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DWR-1222

BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX

TESTIMONY OF LENNY GRIMALDO

I, Lenny Grimaldo, do hereby declare:

I. INTRODUCTION

My name is Lenny Grimaldo and I am employed as a Senior Fisheries Biologist with ICF. I received a Bachelor of Science degree in Fisheries and Wildlife Biology (Fisheries emphasis) from the University of California, Davis in 1996; a Master of Science degree in Marine Biology from San Francisco State University Romberg Tiburon Center in 2004; and a PhD in Ecology (Fisheries emphasis) from the University of California, Davis in 2009. I have been employed with ICF for over 4 years, where the majority of my work has been focused on conducting or overseeing research and monitoring activities for Longfin Smelt, Delta Smelt and Chinook Salmon in the San Francisco Estuary.

I have been conducting research on native fishes in the San Francisco Estuary for over two decades. Over the last decade, my research has focused on ecology Delta Smelt and Longfin Smelt. In my role as a scientist for ICF, I review existing and new scientific information on Longfin Smelt and other species and related ecosystem effects, analyze salvage and entrainment data for Longfin Smelt, develop field studies to test hypotheses underlying Longfin Smelt flow-abundance relationships and entrainment, and am currently helping the Interagency Ecological Program (IEP) develop new conceptual models for Longfin Smelt on factors believed to affect their growth, survival, and abundance in the San Francisco Estuary.

I am currently serving as the lead investigator for the Collaboration Adaptive Management Team (CAMT) Delta Smelt entrainment studies, responsible for overseeing studies that examine Delta Smelt salvage patterns, developing real-time models to predict Delta Smelt salvage, assisting with the development of an adult Delta Smelt behavior model, and reviewing new Delta Smelt proportional loss estimates. I am also serving as a member of the Interagency Ecological Program (IEP) Longfin Smelt and Flow Alteration Team (FLoAT) Management and Analysis Synthesis Team (MAST) teams. My Statement of Qualifications is submitted in this proceeding as Exhibit DWR-1207.

II. OVERVIEW OF TESTIMONY

In my opinion, the scientific community is making rapid progress on understanding factors that affect Longfin Smelt abundance and distribution in the San Francisco Estuary. In my testimony, I highlight key reports and peer-review papers that have been published since 2015 that advance our understanding of Longfin Smelt entrainment and abundance-flow relationships. These studies provide new information and augment the information submitted in the informational proceeding to develop the 2010 Flow Policy Report and the more recent 2012 Water Quality Control Plan workshops, relied on by several parties. (See e.g, Exhibit CSPA-202, errata, pp. 7-11; April 11, 2018 Transcript, Vol. 28, p.33:24 through 35:8; April 24, 2018 Transcript, Vol. 33, pp. 110:2 to 116:23; Exhibit PCFFA-161, p. 8:7-9.) Specifically, I highlight new field studies, reports/presentations, modeling work, and analyses that show Longfin Smelt abundance and distribution is more seaward (i.e., downstream of the Delta) than previously recognized and that San Francisco Bay and connected tributaries support larval and juvenile Longfin Smelt in much greater abundances than has been measured by the long-term monitoring programs. These new studies show that salvage and estimated entrainment losses for Longfin Smelt (juvenile and adult life stages) are low in most years. In my opinion, these new studies and analyses suggest that entrainment is a small source of mortality for Longfin Smelt (all life stages) during most drier and wet year types. Further, it is my opinion that these new studies provide information which suggests that the spring X2-fall abundance relationship is partially driven by larval and juvenile rearing in different geographic regions and habitats of the Delta estuary. I also offer my opinion on how I believe flow influences abundance and distribution of Starry Flounder and Pacific Herring.

I do have a foundation for understanding the existing state of science for Longfin Smelt and how current USFWS and NOAA Biological Opinions affect their entrainment risk at the State Water Project (SWP) and Central Valley Project (CVP).

<u>Summary of my Opinions</u>:

<u>Opinion 1</u>: Entrainment of Longfin Smelt at the SWP-CVP does not represent a significant source of mortality to the Longfin Smelt population, especially under the current biological opinions.

<u>Opinion 2</u>: Longfin Smelt spawning and rearing in San Francisco Bay and Bay Area tributary/marshes is one of several key mechanisms that explain why Longfin Smelt recruitment is higher in years with higher spring outflow. In light of new research, it is also my opinion that juvenile Longfin Smelt have little dependence on low salinity habitat.

<u>Opinion 3</u>: Freshwater harmful algal blooms (HAB's) do not have a significant effect on Longfin Smelt because Longfin Smelt do not reside in significant abundances when and where freshwater HAB's bloom during the summer.

<u>Opinion 4</u>: Flow provides a mechanism for increased regional abundance (e.g., coastal ocean) of Starry Flounder but does contribute to increased recruitment of young Starry Flounder into the estuary due to two-layer gravitational circulation. In my opinion, I

agree with interpretations of Kimmerer et al. (2009) (Exhibit DWR-1262) that Pacific Herring abundance is not related to flow.

III. ENTRAINMENT OF LONGFIN SMELT AT THE SWP-CVP DOES NOT REPRESENT A SIGNIFICANT SOURCE OF MORTALITY TO THE LONGFIN SMELT POPULATION, ESPECIALLY UNDER THE CURRENT BIOLOGICAL OPINIONS

A. Adult Longfin Salvage/Entrainment

In my testimony, I am rebutting Mr. Baxter's testimony that Longfin Smelt salvage increases under drier conditions, especially during recent years when the 2009 Biological Opinions have been in effect (April 11th, 2018, Transcript, Volume 20, p. 77:13-15). Since 2009, only three adult Longfin Smelt have been salvaged at the SWP and CVP fish screen facilities (Table 1), and these observations did not occur in the 3 of the 4 dry/critical water year observed. If Longfin Smelt were moving further into the Delta during dry years, in my opinion, they would show up in greater numbers at the SWP and CVP salvage facilities.

Table 1. Combined SWP and CVP adult Longfin Smelt salvage by water year

Water Year and Sacramento Valley WY Index Classification	Combined SWP and CVP Expanded Salvage (number of individuals)
2009 Dry	0
2010 Below Normal	0
2011 Wet	4 (1 individual)
2012 Below Normal	0
2013 Dry	8 (2 individuals)
2014 Critical	0
2015 Critical	0
2016 Below Normal	0
2017 Wet	0
2018 TBD	0

In my opinion, adult Longfin Smelt salvage has been extremely low for the following reasons: 1) Adult Longfin Smelt spawning habitat (e.g., open-water beaches and shallow habitats, see Martin and Swiderski (2001) [Exhibit DWR-1313]), is limited in the south Delta during all water year types; 2) USFWS and NMFS Biological Opinion RPA rules that limit Old and Middle River (OMR) flows to negative -5000 cfs or more positive during the winter reduces entrainment and salvage risk for adult Longfin Smelt; 3) Longfin Smelt are mostly spawning downstream of the Delta in low salinity habitats during most water year types as indicated by newly hatched larvae distributions (Grimaldo et al. 2017 [Exhibit DWR-1158]); and 4) Longfin Smelt populations have been low since 2009; however, since 2009, Longfin Smelt numbers as measured by the CDFW Bay Survey have remained at consistent low levels. Thus, I conclude, population size is not likely as important a factor as the first three factors listed above.

In my 2009 publication, I found that adult Longfin Smelt salvage increased non-linearly with negative OMR flow (Grimaldo et al. 2009 [Exhibit DWR-1314]). In this paper, I did not explicitly calculate salvage per the population size or calculate proportional losses as a fraction of the population (see Kimmerer 2008 [Exhibit DWR-1257]; Miller 2011 [Exhibit DWR-1315]; and Kimmerer 2011 [Exhibit DWR-1316]). The CWF ITP calculated entrainment losses by dividing salvage per the population size for water years between 1994 and 2008 (Exhibit DWR-1036, p. 4-286). See **Figure 1**, below. The ITP shows that adult Longfin Smelt loss, when calculated as a percent of the population, was less than 1% in all years (1993-2009, see Grimaldo et al. 2009 [Exhibit DWR-1314] for explanation of years) except for 2008. The ITP analysis indicates that SWP and CVP entrainment has been a low source of mortality for adult Longfin Smelt since the 2008 and 2009 USFWS and NMFS Biological Opinions were adopted. SWP and CVP adult Longfin Smelt entrainment is a low concern for population-level effects to Longfin Smelt.

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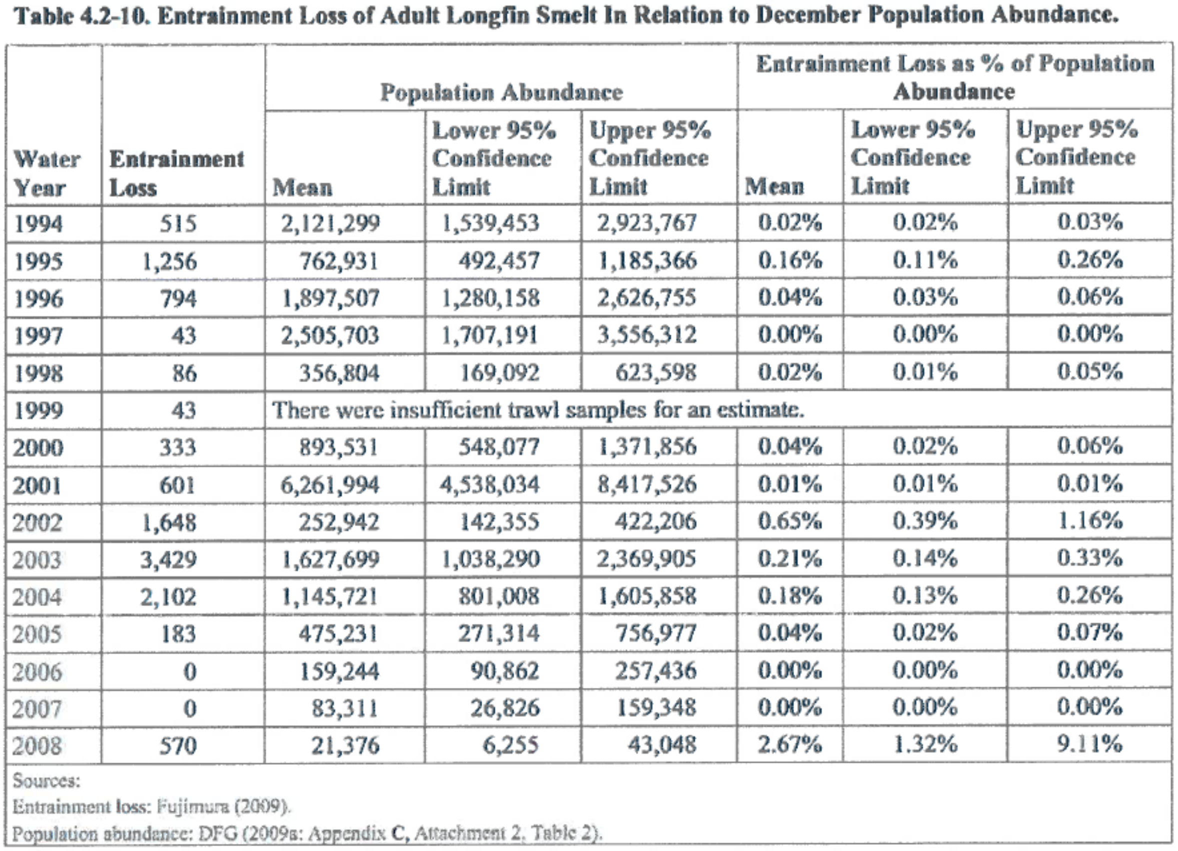

Table 4.2-10. Entrainment Loss of Adult Longfin Smelt In Relation to December Population Abundance.

Water Year	Entrainment Loss	Population Abundance			Entrainment Loss as % of Population Abundance		
		Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit
1994	515	2,121,299	1,539,453	2,923,767	0.02%	0.02%	0.03%
1995	1,256	762,931	492,457	1,185,366	0.16%	0.11%	0.26%
1996	794	1,897,507	1,280,158	2,626,755	0.04%	0.03%	0.06%
1997	43	2,505,703	1,707,191	3,556,312	0.00%	0.00%	0.00%
1998	86	356,804	169,092	623,598	0.02%	0.01%	0.05%
1999	43	There were insufficient trawl samples for an estimate.					
2000	333	893,531	548,077	1,371,856	0.04%	0.02%	0.06%
2001	601	6,261,994	4,538,034	8,417,526	0.01%	0.01%	0.01%
2002	1,648	252,942	142,355	422,206	0.65%	0.39%	1.16%
2003	3,429	1,627,699	1,038,290	2,369,905	0.21%	0.14%	0.33%
2004	2,102	1,145,721	801,008	1,605,858	0.18%	0.13%	0.26%
2005	183	475,231	271,314	756,977	0.04%	0.02%	0.07%
2006	0	159,244	90,862	257,436	0.00%	0.00%	0.00%
2007	0	83,311	26,826	159,348	0.00%	0.00%	0.00%
2008	570	21,376	6,255	43,048	2.67%	1.32%	9.11%

Sources:
Entrainment loss: Fujimura (2009).
Population abundance: DFG (2009a: Appendix C, Attachment 2, Table 2).

FIGURE 1. ENTRAINMENT LOSS OF ADULT LONGFIN SMELT IN RELATION TO DECEMBER POPULATION ABUNDANCE

B. Juvenile Longfin Smelt Salvage/Entrainment

My testimony rebuts Mr. Baxter's statements that Longfin Smelt Salvage increases under drier conditions, especially during recent years when the 2009 Biological Opinions have been in effect (April 11th, 2018 Transcript, Volume 20, p. 77:13-15). My testimony also rebuts Dr. Rosenfield's general assertion that entrainment during drier year types is problematic to the species (NRDC-58 Errata, pp. 30:22 to 31:4).

Since 2009, juvenile salvage numbers have been relatively low compared to pre-Biological Opinion years with the exception of 2012 (**Table 2**) and there appears to be no obvious pattern of increased entrainment with water year type. Similar to adults, the CWF ITP calculated entrainment losses for juvenile Longfin Smelt by dividing salvage by the estimated size of the juvenile population (Exhibit DWR-1036, p. 4-288). See Figure 2 below. Between 1994 and 2008, salvage and mean juvenile entrainment estimates as a percent of the population have been less than 1% in all years except for 2003, which was 2.67%. In my opinion, this indicates that SWP and CVP entrainment is a relatively low source of mortality for juvenile Longfin Smelt since the USFWS and NMFS Biological Opinions were adopted. SWP and CVP adult Longfin Smelt entrainment is a low concern for population-level effects to juvenile Longfin Smelt.

Table 2.

Water Year and Sacramento Valley WY Index Classification	Combined SWP and CVP Expanded Salvage (number of individuals)
2009 Dry	84 (21 individuals)
2010 Below Normal	36 (9 individuals)
2011 Wet	0
2012 Below Normal	3340 (835 individuals)
2013 Dry	872 (218 individuals)
2014 Critical	40 (10 individuals)
2015 Critical	148 (37 individuals)
2016 Below Normal	12 (3 individuals)
2017 Wet	0
2018 TBD	4 (1 individual)

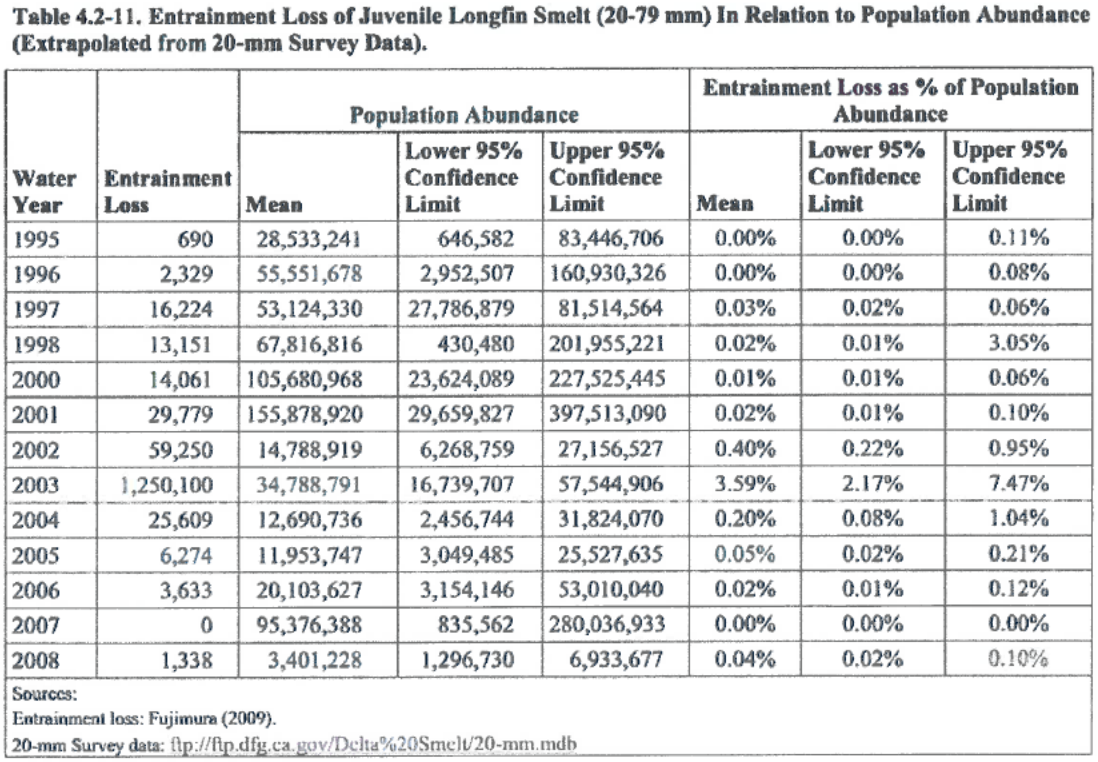

Table 4.2-11. Entrainment Loss of Juvenile Longfin Smelt (20-79 mm) In Relation to Population Abundance (Extrapolated from 20-mm Survey Data).

		Population Abundance			Entrainment Loss as % of Population Abundance		
Water Year	**Entrainment Loss**	**Mean**	**Lower 95% Confidence Limit**	**Upper 95% Confidence Limit**	**Mean**	**Lower 95% Confidence Limit**	**Upper 95% Confidence Limit**
1995	690	28,533,241	646,582	83,446,706	0.00%	0.00%	0.11%
1996	2,329	55,551,678	2,952,507	160,930,326	0.00%	0.00%	0.08%
1997	16,224	53,124,330	27,786,879	81,514,564	0.03%	0.02%	0.06%
1998	13,151	67,816,816	430,480	201,955,221	0.02%	0.01%	3.05%
2000	14,061	105,680,968	23,624,089	227,525,445	0.01%	0.01%	0.06%
2001	29,779	155,878,920	29,659,827	397,513,090	0.02%	0.01%	0.10%
2002	59,250	14,788,919	6,268,759	27,156,527	0.40%	0.22%	0.95%
2003	1,250,100	34,788,791	16,739,707	57,544,906	3.59%	2.17%	7.47%
2004	25,609	12,690,736	2,456,744	31,824,070	0.20%	0.08%	1.04%
2005	6,274	11,953,747	3,049,485	25,527,635	0.05%	0.02%	0.21%
2006	3,633	20,103,627	3,154,146	53,010,040	0.02%	0.01%	0.12%
2007	0	95,376,388	835,562	280,036,933	0.00%	0.00%	0.00%
2008	1,338	3,401,228	1,296,730	6,933,677	0.04%	0.02%	0.10%

Sources:
Entrainment loss: Fujimura (2009).
20-mm Survey data: ftp://ftp.dfg.ca.gov/Delta%20Smelt/20-mm.mdb

FIGURE 2. ENTRAINMENT LOSS OF JUVENILE LONGFIN SMELT (20-79 MM) IN RELATION TO POPULATION ABUNDANCE (EXTRAPOLATED FROM 20-MM SURVEY DATA.

C. Larval Entrainment

Entrainment is a low source of mortality for Longfin Smelt larvae in most water years. New research on Longfin Smelt larvae in the San Francisco Estuary shows they are hatching downstream of the Delta (from Suisun Bay to San Francisco Bay) in higher abundances than previously recognized (Grimaldo et al. 2017 [Exhibit DWR-1158]). Since 2009, the low numbers of adult Longfin Smelt salvaged suggests to me that spawning is not taking place in any significant numbers in the south Delta, for reasons listed above (see section III.A. above regarding adult salvage/entrainment). Thus, I disagree with Dr. Rosenfield's testimony that south Delta entrainment is likely to get worse under CWF (NRDC-58 Errata, p. 31:15-16), which I understand to be at least as protective as the current Biological Opinions.

Previous work by CDFW assumed that Longfin Smelt spawning was centered in the lower Delta (CDFW 2009 ITP [Exhibit DWR-1317]). This assumption was based on the notion that larval Longfin Smelt require freshwater habitats for egg incubation and early larval rearing (CDFW 2009 ITP [Exhibit DWR 1317]; Kimmerer et al. 2009 [Exhibit DWR-1262]). New research shows that peak Longfin Smelt larval hatching, as evidenced by newly hatched larvae with yolk-sacs, can in occur in salinities from 0 to 12 psu, with peak hatching observed between 2-4 psu (Grimaldo et al. 2017 [Exhibit DWR-1158]). Furthermore, analysis of CDFW Smelt Larval Survey Data shows that over 50% of newly hatched larvae are found in Suisun Bay, even during critical and dry years (Grimaldo et al. 2017, **Figure 3** (below) [Exhibit DWR-1158]).

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Estuaries and Coasts

Fig. 7 Percent total abundance of Longfin Smelt larvae (≤9 mm total length TL) by regions of management interest collected during long-term monitoring channel surveys and overall mean densities by year

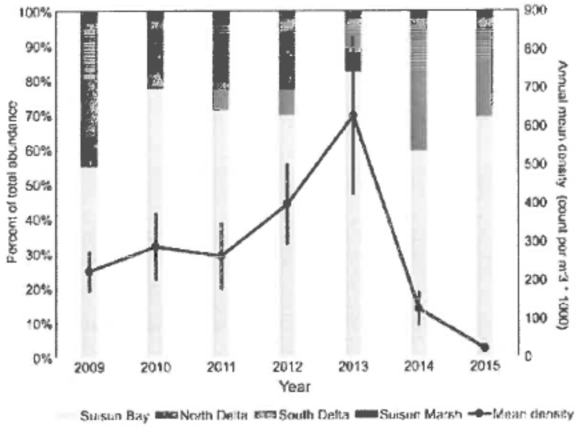

FIGURE 3. PERCENT TOTAL ABUNDANCE OF LONGFIN SMELT LARVAE (≤9 MM TOTAL LENGTH TL) BY REGIONS OF MANAGEMENT INTEREST

In addition, new research is showing that Longfin Smelt are spawning in shallow habitats (open water and marshes) around Suisun Bay in greater abundance than previously recognized (Grimaldo et al. 2017 [Exhibit DWR-1158]). In my opinion, this new research suggests that larval Longfin Smelt are less susceptible to entrainment than hypothesized by Dr. Rosenfield (NRDC-58 Errata, p. 31:15-16) because spawning is concentrated downstream of the Delta in most water years. This is consistent with Mr. Baxter's testimony that upstream spawning and transport from the Delta to Suisun Bay only explains a portion of how the Longfin Smelt population ends up rearing in Suisun Bay (April 11th, 2018 Transcript, Volume 20, p. 38:20-21).

IV. LONGFIN SMELT SPAWNING AND REARING IN SAN FRANCISCO AND BAY AREA TRIBUTARY/MARSHES IS ONE OF SEVERAL KEY MECHANISMS THAT EXPLAIN WHY LONGFIN SMELT RECRUITMENT IS HIGHER IN YEARS WITH HIGHER SPRING OUTFLOW. IN LIGHT OF NEW RESEARCH, IT IS ALSO MY OPINION THAT JUVENILE LONGFIN SMELT HAVE LITTLE DEPENDENCE ON LOW SALINITY HABITAT.

The analyses presented in the CWF FEIR/S and my own research rebut Mr. Baxter's testimony (April 11th, 2018 Transcript, Volume 20, p. 59:22-25) that one of the mechanisms that explain why Longfin Smelt abundance improves in wet years is due to reduced entrainment from increased transport away from SWP and CVP diversions. Mr. Baxter's opinion is inconsistent with existing modeling efforts that show no obvious export effect to

Longfin Smelt populations (See also Thomson et al. 2010 [Exhibit DWR-1253]; Maunder et al. 2015 [Exhibit DWR-1318]).

There are many hypothesized mechanisms that likely explain why Longfin Smelt recruitment improves during the spring of wetter years (Nobriga and Rosenfield 2017 [Exhibit DWR-1320]; Kimmerer 2002 [Exhibit DWR-1319]; Kimmerer et al. 2009 [Exhibit DWR 1262]). Possible mechanisms that have been hypothesized are increased retention, larval transport, improved habitat, reduced entrainment, increased food production, and reduced predation. To date, only habitat volume has been explicitly tested by Kimmerer et al. (2009) (Exhibit DWR-1262), but these authors concluded that increases in habitat volume are not likely to explain the 2-fold variation in Longfin Smelt abundance between wet and dry periods.

New research is now showing that under wetter periods, Longfin Smelt are spawning and rearing in San Francisco Bay and associated tributaries and marshes during wetter periods (**Figure 4**; Grimaldo et al. 2018 [Exhibit DWR-1321]).

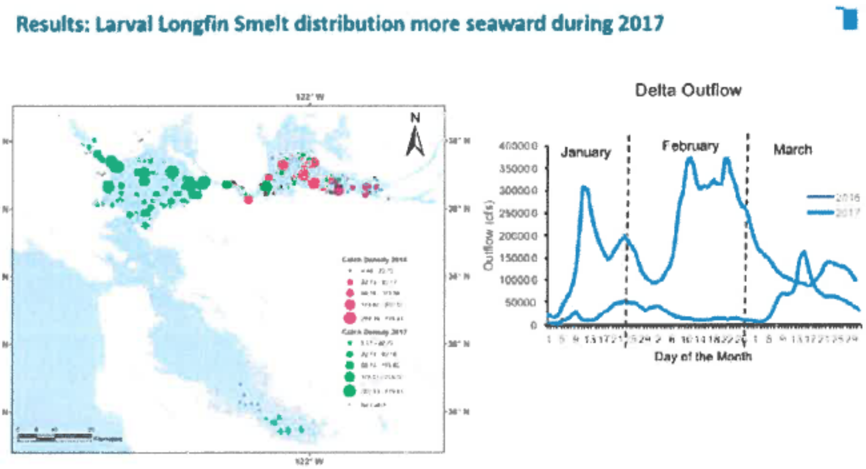

FIGURE 4. LARVAL LONGFIN SMELT DENSITY MAPS FROM 2016 AND 2017.

These new findings suggest that Longfin Smelt rely on flow from local tributaries, such as the Napa River, Petaluma, River, Coyote Creek and possible local run-off in small marshes and Delta outflow that helps improve spawning and rearing habitat in San Pablo Bay. In my opinion, these new data suggest localized spawning in San Francisco Bay is one of the key factors why Longfin Smelt abundance improves during wetter periods. I do agree with Mr. Baxter that larval transport from upstream to downstream habitats could offer one mechanism that improves survival and recruitment, but in my opinion, I believe that horizontal and vertical retention mechanisms are more critical in shaping how larvae aggregate in suitable habitats. It is important to keep in mind, before larval Longfin Smelt develop their airbladder, their ability to manipulate their water column distribution is probably limited and it may take them 3-4 weeks after hatching to grow to a size to develop an air bladder. Per Mr. Baxter's conceptual model that larval transport is key factor that shapes the spring X2-flow abundance relationship, Mr. Baxter doesn't explain how larvae prior to swim bladder development (i.e., minimal ability to swim or manipulate water column against net tidal currents) in their first few weeks of life are able to retain in a favorable position during high flows. In my knowledge of estuarine dynamics and PTM models, particles without behavior can be transported from the lower Delta to the ocean in a matter of days. Thus, in my opinion, I believe that localized spawning and retention mechanisms better explain why larval and juvenile Longfin Smelt are distributed in seaward habitats during wet years than one explained by transport.

The most critical point of the new research is that it highlights the importance of San Francisco Bay rearing as the mechanism that explains enhanced recruitment during wetter, and perhaps average to above normal water years as well. My opinion is reinforced by recent modeling results by Maunder et al. (2015) (Exhibit DWR-1318) that found that Napa River flow was an important factor that explains Longfin Smelt population abundance. During wetter years, Napa River supports ample Longfin Smelt spawning and rearing habitat (Grimaldo et al. 2016 [Exhibit DWR-1346]). It is noteworthy to point out that Thomson et al. (2010) (Exhibit DWR-1253) found importance of spring X2 as a factor that influences Longfin Smelt abundance in the estuary, which is not surprising given the relationship between spring X2 and fall abundance (Kimmerer et al. 2009 [Exhibit DWR-1262]). However, to date, researchers have yet to ascertain the exact mechanisms underlying X2 and Longfin Smelt abundance. In my opinion, under wetter water year types, I believe X2 represents an index of overall regional climatic precipitation conditions. For example, under wetter years, San Francisco Bay and Bay tributaries and marshes transform into low salinity habitats, which the new research shows provides ample spawning and rearing habitat for Longfin Smelt. Under drier conditions, the position of X2 may take on more importance in shaping low salinity habitats in Suisun Bay and western Delta when Bay tributaries are not suitable for spawning and rearing (i.e., they do not get enough local inflow to provide low salinity habitat). It is noteworthy to point out that juvenile Longfin Smelt are able to tolerate salinities up to 30 psu in the late spring and early summer (MacWilliams et al. 2016 [Exhibit DWR-1322]), which suggests that Longfin Smelt has little dependence on low salinity habitat. , This study suggests that juvenile Longfin smelt are not obligated to rear in low salinity habitat once they reach juvenile life stages.

I am currently involved in research with CDFW, San Francisco State University, U.S. Geological Survey, Metropolitan Water District of Southern California, and University of California, Davis (UCD) to better understand how Longfin Smelt respond to environmental conditions. In this research, we are investigating larval hatching origin during wet and dry years to determine spawning locations, examining the role of horizontal and vertical retention to promote larval and juvenile residence in rearing habitats, providing fish to UCD so they can examine tributary and salinity natal origins of larval life states, and examining the importance of prey to support growth and survival of Longfin Smelt larvae among habitats and regions in the estuary. These new research efforts may help reduce uncertainty in future water management actions.

V. FRESHWATER HARMFUL ALGAL BLOOMS (HABS) DO NOT HAVE A SIGNIFICANT EFFECT ON LONGFIN SMELT BECAUSE LONGFIN SMELT DO NOT RESIDE IN SIGNIFICANT ABUNDANCES WHEN AND WHERE FRESHWATER HAB'S BLOOM DURING THE SUMMER.

Dr. Rosenfield asserts in his testimony that harmful algal blooms are likely to increase under CWF and that these effects will likely harm Longfin Smelt (NRDC-58, Errata, pp. 38-39.) However, Dr. Rosenfield's own research and other studies show that by summer and fall, the majority of Longfin Smelt are distributed in San Francisco Bay

(Rosenfield and Baxter 2017 [Exhibit NRDC-36]). Moreover, freshwater harmful algal blooms, such as Microcystis, typically begin in the summer when water temperatures exceed 19 °C (Lehman et al. 2013 [Exhibit DWR-576]). The temperature threshold above which Longfin Smelt would not inhabit based on field and lab studies is threshold 20 °C. (Jefferies et al. 2016 [Exhibit DWR-1323; Grimaldo et al 2017 [Exhibit DWR-1158]). Therefore, I do not believe that freshwater harmful algal blooms (i.e., Microcystis) have any measurable or significant effects to Longfin Smelt populations in the upper San Francisco Estuary.

VI. FLOW PROVIDES A MECHANISM FOR INCREASED REGIONAL ABUNDANCE (E.G., COASTAL OCEAN) OF STARRY FLOUNDER BUT DOES CONTRIBUTE TO INCREASED RECRUITMENT OF YOUNG STARRY FLOUNDER INTO THE ESTUARY DUE TO TWO-LAYER GRAVITATIONAL CIRCULATION. IN MY OPINION, I AGREE WITH INTERPRETATIONS OF KIMMERER ET AL. (2009) THAT PACIFIC HERRING ABUNDANCE IS NOT RELATED TO FLOW.

A. Starry Flounder

Mr. Baxter testified that Starry Flounder are generally more abundant in years with increased outflow (April 11, 2018, Transcript, Vol. 28, p. 43:1-6.) I agree with Mr. Baxter's testimony that Age-1 Starry Flounder exhibit a positive spring X2-flow abundance relationship based on the scientific literature (Kimmerer 2002 [Exhibit DWR-1319]; Kimmerer et al. 2009 [Exhibit DWR-1262]). Mr. Baxter and Kimmerer et al. (2009) hypothesized that this relationship is related to increased two-layer gravitational circulation that promotes Starry Flounder movement and retention into the San Francisco Estuary during wetter years. I also agree with Mr. Baxter's testimony that Starry Flounder spawning takes place in coastal waters based on review of the scientific literature (April 11, 2018 Transcript, Vol. 28, p. 43:11.)). However, to provide clarification to the assertion that flow increases abundance or if flow has an effect on Starry Flounder (April 11, 2018, Transcript, Vol. 28, pp. 161:23 to 162:1). it is important to recognize that Starry Flounder populations are not monitored along the California coastal ocean in a robust or systematic way, making it difficult to ascertain regional abundance trends. Thus, I believe what can be ascertained from the Kimmerer et al (2009) analysis is that retention and abundance within the estuary increases with flow due to gravitational circulation but it is unknown if outflow improves Starry Flounder abundance outside the San Francisco Bay or if Starry Flounder rearing in the Bay contribute to improved populations in the coastal ocean. Mr. Baxter also testified that Starry Flounder cue in on freshwater to move into upstream habitats (April 11, 2018 Transcript, Vol. 28, p. 43:10-14). In my review of the peer-review literature, I cannot find any evidence that Starry Flounder are using cues to move into freshwater habitats and in my opinion consider this a speculative hypothesis at best.

B. Pacific Herring

Mr. Baxter testified that Delta outflows are important to Pacific Herring (April 11, 2018Transcript, Vol. 28, p. 157:1-2). In my review of the scientific literature, I have not found evidence for such a relationship. Specifically, the relationship between spring outflow and Pacific Herring abundance was examined by Kimmerer et al (2009) (Exhibit DWR-1262) and these authors did not find a relationship between outflow and Pacific Herring abundance. They did find that habitat indices were weakly related to flow but flow itself does not affect abundance. In my opinion, I have not reviewed any scientific information that would lead me to conclude that flow affects Pacific Herring abundance in San Francisco Bay.

Executed on this 9 day of July, 2018 in San Francisco, California.

Lenny Grimaldo