NRDC-15

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

Public Comment
Bay-Delta Phase II Working Draft Report
Deadline: 12/16/16 12:00 noon

RECEIVED
12-16-16
SWRCB Clerk

December 16, 2016

Ms. Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Dear Ms. Townsend:

SUBJECT: CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE COMMENTS REGARDING THE WORKING DRAFT SCIENTIFIC BASIS REPORT FOR NEW AND REVISED FLOW REQUIREMENTS ON THE SACRAMENTO RIVER AND TRIBUTARIES, EASTSIDE TRIBUTARIES, DELTA OUTFLOW, AND INTERIOR DELTA OPERATIONS

Enclosed are the California Department of Fish and Wildlife's (Department) comments on the State Water Resources Control Board's (Water Board) "Working Draft Scientific Basis Report for New and Revised Flow Requirements on the Sacramento River and Tributaries, Eastside Tributaries, Delta Outflow, and Interior Delta Operations" (scientific basis report). The Department appreciates this opportunity to review and comment on the Water Board's scientific basis report. The Department recognizes the tremendous effort Water Board staff and Board members have put in over the years to gather scientific information to update the 2006 Water Quality Control Plan for the Bay-Delta (Bay-Delta Plan).

The Department's specific comments are attached to this letter. Department staff is available to work directly with Water Board staff in this continued effort to provide the scientific basis to support the necessary updates to the Bay-Delta Plan to protect public trust resources. In addition, the Department is committed to ongoing collaboration with all of our partners and stakeholders in this worthy endeavor.

If you have any questions, please feel free to contact Stephen Louie at (916) 327-8758 or at Stephen.Louie@wildlife.ca.gov.

Sincerely,

Scott Cantrell

Scott Cantrell
Chief, Water Branch

Enclosures

Bay-Delta Phase 2 Scientific Basis Report
Table 1: CDFW Chapter-Specific Comments

Comment Number	Chapter	Page #	Text, Paragraph, Sentence in Question	Staff Comment or Suggested Edits
1	1	1-3	1.1.2, 3rd Para.	Please add information identifying the range of annual outflow reductions in addition to the mean annual reductions.
2	2	2-19, 2-21, 2-69	last four lines, last lines of 2.2.3.2 and 2.2.3.3, section 2.7, last sentence of first paragraph	Mill, Deer and Antelope creeks are significantly impaired in the late spring, summer and fall (the creeks are not connected to the Sacramento River for months at a time every year).
3	2	2-24	5th paragraph	Tisdale Bypass is the first and most frequent bypass to spill and over tops the weir when Sacramento River flows exceed 23,000 cfs. This flood conveyance system warrants discussion.
4	2	2-25	2nd paragraph	Quartz Bowl pool is not a total fish barrier. During some years spring-run Chinook adults have been observed upstream of Quartz Bowl Pool (2001 was the last year of documented passage)
5	2	2-49	Bottom paragraph, section 2.3.4	The tributaries of the American River Basin should be listed specifically, and are, from north to south, Coon Creek, Auburn Ravine, and the Dry Creek system, including Secret and Miners ravines. These stream systems are significant and continue to support small populations of fall-run Chinook Salmon and steelhead, and support non-natal rearing of emigrating juvenile winter-run Chinook Salmon. Please see CDFW memo (Titus 2013) that addresses these resources in the Dry Creek system. In addition, while Coon Creek and Auburn Ravine enter the Sacramento River via the Natomas Cross Canal, the Dry Creek system does so via the Natomas East Main Drainage Canal (aka Steelhead Creek), which then enters the Sacramento River via Bannon Slough.
6	2.3.5	2-50	5th Paragraph, last sentence	Steelhead habitat is not completely analogous to Chinook salmon habitat, and authors should be careful not to assume that a floodplain habitat will benefit both species equally.
7	2	2-58	First paragraph of 2.4.5, line 9	The document states that South Delta exports have slowly increased since the late 1950s. In actuality, exports have increased very rapidly, especially since the State Water Project came on line during the 1970s. Indeed, there has been as much as a 7-fold increase in July-December exports since the late 1950s. This period of rapid increase corresponded with the near disappearance of juvenile Delta Smelt from the central Delta (see Nobriga, et al 2008. A more careful discussion of the history of exports (with a graph) would be helpful.

8	2	2-65	Figure 2.4-9 shows the cumulative probability distributions of daily X2 locations showing unimpaired flows (green solid line) and three historical periods, 1949-1968 (light solid blue line), 1969-1985 (long-dashed brown line) and 1986-2005 (short-dashed red line), illustrating progressive reduction in salinity variability from unimpaired conditions.	Figure 2.4-9 shows that the X2 location in the recent period has increased over the unimpaired period. The report did not exactly reproduce the figure from Fleenor et al. (2010). The location of the lines intersecting points A, B and C are incorrect.
9	3&4	3-6, 3-46, 3-59, 3-75, 3-78, 3-82, 3-84, 4-12, all	Potamocorbula amurensis or Corbula amurensis, (hereafter referred to as"Corbula") is native to Asia and was first observed in the Bay-Delta in 1986 (Carlton et al. 1990; Jassby 2008).	Change to "*Potamocorbula amurensis* or *Corbula amurensis* , (hereafter referred to as "*Potamocorbula* ") is native to Asia and was first observed in the Bay-Delta in 1986 (Carlton et al. 1990; Jassby 2008)." This description of the taxonomy should be moved to the section of the report where the Asian clam is first introduced. Furthermore, the most recent evidence suggests that *Potamocorbula amurensis* is the best nomenclature for the invasive Asian clam (Thompson and Parchaso 2013). Ultimately, the nomenclature should be consistent throughout the document.
10	3	3-14	Juvenile Life History	Hydrology conditions can influence the expression of life history strategies. Fish evolved to environmental cues. What may appear as a set "stream" type juvenile life history can change if the rainfall pattern is extremely wet. Ocean and Stream type descriptions are very general.
11	3.4.1	3-12	1st Paragraph, 2nd sentence	This comment is often made for recovery and restoration regarding what is good for Salmon is good for Steelhead. Very general statements like needing more water, riparian habitat, spawning habitat are true for both species, but for example when you look at something like spawning habitat closely, you'll find although there is some overlap there are very specific difference in things like gravel size, water depths and flow.
12	3	3-14, 3-21, 3-31	Table 3.4-1 & Table 3.4-4, 3.4.3.3 2nd paragraph	Spring-run should be February-September. Vaki River watcher on Butte Creek has documented spring-run salmon migration at Durham Mutual Weir in February for past three seasons. Spring-run adults have been observed in February since the monitoring began in 1995.
13	3	3-15	Spawning Temperature	Upper limits for spawning temperature vary between Chinook populations. For winter-run a seven day average temp of 57° F may lead to widespread collapse of the cohort. USEPA (2003) recommends a maximum 7DADM criterion of 13°C (55°F) to protect salmon spawning.
14	3	3-15	General Note	It would improve the document to describe the limitations of laboratory experiments reporting metabolic results. Extrapolating laboratory result to field conditions should state caveats.

15	3	3-17	Juvenile Delta Use	Juvenile use of the current Bay-Delta estuary is entirely influenced by the current state of the Bay-Delta. In many other estuaries that have Chinook Salmon, juveniles use the estuary for growth. Similarly, the Bay-Delta estuary likely supported much more juvenile salmonid growth in the past, compared to what is currently supported since the landscape modifications of the Bay-Delta.
16	3	3-17	3.4.2.1 last paragraph	Winter-run spend more than 40 days in the Delta. Winter-run residence timing is documented in the NMFS 2009 BiOp and supporting literature.
17	3.4.2.2	3-17	1st Paragraph	The classification on steelhead is incorrect. The species are Coastal Rainbow Trout, *Oncorhynchus mykiss irideus* , which exhibit 2 primary life history strategies, anadromous rainbow trout, commonly referred to as Steelhead and fresh water (resident) forms referred to as Rainbow Trout. It is true that both have progeny that can exhibit the other strategy, but it should be stated that Steelhead are not the species, only one of the 2 primary life histories.
18	3.4.3.1	3-18	1st paragraph and table 3.4-3	Table 3.4-3 may benefit from including steelhead production estimates and declines.
19	3	3-21	3.4.3.3, last paragraph	Spawning habitat for Central Valley spring-run Chinook salmon is not in the Calaveras River and should be removed from the text.
20	3	3-21	3.4.3.3 3rd paragraph	Butte Creek spring-run juveniles primarily emigrate as YOY fry with >90% "ocean-type". Deer and Mill Creek tend to have more yearling emigrants "river-type".
21	3	3-25	Spawning can occur at any time between October and December in the Merced, Tuolumne and Stanislaus Rivers, but typically happens in November	Carcass surveys show that SJR Chinook also spawn in January, like the Sacramento River Chinook. Department carcass survey data may be used to support spawning timing.
22	3.4.3.6	3-29	1st paragraph	Additional steelhead tributaries include Butte, Big Chico, Cow, Stony, Thomes creeks and Bear and Cosumnes rivers - all which are noted in NMFS 2014
23	3.4.3.6	3-29	5th Paragraph	The appropriate caveats should be stated regarding life history differences of steelhead.
24	3.4.3.6	3-29	6th Paragraph	This list of critical habitat is incomplete, see NMFS recovery website. Also, the most recent CV Steelhead DPS 5 year status review has included Mokelumne Fish Hatchery produced fish as part of the DPS. A table listing the critical habitat may help.

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25	3	3-3	Second paragraph.	While an excellent desktop reference by a highly recognized expert, the report perhaps relies too much on using Moyle (2002) as a default reference, as opposed to using primary sources, including those upon which Moyle (2002) bases his species accounts. In this particular case, the report states that most California native fish species, in particular those associated with the Bay-Delta system, are spring-flow dependent for spawning and rearing. Indeed, many species are, which puts spring flows into the spotlight. However, several very significant species, including those that are the focal point of this analysis are fall and winter spawners, and have juveniles that are dependent upon rearing habitat prior to higher flows later in spring. Notable examples are fall-run and late-fall-run Chinook Salmon, which spawn in fall and winter, and steelhead and White Sturgeon, which are winter spawners although their spawning often extends well into spring, as well. The report should be careful about characterizing the Bay-Delta fish fauna as being primarily dependent upon spring flow conditions for spawning and early rearing, and instead emphasizing the importance of suitable flow conditions in various parts, or all of the system, during all the year to functionally support the life-history needs of all the focus native species.
26	3.4.4.2	3-33	Tributary Habitat section	Tributary habitat may be even more critical to steelhead than Chinook based on the fact that many juveniles rear for 2 years and most of the current main stem tributaries do not have secondary tributaries that produce cold water habitat in the summer months and steelhead do not appear to use the lower Sacramento River or Delta to rear.
27	3.4.4.2	3-34	Floodplain rearing, 4th paragraph	The benefits of floodplain habitat for steelhead may not be completely analogous to benefits to Chinook salmon.
28	3	3-35	The third paragraph of page 3-35 misinterprests del Rosario et al. 2010.	The manuscript shows a correlation between the first pulse flow greater than 14,000 cfs and up to 50% of the winter-run emigrating downstream being detected by the Knights Landing rotary screw traps. Winter-run are migrating before and after this initial pulse flow events with and without pulse flows too.
29	3	3-4	First full paragraph, beginning on line 5	The report states that "the greater quantity of hatchery fish within the river system has caused declines in native salmon..." is an overgeneralization without supporting evidence. Nehlsen et al. (1991) did not present direct evidence for this system, although their overall status assessment was reflective at the time. Indeed, many of the same environmental factors, including flow, affecting the productivity of natural-origin salmon also affect the productivity of hatchery-origin salmon. Throughout this report, please change "native" salmon to "wild" salmon.
30	3.4.4.2	3-43	Last paragraph, 2nd to last sentence	The 6 year study has been implemented, and 2016 is the final year of the study. The study used Mokelumne Fish Hatchery Steelhead, which may not behave exactly like wild San Joaquin steelhead and their migration patterns.

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31	3.5.1	3-44	entire paragraph	Regarding all species overview paragraphs. It is reasonable to include a general introductory paragraph without citations; however, the overview sections should provide citations to support the flow abundance relationships. May consider moving this information to Section 3.5.3.
32	3.5.1	3-44		The paragraph includes no mention of LFS larvae, perhaps the most vulnerable life stage to entrainment. Larvae are typically present from December through April. (Citations: CDFG 2009, Baxter, R. D. 1999. Osmeridae. Pages 179-216 in J. Orsi, editor. Report on the 1980-1995 fish, shrimp and crab sampling in the San Francisco Estuary. Interagency Ecological Program for the Sacramento-San Joaquin Estuary Technical Report 63)
33	3.5.2	3-44	Third sentence about migration to freshwater to spawn	There is strong evidence from lab studies that LFS eggs and newly hatched larvae tolerate brackish water; therefore, indicating that spawning can take place in brackish water is reasonable. (citation: Hobbs, J., J. Lindberg, B. May, and J. Israel. 2013. Interdisciplinary studies of Delta Smelt and Longfin Smelt in support of IEP's 2010 work plan for the Pelagic Organism Decline (Otolith Studies, Laboratory Culture Development and Genetics). U.C. Davis. Final Report for Contract R10AC20108. 85 pages; this reference available through Hobb's ResearchGate site)
34	3.5.3	3-45	1st parag, 2nd sentence	Thomson et al. did not use SF Bay Study data, only FMWT data; revise sentence
35	3.5.3	3-45	1st parag, last sentence	Consider only pointing out the continued decline in LFS abundance. FMWT LFS abundance indices contain an autocorrelation that should be described and discussed otherwise.
36	3.5.3	3-45	Fig 3.5.1	Perhaps remove trend line because it uses all the data, whereas footnote 12 indicates the actual trend analysis did not. This appears common in all abundance trend graphics.
37	3	3-46	3.5.4.1, 3rd Para.	Much of the abundance index variation around the regression line is attributable to parent stock size. Specifically, adults from a wet-year year-class will be more abundant and produce a larger offspring year-class, regardless of water year type, than those of a dry-year year-class (see Nobriga and Rosenfield 2016 for evidence of a stock effect). Thus, wet years occurring every two years for 2 or 3 year intervals will allow the population to build up and have sufficient adults to provide larvae to take advantage of favorable conditions. In this fashion the population can respond better than we have seen recently (i.e. since the late 1990s). For example, the 2011 cohort, which experienced a January through June average Delta outflow of ~58,000 cfs was 20 times the size of the 2009 cohort. This suggests that a multi-year period of good flow conditions could actually result dramatic increase in the size of the population.

38	3.5.4.1	3-46	Fig 3.5-2 and 3.5-3	1) The outflow period of greatest response was indicated to be January through June; thus, the flow periods broken down might more logically be Jan-Mar and Apr-Jun, rather than Mar-May. 2) Another consideration for further analyses is to break the relationship into monthly intervals. All are correlated and not independent in a statistical sense, but they do show the seasonal pattern of high to lower outflows contributing to successful and not-so-successful year-classes, and are perhaps valuable for identifying changing target flows through the season.
39	3	3-46 to 3-48	section 3.5.4.1	This section does a good job of describing the flow relationship and discussing how to incorporate this information in a manner to inform some sort of outflow criteria. The issue, however, is that there is a second step decline that is not being brought into the analysis, which is attributable to the POD. This is problematic as the POD is the current regime that we are in and must manage. Attempting to create an outflow criteria in the absence of this understanding may result in winter-spring flows that aren't as protective as they were intended to be.
40	3.5.4.1	3-49	3rd full sentence	The flow needed to achieve a 50 % probability of population growth is not synonymous with flow needed to achieve positive growth in half the years.
41	3	3-49	3.5.4.2, 1st Para.	Establishing the effect of entrainment loss on the population using statistical methods is extremely challenging, with the weakness of salvage as an entrainment measure being just one of many reasons. Given that there is weak evidence of density-dependent survival at current abundance levels, entrainment should be assumed to have a negative impact on recruitment.
42	3.5.4.2	3-49	little discussion of loss of larvae	Important points: 1) Buoyant pelagic larvae are present from late December through early April, and can be expected to respond similar to juveniles to negative OMR flows; 2) Positive Qwest flows are important during this period to transport larvae hatched in the San Joaquin River downstream from risk of entrainment; large positive Qwest flows reduced particle entrainment relative to moderately negative OMR (see Baxter et al. 2009, pp 22-28, esp. Fig 16).
43	3.5.4.2	3-49	last pargr, last sentence	Consider removing sentence. Baxter et al. 2008 not correct citation for lowest salvage rates. Probably Baxter et al. 2009 if stated at all. Fig 3.5-5 shows lower salvage at positive OMR, so it contradicts statement.
44	3.5.4.2	3-51	first sentence	Correction: Citation should be Baxter et al. 2009
45	3.5.4.2	3-52	first sentence	Correction: Dege and Brown 2004 do not discuss adult migration habits.
46	3.5.4.2	3-52	2nd to last sentence	Correction: the lowest salvage rate appears to be measured +4600 cfs, not -1,250 cfs.
47	3.5.4.2	3-52	last sentence and Table 3.5-1	It appears that periodic strong positive Qwest (+2000 or more) lasting 5-7 days appears sufficient to transport larvae downstream and reduce subsequent juvenile entrainment/salvage. We recommend the Water Board staff evaluate Qwest data, and the impact that Qwest may have on larval transport & salvage.

48	3.6.2.1	3-53	Studies demonstrate that successful recruitment is episodic. Years with high precipitation and large Delta outflow are associated with higher recruitment (Klimley, et al. 2015; Fish 2010).	This is a section about green sturgeon. First sentence is an unsupported assertion. Neither Klimley et al. 2015 or Fish 2010 make that assertion. Suggest revising the passage to emphasize that the flow-recruitment relationship is from white sturgeon and many researchers think it holds true for green sturgeon.
49	3.6.1 and 3.6.4.1	3-53 3-55	Long life and high fecundity make it possible for sturgeon to maintain a stable population with infrequent high outflow years.	Although it is generally true that the population could be stable with episodic successful reproduction, the population is not stable and has been steadily declining. Also, as Fig. 3.6-1 clearly shows the population response to good flow years has been declining. Maybe revise that sentence along the lines of, "Long life and high fecundity make it possible for sturgeon to maintain a stable population with infrequent high outflow years, though the populations are not stable in California." Another important point is that the frequency of adequate spawning flows has been dramatically reduced through water project reservoir operations, a fact that should be addressed in the report.
50	3.6.3	3-55	There is no section on white sturgeon population trends over time, but there is one about green sturgeon.	We recommend adding a subsection 3.6.3.2 abundance of White sturgeon, citing abundance estimates and CPUE. See here: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=44050 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=89901 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=74163
51	3.6.3.1.	3-55	Abundance information for Green sturgeon comes from tagging and genetic studies, CDFW (2002) has estimated from tagging studies that the size of the adult Green sturgeon population in the BayDelta Estuary has ranged from a low of 175 to more than 8,400 adults between 1951 and 2001 with a median size of about 1,500 adults.	The estimates of population size in CDFW (2002) are not rigorous, have been 'heavily caveated' and --- including in the NMFS status report --- criticized over the years, and we no longer produce estimates using that technique. Best to delete the passage.
52	3.6.4.1	3-55	The whole section.	The author identified and faithfully described the available pertinent information; however, we recommend that the authors refer the following citations because it appears that a higher flow may be necessary to for a positive population growth. Robust monitoring or studies may be necessary to determine the casual mechanisms (e.g., temperature, habitat, food web) to set priorities for habitat restoration and best flow regimes to support successful reproduction and survivorship. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=100577 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=133706

53	3	3-58	3.7.1	The second to the last sentence in this subsection concludes that Splittail have large flow needs relative to other species. The flow referred to here are the flows required for strong recruitment. High flows enhance age-0 recruitment/abundance. However, given that this is a relatively long-lived species (e.g. compared to smelt species)strong recruitment every year is not needed for a stable or growing population. In other words, on a multi-year basis the flow needs may not be "among the largest".
54	3.6.4.2	3-58	Green and White sturgeon have been salvaged at the CVP and SWP pumping facilities during all months of the year (NMFS 2009)	A more complete analyses of the temporal aspects of Green and White sturgeon salvage at the CVP and SWP pumping facilities could be completed by directly using data from salvage reports.
55	3.7.1	3-58	first sentence, Fig. 3.7-1	Here and elsewhere in the paragraph, you probably don't want to equate Splittail abundance indices with population size. Abundance indices recently are about 3 percent of abundance in 1967. Indices are typically dominated by or are exclusively age-0 catch, so they only indicate relative strength of one of about 8 year-classes that comprise the population. The section should be revised to make it clear at all points what life stage abundance is being addressed.
56	3.7.2	3-58	Second sentence in "Life History" section. " Their distribution is mostly in the Central Valley and Bay-Delta Estuary although some fish have been collected in the Napa and Petaluma Rivers."	There is no mention of splittail's historic distribution. See Moyle et al. 2004, "Biology and population dynamics of Splittail in the San Francisco Estuary: a review", and sources within. Add to References for distribution in Napa R, Petaluma R and Sonoma Cr: Feyrer, F., J. Hobbs, S. Acuna, B. Mahardja, L. Grimaldo, M. Baerwald, R. Johnson, and S. Teh. 2015. Metapopulation structure of a semi-anadromous fish in a dynamic environment. Canadian Journal Fisheries & Aquatic Sciences doi/10.1139/cjfas-2014-0433 72:1-13. Fish collected in the Napa and Petaluma Rivers have been identified as a genetically distinct population that has limited overlap with the Central Valley population. See Baerwald et al. 2007, "Genetic analysis reveals two distinct Sacramento Splittail populations" and Baerwald et al. 2008, "Distribution of Genetically Differentiated Splittail Populations during Nonspawning Season." The effects of flow on their distributions and overlap have not been assessed, however, its plausible that the overlap would increase as flow increases due to expansion of the low salinity zone. Furthermore, mixing of the populations is more likely during high flow conditions and could increase genetic diversity.

57	3	3-58	First paragraph of 3.7.2	Data and other information on the current recreational fishery for Sacramento Splittail are available from CDFW's Central Valley Angler Survey (Rob Titus, CDFW, as contact). Information is available on the spatial and temporal distribution of the sport fishery in the lower Sacramento River system, including monthly estimates of angling effort, catch, and harvest. In addition, there are several years of size data from the sport catch, and information on the effects of a major fishing regulation change implemented in 2011 that has greatly reduced harvest of Splittail. We can work with the Water Board staff to provide a summary as desired for this effort.
58	3	3-59	3.7.3	Referring to Fig. 3.7-1, this subsection addresses species abundance. Figure 3.7-1 uses data from the FMWT Survey, which is more of a measure of annual juvenile recruitment than overall species abundance, so the text needs to be clear about this.
59	3.7.3	3-59	first and second sentence	Figure 3.7-1 trend line is not consistent with the statistical analysis described in the text and footnote 15 regarding a statistical decline over time. Please elaborate on the statistical analyses used to evaluate splittail declines since 1967 and 2000.
60	3.7.3	3-59	Footnote number 15. " The decline was estimated from the average of the first three (1967 - 1970) and the last three (2012 2014) years of the FMWT index to account for inter-annual variability."	1) 1967-1970 is four years but the text says three years. If there is as reason that one year was omitted, you need to elaborate. 2) 1967 - 1970 consists of 3 wet years and one below normal year, while 2012 - 2014 are below normal, dry and critically dry years, based on DWR water designations for the Sacramento Valley. Designations for the San Joaquin Valley were similar. This comparison is between a relatively wet period, when YOY abundance is expected to be high, and a relatively dry period when it is expected to be low. Add some language explaining that the decline in abundance reflects more than variation associated with wet vs. dry periods. Emphasize the magnitude of the decline.
61	3.7.3	3-59	first two sentences	The decline of splittail is evident. However, the FMWT is not the best index for an accurate idea of year class strength, but it is the index of reference to historical work and should be presented for that reason. In addition consider using the USFWS Beach Seine juvenile Splittail abundance index, which is much more reflective of actual recruitment since sampling is conducted within the Sacramento and San Joaquin rivers. See reference: La Luz, F., and R. Baxter. 2015. 2014 Status and trends report for pelagic fishes of the upper San Francisco Estuary. IEP Newsletter 28(2):3-12. Contact either author for further information.
62	3.7.3	3-59	Second paragraph	Targeting an historical index of 10 is laudable and arguably protective, but the estuary has changed, and although flows to reach that index level undoubtedly result in increased numbers of Splittail on the order of historical number, they will not likely be detected well by FMWT. The estuary no longer supports a mysid population through fall sufficient to instigate pelagic feeding of Splittail present during fall, so FMWT will not reflect or detect recruitment regularly; Splittail are all rearing along the shoreline, thus the beach seine index is arguably a better metric.

63	3.7.4.1	3-60	Second sentence on page 3-60. "The current relationship is still significant ($P < 0.001$)."	Elaborate on the statistical analysis used. The report is not clear whether the methods were similar as Kimmerer 2002a cited on previous page or Kimmerer 2002 cited later in same paragraph.
64	3.7.4.1	3-60	2nd paragraph	Target flow ranges will certainly "activate" flood terraces; however, the analyses might benefit from an estimate of floodplain acreage and duration. Specifically, if during March 1 through May 1, Fremont Weir has spilled for 15-20 days maintain spill for 30 days, to complete rearing period necessary for successful rearing.
65	3.7.4.1	3-60	Second sentence of second paragraph on page 3-60. "First, a regression analysis was conducted with Delta outflow and Splittail abundance during the February through May time frame to determine the 38,000 cfs was correlated with the abundance goal."	FMWT does not sample from Feb to May. Please clarify which abundance metric is being used for the analysis e.g., fall abundance, measured by FMWT, correlates with Feb - May delta outflow.
66	3.7.4.1	3-60	Second half of second paragraph on page 3-60.	The SWRCB report recommends maintaining sufficient flow to maintain 30 days or more of floodplain inundation. This is consistent with much of the literature cited in this section. Determine the daily flow required to inundate Yolo and Sutter Bypasses, and evaluate this regime as a minimum flow required for Feb - May. This would be in line with the literature and has a mechanistic relationship with Splittail abundance. High flows produce more Splittail because of floodplain inundation. Take the argument one more step and base it on floodplains. In addition, a sizeable area is inundated in the Sutter Bypass prior to the Fremont Weir spilling (e.g., at approximately 20 ft stage); notching Fremont weir could possibly reduce the available floodplain habit for splittail in the Sutter Bypass.
67	3.7.4.2	3-62	final paragraph of section	Yes, in regards to overall splittail population salvage is a small concern; however, salvage rates of splittail increase when SJR flows are high and recruitment is good throughout the Sacramento-San Joaquin system.
68	3	3-62	3.8.1	The final sentence of the subsection uses the term "tidally transported" to describe larval downstream movement in early summer. The downstream movement of larvae and juveniles is probably more active than the report's characterization. Some Delta Smelt likely leave the south Delta as juveniles, potentially using tide-based vertical or horizontal movements to facilitate downstream movement. Also, juvenile Delta Smelt are common in the lower Sacramento River in summer, and once were common in this season in the lower San Joaquin River.
69	3.8.2	3-62	2nd paragr, 1st sentence	Freshwater residence of Delta smelt can occur in the Sacramento Deepwater Ship Channel or in the lower Sacramento River in the vicinity of Sherman Island.
70	3.8.2	3-63	1st full paragr, 2nd to last sentence	Dege and Brown 2004 provide distance from X2 in kilometers, and citations should be in those units. It appears that the conversion into miles is in error because the range is about 10 to 60 km (or about 6 mi to 36 mi).

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71	3.8.2	3-63	1st full paragr, last sentence	By the time increased water temperatures force movement most Delta smelt have grown beyond the larval stage . So, larvae and juveniles respond to warming temperatures by moving downstream.
72	3	3-63	"pumping facilities during first flush events are characterized by sharp unimodal peaks, suggesting that rapid changes in environmental conditions trigger population-level migrations"	This is generally true, however; there are years where first flush events do not occur (such as some of the years in the recent drought period), but yet migrating Delta smelt are still observed in upstream areas. Delta smelt are an annual species which must spawn every year even in the absence of rain. Rapid changes in conditions is just one way Delta smelt may be cued to migrate, other factors, such as water temperature or photo period, may also trigger migrations in the absence of strong first flush events. There are other instances in the document where similar statements are made about migration cues, that should probably not be written as an absolute on migration.
73	3.8.2	3-63	2nd full paragr, last sentence	In this context, the Jassby et al. 1995 citation regarding X2 and DS distribution is incorrect. This sentence makes the same point as the previous one, so consider removing it.
74	3.8.3	3-63	last sentence	The Messineo et al. 2010 reference can be updated with: La Luz, F., and R. Baxter. 2015. 2014 Status and trends report for pelagic fishes of the upper San Francisco Estuary. IEP Newsletter 28(2):3-12.
75	3.8.3	3-64	1st partial paragr	Based on the text and Figure 3.8-1, there appears to be a couple of different analyses performed. Please clarify the statistical analyses used to depict the decline.
76	3.8.4.1	3-65	1st paragr, 1st sentence	Jassby et al. 1995 did not use the Feb-June averaging period, nor did they find any flow relationship with DS. Sentence has an open parentheses.
77	3.8.4.1	3-65	1st paragr, 2nd sentence	It might be quicker to point out that historically Delta smelt did best at intermediate outflows and generally more poorly at both extremely high and low outflows.
78	3.8.4.1	3-65	footnote 17	The 20-mm Survey measures the abundance of large larvae and small juvenile Delta Smelt based on data from 2 surveys prior and 2 surveys after mean Delta smelt length reaches 20 mm.
79	3.8.4.1	3-65	footnote 19	SKT survey is conducted between January and May.
80	3.8.4.2	3-67	footnote 20	STN index is based on data from the first two surveys of each sampling season, currently, the two surveys in June.
81	3.8.4.4	3-71	2nd paragr, last sentence	Authors should reference Fig 3.8-6 versus 3.8-5. Also based on Fig 3.8-6 and m3 to cfs conversion, the upper end of the flows may actually be higher than 25,000 cfs.
82	3.8.4.4	3-72	2nd paragr	OMR flows are relevant to Delta smelt entrainment. For adults spawning and larvae hatching in the SJR channel, Qwest is an important measure as well. Positive Qwest can provide net downstream transport for organisms in the SJR channel even when OMR is moderately negative. See Longfin smelt effects analysis (Baxter et al. 2009)

83	3.9.	3-73	1st paragr, 2nd sentence	It would be more accurate to say young rear for a couple years in the upper estuary because not all rear in the Delta and fish begin to move downstream somewhat after age-0.
84	3.9.2	3-74	1st paragr, last sentence	Starry Flounder is a benthic species, not a pelagic species. Older larvae and newly transformed juveniles are known to move into the water column to use tides and gravitational flows to move upstream.
85	3.9.2	3-74	2nd paragr, 4th sentence	About the time larvae settle to the bottom, they complete transformation and become juveniles. Juveniles spend the next several years in fresh and estuarine waters.
86	3.9.2	3-74	2nd paragr, 2nd to last sentence	Baxter 1999 is a better reference for Starry flounder distribution than Jassby et al. 1995.
87	3.9.3	3-74	1st paragr, 2nd sentence	The report should identify the uncertainty of estimates of Starry flounder abundance using the SF Bay Study because the SF Bay study samples a limited range for age-1 fish, whereas, a substantial number of age-0 fish were believed to rear upstream of survey sampling reach.
88	3.9.4	3-76	First para and figure 3.9-2	In text, reports that outflow from years 1994-2014 were used, but in the figure caption, years were 1994-2013. If the 1994-2014 age-1 Starry Flounder index was used, should be 1993-2013 outflow (i.e., the year when originally recruited).
89	3	3-77	First para, 2nd sentence	The index represents population abundance of juvenile (< 1-year old shrimp), not 1-year old shrimp.
90	3	3-77	Life History, 1st para	It is primarily an estuarine species, common in bays on mud and sand, also found in near shore coastal waters (Schmitt 1921).
91	3	3-77	Life History, all paragraphs	Siegfried 1989 and Reilly et al. 2001 are primarily review documents. When possible, the authors should review and cite the primary works.
92	3	3-77	Life History, 2nd para	12,969 pounds of bay shrimp landed in SF Bay in 2015 (see 2015 commercial fishery landings, https://www.wildlife.ca.gov/Fishing/Commercial/Landings#260041375-2015)
93	3	3-77	Life History, 2nd para	Citations: Bonnot 1932 (2nd sentence); Skinner 1962, Reilly et al. 2001, and California Commercial Landings, online.
94	3	3-77	Life History, 4th para	It is unclear whether the author is referring to *C. franciscorum* or several species of Bay shrimp. The author Should specify *C. franciscorum* , or if common name is preferred, California bay shrimp. The first sentence, which refers to several species, is not needed. Bay shrimp is a generic term for several species of shrimp, which includes Crangon and other genera. The common name for *Crangon franciscorum* is the California bay shrimp, but it is preferred that the scientific name is used when discussing invertebrates.
95	3	3-77	Life History, 4th para	Original citations include Israel 1936, Krygier and Horton 1975, Hatfield 1985; but not Siegfried 1989.
96	3	3-78	Life History, top para, last sentence	*Pseudodiaptomus forbesi* was not detected in the estuary until 1987. Please verify whether Wahle 1985 or a more recent citation would be more appropriate reference to *P. forbesi* .

97	3	3-79	Flow Effects, first para, first sentence.	"...between abundance of juvenile Bay shrimp and Delta outflow..." not 1-year old Bay shrimp
98	3	3-79	Flow Effects, last para.	Please note that the mechanisms were hypothesized. Original citations are not Reilly 2001 and Siegfried 1989; rather Hatfield 1985 for gravitational circulation and CDFW 1992 for nursery area size.
99	3	3-80	Delta Outflow, last paragraph	The *C. franciscorum* population varies annually with Delta outflow. The range of flows, 19,000 to 26,000 cfs, March to May, should result in no decline over time. This is different than maintaining the present population size, which can vary several orders of magnitude from year to year.
100	3.11.2.2	3-82 (entire 2 paragraphs)		Additional literature could help to support this section. For instance, copepod diet topics should include the references: Kimmerer 2002, Kimmerer et al. 2014a. For *Eurytemora* as an important food source for fish, include: Nobriga 2002, Moyle et al., 1992; Slater and Baxter 2014.
101	3.11.2.2	3-82 (entire paragraph)		Please provide more information regarding zooplankton life history (e.g., adult size, time to mature, where in the water column it is found, the temperature range in which it is found, and temperature impacts on growth rates), which may be influence by flow rates.
102	3.11.2	3-82 (last line of paragraph)	Citation refers to SWRCB 2010	SWRCB 2010 not listed in references for zooplankton. Recommend including the original flow-abundance citations for each species instead. For instance: Jassby et al. 1995, Kimmerer 2002 for both Eurytemora and Neomysis (other references include again below)
103	3.11.2.2	3-82 (last part)	...has been observed...	Including a discussion on salinity tolerance and temperature impacts on zooplankton growth rates, survival, etc. may help determine the hydrologic conditions necessary to support zooplankton communities.
104	3.11.2.1	3-82 (last sentence in 2nd paragraph)	abundant in LSZ	Include more references (Knutson and Orsi 1983).
105	3.11.2.1	3-82 (last sentence)	...feeds on...copepods...	*Eurytemora* is a major prey item of this mysid (Orsi and Mecum 1996)
106	3.11.1	3-82 (line 5)	...replaced by...copepod taxa...	It is not just copepods that have replaced these organisms, but an amphipod (*Gammarus daiberi* introduced in 1983 (Peterson and Vayssieres 2010)) and other mysids.
107	3.11.1	3-82 (line 5-6)	replaced by a group of alien copepod taxa from East Asia that are smaller and may be less nutritious for planktivorous fish	Only one of the non-native copepod species is very small (*Limnoithona tetraspina).* Introduced copepod species are roughly nutritionally equivalent (Kratina and Winder 2015) but not equally available to consumers (Meng and Orsi 1991).
108	3.11.2.1	3-82 (lines 4-5 in paragraph)	...with reproduction occurring in winter and spring (Durand 2015)	*Neomysis mercedis* reproduces year round (Orsi and Mecum 1996), not only during winter and spring as stated.

109	3.11.4.1	3-83 (paragraph)	other references to include for flow abundance relationships	Jassby et al. (1995) found a negative relationship with X2 from the early 1960s to 1993 (March-Nov), similar to what Kimmerer 2002 found prior to 1987. Orsi and Mecum 1996 also found that "outflow explains a substantial portion of the variance" for this mysid. Similarly, Knutson and Orsi 1983 found that populations of this mysid decreased in the low salinity zone as salinity intrusion up the estuary increased (prior to clam invasion). Again, Orsi and Knutson 1979 (prior to clam invasion), showed that abundance was high at intermediate freshwater flows. The most recent findings is from the one that is cited in the text (Kimmerer 2002)
110	3.11.4.2	3-83 (1st sentence of the paragraph)	...was not correlated with X2	There appears to be a lack of consistency regarding the seasons e.g., a lack of a pattern in summer before 1987, and then begins to show a relationship with spring outflow after 1987.
111	3.11.3.2	3-83 (1st sentence)	"around"	Typo: "round". Also, include Merz et al. 2016 to show that seasonality shifted: the peak in abundance now occurs at the end of March beginning of April, whereas it previously peaked in July.
112	3.11.4.3	3-83 (1st sentence)	...more salinity tolerant non-native copepod...	Limnoithona tetraspina is not more tolerant to salinity. Bouley and Kimmerer 2006 and Orsi and Ohtsuka 1999 cite its salinity range as 1-10 ppt, which is less tolerant than either *Neomysis mercedis* or *Eurytemora*
113	3.11.3.1	3-83 (2nd sentence)	......competition for food...	The decline is most likely due to competition between juvenile mysids and clams (not all stages of mysids as is implied here). Perhaps include that the decreases in phytoplankton was mostly due to a decrease in diatoms, thought to be consumed by the clams; this is the main food source for the early life stages of mysids (Orsi and Mecum 1996).
114	3.11.3.1	3-83 (2nd sentence)	...and other benthic grazers...	Please list the other benthic grazers.
115	3.11.4.1	3-83 (2nd sentence)	After 1987...	Please specify whether this sentence is referring to just summer abundance again, or for the whole year.
116	3.11.3.1	3-83 (entire paragraph)		Add when it reaches peak abundance: annual abundance peaks from May to July (Spring) (Orsi and Mecum 1996)

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117	3.11.4.3	3-83 (final paragraph)	non-native zooplankton	*Pseudodiaptomus* is an important component of many fish diets (Bryant and Arnold 2007, Slater and Baxter 2014). As stated earlier in the report, *Pseudodiaptomus* is an important food item for Delta smelt, as well, calanoid copepod abundance in the low salinity zone is positively correlated with Delta Smelt survival from summer to fall (last paragraph section 3.8.2 page 3-63). *Pseudodiaptomus* is more abundant upstream and subsidizes populations downstream (Durand 2010, Kayfetz 2014) via advection and dispersion (Kimmerer et al. 2014b). This brings them to Suisun Bay in summer and fall where fish are feeding. The recommended flow range to protect zooplankton in Section 3.11 is based on maintaining X2 between 64 and 75 km between February and June. However, preliminary statistical analyses of the recent IEP Zooplankton Study has shown strong positive statistical correlations between zooplankton abundance indices and Delta outflow. These flow vs. abundance relationships could be used to estimate the protective Delta outflow to protect zooplankton. The Zooplankton Study data is available: ftp://ftp.dfg.ca.gov/IEP_Zooplankton/1972-Sep2016CBMatrix.xlsx or Water Board staff contact Department staff to discuss the data used and analyses.
118	3.11.3.1	3-83 (first sentence)	but has now decline to low levels...	Please add: " in all seasons, and summer levels declining 50-fold " and include the reference (Orsi and Mecum 1996)
119	3.11.4	3-83 (general)	Tables 3.11-1; 3.13-2; 3.13-3	The monthly periods included for the flow requirements given in Tables 3.11-1; 3.13-2; 3.13-3 are inconsistent. According to our recent analyses the flow recommendations for zooplankton of 11,400-29,200 cfs may be insufficient to benefit *Eurytemora* and *Neomysis* . The recommended flow range to protect zooplankton in Section 3.11 is based on maintaining X2 between 64 and 75 km between February and June. However, preliminary statistical analyses of the recent IEP Zooplankton Study has shown strong positive statistical correlations between zooplankton abundance indices and Delta outflow. These flow vs. abundance relationships could be used to estimate the protective Delta outflow to protect zooplankton. The Zooplankton Study data is available: ftp://ftp.dfg.ca.gov/IEP_Zooplankton/1972-Sep2016CBMatrix.xlsx or Water Board staff contact Department staff to discuss the data used and analyses.

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120	3.11.4	3-83 (general)		In the report, mysid shows a negative relationship with flow, while *Eurytemora* shows a positive relationship. Department analyses shows a positive relationship with flow for the mysid in the spring months (March-May). During this period *Eurytemora* and the mysid show similar abundance patterns with flow. For mysids, spring months are better to develop relationships because abundance of *Neomysis mercedis* is very low in the summer months. Thus, the spring may be the most important time to for flow to support mysid populations. The Zooplankton Study data is available: ftp://ftp.dfg.ca.gov/IEP_Zooplankton/1972-Sep2016CBMatrix.xlsx or Water Board staff contact Department staff to discuss the data used and analyses.
121	3.11.4.2	3-83 (last sentence of the paragraph)	As flows decrease...	Hennessy (2009) refers to 1 or 2 years (2008), and the results should not be applied to anything outside of those years. The decline in abundance is most likely due to increased grazing in the summer by the clam, and competition with *Pseudodiaptomus* (Durand 2010; Kimmerer et al 1994). Flow likely indirectly influences this by affecting clam abundance.
122	3.11.3.2	3-83 (line 7)	...competition for food...	Please clarify the sentence with "...competition for food with and predation by the two invaders..."
123	3	3-84	American shad historically supported a large commercial gill net fishery in California but this was banned in 1957 to protect the recreational Striped bass fishery (Moyle 2002; Dill and Cordone 1997).	Please clarify the statement, from Moyle (2002), American shad section, pg. 106: "In 1957, the commercial fishery was banned in favor of the rapidly developing sport fishery."
124	3.12	3-84	3rd parag, 4th sentence	Consider pointing out that the increased intercept since establishment of Potamocorbula is unusual; most intercepts declined.
125	3	3-84	First paragraph under 3.12	There are CDFW publications that illustrate the positive flow-abundance relationships for American Shad and Striped Bass. We recommend that those studies, or at least a representative one, be cited here, and that graphics of the relationships also be provided to illustrate the point. Indeed, it is important to point out that both native and introduced species in the Bay-Delta system respond favorably to increased Delta outflow conditions.

126	3	3-84	End of second paragraph under 3.12	While Wang's (1986) guide to the early life histories of Bay-Delta fishes is a good general reference, it is not a primary source of information on the sport fisheries in the system. CDFW has conducted a comprehensive angler survey on the Sacramento River system, from the Carquinez Strait to Keswick Dam, and on the lower Calaveras, Mokelumne, American, Yuba, and Feather rivers in three phases since 1991. The current phase has been underway continuously since 2006. The following report provides sport fishery results for 2 years, and which can be cited here and elsewhere in the report in relation to sport fishery trends in the Sacramento River system. In this particular context, the distribution of the American Shad sport fishery should be noted to include not only the American and Feather rivers, but also the Sacramento River where the majority of fishing effort for Shad consistently occurs. Please see the following citation, which illustrates this information not only for American Shad, but also the other major anadromous and resident sport fisheries in the system, should be cited as: Titus, R., M. Brown, J. Lyons, E. Collins, and L. Koerber. 2012. Annual Project Performance Report: F-119-R, Central Valley Angler Survey, July 1, 2009 to June 30, 2011. Report to U.S. Fish and Wildlife Service, California/Nevada Operations Office, Federal Assistance for Sport Fish Restoration Act.
127	3	3-84	Last paragraph, line 3	While Moyle (2002) is correct in identifying the Striped Bass fishery as the most important recreational fishery in the Bay-Delta Estuary, a primary source for supporting this statement is the report by Titus et al. (2012). Indeed, more than 1.1 million angler hours of effort are expended annually for Striped Bass.
128	3.11.4.3	3-84 (Table 3.11-1)	Include different protective outflow for each of the 2 species in Table 3.11-1.	Include the following periods: For *Eurytemora* : March to June; For *Neomysis* : March to May and Summer (lower flow rates from Kimmerer 2002) The recommended flow range to protect zooplankton in Section 3.11 is based on maintaining X2 between 64 and 75 km between February and June. However, preliminary statistical analyses of the recent IEP Zooplankton Study has shown strong positive statistical correlations between zooplankton abundance indices and Delta outflow. These flow vs. abundance relationships could be used to estimate the protective Delta outflow to protect zooplankton. The Zooplankton Study data is available: ftp://ftp.dfg.ca.gov/IEP_Zooplankton/1972-Sep2016CBMatrix.xlsx or Water Board staff contact Department staff to discuss the data used and analyses.
129	3	n/a	Chinook salmon life history	In general, there appears to be inconsistencies with the scientific literature. A few papers are cited, but it does not appear to capture the entirety of the life history strategies for CV salmonids. DFW staff are available to assist in providing relevant citations.
130	4	4-1	4.2	Text should be added to this section noting that much of the habitat loss occurred prior to recent species declines.

131	4	4-1	General comment	The chapter appears to describe stressors in the form of an unprioritized list, without a rigorous assessment of relative importance or interaction with water project-related effects. Also, the chapter would benefit from inclusion of a summary table where stressor effects and importance could be easily compared. Including a list of known impairments to beneficial uses (e.g., 303(d) listed constituents and water bodies) could be helpful.
132	4	4-1	General comment	Because of the general disconnect between the timing of some stressor introductions, it may be better to discuss some stressor reductions as a potential means of reducing the water cost of species restoration, rather the cause of species declines.
133	4	4-10	4.4	There are two important points that should be made in the introductory part of section 4.4. The first point is that some of the native species now in decline successfully co-inhabited the system with non-natives for many decades. The second point is that there is clear evidence that human-induced stressors have exacerbate the negative interactions of native and non-native species.
134	4	4-10	Section 4.4	It is important within this general discussion of the effects of nonnative species on native Bay-Delta species that perspective be stated of the historic productivity among native and nonnative fishes in the system. Prior to the major water projects coming on line, system productivity supported relatively high abundances of both native and nonnative fishes. Predation is obviously a "stressor," but as concluded by Grossman et al. (2013) there is a high level of uncertainty of its relative importance, both spatially and temporally. Indeed, predation opportunity is greatly enhanced by the "plumbing" of the system for transferring water to the pumps in the South Delta.
135	4	4-11 4-12	Nonnative fishes	There has been a relatively strong relationship between American Shad age-0 abundance and outflow. Please include American Shad into the report because it is an important fishery.
136	4	4-12	4.4.1.5	The Inland Silversides subsection does a better job than the other non-native species subsections in framing the species as a stressor. This type of detail should be included in the discussions of other non-native species.
137	4	4-12	4.4.2	Section 4.4.2 does a generally effective job of framing invertebrate species introductions/presence as a stressor. The text would be enhanced, however, if some basic information were provided on how flow influences effects.
138	4.4.1.4	4-12	Centrarchids	The expansion of Centrarchid fishes is a prime indicator of the massive ecosystem shift that has been occurring and continues to occur in the Delta and it's tributaries. Centrarchids are able to proliferate because the Delta's hydrology is now conducive to support a warm water fishery.

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139	4	4-12	Section 4.4.1.4	The synopsis on Largemouth Bass predation on native aquatic species does not seem very objective. The report mentions on line 3 of this section that Largemouth Bass have many similarities to Striped Bass. Largemouth Bass also have many dissimilarities to Striped Bass. It is unclear as to why this comparison is being made other than to potentially vilify Largemouth Bass as yet another predator on native species. It is important to note that Largemouth Bass are also a predator on nonnative species, such as Threadfin Shad, which, until recently, were the most abundant fish species in Bay-Delta monitoring. Please maintain an objective tenor with respect to characterizing the known relative importance of Bay-Delta flows with other stressors, such as predation, competition, and other interspecific interactions in a very complex food web.
140	4	4-13	Nonnative invertebrates, paragraph 4	There is only one native shrimp, *Crangon franciscorum* , found in the Delta (brackish only, not freshwater), not several species as stated in the text. We do not know of any report or paper that has shown it to be impacted by introduced species, including introduced shrimp, so it is a hypothesis that it has been impacted. There are 2 introduced shrimp in the Delta, *Palaemon macrodactylus* and *Exopalaemon modestus* , which are found in brackish and fresh water. Since *C. franciscorum* is not found in freshwater, it certainly has not been replaced in the fresh water portions of the delta by introduced shrimp. In addition, there is no commercial fishery for bay or grass shrimp in the Delta. Fishing for bay shrimp is prohibited above Carquinez Strait.
141	4	4-13	Nonnative invertebrates, paragraph 5	Nonnative jellies also in Suisun Marsh and the Delta, not limited to Suisun Bay. There are much more recent references about the potential impacts of these 2 jellies than Rees and Gershwin 2000. Specifically papers by Wintzer, Meek, and Moyle (2011).
142	4.4.2	4-13	(Greene et al., 2011)	Please Include: Durand 2010; Kimmerer et al 1994 to support these food web discussions.
143	4.4.2	4-13 (2nd to last paragraph, last sentence)	Rotifers...have also declined	Rotifers declined in the 1970s and 1980s, but have stabilized since the 1990s (Hennessy and Enderlein 2013)
144	4.4.2	4-13 (3rd to last paragraph)	"P. forbesi species also tend to consume ciliates..."	*P. forbesi* in the Columbia River primarily consume diatoms, ciliates, flagellates, and dinoflagellates, with a general preference for diatoms and ciliates (Bowen et al. 2015).
145	4	4-15	4.5.1	Missing from the "harvest" subsection is any mention (or description) of the massive changes that have occurred in fishing regulations/enforcement in recent years to protect fish species. This management effort has arguably been more aggressive than any other stressor reduction.
146	4.5.1	4-15	The whole section.	We recommend elaborating on the white sturgeon fishery like was done for the salmon fisheries because the white sturgeon fishery may be unsustainable.

147	4.5.2	4-15	The whole section.	Though it's probably not a big factor, the author might mention 'boat strike' as a source of mortality for sturgeon. NMFS addresses boat strike in various assessments of risk for green sturgeon.
148	4	4-15	Second paragraph under Section 4.5.1	The purpose and message of this paragraph is unclear. We recommend that it be re-written stating a clear and objective message about the role of fishing in determining abundance of both native and nonnative game fishes in the Bay-Delta. Subsistence fisheries, as typically associated with traditional uses of fishery resources by indigenous peoples, are minor in the Bay-Delta system. Alluding to an increasing trend of harvesting fish for food by certain ethnic groups seems inappropriate. Harvest occurs among a broad spectrum of anglers, and is regulated through implementation of daily bag and possession limits. Poaching has long been a resource management challenge, even though the demographics and ethnicities of poachers changes over time. We recommend avoiding the association of illegal harvest to ethnicity altogether.
149	4	4-15	Section 4.5.1, third paragraph, line 3, and elsewhere in the report	Replace "wild" with "natural origin" here and elsewhere in the report, especially with respect to Chinook Salmon and steelhead. Given that many Chinook Salmon and steelhead that spawn naturally are F1 hatchery progeny themselves qualifies their status as being truly and completely "wild." Thus, natural origin is more appropriate, indicating that they are the result of natural reproduction, regardless of their genetic origin.
150	4	4-15	Section 4.5.1 in general	Integrate Central Valley Angler Survey data, such as those contained in report by Titus et al. (2012), to characterize harvest of game fishes in the Bay-Delta system. Note also that harvest in these fisheries is largely self regulating. That is, when fish abundance is low, angling effort is low, resulting in low levels of legal catch and harvest. Please see Titus et al. (2014) which describes Sacramento River fall-run Chinook Salmon. Angler behavior, in terms of the effort they expend, is very deterministic as a function of target species abundance.
151	4	4-16	4.5.3	There is important context missing from the "hatcheries" subsection, that is that many of the hatcheries and hatchery operations are essentially water project mitigation intended to compensate for lost access to spawning habitat.
152	4.5.3	4-16	Hatcheries	Please clarify which hatchery management practices have contributed to the listing of steelhead. CDFW is unaware of hatchery practice(s) that contributed to or led to the federal listing of steelhead in the Central Valley. Steelhead have primarily declined due to the loss of over 80% of their habitat.
153	4	4-2 & 4-3	4.2.1 & 4.2.2, 2nd Para.	The reference here "past 100 years" misses the point that much of the habitat loss long preceded recent species declines.

154	4	4-6	4.3.1.1, 5th Para,	It is unclear why "legacy contaminants" are being presented as a stressor when concentrations have declined along with species abundance since the 1970s. It would be helpful (in terms of stressor prioritization) if the subsection text included clear examples of how mercury contamination or other legacy contaminants have contributed to species declines in the Bay-Delta. (Sandheinrich and Wiener 2011; Gehringer et al. (2012))
155	4	4-9	4.3.3, 2nd Para.	The second sentence points out that turbidity has "decreased through time". The utility of this observation would be enhanced if some additional text were added describing how this decrease has varied in timing and location in the Bay-Delta. Thomson et al. 2010 found that water clarity (evaluated among other factors) was negatively associated with Delta fish species abundances.
156	5	5-7	3rd paragraph; 5th sentence	If flow in April-May in the lower Sacramento River could exceed 20,000 cfs for more than 50% of the time, adult spring-run chinook would also benefit as these months are their peak migration months
157	5	5-10	7 lines from the bottom	Elevated temperatures are observed in the spring and fall in addition to summer.
158	5	5-11	5.2.3 first paragraph	While the statement is true, it should be expanded. Year round flows would also benefit protection of critical habitat such as riparian recruitment, channel stability and formation, etc. It is important to protect all life stages of fish and wildlife, when present in the ecosystem.
159	5	5-12	While the existing Sacramento River at Rio Vista flow requirements are minimal, they could help to ensure that existing minimally protective flows are maintained. Accordingly, at this time, no changes to these requirements are specifically recommended.	Sacramento River at Rio Vista objectives should use the unimpaired flow method or other appropriate method to ensure that the unimpaired flow from upstream tributaries, or the natural hydrology cues and benefits it provides, is protected and maintained through the Delta. Unimpaired flow or appropriate metric should be measured/monitored at Rio Vista as an intermediate station for compliance monitoring.
160	5	5-12	To better integrate the inflow and outflow requirements during this time period, use of the current month's ERI is recommended rather than the prior month. The State Water Board is specifically requesting input on this approach.	The use of the current month's unimpaired flow for the Eight River Index rather than using the previous month ERI to maintain MRDO is a better approach provided that reservoir storage for cold water pool needed to support is not adversely affected. Further, adopting the use of the current month's ERI would allow for the possibility of "fine tuning" MRDO in near real time to provide additional beneficial outflows when necessary.

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161	5	5-13	Recommendations for changes to summer Delta outflows, including adaptive management experiments, may be provided in the final Report based on evolving science. This is another issue that the State Water Board is specifically seeking feedback on.	There is emerging evidence that summer Delta outflow requirements may be necessary to protect Delta smelt. Delta smelt would benefit by increasing July and August flows from 7,100 cfs to 11,400 cfs and thereby moving X2 downstream to provide an increase in high quality rearing habitat in Suisun Bay (USFWS 2008). However, the 2015 IEP report (IEP 2015) found that abundance of Delta smelt in the spring 20-mm index was higher the further west the location of X2 the previous fall. Therefore, increasing flows to at least 11,400 cfs through October would provide an even greater benefit to Delta smelt. The USFWS BO requires Delta outflow to be managed in September and October so that X2 is no greater than 74 km or 81 km following wet and above normal water years, respectively.
162	5		Year-round Delta outflow is also important for the survival of Chinook salmon and steelhead. Thus, the State Water Board will also consider the adoption of a year-round outflow narrative objective. The State Water Board may also need to revisit numeric outflow objectives outside of the winter-spring period if protective flows are not provided through the adaptive management provisions.	Although minimum flow standards to support salmonid spawning, rearing, and emigration are established for Sacramento rivers and streams, augmentation of minimum flows would provide increased spawning and rearing habitat as well as increased survival during downstream emigration. A year-round outflow objective would provide cold-water holding habitat for adults and rearing habitat for salmonids who express yearling life history strategy. There may be tangential benefit to salmonids through benefits to estuarine food web. Adopting a year-round outflow narrative objective would enable the development of a more responsive adaptive management strategy for increased protection of all salmonid runs.
163	5	5-28	This Report recommends increases in outflow, particularly in spring, for the update to the Bay-Delta Plan to provide reasonable protection of fish and wildlife beneficial uses to stabilize and enhance the distribution and abundance of aquatic resources. The beneficial uses that would be protected include Warm and Cold Water Habitat, Migration of Aquatic Organisms, Spawning, Reproduction and/or Early Development, Estuarine Habitat and Rare, Threatened or Endangered Species.	Degraded aquatic environments that don't support healthy fish populations also impair COMM, REC-1, SHELL, and AQUA, which are designated beneficial uses of the Bay-Delta. Unhealthy fish populations greatly reduces fishery resources for human consumption and recreation. Subsistence anglers actively fish the Delta waterways year round (Wood et al. 2010), and many of the declining fish species highlighted in this report are typically targeted by subsistence anglers. As well, aquatic conditions which coincide with reduced fish growth rates can exacerbate methylmercury bioaccumulation and biomagnification through the food web. The Bay-Delta is widely known to be impaired by mercury due to elevated fish methylmercury levels. The modified flow regime in the Bay-Delta likely also exacerbates elevated methylmercury concentrations in Bay-Delta fish, thus resulting in increased risk and exposure of human and wildlife consumers of fish to mercury contamination.

164	5	5-32	5.4	The temperature criteria listed seemed to be coming from a wide array of sources with no consistent limits. It would be hard to expect any hard clear guidelines from this. Central Valley Region Water Quality Control Board used USEPA Region 10 criteria for salmonids to identify temperature impairments (e.g., 303 (d) list). The report should be consistent in the criteria its uses to measure benefits or harm to the system. The document cites numerous papers and states a numeric temperature value. For example, this report needs to define if the papers are citing a daily average, maximum, etc. Simply stating 56 degrees is not informative and will mislead numerous readers.
165	5	5-32 - lines 7&8	"Warmer rearing temperatures (46.5 to 77°F) provide for optimal growth if food is readily available."	This seems like typo and 77 degrees would be excessively warm for juveniles. Sentence is confusing cause it seems to be juveniles but is after a sentence on eggs which didn't seem to be the end of the egg discussion.
166	5	5-32	Second paragraph, line 5	The thermal maximum listed for juvenile steelhead, up to 81°F, is beyond the lethal limit for steelhead (i.e., 75°F). On the lower American River, we have repeatedly seen symptoms of thermal stress in juvenile steelhead when daily mean water temperature is 65°F or higher for protracted periods during summer and early fall. While juvenile steelhead may survive occasional exposure to *peak* water temperatures as high as 81°F with acclimation in that range, this thermal maximum should not be promulgated for steelhead. I recommend that a more thorough review of existing literature and fishery agency data be conducted to arrive at a more suitable upper limit to temperature criteria for juvenile steelhead in the Bay-Delta system. The extensive work conducted by CDFW during the 1990s on the effects of flow fluctuations on anadromous salmonids in the lower American should be cited here. The citation is: Snider, B., R. Titus, and K. Vyverberg. 2001. Evaluation of the effects of flow fluctuations on the anadromous fish populations in the Lower American River. California Department of Fish and Game, Stream Evaluation Program Technical Report No. 01-2. This publications currently cited in the report as Snider (2001), but should be corrected to Snider et al. (2001) with the complete authorship in the reference listing, as well.

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167	5	5-38	At this time, no changes to the Delta inflow to export ratio requirements are proposed. However, this is an issue the State Water Board is specifically seeking input on.	Export ratios (E:I) specified under the Bay-Delta Plan are less restrictive than the I:E ratio range of 1:1 to 4:1 specified in the 2009 NMFS Biological Opinion and neither have shown to provide adequate protection to salmonids and Delta smelt over the annual export cycle. In addition, and as identified in Chapter 3 of the report, the existing minimum export of 1,500 cfs believed to be necessary for health and safety of CVP and SEP exports can likely be reduced to 800 cfs. This further reduction in export volume would benefit all outmigrating anadromous species, in particular, San Joaquin origin juvenile salmonids outmigrating from February through June. Recommendations are to adopt the export ratios specified by the NMFS Biological Opinion and to evaluate the benefits of further reducing export ratios in conjunction with reducing the minimum export levels. The proposed adaptive management provisions for the interior Delta flows should be proactive and provide for versatility to make real-time changes in exports to enhance protection of salmonids, sturgeon, Delta smelt, and other native species. We recommend that the proposed, and any additional, export rates be evaluated to determine their effectiveness in providing San Joaquin River flow at Jersey Point. This will also help to evaluate the protection of any additional San Joaquin River flows that will be provided from Phase I of the Bay-Delta Plan Update process.
168	5	5-39	The information above and in Chapter 3 supports the addition of the month of October to the BayDelta Plan's existing suite of DCC gate closure requirements. Specifically, additional potential closure days are recommended during October based on fish presence and in coordination with the fisheries agencies.	Middle Sacramento River RST traps often catch "winter-run" sized fish during the month of October. Extending the DCC closure requirements to include October would provide an additional measure of protection to early outmigrating winter-run Chinook salmon. In years with above average October rainfall, an increase in Sacramento River flows can trigger an earlier outmigration pattern which could result in a significant proportion of winter run smolts entering the DCC gates and hence the interior Delta. October closure of the DCC gates would also decrease straying of returning of San Joaquin River and east tributary origin fall-run Chinook salmon.
	<end>			

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Table 2 CDFW Typographical Edits

Comment Number	Chapter	Page #	Text, Paragraph, Sentence in Question	Staff Comment or Suggested Edits
1	1	1-14	First paragraph, line 10, and throughout the document	Replace "race" of salmonid with "run." Run is the appropriate and accepted term for distinguishing the different temporal runs of Chinook salmon and steelhead.
2	1	1-15	Third paragraph, and throughout the document	Replace "outmigrating" or "outmigration" with "emigrating" or "emigration." Emigration is a recognized and accepted ecological term, while outmigration is not.
3	2	2-26	2.2.5.2 - Sentence 1 and 2	Colby Mountain not Colb
4	2	2-26	2nd and 4th paragraph	Lindo Flood Control Channel not Lido
5	2	2-69	2.7	It seems like "water for domestic use" would be a more useful reference than "drinking water". Very little of the developed water is consumed through drinking.
6	2	2-9	Second paragraph, lines 6 and 7, and throughout the document	Replace data "was/is" with data "were/are." That is, data is plural. Associated verbs should be conjugated accordingly.
7	2	2-9	Last paragraph, beginning of first sentence	Figure 2.1-7 is really a table, and should be labeled as such.
8	2.7	2-70 (line 8)	"conditions Delta"	should read: "conditions of Delta"
9	3	3-15	Fourth full paragraph, and elsewhere	Salmon lengths are reported here in inches. Essentially all presentation of scientific evidence related to Chinook Salmon life histories uses metric units of measurement. I recommend that metric units be used primarily throughout the report, and that if English units are also desired for general public reading, that they follow the metric units in parentheses.
10	3	3-15	Fifth full paragraph, and elsewhere	While the term, "smoltification," is broadly used in especially North American fishery literature, the correct term is "smolting." I recommend this correction be made throughout the report.
11	3	3-36	Labels on the graph are not consistent	Change X-axis label on one to make it match the other.
12	3	3-44	3.5.1	The sentence beginning "Average daily..." is a bit awkward, and the meaning unclear.
13	3	3-51	Fig. 3.5-5	The figure title has some odd capitalizations, and the word "same is missing its "a".
14	3	3-61	Fig. 3.7-2	The figure appears to use a log index scale, which should be specified in the axis label and title text.

15	3	3-64	Fig. 3.8-1	The word "Trend" in the title need not be capitalized, nor the word "INDEX".
16	3	3-68	3.8.4.3	The reference to "Table 3-8-1" should instead be "Table 3.8-1".
17	3	3-68	footnotes	Insert "a sustained Delta outflow of" in front of the CFS values.
18	3	3-69	Table 3.8-1	The word "Protective" should not be capitalized.
19	3	3-72	Figure 3.8-6	The figure title contains inconsistent capitalization
20	3	3-72		Delete the phrase "salvage and" from 1st sentence of 2nd paragraph
21	3	3-77	Life History, 1st para	Three common native species of Crangon in the estuary
22	3	3-77	Life History, 1st para	"The California bay shrimp is widely distributed..." (grammar, species is singular)
23	3	3-77	Life History, 3rd para	"*Crangon* spp are a major component...", not "*Crangon* spp. is..." spp. refers to more than one species, is plural.
24	3	3-77	Life History, 3rd para	Citation is Ganssle 1966, not Granssle 1966.
25	3	3-78	Trends over time, first para, last sentence, figure 3.10-1	Abundance has changed since 2000, as there is often interannual variation in abundance for this short-lived species. It is recommended that the report include the addition of the 2014 and 2015 abundance indices, as it may change the trend downward.
26	3	3-79	Figure 3.10-2	The relationship between flow and abundance in Figure 3.10-2 appears to be consistent with our data.
27	3.12	3-84	4th parag, 1st sentence	Change "... years had become a commercial fishery.." to "... years had increased in abundance sufficiently to support a commercial fishery..."
28	3.12	3-85	1st parag, 1st sentence	Change "...survival of Striped Bass eggs through their first summer..." to "... survival of Striped Bass from eggs to juveniles during their first summer..."
29	3.13	3-89 (last paragraph)	there is a misplaced period here	

30	3.6	3-53	The whole section	Consider reorganizing such that white sturgeon is discussed before green sturgeon, because that approach could be done clearly with far fewer words. The white sturgeon section would have the flow values. The green sturgeon section about flow could pretty much say something along the lines of "There is no quantitative information on-topic but we assume the relationship is similar to that for white sturgeon (see above)."
31	3.7	3-58	Third sentence in "Life History" section. "Splittail were historically fished by both commercial and Native Americans and are now part of a small recreational fishery."	Change to : "Splittail were historically fished both commercially and by Native Americans ..."
32	5	5-11	5.2.3 1st paragraph; last sentence	"Increased tributary flow....increase flooding in the Yolo **and Sutter** Bypasses..."
33	6	44-46	References	Ganssle, not Granssle (spelled incorrectly in the Starry Flounder references too). Add Bonnot 1932, Israel 1935, Schmitt 1921, Skinner 1962, all classic original references for *Crangon franciscorum* in SF Estuary.
34	2.4.5	2-60 (3rd line)	thorough	should read: through
35	2.4.5	2-60 (6th line)	"more predictable to operate to"	remove the last "to"
36	2.4.6	2-67 (line 2)	"Dalow's"	should read: Dayflow's
37	3.11.1	3-82 (line 3)	...relationship are N*eomysis*	should read: "...relationships are the mysid *Neomysis mercedis* and the calanoid copepod..."
38	3.11.1	3-82 (line 7)	The CDFW recommends...between February and June...	CDFG Draft 2010 Biological Objectives and Flow Criteria recommends flows of 11,400-29,200cfs from January through June (page 87) not February through June
39	3.11.2.2	3-82 (1st sentence in paragraph)	In San Francisco Bay	change to: "In the San Francisco Bay Estuary, "
40	3.11.3.2	3-83 (line 9)	...nauplii larval stage...	change to: naupliar larval stage
41	3.11.4.3	3-84 (last paragraph)	(SWRCB 2010,)and	delete the comma and put a space after the parenthesis
42	3.2.2	3-7 (2nd to last paragraph, 2nd to last sentence)	"Kimmerer 20004"	Kimmerer 2004
43	3.4.2.2	3-17	4th paragraph, 4th sentence	The document needs to be consistent in naming, steelhead or steelheads?
44	3.4.2.2	3-17	4th paragraph, 5th sentence	"Steelhead fish" is redundant, remove "fish".

45	3.4.3.6	3-29	3rd paragraph	The Battle Creek hatchery is named Coleman National Fish Hatchery.
46	3.5.1	3-44	last sentence "...are expected to reduce smelt salvage..."	Suggested change. Should be: " ... are expected to reduce smelt entrainment and thus salvage at the two ..." . We want to reduce entrainment into diversions.
47	3.5.2	3-44	Throughout paragraph.	Several sentences contain periods before and after parenthetical references.
48	3.5.2	3-44	Second to last sentence in paragraph	Please include references: Baxter, R. D. 1999. Osmeridae. Pages 179-216 in J. Orsi, editor. Report on the 1980-1995 fish, shrimp and crab sampling in the San Francisco Estuary. Interagency Ecological Program for the Sacramento-San Joaquin Estuary Technical Report 63. and Dege and Brown 2004
49	3.5.2	3-44	Last sentence	Change to "Larvae, juveniles and adults ..."
50	3.5.4.1	3-49	last two sentences	These last two sentences include reference to "other species", which seems out of place at this point in the document. Suggest they reference only LFS and similar comments be included in a summary section at the end of all the fish sections.
51	3.5.4.2	3-52	3rd and 4th sentences	Re-write to combine sentences using Fig 3.5-4 as reference. Reference to fig 3.5-6 in 3rd sentence is incorrect.
52	3.6.1	3-53	Years with high precipitation and large Delta outflows in winter and spring are associated with higher recruitment.	This is the overview, so speaks about both species. The statement has only been demonstrated for white sturgeon. Suggest revising the passage to emphasize that the flow-recruitment relationship is from white sturgeon and many researchers think it holds true for green sturgeon. It's clear the author understands the matter, such that the solution is just a matter of polishing the language.
53	3.6.2.2.	3-54	Kolhurst	Typo. Should be "Kohlhorst"
54	3.6.3.1	3-55	population discussion	Population estimates may be updated with a CDFW study report due March 31 2017. DFW staff can provide the report to Water Board staff once the sturgeon report is finalized

55	3.6.3.1.	3-55	The second paragraph about estimated salvage of green sturgeon.	CDFW does not think the differences in estimated green sturgeon salvage over time indicate a reduction in abundance, such that --- amongst the fish agencies --- only NMFS made the inference the author mentions. Maybe (1) delete this passage or (2) indicate that NMFS made the inference.
56	3.7.1	3-58	Last sentence in "Overview" paragraph. "The magnitude of these flows might be reduced if the Fremont Weir had an operable control gate and the Yolo Bypass was able to be flooded at a lower Sacramento River flow."	Rephrase to better link the concept that installing an operable gate would reduce the river stage required to flood the Yolo Bypass. This sentence makes flooding them sound like two separate actions are required. I suggest; "The magnitude of these flows might be reduced by installing an operable gate on Fremont Weir, thereby reducing the river stage required to flood the Yolo Bypass."
57	3.7.2	3-59	first, second and fifth sentences	Citation Feyrer et al. 2006 is the only reference by that author for year, so no "a" needed.
58	3.7.3	3-59	Second paragraph in "Population Trends Over Time" section.	Re-write this paragraph so that it is easier to understand. I suggest directly quoting the text from the SWRCB report followed by "The long term population index value, and recovery goal evaluated for this report, is equal to the median FMWT index from 1967 to 2014." Add a sentence stating the value. Close paragraph with current values, i.e. "...three year average FMWT index for 2012-2014 is 1 and has not been greater than 10 from 2001 to 2014 (text says last 13 years, but 2016 data will likely be available shortly so be specific).
59	3.7.4.1	3-60	4th full sentence	Add text for completeness: "...with timing of adult spawning and larval rearing <u>in riverine floodplains and terraces, and in the Delta...</u>"
60	3.8.4	3-65	1st paragraph, 2nd to last sentence	"Emerging evidence...spring, summer and fall flows combine to produce a strong Delta smelt year class (IEP 2015)."
61	3.8.4.3	3-68	1st paragraph, 1st sentence	Remove Nobriga et al. (2008) from sentence. They did not use FMWT data, but instead used STN data to look at summer habitat.

62	3.8.4.4	3-71	1st paragraph, 2nd sentence	Should add larval to the sentence. "Larval and juvenile fish are at risk hatching and rearing in the central or south Delta or when moving downstream to Suisun Bay."
63	3.9.3	3-74	1st paragraph, current 2nd sentence	The report should mention that there was a non-significant decline in age-1 abundance (P= 0.08).
64	3.9.4	3-75	Relationship to flow section.	Missing abundance vs. outflow figure, please add.
65	3.9.4	3-75	3rd paragraph,	The report does a good job of accurately capturing the description of the relationship between flow mechanisms and abundance.
66	4.4.2	4-12 to 4-13	...hereafter referred to as"Corbula"	insert a space after "as"
67	4.4.2	4-13 (2nd to last paragraph)	...natives have been replaced by nonnatives including Gammarus...	This implies that *Gammarus* is a mysid or shrimp, and not an amphipod.
68	4.4.2	4-13 (middle paragraph	Psuedodiaptomus	Spelling
69	4.5.1	4-15	The Delta and its tributaries currently support a commercial salmonid ocean fishery and a recreational and subsistence marine and freshwater fishery for striped bass, largemouth bass, black bass, white sturgeon, Chinook salmon, steelhead, catfish, and American shad (DFW 2012).	Suggest adding splittail to the list, because there is a directed fishery for that species.
70	6.3.5	6-36	DuBois, J., and M. Gringras	Typo. Should be "DuBois, J., and M. Gingras"
71	6.3.5	6-36	DuBois, J., M. Gringras, and G. Aasen.	Typo. Should be "DuBois, J., M. Gingras, and G. Aasen."

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Table 3: CDFW Recommended Citations

1	Wintzer, A., M. Meek, and P. Moyle. 2011. Trophic ecology of two non-native hydrozoans in the upper San Francisco Estuary: implications for the Pelagic Organism Decline. Marine and Freshwater Res. 62(8): 952- 961.
2	Wintzer, A., M. Meek, and P. Moyle. 2011. Life history and population dynamics of *Moerisia* sp., a non- native hydrozoan in the upper San Francisco Estuary (U.S.A.). Estuarine Coastal and Shelf Sci. DOI:10.1016/j.ecss.2011.05.017.
3	Bonnot, P. 1932. The California shrimp industry. California Department of Fish and Game, Fish Bulletin 38.
4	Israel, H.R. 1936. A contribution toward the life histories of two California shrimps, *Crago franciscorum* (Stimpson) and *Crago nigricauda* (Stimpson). California Department of Fish and Game, Fish Bulletin 46.
5	Schmitt, W.L. 1921. The marine decapod crustacea of California. University of California Publications in Zoology 23.
6	Skinner, J.E. 1962. A Historical Review of the Fish and Wildlife Resources of the San Francisco Bay Area. California Department of Fish and Game Water Projects Branch Report #1, 225 pp.
7	Slater, Steven B.; and Baxter, Randall D.(2014). Diet, Prey Selection, and Body Condition of Age-0 Delta Smelt, Hypomesus transpacificus, in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science, 12(3). jmie_sfews_15840. Retrieved from: https://escholarship.org/uc/item/52k878sb
8	Nobriga, M. L. 2002. Larval delta smelt diet composition and feeding incidence: environmental and ontogenetic influences. California Fish and Game, 88(4), 149-164.
9	Moyle, P. B., Herbold, B., Stevens, D. E., and Miller, L. W. (1992). Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society, 121(1), 67-77.
10	Orsi, J. J., and Mecum, W. L. 1996. Food limitation as the probable cause of a long-term decline in the abundance of Neomysis mercedis the opossum shrimp in the Sacramento-San Joaquin estuary. San Francisco Bay: the ecosystem. American Association for the Advancement of Science, San Francisco, 375-401.
11	Kimmerer, W. 2004. Open water processes of the San Francisco Estuary: from physical forcing to biological responses. San Francisco Estuary and Watershed Science, 2(1).
12	Kimmerer, W. J., Ignoffo, T. R., Slaughter, A. M., and Gould, A. L. 2014a. Food-limited reproduction and growth of three copepod species in the low-salinity zone of the San Francisco Estuary. Journal of Plankton Research, 36(3), 722-735.
13	Merz, J. E., Bergman, P. S., Simonis, J. L., Delaney, D., Pierson, J., and Anders, P. 2016. Long-Term Seasonal Trends in the Prey Community of Delta Smelt (Hypomesus transpacificus) Within the Sacramento-San Joaquin Delta, California. Estuaries and Coasts, 1-11.
14	Bouley, P., and Kimmerer, W. J. 2006. Ecology of a highly abundant, introduced cyclopoid copepod in a temperate estuary. Marine Ecology Progress Series, 324, 219-228.
15	Orsi, J. J., and Ohtsuka, S. 1999. Introduction of the Asian copepods Acartiella sinensis, Tortanus dextrilobatus (Copepoda: Calanoida), and Limnoithona tetraspina (Copepoda: Cyclopoida) to the San Francisco Estuary, California, USA. Plankton Biology and Ecology, 46(2), 128-131.
16	Kimmerer WJ, Gartside E, Orsi JJ. 1994. Predation by an introduced clam as the probable cause of substantial declines in zooplankton in San Francisco Bay. Marine Ecology Progress Series 113:81-93.

17	Jassby, A.D., Kimmerer W.J., Monismith S.G., Armor C., Cloern J.E., Powell T.M., Schubel J.R., and Vendlinski T.J. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications 5, no. 1: 272-289.
18	Knutson Jr, A. C., and Orsi, J. J. 1983. Factors regulating abundance and distribution of the shrimp Neomysis mercedis in the Sacramento-San Joaquin Estuary. Transactions of the American fisheries Society, 112(4), 476-485.
19	Carlton, J.T., J.K. Thompson, L.E. Schemel, and F.H. Nichols. 1990. Remarkable invasion of the San Francisco Bay (California, USA) by the Asian clam Potamocorbula amurensis. I. Introduction and dispersal. Marine Ecology Progress Series 66:81-94.
20	Peterson, H.A. and Vayssieres M. 2010. Benthic assemblage variability in the upper San Francisco Estuary: a 27-year retrospective. San Francisco Estuary and Watershed Science, 8(1). http://escholarship.org/uc/item/4d0616c6
21	Kayfetz, K.R. 2014. Biotic vs. abiotic effects on distribution of the estuarine copepod Pseudodiaptomus forbesi [Master's thesis]. [San Francisco (CA)]: San Francisco State University.
22	Kratina P., and M. Winder. 2015. Biotic invasions can alter nutritional composition of zooplankton communities. Oikos 124(10): 1337-1345.
23	Meng, L., and J.J. Orsi. 1991. Selective predation by larval striped bass on native and introduced copepods. Transactions of the American Fisheries Society 120:187-192.
24	Kimmerer W.J., E.S. Gross, M.L. MacWilliams. 2014b. Tidal migration and retention of estuarine zooplankton investigated using a particle-tracking model. Limnology and Oceanography 59:901-916.
25	Bowen, A., G. Rollwagen-Bollens, S.M. Bollens, and J. Zimmerman. 2015. Feeding of the invasive copepod Pseudodiaptomus forbesi on natural microplankton assemblages within the lower Columbia River. 0(0):1-6.
26	Thompson, J.K. and F. Parchaso. 2013. *Potamocorbula amurensis* Conceptual model. Sacramento (CA): Delta Regional Ecosystem Restoration Implementation Plan.
27	Gehringer DB, Finkelstein ME, Coale KH, Stephenson M, Geller JB. Assessing Mercury Exposure and Biomarkers in Largemouth Bass (Micropterus Salmoides) from a Contaminated River System in California. Archives of Environmental Contamination and Toxicology 2012; 64: 484-493.
28	Sandheinrich MB, Wiener JG. Methylmercury in freshwater fish: recent advances in assessing toxicity of environmentally relevant exposures. Boca Raton, FL, USA.: CRC Press, 2011.
29	Thomson JR, Kimmerer WJ, Brown LR, Newman KB, Nally RM, Bennett WA, et al. Bayesian change point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. Ecological Applications 2010; 20: 1431-1448.
30	Titus, R., M. Brown, J. Lyons, E. Collins, and L. Koerber. 2012. Annual Project Performance Report: F-119-R, Central Valley Angler Survey, July 1, 2009 to June 30, 2011. Report to U.S. Fish and Wildlife Service, California/Nevada Operations Office, Federal Assistance for Sport Fish Restoration Act.
31	Titus, R., M. Brown, J. Azat. 2014. Is the Sacramento River Fall-run Chinook salmon sport fihsery selt-regulating? Presentation at the Cal-Neva Chapter of the American Fisheries Society 48th Annual Meeting. Sacramento, CA March 27-29, 2014.
32	Titus, R. 2013. Department of Fish and Wildlife Memorandum from Dr. Robert Titus to Carol Oz. Chinook Salmon and Steelhead Use of Steelhead Creek. November.
33	Mount, J., W. Fleenor, B. Gray, B. Herbold, and W. Kimmerer. 2013. Panel Review of the draft Bay-Delta Conservation Plan. Prepared for the Nature Conservancy and American Rivers. September. Saracino & Mount, LLC, Sacramento, CA. pg 67

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