

State Water Project Incidental Take Permit Risk Assessment for Delta Smelt and Longfin Smelt.

Section 1: Overview

Date: 12/28/2021

Life Stages Present

Delta Smelt (DS): Adult, sub-adult

Longfin Smelt (LFS): Adults, sub-adults, and larvae

Advice to Water Operations Management Team (WOMT):

No Advice. Condition of Approval 8.3.1 was triggered by conditions.

Risk Assessment:

Delta Smelt: Based on distribution patterns over the past decade and rare detections, DS are unlikely to be prevalent in the south Delta. Limited detection data support DS being present in the Sacramento Deep Water Ship Channel (SDWSC), lower San Joaquin River, and the lower Sacramento River. Six tagged Delta Smelt have been collected since 12/21/2021. The implementation of the Early Winter Pulse Protection action is expected to reduce the chance that migrating Delta Smelt will move into areas with a high likelihood of entrainment. The likelihood of Delta Smelt adult entrainment remains low given the most recent detections, persistent low turbidity in the south Delta, and the expected OMR index range over the next seven days.

Longfin Smelt: OMR is projected to be no more negative than -2,000 cfs on a 14-day average due to COA 8.3.1. X2 has shifted downstream to Port Chicago due to recent storm runoff. The SMT has determined that risk of entrainment is low for larvae and older fish due to the continued low exports. LFS adults are present in the Delta based on detections by Chipps Island Trawl. There is evidence that the spawning has commenced based on detections of larvae in the Delta by SLS. Risk of entrainment remains low due to reduced exports. Adult salvage has been rare in recent history and the SMT determined that adults are at low risk of entrainment. Due to dry hydrology observed over the season, the SMT expects to see larvae in the central and south Delta when they begin to emerge. Longfin Smelt protections would be relaxed under wet conditions described in COA 8.4.3, however, the thresholds described within have not been met.

Section 1-A: Sacramento River and Confluence

Risk of entrainment into the central Delta and export facilities for DS and LFS in Sacramento River (8.1.5.2 C ii, iii, iv)

- Exposure Risk (Hydrology):
 - DS: Low
 - LFS: Risk for larvae is low due to reduction in exports and positive Qwest. See 'Routing Risk' for more information on adults and sub-adults.
- Routing Risk (Behavior and life history):
 - DS: Low due to low turbidity in the central Delta.
 - LFS: Low risk of entrainment. There is potential for adult and sub-adult movement into the central Delta. Spawning migration has begun, dry year conditions elevate likelihood of movement into the lower San Joaquin River. Larvae do not exhibit swimming behaviors that would result in volitional movement into areas with a higher risk of entrainment.
- Overall Entrainment Risk
 - DS: Low. The implementation of COA 8.3.1 is expected to reduce the chance of that migrating Delta Smelt will move into areas with a high likelihood of entrainment.
 - LFS: Low for adults, sub-adults and larvae, due to:
 - Exports targeting OMR no more negative than -2,000 cfs reduces risk of entrainment for larvae.
 - Lack of detections of adults and sub-adults in the Lower San Joaquin/South Delta.
 - Adult salvage has been rare following the Pelagic Organism Decline.

Section 1-B: Central Delta

Risk of entrainment into the export facilities for DS and LFS in the central Delta (8.1.5.2 D iii, iv, v)

- Exposure Risk (Low, Medium, High):
 - DS: Low. Delta Smelt are unlikely to be prevalent in the south Delta. The likelihood of adult Delta Smelt entrainment is low given the most recent detections, persistent low turbidity in the south Delta, and expected OMR index range over the next seven days.
 - LFS: Low risk for adult and sub-adult LFS entrainment if they are present in the Lower San Joaquin River and south Delta. No LFS have been detected by EDSM in those strata.
 - Low risk for larvae observed in the lower San Joaquin River by SLS due to favorable hydrology (Positive Qwest and exports targeting OMRI no more negative than -2,000 cfs)
- Change in exposure from previous week: (Note: The change in risk compared to previous weeks is not required by the Incidental Take Permit [ITP]).
 - DS: No change from last week.

- LFS: No change from last week.
- Reporting Old and Middle River Index (OMRI) (Number and range of OMRI bins will vary based on anticipated hydrology and operations)
 - SMT will begin assessing OMR levels following the first flush period.

Section 2: Basis for Advice

The 2020 ITP ([Incidental Take Permit for Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta 2081-2019-066-00](#)) states that advice to WOMT shall be based on the following Conditions of Approval:

List relevant Condition of Approval number and title based on species/life stage, time of year, etc.

8.3.1 Integrated Early Winter Pulse Protection. Between December 1 and January 31 each year Permittee shall reduce south Delta exports for 14 consecutive days to maintain a 14-day average OMR index no more negative than -2,000 cfs, and convene the Smelt Monitoring Team within one day of triggering the following criteria:

- Three-day running average daily flows at Freeport greater than, or equal to, 25,000 cfs, AND
- Three-day running average of daily turbidity at Freeport greater than, or equal to, 50 Nephelometric Turbidity Units (NTU), OR
- The Smelt Monitoring Team determines that real-time monitoring of abiotic and biotic factors indicates a high risk of DS migration and dispersal into areas at high risk of future entrainment.

After maintaining a 14-day average OMR index no more negative than -2,000 cfs for 14 days, Permittee shall maintain a 14-day average OMR index no more negative than -5,000 cfs, initiating the OMR Management season, until the OMR Management Season ends (Condition of Approval 8.8).

The Integrated Early Winter Pulse Protection Action may only be initiated once during the December 1 through January 31 time period each year.

8.3.3 Adult Longfin Smelt Entrainment Protection. After December 1, if an Integrated Early Winter Pulse Protection (Condition of Approval 8.3.1) has not yet initiated, Permittee shall reduce south Delta exports to maintain a 14-day average OMR index no more negative than -5,000 cfs and initiate OMR Management (Condition of Approval 8.3) if:

- Cumulative combined LFS expanded salvage (total estimated LFS counts at the CVP and SWP salvage facilities beginning December 1 through February 28 exceeds the most recent Fall Midwater Trawl (FMWT) LFS index¹ divided by 10, OR
- Real-time monitoring of abiotic and biotic factors indicates a high risk of LFS movement into areas at high risk of future entrainment, as determined by DWR and CDFW Smelt Monitoring Team staff.

When evaluating the possibility of LFS movement into areas that may be subject to an elevated risk of entrainment, the Smelt Monitoring Team shall evaluate catch of LFS with fork length ≥ 60 mm by the Chipps Island Trawl (conducted by USFWS) as an early warning indicator for LFS migration movement into the Delta, in addition to other available survey and abiotic data. The Smelt Monitoring Team shall communicate the results of these risk assessments and advice to the WOMT (Condition of Approval 8.1.3), and operational decisions shall be made as described in Condition of Approval 8.1.4 (Collaborative Approach to Real-time Risk Assessment).

8.4.1 OMR Management for Adult Longfin Smelt. From the onset of OMR Management (Condition of Approval 8.3) through February 28, the Smelt Monitoring Team shall conduct weekly, or more often as needed, risk assessments (see Condition of Approval 8.1.5.2) and decide whether to recommend an OMR flow requirement between -5,000 cfs and -1,250 cfs to minimize entrainment and take of adult LFS. The Smelt Monitoring Team may provide advice to restrict south Delta exports for seven consecutive days to achieve a seven-day average OMR index within three risk categories:

- Low risk: OMR between -4,000 cfs to -5,000 cfs
- Medium risk: OMR between -2,500 cfs to -4,000 cfs
- High risk: OMR between -1,250 cfs to -2,500 cfs

If a risk assessment conducted by the Smelt Monitoring Team determines that a more restrictive OMR flow requirement is needed to minimize take of adult LFS, the Smelt Monitoring Team shall provide its advice to WOMT (Condition of Approval 8.1.3) and operational decisions shall be made following the process described in Condition of Approval 8.1.4 (Collaborative Approach to Real-time Risk Assessment).

This Condition will terminate when a high-flow off-ramp occurs (Condition of Approval 8.4.3), or when LFS spawning has been detected in the system, as determined by the Smelt Monitoring Team, or, if there is disagreement and resolution is not reached within WOMT, as determined by CDFW. The Smelt Monitoring Team shall consider results from Additional LFS Larval

¹ The Fall Midwater Trawl (FMWT) Survey annual abundance index for LFS is calculated as the sum of September through December monthly abundance indices and is typically reported at about the same date as adult salvage begins in December. The FMWT Index available beginning on December 1 each year shall be used to establish this threshold.

Sampling (Condition of Approval 7.6.1) to inform its assessment of the start of LFS spawning. After LFS spawning has been observed, Permittee shall implement Condition of Approval 8.4.2 to minimize take of larval and juvenile LFS.

8.4.2 Larval and Juvenile Longfin Smelt Entrainment Protection. From January 1 through June 30, when a single Smelt Larva Survey (SLS) or 20 mm Survey (20 mm) sampling period exceeds one of the following thresholds:

- LFS larvae or juveniles found in four or more of the 12 SLS or 20 mm stations in the central Delta and south Delta (Stations 809, 812, 815, 901, 902, 906, 910, 912, 914, 915, 918, 919), or
- LFS catch per tow exceeds five LFS larvae or juveniles in two or more of the 12 stations in the central Delta and south Delta (Stations 809, 812, 815, 901, 902, 906, 910, 912, 914, 915, 918, 919).

Permittee shall restrict south Delta exports for seven consecutive days to maintain a seven-day average OMR index no more negative than -5,000 cfs. Permittee shall also immediately convene the Smelt Monitoring Team to conduct a risk assessment (see Condition of Approval 8.5.1.2) to assess the risk of larval and juvenile LFS entrainment into the South Delta Export Facilities, determine if an OMR flow restriction is warranted, and recommend an OMR flow limit between -1,250 and -5,000 cfs. The Smelt Monitoring Team risk assessment and operational advice shall be reviewed by the WOMT (Condition of Approval 8.1.3) via the Collaborative Real-time Decision-making process (Condition of Approval 8.1.4). Permittee shall operate to the export restriction and OMR flow target approved through Conditions of Approval 8.1.3 and 8.1.4. Each week the Smelt Monitoring Team shall convene to conduct a new risk assessment and determine whether to maintain, or off ramp from, export restrictions based on the risk to LFS, or until the DS and LFS off-ramp has been met as described in Condition of Approval 8.8 (End of OMR Management).

From January 1 through June 30, DWR and CDFW Smelt Monitoring Team staff shall conduct weekly, or more often as needed, risk assessments (see Condition of Approval 8.5.1.2) to assess the risk of larval and juvenile LFS entrainment into the South Delta Export Facilities. As a part of the risk assessment the Smelt Monitoring Team shall provide advice on the appropriate OMR flow targets to minimize LFS entrainment or entrainment risk, or both. The Smelt Monitoring Team shall provide its advice to WOMT (Condition of Approval 8.1.3) and use the Collaborative Approach to Real-time Risk Assessment process described in Condition of Approval 8.1.4 to determine if an OMR flow restriction is warranted and determine OMR flow limit between -1,250 and -5,000 cfs. The OMR flow limit shall be in place until the next risk assessment conducted by the Smelt Monitoring Team determines that it is no longer necessary to minimize take or related impacts to LFS, or until the DS and LFS off-ramp has been met as described in Condition of Approval 8.8 (End of OMR Management).

8.4.3 High Flow Off-Ramp from Longfin Smelt OMR Restrictions. OMR management for adult, juvenile, or larval LFS as described in Conditions of Approval 8.4.1 and 8.4.2 are not required, or

would cease if previously required, when river flows are (a) greater than 55,000 cfs in the Sacramento River at Rio Vista or (b) greater than 8,000 cfs in the San Joaquin River at Vernalis. If flows subsequently drop below 40,000 cfs in the Sacramento River at Rio Vista or below 5,000 cfs in the San Joaquin River at Vernalis, the OMR limit previously required as a part of Conditions of Approval 8.4.1 and 8.4.2 shall resume.

8.5.1 Turbidity Bridge Avoidance. The purpose of this Condition is to minimize the risk of entrainment of adult DS in the corridors of the Old and Middle rivers into the south Delta export facilities. This Condition is intended to avoid the formation of a turbidity bridge from the San Joaquin River shipping channel to the south Delta export facilities, which historically has been associated with elevated salvage of pre-spawning adult DS.

After the Integrated Early Winter Pulse Protection (Condition of Approval 8.1.3) or February 1 (whichever comes first), until April 1, Permittee shall manage exports to maintain daily average turbidity in Old River at Bacon Island (OBI) at a level of less than 12 NTU. If the daily average turbidity at OBI is greater than 12 NTU, Permittee shall restrict south Delta exports to achieve an OMR flow that is no more negative than -2,000 cfs until the daily average turbidity at OBI is less than 12 NTU.

If, after five consecutive days of OMR flow that is less negative than -2,000 cfs and the daily average turbidity at OBI is not less than 12 NTU, the Smelt Monitoring Team may convene to assess the risk of entrainment of DS (Condition of Approval 8.1.5.2). The Smelt Monitoring Team may provide advice to WOMT regarding changes in operations that could be conducted to minimize the risk of entrainment of DS (Condition of Approval 8.1.3). The Smelt Monitoring Team may also determine that OMR restrictions to manage turbidity are infeasible and may instead provide advice for a different OMR flow target that is between -2,000 and -5,000 cfs and is protective based on turbidity and adult DS distribution and salvage to the WOMT for consideration (Condition of Approval 8.1.3). Operational decisions shall be made following the process described in Condition of Approval 8.1.4 (Collaborative Real Time Risk Assessment).

Turbidity readings at individual sensors can generate spurious results in real time. Spurious results could be incorrectly interpreted as a turbidity bridge, when in fact the cause is a result of local conditions or sensor error. To assess whether turbidity readings at OBI are attributable to a sensor error or a localized turbidity spike, Permittee, in coordination with Reclamation, may consider and review data from other nearby locations and sources. Additional information that will be reviewed include regional visualizations of turbidity, alternative sensors, and boat-based turbidity mapping, particularly if there was evidence of a local sensor error. Permittee may bring data from these additional sources to the Smelt Monitoring Team for consideration during the development of a risk assessment to be provided to the WOMT for evaluation (Condition of Approval 8.1.3).

Permittee shall use the decision-making process described in Condition of Approval 8.1.4 (Collaborative Real-time Risk Assessment) to determine if south Delta exports may increase after five days of OMR no more negative than -2,000 cfs, or to determine that this

action is not warranted due to a sensor error or localized turbidity event. Permittee shall implement this action until CDFW is in agreement that the action may be ended or modified.

8.5.2 Larval and Juvenile Delta Smelt Protection. If the five-day cumulative salvage of juvenile DS at the CVP and SWP facilities is greater than or equal to one plus the average prior three years' FMWT index (rounded down), Permittee shall restrict south Delta exports for seven consecutive days to maintain a seven-day average OMR index no more negative than -5,000 cfs. Additionally, if the five-day cumulative salvage threshold is met or exceeded, Permittee shall immediately convene the Smelt Monitoring Team to conduct a risk assessment (Condition of Approval 8.1.5.2) and determine the future risk of entrainment and take of larval and juvenile DS. The Smelt Monitoring Team may provide advice to further restrict south Delta exports to maintain a more positive OMR than -5,000 cfs. The Smelt Monitoring Team may provide advice for further restrictions within three risk categories:

- Low risk: Limit OMR between -4,000 cfs to -5,000 cfs
- Medium risk: Limit OMR between -2,500 cfs to -4,000 cfs
- High risk: Limit OMR between -1,250 cfs to -2,500 cfs

The duration and magnitude of operational advice shall be provided to the WOMT (Condition of Approval 8.1.3) and decisions shall be made following the process described in Condition of Approval 8.1.4 (Collaborative Real Time Risk Assessment). When conducting risk assessments to evaluate the risk of entrainment and take of juvenile DS, the Smelt Monitoring Team shall evaluate the following information sources, in addition to any other models or surveys they deem appropriate and those listed in Condition of Approval 8.1.5.2:

- Results from a CDFW approved DS life cycle model.
- DS recruitment levels identified by the Smelt Monitoring Team using the CDFW-approved life cycle model that links environmental conditions to recruitment, including factors related to loss as a result of entrainment such as OMR flows. In this context, recruitment is defined as the estimated number of post-larval DS in June per number of spawning adults in the prior February-March period.
- Hydrodynamic models and forecasts of entrainment informed by the EDSM or other relevant survey data to estimate the percentage of larval and juvenile DS that could be entrained.

If expanded salvage at the CVP and SWP facilities of juvenile DS exceeds 11 within a three-day period under this condition, Permittee shall restrict south Delta exports for seven consecutive days to maintain a seven-day average OMR index no more negative than -3,500 cfs. If juvenile DS continue to be salvaged at the CVP and SWP facilities during the seven days of OMR restrictions, then Permittee shall continue restrictions and request a risk assessment by the Smelt Monitoring Team to determine if additional advice and subsequent restrictions are

warranted and provide advice to WOMT (see Condition of Approval 8.1.3) and follow the decision-making process described in Condition of Approval 8.1.4.

Discussion of Conditions of Approval

Provide discussion addressing criteria for each Condition of Approval listed in “Basis for Advice” section. Refer to data below where appropriate.

COAs relevant to initiating OMR management went into effect December 1st. The Smelt Monitoring Team conducted a Risk Assessment based on COA 8.1.5.2.

8.3.1: This COA was triggered by conditions measured on 12/17/2021 when the running three-day average of daily flow and turbidity reached 27,152 cfs and 66.79 FNU respectively. Operations were reduced on 12/20/2021 targeting a 14-day average OMR index no more negative than -2,000 cfs for 14 consecutive days. After maintaining a 14-day average OMR index no more negative than -2,000 cfs for 14 days, Permittee shall maintain a 14-day average OMR index no more negative than - 5,000 cfs, initiating the OMR Management season, until the OMR Management Season ends (Condition of Approval 8.8).

8.3.3: This COA is no longer active due to the initiation of an Integrated Early Winter Pulse Protection (COA 8.3.1).

8.4.1: This COA is no longer active due to the detection of larval LFS by Smelt larva Survey (SLS).

8.4.2: This COA will go into effect following the 14-day Integrated Early Winter Pulse Protection action. The most recent SLS survey collected three larval LFS at station 809 and one larval LFS at station 812.

8.5.1: This COA will go into effect following the Integrated Early Winter Pulse Protection (COA 8.3.1).

8.5.2: The FMWT Annual Index for Delta Smelt is zero for the fourth consecutive year. The salvage threshold is one Juvenile Delta Smelt.

Section 3: Hydrology and Operations Assessment of hydrologic, operational, and meteorological information. 8.1.5.2 A.

Section 3-A: Water operations conditions. 8.1.5.2.A. i

- Antecedent Actions: *(e.g. Delta Cross Channel [DCC] gate closure and actions such as integrated early winter pulse protection, etc.)*
 - COA 8.3.1 was triggered by conditions measured on 12/17/2021. Operations were reduced to comply with this COA on 12/20/2021.
 - DCC gates closed on 11/30/2021.
 - Grantline barrier has been breached. This changes the OMRI calculation.
- Controlling Factors: OMR no more negative than -2,000 cfs

- Water Temperature:
 - Clifton Court Forebay (CCF) Daily Average Water Temperature = NA
 - 3 Station Average = 9.33°C
- Tidal Cycle: Spring Tide occurred this week.
- Turbidity:
 - 8.3.1 Freeport 3-day average = NA
 - 8.5.1 Old River at Bacon Island (OBI) Turbidity = 2.99 FNU
- Salinity: X2 = 68 km
- Hydrologic Footprint: No Particle Tracking Models were requested.

Section 3-B: Water operations outlook. 8.1.5.2.A. ii

- Outages
 - State Water Project (SWP): None
 - Central Valley Project (CVP): None.
- Exports:
 - CCF: Decreasing from 800 cfs to 300 cfs.
 - Jones: 1,700 cfs
- Meteorological Forecast: A storm system is expected to reach the Central Valley on Wednesday 12/29/2021, followed by another storm system early next week.

Section 3-C: Projected conditions. 8.1.5.2.A. iii

- DCC Gates position: Closed 11/30/2021.
- Sacramento River flow at Freeport: Peaked at 35,000 cfs and may increase due to increase releases on the American River
- San Joaquin River flow at Vernalis: 1,600 cfs and may increase to 2,000 cfs.
- Qwest: +11,000 cfs and is expected to remain positive until exports increase.
- OBI Turbidity: 2.99 FNU
- Expected changes in South Delta Exports: Exports may increase based on San Joaquin River flow at Vernalis. Combined exports are targeting an OMR Index no more negative than -2,000 cfs through 01/02/2022. Combined exports will target an OMR Index no more negative than -5,000 cfs beginning 01/03/2022.
- NDOI: 40,000 cfs and is expected to decrease.
- Upstream releases: (Note: upstream releases may increase due to flood management)
 - Keswick = 3,250 cfs
 - Nimbus = 1,750 cfs increasing to 5,000 cfs
 - Goodwin = 800 cfs
 - Oroville = 950 cfs

Table 1: Comparison of OMR and OMR Index (5-day and 14-day averages for OMR Index and USGS gauge were reported on [SacPAS website](#), accessed 12/28/2021.

Date	Averaging Period	USGS gauges (cfs)	Index (cfs)
12/21/21	Daily	Not Reported	-2,000 cfs
12/22/2021	5-day	-4,680 cfs	-4,730 cfs
12/22/2021	14-day	-3,960 cfs	-4,100 cfs

Section 4: Distribution and Biology.

8.1.5.2.B. Assessment of biological information for Delta Smelt and Longfin Smelt

Section 4-A: Delta Smelt population status 8.1.5.2.B. i

- The last Delta Smelt detection occurred on 12/28/2021 in the lower Sacramento River.
- EDSM: From 12/20/2021 to 12/23/2021, EDSM collected four tagged Delta Smelt; 2 in the Lower Sacramento River, 1 in the Lower San Joaquin River, and 1 in the Sacramento River Deep Water Shipping Channel. EDSM also reported 2 Delta Smelt collected in the lower Sacramento River during sampling conducted on 12/27/2021 and 12/28/2021. These two Delta Smelt will be reported on next week’s catch table
- EDSM Delta Smelt abundance estimate = 1,789 and includes tagged Delta Smelt of hatchery origin.
- Fall Mid-water Trawl (FMWT) Index for Delta Smelt = 0
- Delta Smelt life cycle model (LCM) discussion: NA
- Biological Conditions: NA
- % of population in Delta zones: NA
- Smelt Larva Survey (SLS) began on 12/13/2021 and did not collect any Delta Smelt in stations processed to date. Sample Processing is approximately 50% complete.
- Salvage: No DS have been salvaged at either facility.

Section 4-B: Longfin Smelt population status 8.1.5.2.B. ii.

- FMWT Index for LFS = 323
- Other Surveys:
 - EDSM: 12 LFS; 5 LFS in Suisun Bay, 2 LFS in Suisun Marsh, and 5 LFS in the Lower Sacramento River.. See Table 1 for details.
 - Chipps Island Trawl: From 12/19/2021 to 12/23/2021, Chipps Island Trawl collected 94 LFS, 42 of which were transferred to the FCCL. SLS: For stations sampled from 12/13/2021 through 12/16/2021, twenty larval LFS were collected at stations processed to date. Three were collected at station 809 and one was collected at station 812. Sample processing is approximately 50% complete.

- Salvage: No LFS have been salvaged at either facility.

Section 4-C: Additional data sources to assess sensitivity to entrainment Delta.8.1.5.2.C & D. i

The SMT viewed turbidity distribution on the [Bay Delta Live](#) website.

Notes:

- The pilot larval entrainment monitoring program is scheduled to begin 01/03/2022.
- The SMT will adjust the agenda so that the Delta Smelt assessment will occur before the Longfin Smelt assessment. This will allow for better consistency between the PA Assessment and ITP Delta Smelt Risk Assessment.
- The FMWT annual abundance indices have been released. A memo describing these indices can be accessed on the [FMWT online bibliography](#).
- The SMT discussed the need for PTM runs and determined that a more informed request could be made at the next meeting when SLS 13 data will be available.

Literature Cited

Davis, Brittany E., Dennis E Cocherell, Ted Sommer, Randall D Baxter, Tien-Chieh Hung, Anne E Todgham, Nann A Fangué, Sensitivities of an endemic, endangered California smelt and two non-native fishes to serial increases in temperature and salinity: implications for shifting community structure with climate change, Conservation Physiology, Volume 7, Issue 1, 2019, coy076, <https://doi.org/10.1093/conphys/coy076>

Jassby, Alan D., William J. Kimmerer, Stephen G. Monismith, Charles Armor, James E. Cloern, Thomas M. Powell, Jerry R. Schubel, Timothy J. Venlinski (1995) Isohaline Position as a Habitat Indicator for Estuarine Populations. Ecological Applications, 5:1, 272-289, DOI: <https://doi.org/10.2307/1942069>

Sommer, T., F. Mejia, M. Nobriga, and L. Grimaldo. 2011. The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science 9(2), DOI: <https://doi.org/10.15447/sfews.2014v9iss2art2>

Attachments: Table 1: EDSM Catch Table, Figure 1: EDSM Sample Locations, Table 2: Chipps Island Catch Table.

Table 1. Delta Smelt (DSM) and Longfin Smelt (LFS) catch per station for EDSM 2022 Phase 1 Kodiak trawls, from 12/20/2021–12/23/2021. These data are preliminary and subject to change.

Water Year	Phase	Station Code	Date	# Tows	Species	Mark Type	Fork Length	Total Catch	Stratum
2022	1	22-21-CF01	12/23/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-CF02	12/23/2021	4	LFS	None	70	1	Suisun Bay
2022	1	22-21-CF02	12/23/2021	4	LFS	None	60	1	Suisun Bay
2022	1	22-21-CF02	12/23/2021	4	LFS	None	99	1	Suisun Bay
2022	1	22-21-CF03	12/22/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-CF04	12/23/2021	4	LFS	None	111	1	Suisun Bay
2022	1	22-21-HB01	12/21/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-SBM02	12/22/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-SBM03	12/22/2021	4	LFS	None	93	1	Suisun Bay
2022	1	22-21-SBW01	12/21/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-SBW02	12/21/2021	4	NA	NA	NA	NA	Suisun Bay
2022	1	22-21-GB01	12/20/2021	4	LFS	None	76	1	Suisun Marsh
2022	1	22-21-GB01	12/20/2021	4	LFS	None	72	1	Suisun Marsh
2022	1	22-21-GB02	12/20/2021	4	NA	NA	NA	NA	Suisun Marsh
2022	1	22-21-SM01	12/20/2021	4	NA	NA	NA	NA	Suisun Marsh
2022	1	22-21-LSR01	12/22/2021	4	NA	NA	NA	NA	Lower Sac River
2022	1	22-21-LSR02	12/22/2021	4	NA	NA	NA	NA	Lower Sac River

Water Year	Phase	Station Code	Date	# Tows	Species	Mark Type	Fork Length	Total Catch	Stratum
2022	1	22-21-LSR03	12/22/2021	3	LFS	None	60	1	Lower Sac River
2022	1	22-21-LSR04	12/22/2021	4	NA	NA	NA	NA	Lower Sac River
2022	1	22-21-RV01	12/23/2021	3	LFS	None	86	1	Lower Sac River
2022	1	22-21-RV01	12/23/2021	3	LFS	None	90	1	Lower Sac River
2022	1	22-21-RV01	12/23/2021	3	LFS	None	92	1	Lower Sac River
2022	1	22-21-RV02	12/23/2021	3	DSM	AdClipped	53	1	Lower Sac River
2022	1	22-21-RV02	12/23/2021	3	DSM	AdClipped	80	1	Lower Sac River
2022	1	22-21-RV02	12/23/2021	3	LFS	None	95	1	Lower Sac River
2022	1	22-21-LSJ01	12/22/2021	4	NA	NA	NA	NA	Lower San Joaquin River
2022	1	22-21-LSJ02	12/22/2021	4	NA	NA	NA	NA	Lower San Joaquin River
2022	1	22-21-LSJ03	12/22/2021	4	NA	NA	NA	NA	Lower San Joaquin River
2022	1	22-21-PP01	12/23/2021	4	NA	NA	NA	NA	Lower San Joaquin River
2022	1	22-21-PP02	12/23/2021	4	DSM	AdClipped	53	1	Lower San Joaquin River
2022	1	22-21-SJT01	12/23/2021	4	NA	NA	NA	NA	Lower San Joaquin River

Water Year	Phase	Station Code	Date	# Tows	Species	Mark Type	Fork Length	Total Catch	Stratum
2022	1	22-21-CS01	12/20/2021	4	NA	NA	NA	NA	Cache Slough
2022	1	22-21-CS03	12/20/2021	4	NA	NA	NA	NA	Cache Slough
2022	1	22-21-CS04	12/20/2021	4	NA	NA	NA	NA	Cache Slough
2022	1	22-21-LSSC01	12/21/2021	4	NA	NA	NA	NA	Sac Deep Water Ship Channel
2022	1	22-21-USSC01	12/21/2021	4	NA	NA	NA	NA	Sac Deep Water Ship Channel
2022	1	22-21-USSC02	12/21/2021	4	DSM	VIE	54	1	Sac Deep Water Ship Channel
2022	1	22-21-FT02	12/20/2021	4	NA	NA	NA	NA	Southern Delta
2022	1	22-21-FT04	12/20/2021	4	NA	NA	NA	NA	Southern Delta
2022	1	22-21-MIW01	12/21/2021	4	NA	NA	NA	NA	Southern Delta
2022	1	22-21-MIW03	12/21/2021	4	NA	NA	NA	NA	Southern Delta
2022	1	22-21-OR01	12/20/2021	4	NA	NA	NA	NA	Southern Delta
2022	1	22-21-VC01	12/21/2021	4	NA	NA	NA	NA	Southern Delta

Unmarked DSM collected during Phase 1 are transferred alive to FCCL to contribute to DSM brood stock if tow temperatures are below 17°C. If tow temperatures are above 17°C, unmarked DSM are flash frozen in liquid nitrogen and transferred to UC Davis. All marked DSM are flash frozen in liquid nitrogen and transferred to UC Davis.

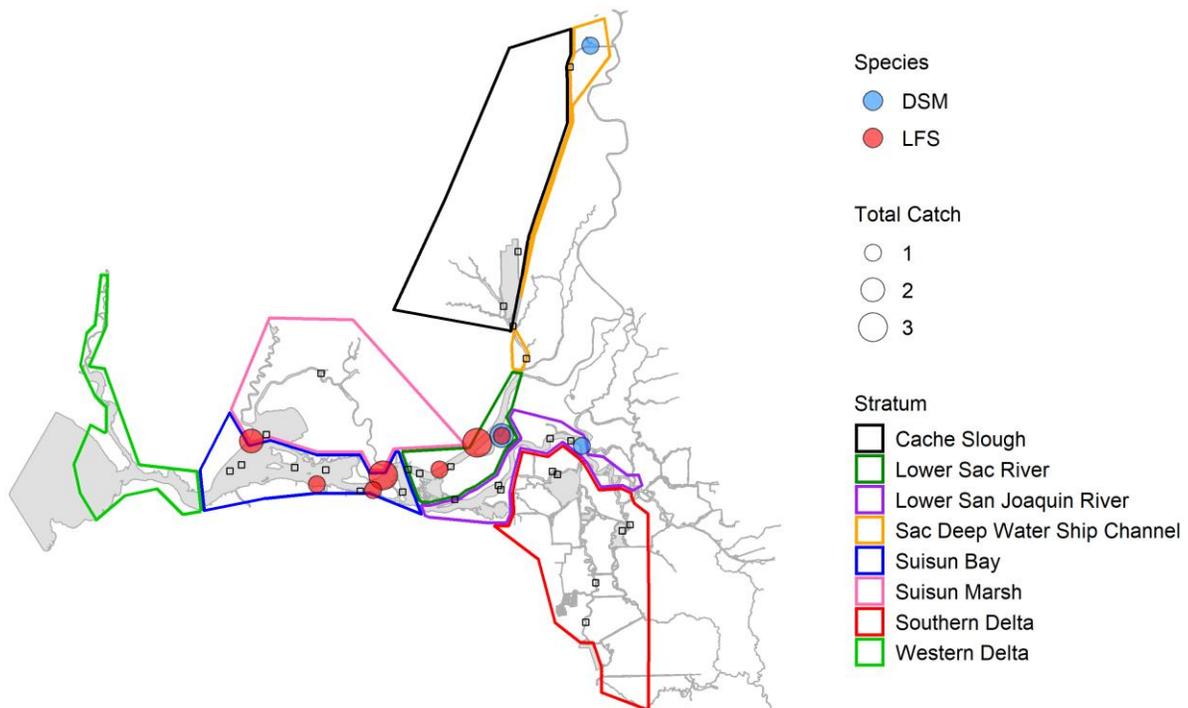


Figure 1. Delta Smelt (DSM) and Longfin Smelt (LFS) catch per station for EDSM 2022 Phase 1 Kodiak trawls, from 12/20/2021–12/23/2021. Sites with no DSM or LFS catch are indicated with squares.

Table 2. Delta Smelt (DSM) and Longfin Smelt (LFS) catch in Chipps Island mid-water trawls from 12/19/2021–12/23/2021. These data are preliminary and subject to change.

Water Year	Station Code	Date	Species	Fork Length	Total Catch	Maturation	Special Study	Location
2022	SB018N	12/19/2021	LFS	73	1	X	n/a	Chipps Island
2022	SB018M	12/20/2021	LFS	106	1	n/p	FCCL	Chipps Island
2022	SB018N	12/20/2021	LFS	89	1	n/p	FCCL	Chipps Island
2022	SB018S	12/20/2021	LFS	93	1	n/p	FCCL	Chipps Island
2022	SB018S	12/20/2021	LFS	98	1	n/p	FCCL	Chipps Island
2022	SB018S	12/20/2021	LFS	108	1	n/p	FCCL	Chipps Island
2022	SB018M	12/21/2021	LFS	91	1	n/p	FCCL	Chipps Island

Water Year	Station Code	Date	Species	Fork Length	Total Catch	Maturation	Special Study	Location
2022	SB018M	12/21/2021	LFS	92	1	n/p	FCCL	Chippis Island
2022	SB018M	12/21/2021	LFS	103	1	n/p	FCCL	Chippis Island
2022	SB018M	12/21/2021	LFS	104	1	n/p	FCCL	Chippis Island
2022	SB018M	12/21/2021	LFS	105	1	n/p	FCCL	Chippis Island
2022	SB018M	12/21/2021	LFS	108	1	n/p	n/a	Chippis Island
2022	SB018N	12/21/2021	LFS	102	1	n/p	FCCL	Chippis Island
2022	SB018N	12/21/2021	LFS	105	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	74	1	X	n/a	Chippis Island
2022	SB018S	12/21/2021	LFS	95	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	98	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	100	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	105	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	107	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	115	1	n/p	FCCL	Chippis Island
2022	SB018S	12/21/2021	LFS	115	1	n/p	FCCL	Chippis Island
2022	SB018M	12/22/2021	LFS	99	1	n/p	FCCL	Chippis Island
2022	SB018M	12/22/2021	LFS	100	3	X	n/a	Chippis Island
2022	SB018M	12/22/2021	LFS	102	1	n/p	FCCL	Chippis Island
2022	SB018M	12/22/2021	LFS	104	1	n/p	FCCL	Chippis Island
2022	SB018M	12/22/2021	LFS	107	1	X	n/a	Chippis Island
2022	SB018M	12/22/2021	LFS	108	2	X	n/a	Chippis Island
2022	SB018M	12/22/2021	LFS	110	1	X	n/a	Chippis Island

Water Year	Station Code	Date	Species	Fork Length	Total Catch	Maturation	Special Study	Location
2022	SB018M	12/22/2021	LFS	117	1	n/p	FCCL	Chippis Island
2022	SB018N	12/22/2021	LFS	100	2	X	n/a	Chippis Island
2022	SB018N	12/22/2021	LFS	110	1	X	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	71	1	X	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	77	2	X	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	96	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	96	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	97	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	98	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	99	3	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	100	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	102	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	103	2	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	103	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	104	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	105	3	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	105	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	107	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	110	2	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	112	2	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	115	1	n/p	FCCL	Chippis Island
2022	SB018S	12/22/2021	LFS	116	1	n/p	FCCL	Chippis Island

Water Year	Station Code	Date	Species	Fork Length	Total Catch	Maturation	Special Study	Location
2022	SB018S	12/22/2021	LFS	116	1	n/p	n/a	Chippis Island
2022	SB018S	12/22/2021	LFS	120	2	n/p	FCCL	Chippis Island
2022	SB018M	12/23/2021	LFS	98	1	M	n/a	Chippis Island
2022	SB018M	12/23/2021	LFS	100	1	E	n/a	Chippis Island
2022	SB018M	12/23/2021	LFS	106	1	X	n/a	Chippis Island
2022	SB018M	12/23/2021	LFS	110	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	60	1	n/p	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	67	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	70	1	n/p	L*	Chippis Island
2022	SB018N	12/23/2021	LFS	77	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	80	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	97	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	98	1	E	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	100	1	X	n/a	Chippis Island
2022	SB018N	12/23/2021	LFS	103	2	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	94	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	95	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	97	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	98	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	103	2	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	105	2	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	106	1	X	n/a	Chippis Island

Water Year	Station Code	Date	Species	Fork Length	Total Catch	Maturation	Special Study	Location
2022	SB018S	12/23/2021	LFS	108	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	109	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	111	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	112	1	X	n/a	Chippis Island
2022	SB018S	12/23/2021	LFS	115	1	X	n/a	Chippis Island

L*: Fish dead, taken back to LFWO lab for preservation.

When requested by FCCL, LFS > 80 mm fork length collected in Chippis Island trawls during Dec-Apr are transferred alive to FCCL to contribute to LFS brood stock if tow temperatures are below 14.5°C. Generally, LFS collected >65 mm are checked for expression (M=milt, E=eggs, X=no expression). Fish transferred to FCCL are NOT expressed. All DSM collected will be retained and flash frozen in liquid nitrogen for genetic analysis and ID verification.