Appendix I, Old and Middle River Flow Management

Attachment I.4 Longfin Smelt Salvage OMR Relationship

I.4.1 Model Overview

The Longfin smelt salvage OMR relationship is a model of salvage at south Sacramento–San Joaquin Delta (Delta) facilities as a function of flow based on historical salvage data. The results are a quantitative analysis of loss differences between operating scenarios (including the Proposed Action). The method uses data from 1993-2005, reflective of historically high periods of juvenile salvage at the CVP and SWP collection facilities and OMR flows. This period represents conditions prior to the 2009 Biological Opinion and conditions under the 2019 Biological Opinion.

I.4.2 Model Development

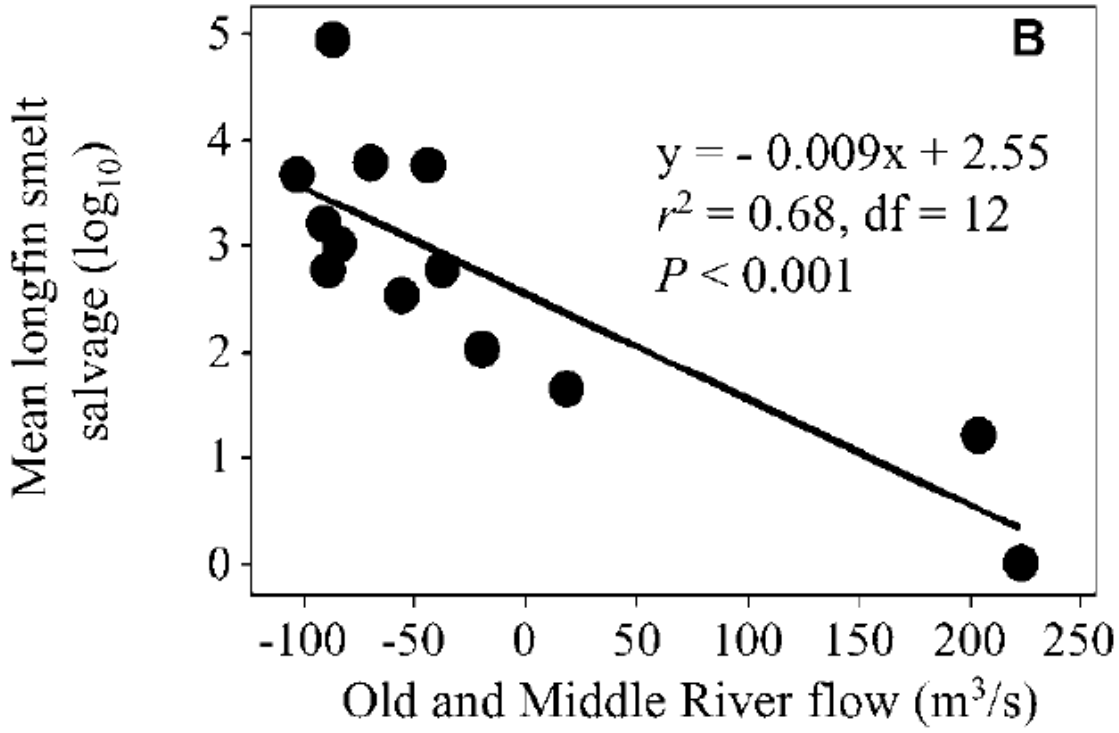
I.4.2.1 Methods

Grimaldo et al. (2009:Figure 7B) found a significant relationship between juvenile Longfin Smelt salvage in April and May as a function of mean April–May Old and Middle River flows. In order to assess potential differences in salvage between the modeled scenarios, the regression of Grimaldo et al. (2009) was recreated in order to be able to fully account for sources of error in the predictions; this allowed calculation of prediction intervals from CalSim 3-derived estimates of Old and Middle River flows for the modeled scenarios, as recommended by Simenstad et al. (2016:49).

Longfin Smelt salvage data for April and May 1993–2005 were obtained from the California Department of Fish and Wildlife salvage monitoring website.1 Consistent with Grimaldo et al. (2009), a record of 616 Longfin Smelt salvaged on April 7, 1998, was assumed to be in error, and was converted to zero for the analysis. Old and Middle River flow data were provided by Smith (pers. comm. 2012). Following Grimaldo et al. (2009), $\log_{10}$(total salvage) was regressed against mean April–May Old and Middle River flow (converted to cubic meters/second). The resulting regression equation was very similar to that obtained by Grimaldo et al. (2009; Figure I.4-1):

[1] http://www.dfg.ca.gov/delta/apps/salvage/SalvageExportChart.aspx?Species=1&SampleDate=1%2f22%2f2016&Facility=1, accessed January 1, 2016, and August 17, 2016 (salvage for Longfin Smelt at both facilities was selected).

Log_{10}(April–May total Longfin Smelt salvage) = 2.5454 (± 0.2072 SE) – 0.0100 (± 0.0020 SE)*(Mean April–May Old and Middle River flow);
r^2 = 0.70, 12 degrees of freedom.



Source: Grimaldo et al. 2009.

Figure I.4-1. Regression of April–May Longfin Smelt Salvage as a Function of Old and Middle River Flow.

For the comparison of the modeled scenarios, CalSim 3 data outputs were used to calculate mean April–May Old and Middle River flows for each year of the 1922–2021 simulation. The salvage-Old and Middle River flow regression calculated as above was used to estimate salvage for the modeled scenarios. The log-transformed salvage estimates were back-transformed to a linear scale for comparison of the modeled scenarios. In order to illustrate the variability in predictions from the salvage-Old and Middle River flow regression, annual estimates were made for the mean and upper and lower 95% prediction limits of the salvage estimates, as recommended by Simenstad et al. (2016). Means and prediction limits giving negative estimates of salvage were converted to zero before statistical summary. Statistical analyses were conducted with R statistical software (R Core Team 2023).

I.4.2.2 Assumptions/Uncertainty

Salvage record used to develop regression = pre 08/09 BiOps

More updated analyses between entrainment and flow also use other factors such as turbidity, this model may be too simple.

I.4.2.3 Code and Data Repository

OMR Data: Old Middle River flow data are available online at:
https://data.cnra.ca.gov/dataset/dayflow

Salvage data are available at online at: Salvage inputs: Salvage data available online at
http://www.cbr.washington.edu/sacramento/data/query_loss_detail.html

Model predictions are available on ICF Sharepoint"
2021_LTO_OMR_salvage_inputs_10192023.xlsx

I.4.3 Results

Table I.4-1. April – May predicted Longfin Smelt salvage by water year type (WYT) for modeled scenarios.

WYT	EXP1	EXP3	NAA	Alt2wTUCP woVA	Alt2woTUCP woVA	Alt2woTUCP DeltaVA	Alt2woTUCP AllVA
Wet	28	37	1359	3712	3706	2764	2697
Above Normal	89	117	1335	3754	3757	1829	1779
Below Normal	152	172	1451	2537	2647	1901	1763
Dry	218	247	1464	2090	2091	1578	1403
Critical	304	286	905	1168	1110	1170	1126

Table I.4-2. April – May predicted Longfin Smelt salvage by water year type (WYT) for modeled scenarios. [extra text – e.g., rounded, absolute values; percent diff from NAA also rounded]

WYT	NAA	Alt1	Alt2wTUCP woVA	Alt2woTUCP woVA	Alt2woTUCP DeltaVA	Alt2woTUCP AllVA	Alt3	Alt4
Wet	1359	4,032 (197%)	3,712 (173%)	3,706 (173%)	2,764 (103%)	2,697 (98%)	109 (-92%)	3,508 (158%)
Above Normal	1335	5,280 (295%)	3,754 (181%)	3,757 (181%)	1,829 (37%)	1,779 (33%)	265 (-80%)	3,813 (185%)
Below Normal	1451	3,388 (134%)	2,537 (75%)	2,647 (82%)	1,901 (31%)	1,763 (22%)	395 (-73%)	2,700 (86%)
Dry	1464	2,390 (63%)	2,090 (43%)	2,091 (43%)	1,578 (8%)	1,403 (-4%)	449 (-69%)	2,124 (45%)
Critical	905	1,226 (35%)	1,168 (29%)	1,110 (23%)	1,170 (29%)	1,126 (24%)	477 (-47%)	1,114 (23%)

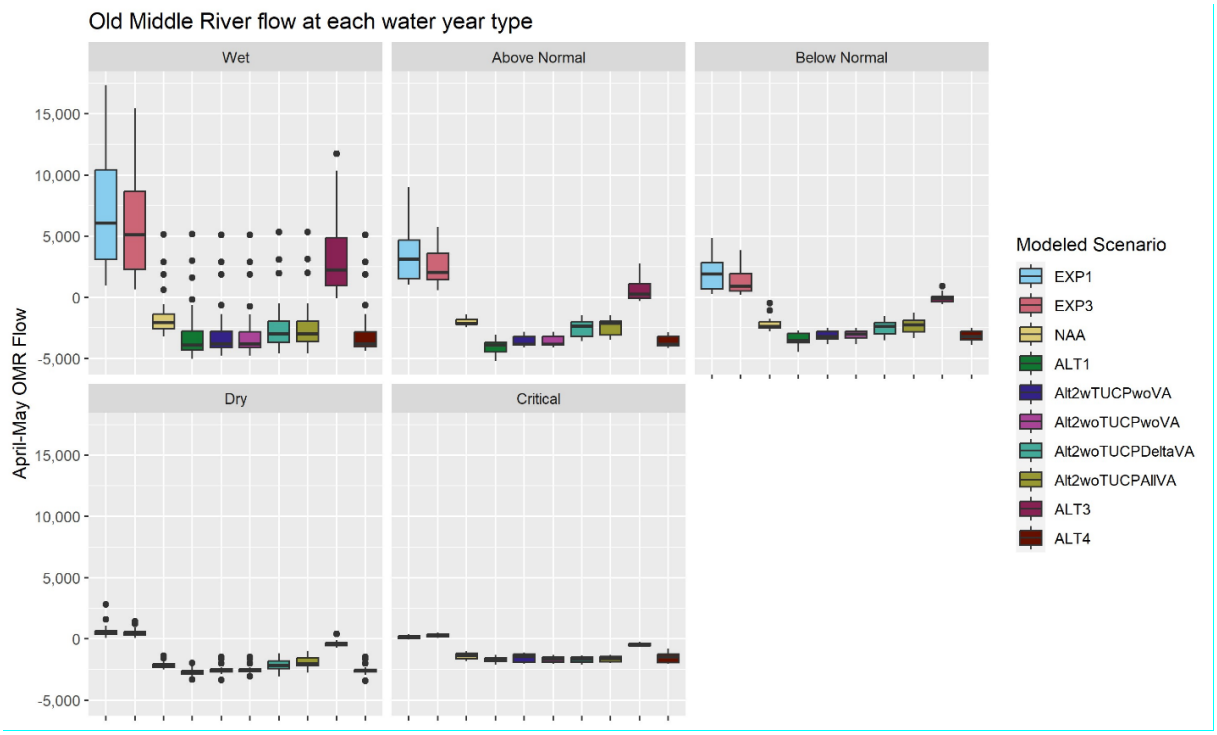


Figure I.4-2. monthly Old and Middle River flows by water year type for all scenarios. Note the y-axis scale is fixed.

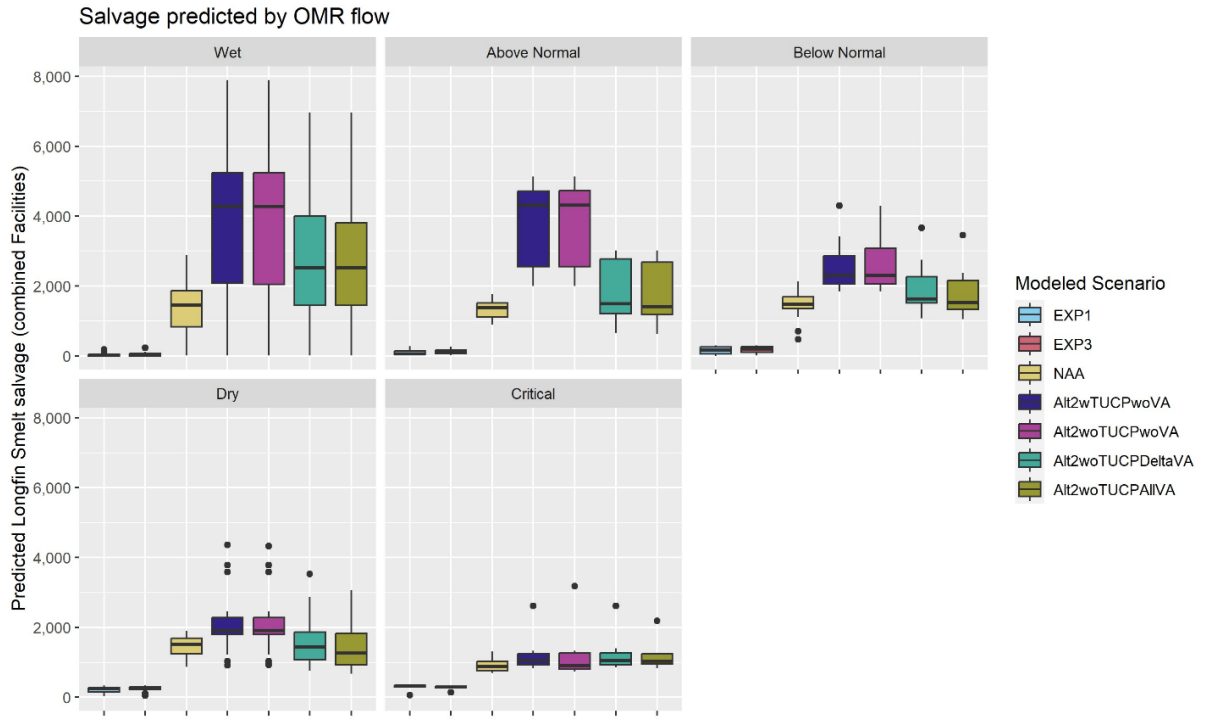


Figure I.4-3. Total salvage at USBR and CDWR facilities, predicted from Old and Middle River flows. Figure displays data given in Table I.4-1.

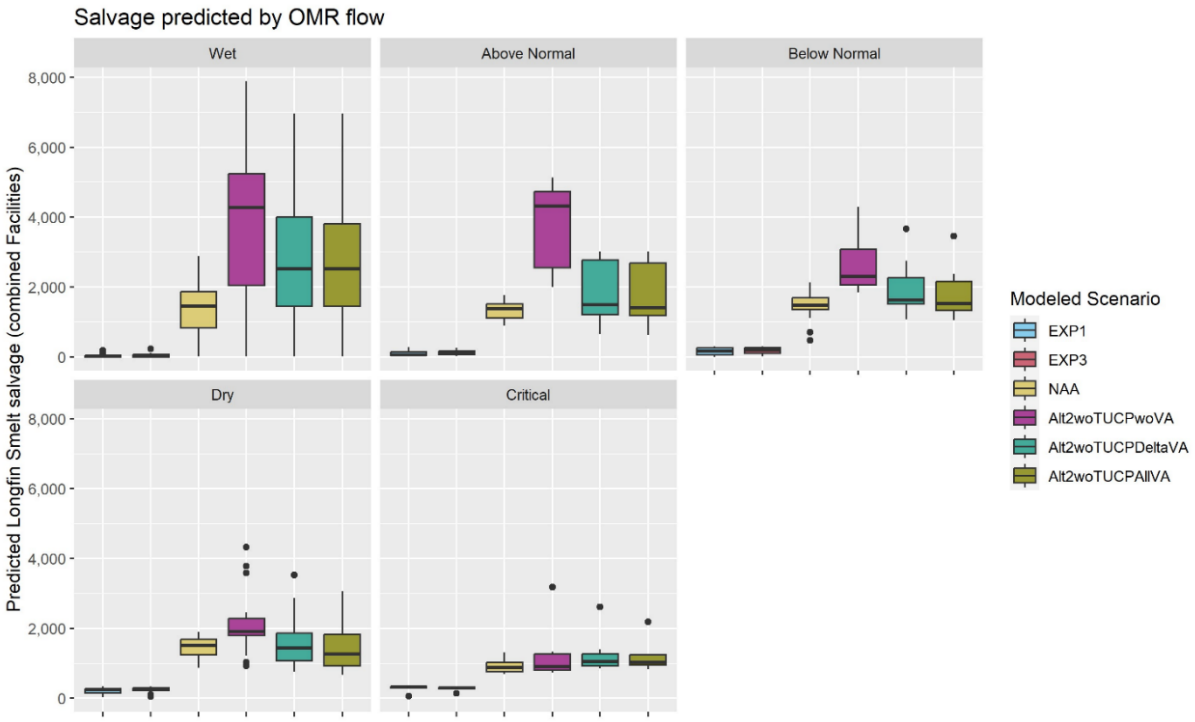


Figure I.4-4. Total salvage at USBR and CDWR facilities, predicted from Old and Middle River flows. Figure displays data given in Table I.4-1.

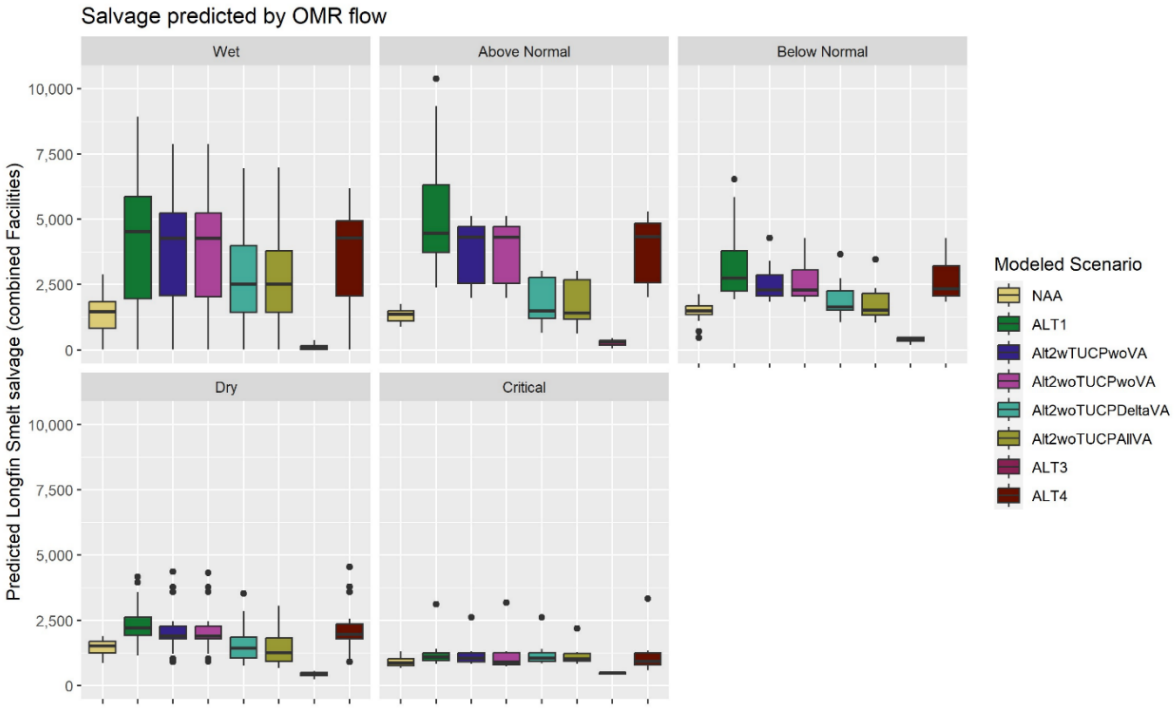


Figure I.4-5. Total salvage at USBR and CDWR facilities, predicted from Old and Middle River flows. Figure displays data given in Table I.4-2.

I.4.4 References

I.4.4.1 Printed References

Grimaldo, L., T. Sommer, N. Van Ark, G. Jones, E. Holland, P. Moyle, P. Smith, and B. Herbold. 2009. Factors Affecting Fish Entrainment into Massive Water Diversions in a Freshwater Tidal Estuary: Can Fish Losses Be Managed? *North American Journal of Fisheries Management* 29:1253–1270.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Simenstad, C., J. Van Sickle, N. Monsen, E. Peebles, G. T. Ruggerone, and H. Gosnell. 2016. *Independent Review Panel Report for the 2016 California WaterFix Aquatic Science Peer Review*. Sacramento, CA: Delta Stewardship Council, Delta Science Program.

I.4.4.2 Personal Communications

Smith, Peter. U.S. Geological Survey. 2012—Spreadsheet with Old and Middle River daily flows for WY 1979-2012, sent to Lenny Grimaldo, U.S. Bureau of Reclamation, Sacramento, CA.