

Delta Operations for Salmonids and Sturgeon (DOSS) Group
Conference call: 3/1/16 at 9:00 a.m.

Objective: Provide advice to the Water Operations Management Team (WOMT) and National Marine Fisheries Service (NMFS) on measures to reduce adverse effects from Delta operations of the Central Valley Project and the State Water Project on salmonids and green sturgeon. DOSS will work with other technical teams. DOSS notes and advice can be found at: http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html.

DWR: Aaron Miller, Rhiannon Mulligan, Jim Gleim
Reclamation: Josh Israel, Peggy Manza
NMFS: Barb Byrne, Jeff Stuart
CDFW: Bob Fujimura, Duane Linander, Ken Kundargi
SWRCB: Matt Holland, Laurel Karren
FWS: Craig Anderson
EPA: Erin Foresman

Agenda Items

1. Agenda review and introductions
2. RPA Implementation review
3. Current Operations
4. Smelt Working Group
5. Fish Monitoring: Salvage
6. Fish Monitoring: Hatchery winter-run Chinook acoustic-tracking
7. Fish Monitoring: RSTs/trawls/seines
8. DOSS Estimates of Fish Distribution and Entrainment Risk
9. DOSS Advice
10. Next DOSS meeting

Agenda Item 2.

RPA Implementation Review

Delta RPA Actions that may affect operations during March:

Action IV.1.2¹ (DCC gate operations):

- DCC gates have been closed since 12/15/15.

Action IV.2.3² (OMR Flow Management)

- No triggers exceeded over past week.
- OMR limit of -5,000 cfs is in effect

¹ For details, see pages 62-66 in Enclosure 2 of the 2011 Amendments to the 2009 RPA document at: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf

² For details, see pages 74-79 in Enclosure 2 of the 2011 Amendments to the 2009 RPA document at: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf

Agenda Item 3.

Current Operations (3/1/16)

SWP		CVP	
Exports (cfs)			
Clifton Court Forebay	2,360	Jones Pumping Plant	3,400
Reservoir Releases (cfs)			
Feather - Oroville	950*	American - Folsom	Ramping down to 3000 cfs by 2 am on 3/2/16
		Sacramento - Keswick	3,250
		Stanislaus - Goodwin	200
		Trinity - Lewiston	300
Reservoir Storage (in TAF)			
San Luis (SWP)	577	San Luis (CVP)	311
Oroville	1,865	Shasta	2,766
New Melones	459	Folsom	606
Delta Operations			
DCC	Closed	Sacramento River at Freeport (cfs)	15,393
Outflow Index (cfs)	10,873	San Joaquin River at Vernalis (cfs)	793
E:I	30% (14-day avg.) 31% (3-day avg.)	X2	70 km

*Releases will be ramped down to 800 cfs later today (3/1/16).

OMR as of 2/26/16:

	USGS gauges (cfs)	Index ³ (cfs)
5-day	-5,070	-4,990
14-day	-5,110	-4,990

Review of factors controlling Delta exports for the period 2/23/16 to 3/1/16:

- *Friday (2/23/16) – Tuesday (3/1/16):* -5,000 cfs OMR limit per both NMFS BiOp and 2/10/16 FWS determination.

DWR reported that based on preliminary estimates of the Eight River Index for February 2016, it is expected that 31 “Chippis Days” will be required during March 2016 per the D-1641 outflow

³ Beginning 2/16/16, the OMR Index values reported in the DOSS notes were calculated using an OMR Index equation that no longer includes (per the original intent of the index equation) the Contra Costa Water District’s Rock Slough diversion in the export term. Beginning February 2016, the OMR Index values reported in the monthly OMR reports on the “CVO Reports” website (<http://www.usbr.gov/mp/cvo/index.html>) were calculated using this adjusted equation without the Rock Slough diversion.

requirement. Today, and over much of the next week, the “Chippys Day” requirement⁴ is expected to be met based on electrical conductivity rather than outflow.

A significant storm may be coming over the weekend; the Bend Bridge river guidance plot⁵ shows flows increasing from the current flow of ~5,700 cfs to ~30,000 cfs by Sunday.

Agenda Item 4.

Smelt Working Group

The SWG met on Monday, 2/29/16 at 10am. Byrne (NMFS) provided the following SWG meeting summary:

The Working Group reviewed current Delta Smelt distribution, salvage data, and Delta conditions. The Working Group described the risk of entrainment under the Service-provided advice framework. Under this framework the relative risk of entrainment for OMR flow ranges is discussed and assessed. For the current week, the risk of entrainment of adult delta smelt for each of the flow ranges is characterized as follows:

- -1250 to -2000 cfs has a low risk of entrainment,
- -2000 to -3500 cfs has a medium risk of entrainment,
- -3500 to -5000 cfs has a medium to high risk of entrainment.

The Working Group is following guidance for entrainment protections from both Action 2 (adult Delta Smelt) and Action 3 (juvenile Delta Smelt). The risk values provided for this week refer to adult Delta Smelt. The Working Group will continue to monitor Delta Smelt survey and salvage data and Delta conditions, and will meet again on Monday, March 7, 2016 at 10 am.

SWG meeting notes are available at: http://www.fws.gov/sfbaydelta/cvp-swp/smelt_working_group.cfm.

Agenda Item 5.

Fish Monitoring: Salvage⁶

Fujimura (CDFW) provided the following summaries of salvage and loss at the SWP and CVP fish collection facilities. The salvage figures were generated on the CDFW salvage monitoring web-page: <http://www.dfg.ca.gov/delta/apps/salvage/SalvageExportCalendar.aspx>.

⁵ http://cdec.water.ca.gov/guidance_plots/BND_gp.html

⁵ http://cdec.water.ca.gov/guidance_plots/BND_gp.html

⁶ Salvage data reported in this section represent the total estimated and expanded salvage based on the number of fish observed at the fish collection facility. For example, if one steelhead is observed in the typical ½-hour sampling period within a 2-hour operation period, the single steelhead is expanded to a salvage of four.

DOSS Weekly Salvage Update

Reporting Period: February 22-February 28, 2016
 Prepared by Bob Fujimura on February 29, 2016 13:47
 Preliminary Results -Subject to Revision

Criteria	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	Trend	
Loss Densities									
Wild older juvenile CS	0.25	0	0	0	0	0	0	↗	0.04
Wild steelhead	0	0	0	0	1.52	0	0	↘	0.22
Exports									
SWP daily export	4,859	4,974	5,190	4,791	4,660	4,314	4,663	→	4,779
CVP daily export	6,728	6,795	6,726	6,814	6,737	6,725	6,749	→	6,753
SWP reduced counts	0%	0%	0%	0%	0%	0%	0%	→	0%
CVP reduced counts	0%	0%	0%	0%	0%	0%	0%	→	0%

Loss Density = fish lost/TAF; water export = AF; Trend = compared to previous week; wild = adipose fin present
 Loss = estimated number of fish lost at the CVP and SWP Delta export facilities based on estimated salvage (see below)
 Reduced counts = percentage of time that routine salvage sample time were less than 30 min per 2 hours of salvage and export operations
 Yellow highlighted dates indicate TFCF salvage outage or operational impairment occurred

Chinook Salmon Weekly/Season Salvage and Loss

Combined salvage and loss for both CVP and SWP fish facilities
 Race determined by size at date of capture; hatchery = adipose fin missing;

Category	Weekly Total			Season Total	
	Salvage	Loss	Trend	Salvage	Loss
Wild					
Winter Run	4	3	↗	28	51
Spring Run	8	5	↗	16	10
Late Fall Run	0	0	→	44	166
Fall Run	4	3	↘	56	69
Unclassified	0	0	→	10	NC
Total	16	10		154	295
Hatchery					
Winter Run	0	0	→	193	599
Spring Run	0	0	→	0	0
Late Fall Run	0	0	→	93	298
Fall Run	0	0	→	1	4
Unclassified	0	0	→	0	0
Total	0	0		287	901

Trend = weekly loss per race; Salvage = estimated number of fish collected by the CVP and SWP fish protective facilities per unit of time
 NC = can not be calculated

Steelhead Weekly/Season Salvage and Loss

Combined salvage and loss for both CVP and SWP fish facilities

Category	Weekly Total			Season Total	
	Salvage	Loss	Trend	Salvage	Loss
Wild	4	17	↘	42	80
Hatchery	179	384	↘	627	1,594
Total	183	402		669	1,674

State Water Project loss = salvage x 4.33; Central Valley Project loss = salvage x 0.68

Figure 1. DOSS weekly salvage update for the reporting period 2/22/16-2/28/16. On 2/22/16 at the CVP facility, primary louver panel #7 to Bypass #2 became stuck and could not be fully lowered at 1:40 am. A repair crew was called and started work at about 3:30 am and the panel was fully lowered at 4:10 am. On 2/23/16 at the CVP facility, salvage was stopped for 20 minutes to install a hydrophone.

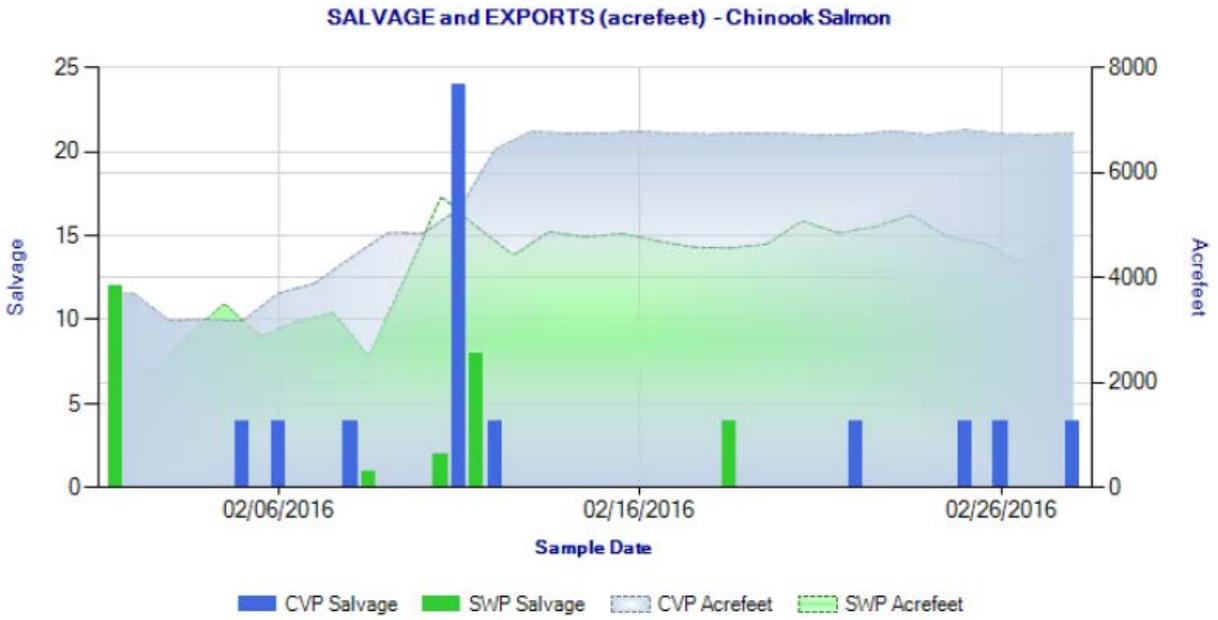


Figure 2. Daily salvage of Chinook salmon (all races) and water exports from the state and federal fish salvage facilities during February 2, 2016 through February 28, 2016.

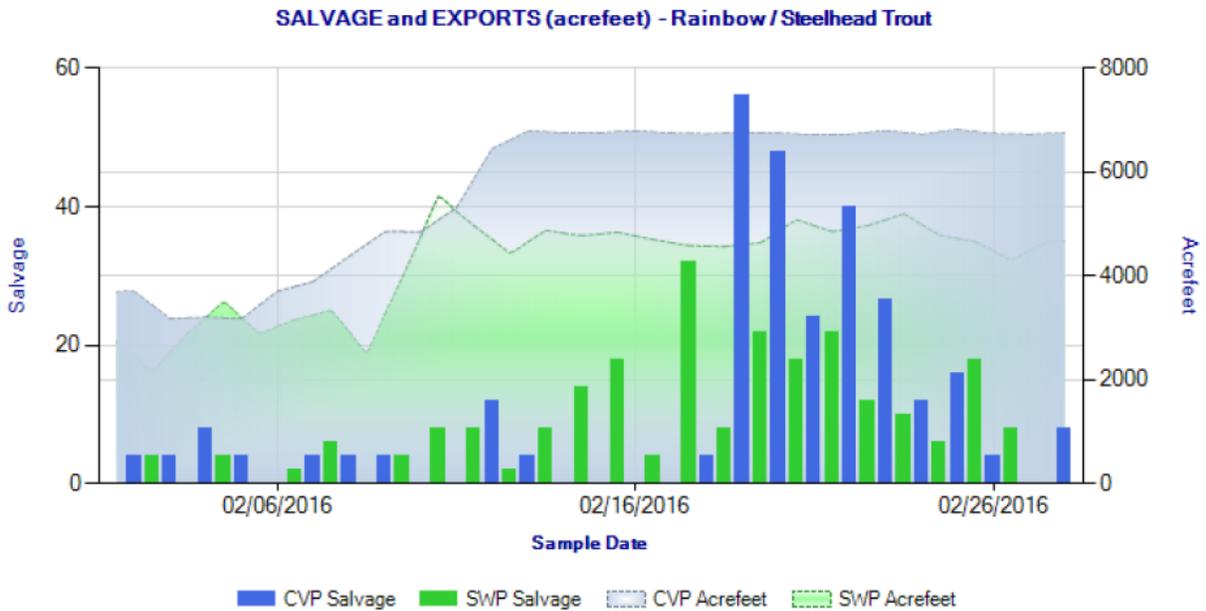


Figure 3. Daily salvage of steelhead and water exports from the state and federal fish salvage facilities during February 2, 2016 through February 28, 2016.

Preliminary salvage report for Monday, 2/29/16, was that a few clipped steelhead were observed for a total salvage of 8.

Coded-wire-tag recoveries

Mulligan (DWR) provided the following summary of coded-wire-tag recoveries at the SWP and CVP fish collection facilities. DOSS noted that the 0.412% cumulative loss of the third spring-run Chinook surrogate group (released from Coleman National Fish Hatchery on 1/12/16) was near 0.5%, an OMR trigger threshold under Action IV.2.3. However, no loss of hatchery Chinook has occurred since 2/12/16.

CONFIRMED HATCHERY (ADIPOSE-FIN CLIPPED) CHINOOK SALMON LOSS AT THE SWP & CVP DELTA FISH FACILITIES, 2015/2016

Release Date	CWT Race	Hatchery	Release Site	Release Type	Confirmed Loss	Number Released ₁	Total Entering Delta	% Loss of Number Released ₂	% Loss of Total Entering Delta ₃	First Concern Level	Second Concern Level	Date of First Loss ₄	Date of Last Loss ₄
6/11/2015 to 6/12/2015	LF	Coleman NFH	Balls Ferry Boat Ramp, Sacramento River	Production	0.00	434,227	n/a	0.000	n/a	n/a	n/a	-	-
12/9/2015	LF	Coleman NFH	Battle Creek	Production	305.22	261,213	n/a	0.117	n/a	n/a	n/a	12/25/2015	2/12/2016
12/11/2015	LF	Coleman NFH	Battle Creek	Spring Surrogate	128.05	77,000	n/a	0.166	n/a	0.5%	1.0%	12/25/2015	1/21/2016
12/22/2015	LF	Coleman NFH	Battle Creek	Spring Surrogate	170.59	68,000	n/a	0.251	n/a	0.5%	1.0%	1/6/2016	2/2/2016
1/12/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	278.65	67,700	n/a	0.412	n/a	0.5%	1.0%	1/20/2016	2/12/2016
2/17/2016 to 2/18/2016	W	Livingstone stone NFH	Sacramento River	Winter Run Production	0.00	420,006	155,400	0.000	0	0.5%	1.0%	-	-

UNCONFIRMED HATCHERY (ADIPOSE-FIN CLIPPED) CHINOOK SALMON LOSS AT THE SWP & CVP DELTA FISH FACILITIES, 2015/2016

Facility	Unknown CWT Loss ₅	Unread CWT Loss ₅	Unknown Hatchery Loss ₅	Acoustic Tag Loss ₅	Number of Unassigned CWT ₅
SWP	18.16	0.00	0.00	0.00	0
CVP	0.00	0.00	0.00	0.00	0
TOTAL	18.16	0.00	0.00	0.00	0

SWP and CVP adipose-fin clipped Chinook lost from 12/25/2015

¹Number released with the adipose-fin clipped and a coded-wire tag (CWT).

²% Loss of Number Released = (Confirmed Loss/Number Released)*100.

³% Loss of Total Entering Delta= (Confirmed Loss/Total Entering Delta)*100.

⁴Date of first and last loss accounts for all CWT loss even those from special studies where salvage and loss=0.

⁵Adipose-fin clipped Chinook was observed during fish count, but tag code could not be determined (e.g., damaged tag, lost tag, no tag, or Chinook accidentally released).

⁶Adipose-fin clipped Chinook was collected during fish count and has not been processed yet.

⁷CWT has been read, but hatchery release information not yet available.

⁸Adipose-fin clipped Chinook released due to presence of sutures.

⁹CWT cannot currently be assigned to a salvage record with certainty since the CWT was lost and then found. CWT may be assigned to a salvage record if new information is available.

** Information not yet available.

DWR-DES Revised 03/01/2016

Preliminary data from DFW, DWR, FWS, and Reclamation; subject to revision.

Agenda Item 6.

Fish Monitoring: Hatchery winter-run Chinook acoustic-tracking

Livingston Stone National Fish Hatchery released two groups of about 210,000 (for a total of approximately 420,000) hatchery winter-run Chinook at Bonnyview Bridge in Redding – one group on 2/17/16 and the other group on 2/18/16. 285 of each release group (for a total of 570) were acoustic-tagged with JSATS tags and NOAA’s Southwest Fisheries Science Center (SWFSC) is tracking movement of these acoustic-tagged fish past eight “real-time” receiver locations from Redding to Middle River.

Highlights from the latest (as of 10:00 am on 2/29/16) acoustic-tracking data from Arnold Amman (SWFSC) are provided below.

- Rough estimate of survival between Redding and Colusa is ~66%, the highest survival through that reach compared to the previous three years of data.
- Main pulse of winter-run hatchery migrants entered the Delta in late February; trickle of fish expected for at least a few more weeks.
- 27.4% of the first release and 32.3% of the second release have passed the Tower Bridge receiver in Sacramento.

Table 1. FIRST RELEASE ONLY - Preliminary Data, subject to change

Location	rkm of location	Total Fish detected	FASTEST FISH ID: 4AA8			
			First arrival	Travel Time (days)	Speed (rkm/day)	Speed (miles/day)
Bonneyview	540.4	285	2/17/2016 18:00			
Colusa	314.4	188	2/20/2016 5:40	2.5	90.9	56.5
Tisdale	269.2	147	2/20/2016 20:38	0.6	72.5	45.0
Knights Landing	224.1	120	2/21/2016 11:09	0.6	74.6	46.3
Verona	203.5	81	* went through this area when receivers not operating			
Tower Bridge	172.0	78	2/22/2016 4:22	0.7	72.6	45.1
I80 Bridge	170.8	77	2/22/2016 4:54	0.0	53.9	33.5
Hood	138.9	42				
Middle River	150	0				

Table 2. SECOND RELEASE ONLY - Preliminary Data, subject to change

Location	rkm of location	Total Fish detected	FASTEST FISH ID: 4AD2			
			First arrival	Travel Time (days)	Speed (rkm/day)	Speed (miles/day)
Bonneyview	540.4	285	2/18/2016 18:00			
Colusa	314.4	184	2/21/2016 9:18	2.6	85.7	53.2
Tisdale	269.2	151	2/22/2016 1:20	0.7	67.7	42.1
Knights Landing	224.1	118	2/22/2016 17:55	0.7	65.3	40.6
Verona	203.5	85	2/22/2016 23:30	0.2	88.4	54.9
Tower Bridge	172.0	92	2/23/2016 19:30	0.8	37.8	23.5
I80 Bridge	170.8	90	2/23/2016 20:01	0.0	56.1	34.8
Hood	138.9	53				
Middle River	150	0				

Bonneyview = site of release, fish trucked from LSNFH

rkm of location = distance via mainstem path from Golden Gate Bridge, GG Bridge = 0 rkm.

Travel Time = arrival date to location minus arrival date of location above / distance

Verona receivers not online until 2/22/2016 13:23

Hood receiver online starting 2/26/2016 14:35

Table 3. Survival estimates by reach for Livingston Stone National Fish Hatchery JSATS acoustic tagged winter-run juveniles for BY2012, BY2013, BY2014.

Reach	Reach Length (rkm)	Survival Estimates			
		BY2012	BY2013	BY2014 release 1	BY2014 release 2
Redding to Colusa	237	0.204	0.419	0.510	0.600
Colusa to Tisdale	45	0.811	0.983	0.989	0.968
Tisdale to Knights Landing	45	0.996	0.986	0.916	0.942
Kights Landing to Verona	21	0.900	1.000	0.973	0.999
Verona to Tower/I80 Bridge	32	1.000	0.931	0.972	0.962
I80 to Hood	33	NA	NA	NA	0.961
Redding to Tower/I80 Bridge	379	0.149	0.378	0.441	0.525

*BY = Brood Year, hatchery releases occur in next calander year, example BY2012 were released 2013
Survival estimates from Cormack-Jolly-Seber model with survival and detection probability varying by reach
Release of hatchery fish each year occurred in early February at Redding, Caldwell Park*

Table 4. Average travel time in days from release location to each downriver location for the two release groups of LSNFH winter-run Chinook salmon juveniles.

Location	rkm	Release Date	
		2/17/2016	2/18/2016
Colusa	314	5.5	5.1
Tisdale	269	7.0	6.4
Knights Landing	224	8.0	7.1
Verona	203	8.7	7.5
Tower Bridge	172	8.7	8.1
I80 Bridge	171	8.7	8.3
Hood	138	10.1	9.4

Agenda Item 7.

Fish Monitoring: RSTs/trawls/seines

The following table presents fish monitoring data. Unless otherwise noted, reported sizes are fork length. See also:

<http://www.water.ca.gov/swp/operationscontrol/calfed/calfedmonitoring.cfm>.

Location	Chippis Is. Midwater Trawl ^A	Station 902/Jersey Pt./Prisoners Pt. Trawls ^A	Sacramento Trawl ^A	Beach Seines ^A	Knights Landing RST ^B	Tisdale RST ^C	GCID RST ^D	Mossdale Kodiak Trawl ^A
Sample Date	2/22, 2/24, 2/26	902: 2/26 Jersey Pt: 2/23, 2/25 Pris. Pt: 2/22, 2/24	2/22, 2/24, 2/26	2/23, 2/25	2/22-2/29	2/22-2/28	2/24-2/29	2/22, 2/24, 2/26
FR Chinook			10	405	35	72	25	No species of management concern
WR Chinook	1			1	1		3	
SR Chinook				3	2	21		
LFR Chinook								
Ad-Clipped Chinook	4				43	77	40	
Chinook Adult								
Steelhead (wild)							1	
Steelhead (ad-clip)	9				2		3	
Green Sturgeon								
Delta Smelt		1						
Splittail				2				
Longfin Smelt	3							
Flows (avg. cfs)					7,997	8,108	977	
W. Temp. (avg. °F)					56.0	53.0	55.0	
Turbidity (avg. NTU)					13.9	16.9	8.9	

^A Data reported in the 2/21 to 2/27 DJFMP sampling summary

^B Sampling period was from 2/22 at 9:45 am to 2/29 at 11:00 am.

^C Sampling period was from 2/22 at 8:30 am to 2/28 at 8:30 am.

^D Sampling period was from 2/24 at 9:00 am to 2/29 at 9:00 am. From 2/19 to 2/24, the RST cone was raised to avoid the increase in flows, heavy debris, and the release of 420,000 hatchery winter-run Chinook salmon.

Monitoring Summary for DCC and Early Warning surveys: This table provides recent monitoring information not included in the 2/21 to 2/27 DJFMP sampling summary and thus not captured in the table above.

Location	Prisoners Pt. Trawls	Sacramento Trawl
Sample Date	2/29	2/29
FR Chinook	0	0
WR Chinook	0	0
SR Chinook	0	0
Ad-Clipped Chinook	0	0
Delta Smelt	0	0

Red Bluff Diversion Dam (RBDD) Monitoring

USFWS biweekly report (2/12/16-2/25/16) for preliminary estimates of passage by brood-year and run for unmarked juvenile Chinook salmon captured by rotary screw traps at RBDD included:

Run and Species	Biweekly Total	Brood Year Total
Winter-run Chinook (BY2015)	426	334,170

Agenda Item 8.

DOSS Estimates of Fish Distribution and Entrainment Risk

DOSS estimates of the current distribution of listed Chinook, as a percentage of the population, are based on recent monitoring data and historical migration timing patterns. As monitoring information is received, listed species distribution will be updated and included in the following table.

Location	Yet to Enter Delta (Upstream of Knights Landing)	In the Delta	Exited the Delta (Past Chipps Island)
<i>Young-of-year (YOY) winter-run Chinook salmon</i>	<5% (Last week: 5-10%)	>95% (Last week: 90-95%)	<5% (Last week: 0% - 5%)
<i>Young-of-year (YOY) spring-run Chinook salmon*</i>	30% - 40% (Last week: same)	60% - 70% (Last week: same)	0% - 5% (Last week: same)
<i>Hatchery winter-run Chinook salmon</i>	>50% (Last week: >95%)	25-50% (Last week: 0-5%)	<5% (Last week: 0%)

*When reviewing monitoring data, DOSS assumes that some of the juvenile Chinook categorized as fall-run (based on the length at date criteria) are actually genetic spring-run Chinook.

DOSS Feedback on Entrainment Risk

DOSS provides weekly entrainment risk outlooks by considering (a) two different categories of entrainment risk based on listed fish distribution and (b) factors that influence their potential for entrainment. The two entrainment risk categories considered include:

- **Interior Delta Entrainment Risk**- fish in the Sacramento River that have the potential to be entrained into the Interior Delta through the Delta Cross Channel (when open) and/or Georgiana Slough; and
- **CVP/SWP Facilities Entrainment Risk**- fish in the Interior Delta that have the potential to be entrained into the CVP/SWP facilities.

Influencing factors considered include:

- **Exposure Risk** (both categories)- estimated scale (low, medium, high) of fish anticipated to be in vicinity of an entrainment risk,
- **Routing Risk** (Interior Delta Entrainment Risk)- estimated scale (low, medium, high) that flow split conditions could result in fish migrating into the interior delta instead of remaining in main channel, and
- **OMR/Export Risk** (CVP/SWP Facilities Entrainment Risk)- for fish in the Interior Delta, estimated scale (low, medium, high) that OMR and/or Export levels could result in entrainment associated with CVP/SWP facilities.

To provide an overall assessment of entrainment risk, the estimated current status of these influencing factors are described below for each of the entrainment risk categories.

Interior Delta Entrainment Risk for listed salmonids in the Sacramento River over the next week:

- **Exposure Risk: MEDIUM**
 - Relatively low flows and turbidities are expected to be associated with limited salmonid movement.
- **Routing Risk: MEDIUM**
 - Relatively low river flows (compared to Sacramento River flows during January storms) are associated with greater tidal effects at Georgiana Slough and a medium risk of routing into Georgiana Slough.
- **Overall Entrainment Risk: MEDIUM**

CVP/SWP Facilities Entrainment Risk for listed salmonids in the Interior Delta over the next week:

- **Exposure Risk: MEDIUM**
 - Listed runs are expected to have previously migrated into and be rearing within the Interior Delta.
- **OMR/Export Risk:**
 - OMR -2,500 cfs to -3,500 cfs: LOW
 - OMR -3,500 cfs to -5,000 cfs: MEDIUM to HIGH
- **Overall Entrainment Risk:**
 - OMR -2,500 cfs to -3,500 cfs: LOW to MEDIUM
 - OMR -3,500 cfs to -5,000 cfs: MEDIUM

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DOSS Advice to WOMT and NMFS: None

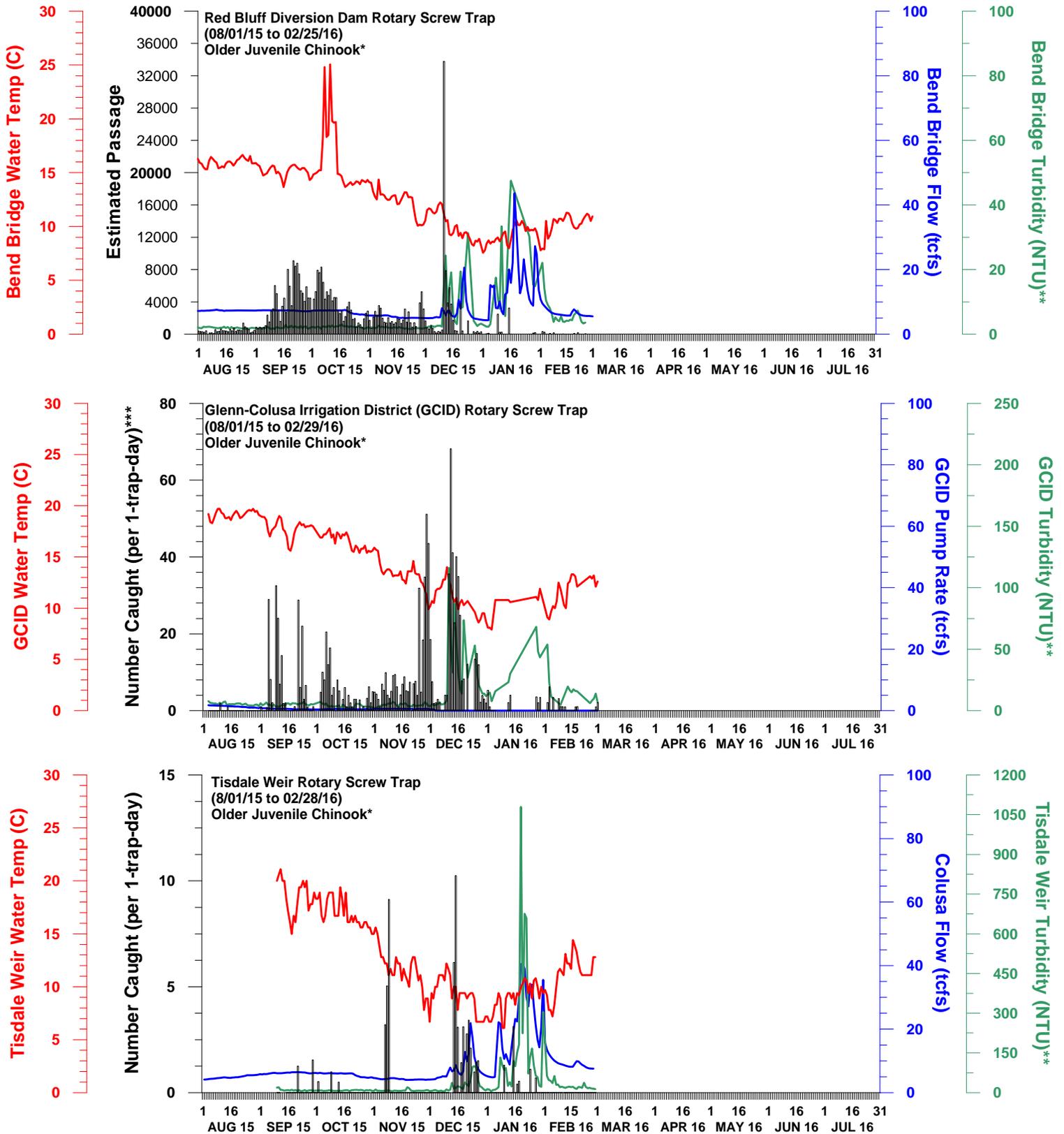
Agenda Item 10.

Next Meeting: The next DOSS conference call will be on 3/8/16 at 9am.

The following graphs were provided by DWR for Chinook salmon and steelhead observed at monitoring locations in the Sacramento and San Joaquin rivers and Delta. Also available at:

<http://www.water.ca.gov/swp/operationscontrol/calfed/calfedmonitoring.cfm>

NUMBER OF UNMARKED OLDER JUVENILE CHINOOK MEASURED IN THE SACRAMENTO RIVER

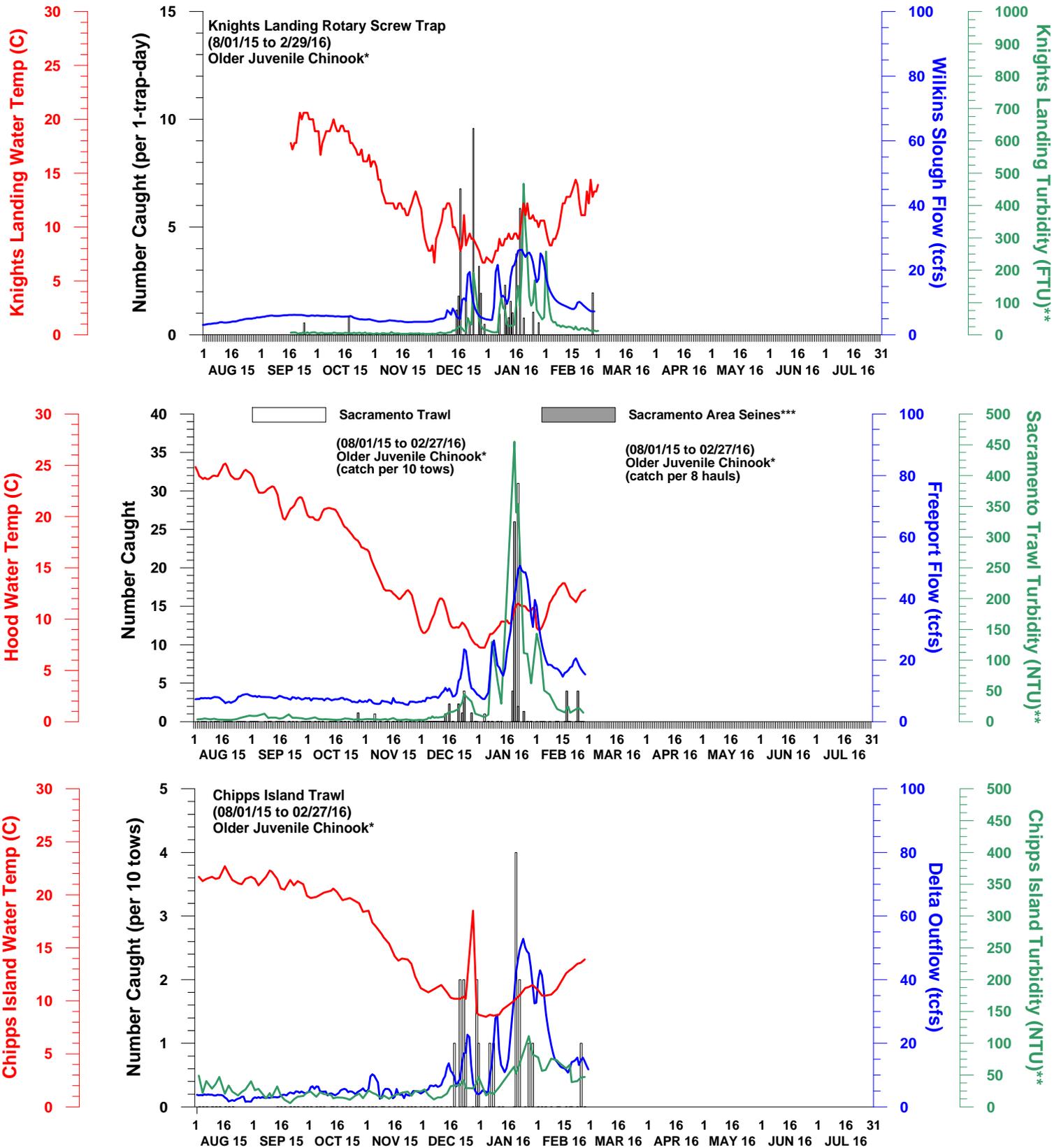


DWR-DES 01 MARCH 2016
Preliminary data from DFW, FWS, GCID, and CDEC; subject to revision.

*Older juvenile Chinook defined as all Chinook greater than or equal to the minimum winter run length-at-date criteria and less than the maximum size included in the length-at-date criteria (Frank Fisher model) for which a race is assigned on a given sampling date.

-Tisdale: 12/12/2015-12/13/2015 there was a river right revolution malfunction.

NUMBER OF UNMARKED OLDER JUVENILE CHINOOK MEASURED IN THE LOWER SACRAMENTO RIVER AND CHIPPS ISLAND



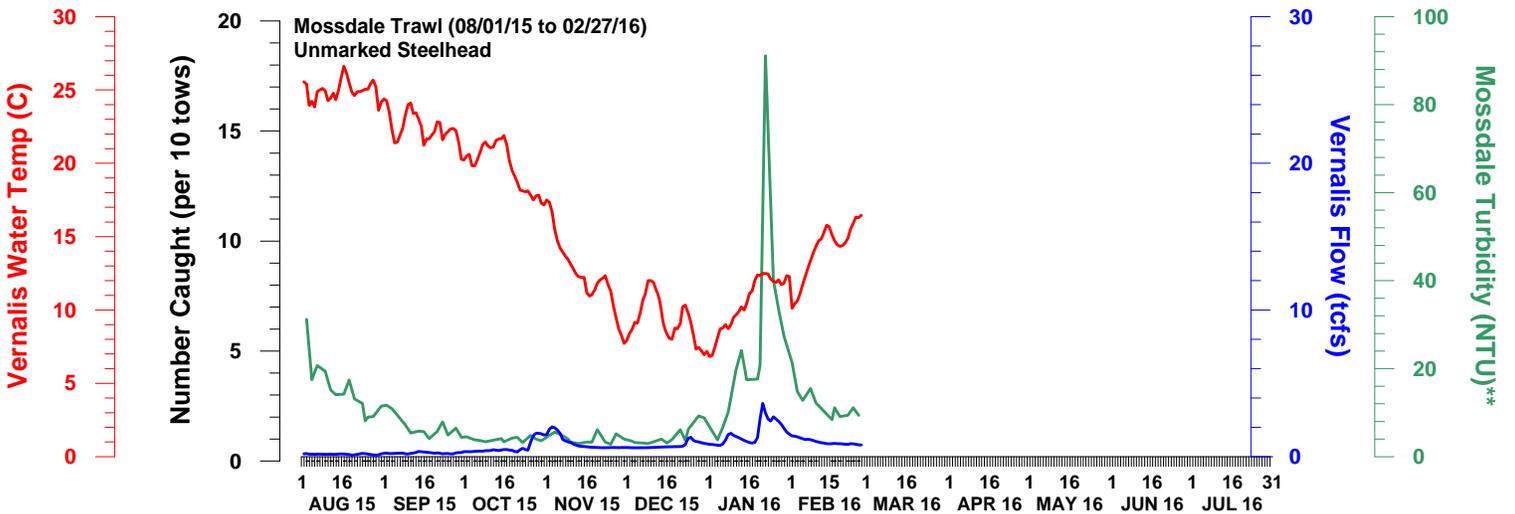
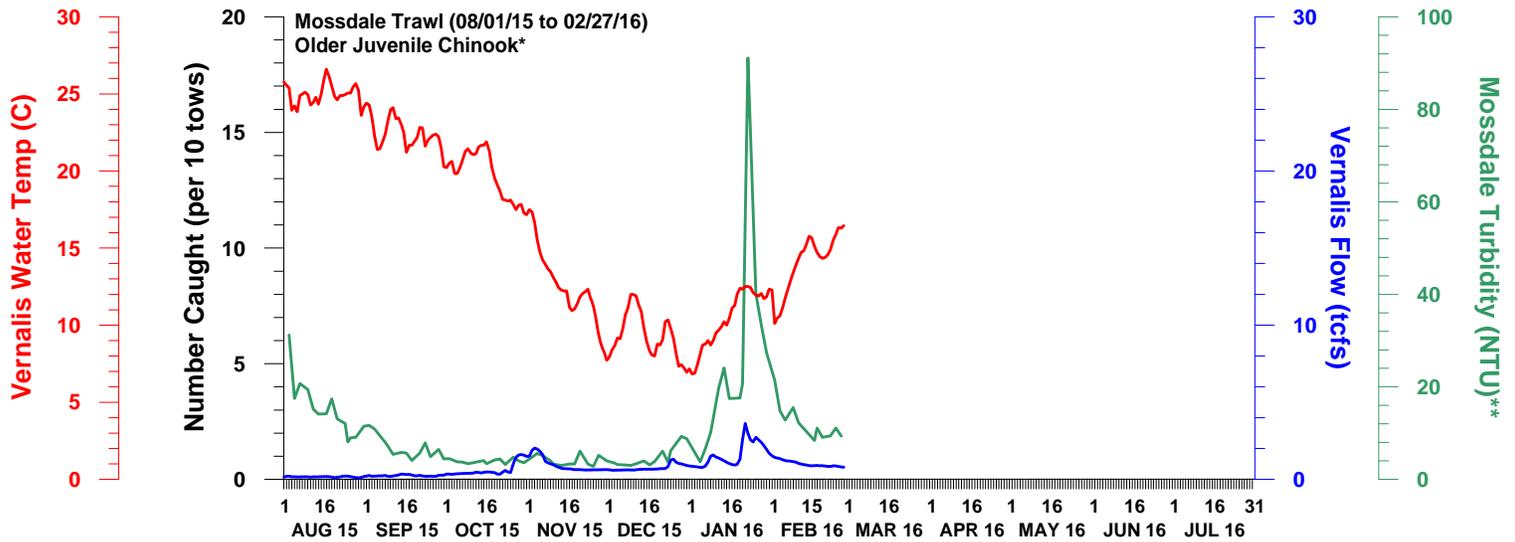
DWR-DES 01 MARCH 2016
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*Older juvenile Chinook defined as all Chinook greater than or equal to the minimum winter run length-at-date criteria and less than the maximum size included in the length-at-date criteria (Frank Fisher Model) for which a race is assigned on a given sampling date.

**Turbidity is a discrete measurement and is not measured continuously. Therefore, data are interpolated on days when turbidity was not measured unless data are missing for more than five days. Knights Landing turbidity measured in FTU, which should be roughly equivalent to NTU.

***Sacramento area seine route consists of the following seine sites: Verona, Elkhorn, Sand Cove, Discovery Park, American River, Miller Park, Sherwood Harbor, and Garcia Bend. Bars are stacked if Chinook caught from the trawl and seines are from the same day.

NUMBER OF UNMARKED OLDER JUVENILE CHINOOK AND STEELHEAD MEASURED IN THE SAN JOAQUIN RIVER

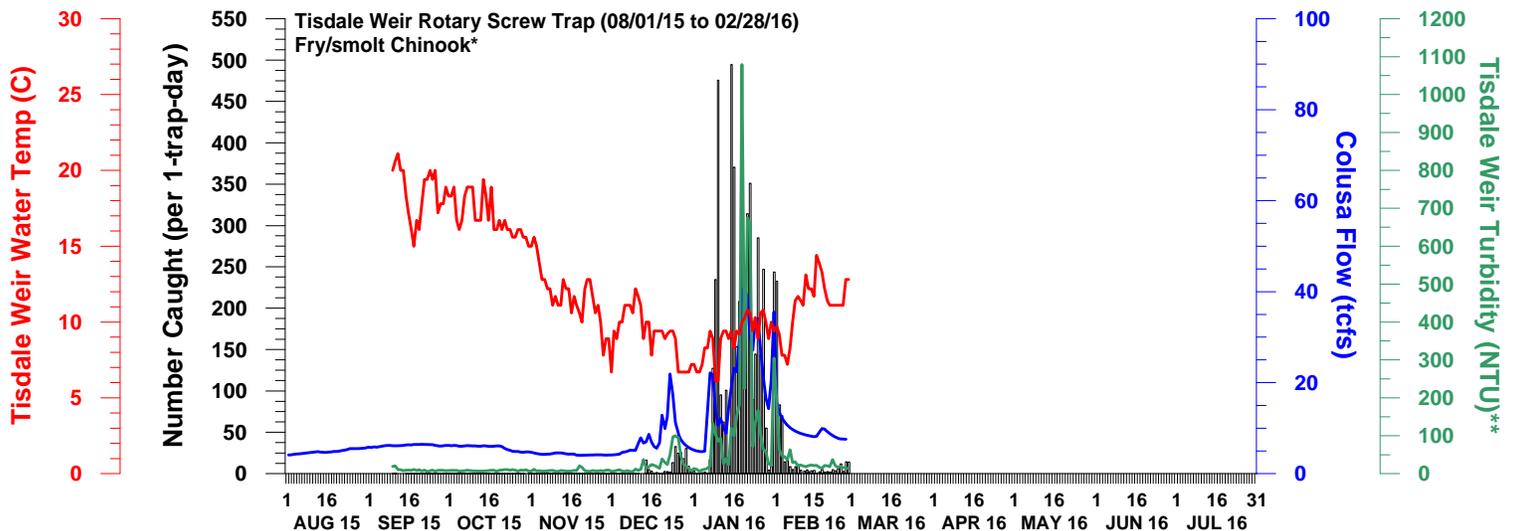
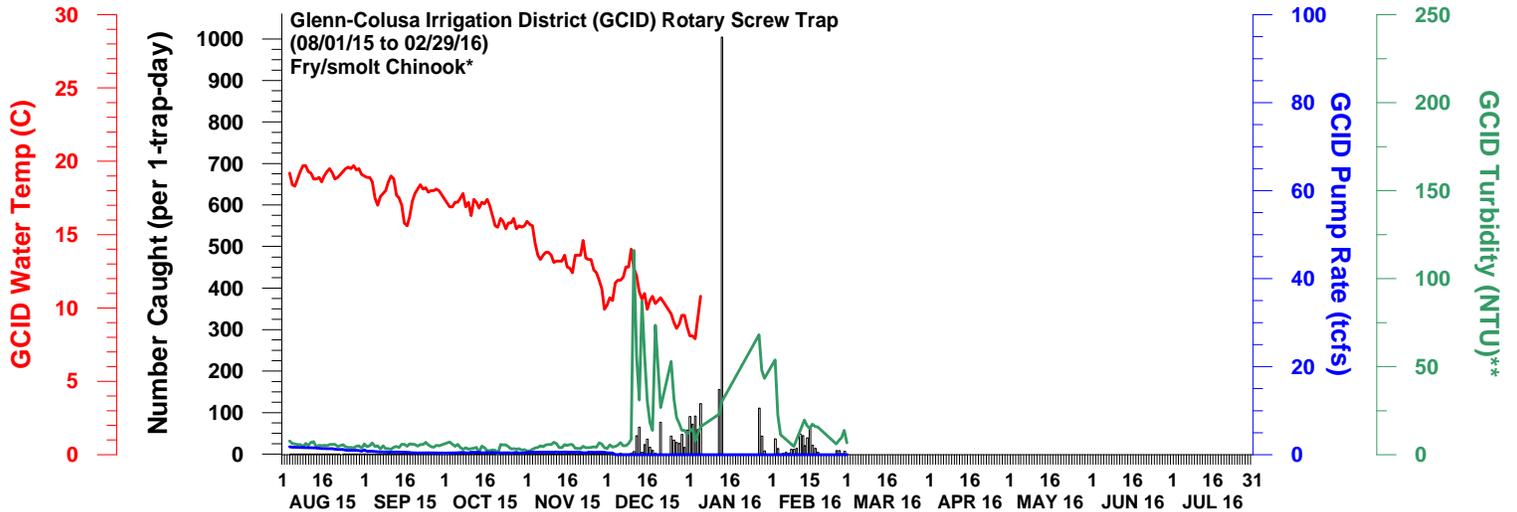
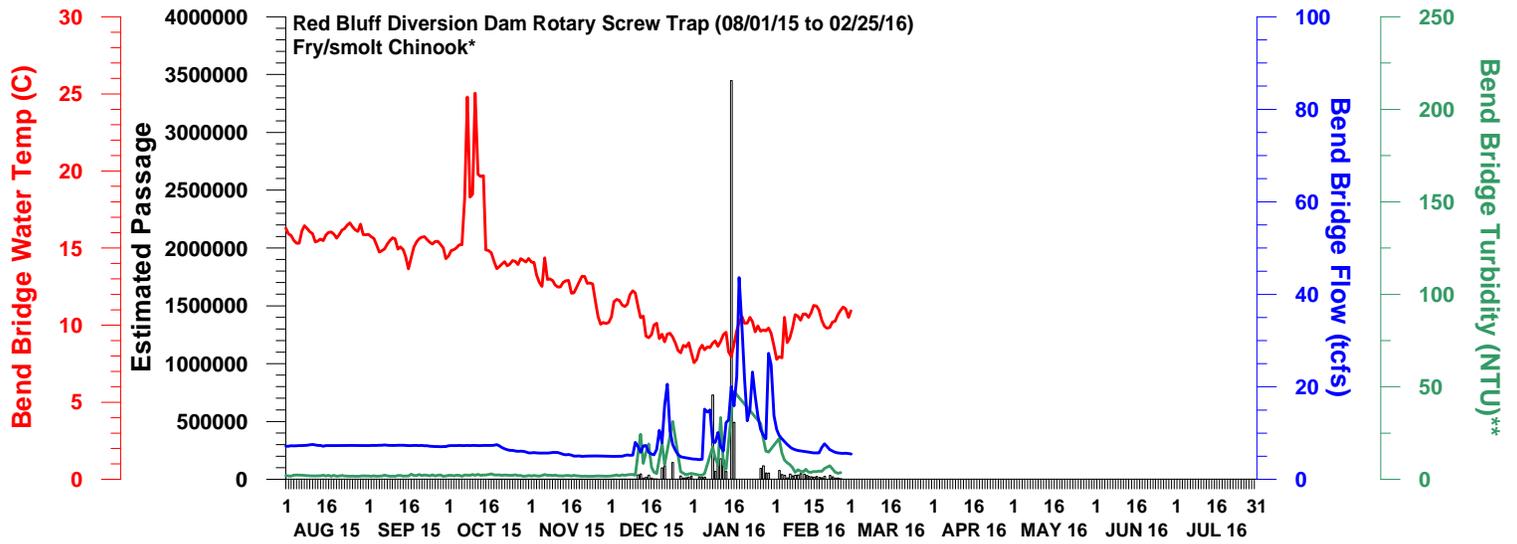


DWR-DES 01 MARCH 2016
Preliminary data from FWS and CDEC; subject to revision.

*Older juvenile Chinook defined as all Chinook greater than or equal to the minimum winter run length-at-date criteria and less than the maximum size included in the length-at-date criteria (Frank Fisher model) for which a race is assigned on a given sampling date.

**Turbidity is a discrete measurement and is not measured continuously. Therefore, data are interpolated on days when turbidity was not measured unless data are missing for more than five days.

NUMBER OF UNMARKED FRY/SMOLT CHINOOK MEASURED IN THE SACRAMENTO RIVER



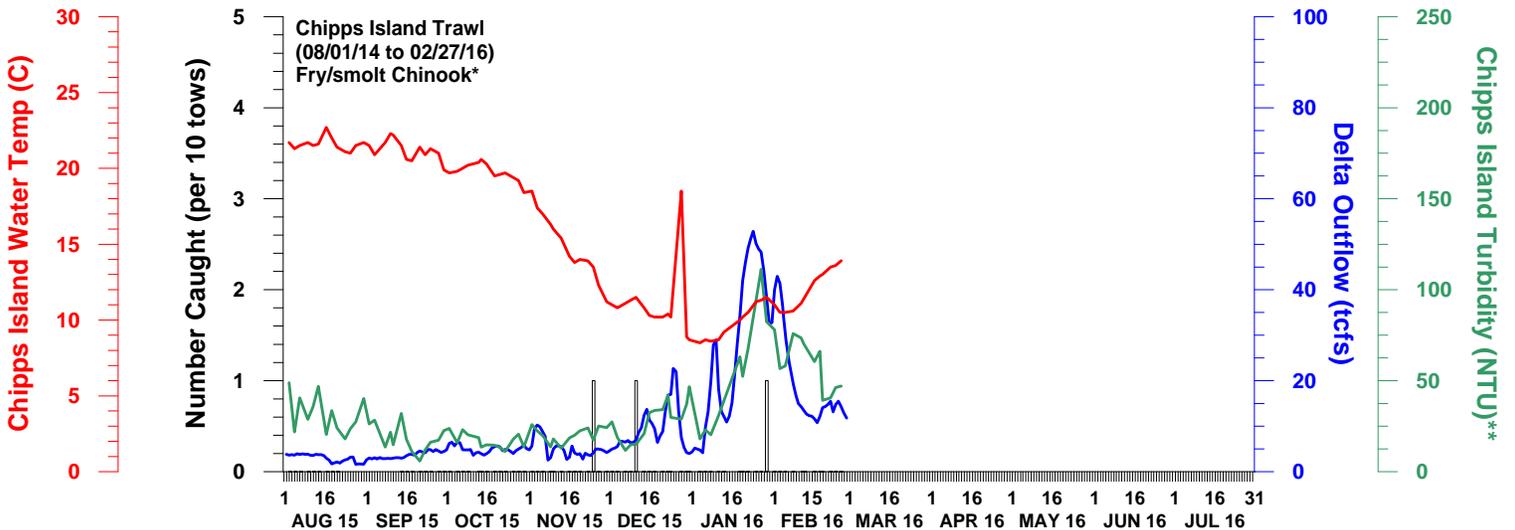
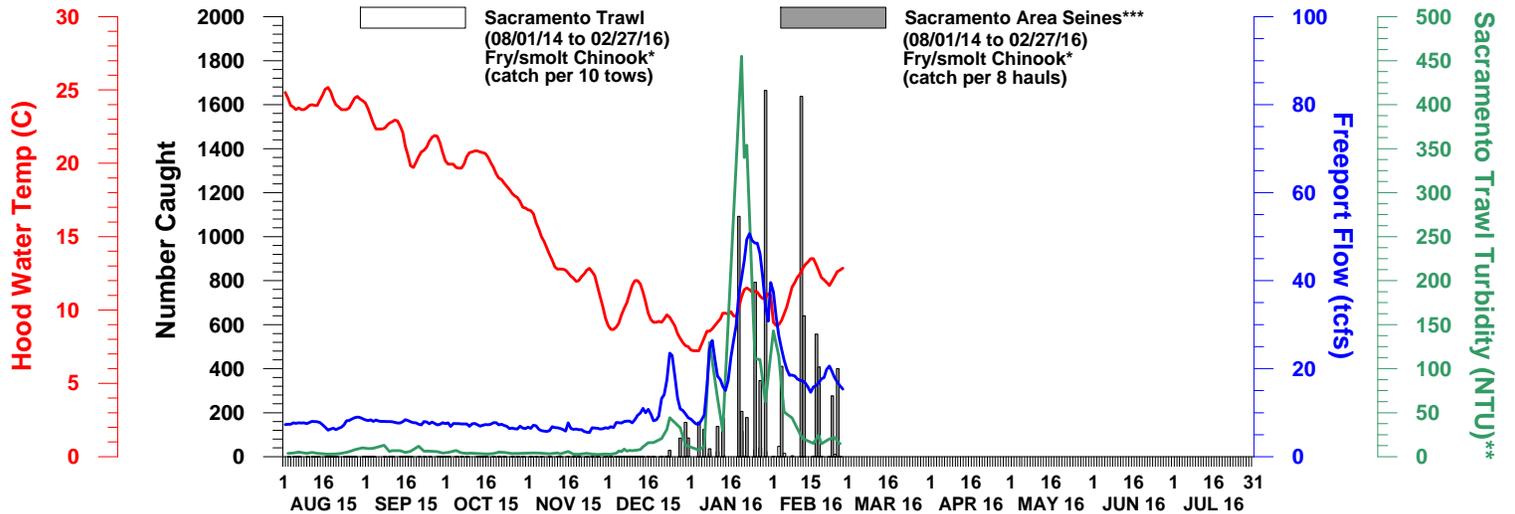
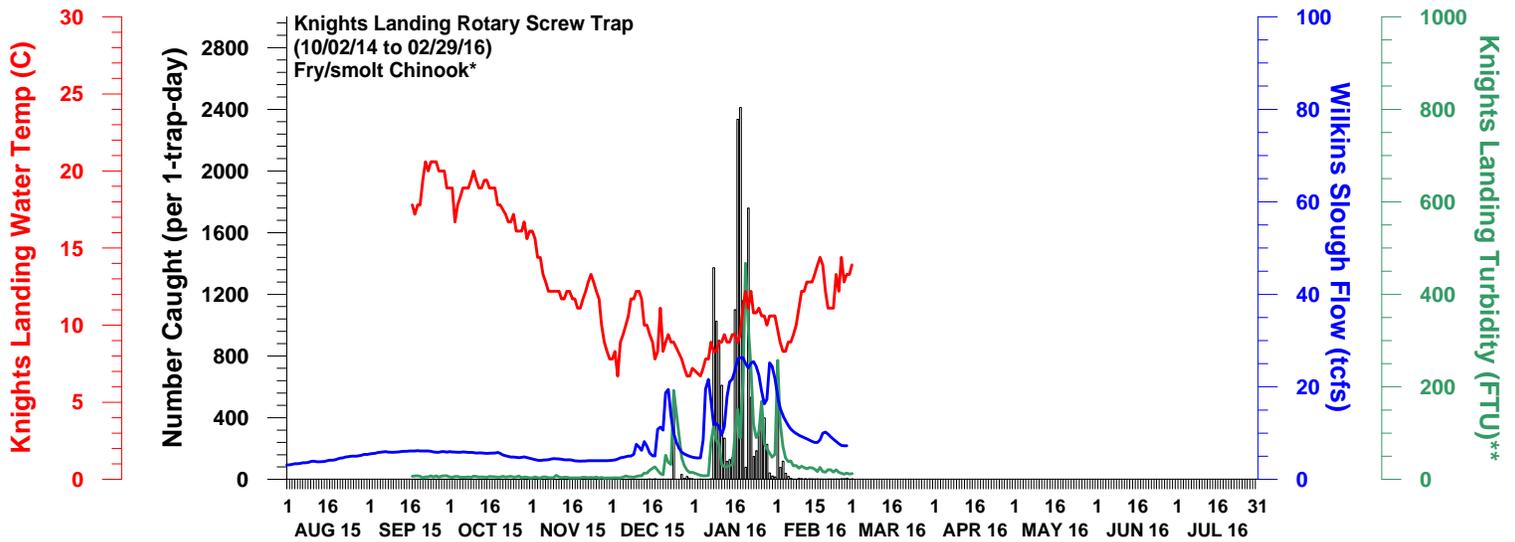
DWR-DES 1 March 2016

Preliminary data from DFW, FWS, GCID, and CDEC; subject to revision.

*Fry/smolt Chinook defined as all Chinook less than the minimum winter run length-at-date criteria (Frank Fisher model).

**Turbidity is a discrete measurement and is not measured continuously. Therefore, data are interpolated on days when turbidity was not measured unless data are missing for more than five days.

NUMBER OF UNMARKED FRY/SMOLT CHINOOK MEASURED IN THE LOWER SACRAMENTO RIVER AND CHIPPS ISLAND



DWR-DES 01 MARCH 2016

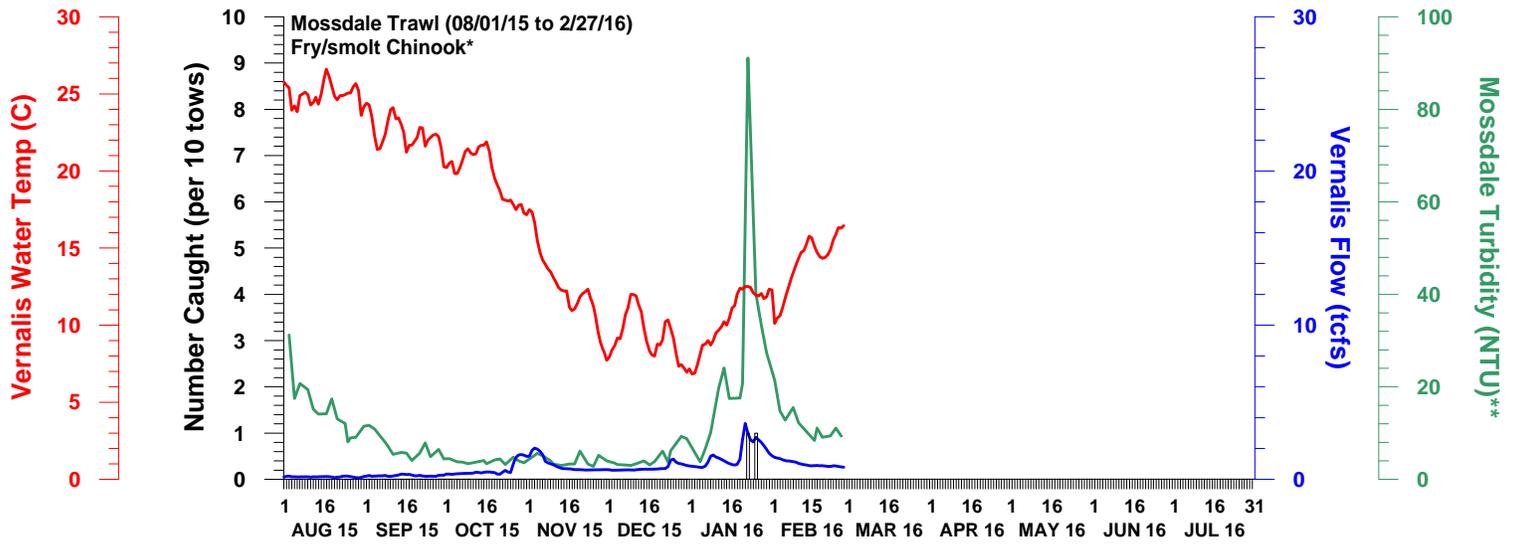
Preliminary data from DFW, FWS, and CDEC; subject to revision.

*Fry/smolt Chinook defined as all Chinook less than the minimum winter run length-at-date criteria (Frank Fisher model).

**Turbidity is a discrete measurement and is not measured continuously. Therefore, data are interpolated on days when turbidity was not measured unless data are missing for more than five days. Knights Landing turbidity measured in FTU, which should be roughly equivalent to NTU.

***Sacramento area seine route consists of the following seine sites: Verona, Elkhorn, Sand Cove, Discovery Park, American River, Miller Park, Sherwood Harbor, and Garcia Bend. Bars are stacked if Chinook caught from the trawl and seines are from the same day.

NUMBER OF UNMARKED FRY/SMOLT CHINOOK MEASURED IN THE SAN JOAQUIN RIVER



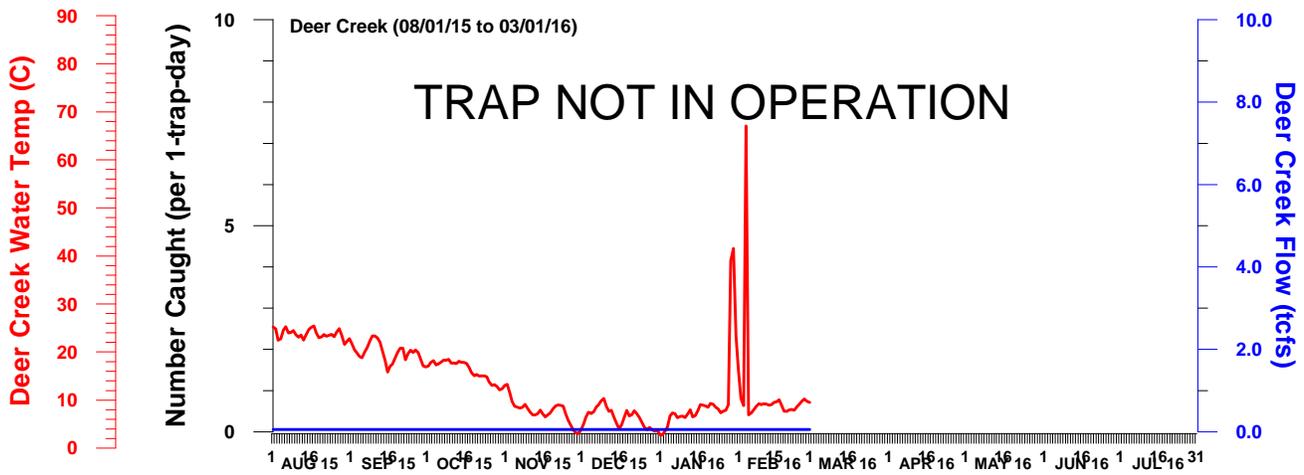
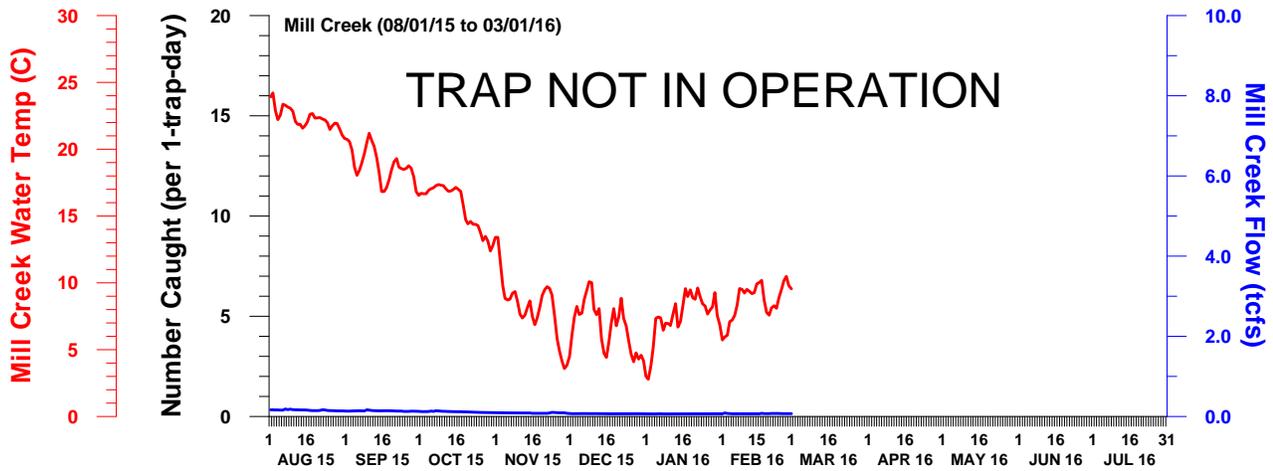
DWR-DES 01 MARCH 2016

Preliminary data from FWS and CDEC; subject to revision.

*Fry/smolt Chinook defined as all Chinook less than the minimum winter run length-at-date criteria (Frank Fisher model).

**Turbidity is a discrete measurement and is not measured continuously. Therefore, data are interpolated on days when turbidity was not measured unless data are missing for more than five days.

WATER TEMPERATURE AND FLOW MEASURED AT MILL AND DEER CREEK



Data Acquisition:

All data are preliminary and subject to revision.

The estimated passage data for the Red Bluff Diversion Dam were obtained directly from the US Fish and Wildlife Service (FWS), Red Bluff Fish and Wildlife Office (http://www.fws.gov/redbluff/rbdd_biweekly_final.html).

The catch data for Glenn-Colusa Irrigation District (GCID) were obtained directly from GCID.

The catch data for Tisdale Weir and Knights Landing were obtained directly from the California Department of Fish and Wildlife (DFW)¹, North Central Region.

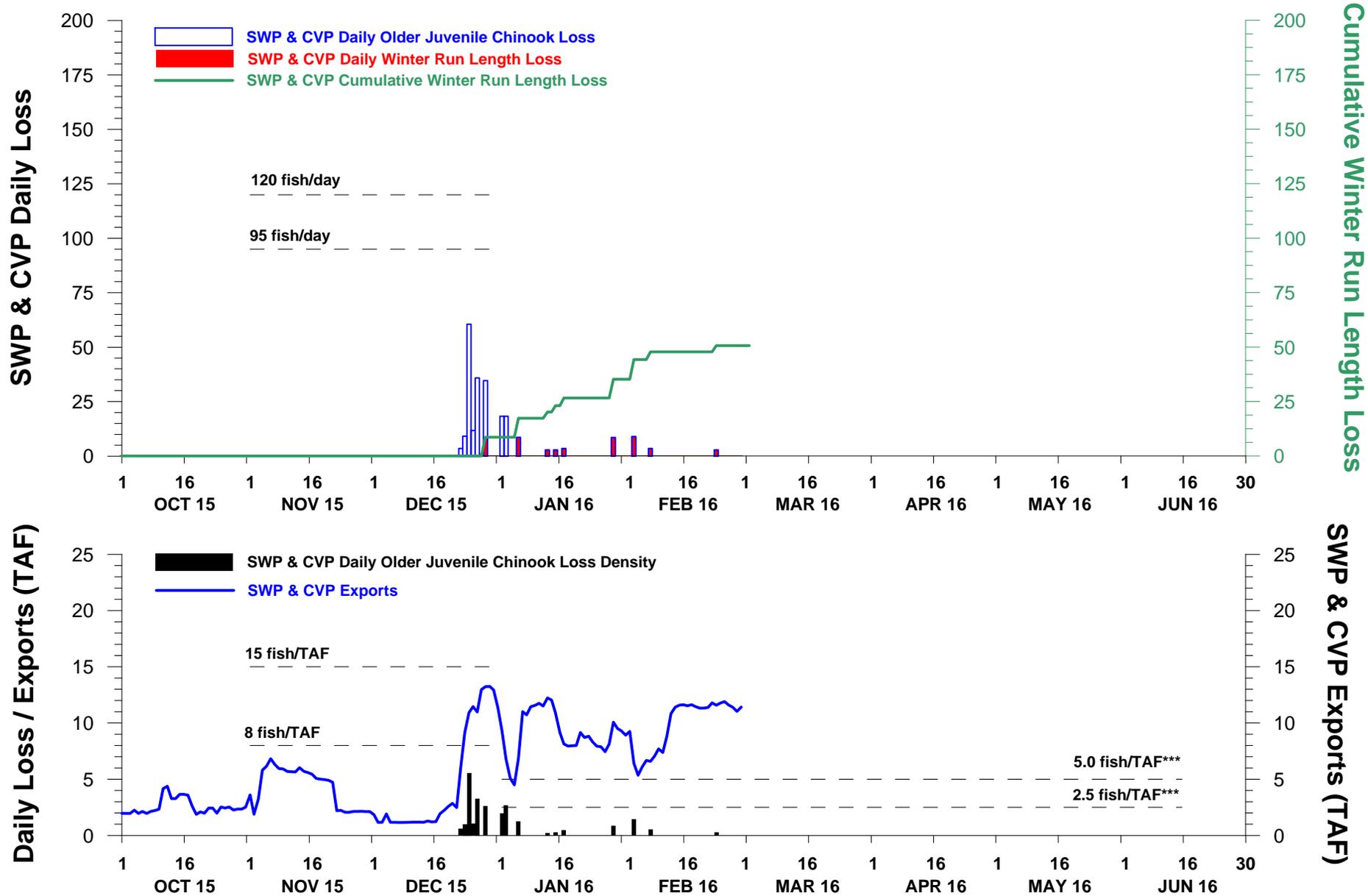
Sacramento River Trawl, Sacramento Area Beach Seine, and Chipps Island Trawl data were obtained directly from FWS, Stockton Fish and Wildlife Office (<http://www.fws.gov/stockton/ifmp/>).

Mossdale Trawl data were either obtained directly from FWS, Stockton Fish and Wildlife Office or from DFW (Region 4).

The hydrology data were either downloaded from the California Data Exchange Center (CDEC) (<http://cdec.water.ca.gov>) or obtained directly from the California Department of Water Resources, Operations Control Office.

¹ Formerly known as the California Department of Fish and Game (DFG).

NON-CLIPPED WINTER RUN & OLDER JUVENILE CHINOOK LOSS AT THE DELTA FISH FACILITIES 01 OCT 2015 THROUGH 01 MARCH 2016



DWR-DES 01 MARCH 2016

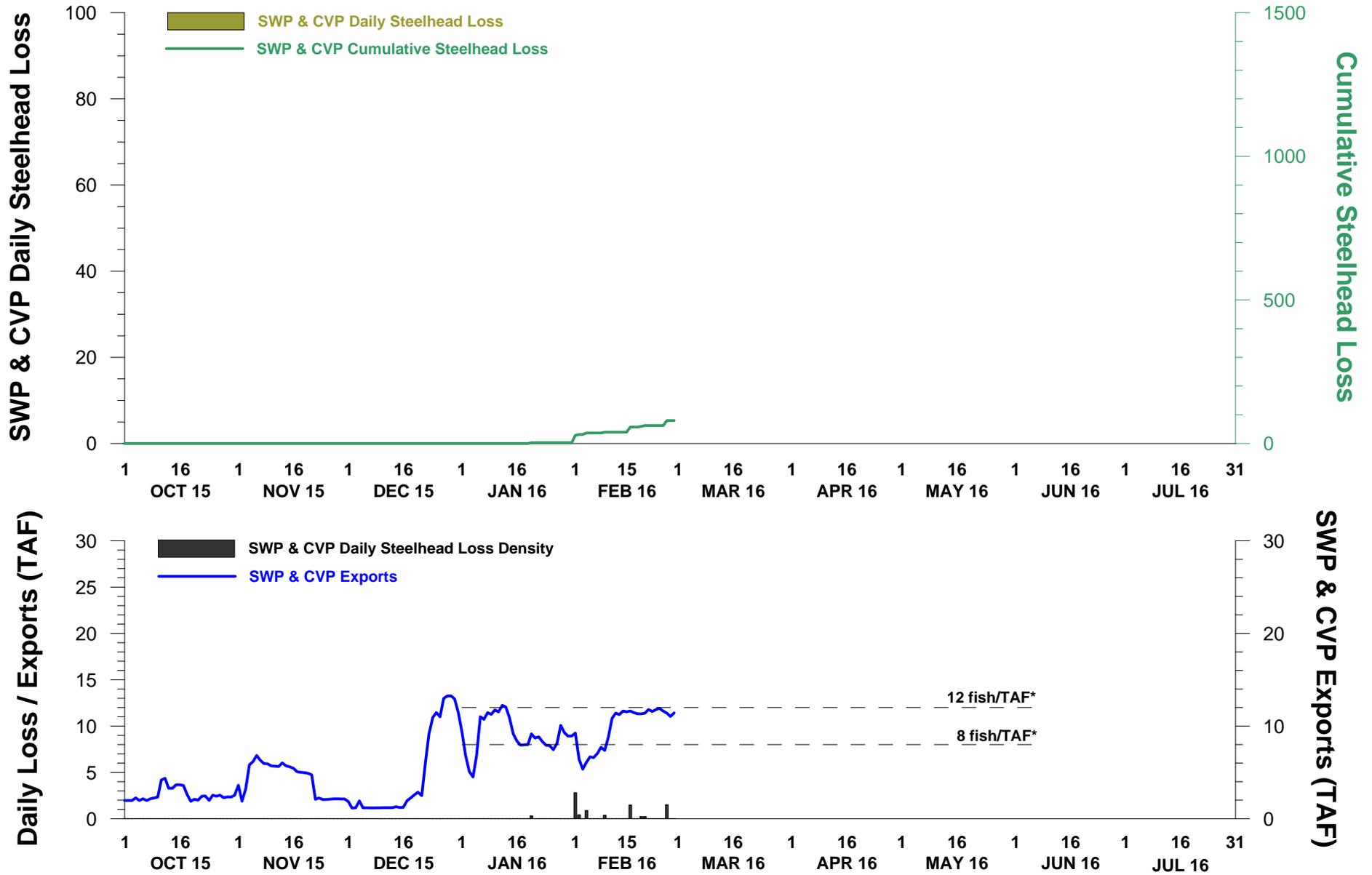
Preliminary data from DFW; subject to revision.

*Older juvenile Chinook defined as all Chinook greater than or equal to the minimum winter run length-at-date criteria and less than the maximum size included in the length-at-date criteria (Delta model) for which a race is assigned on a given sampling date.

**ITL (Incidental Take Limit) is based on the JPE, which is not yet available.

***minimum value determined by NMFS

NON-CLIPPED STEELHEAD LOSS AT THE DELTA FISH FACILITIES 01 OCT 2015 THROUGH 01 MARCH 2016

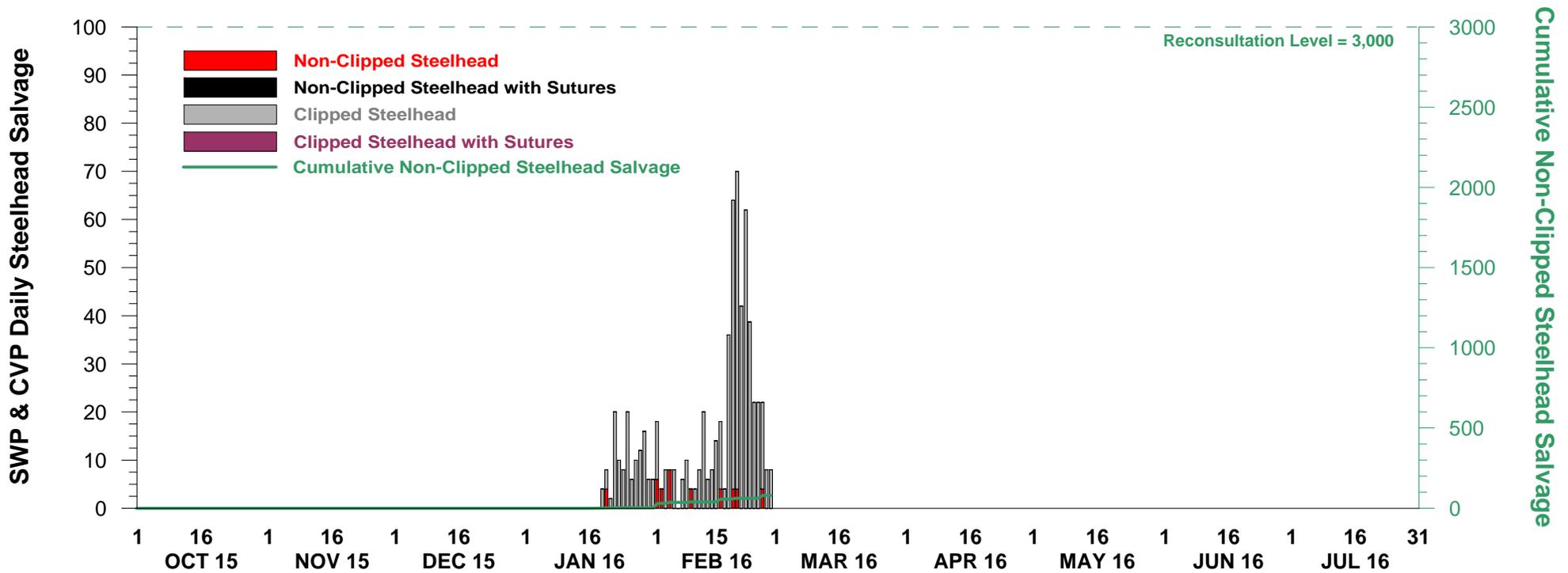


DWR-DES 01 March 2016

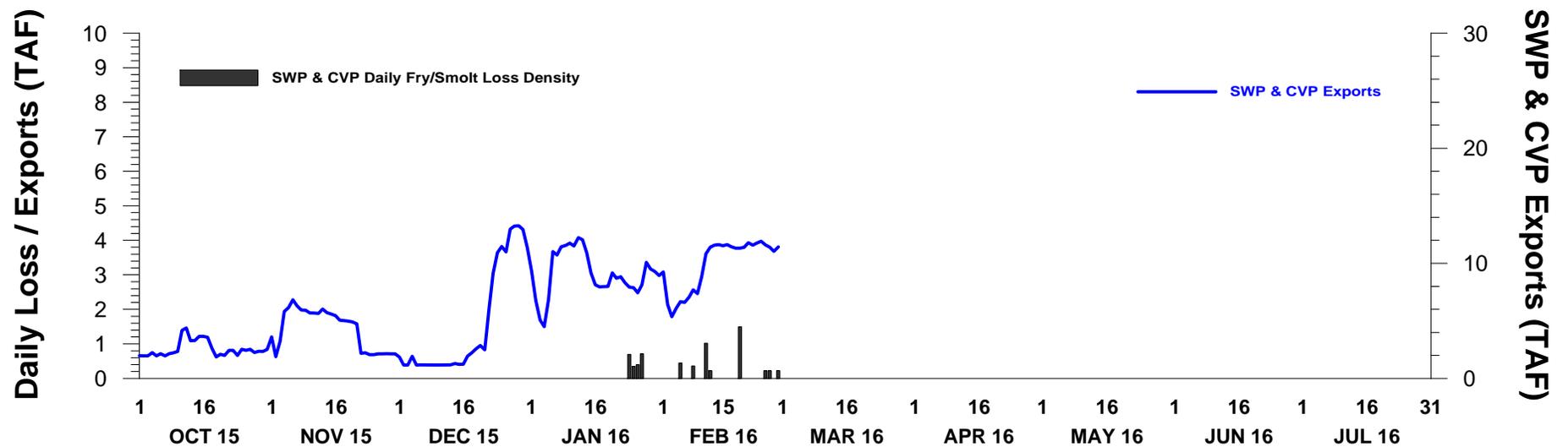
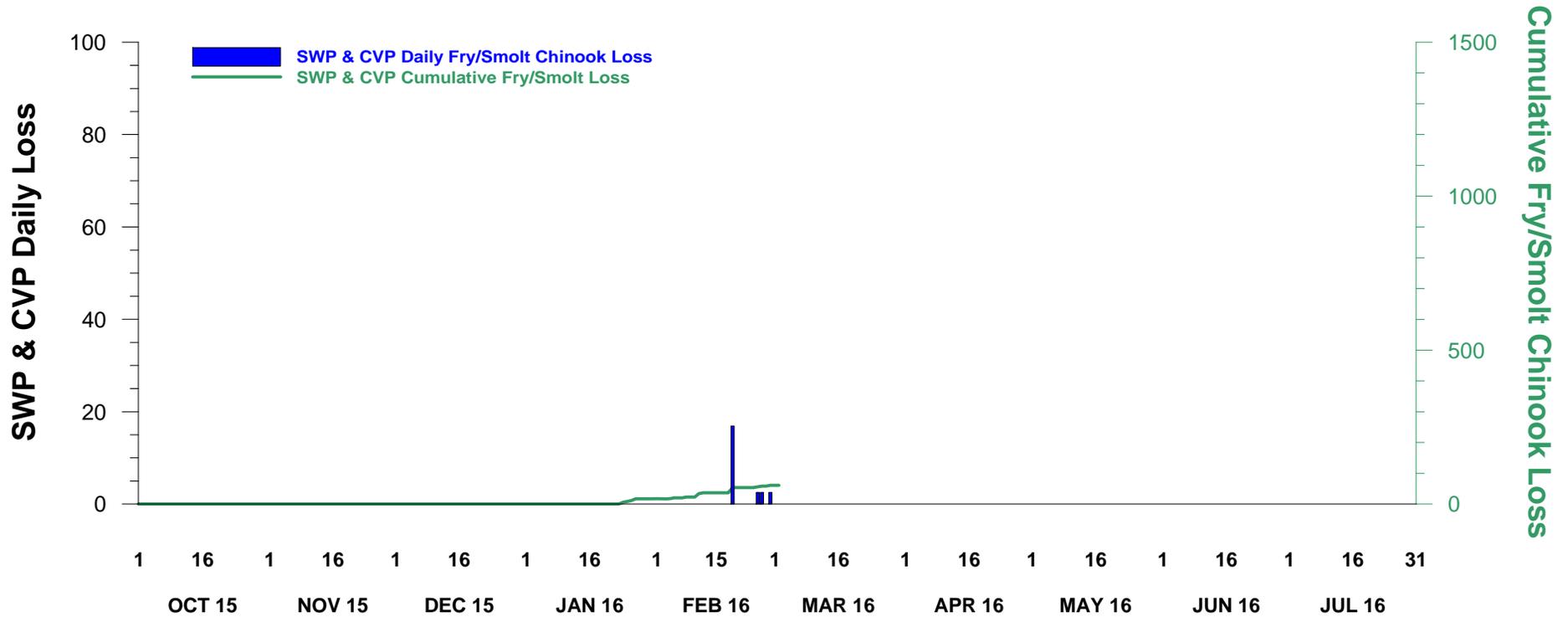
Preliminary data from DFW; subject to revision.

*Used to roughly estimate whether the daily loss is greater than 8 fish/TAF multiplied by the volume exported in TAF or 12 fish/TAF multiplied by the volume exported in TAF.

STEELHEAD SALVAGE AT THE DELTA FISH FACILITIES 01 OCT 2015 THROUGH 01 MARCH 2016



NON-CLIPPED FRY/SMOLT CHINOOK LOSS AT THE DELTA FISH FACILITIES 01 OCT 2014 THROUGH 01 MARCH 2016



DWR-DES 01 MARCH 2016
 Preliminary data from DFW; subject to revision.
 *Fry/smolt Chinook defined as all Chinook less than the minimum winter run length-at-date criteria (Delta model).