



# Weekly Assessment of CVP and SWP Delta Operations on ESA-listed Species

May 9, 2023

## Executive Summary

### Operational Conditions

See Weekly Fish and Water Operation Outlook document for May 9 – May 16 which includes the initial CVP and SWP operational intent and biological justification for the next seven days. Any recommended changes or alternatives to those operations made by either monitoring team is captured herein.

### Winter-run Chinook Salmon

Loss of natural winter-run Chinook Salmon (by length at date, LAD) has not occurred in the past week at the State and Federal fish salvage facilities (WY 2023 total loss = 109.88 fish, as of 5/8/2023). Loss of natural winter-run Chinook Salmon at the Central Valley Project (CVP) and State Water Project (SWP) fish collection facilities may occur over the next week. 1-5% of juvenile natural winter-run Chinook Salmon from brood year (BY) 2022 are estimated to be present in the Delta. The Delta Cross Channel (DCC) gates closure for the season reduces exposure of winter-run Chinook Salmon juveniles that are present in the Sacramento River near the DCC gates into the interior Delta.

### Spring-run Chinook salmon

Loss of natural spring-run Chinook Salmon (by length at date, LAD) has occurred in the past week at the State or Federal fish salvage facilities (WY 2023 total loss = 1800.58 fish as of 5/8/2023). Loss of spring-run Chinook salmon at the CVP and SWP fish collection facilities may occur over the next week. 20-35% of juvenile natural spring-run Chinook Salmon from brood year (BY) 2022 are estimated to be present in the Delta. The DCC gates closure for the season reduces exposure of spring-run Chinook Salmon juveniles that are present in the Sacramento River near the DCC gates into the interior Delta.

### Central Valley Steelhead

Loss of natural California Central Valley (CCV) steelhead has not occurred in the past week at the State and Federal fish salvage facilities (WY 2023 December 1 - March 31 total loss = 1015.16 fish, April 1 – June 15 total loss = 160.21 fish, as of 5/8/2023). Loss of Central Valley steelhead at the CVP and SWP fish collection facilities is likely to occur over the next week. 20-40% of juvenile natural CCV Steelhead from brood year (BY) 2022 are estimated to be present in the Delta. DCC closure for the season reduces exposure to Central Valley steelhead juveniles that are potentially present in the Sacramento River near the DCC gates.

## **Green Sturgeon**

Loss of green sturgeon has not occurred in the past week at the State and Federal fish salvage facilities (WY 2023 total loss = 0 fish, as of 5/8/2023). Loss of green sturgeon is unlikely to occur over the next week due to their rare presence in the South Delta.

## **Delta Smelt**

Based on recent detection data and distribution patterns over the past decade, Delta Smelt are spawning and larval Delta Smelt are present. No adult Delta Smelt have been detected since 3/21/2023. Twenty-four larval Delta Smelt (23 confirmed/1 preliminary) have been detected since 3/13/2023. No Delta Smelt have been detected in Salvage since 3/2/2023. Three-day average water temperature at Jersey Point exceeded 12° C on 3/18/2023, and the most recent Secchi depths in the South Delta were below 1m, triggering COA 8.5.2. However, these actions are not controlling OMRI. Due to highly positive QWEST and OMRI, overall risk for entrainment is low for all life stages of Delta Smelt throughout the Delta.

## **Delta Cross Channel Gates**

The DCC gates were closed on 11/28/2022 to meet LTO Proposed Action and are expected to remain closed until May. DCC gates may only be opened to maintain water quality under D-1641 between November and January.

## **Monitoring Teams summary**

There were no non-consensus issues to report from the Salmon Monitoring Team.

There were no non-consensus issues to report from the Smelt Monitoring Team.

## **Operational and Regulatory Conditions**

See current Weekly Fish and Water Operation Outlook document.

## **Biology, Distribution, and Evaluation Winter-run Chinook salmon, Spring-run Chinook salmon, Central Valley Steelhead**

### **Population Status**

#### ***Winter-run Chinook Salmon***

- Delta Life Stages:
  - Juveniles, Adults
- Brood Year 2022 Productivity:

- Natural winter-run Chinook salmon: Draft Juvenile production estimate (JPE) calculations have been established for brood year (BY) 2022 winter-run Chinook salmon. The final BY 2022 JPE is 49,924 natural origin juvenile winter run Chinook salmon.
- Mean cumulative weekly passage of winter-run Chinook salmon through 4/22/2023 at Red Bluff Diversion Dam (RBDD) for the last 20 years of passage data is 100.0% (one SD of 0.1%). By 4/22/2023, 240,059 winter-run Chinook salmon were estimated to have passed RBDD compared to the cumulative passage last year of 572,568 winter-run Chinook salmon.
- Hatchery winter-run Chinook salmon:
  - Approximately 432,458 Livingston Stone NFH brood year 2022 winter Chinook salmon were released at dusk on 1/26-1/27/2023 into the Sacramento River at John F. Reginato River Access boat ramp, Redding, CA. This is the first release of LSNFH brood year 2022 hatchery winter Chinook salmon comprising of approximately 58% of the total hatchery production for the Sacramento River supplementation program. The release group is 100% marked (adipose-fin clip and CWT) with an overall estimated average fork length of 85mm. There has been no loss so far this water year with this release group.
  - Approximately 299,866 Livingston Stone NFH brood year 2022 winter Chinook salmon were released at dusk on 3/1/2023 into the Sacramento River at John F. Reginato River Access boat ramp, Redding, CA. This is the final release for the Livingston Stone NFH brood year 2022 winter Chinook Salmon supplementation program. This release group 100% marked (with an adipose-fin clip and CWT) and has an overall estimated average fork length of 85 mm. There has been no loss so far this water year with this release group.
  - Approximately 97,134 Coleman NFH Complex brood year 2022 winter Chinook Salmon were released on March 17, 2023. The release took place on the North Fork Battle Creek at Wilson Hill Bridge near Manton, CA. This is the first release of the brood year 2022 Jumpstart winter Chinook Salmon, and the only release of fish reared at the Mount Lassen Trout Farm, a private aquaculture facility located on North Fork Battle Creek. This group is 100% marked (with an adipose-fin and a left pelvic-fin clip and CWT).
  - Approximately 77,416 Coleman NFH Complex brood year 2022 winter Chinook Salmon were released on April 24, 2023. The release took place on the North Fork Battle Creek at Wilson Hill Bridge near Manton, CA. This is the final release of the brood year 2022 Jumpstart winter Chinook Salmon. This group is 100% marked (with an adipose-fin and a left pelvic-

fin clip and CWT) and has an overall estimated average fork length of 85 mm.

### ***Spring-run Chinook Salmon***

- Delta Life Stages:
  - Young-of-year (YOY) and Yearlings
- Brood Year 2022 Productivity:
  - Natural spring-run Chinook salmon: No JPE has been established for spring-run Chinook salmon.
  - Hatchery spring-run Chinook salmon surrogates associated with the Proposed Action (PA 4.10.5.10.2 Additional Real-Time OMR Restrictions and Performance Objectives):
    - Approximately 71,057 late-fall Chinook salmon from Coleman National Fish Hatchery were released at Battle Creek on 12/5/2022. This group is 100% marked with adipose-fin clip and CWT and have an estimated average fork length of 145mm. This is the first spring-run Chinook salmon surrogates release group associated with the Proposed Action. There has been no loss this water year of fish associated with the first surrogate release group.
    - Approximately 66,735 late-fall Chinook salmon from Coleman National Fish Hatchery were released at Battle Creek on 12/23/2022. This group is 100% marked with adipose-fin clip and CWT and have an estimated average fork length of 145mm.
    - Approximately 60,712 Coleman NFH brood year 2022 late-fall Chinook Salmon on January 13, 2023 into Battle Creek at Coleman NFH. This group is 100% marked (with an adipose-fin clip and CWT) and has an overall estimated average fork length of 145 mm.
  - There has been loss this water year of fish associated with the first, second, and third surrogate release groups.
  - The agencies in the SaMT discussed the thiamine vitamin deficiency that was observed in winter run Chinook salmon broodstock at the Livingston Stone National Fish Hatchery (LSNFH) in BY 2022. Last year the thiamine deficiency appeared to negatively affect survival of juvenile fish as they migrate downstream towards the Delta. The thiamine deficiency issue is also likely impacting spring-run Chinook salmon.

### ***Central Valley Steelhead***

- Delta Life Stages:

- Spawning Adults, Kelts, Juveniles
- Brood Year 2022 Productivity:
  - Spawner abundance: There is limited information about the adult steelhead population. It is estimated to be small, contributing to the limited productivity of the population.
  - Natural steelhead: No JPE has been established for steelhead. Data are limited.
  - Hatchery steelhead: Reclamation's Proposed Action has no hatchery steelhead triggers.

## Distribution

### *Winter-run Chinook Salmon*

#### Current Distribution:

- For Winter-run Chinook Salmon observations reported to SaMT since previous meeting, see Table 1.
- For SaMT distribution estimates, see Table 2.
- There is uncertainty in the identification of some untagged salmonids potentially due to either tag loss or poor quality adipose clipping from hatchery releases made in the South Delta. Lower rates of tagging success were confirmed for by hatchery staff for some releases. Confirmation of origin of these fish will be through genetic identification.
- For fish observed in salvage and genetically analyzed through 4/25/2023, one has been genetically identified as Winter-run Chinook Salmon (see attachment A). The single winter-run LAD Chinook Salmon observed at the CVP facility on 2/23/2023 was genetically identified as a winter-run for a loss of 2.88. One winter-run LAD was observed at the CVP on 4/25/2023 and was genetically assigned as a fall run.

#### Historic Trends

- For historical winter-run Chinook salmon trends in salvage, see Table 3.
- Loss of natural winter-run Chinook salmon at the CVP and SWP fish collection facilities may occur over the next week based on life history and detections in real-time monitoring locations in the Delta. However, if historic trends in salvage were to continue, winter-run Chinook salmon loss is expected to decrease over the next week.

#### Forecasted Distribution within Central Valley and Delta regions

- Movement of winter-run Chinook salmon juveniles into the lower reaches of the Sacramento River and upper Delta may continue over the next week.

- The STARS model projects route-specific proportion of entrainment, survival, and travel times (Table 5). This model does not estimate entrainment into the lower Sacramento River sloughs (i.e., Three-Mile Slough).
- The DCC gates were closed 11/28/22 and are expected to remain closed through mid-May 2023.

### ***Spring-run Chinook salmon***

#### **Current Distribution**

- For Spring-run Chinook salmon observations reported to SaMT since previous meeting, see Table 1
- For SaMT distribution estimates, see Table 2

#### **Historical Trends**

- For historical spring-run Chinook salmon trends in salvage, see Table 3. If historic trends in salvage were to continue YOY spring-run Chinook salmon loss is unlikely to increase over the next week.

#### **Forecasted Distribution within Central Valley and Delta regions**

- Yearling spring-run Chinook are thought to be migrating through the Delta.

### ***Central Valley Steelhead***

#### **Current Distribution**

- For CCV Steelhead observations reported to SaMT since previous meeting, see Table 1.
- For SaMT distribution estimates, see Table 2.

#### **Historical Trends**

- For historical CCV steelhead trends in salvage, see Table 2. If historic trends in salvage were to continue, juvenile CCV steelhead loss may occur over the next week.

#### **Forecasted Distribution within Central Valley and Delta regions**

- The entrainment tool estimates of CCV steelhead loss to be moderate (Table 6, Fig. 1).
- Closure of the DCC gates for the season will reduce exposure and possible entrainment of juvenile CCV steelhead from the Sacramento River into the interior Delta via the DCC gates.

Table 1. Fish observation reported since the previous SaMT meeting. NAs represent no data reported. See Operations Outlook for notes on interruptions in any surveys.

Locations	Reporting Period	SR Chinook	WR Chinook	LFR Chinook	Steelhead (Wild)	Green Sturgeon
GCID RST	NA	NA	NA	NA	NA	NA
Butte Creek RST	4/23-4/27	22	0	0	0	0
Tisdale RST	4/29-5/4	1	0	0	0	0
Knights Landing RST	4/30-5/7	2	0	0	0	0
Lower Sacramento RST	5/1-5/7	2	0	0	0	0
Beach Seines	4/30-5/6	0	0	0	0	0
Sac. Trawl	4/30-5/6	5	0	0	0	0
Chippis Island Midwater Trawl	4/30-5/6	70	2	0	0	0
Mossdale Kodiak Trawl	4/24-5/6		NA	NA	NA	NA
EDSM	4/30-5/6	0	0	0	0	0
Feather River Herring RST	4/31-5/	6	0	0	1	0
Feather River Eye Side RST	4/30-5/4	0	0	0	7	0
Lower Feather River	4/21-4/28	0	0	0	0	0

Table 2. Salmonid distribution estimates.

Location	Yet to Enter Delta (%)	In the Delta (%)	Exited Delta past Chipps Island (%)
Young-of-year (YOY) winter-run Chinook salmon	Current: 0-1% Last Week: 0-2%	Current: 1-5% Last Week: 3-10%	Current: 95-98% Last Week: 90-95%
YOY spring-run Chinook salmon	Current: 5-10% Last Week: 5-10%	Current: 20-35% Last Week: 30-45 %	Current: 60-70% Last Week: 50-60%
YOY hatchery winter-run Chinook salmon	Current: 0% Last Week: 0%	Current: 0% Last Week: 0-5%	Current: 100% Last Week: 95-100%
Natural origin steelhead	Current: 5-15% Last Week: 5-20%	Current: 20-40% Last Week: 20-45%	Current: 55-65% Last Week: 50-60%

Table 3. Historic migration and salvage patterns. Last updated 5/8/2023.

Species	Red Bluff Diversion Dam	Tisdale Rst	Knights Landing Rst	Sac Trawl Sherwood Catch Index	Chippis Island Trawl Catch Index	Salvage
Chinook, Winter-run, Unclipped	100.0%(100.0%,100.0%) BY: 2013 - 2021	100.0%(100.0%,100.0%) BY: 2013 - 2021	100.0%(100.0%,100.0%) BY: 2013 - 2021	100.0%(100.0%,100.0%) BY: 2013 - 2021	99.9%(99.7%,100.1%) BY: 2013 - 2021	99.9%(99.7%,100.1%) WY: 2013 - 2022
Chinook, Spring-run, Unclipped	97.8%(95.4%,100.1%) BY: 2013 - 2021	99.9%(99.8%,100.0%) BY: 2013 - 2021	99.8%(99.6%,100.1%) BY: 2013 - 2021	98.5%(96.4%,100.6%) BY: 2013 - 2021	93.7%(90.5%,96.8%) BY: 2013 - 2021	83.5%(69.7%,97.3%) WY: 2013 - 2022
Steelhead, Unclipped (January-December)	21.1%(10.3%,31.8%) BY: 2013 - 2022	76.3%(52.2%,100.5%) BY: 2014 - 2022	74.5%(52.3%,96.7%) BY: 2014 - 2022	85.5%(74.0%,97.1%) BY: 2013 - 2022	84.8%(78.5%,91.0%) BY: 2013 - 2022	N/A
Steelhead, Unclipped (December-March)	N/A	N/A	N/A	N/A	N/A	100.0%(100.0%,100.0%) WY: 2014 - 2023
Steelhead, Unclipped (April-June)	N/A	N/A	N/A	N/A	N/A	70.7%(51.7%,89.8%) WY: 2013 - 2022

Table 4. Mean daily flow and percent change (Wilkins Slough, Deer Creek, Mill Creek; cfs from CDEC) and temperature and percent change (Knights Landing; °F from RST).

Date	Mill Creek (MLM): mean daily flow (cfs)	Mill Creek (MLM): flow percent change	Mill Creek (MLM): Alert	Deer Creek (DCV): mean daily flow (cfs)	Deer Creek (DCV): flow percent change	Deer Creek (DCV): Alert	Wilkins Slough (WLK): mean daily flow (cfs)	Knights Landing RST: water temperature (f)	Alert Triggered
5/7/2023	592.5	-4.6%	Flow>95cfs	795.2	2.4%	Flow>95cfs	16,057.0	N/A	N/A
5/6/2023	621.0	-3.6%	Flow>95cfs	776.3	-0.5%	Flow>95cfs	14,723.0	N/A	N/A
5/5/2023	644.2	-10.6%	Flow>95cfs	779.9	-8.3%	Flow>95cfs	14,185.3	45.7	WLK>7500cfs and



Date	Mill Creek (MLM): mean daily flow (cfs)	Mill Creek (MLM): flow percent change	Mill Creek (MLM): Alert	Deer Creek (DCV): mean daily flow (cfs)	Deer Creek (DCV): flow percent change	Deer Creek (DCV): Alert	Wilkins Slough (WLK): mean daily flow (cfs)	Knights Landing RST: water temperature (f)	Alert Triggered
									KNL < 56.3 F
5/4/2023	720.6	-3.8%	Flow > 95cfs	850.9	-6.4%	Flow > 95cfs	14,844.0	45.8	WLK > 750 cfs and KNL < 56.3 F
5/3/2023	749.0	-21.4%	Flow > 95cfs	909.4	-14.4%	Flow > 95cfs	15,179.0	47.1	WLK > 750 cfs and KNL < 56.3 F
5/2/2023	952.3	-16.0%	Flow > 95cfs	1,062.0	-11.9%	Flow > 95cfs	15,245.8	48.6	WLK > 750 cfs and KNL < 56.3 F
5/1/2023	1,134.3	-7.6%	Flow > 95cfs	1,205.7	-4.8%	Flow > 95cfs	15,038.1	49.6	WLK > 750 cfs and KNL < 56.3 F

Table 5. STARS model simulations for route-specific entrainment, travel times, and survival. Travel time is calculated in days.

Stock	Date	Route	Median Travel Time	Survival	Routing Probability
Winter Chinook	2023-05-07	Overall	5.28	0.65	N/A
Winter Chinook	2023-05-07	Sacramento River	4.96	0.69	0.64
Winter Chinook	2023-05-07	Yolo Bypass	9.45	0.65	0.00
Winter Chinook	2023-05-07	Sutter Slough	5.02	0.58	0.13
Winter Chinook	2023-05-07	Steamboat Slough	4.86	0.68	0.11
Winter Chinook	2023-05-07	Interior Delta	7.78	0.42	0.11
Late-fall Chinook	2023-05-07	Overall	5.73	0.60	N/A
Late-fall Chinook	2023-05-07	Delta Cross Channel	NA	NA	0.00
Late-fall Chinook	2023-05-07	Georgiana Slough	8.73	0.33	0.19

Stock	Date	Route	Median Travel Time	Survival	Routing Probability
Late-fall Chinook	2023-05-07	Sacramento River	4.96	0.68	0.47
Late-fall Chinook	2023-05-07	Sutter and Steamboat Slough	5.60	0.66	0.34

The entrainment tool estimates a median and maximum loss of winter-run Chinook Salmon and juvenile CCV Steelhead each week (Table 6a).

Table 6a-b. WY 2023 loss and salvage predictor data: Environmental details, current and forecast. Model results from 5/8/2023.

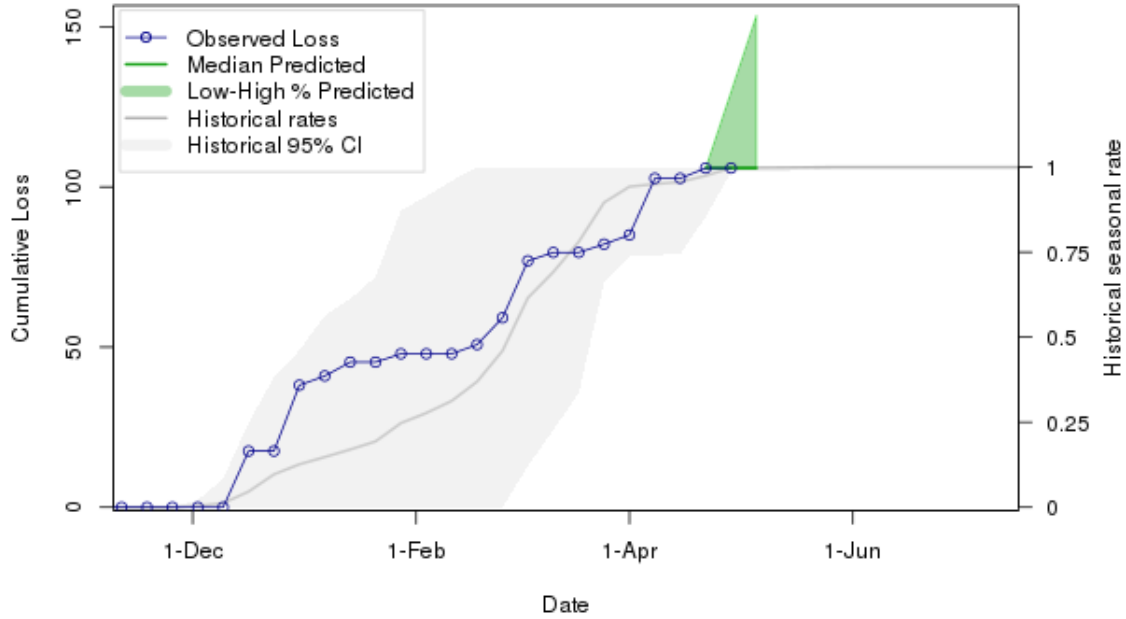
- a) WY 2023 loss and salvage predictor data: Predicted weekly loss of winter-run Chinook salmon and steelhead at CVP and SWP facilities.

Parameter	Modeled Current Week	Modeled Next Week
Predicted Steelhead, Median %	9	9
Predicted Steelhead, High %	141	118
Predicted Chinook Winter Run, Median %	0	0
Predicted Chinook Winter Run, High %	24	24

- b) Environmental details, current and forecast.

Parameter	Data	Forecast
Temperature (Mallard Island, C)	16.9	16.9
Precipitation (5-d running sum, inches)	0.02	0.02
Old and Middle River Flows (cfs)	7981	7981
Sacramento River Flow (Freeport, cfs)	49290	49290
DCC Gates	closed	closed
San Joaquin River Flow (Vernalis, cfs)	28627	28627
Export	6909	6909

**Winter Run Loss 2023-05-05 Water Year: 2023 & WY.week 31**



**Steelhead Loss 2023-05-05 Water Year: 2023 & WY.week 31**

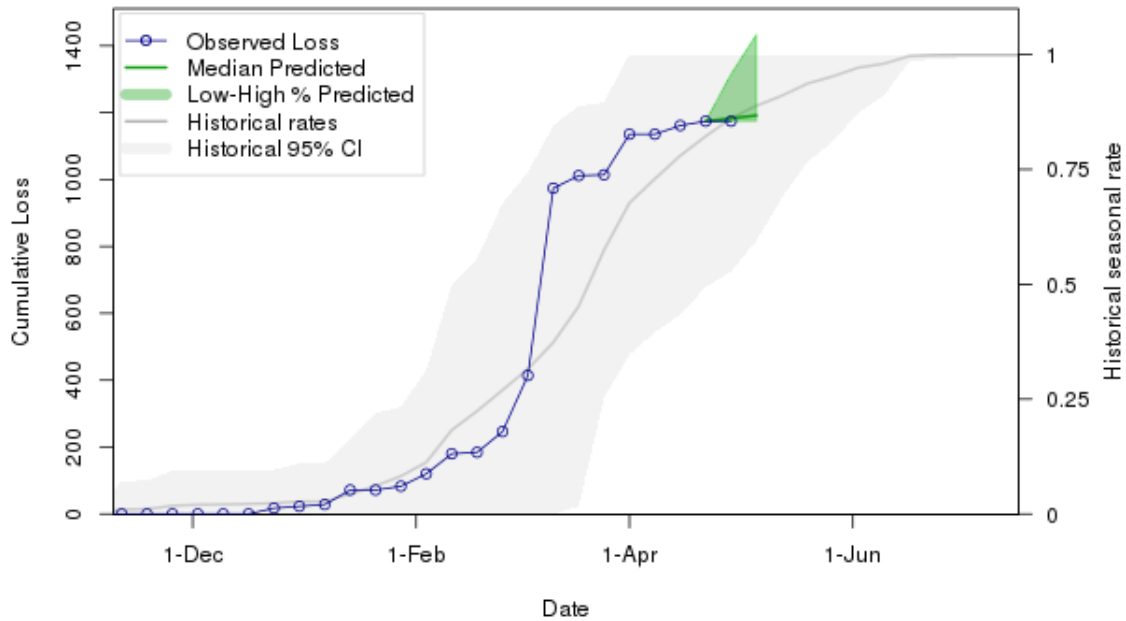


Figure 1. Predicted weekly loss of steelhead and winter-run Chinook salmon at the CVP and SWP facilities.

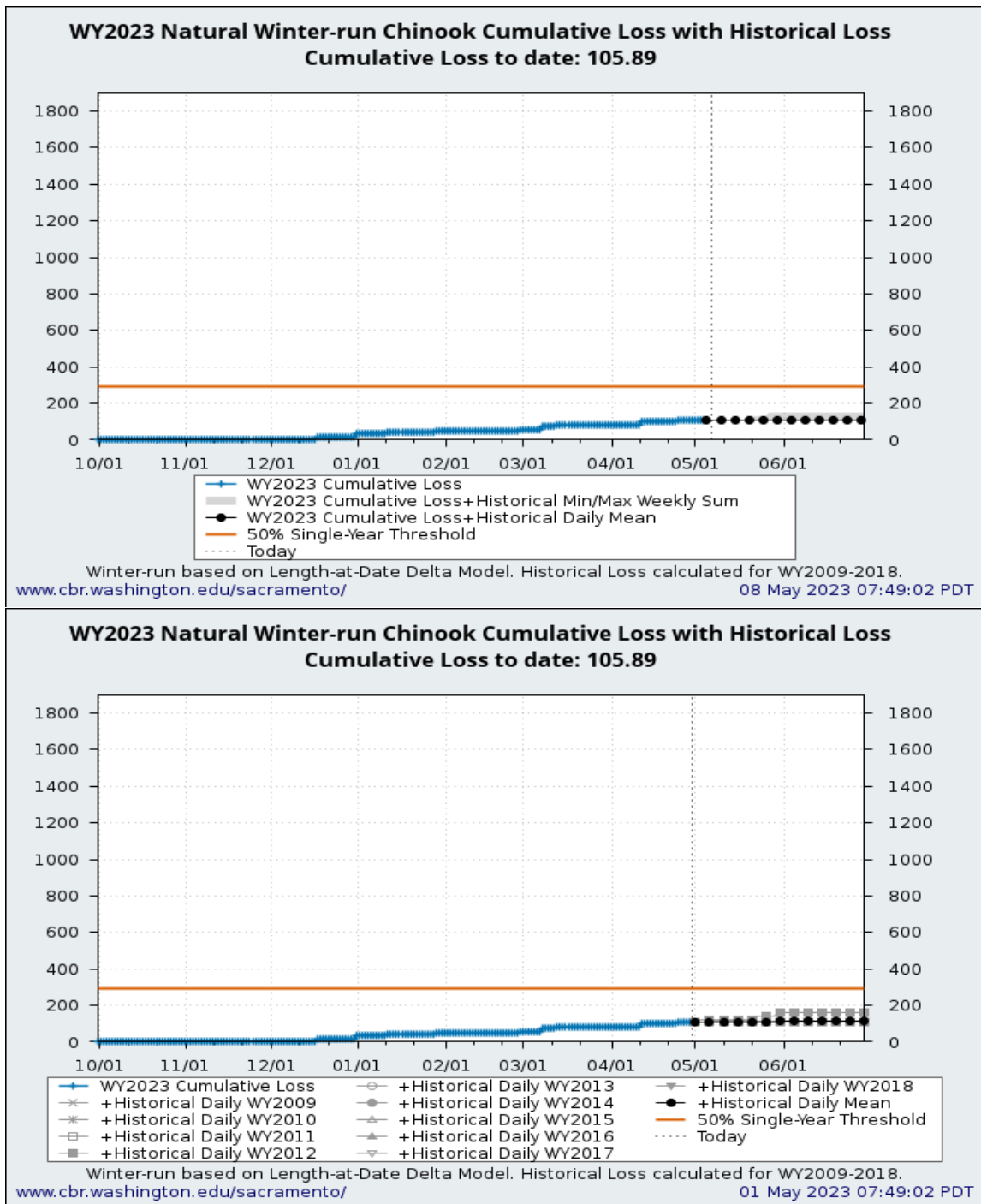


Figure 2. Predicted weekly loss of winter-run Chinook salmon at the CVP and SWP facilities based on historical loss.

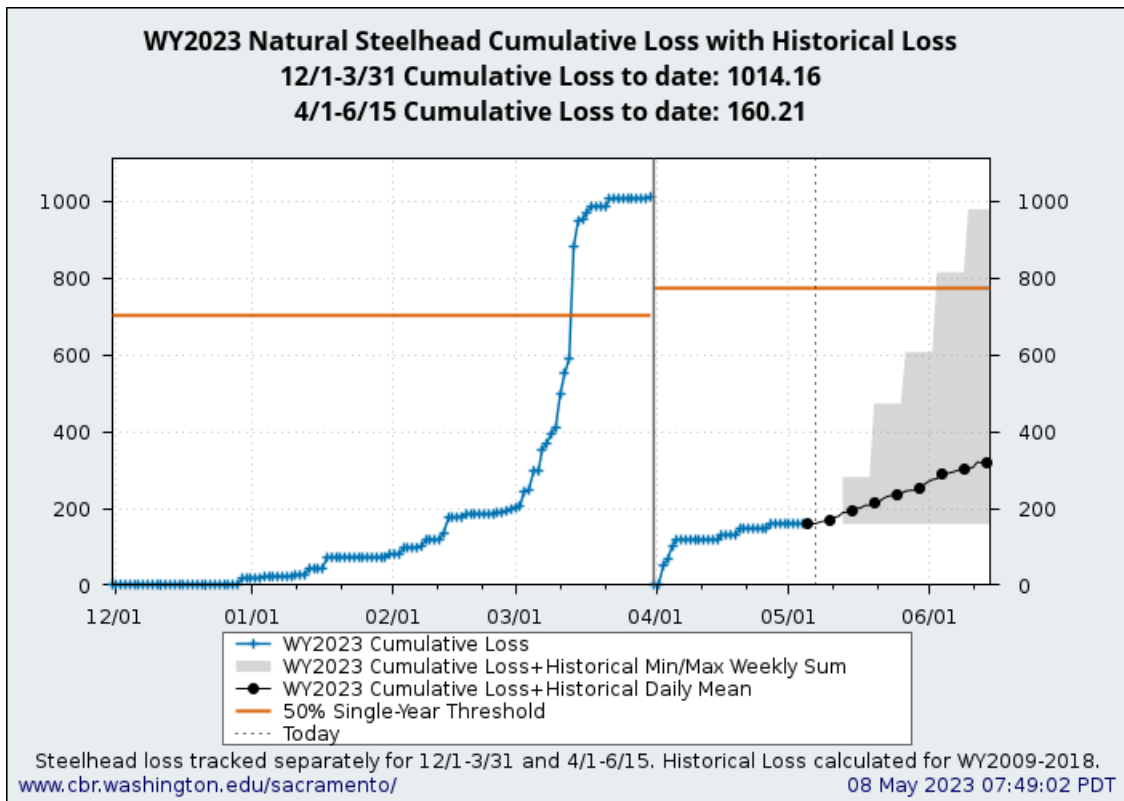


Figure 3. Cumulative natural steelhead loss for the year (blue) and 2009 – 2018 historic cumulative loss (gray, different symbols). Historic daily mean plotted in black circles.

## Evaluation

1. After January 1, are more than 5% of juveniles from one or more salmonid species present in the Delta?

Greater than 5% of all juvenile salmonids are present in the Delta.

2. Does the operational outlook's ranges impact fish movement and change the potential distribution of fish?

Potential effects within the 7 days (near-term) in the operations outlook.

OMR flow is expected to remain at or more positive than -5,000 cfs this upcoming week. OMR flows more positive than -5,000 cfs are hypothesized to have minimal impact on movement and distribution of salmonids in the South Delta.

Potential effects longer than the 7 days (longer-term) in the operations outlook.

Not applicable, see response above.

3. What is the likelihood of increased loss exceeding the next annual loss threshold (50%, 75% or 90% of threshold) resulting in OMR management actions based on population distribution, abundance, and behavior of fish in the Delta?

#### Winter-run Chinook salmon

Total juvenile natural winter-run Chinook salmon (LAD) loss is 109.88 fish (as of 5/8/2023). Loss of juvenile winter-run LAD Chinook salmon has not occurred in the past week at the CVP and SWP fish salvage facilities. Final JPE calculations have been established for brood year (BY) 2022 winter-run Chinook salmon. The agencies in the SaMT assessed the likelihood of exceeding the next annual loss threshold and believe that loss occurring in the next week is unlikely to lead to exceedance of the 50% single-year loss threshold (see Figures 1 and 2). Based on historical data, >99% of salvage for winter-run LAD Chinook salmon should have occurred at this time of the year (Table 3).

#### Spring-run Chinook salmon

Total natural young of year spring-run Chinook salmon (LAD) loss is 1800.58 fish (as of 5/8/2023). Loss of natural juvenile spring-run LAD Chinook salmon has occurred in the past week at the CVP and SWP fish salvage facilities. 9 genetically confirmed older spring-run have been caught in salvage this WY with a total loss of 62.79. Loss for yearling spring-run surrogate has not exceeded the 0.5 % threshold for any release group (refer to Ops Outlook Table 2). The agencies in the SaMT assessed the likelihood of exceeding annual loss threshold and believe that loss occurring in the next week is unlikely to lead to exceeding the hatchery spring-run surrogate threshold.

#### Central Valley Steelhead

Total natural juvenile steelhead loss (April 1 through June 15) is 160.21 fish (as of 5/8/2023). Loss of natural juvenile steelhead has not occurred in the past week at the CVP and SWP fish salvage facilities. See table 6a for predicted weekly loss of steelhead at the CVP and SWP facilities. The agencies in the SaMT assessed the likelihood of exceeding the 50% annual loss threshold and believe that loss occurring in the next week is unlikely to lead to the exceedance of 50% annual loss threshold (see Figures 1 and 3).

Total natural juvenile steelhead loss for the December 1 through March 31 period was 1015.16 fish. The December-March 50% annual loss threshold (707) was exceeded on 3/15/2023. See table 6a for predicted weekly loss of steelhead at the CVP and SWP facilities. Information is limited on steelhead population, so it is not possible to assess the effects on steelhead at a population level.

4. If an annual loss threshold has been exceeded, do continued OMR restrictions benefit fish movement and survival based on real-time information?

#### Winter-run Chinook salmon

The annual loss threshold for winter-run Chinook salmon has not been exceeded in WY 2023.

#### Spring-run Chinook salmon

The annual loss threshold for spring-run Chinook salmon has not been exceeded in WY 2023.

#### Central Valley Steelhead

The April 1 – June 15 50% annual loss threshold for steelhead has not been exceeded in WY 2023.

The December 1 – March 31 50% annual loss threshold for steelhead (December 1 – March 31) was exceeded in WY 2023 and the 75% annual loss threshold was nearly exceeded; however, the December-March season for steelhead is over.

5. If OMR is more negative than -5,000 cfs, are there changes in spawning, rearing, foraging, sheltering, or migration behavior beyond those anticipated to occur under OMR management at -5,000 cfs?

Expected OMR flows are 3,500 to 13,000 cfs for the next week. Under OMR flows more negative than -5,000 cfs the SaMT expects impacts to rearing, foraging, sheltering, or migration of salmonids present in the south Delta. Salmonid presence in the south Delta is difficult to assess because of limited observations and there is uncertainty in how much of the population might be impacted.

## **Biology Distribution and Evaluation of Green Sturgeon**

### **Population Status**

- Delta Life Stages:
  - Adults and Juveniles

### **Distribution**

#### ***Current Distribution***

- Adults: Most abundant during spring spawning migration period of March through May, and post spawning out-migration periods May through June; October through January

depending on first winter storm event resulting in significant Sacramento River flow increases. Adult presence year-round to a lesser extent mainly in San Pablo Bay.

- Juveniles: Age-1 through Age-3 juveniles present year-round and widely distributed. Juveniles tagged with acoustic tags in the main channel Sacramento River near Sherman Island detected in the Sacramento River as far upstream as the Cache Slough complex, in the San Joaquin River at the Antioch Bridge, in Threemile, Horseshoe Bend, and Montezuma Sloughs. Seasonal abundance at the primary sampling site (near Sherman Island) appears to be highest during summer in based on capture and telemetry data. Residence time at the primary sampling site for individual fish ranges from one day to over one year but telemetry data show outmigration from the primary sampling site to the Pacific Ocean ranges from 27 to 552 days. Recent capture data shows diurnal depth preference in the main channel of the Sacramento River. No recent documentation of shallow water habitat presence or foraging but likely.

### ***Historical Trends***

- Juvenile and adult green sturgeon are historically present in the San Joaquin and Sacramento rivers and Delta.

### ***Forecasted Distribution within Central Valley and Delta regions***

- Juvenile and adult green sturgeon are present in the San Joaquin and Sacramento rivers and Delta during the next week.

## **Evaluation**

1. Is there likely to be salvage that may exceed the annual loss limit?

Green sturgeon salvage is 0 fish (as of 5/8/2023). The agencies in the SaMT assessed the likelihood of salvage occurring in the next week is unlikely to occur.

## **Biology, Distribution, and Evaluation of Delta Smelt**

### **Population Status**

- Delta Smelt Life Stages:
  - Adults, larvae
- Brood Year 2022:
- Abundance estimate:
  - The most recent abundance estimate for postlarval/juvenile Delta Smelt is from April 28, 2023, and was 2,017,389 (95% CI: 151,146 to 9,052,865).
- Biological Conditions:



- Delta Smelt are spawning and larval Delta Smelt are present. Adult Delta Smelt have not been detected since 3/21/2023. Larval Delta Smelt are expected to be present in the Lower and Upper Sacramento, Suisun Marsh, Suisun Bay, Cache Slough/Liberty Island, and Sacramento Deep Water Shipping Channel based on the most recent survey detections. The Smelt Monitoring Team discussed the most recent monitoring data (Table 4) and considered published literature and professional judgement on the historical trends in regional distribution.

**Distribution**

***Current Distribution***

- Real time detection data are currently limited to EDSM and Chipps Island Trawl; Bay Study, and 20mm survey provide data as available.
- No adult Delta Smelt have been detected since 3/21/2023.
- Twenty-three confirmed and one preliminary larval Delta Smelt have been detected by surveys in Suisun Bay, Suisun Marsh, the Lower and Upper Sacramento River, the Lower San Joaquin River Cache Slough/Liberty Island, and the Sacramento Deep Water Shipping Channel between 3/13/2023-4/24/2023.
- No Delta Smelt have been detected in salvage at the SWP and CVP since 3/2/2023. Cumulative seasonal salvage is 52.
- Experimental release of hatchery Delta Smelt occurred at Rio Vista on 11/30/2022, and 1/18/2023-1/19/2023, and in the Deep Water Shipping Channel on 1/25/2023-1/26/2023. Forty-two fish from the experimental release have been caught or salvaged since 12/14/2022.
- Larval sampling at the Skinner Fish Facility (SFF) and the Tracy Fish Collection Facility (TFCF) was initiated by the SMT at 0400 on March 1.
- COA 8.5.2: Larvae are present, and the average 12-station Secchi depth is 97 cm.

Table 7. Summary of newly reported detections of Delta Smelt by Region and Salvage Facilities since the last assessment. Regions are those defined by EDSM sampling. Delta Smelt >58mm FL are considered adults. Subadult fish are considered by the SMT to be fish from the previous year’s cohort based on size and timing of collection. Young of year are considered juveniles and larvae.

<b>Life Stage</b>	<b>North</b>	<b>South</b>	<b>West</b>	<b>Far West</b>	<b>Salvage</b>
Adult	0	0	0	0	0
Subadult	0	0	0	0	0
Larvae/Juvenile	0	0	1*	1	0

\*preliminary detection

Table 8. Summary of recent Delta Smelt detections reported since last assessment and the total detections for the current water year. Notes reflect latest information on reported detections or completion of survey for the water year and include both larval and adult detections. Total Fish counts do not distinguish between hatchery origin and wild Delta Smelt. Table indicates new detections and previously reported detections that have undergone preliminary ID, QA/QC, and genetic confirmation. Numbers are updated as QA/QC and genetic confirmation become available.

Sampling Method	Frequency	New Detections	Preliminary Detections	QA/QC Detections	Genetically Confirmed to Date	Total WY2023	Notes
EDSM	Weekly	1	N/A	33	1	35	Phase 2 began 4/4/23 Phase 1 ended 4/28/23
SKT	Monthly	0	N/A	4	N/A	4	Complete
SLS	Biweekly	0	0	4	N/A	4	Complete
20-mm	Biweekly	1	N/A	12	N/A	13	Ongoing
Summer Townet	Biweekly	0	N/A	N/A	N/A	0	Begins: June
Bay Study	Monthly	0	N/A	N/A	N/A	0	Ongoing
FMWT	Monthly	0	N/A	N/A	N/A	0	Complete
Chippis Island Trawl	Weekly	0	N/A	2	N/A	2	Ongoing
FCCL Brood Stock Collections	Weekly	0	N/A	2	N/A	2	Ongoing
LEPS	As available	0	N/A	N/A	N/A	0	Complete

Sampling Method	Frequency	New Detections	Preliminary Detections	QA/QC Detections	Genetically Confirmed to Date	Total WY2023	Notes
FRP	Daily	0	N/A	N/A	N/A	0	Ongoing
Tracy Fish Collection Facility (CVP)	Daily	0	N/A	9	N/A	9	Ongoing
Skinner Fish Facility (SWP)	Daily	0	N/A	4	N/A	4	Ongoing
Total	N/A	N/A	N/A	N/A	N/A	73	Sum of all Delta Smelt observed during the OMR Management Season

***Cultured Delta Smelt Experimental Releases***

- Experimental releases included:
  - 13,140 fish on November 30, 2022,
  - 17,570 fish on January 18-19, 2023, both at Rio Vista,
  - 12,995 in the Sacramento Deep Water Ship Channel.
- Experimental releases are complete.
- Details of Delta Smelt releases are available at: [SacPAS: Central Valley Prediction & Assessment of Salmon](#)

Table 9. Weekly summary of the origin of Delta Smelt. These identifications are considered tentative and additional genetic testing will confirm the identity of individuals. Individuals with no tags are provided alive to the FCCL as potential additions to the FCCL Broodstock.

Date	Survey	Stratum/Station	Total Caught	Ad. Clipped	VIE	No Tag
4/27/2023	EDSM (20mm)	Suisun Bay	1	N/A	N/A	X
4/24/2023	20mm	Lower Sacramento (706)	1	N/A	N/A	X

### ***Historical Trends***

- Upstream migration for Delta Smelt occurs between September and December and in response to “first flush” conditions (Sommer et al. 2011, Grimaldo et al. 2009). Migration typically ranges one to four weeks after flow and turbidity increases, based on salvage data (Sommer et al. 2011).
- Historically, detections of ripe Delta Smelt began in January and peaked in February and March and the majority of Delta Smelt spawning occurs within a temperature range of 9-18°C (Figure 4; Table 12; Damon et al. 2016).
- Based on historical monitoring data from the past few years (<https://github.com/Delta-Stewardship-Council/deltafish>), first detection of larvae in the Central and South Delta has typically occurred by mid to late March ([https://www.cbr.washington.edu/sacramento/tmp/hrtsalvage\\_1676407207\\_694.html](https://www.cbr.washington.edu/sacramento/tmp/hrtsalvage_1676407207_694.html)).
- Salvage data as presented on SacPas indicates that adult Delta Smelt salvage in recent years has reached the 50th percentile at the end of February – beginning of March.
- Historically, the highest peak in salvage is in May and the second highest is in June (Grimaldo et al 2009).

### ***Forecasted Distribution within Central Valley and Delta regions***

- Predicting the distribution of Delta Smelt is currently difficult because detection data is limited to a few wild individuals and historic patterns may not be representative of the low population levels.
- The SMT uses turbidity as a surrogate for Delta Smelt presence and in making assessments of the likelihood of entrainment for larval Delta Smelt after spawning begins.
- The potential of experimentally released Delta Smelt to distribute from their release site is unknown at this time and SMT cannot predict their distribution beyond the original release site and subsequent recaptures. There is a high degree of uncertainty regarding the response of cultured fish to environmental cues typically applied to wild Delta Smelt.

## Abiotic Conditions

### *Turbidity*

- Mostly clear and sunny with cooler temperatures at the beginning of this week will increase to 90-94°F by the end of the week. In Stockton, winds are forecast to be W at 7-15 mph, with gusts up to 20 mph, decreasing and becoming NW by Thursday. In Antioch, winds are forecast to be WSW at 14-18 mph with gusts up to 22 mph through Wednesday, becoming W at 9-11 mph.
- Turbidity is below 12 FNU at OBI and at other stations in the central and south Delta. Turbidity is expected to remain stable over the next week.

Table 10. Relevant Environmental Factors to the current management actions for Delta Smelt.

Date Reported	SJJ 3-day Average Water temperature (°C)	20 mm 4 Avg Secchi Depth (m)
5/4/2023	17.2	0.97*

\*Data from 4/24/2023-4/25/2023

### *X2 Conditions*

- As of 5/8/2023, X2 is estimated to be around Martinez (<56 km).
- When X2 is above 81 km, the SMT uses the X2\_EC\_Graph.xlsx tool to estimate the position of X2 for both the Sacramento and San Joaquin Rivers and assumes the average of the two is representative of an approximate X2 position.

### *Other Environmental Conditions*

- The Fish and Water Operation Outlook OMR Index values are expected to range between +3,500 to +13,000 cfs this week.
- QWEST was estimated at 31,500 cfs on 5/8/2023 and is expected to remain stable this week.
- Water temperature at Rio Vista was 14.2°C and at Antioch was 16.3°C on 5/8/2023.
- Real time tracking of environmental conditions, relevant thresholds and Delta Smelt catch data are updated daily at: [SacPAS: Central Valley Prediction & Assessment of Salmon](#).

## Evaluation

### USBR and DWR Proposed Operations:

- 5/9/2023-5/15/2023:

- The 3-day average water temperature at Jersey Point is greater than 12 degrees Celsius and the average Secchi depth at the 12 central and south Delta stations is less than 1 meter, requiring a 7-day average OMR index limit of less negative than or equal to -3,500 cfs for larval Delta smelt protection under the amended ITP COA 8.5.2. Also, COA 8.17 of the ITP, Export Curtailments for Spring Outflow, is effective, with 4:1 Vernalis flow/export ratios due to a Wet Year classification. However, three-day average Delta Outflow is above 44,500 cfs, so the condition is “off-ramped”.
- Due to high flows, the Bay/Delta is in excess conditions and the OMRI limit is not controlling exports.
- Interim Operations have been adopted. USBR will be adhering to ITP Protections for Larval & Juvenile Delta Smelt (COA 8.5.2) or the PA's Larval and Juvenile Smelt Protections, whichever is more protective.

1. Between December 1 and January 31, has any first flush condition been exceeded?

First flush conditions based on running 3-day average flow and running 3-day average turbidity at Freeport were met on December 31, 2022, triggering IEWPP regulations. The CVP and SWP reduced exports beginning on 1/3/2023 through 1/16/2023.

2. Do DSM have a high risk of migration and dispersal into areas at high risk of future entrainment? (December 1- January 31)

This is no longer applicable.

3. Has a spent female been collected?

A spent female has not been collected, but two cultured ripe females were caught by SKT on 2/8/2023. Some of the fish released in January were observed to be ripe and releasing eggs upon release. This could be due to warmer water temperatures at culture facilities, or due to stress from releases.

4. If OMR of -2000 cfs does not reduce OBI turbidity below 12NTU/FNU, what OMR target is deemed protective between -2000 and -5000 cfs?

This question is not applicable as the turbidity bridge avoidance action was off-ramped starting 2/9/2023 with the capture of two ripe, marked female Delta Smelt.

5. If OBI is 12 NTU/FNU, what do other station locations show?

This question is not applicable as the action was off-ramped starting 2/9/2023 with the capture of two ripe, marked female Delta Smelt.

6. If OBI is 12 NTU/FNU, is a turbidity bridge avoidance action not warranted? What is the supporting information?

This question is not applicable as the action was off-ramped starting 2/9/2023 with the capture of two ripe, marked female Delta Smelt.

7. After March 15 and if QWEST is negative, are larval or juvenile DSM within the entrainment zone of the CVP and SWP pumps based on surveys?

QWEST is positive and anticipated to remain positive through the week. Twenty-three confirmed and one preliminary larval DSM were detected since 3/13/2023, all outside of the entrainment zone.

8. Based on real-time spatial distribution of Delta Smelt and currently available turbidity information, should OMR be managed to no more negative than -3,500?

Turbidity and temperature conditions: On 4/24/2023-4/25/2023, 20 mm Survey #4 mean Secchi depth at the South Delta stations was below 1m (0.97m). The 3-day mean water temperature at Jersey Point exceeded 12°C on 3/18/23.

Real-time biological conditions: All confirmed and preliminarily identified larval DSM have been detected outside of the entrainment zone.

Current OMRI management: Yes, larval protection of an OMRI no more negative than -3500 cfs was triggered on 3/18/2023 and continues to be triggered based on temperature and Secchi depth data.

9. What do hydrodynamic models, informed by EDSM or other relevant data, suggest the estimated percentage of larval and juvenile DSM that could be entrained may be?

OMRI values are anticipated to be between +3,500 cfs and +13,000 cfs throughout the week. The majority of spawning typically occurs between 11-14°C but can continue up to 18°C (Damon et al. 2016; Attachment A, Figure 4). Daily and 3-day average water temperatures have decreased in response to cooler air temperatures but remain greater than 14°C. Based on detections in salvage earlier this season, adult fish were in the South Delta and may have spawned there. Spawning is ongoing, and no larvae have been detected inside of the entrainment zone. The likelihood of larval DSM entrainment is low, given highly positive OMRI and QWEST values.

## Delta Smelt References

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## Attachment A.

Table 11. Salmonid Genetic testing results for WY 2023 as of this assessment. Genetic identification of salmon is not used in calculating loss.

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C220127CVP	12/17/2022 22:00	185	171	late	male	Non-winter	1.000	Spring	1.000	Fall	CVP	C220127CVP
C220098SWP	12/18/2022 13:00	137	172	late	female	Non-winter	1.000	Spring	1.000	Winter	SWP	C220098SWP
C220099SWP	12/28/2022 5:00	154	181	late	male	Non-winter	1.000	Spring	0.607	Late Fall	SWP	C220099SWP
C220128CVP	12/30/2022 23:59	163	184	late	female	Non-winter	1.000	Fall	0.981	Late Fall	CVP	C220128CVP
C220180SWP	12/31/2022 3:00	180	184	late	male	Non-winter	1.000	Fall	1.000	Late Fall	SWP	C220180SWP
C230082SWP	1/1/2023 10:00	150	185	late	male	Non-winter	1.000	Fall	0.982	Winter	SWP	C230082SWP
C230083SWP	1/1/2023 11:00	113	185	late	female	Non-winter	1.000	Fall	0.988	Winter	SWP	C230083SWP
C230082CVP	1/2/2023 14:00	212	187	early	male	Non-winter	1.000	Fall	0.988	Fall	CVP	C230082CVP
C230001CVP	1/3/2023 10:00	35	187	late	female	Non-winter	1.000	Fall	0.982	Fall	CVP	C230001CVP
C230002CVP	1/3/2023 10:00	34	187	late	male	Non-winter	1.000	Fall	0.769	Fall	CVP	C230002CVP
C230003CVP	1/3/2023 10:00	33	187	late	female	Non-winter	1.000	Fall	0.930	Fall	CVP	C230003CVP
C230004CVP	1/3/2023 10:00	34	187	late	male	Non-winter	1.000	Fall	0.984	Fall	CVP	C230004CVP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230005CVP	1/3/2023 12:00	35	188	late	male	Non-winter	1.000	Unassigned	0.627	Fall	CVP	C230005C VP
C230006CVP	1/4/2023 8:00	38	188	late	female	Non-winter	1.000	Fall	0.996	Fall	CVP	C230006C VP
C230007CVP	1/4/2023 12:00	36	189	late	female	Non-winter	1.000	Fall	0.922	Fall	CVP	C230007C VP
C230008CVP	1/4/2023 12:00	38	189	late	female	Non-winter	1.000	Fall	0.999	Fall	CVP	C230008C VP
C230009CVP	1/4/2023 12:00	36	189	late	female	Non-winter	1.000	Spring	0.661	Fall	CVP	C230009C VP
C230010CVP	1/4/2023 14:00	38	189	late	male	Non-winter	1.000	Fall	0.645	Fall	CVP	C230010C VP
C230084SWP	1/4/2023 15:00	162	189	late	male	Non-winter	1.000	Fall	0.877	Late Fall	SWP	C230084S WP
C230012CVP	1/4/2023 22:00	148	189	late	male	Non-winter	1.000	Spring	0.836	Winter	CVP	C230012C VP
C230011CVP	1/5/2023 10:00	37	189	late	female	Non-winter	1.000	Fall	0.696	Fall	CVP	C230011C VP
C230013CVP	1/5/2023 14:00	163	190	late	female	Non-winter	1.000	Fall	1.000	Late Fall	CVP	C230013C VP
C230015CVP	1/11/2023 6:00	38	195	late	male	Non-winter	1.000	Fall	0.970	Fall	CVP	C230015C VP
C230016CVP	1/12/2023 8:00	166	196	late	female	Non-winter	1.000	Spring	0.870	Winter	CVP	C230016C VP
C230019CVP	1/12/2023 10:00	42	196	late	male	Non-winter	1.000	Spring	0.870	Fall	CVP	C230019C VP
C230018CVP	1/12/2023 12:00	34	197	late	female	Non-winter	1.000	Fall	0.986	Fall	CVP	C230018C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230020CVP	1/12/2023 23:59	31	197	late	male	Non-winter	1.000	Fall	0.998	Fall	CVP	C230020C VP
C230021CVP	1/13/2023 6:00	35	197	late	male	Non-winter	1.000	Fall	0.981	Fall	CVP	C230021C VP
C230022CVP	1/13/2023 10:00	35	197	late	male	Non-winter	1.000	Spring	0.917	Fall	CVP	C230022C VP
C230023CVP	1/13/2023 23:59	38	198	late	male	Non-winter	1.000	Fall	0.966	Fall	CVP	C230023C VP
C230024CVP	1/14/2023 2:00	38	198	late	female	Non-winter	1.000	Fall	0.999	Fall	CVP	C230024C VP
C230025CVP	1/14/2023 6:00	35	198	late	male	Non-winter	1.000	Fall	0.994	Fall	CVP	C230025C VP
C230026CVP	1/14/2023 6:00	195	198	late	male	Non-winter	1.000	Fall	1.000	Late Fall	CVP	C230026C VP
C230027CVP	1/14/2023 14:00	36	199	late	female	Non-winter	1.000	Fall	0.991	Fall	CVP	C230027C VP
C230086SW P	1/17/2023 7:45	149	201	late	female	Non-winter	1.000	Fall	0.950	Winter	SWP	C230086S WP
C230029CVP	1/17/2023 8:00	36	201	late	female	Non-winter	1.000	Fall	0.998	Fall	CVP	C230029C VP
C230031CVP	1/17/2023 23:59	36	202	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230031C VP
C230032CVP	1/17/2023 23:59	35	202	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230032C VP
C230033CVP	1/17/2023 23:59	35	202	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230033C VP
C230034CVP	1/18/2023 4:00	35	202	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230034C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230035CVP	1/18/2023 4:00	35	202	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230035C VP
C230036CVP	1/18/2023 12:00	38	203	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230036C VP
C230037CVP	1/18/2023 14:00	37	203	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230037C VP
C230038CVP	1/18/2023 16:00	34	203	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230038C VP
C230039CVP	1/19/2023 10:00	32	203	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230039C VP
C230040CVP	1/19/2023 10:00	37	203	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230040C VP
C230041CVP	1/19/2023 14:00	37	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230041C VP
C230042CVP	1/19/2023 18:00	35	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230042C VP
C230043CVP	1/19/2023 18:00	30	204	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230043C VP
C230044CVP	1/19/2023 18:00	38	204	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230044C VP
C230045CVP	1/20/2023 2:00	35	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230045C VP
C230046CVP	1/20/2023 2:00	35	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230046C VP
C230047CVP	1/20/2023 2:00	34	204	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230047C VP
C230048CVP	1/20/2023 6:00	35	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230048C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230049CVP	1/20/2023 10:00	37	204	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230049C VP
C230050CVP	1/20/2023 18:00	30	205	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230050C VP
C230051CVP	1/21/2023 12:00	34	206	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230051C VP
C230052CVP	1/22/2023 2:00	38	206	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230052C VP
C230053CVP	1/22/2023 12:00	35	207	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230053C VP
C230054CVP	1/22/2023 14:00	36	207	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230054C VP
C230055CVP	1/23/2023 12:00	37	208	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230055C VP
C230056CVP	1/24/2023 14:00	37	209	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230056C VP
C230057CVP	1/26/2023 14:00	35	211	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230057C VP
C230058CVP	1/26/2023 23:59	37	211	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230058C VP
C230060CVP	1/27/2023 8:00	42	211	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230060C VP
C230061CVP	1/27/2023 10:00	37	211	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230061C VP
C230062CVP	1/27/2023 14:00	35	212	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230062C VP
C230063CVP	1/27/2023 18:00	52	212	late	female	Non-winter	1.000	Fall	1.000	Spring	CVP	C230063C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230064CVP	1/27/2023 18:00	36	212	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230064C VP
C230065CVP	1/27/2023 18:00	30	212	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230065C VP
C230066CVP	1/28/2023 12:00	36	213	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230066C VP
C230067CVP	1/28/2023 14:00	35	213	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230067C VP
C230068CVP	1/29/2023 8:00	37	213	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230068C VP
C230069CVP	1/29/2023 8:00	39	213	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230069C VP
C230070CVP	1/29/2023 8:00	38	213	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230070C VP
C230071CVP	1/29/2023 8:00	39	213	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230071C VP
C230072CVP	1/29/2023 8:00	37	213	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230072C VP
C230073CVP	1/29/2023 8:00	38	213	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230073C VP
C230074CVP	1/30/2023 6:00	38	214	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230074C VP
C230075CVP	1/30/2023 6:00	36	214	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230075C VP
C230076CVP	1/30/2023 8:00	145	214	late	male	Non-winter	1.000	Spring	1.000	Winter	CVP	C230076C VP
C230077CVP	1/30/2023 8:00	36	214	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230077C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230078CVP	1/30/2023 18:00	45	215	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230078C VP
C230079CVP	1/30/2023 18:00	36	215	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230079C VP
C230080CVP	1/30/2023 20:00	37	215	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230080C VP
C230081CVP	1/30/2023 22:00	34	215	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230081C VP
C230084CVP	1/31/2023 8:00	40	215	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230084C VP
C230085CVP	1/31/2023 8:00	40	215	early	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230085C VP
C230086CVP	1/31/2023 16:00	34	216	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230086C VP
C230087CVP	1/31/2023 20:00	44	216	early	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230087C VP
C230088CVP	2/1/2023 8:00	38	216	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230088C VP
C230089CVP	2/1/2023 10:00	35	216	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230089C VP
C230090CVP	2/1/2023 10:00	37	216	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230090C VP
C230091CVP	2/1/2023 20:00	34	217	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230091C VP
C230092CVP	2/1/2023 20:00	33	217	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230092C VP
C230093CVP	2/2/2023 10:00	41	217	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230093C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230094CVP	2/2/2023 12:00	39	218	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230094C VP
C230097CVP	2/3/2023 6:00	42	218	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230097C VP
C230098CVP	2/3/2023 6:00	48	218	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230098C VP
C230099CVP	2/5/2023 6:00	38	220	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230099C VP
C230100CVP	2/5/2023 6:00	36	220	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230100C VP
C230102CVP	2/5/2023 14:00	41	221	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230102C VP
C230103CVP	2/6/2023 8:00	38	221	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230103C VP
C230104CVP	2/6/2023 8:00	38	221	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230104C VP
C230105CVP	2/6/2023 8:00	34	221	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230105C VP
C230106CVP	2/7/2023 6:00	38	222	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230106C VP
C230107CVP	2/7/2023 18:00	39	223	late	female	Non-winter	1.000	Fall	0.992	Fall	CVP	C230107C VP
C230108CVP	2/9/2023 12:00	38	225	late	male	Non-winter	1.000	Spring	0.602	Fall	CVP	C230108C VP
C230109CVP	2/9/2023 12:00	40	225	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230109C VP
C230087SW P	2/10/2023 9:00	35	225	late	female	Non-winter	1.000	Fall	0.977	Fall	SWP	C230087S WP



ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230110CVP	2/15/2023 10:00	53	230	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230110C VP
C230111CVP	2/16/2023 23:59	48	232	late	female	Non-winter	1.000	Fall	0.999	Fall	CVP	C230111C VP
C230112CVP	2/18/2023 6:00	44	233	late	female	Non-winter	1.000	Spring	0.609	Fall	CVP	C230112C VP
C230113CVP	2/22/2023 12:00	48	238	late	male	Non-winter	1.000	Spring	1.000	Fall	CVP	C230113C VP
C230114CVP	2/23/2023 18:00	34	239	late	male	Non-winter	1.000	Spring	1.000	Fall	CVP	C230114C VP
C230115CVP	2/23/2023 23:59	130	239	early	male	Winter	1.000	Winter	1.000	Winter	CVP	C230115C VP
C230116CVP	2/28/2023 10:00	138	243	late	male	Non-winter	1.000	Spring	1.000	Winter	CVP	C230116C VP
C230117CVP	2/28/2023 23:59	148	244	late	female	Non-winter	1.000	Spring	1.000	Winter	CVP	C230117C VP
C230118CVP	3/3/2023 4:00	171	246	late	female	Non-winter	1.000	Late Fall	1.000	Winter	CVP	C230118C VP
C230121CVP	3/3/2023 20:00	35	247	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230121C VP
C230123CVP	3/3/2023 20:00	55	247	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230123C VP
C230124CVP	3/4/2023 4:00	38	247	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230124C VP
C230125CVP	3/4/2023 16:00	38	248	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230125C VP
C230126CVP	3/5/2023 2:00	57	248	early	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230126C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230127CVP	3/5/2023 2:00	60	248	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230127C VP
C230128CVP	3/5/2023 6:00	37	248	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230128C VP
C230129CVP	3/5/2023 8:00	62	248	late	male	Non-winter	1.000	Fall	1.000	Spring	CVP	C230129C VP
C230131CVP	3/5/2023 10:00	38	248	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230131C VP
C230132CVP	3/5/2023 12:00	39	249	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230132C VP
C230133CVP	3/5/2023 14:00	40	249	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230133C VP
C230135CVP	3/6/2023 8:00	36	249	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230135C VP
C230136CVP	3/6/2023 20:00	36	250	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230136C VP
C230137CVP	3/7/2023 2:00	40	250	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230137C VP
C230139CVP	3/7/2023 10:00	37	250	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230139C VP
C230140CVP	3/8/2023 4:00	40	251	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230140C VP
C230141CVP	3/8/2023 12:00	57	252	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230141C VP
C230142CVP	3/8/2023 14:00	39	252	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230142C VP
C230088SW P	3/8/2023 15:00	156	252	late	female	Non-winter	1.000	Fall	1.000	Winter	SWP	C230088S WP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230144CVP	3/12/2023 20:00	73	256	early	female	Non-winter	1.000	Fall	1.000	Spring	CVP	C230144C VP
C230145CVP	3/13/2023 2:00	60	256	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230145C VP
C230146CVP	3/13/2023 8:00	37	256	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230146C VP
C230147CVP	3/13/2023 8:00	53	256	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230147C VP
C230148CVP	3/13/2023 10:00	38	256	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230148C VP
C230149CVP	3/13/2023 16:00	33	257	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230149C VP
C230150CVP	3/13/2023 16:00	43	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230150C VP
C230152CVP	3/13/2023 18:00	137	257	late	female	Non-winter	1.000	Fall	1.000	Winter	CVP	C230152C VP
C230151CVP	3/13/2023 18:00	51	257	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230151C VP
C230153CVP	3/13/2023 22:00	34	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230153C VP
C230154CVP	3/14/2023 2:00	35	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230154C VP
C230155CVP	3/14/2023 8:00	37	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230155C VP
C230156CVP	3/14/2023 8:00	38	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230156C VP
C230157CVP	3/14/2023 9:00	35	257	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230157C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230158CVP	3/14/2023 9:00	37	257	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230158C VP
C230159CVP	3/14/2023 9:00	37	257	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230159C VP
C230160CVP	3/14/2023 16:00	36	258	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230160C VP
C230162CVP	3/14/2023 20:00	38	258	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230162C VP
C230163CVP	3/15/2023 2:00	80	258	late	male	Non-winter	1.000	Fall	1.000	Spring	CVP	C230163C VP
C230164CVP	3/15/2023 8:00	38	258	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230164C VP
C230165CVP	3/15/2023 8:00	36	258	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230165C VP
C230166CVP	3/15/2023 12:00	37	259	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230166C VP
C230168CVP	3/15/2023 12:00	37	259	late	male	Non-winter	1.000	Fall	1.000	Fall	CVP	C230168C VP
C230169CVP	3/16/2023 8:00	36	259	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230169C VP
C230089SW P	3/16/2023 13:00	77	260	early	female	Non-winter	1.000	Fall	1.000	Spring	SWP	C230089S WP
C230170CVP	3/18/2023 22:00	36	262	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230170C VP
C230171CVP	3/18/2023 23:59	38	262	late	female	Non-winter	1.000	Fall	1.000	Fall	CVP	C230171C VP
C230179CVP	3/30/2023 23:59	228	274	late	male	Non-winter	1.000	Spring	1.000	Winter	CVP	C230179C VP

ID	Sample Date	Fork Length	Julian	ots28	sexid	Assignment	PosProb1	Group	PosProb2	Model	Facility	Original ID
C230181CVP	4/3/2023 22:00	154	278	late	female	Non-winter	1.000	Fall	0.989	Winter	CVP	C230181C VP
C230165SWP	4/11/2023 14:00	122	286	early	male	Non-winter	1.000	Spring	1.000	Spring	SWP	C230165S WP
C230092SWP	4/12/2023 9:00	135	286	early	female	Non-winter	1.000	Spring	1.000	Winter	SWP	C230092S WP
C230249CVP	4/25/2023 14:00	176	300	late	male	Non-winter	1.000	Fall	1.000	Winter	CVP	C230249C VP

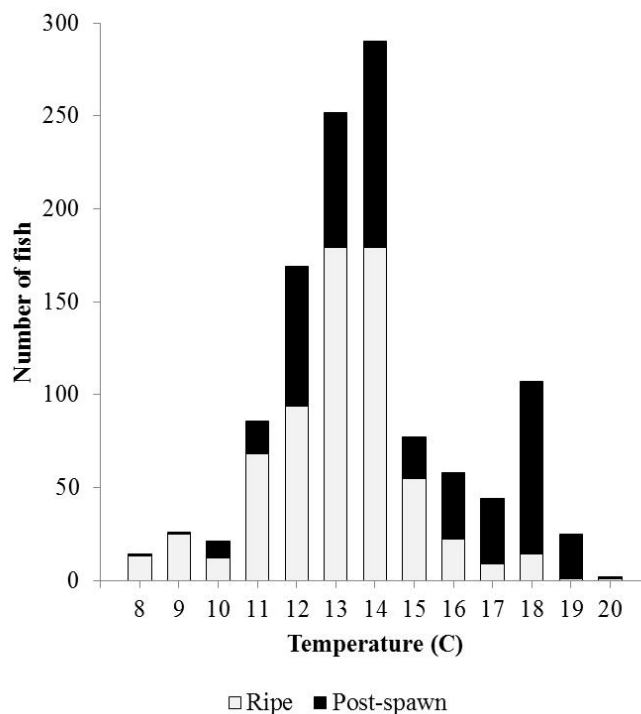


Figure 4.—The number of ripe (grey) or post-spawn (black) delta smelt caught in a specific temperature range during routine monthly sampling in the upper San Francisco Estuary during January-May for years 2002-2015 (Figure 8 from Damon et al. 2016).

Table 12. Number and size range (mm FL) of near-ripe female delta smelt on their first or subsequent clutch of eggs by month of collection. Delta smelt were used in this study’s fecundity analysis and collected during routine monthly sampling during January-May for years 2012-2015 (Table 3 from Damon et al. 2016).

Month	First	Subsequent	Total
January	2 (72-73)	0	2 (72-73)
February	41 (56-84)	2 (65-85)	43 (56-85)
March	37 (63-77)	5 (63-81)	42 (63-81)
April	6 (62-82)	9 (65-90)	15 (62-90)
May	7 (68-78)	20 (69-83)	27 (68-83)