UNIVERSITY OF SOUTH FLORIDA
University of South Florida
College of Marine Science
St. Petersburg Campus
140 Seventh Avenue South
St. Petersburg, Florida 33701-5016
(727) 553-1130
FAX (727) 553-1189

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Subject : Independent scientific review of report titled “An updated conceptual model for delta smelt: our evolving understanding of an estuarine fish” prepared by the Interagency Ecological Program, Management, Analysis, and Synthesis Team (MAST)

Independent reviewer:

Ernst B. Peebles, Ph.D., Associate Professor
College of Marine Science
University of South Florida
140 Seventh Avenue South
St. Petersburg, FL 33701-5016
epeebles@mail.usf.edu
(727) 553-3983

I have read and reviewed the above-titled report in its entirety. My review statements appear below; these are presented in three sections: (1) Answers to Review Questions, (2) Other Observations, and (3) Typographic Errors Noted. The review questions were provided by the document titled “Writing, reviewing and completing the 2013 MAST report.”

Signed,

Ernst Peebles, Ph.D.

Answers to Review Questions:

1. Are the objectives and/or questions the report seeks to address clearly described in the report? Are they fully addressed? Do the authors go beyond these objectives/questions?

   Answer:
   Three objectives are identified on lines 430-434. These objectives are very specific and at first appear to not match the title of the report. The fact that these three objectives helped with the model update is explained subsequently within the report, but limiting the list to these three objectives with no mention of the conceptual model is initially disorienting. Perhaps the order of presentation could be changed to avoid this, or a fourth objective could be listed to explain that the first three contributed to the model update. All objectives are fully addressed and the authors' statements stay within reason while addressing them.

2. Are the conclusions and recommendations adequately supported by evidence and analyses? Are uncertainties, alternative hypotheses and conceptual models, or incompleteness in the evidence explicitly recognized? If report content is based on unpublished results, are findings and conclusions properly attributed to an individual or a specific program/project?

   Answer:
   In general, the authors have demonstrated the highest level of scientific competence in their many interpretations of data. The authors should ensure that scientific dissent or scientific perspectives held by a minority are represented in the report. The minimum treatment for dissenting views should be documentation of (1) the viewpoint and (2) the basis for its criticism or rejection. These concerns are discussed in the FLaSH review panel's recommendation.

   Statements appropriately cite the relevant literature, much of which was conducted within the San Francisco Estuary (SFE). This is impressive testimony to the size of the body of research that has been conducted in the SFE, yet the authors should consider literature reviews and non-SFE studies that encompass larger theoretical principles, where applicable.

3. Are the data and analyses handled competently and applied appropriately?

   Answer:
   This general (NRC-based) question doesn't quite fit the nature of the document because the data and figures presented in the document are largely derived from other works. However, the presentation of such materials is appropriate, as are the associated interpretations. It is clear that a great deal of careful thought has gone into the data interpretations, but that different researchers are thinking along different scientific lines (evident in Chapter 5), and it is these differences that need to be organized in the future.

4. Is the report's organization effective? Is the title appropriate?

   Answer:
   In its entirety (but without Chapter 6), the report is an outstanding reference on the history and status of delta smelt research. In addition to serving as a useful compendium, the report contains an appropriate amount of reasonable and apparently objective interpretations.

   The title is appropriate (but see answer to Question 1 above). It should be made clearer in the text that Fig. 8 is the updated model that has been expanded to life-stage-specific models in Figs. 9-12. The placement of this updated model before discussion of ecosystem trends (Chapter 4) and hypotheses seems odd. The reader does not understand the hypotheses in Fig. 9-12 until after reading Chapter 5. Can the updated model be introduced after Chapter 5? The (preliminary) hypothesis evaluation in Chapter 5 is very good in itself, but is even better because it is organized and the arguments are straightforward.

5. Is the report objective? Is its tone impartial?

   Answer:
   Any possible rancor that may have existed during the long, complex history of Delta research is not apparent to external reviewers, which is commendable. The report appears to be very objective and impartial.

6. What other significant improvements, if any, might be made in the report?

   Answer:
   The most important improvements are organizational, as indicated in my answer to Question 4.

   What the report needs most - a synthesis - is planned (Chapter 6). However, the key points outlined for Chapter 6 are generic; most or all of these points apply to any number of species around the world (lines 2552-2559). The outline for next steps is also weak at this point, as it largely consists of statements that future activities and actions will be considered or evaluated (lines 2560-2570). The development of performance metrics is certainly a good idea, but these need to be soundly and explicitly based on processes identified within the updated model.

   Chapter 6 should not just be a condensed review of Chapters 2-5, but should instead include an assessment of what needs to be done next, explaining a methodical, yet adaptive, plan of approach for moving forward. Chapter 6 should serve as a reference in itself that can be read independently of earlier chapters while referring to material presented in the preceding chapters.

   As described in the FLaSH recommendation, the purpose of conceptual models is (1) to bring researchers together under a common framework or frameworks, (2) to improve communication of research, and (3) perhaps most importantly, to explicitly identify hypotheses, linkages, and assumptions for evaluation. Hypotheses, linkages, and assumptions that have already been evaluated should be identified in the conceptual model, and the pedigrees associated with these evaluations (peer-reviewed papers, reports,

etc.) should be linked to them so that others can understand the basis of their evaluation, whether positive, negative, or neutral. Important but weakly supported linkages in the conceptual model (i.e., hypotheses, linkages, or assumptions with poor pedigrees) can thus be prioritized for testing and evaluation, ensuring that the overall research of the problem advances to a more useful state. Most conceptual models exist in an unfinished, but evolving condition (as acknowledged by the report title), which is normal and expected.

As it stands, the graphical portrayal of the updated conceptual model (Figs. 8-12) is lacking depiction of processes that have caused ecosystem change over time. For example, a more complete, but brief, synthesis of data presented in the report may be something like the following, where page and line numbers refer to the basis for statements:

> In a light-limited setting (line 1354), long-term changes in the supply of all types of light attenuating materials (not just mining-related sediments, lines 989-998) are of interest. Increased light reaching the bottom, increased *Pomatocorbula amurensis* abundance, and increased epiphytic surface area on the invasive *Egeria densa* SAV could each contribute to a shift from planktonic to benthic/epiphytic basal resources, which can be viewed as a regime shift of unknown hysteretic strength (lines 390-398, 1450-1457). In addition, ammonium enrichment may have favored smaller-celled primary producers and thus smaller consumers (*Limnoithona*), reducing the overall trophic transfer efficiency and carrying capacity of the estuary and its tidal fresh waters (lines 1334-1387, 1477-1479). Larger prey such as phytoplanktivorous mysids would also be negatively affected by these concurrent trends, therein influencing the bioenergetics of older delta smelt and their lifetime reproductive potential (pages 83-84, etc.).

This brief example synthesis incorporates a broad range of observations from the report, ranging from the light and nutrient environment to invasives, trophic relationships, and adult delta smelt reproduction, but it is unlikely to be (and is not expected to be) completely correct. It can be broken down into numerous testable hypotheses, linkages, and assumptions that can then be tested to find faults, thus moving forward. Figures 8-12 and associated hypotheses in Chapter 5 offer a substantial advance, but word lists do not always convey processes well enough. The proposed content for Chapter 6 appears to be disconnected from the process of continual improvement.

For clarity, information listed in the four corners of Fig. 8 should be explicitly linked to discussions of ecosystem trends in Chapter 4. Within Chapter 4, lines 1314-1331 are particularly compelling.

Regarding bioenergetics and reproduction (pages 77, 81, 83-84, 89-90 and 93-95), the authors should refer to the recent review by McBride et al. (2013). In addition, the authors should acknowledge the potential role of skip spawning (lines 1850-1851), which is described by McBride et al. (2013).

McBride, R. S et al. 2013. Energy acquisition and allocation to egg production in relation to fish reproductive strategies. *Fish and Fisheries*
DOI: 10.1111/faf.12043

Other Observations:

The concept behind the statement on lines 641-643 needs to be echoed throughout the document.

Citations are needed for statements on lines 950-957.

Reference to ammonium under *Toxicity and Contaminants* (line 1277) may remind some readers that un-ionized ammonia is highly toxic to some fishes (see also lines 1355-1356, 1382-1383). The proportion that is un-ionized largely depends on pH.

The Allee effect (line 411, also 1752-1756) refers to complications that arise from low population density (difficulty finding a mate, loss of cooperative defense, etc.). It should be considered that, in the delta smelts's case, population sizes below a certain threshold may not be able to produce enough eggs or larvae to overwhelm egg/larval predators.

The absence of amphipod tubes (lines 1999-2001) could mean amphipods were undergoing selective tidal stream transport ("tidal surfing"), although some species carry tubes with them into the water column.

Typographic Errors Noted:

Line 586: change "evalue" to "evaluate"
Line 644: change "is" to "were"
Line 645: change "is" to "was"
Line 646: change "can" to "could"
Line 693: delete extra "the"
Line 695: remove comma
Line 788: add "to" before ingest
Line 840: change "erffects" to "effects"
Line 1416: change "freshwater" to "fresh water" and add "ppt" after "<1"
Line 1418: change "gamarid" to "gamaridean"
Line 1678: change "escaoe" to "escape"
Line 2000: change "juveniles" to "juvenile"