to Delta Smelt remained low and Action 2 was not implemented by the Service in WY 2018, nor were any suspension

criteria exceeded based on flows in the Sacramento or San Joaquin rivers. Details on each Working Group meeting can be found at: <https://www.fws.gov/sfbaydelta/cvp-swp/SmeltWorkingGroup.htm>.

Among other data, the SWG reviews catch data from the Spring Kodiak Trawl survey in assessing risk of entrainment of adult Delta Smelt. Results from the SKT from 2018 indicated near record-low abundance. The very low survey catch was of concern to the SWG, as was the near record-low annual abundance index of 2.1 (Figure 3). Please refer to SWG notes for detailed discussion regarding the survey results (<https://www.fws.gov/sfbaydelta/cvp-swp/SmeltWorkingGroup.htm>).

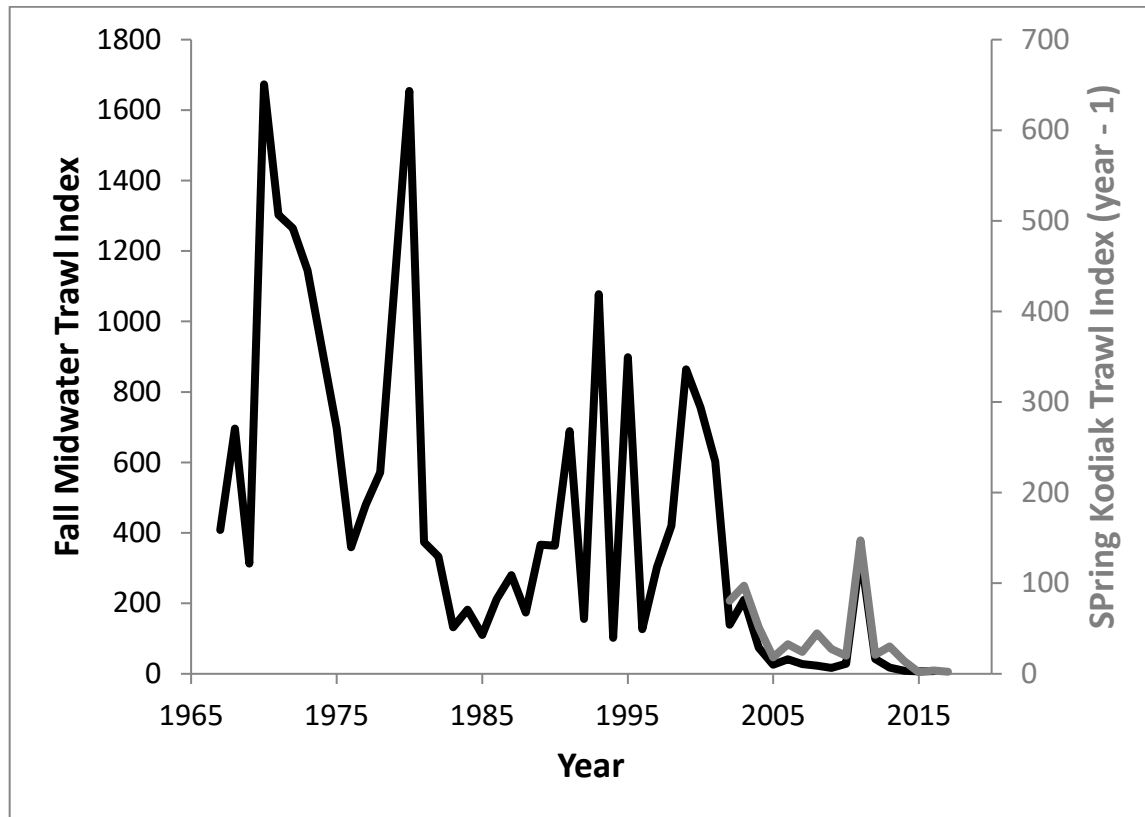


Figure 3. Time series of the California Department of Fish and Wildlife’s Fall Midwater Trawl Survey 1967-2017 (black line; primary y-axis) and Spring Kodiak Trawl Survey 2003-2018 (gray line; secondary y-axis) abundance indices for Delta Smelt.

## 2.2 Component 2: Juvenile Entrainment

### *Juvenile Incidental Take*

Similar to the adult take calculation, incidental take for juvenile Delta Smelt is based upon historic observed salvage and relative abundance (BiOp, pp 289-293). Because of the historical difficulty in identifying larval smelts to species, only Delta Smelt greater than 20 mm in length are counted in salvage. However, based on any combination of observations in the field (typically appropriate spawning temperatures) that indicate spawning may be underway, the Tracy Fish Collection Facility and the Skinner Fish Facility will initiate larval sampling to provide an early indicator of

possible incoming salvage events. Juvenile take is estimated by month for the April-through-July period and summed for a seasonal total. Authorized juvenile take for WY 2018 was 112 with a corresponding concern level of 75. There were no larval or juvenile salvage events recorded at either facility for WY 2018.

### *Action 3.*

Implementation of Action 3 begins when the SWG determines that spawning has begun and larval fish are present in the Delta, following the guidance in the BiOp. Given current low abundance, it is likely that water temperature is now a more reliable early indicator of the presence of larvae than survey sampling. The SWG monitors water temperature, adult spawning condition (i.e., gonad development based on Delta Smelt collected in field surveys or at the salvage facilities), larval occurrence and distribution to assess the relative risk of entrainment. Action 3 concludes when Delta water temperatures reach a daily average of 25° Celsius at Clifton Court Forebay for three consecutive days, or June 30, whichever occurs first (BiOp pp 357- 359).

Action 3 implementation was triggered on February 4 by the temperature criterion when early warming temperatures in the Delta reached 12°C, which is considered the temperature threshold appropriate for Delta Smelt spawning to begin. While Action 3 does not have any temporary suspension criteria, OMR flows during the period of April 11 to May 7 were frequently positive and outside of the range prescribed in the BiOp. During this time, the SWG met intermittently and did not provide any recommendation for operations under Action 3.

In WY 2018, the SWG monitored Delta hydrology and juvenile distribution as indicated by the Smelt Larval Survey (SLS) and 20-mm Survey. No Delta Smelt were collected until SLS survey #6 (the final SLS of the year), in which Delta Smelt were observed in Suisun Bay and the confluence of the Sacramento and San Joaquin rivers. The timing confirmed that early spring hatching had occurred. After the SLS ended, Delta Smelt larvae were detected in the first 3 surveys of the 20-mm Survey in March and early April. The survey caught zero Delta Smelt in May and June, during which the average length of young-of-the-year would typically reach 20-mm. The first Delta Smelt greater than 20-mm in length detected by the survey were observed in the last 20-mm survey of the season in July. The majority of the catch occurred in the Cache Slough system, Suisun Bay, and the confluence area. Catches of Delta Smelt for both the 20-mm Survey and STNS were low. The index for the 20-mm survey was incalculable for Delta Smelt due to low catches and the STN Delta Smelt index was zero. The annual abundance indices reflect a continued decline in abundance for the species (Figure 4).

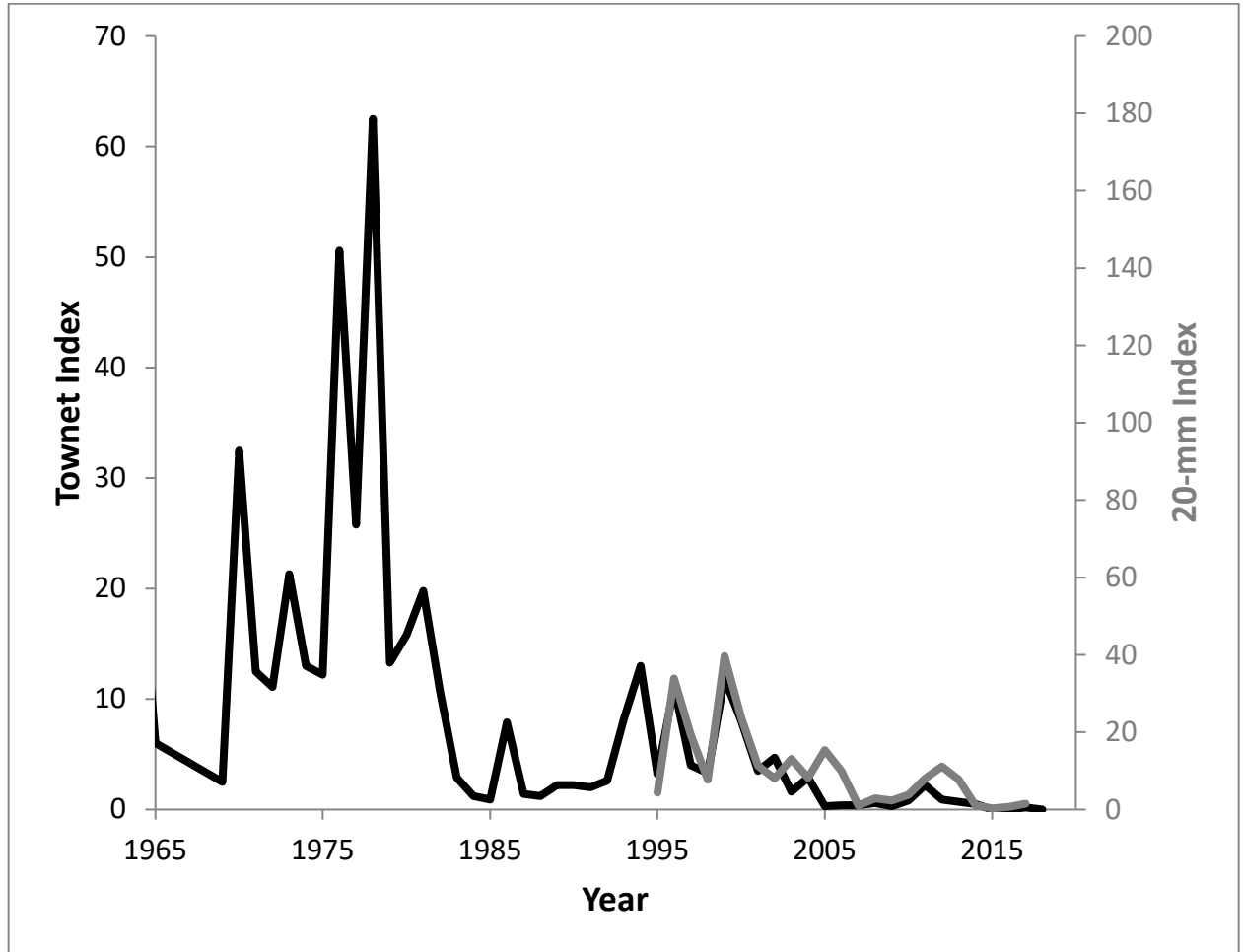


Figure 4. Time series of the California Department of Fish and Wildlife’s Summer Townet Survey 1965-2018 (black line; primary y-axis) and 20-mm Survey 1995-2018 (gray line; secondary y-axis) abundance indices for Delta Smelt.

On June 26, 2018, the temperature offramp criterion for juvenile Delta Smelt entrainment protection under Action 3 was satisfied. Therefore, the June 18, 2018, SWG meeting was the last meeting of WY 2018.

## Chapter 3. Water Operations Summary for Water Year 2018

Hydrologic year type for the Sacramento River and the San Joaquin River basins were both classified as Below Normal in WY 2018.

The Regional Directors for the USFWS, DWR, NMFS, DFW and Reclamation held semi-regular coordination calls throughout the season which resulted in changes to export pumping rates. In early December, system capacity and outflow requirements under D-1641 both played roles as the limiting factor on export levels. While there were minor precipitation events in the early winter months, conditions were largely dry throughout December. The first major storm event of the season occurred the week after NMFS RPA action 4.2.3 (OMR management) began on January 1; this action continued to control operations during the remainder of January. In mid-February, water quality standards in D-1641 restricted operations to the lowest export levels of the water year in order to meet outflow requirements. The largest storm event of the season occurred in late March and led to the highest pumping rates of the season, with exports nearing the combined maximum permitted capacity of the facilities. Beginning in April, NMFS RPA action 4.2.1 (San Joaquin River inflow to export ratio) controlled exports and continued through the end of May. The limiting factor transitioned to outflow requirements in D-1641 through June and through the end of the smelt entrainment season. On June 26, 2018, the temperature off-ramp criterion for RPA Component 2, Action 3 was satisfied. Descriptions of what factors were controlling pumping in any given week are described in the Working Group notes.

Please refer to Figure 5 for sections 3.1 through 3.3.

### *3.1 Export Pumping*

The combined Projects' export rate averaged approximately 8,200 cfs in December, 6,300 cfs in January, 3,900 cfs in February, 6,400 cfs in March, 3,700 cfs in April, 2,500 cfs in May, and 4,000 cfs in June. Constraints on export levels ranged from facility conveyance capacity, low water demands, ESA species protective actions, and D-1641 standards.

### *3.2 River Flows*

WY 2018 presented a modest precipitation year for the Sacramento Valley. The largest storm of the season occurred in late March, resulting in peak river flows for the water year. Sacramento River flow at Freeport peaked at approximately 78,700 cfs on April 9, but flows for the season remained generally moderate at below 20,000 cfs. The San Joaquin River peaked at approximately 10,000 cfs on April 8, but remained at around 2,000 cfs for the December through June period.

### *3.3 Delta Outflow and Winter Pulse*

Delta outflow generally parallels Sacramento River flows, depending on the rainfall and snowfall patterns throughout the water year. Delta outflow peaked on April 10 at 113,500 cfs and dropped quickly in the days following.



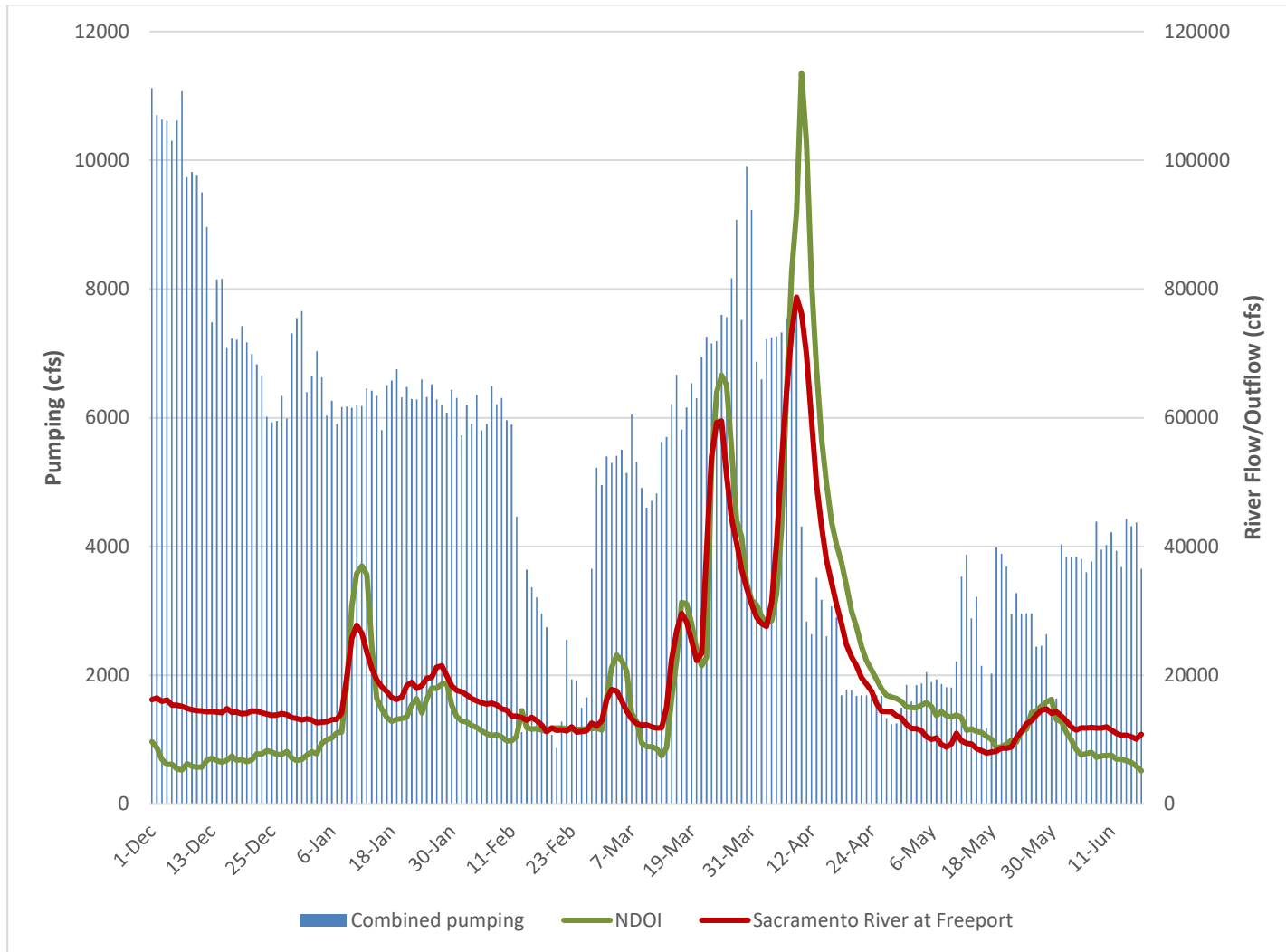


Figure 5. Export pumping, river flow, and outflow levels in WY 2018

Attachment 1. December 1, 2015, SWG Framework for Providing  
Advice to the Service

### **Smelt Working Group Framework for providing advice to the Service**

The U.S. Fish and Wildlife Service (Service) is requesting that the Smelt Working Group (SWG) provide delta smelt entrainment protection advice in a new format, and has supplied a framework for how to provide the additional information. In summary, the Service's SWG advice framework provides structure for assessing entrainment risk and describing salvage trend, given current conditions. The Service will incorporate the SWG's advice in its determination with regard to implementation of the biological opinion (BiOp).

As it has in the past, the SWG will continue to compile and interpret real-time information regarding delta and longfin smelt. The SWG will submit its advice in writing to the Service and California Department of Fish and Wildlife if the SWG agrees, based on a review of relevant information and an internal assessment of risk, that the level of entrainment risk may warrant a less negative OMR flow to reduce smelt entrainment under RPA Components 1 and 2.

#### **PROCESS**

- The SWG will, as before, review real-time biological data as they pertain to delta smelt entrainment risk as defined in RPA 1 and 2, including population status, relative abundance and distribution, sexual maturation, Delta conditions, cumulative salvage, and current operations. The SWG will also consider historic operations, hydrology and resultant smelt take in interpreting the current biological data and assessing level of entrainment risk.
- The SWG will provide a delta smelt entrainment risk assessment to the Service, which may include advice on reducing entrainment risk through operational changes as described below:
- Individual risk narratives for the following OMR flow ranges:
  - -1250 to -2000 cfs
  - -2000 to -3500 cfs
  - -3500 to -5000 cfs
- For each OMR range:
  - What effect would operations in that flow range have on the risk factors that are currently important? Examples of the currently important risk factors are Delta conditions, population status, relative abundance and distribution, sexual maturation, and season (ie. life history stage)
  - What effect would operations in that range have on salvage, relative to recent salvage?
  - What "unknowns" (e.g. weather) might affect risk for operations in this range?
  - If operations in that range would result in increased risk of salvage, how long would that risk persist if average OMR remained within the range?

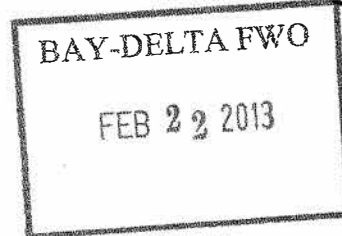
- What do you think operations at this level would achieve? If you expect salvage rate to change over time if operations are held at the level you recommend, what is your prediction? What “unknowns” (e.g. predicted weather/river discharge events, with time horizon) might affect risk for operations at this OMR level?

Attachment 2. February 22, 2013, Memo Describing Corrected  
Incidental Take Statement



## United States Department of the Interior

**FISH AND WILDLIFE SERVICE**  
San Francisco Bay-Delta Fish and Wildlife Office  
650 Capitol Mall, Suite 8-300  
Sacramento, California 95814



### Memorandum

**To:** Area Manager, Bay-Delta Office, Bureau of Reclamation, Sacramento, California

**From:** Field Supervisor, Bay-Delta Fish and Wildlife Office, Fish and Wildlife Service, Sacramento, California *Mike Chander*

**Subject:** Corrected Delta Smelt Incidental Take Statement for the 2008 Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project and State Water Project

With this memorandum, the U.S. Fish and Wildlife Service (Service) provides to the Bureau of Reclamation corrections to the adult delta smelt incidental take statement and larval-juvenile incidental take statement for the Service's 2008 Biological Opinion (BiOp) for the Proposed Coordinated Operations of the Central Valley Project and State Water Project (Service File No. 81420-2008-F-1481-5). These corrections are being made during the reinitiation period.

In the 2008 BiOp, the Service calculated expected salvage levels due to project operations under the Reasonable and Prudent Alternative, using historic salvage information from years when similar water operations were in effect (2006 to 2008; see page 386 of the BiOp). We calculated a Cumulative Salvage Index (CSI) for each of the three years by dividing observed salvage by the previous fall midwater trawl index (FMWT). We then calculated an average CSI for the 2006-2008 period. Estimated salvage was expected to vary as a function of the population, therefore, take is calculated using a multiplier of the average CSI \* the FMWT for each water year.

On February 15, 2013, the Service received notification that the salvage numbers used in the BiOp appeared to be incorrect. In the BiOp, 2006 adult salvage was reported as 216, 2007 salvage was 36, and 2008 salvage was 352. The BiOp calculation presented on page 386 uses these numbers to derive a CSI of 7.25. Using this CSI, the annual incidental take of adult delta smelt for water year (WY) 2013 is:

Original WY 2013 adult incidental take is  $7.25 * 42 = 305$  delta smelt

After evaluating this information, we have determined that, in fact, we used incorrect salvage numbers for 2006 and 2008 in the calculation. The correct adult salvage number for 2006 is 324, and the correct number for 2008 is 350. Using these corrected numbers in the calculation on page 386 yields a CSI of 8.63; thus, the 2013 incidental take limit for adult delta smelt becomes:

Revised WY 2013 adult incidental take is  $8.63 * 42 = 362$  delta smelt

The Service also reviewed the take estimate associated with larval-juvenile incidental take (see Table C-4, page 392 of the 2008 BiOp). We have determined that there are discrepancies between the salvage data provided in Table C-4 and updated salvage information provided by the California Department of Fish and Wildlife (CDFW) on February 21, 2013 (Table 1, below, presents the original and updated annual values for the years relevant to the larval-juvenile take calculation and updated monthly values). Using the originally reported salvage data and method described on pages 389-390, the BiOp calculated an incidental take statistic for annual larval-juvenile incidental take to be:

Original WY 2013 larval-juvenile incidental take is  $56.2 * 42 = 2360$  delta smelt

Using the updated salvage information in Table 1 below, and applying the method described on pages 389-390 of the BiOp to re-derive the incidental take statistic for annual larval-juvenile incidental take, the 2013 incidental take for larval-juvenile delta smelt becomes:

Revised WY 2013 larval-juvenile incidental take is  $55.95 * 42 = 2350$  delta smelt

During our review, we also found that 2005 FMWT value used in the BiOp in Table C-4 was given as 27, when it should be 26. The revised larval-juvenile incidental take calculation given for WY 2013 above reflects this correction.

Thank you for your continued cooperation in protecting the Bay Delta Ecosystem. If you have any questions, please do not hesitate to call.

Table 1. Updated monthly salvage, April through July, for 2005 through 2008. The column headed "Salvage 2008 BiOp" gives the April through July salvage number as reported in the 2008 BiOp.

	April	May	June	July	Revised April through July Salvage	Salvage Reported in 2008 BiOp
2005	0	529	1193	0	1722	1734
2006	12	0	0	0	12	12
2007	24	428	1509	711	2672	2669
2008	6	911	757	14	1688	1705



Attachment 3. December 23, 2015, Memo Describing Updated  
Incidental Take Statement



# United States Department of the Interior



FISH AND WILDLIFE SERVICE  
Pacific Southwest Region  
2800 Cottage Way, Suite W-2606  
Sacramento, California 95825

IN REPLY REFER TO:  
FWS/R8/FAC/BDFWO

DEC 23 2015

## Memorandum

To: Regional Director, Bureau of Reclamation, Mid-Pacific Region  
Sacramento, California

From: Regional Director, Fish and Wildlife Service, Pacific Southwest Region  
Sacramento, California

Subject: Update on the Incidental Take Statement for the 2008 Formal Endangered Species Act Consultation on Coordinated Long-term Operation of the Central Valley Project and State Water Project and Conveyance of a Revised Incidental Take of 56 Delta Smelt for the 2016 Water Year

With this memorandum, the U.S. Fish and Wildlife Service (Service) provides an amended adult delta smelt incidental take statement for the Service's 2008 Biological Opinion (2008 BiOp) concerning the Coordinated Long-term Operation of the Central Valley Project and State Water Project (Service File No. 81420-2008-F-1481-5) to the Bureau of Reclamation (Reclamation).

In the 2008 BiOp, the Service calculated expected salvage levels due to project operations under the Reasonable and Prudent Alternative (RPA), using historic salvage information from years when similar water operations were in effect (2006 to 2008; see page 386 of the 2008 BiOp). We calculated a Cumulative Salvage Index (CSI) for each of the three years by dividing observed salvage by the previous fall midwater trawl index (FMWT). We then calculated an average CSI for the years 2006 through 2008. Estimated salvage was expected to vary as a function of the delta smelt population size, therefore, take is calculated using a multiplier of the average CSI \* FMWT for each water year.

In a January 9, 2015 memorandum to Reclamation, the Service accepted Reclamation's alternative incidental take calculation method with the modification provided by the Independent Review Panel for the 2014 Long-term Operation Biological Opinions (LOBO) Annual Science Review as a viable interim approach to addressing incidental take estimation to the method set forth in the 2008 BiOp. Subsequently, the Service corrected the initial 2015 approach by reducing the data set to only years that included Old and Middle river flow values less negative or equal to -5000 cfs during the relevant months. This correction was necessary because the calculated incidental take should estimate the amount of take anticipated from project operations analyzed in the 2008 Biological Opinion. The corrected CSI variable is 7.98. Using the data for this water year (the 2015 FMWT index is 7) the adult delta smelt anticipated incidental take for WY 2016 is 56 ( $7.98 * 7 = 56$ ) delta smelt.

In November 2015, the Service presented an alternative approach to calculating anticipated adult incidental take to the 2015 LOBO Independent Review Panel. In this alternative approach, an estimate of delta smelt absolute abundance is calculated using California Department of Fish and Wildlife's data and a recently implemented December Kodiak Trawl (DKT) survey.

The Service has reviewed the Panel's comments and will pilot the alternative approach in Water Year 2016 using DKT to calculate incidental take. Because the DKT is new and untested, we intend to use this year to see if the estimates of salvage generated by the alternative approach correspond with the actual salvage that occurs in the 2016.

Thank you for your continued leadership in protecting the Bay Delta Ecosystem. If you have any questions, please do not hesitate to call.

cc: Supervisor, Bay Delta Fish and Wildlife Office  
Assistant Regional Director, Fish and Aquatic Conservation

Attachment 4. January 4, 2018, Memo Describing Adult Delta Smelt  
Incidental Take for Water Year 2018




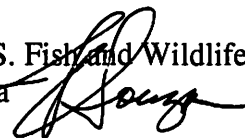
## United States Department of the Interior



FISH AND WILDLIFE SERVICE  
Pacific Southwest Region  
2800 Cottage Way, Room W-2606  
Sacramento, California 95825-1846

JAN 04 2018

To:  ~~Regional Director~~, Bureau of Reclamation, Mid-Pacific Region  
Sacramento, California

From: Regional Director, U.S. Fish and Wildlife Service, Pacific Southwest Region  
Sacramento, California 

Subject: Confirmation of Initial Incidental Take for Adult Delta Smelt for the 2018 Water Year

The U.S. Fish and Wildlife Service (Service) provides this memo to the Bureau of Reclamation (Reclamation) confirming the adult delta smelt incidental take for the 2018 Water year based on the 2015 amendment of the incidental take statement for the Service's 2008 Biological Opinion (2008 BiOp) for the Coordinated Long-term Operation of the Central Valley Project and State Water Project (Service File No. 81420-2008-F-1481-5).

This past water year California experienced record-levels of precipitation that created high flow conditions in the Delta during the winter and spring. The Enhanced Delta Smelt Monitoring (EDSM) effort, launched in December 2016, showed a promising increase in abundance of delta smelt through May 2017, with estimates of larval abundance hovering around 3-4 million delta smelt at that time. EDSM is designed to provide richer information about the geographic distribution of smelt, offering more detailed data for real time management than had existed previously through other surveys such as the Fall Midwater Trawl, which are more temporally limited.

After May 2017, conditions in the Delta were notably hot and dry and these conditions extended into the fall. After July, delta smelt were identified in surveys less frequently. The Fall Midwater Trawl (FMWT), for example, caught 2 delta smelt, which is the lowest in FMWT history. As defined in the Incidental Take Statement of the 2008 biological opinion (BiOp), as updated per our December 23, 2015 memo, the level of incidental take of delta smelt calculated from this FMWT number for the upcoming water year would be 16. As you know, reinitiation of consultation regarding the 2008 BiOp has already occurred and our teams are coordinating to conduct needed environmental reviews, including a new BiOp that will incorporate all of the new scientific information that has been developed since the 2008 BiOp.

It is unclear why all of the surveys have recorded such low numbers in recent months. One hypothesis suggests that the high flows from the last water year dispersed smelt significantly and resulted in lower reproduction and survival, although relatively higher larval abundance in June and July suggest otherwise. Another suggests that the extended hot and dry period in the summer and fall reduced survival. Yet another speculates that the extended sunny and clear period in November and December caused the fish to be less susceptible to capture than they would be under overcast, rainy or turbid conditions. These and other factors may also be working in combination.

We have not recorded delta smelt in the area around Old and Middle River this fall and winter, so we believe the risk of entrainment is currently very low. As storm events occur this year and turbidity increases, we expect EDSM to catch more fish and provide clearer information about the species' population size and distribution. As a result, we see this as a transition year that will incorporate EDSM into management decisions, including the incidental take calculation.

Therefore, the initial incidental take threshold for this water year will begin at 16 per the incidental take calculation method described in the 2008 BiOp and 2015 memo. However, we plan to revise the BiOp with a new approach for determining incidental take that relies upon the best available science now provided by substantially more years of California Department of Fish and Wildlife index data and EDSM. This will allow our agencies to use the strength of EDSM's information for adaptive management and develop an incidental take threshold that is more realistic based upon current conditions. Our teams have already begun discussions on this effort, and we would sincerely appreciate your continued participation. This approach may or may not be ready for use in the 2018 Water Year.

In the interim, we believe that continuing to implement the conservation provisions in the 2008 BiOp will be protective of the species. Real time water management will be informed by the accumulating EDSM presence, absence, and geographic distribution information, current and forecasted flows and turbidity. Additionally, we understand the State Water Contractors will be undertaking a new eDNA study that will help set the baseline for this new survey method. We stand ready to fully engage in our weekly (or more frequent if necessary) water management discussions and are confident this information can be used to minimize impacts to the species. This interim approach will avoid jeopardy and adverse modification of critical habitat in the coming water year until the Incidental Take Statement of the BiOp is revised to incorporate the new methodology, or sooner through a modification to the incidental take threshold if necessary for 2018. If 75 percent of this initial incidental take is reached, or 50 percent of incidental take is reached and there is a high likelihood of continued salvage, we will reassess expected take for the remainder of the pre-spawning adult protection season that could extend through approximately the end of March.

Thanks for your partnership and please don't hesitate to call me with questions.