Appendix 5.B
Entrainment

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5.B.0 Executive Summary

Entrainment occurs when fish are drawn into an intake facility with water being diverted. In the Sacramento–San Joaquin River Delta (Delta), entrainment occurs at many locations, including the south Delta State Water Project/Central Valley Project (SWP/CVP) intake facilities, Mirant power plants, agricultural diversions, managed wetlands, duck clubs, wildlife refuges, and other intake facilities such as those operated by Contra Costa Water District (CCWD) and Freeport Regional Water Authority (FRWA). Among entrainment sources, the Bay Delta Conservation Plan (BDCP) covers operations of the SWP/CVP south Delta export facilities and the proposed north Delta intakes, as well as the SWP North Bay Aqueduct (NBA). The BDCP also may influence entrainment by decommissioning agricultural diversions in restored tidal habitat areas and screening or reconfiguring other agricultural or nonproject intakes. Entrainment has been a major issue of concern related to the aquatic species covered in the BDCP, and as such must be evaluated carefully in the Effects Analysis. A cornerstone of the BDCP is the proposed new intake facilities in the north Delta, which allow for more effective screening of fish and less reliance on the south Delta facilities. This component of the BDCP has the potential to reduce entrainment through changes in Delta water management. This appendix provides a description of the potential mechanisms for entrainment; an overview of the historical and current significance of entrainment on each fish species population; a description of the methods used to predict the potential entrainment under the BDCP; results of the application of these methods; and based on these results, a comprehensive description of the potential entrainment of each life stage of each covered fish species. (Population-level effects on each species are assessed in Chapter 5, *Effects Analysis*.)

The methods used to assess entrainment risk are based on historical salvage data, CALSIM and DSM2 modeling outputs, assumed and measured locations of fish, previous studies in the Delta, a qualitative analysis of proposed BDCP conservation measures named in the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) analyses, and professional judgment. The methods used reflect the best available tools and data regarding fish abundance, movement, and behavior. These methods were applied to a comparison of future conditions with the BDCP under the evaluated starting operations (ESO)[1] scenarios and future conditions without the BDCP (projected from existing biological conditions 2 [EBC2]) at two time periods in the permit term (early long-term [ELT] and late long-term [LLT]). Table 5.B.0-1 provides a description of each of

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[1] This appendix uses physical modeling results primarily from the evaluated starting operations (ESO) to evaluate entrainment effects of the operation of the BDCP conveyance facilities, which incorporates Scenario B water operations. The ESO does not incorporate the full range variation in spring and/or Fall X2 or flows that could occur under the BDCP as a result of implementation of spring and fall outflow decision trees (See Chapter 3, Section 3.4.1.4.4, *Decisions Trees*, for a complete description). Using the best available information to date, some methods for evaluation of entrainment were able to capture this range of potential effects, while others require the completion of additional modeling, which is underway. Overall, the range of potential entrainment effects is described in this analysis but will be supplemented with additional detail in the Final BDCP.

these scenarios. For some methods, five water-year types were modeled based on the historical CALSIM record to determine the variation in entrainment under different flow conditions.

Table 5.B.0-1. Analytical Conditions of the Modeled Scenarios

Condition		Description
Existing Biological Conditions	EBC1	Current operations, based on the USFWS (2008) and NMFS (2009) BiOps, excluding management of outflows to achieve the Fall X2 provisions of the USFWS (2008) BiOp.
	EBC2	Current operations based on the USFWS (2008) and NMFS (2009) BiOps, including management of outflows to achieve the Fall X2 provisions of the USFWS (2008) BiOp.
Projected Future Conditions without the BDCP	EBC2_ELT	EBC2 projected into year 15 (2025) accounting for climate change conditions expected at that time.
	EBC2_LLT	EBC2 projected into year 50 (2060) accounting for climate changes conditions expected at that time.
Projected Future Conditions with the BDCP[a]	ESO_ELT	Evaluated starting operations in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	ESO_LLT	Evaluated starting operations in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.
	HOS_ELT	High-outflow operations (high-outflow outcomes of decision tree for management of spring and fall outflow) in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	HOS_LLT	High-outflow operations (high-outflow outcomes of decision tree for management of spring and fall outflow) in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.
	LOS_ELT	Low-outflow operations (low-outflow outcomes of decision tree for management of spring and fall outflow) in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	LOS_ELT	Low-outflow operations (low-outflow outcomes of decision tree for management of spring and fall outflow) in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.

[a] The decision-tree process, described in Chapter 3, Section 3.4.1.4.4, *Decisions Trees*, provides a mechanism for selection of one of four potential operational outcomes for *CM1 Water Facilities and Operation*: evaluated starting operations, high outflow-scenario, low-outflow scenario.

USFWS = U.S. Fish and Wildlife Service.

NMFS = National Marine Fisheries Service.

BiOp = biological opinion.

The following methods were used to evaluate entrainment (refer also to Table 5.B.5-2).

- **Salvage density**. Uses historical salvage data and CALSIM outputs to estimate entrainment under various flow conditions.
- **Old and Middle River (OMR) flow proportional entrainment regressions**. Uses linear regression (based on USFWS [2008], and incorporates the adjustment of Kimmerer [2011]) and CALSIM data to estimate the proportion of delta smelt population that would be entrained.
- **DSM2 Particle Tracking Model (PTM)**. Uses data from Interagency Ecological Program (IEP) trawls to estimate the movement of larval smelts that are assumed to be influenced primarily by flows and may be entrained.

- **Delta Passage Model (DPM) proportional salvage estimates**. Uses coded wire tag (CWT) salvage data to estimate the proportion of Chinook salmon runs that would be entrained.
- **Effectiveness of nonphysical barriers**. Uses results of recent studies at Georgiana Slough and Old River to assess potential effectiveness of barriers in other Delta locations that would exclude fish from diversions.
- **North Delta intakes screening effectiveness analysis**. Assessed potential for direct entrainment loss and impingement at screens for different sizes of fish based on literature and professional judgment.
- **DRERIP analysis of nonproject diversions**. Assumes removal of nonproject diversions would result in a proportional reduction in entrainment.

No single one of these methods could be used for all life stages of all species. As a result, it was necessary to employ these methods in combination to complete the assessment of entrainment. For example, the OMR regression is applicable only to delta smelt, while the DPM is applicable only to Chinook salmon. Similarly, the assessment of the north Delta screening efficiency was specific to that facility and focused primarily on larvae life stages. Of the methods summarized above, several must be applied to account for changes in outflow attributable to the decision trees for spring X2: OMR proportional entrainment regressions (larval/juvenile delta smelt), DSM2 PTM, and the DPM proportional salvage estimates.

These methods were applied to each species and life stage as appropriate, and the results of the assessment are presented in Section 5.B.6. The conclusions presented in Section 5.B.7 synthesize multiple results because multiple methods were applied to some species and life stages. The conclusions therefore provide a final determination of the effect of entrainment on each species and life stage. Where information is available, the proportion of a population affected is provided.

Table 5.B.0-2 summarizes the results of the numerous analyses of the effects of the BDCP on entrainment in the Plan Area by species and life stage. General conclusions related to this table are presented in the conclusion statements following the table. Within the table, effects are summarized for each of the major sources of entrainment. Effects of the SWP/CVP south Delta export facilities generally are separated by each of five water-year types when possible (wet, above-normal, below-normal, dry, and critical). Estimated effects of entrainment at most of the other sources are not differentiated by water-year type. For analyses based on limited water years (e.g., analyses using DSM2 modeled flows), summaries were calculated only for all water years. The color coding in the table is based on consideration of the percentage change between EBC2_ELT and ESO_ELT and between EBC2_LLT and ESO_LLT, with estimated percentage values shown in text. Table 5.B.0-2 focuses on the ESO_ELT vs. EBC2_ELT and ESO_LLT vs. EBC2_LLT comparisons to account for climate change effects and to provide a concise summary. As with all such analyses, caution should be applied when interpreting absolute differences (e.g., numbers of fish) and more emphasis should be put on relative differences between scenarios.

The BDCP would substantially change the amount and pattern of water exports from the south Delta SWP/CVP facilities, which generally would be expected to lower the number of fish of all species entrained relative to existing biological conditions.

Across the five water-year types, exports from the south Delta were modeled to change from 100% of total exports under the existing biological conditions to an average of 55–56% under the evaluated starting operations. The proportion of total exports from the south Delta facilities under the BDCP was lowest in wet water years (36–37%) and highest in critical water years (80–81%). In general, the BDCP evaluated starting operations had similar or greater average total exports compared to baseline during most months of most water-year types, reflecting the use of the north and south Delta intakes; however, in some months total exports were lower than under EBC1 or EBC2 (e.g., August–November in wet and above-normal years). Average exports from the south Delta facilities generally were appreciably lower under the evaluated starting operations than existing biological conditions and the differences decreased as the water-year type became drier. The smallest average differences in south Delta exports between evaluated starting operations scenarios and existing biological scenarios generally were in April and May. Under evaluated starting operations, total exports from combined north and south Delta intakes would be greater in the early and late long-term relative to future conditions without the BDCP in wet, above-normal, and below-normal water years. Under dry and critical water years, total exports would be quite similar between the evaluated starting operations and existing biological conditions. Nonetheless, overall the evaluated starting operations will substantially reduce exports from the south Delta export facilities in most months relative to the existing biological conditions. Entrainment in the south Delta is expected to be reduced most in wetter years because there would be fewer restrictions from bypass flows and a greater percentage of flow will be diverted from the north Delta in wetter years than in drier years.

Entrainment of salmonids at the south Delta export facilities is projected to be lower under evaluated starting operations relative to existing biological conditions, with differences between water-year types.

Consistent with the general pattern of decreased south Delta exports under the evaluated starting operations reducing entrainment relative to existing biological conditions, entrainment of juvenile salmonids at the south Delta export facilities also generally would be lower under evaluated starting operations compared to existing biological conditions, with differences according to species and water-year type.

Based on the salvage-density method, juvenile steelhead entrainment would decrease substantially overall across all water years averaged together (greater than 50% decrease in both ELT and LLT), with decreases occurring mostly in wet (around 70%), above-normal (around 55–60%), and below-normal years (around 33–40%); average annual entrainment of juvenile steelhead in dry and critical years was estimated to be around 16–23% lower under the evaluated starting operations than under existing biological conditions (Table 5.B.0-2).

The relative change in juvenile winter-run Chinook salmon entrainment under the evaluated starting operations compared to existing biological conditions was very similar to that for juvenile steelhead, with overall average decreases across all water years of just over 50% based on the salvage-density method (Table 5.B.0-2). As with steelhead, this reduction was attributable to appreciable decreases in entrainment in wet, above-normal, and below-normal years and lower reductions in dry and critical years. The DPM suggests that the average percentage of winter-run Chinook salmon smolts salvaged under the evaluated starting operations (ESO_ELT/ESO_LLT) would be around 61–62% (0.02% of all individuals) less than under future conditions without the BDCP (EBC2_ELT/EBC2_LLT).

Average annual entrainment loss of juvenile spring-run Chinook salmon was estimated to be around 40% lower under the evaluated starting operations than under existing biological conditions across all water years (Table 5.B.0-2). The salvage-density results suggested that substantially lower entrainment in wet years under the evaluated starting operations (over 60% lower, but involving relatively large numbers of fish) contrasted with similar or modestly lower entrainment (0–17%) under the evaluated starting operations in dry and critical years, albeit with lower numbers of fish estimated to be entrained in these water-year types. The estimates of the percentage of spring-run Chinook salmon juveniles entrained at the south Delta export facilities from the salvage-density method was up to 5% for the evaluated starting operations and over 10% for existing biological conditions (e.g., Table 5.B.6-53), but these percentages are probably an overestimate because the length-based classification method may classify fall-run Chinook salmon as spring-run and assumed a fixed number of individuals entering the Delta each year. The relative change between scenarios is the more appropriate measure to focus on as it removes the uncertainty of run size and number of fish entrained and essentially illustrates pumping differences between scenarios weighted by species relative abundance. Results from the DPM showed that the average percentage of smolts entrained under the evaluated starting operations was 53–56% less (or 0.007% of modeled smolts) than under existing biological conditions, when comparing within the early- and late-long term periods.

The general similarity in emigration timing of juvenile fall-run Chinook salmon to spring-run Chinook salmon resulted in similar salvage-density method results: overall reduced average annual entrainment losses (around 40% across all years) under the evaluated starting operations compared to existing biological conditions that was driven largely by substantial decreases in entrainment in wet and above-normal years when more export pumping shifts to the north Delta intakes (Table 5.B.0-2). In below-normal and critical years, average annual entrainment loss was estimated to be 21–29% lower under the evaluated starting operations compared to existing biological conditions, whereas average entrainment loss was similar or slightly lower (4–17%) under the evaluated starting operations in dry years. The results for late fall–run Chinook salmon suggested lower average annual entrainment loss under the evaluated starting operations by around 33% across all water years relative to existing biological conditions, a pattern that reflected lower average entrainment loss under the evaluated starting operations of 34–47% in wet, above-normal, and below-normal years, and 16–25% lower entrainment loss under the evaluated starting operations in dry and critical years (Table 5.B.0-2). The results of the DPM for fall-run Chinook salmon suggested around 43–45% lower salvage (0.005% of smolts) under the evaluated starting operations than under existing biological conditions for fish from the Sacramento River watershed and 22% lower salvage (0.10% of smolts) under evaluated starting operations for fish from the San Joaquin watershed. Data for the Mokelumne River fall-run Chinook salmon smolts were highly skewed and examination of median estimates suggested that salvage under the evaluated starting operations (ESO_ELT/ESO_LLT) would be 6–13% less (0.01–0.02% of smolts) than under future biological conditions without the BDCP (EBC2_ELT/EBC2_LLT) . The average percentage of late fall–run Chinook salmon smolts estimated to be salvaged using the DPM was 62–64% lower (0.03% of smolts) than under existing biological conditions in the early- and late-long term.

As noted for delta smelt (below), existing south Delta exports are managed in real-time according to triggers laid out in the Operations Criteria and Plan (OCAP) biological opinions (BiOps), in this case to minimize salmonid entrainment per the National Marine Fisheries Service (NMFS) (2009) BiOp. Such operational changes are difficult to simulate with CALSIM modeling. Nevertheless, the modeling here provides a sense of the potential differences in entrainment between the evaluated starting operations and existing biological conditions.

Entrainment loss of delta smelt at the south Delta export facilities was projected to be lower under evaluated starting operations relative to existing biological conditions, with appreciably lower loss of adults (December–March) and little difference in loss of larvae and juveniles (March–June); real-time management would be implemented and makes forecasting of changes challenging.

In general, entrainment of delta smelt was lower under the evaluated starting operations relative to existing biological conditions, reflecting the reduced south Delta exports. Therefore the evaluated starting operations generally would maintain or reduce the low entrainment from south Delta pumping regulations assumed under the existing biological conditions. For adults (December–March), considerably lower entrainment was modeled to occur under the evaluated starting operations in wet water years (Table 5.B.0-2), when the north Delta export facilities would provide a larger proportion of total exports. Differences between the evaluated starting operations and existing biological conditions were smaller in drier years, when north Delta bypass flows would require greater use of the south Delta export facilities. The relative differences in proportional entrainment loss between scenarios were greatest in wet years, in which ESO scenarios averaged losses of around 0.03 (i.e., 3% of the adult population); these losses were around 40% lower than the average losses under EBC scenarios (0.07, i.e., 7% of the adult population). In other water years, average annual entrainment loss under the evaluated starting operations ranged from 25–26% lower in above-normal years to 2% lower in critical years.

Larval and juvenile delta smelt proportional entrainment loss was similar between the evaluated starting operations and existing biological conditions averaged over all years (Table 5.B.0-2). Differences in average annual entrainment loss for future scenarios ranged from around 0.01–0.02 (16–24%) lower entrainment under ESO_ELT/ESO_LLT compared to EBC2_ELT/EBC2_LLT in wet and above-normal years, to similar (1–4% more) entrainment under the ESO scenarios in below-normal, dry, and critical years. The combination of adult and larval/juvenile proportional entrainment into estimates for total entrainment suggested that average annual entrainment loss under the evaluated starting operations in the early and late long-term would be less than or similar to existing biological conditions, reflecting lower entrainment in wet and above-normal years, and similar entrainment in below-normal, dry, and critical years (Table 5.B.6-138).

It is emphasized that modeling of entrainment of delta smelt, and indeed other species, has uncertainty because of real-time management decisions that could occur and alter export rates from those modeled here. Implementation of the BDCP would include a real-time operations management group, similar to (or a continuation of) the current Delta Smelt Working Group, which would meet weekly to examine hydrodynamic data and species distribution in order to recommend appropriate levels of export pumping that would minimize entrainment loss. Such decisions cannot be modeled accurately; accordingly, the results of the entrainment analyses should be viewed with some caution. Nevertheless, the existing modeling does suggest that there generally would be lower south Delta entrainment of delta smelt with implementation of the BDCP.

Table 5.B.0-2. Summary of Effects of the BDCP on Entrainment of Covered Fish Species

Species	Life Stage	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)													SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake		Agricultural Diversions	
		Method (Document Section for Detailed Results)/Metric	All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results	Method (Document Section for Detailed Results)/Metric	Results
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT						
Steelhead	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream of Plan Area																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.1.1)/ Number of fish (% change)	-4,810 (-52%)	-4,506 (-51%)	-4,443 (-68%)	-4,271 (-68%)	-7,752 (-58%)	-7,389 (-55%)	-4,674 (-39%)	-3,683 (-33%)	-1,517 (-21%)	-1,591 (-23%)	-917 (-16%)	-858 (-16%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Winter-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.2.1)/ Number of fish (% change)	-3,773 (-54%)	-3,524 (-52%)	-8,670 (-72%)	-8,237 (-70%)	-4,396 (-65%)	-4,043 (-60%)	-3,230 (-44%)	-2,241 (-33%)	-793 (-22%)	-809 (-23%)	-170 (-14%)	-205 (-18%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Smolts only	DPM (5.B.6.1.2.2)/ % of smolts (% change)	-0.033 (-62%)	-0.031 (-63%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Spring-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.3.1)/ Number of fish (% change)	-14,788 (-38%)	-15,755 (-40%)	-57,967 (-63%)	-58,340 (-63%)	-8,520 (-31%)	-10,644 (-36%)	-1,669 (-25%)	-1,579 (-22%)	74 (0%)	-1,960 (-11%)	-1,916 (-17%)	-1,316 (-13%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Smolts only	DPM (5.B.6.1.3.2)/ % of smolts (% change)	-0.012 (-55%)	-0.012 (-58%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Fall-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.4.1)/ Number of fish (% change)	-23,707 (-42%)	-24,016 (-44%)	-85,155 (-64%)	-80,786 (-63%)	-14,279 (-42%)	-13,962 (-42%)	-3,951 (-29%)	-3,864 (-28%)	-760 (-4%)	-3,538 (-17%)	-11,208 (-29%)	-7,626 (-21%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (both qualitative scores = 1 out of 4)
	Smolts only (Sacramento River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.008 (-45%)	-0.008 (-47%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Smolts only (San Joaquin River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.108 (-22%)	-0.104 (-22%)											Unlikely to encounter these intakes		Unlikely to encounter these intakes			
	Smolts only (Mokelumne River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.017 (-13%)*	-0.007 (-6%)*											Unlikely to encounter these intakes		Unlikely to encounter these intakes			
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		

75% or more	50 to 75%	25 to 50%	5 to 25%	▨ -5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Species	Life Stage	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)												
		Method (Document Section for Detailed Results)/Metric	All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)	
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
Late fall–run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area												
	Fry	Occur upstream or otherwise included under analysis of juveniles												
	Juvenile	Salvage-density method, normalized (5.B.6.1.4.1)/ Number of fish (% change)	-643 (-33%)	-627 (-34%)	-2,895 (-47%)	-2,714 (-46%)	-223 (-39%)	-245 (-44%)	-26 (-45%)	-18 (-34%)	-30 (-23%)	-29 (-24%)	-25 (-16%)	-38 (-25%)
	Smolts only	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.052 (-63%)	-0.046 (-64%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given									
	Adult	Large body size/strong swimming ability make entrainment very unlikely												
Delta smelt	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment												
	Larva	Proportional entrainment regression (5.B.6.1.5.1)/ Proportion of population (% change)	-0.004 (-3%)	-0.005 (-3%)	-0.011 (-23%)	-0.016 (-24%)	-0.017 (-19%)	-0.018 (-16%)	0.001 (1%)	0.003 (1%)	0.006 (3%)	0.004 (2%)	0.003 (1%)	0.011 (4%)
	Juvenile													
	Adult	Proportional entrainment regression (5.B.6.1.5.2)/ Proportion of population (% change)	-0.016 (-21%)	-0.015 (-20%)	-0.029 (-42%)	-0.027 (-39%)	-0.021 (-26%)	-0.020 (-25%)	-0.011 (-14%)	-0.008 (-10%)	-0.008 (-9%)	-0.008 (-10%)	-0.002 (-2%)	-0.001 (-2%)
Longfin smelt	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment												
	Larva	PTM (5.B.6.1.6.1) / Percent of particles (% change) Wetter starting distribution	30 days: -0.20 (-22%); 60 days: -0.16 (-11%)	30 days: -0.43 (-49%); 60 days: -0.45 (-31%)	Relatively few months run in DSM2, so results are presented as averages over all years									
		Drier starting distribution	30 days: -0.27 (-25%); 60 days: -0.32 (-17%)	30 days: -0.48 (-46%); 60 days: -0.50 (-28%)										
	Juvenile	Salvage-density method (5.B.6.1.6.2)/ Number of fish (% change)	-108,770 (-37%)	-122,883 (-42%)	-37,987 (-56%)	-39,655 (-57%)	-1,062 (-22%)	-1,343 (-28%)	-484 (-16%)	-779 (-24%)	-38,267 (-7%)	-123,418 (-21%)	-173,992 (-32%)	-125,616 (-25%)

Species	Life Stage	SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake			Agricultural Diversions		
		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results		Method (Document Section for Detailed Results)/Metric	Results	
Late fall–run Chinook salmon	Egg/ Alevin								
	Fry								
	Juvenile	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (both qualitative scores = 1 out of 4)	
	Smolts only								
	Adult								
Delta smelt	Egg/ Embryo								
	Larva	i) screening effectiveness analysis, ii) PTM (5.B.6.2.2.2)	i) 100% screened at >~22 mm, ii) entrainment occurs in proportion to flow diverted, but the great majority of larvae would be downstream of the intake and not susceptible to entrainment	PTM (5.B.6.3.1) /Percent of particles (% change)	**ESO_ELT vs. EBC2_ELT** 30 days: -1.08 (-61%); 60 days: -0.99 (-53%)	**ESO_LLT vs. EBC2_LLT** 30 days: -0.81 (-47%); 60 days: -0.46 (-25%)	PTM (5.B.6.4.1) /Percent of particles (% change)	**ESO_ELT vs. EBC2_ELT** 30 days: -0.13 (-5%); 60 days: -0.13 (-3%)	**ESO_LLT vs. EBC2_LLT** 30 days: -0.13 (-5%); 60 days: -0.31 (-8%)
							DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Second lowest magnitude of positive population-level effect and certainty (both qualitative scores = 2 out of 4)	
	Juvenile	Impingement and screen contact (5.B.6.2.2.3)	Potential for screen contact-related mortality increases with increasing approach and sweeping velocity, by night, and with longer screens	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude smelt >15 mm based on north Delta intakes analysis					
	Adult						NA		
Longfin smelt	Egg/ Embryo								
	Larva	i) screening effectiveness analysis, ii) PTM (5.B.6.2.3.2)	i) 100% screened at >~22 mm, ii) entrainment occurs in proportion to flow diverted but the great majority of larvae would be downstream of the intake and not susceptible to entrainment	PTM (5.B.6.3.2) /Percent of particles (% change) Wetter starting distribution	**ESO_ELT vs. EBC2_ELT** 30 days: 0.04 (63%); 60 days: 0.08 (81%)	**ESO_LLT vs. EBC2_LLT** 30 days: 0.00 (4%); 60 days: 0.01 (10%)	PTM (5.B.6.4.2) /Percent of particles (% change) Wetter starting distribution	**ESO_ELT vs. EBC2_ELT** 30 days: -1.86 (-49%); 60 days: -3.02 (-56%)	**ESO_LLT vs. EBC2_LLT** 30 days: -2.30 (-63%); 60 days: -3.53 (-66%)
							Drier starting distribution	days: -1.70 (-47%); 60 days: -2.75 (-53%)	30 days: -2.09 (-59%); 60 days: -3.18 (-62%)
				Drier starting distribution	30 days: 0.08 (64%); 60 days: 0.14 (81%)	30 days: 0.01 (16%); 60 days: 0.04 (31%)	DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)	
	Juvenile	Impingement and screen contact	Possibly similar to delta smelt (see above)	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens					

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Species	Life Stage	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)														SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake		Agricultural Diversions	
		Method (Document Section for Detailed Results)/Metric		All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results	Method (Document Section for Detailed Results)/Metric	Results
				ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT						
	Adult	Salvage-density method (5.B.6.1.6.3)/ Number of fish (% change)		-1,924 (-52%)	-1,849 (-52%)	-78 (-58%)	-71 (-53%)	-302 (-43%)	-342 (-50%)	-907 (-45%)	-650 (-35%)	-336 (-28%)	-299 (-26%)	-3,991 (-18%)	-5,847 (-26%)	(5.B.6.2.3.3)		of 1.75-m mesh and therefore exclude smelt >15 mm based on north Delta intakes analysis		NA	
Sacramento splittail	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																			
	Larva	NA		NA		NA		NA		NA		NA		NA		Screening effectiveness analysis (5.B.6.2.4.1)	100% screened at >~22 mm	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude splittail >10 mm based on north Delta intakes analysis		NA	
	Juvenile	Per capita–based salvage-density method (5.B.6.1.7.1)/ Number of fish (% change)		-180,131 (-37%)	-168,940 (-38%)	-928,107 (-49%)	-774,445 (-46%)	-42,648 (-35%)	-43,187 (-38%)	-1,202 (-13%)	-2,166 (-22%)	-306 (-18%)	-401 (-26%)	-456 (-39%)	-369 (-34%)	Impingement and screen contact (5.B.6.2.4.2)	Number of screen contacts increases at night, with lower sweeping velocity, with lower approach velocity, and with larger fish size (during the day)			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
		Yolo Bypass inundation-based salvage density method (5.B.6.1.7.1)/ Number of fish (% change)[1]		1,901,912 (485%)	1,424,440 (385%)	5,589,647 (461%)	4,161,915 (363%)	853,965 (1,962%)	699,135 (1,881%)	22,475 (667%)	12,338 (413%)	3,540 (133%)	4 (70%)	-4 (0%)	3 (0%)						
	Adult	Salvage density method (5.B.6.1.7.2)/ Number of fish (% change)		-1,916 (-54%)	-1,765 (-52%)	-2,986 (-72%)	-2,857 (-70%)	-3,258 (-68%)	-3,024 (-63%)	-1,344 (-40%)	-1,011 (-32%)	-616 (-26%)	-625 (-27%)	-494 (-15%)	-512 (-16%)	NA				NA	
White sturgeon	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																			
	Larva	Uncertain as to what extent entrainment occurs because most of the larval population is upstream of the south Delta export facilities														Screening effectiveness analysis (5.B.6.2.5.1)	100% screened at >10 mm	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude sturgeon >10 mm based on north Delta intakes analysis		NA	
	Juvenile	Salvage-density method (5.B.6.1.8.1) / Number of fish[2] (% change)	Sacramento Valley WY classification	NA		-150 (-58%)	-139 (-58%)	-150 (-58%)	-139 (-58%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	Impingement and screen contact (5.B.6.2.6.2)	Possibly similar to green sturgeon (see below)			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
			San Joaquin Valley WY classification			-161 (-55%)	-148 (-54%)	-161 (-55%)	-148 (-54%)	-9 (-26%)	-8 (-25%)	-9 (-26%)	-8 (-25%)	-9 (-26%)	-8 (-25%)						
	Adult	Large body size/strong swimming ability make entrainment very unlikely																			
Green sturgeon	Egg/ Embryo	Occur upstream of Plan Area																			
	Larva	Occur upstream of Plan Area																			
	Juvenile	Salvage-density method (5.B.6.1.9.1) / Number of fish[2] (% change)	Sacramento Valley WY classification	NA		-62 (-56%)	-59 (-57%)	-62 (-56%)	-59 (-57%)	-17 (-37%)	-15 (-37%)	-17 (-37%)	-15 (-37%)	-17 (-37%)	-15 (-37%)	i) Screening effectiveness analysis (5.B.6.2.6.1), ii) impingement and screen contact (5.B.6.2.6.2)	i) 100% screened, ii) water column position and lab studies suggest little potential for adverse effects, but uncertain	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
			San Joaquin Valley WY classification			-68 (-54%)	-65 (-56%)	-68 (-54%)	-65 (-56%)	-16 (-41%)	-15 (-41%)	-16 (-41%)	-15 (-41%)	-16 (-41%)	-15 (-41%)						
	Adult	Large body size/strong swimming ability make entrainment very unlikely																			
Pacific lamprey and river lamprey	Egg/ Embryo	Occur upstream of Plan Area																			
	Ammocoete	Generally buried in the substrate upstream of the Plan Area but may be subject to entrainment if washed out of natal streams into the Plan Area (before burying into Plan Area substrates)														Screening effectiveness analysis (5.B.6.2.7.1)	Susceptible to entrainment at less than 50–60-mm total length	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4), although lamprey would be longer than this because of body shape; Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude lamprey >50–60-mm total length based on north Delta intakes analysis		Not explicitly analyzed, but presumably some minor benefit as suggested for other species from DRERIP evaluation (see above)	
	Macro-pthalmia	Salvage-density method (5.B.6.1.10.1)/Number of fish[3] (% change)		-1,504 (-45%)	-1,356 (-41%)	NA										Impingement and screen contact (5.B.6.2.7.2)	Possibly little potential for adverse effect, but uncertain				
	Adult																				

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Note: Quantitative results are presented as mean or median (for skewed data, indicated with an asterisk *) difference between ESO_ELT and EBC2_ELT and between ESO_LLT and EBC2_LLT. See Table 5.B.0-1 for a description of these modeled scenarios.
Negative values indicate lower entrainment under the ESO scenarios relative to EBC2 scenarios. Percentage difference between scenarios is color-coded as shown below.

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

CVP = Central Valley Project.
DPM = Delta Passage Model
NBA = North Bay Aqueduct.
NA = Not Analyzed.
PTM = Particle Tracking Model.
SWP = State Water Project.

[1] Anomalously greater salvage estimates under ESO scenarios relative to EBC2 scenarios because of estimated increase in overall population size caused by enhanced Yolo Bypass inundation under *CM2 Yolo Bypass Fisheries Enhancement.*

[2] Analysis was divided into wetter (wet and above-normal) and drier (below-normal, dry, and critical) water years. Results are shown for each water-year type separately, but were calculated together. Upper row and lower rows show results for Sacramento and San Joaquin Valley water-year types, respectively.

[3] Analysis included Pacific lamprey and river lamprey combined because taxa are not identified to species.

Entrainment loss of longfin smelt at the south Delta export facilities was projected to be lower under evaluated starting operations relative to existing biological conditions, with differences by water-year type.

Overall, entrainment loss of longfin smelt at the south Delta export facilities was estimated to be lower under the evaluated starting operations relative to existing biological conditions. There were decreases in average annual entrainment loss from the salvage-density method under the evaluated starting operations relative to existing biological conditions of around 40% for juveniles and around 50% for adults (Table 5.B.0-2). For adults, entrainment reductions under the evaluated starting operations were greatest in wet years (53–58%) and appreciable in above and below-normal years (35–50%); there was less reduction in dry and critical years (18–28%). For juveniles, reductions in average annual entrainment loss under the evaluated starting operations were again greatest in wet years (56–57%), and ranged from 7% to 32% in the remaining water-year types. Consistent with these changes, entrainment of larval longfin smelt as assessed by particle tracking modeling also was estimated to be lower under the evaluated starting operations, on average by around 20–60%.

Entrainment of Sacramento splittail at the south Delta export facilities was projected to increase because improved reproduction from increased accessibility to floodplain habitat would increase population size; losses on a per-capita basis were estimated to be lower because of lower pumping under the BDCP.

The two different modeling techniques for entrainment (represented by salvage) of Sacramento splittail gave opposite results because of their differing assumptions. The per capita salvage-density method estimated substantially less average annual salvage (nearly 40% less across all water-year types) under the evaluated starting operations compared to existing biological conditions because of reduced pumping in the south Delta (Table 5.B.0-2). This method essentially weights difference in pumping between scenarios by fixed monthly patterns of relative abundance. In contrast, the Yolo Bypass days of inundation method estimated that there would be substantial increases (severalfold to an order of magnitude or more) in the number of Sacramento splittail entrained in most water-year types; this would occur because of increased accessibility to floodplain habitat for spawning and early rearing, leading to substantially more juvenile splittail occupying the Plan Area. However, the general decrease in export pumping from the south Delta during the main May–July entrainment period for juvenile splittail will have the potential to result in a lower overall proportion of the splittail population being entrained. Increased abundance of juvenile and larval splittail due to increased floodplain habitat could result in an associated increase in entrainment, although the overall proportion of the population subject to entrainment may be lower than previously because of lower pumping during the months of greater abundance.

Entrainment of white sturgeon and green sturgeon at the south Delta export facilities was projected to decrease because of reduced export pumping.

Under the assumption that reduced export pumping in the south Delta is directly proportional to entrainment of juvenile white and green sturgeon (i.e., the salvage-density method), entrainment of these two species should decrease under the evaluated starting operations relative to existing biological conditions. The decrease was estimated to be greater in wet and above-normal years (50–60%) than in below-normal, dry, and critical years (25–40%), reflecting south Delta operations (Table 5.B.0-2).

Entrainment of pacific lamprey and river lamprey at the south Delta export facilities was projected to decrease because of reduced export pumping.

As with white and green sturgeon, reductions in south Delta export pumping would be expected to decrease entrainment of Pacific and river lamprey macropthalmia and adults under the evaluated starting operations relative to existing biological conditions. The estimated level of reduction (41–45% averaged across all water years) is based on the salvage-density method, i.e., on the assumption that proportional changes in flow lead to similar proportional changes in entrainment (Table 5.B.0-2).

Nonphysical barriers have the potential to reduce entrainment of some covered fish species at the SWP/CVP south Delta export facilities, but there is uncertainty about whether this would translate into increased survival because of other localized factors.

Nonphysical barriers at the entrances to Clifton Court Forebay (CCF) and the Delta-Mendota Canal (DMC) have the best potential to reduce entrainment of juvenile Chinook salmon and steelhead and juvenile and adult delta smelt, longfin smelt, and Sacramento splittail. There is little potential to reduce entrainment of white and green sturgeon or Pacific and river lamprey because these species are not as sensitive to the acoustic deterrence of the nonphysical barriers. The effectiveness of nonphysical barriers will depend on the water velocity characteristics in the vicinity of the barrier and on the extent to which predatory fish occur along the barrier. There is also uncertainty as to whether preventing entrainment into CCF and the DMC will enhance survival given the prevailing hydrodynamics in the area, i.e., if net reverse flows are present that may not allow fish to move away from the area and make them more susceptible to entrainment. Such uncertainties necessitate study to assess the effectiveness of nonphysical barriers at these locations.

Screening of the SWP/CVP north Delta intakes will prevent entrainment of all but the smallest life stages of covered fish species; potential negative effects associated with screen contact, impingement, and passage time will require monitoring.

Screening of the proposed north Delta intakes will prevent entrainment through the screens of most life stages of covered fish species, with larval delta smelt, longfin smelt, Sacramento splittail, and smaller lamprey ammocoetes that may encounter the intakes having the greatest potential for entrainment. There is potential for larger fish to have detrimental interactions with the screens. Final specifications have not been established fully for the screens but laboratory studies show that salmonid screen passage time would be expected to be facilitated by greater sweeping velocity. The proportion of Sacramento River-origin salmonids that may pass close enough to the intakes is uncertain but may be appreciable given the likely siting near the outside of river bends to minimize sedimentation and maintain sweeping velocity. Existing survey data suggest that most delta smelt and longfin smelt would be well downstream of the intakes, but those that do occur in the intake vicinity and near the shoreline may contact the screens and could suffer injury and potentially mortality. Approach velocity will be limited to 0.2 feet/second (ft/sec) when delta smelt are present. Laboratory studies have shown that the probability of mortality is greater with higher sweeping velocity and at night. Screen contact rate for Sacramento splittail decreases with increased sweeping velocity, so it is apparent that there are potentially different effects on different species from the north Delta intakes. Monitoring would be used to determine the actual impingement and related negative screen interactions for covered fish species at the proposed north Delta intakes.

Implementation of a dual conveyance for the SWP North Bay Aqueduct should reduce entrainment of delta smelt and longfin smelt larvae.

Construction of an alternative intake on the Sacramento River for the NBA will provide flexibility in operations and facilitate reduced pumping from the Barker Slough Pumping Plant in the Cache Slough subregion, a particularly important portion of the delta smelt range. This should reduce entrainment of delta smelt larvae because delta smelt are not commonly found in the vicinity of the alternative intake. It was estimated that under the evaluated starting operations, entrainment of longfin smelt larvae at the Barker Slough Pumping Plant may be similar or slightly greater under the evaluated starting operations relative to existing biological conditions; however, the percentage of entrained particles was very low and would become even lower with the implementation of a dual conveyance.

Decommissioning of agricultural diversions in the BDCP restoration opportunity areas will reduce entrainment of covered species to a small degree.

The level of entrainment of covered fish species at agricultural diversions in the Plan Area is largely unknown, but it is likely some entrainment is occurring. Whatever entrainment is occurring would be reduced by decommissioning agricultural diversions in the BDCP restoration opportunity areas (ROAs) and implementing *Conservation Measure (CM) 21 Nonproject Diversions*, which will reduce entrainment through removal, consolidation, relocation, reconfiguration, and screening at nonproject diversions. Particle-tracking modeling of larval smelt entrainment suggested that changes in water operations under *CM1 Water Facilities and Operation* may result in lower entrainment of longfin smelt larvae under the evaluated starting operations compared with the existing biological conditions and similar or slightly higher entrainment of delta smelt larvae under the evaluated starting operations relative to existing biological conditions (Table 5.B.0-2). Changes in larval smelt entrainment are uncertain because particle tracking is not necessarily an accurate representation of smelt larval behavior in relation to agricultural intakes, nor does it account for the changes in diversions from tidal restoration or CM21. Greater benefits to smelt and other covered species associated with removing water diversion structures may occur from the reduction of predator holding habitat (Appendix 5.F, *Biological Stressors on Covered Fish*) than from reductions in entrainment.

Estimates of entrainment changes under the BDCP are uncertain, but entrainment is readily monitored.

The relationship between pumping levels and entrainment is not fully understood; however, decreases in pumping generally should lead to decreased entrainment. An example of uncertainty is whether relationships between pumping and entrainment are linear or nonlinear. However, fish entrainment (and impingement) is readily monitored and the BDCP includes such monitoring. It is expected that monitoring will improve understanding and, through adaptive management, lead to refinements in BDCP implementation where appropriate. Particular emphasis will be placed on the following areas of monitoring.

- Continuing salvage and entrainment monitoring at the SWP/CVP south Delta export facilities.
- Entrainment and impingement monitoring at the new SWP/CVP north Delta intakes.
- Entrainment and impingement monitoring at the SWP NBA Barker Slough Pumping Plant and Alternative Intake on the Sacramento River.

Continuing entrainment monitoring into the future will be of particular importance, given the likely changes in species distribution caused by large-scale habitat changes and/or climate change. For example, species such as longfin smelt may spawn farther upstream as sea level rises.

Winter-Spring south delta entrainment would be similar between low-outflow (LOS) and evaluated starting operations (ESO) scenarios, whereas the high-outflow scenario (HOS) would have lower entrainment

Most BDCP covered fish species that occur within the Plan Area are susceptible to entrainment during winter and spring (roughly December–June). For these species, there would be little difference in entrainment at the south Delta export facilities between ESO and LOS scenarios because pumping is similar for these two scenarios in winter and spring. In contrast, the HOS has lower south Delta export pumping and greater outflow during spring in particular. This has the potential to result in less entrainment compared with the ESO/LOS scenarios, as shown for delta smelt larvae/juveniles. Relatively few species are susceptible to entrainment during summer/fall because of their phenology, but for those that are—the sturgeons are the best examples—entrainment under the HOS would be similar to or less than the ESO, with both of these scenarios generally having somewhat lower entrainment than the LOS because of inclusion of the USFWS (2008) BiOp Fall X2 RPA under the HOS and ESO scenarios. As noted elsewhere in this appendix, modeling of entrainment has some uncertainty because of real-time management decisions that could occur and alter export rates from those modeled here.

Appendix 5.B
Entrainment

Contents

Tables

Figures

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Acronyms and Abbreviations

Bay-Delta	San Francisco Bay/Sacramento–San Joaquin River Delta
BDCP	Bay Delta Conservation Plan
BiOp	biological opinion
CALFED	CALFED Bay-Delta Program
CCF	Clifton Court Forebay
CCWD	Contra Costa Water District
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CM	conservation measure
cm	centimeters
CVP	Central Valley Project
CWT	coded wire tag
D-1641	State Water Resources Control Board water right Decision 1641
DA8	Delta Action 8
Delta	Sacramento–San Joaquin River Delta
DFW	California Department of Fish and Wildlife
DMC	Delta-Mendota Canal
DPM	Delta Passage Model
DRERIP	Delta Regional Ecosystem Restoration Implementation Plan
DWR	California Department of Water Resources
EBC	existing biological conditions
EIR/EIS	environmental impact report/environmental impact statement
ELT	Early Long-Term
ESA	federal Endangered Species Act
ESO	evaluated starting operations
FRWA	Freeport Regional Water Authority
ft/sec	feet per second
HOS	high-outflow scenario
HZI	hydraulic zone of influence
IEP	Interagency Ecological Program
IOS	Interactive Object-Oriented Simulation Model
LLT	Late Long-Term
LOS	low-outflow scenario
mm	millimeter
NAVD	North American Vertical Datum
NBA	North Bay Aqueduct
NMFS	National Marine Fisheries Service
OBAN	Oncorhynchus Bayesian Analysis
OCAP	Operations Criteria and Plan
OMR	Old and Middle River

OSCM	Other Stressors Conservation Measure
POD	Pelagic Organism Decline
PTM	Particle Tracking Model
RBDD	Red Bluff Diversion Dam
ROAs	Restoration Opportunity Areas
ROD	Record of Decision
RPAs	Reasonable and Prudent Alternatives
Skinner fish protection facility	John E. Skinner Delta Fish Protective Facility
SL	Standard Length
SWP	State Water Project
SWP Banks	SWP Harvey O. Banks Pumping Plant
taf	per thousand acre-feet
UC Davis	University of California, Davis
USFWS	U.S. Fish and Wildlife Service
YOY	young-of-year

Appendix 5.B
Entrainment

5.B.1 Organization of the Appendix

This appendix provides details of technical analyses of entrainment of covered fish species in water diversions under the Bay Delta Conservation Plan (BDCP) evaluated starting operations (ESO). The appendix is organized as follows.

- **Section 5.B.2 (Introduction)** provides background on the issue of entrainment in the Plan Area, a conceptual model for the factors affecting entrainment, the potential importance of entrainment as assessed in the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) species conceptual models, the ways in which entrainment has been reduced by the U.S. Fish and Wildlife Service (USFWS) (2008) and National Marine Fisheries Service (NMFS) (2009) biological opinions (BiOps), the means by which the BDCP may affect entrainment, and the objectives of the appendix.
- **Section 5.B.3 (Sources of Entrainment—Water Diversion Facility Descriptions)** provides descriptions of the main water diversion facilities that would be constructed or would have changed operations under the BDCP (i.e., the State Water Project [SWP]/Central Valley Project [CVP] south Sacramento–San Joaquin River Delta (Delta) export facilities, the SWP/CVP north Delta intake, the North Bay Aqueduct (NBA) Barker Slough Pumping Plant and Alternative Intake, and agricultural diversions).
- **Section 5.B.4 (Water Diversion Scenarios)** summarizes the changes in diversion flows and schedules under the evaluated starting operations for the SWP/CVP south Delta export facilities, the SWP/CVP north Delta intake, and the NBA Barker Slough Pumping Plant.
- **Section 5.B.5 (Methods of Biological Analysis)** outlines the procedures used to assess the exposure of each species to entrainment and describes in detail the technical methods used to analyze the effects of entrainment on covered fish species.
- **Section 5.B.6 (Results of Biological Analysis)** describes in detail the results of the entrainment analyses for all covered fish species.
- **Section 5.B.7 (Summary and Conclusions for Effects on Entrainment)** summarizes the overall results of the entrainment analyses by describing percentage change from baseline that is attributable to the BDCP and provides narrative conclusions regarding the results.
- **Section 5.B.8 (References Cited)** lists literature and personal communications cited in this appendix.

5.B.2 Introduction

This appendix describes changes in operations of water diversions in the Delta as a result of the BDCP and provides estimates of entrainment of covered fish species under the BDCP. The main objective of the appendix is to use these estimates of entrainment to estimate the relative difference in entrainment between the BDCP's evaluated starting operations (ESO) scenario and baseline conditions—referred to as the *existing biological conditions* or EBC. The results from this appendix are incorporated into Chapter 5, *Effects Analysis*, allowing the relative change to be placed in the context of the overall importance of the stressor to the populations of covered fish species.

Entrainment is the removal of fish and other aquatic organisms from water bodies by water diversions[2]. In the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta), there are many water diversions, both project (i.e., the SWP and CVP) and nonproject, with varying potential to cause entrainment, with some diversions under the cover of the BDCP (e.g., SWP and CVP facilities) and others outside the purview of the BDCP (e.g., Freeport Regional Water Authority (FRWA) and Contra Costa Water District (CCWD) intakes). Water diversions in the Delta include the following.

- SWP and CVP south Delta export facilities (South Delta subregion).
- SWP NBA Barker Slough Pumping Plant (Cache Slough subregion).
- Other larger diversions (e.g., FRWA intake, CCWD intakes at Rock Slough, Old River, and other locations).
- Agricultural[3] diversions and other diversions (all subregions).
- Cooling intakes for energy generating facilities (e.g., Mirant power plant)

Fish entering a water diversion facility are considered to be entrained (Kimmerer 2008). For most diversions, entrained fish are regarded as mortalities and removed from the system. However, the CVP and SWP south Delta pumping facilities have louver systems designed to support fish salvage by diverting a portion of entrained fish into facilities where fish can be sampled, counted, and ultimately transferred to transport trucks to be moved downstream of the pumping stations. Sampling of fish in the salvage facilities is the primary numeric measure of the impacts of entrainment on Delta fish species and provides the basis for most estimates of entrainment. These salvage facilities were designed primarily to protect juvenile salmonids. More fragile species such as delta smelt have lower survival during salvage (Morinaka 2010.) All delta smelt entering salvage are considered mortalities (U.S. Fish and Wildlife Service 2008). The mechanisms for salvage are described in Chapter 4, Section 4.2.1.2.3, *John E. Skinner Delta Fish Protective Facility*, and summarized below.

The BDCP is intended minimize entrainment levels, while also increasing water supply and water supply reliability. This is accomplished through the use of the proposed north Delta intake facilities in addition to the existing south Delta facilities. The north Delta intakes will have state-of-the-art screening and operational criteria intended to minimize entrainment from these intakes.

The definition of change in either water diverted or fish entrained is made by comparing conditions under the ESO scenario to existing biological conditions (EBC). EBC1 is appropriate for consideration of change relative to the needs of the California Environmental Quality Act (CEQA). It includes operations in the USFWS (2008) and NMFS (2009) BiOps except for provisions relating to management of the position of X2 in the fall which have not yet been implemented. EBC2 is

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[2] This definition of entrainment is consistent with the general usage in California. With respect to removal of fish at cooling water intakes, the term *entrainment* generally is applied only to organisms such as fish eggs or larvae that are too small to be screened (Langford 1983).

[3] The term *agricultural diversions* includes the great majority of diversions, not part of the SWP and CVP.

appropriate for consideration of change relative to the requirement of federal Endangered Species Act (ESA) and includes all provision of the USFWS (2008) and NMFS (2009) BiOps including the Fall X2 provisions. Because the difference between EBC1 and EBC2 rests primarily in the assumptions around the Fall X2 provision, the results of EBC1 biological analyses generally are rather similar to those of EBC2, because entrainment issues for covered fish species generally occur in months other than fall. Results relating to EBC1, therefore, are not discussed in detail in the remainder of the appendix but are presented for information.

This appendix analyzes the entrainment effects of the ESO, which incorporates Scenario H operations as described in Chapter 3, Section 3.4.1.3, *Flow Criteria*, and BDCP Environmental Impact Report/Environmental Impact Statement (EIR/EIS) Chapter 3, Section 3.4.1.2, *Operational Components* (California Department of Water Resources et al. 2012). The modeling for the ESO is identical to the modeling designated as Alternative 4 for the BDCP EIR/EIS. The ESO (Alternative 4) represents one of four possible operational scenarios for the BDCP, reflecting different potential outcomes of the decision trees for spring and fall outflow. The ESO includes low spring/high fall outflows. Low spring outflow refers to March–May outflow that meets State Water Resources Control Board water right Decision 1641 (D-1641) requirements but that is less than the high outflow resulting from south Delta pumping restrictions assumed under the EBC scenarios to reflect the USFWS (2008) and NMFS (2009) BiOp Reasonable and Prudent Alternatives (RPAs). High fall outflow refers to fall outflow following wet and above-normal water years that meets the requirements of the USFWS (2008) BiOp RPA; low fall outflow refers to fall outflow meeting D-1641 requirements but not the USFWS (2008) BiOp RPA. As described below, additional consideration is given in this appendix to a high-outflow scenario (HOS) that includes high spring and fall outflows and a low-outflow scenario (LOS) that includes low spring and fall outflows.

Table 5.B.2-1 provides a description of each of these scenarios.

Table 5.B.2-1. Analytical Conditions of the Modeled Scenarios

Condition		**Description**
Existing Biological Conditions	EBC1	Current operations, based on the USFWS (2008) and NMFS (2009) BiOps, excluding management of outflows to achieve the Fall X2 provisions of the USFWS (2008) BiOp.
	EBC2	Current operations based on the USFWS (2008) and NMFS (2009) BiOps, including management of outflows to achieve the Fall X2 provisions of the USFWS (2008) BiOp.
Projected Future Conditions without the BDCP	EBC2_ELT	EBC2 projected into year 15 (2025) accounting for climate change conditions expected at that time.
	EBC2_LLT	EBC2 projected into year 50 (2060) accounting for climate changes conditions expected at that time.
Projected Future Conditions with the BDCP[a]	ESO_ELT	Evaluated starting operations in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	ESO_LLT	Evaluated starting operations in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.
	HOS_ELT	High-outflow operations (high-outflow outcomes of decision tree for management of spring and fall outflow) in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	HOS_LLT	High-outflow operations (high-outflow outcomes of decision tree for management of spring and fall outflow) in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.
	LOS_ELT	Low-outflow operations (low-outflow outcomes of decision tree for management of spring and fall outflow) in year 15; assumes the new intake facility is operational but restoration actions are not fully implemented.
	LOS_ELT	Low-outflow operations (low-outflow outcomes of decision tree for management of spring and fall outflow) in year 50; assumes the new intake facility is operational and restoration actions are fully implemented.

[a] The decision-tree process, described in Chapter 3, Section 3.4.1.4.4, *Decisions Trees*, provides a mechanism for selection of one of four potential operational outcomes for *CM1 Water Facilities and Operation*: evaluated starting operations, high outflow-scenario, low-outflow scenario.

USFWS = U.S. Fish and Wildlife Service.

NMFS = National Marine Fisheries Service.

BiOp = biological opinion.

5.B.2.1 Conceptual Model of Entrainment

Susceptibility of covered fish species to entrainment is a function of a number of factors, represented conceptually in Figure 5.B.2-1. These can be summarized as follows.

- Individuals of a species must occur in the vicinity of an intake to be susceptible to entrainment.
  - Seasonal migrations may cause species to pass close to intakes.
  - Habitat preferences affect proximity (e.g., littoral species may be more susceptible than pelagic species [Nobriga et al. 2004]; species may occur in the vicinity of an intake if preferred physicochemical conditions such as salinity or turbidity are found there [Grimaldo et al. 2009]).
  - Bidirectional flows in tidal areas may increase the number of times fish encounter intakes.

- The size of an intake relative to the water body that it is in affects entrainment susceptibility.
    - The size of the hydraulic zone of influence (HZI)[4] (Richardson and Dixon 2004) increases as water diversion rate increases and as water body size decreases.
- The ability of a fish to avoid entrainment is a function of its ability to detect, orient away from, and escape the intake.
    - Detection and orientation are most affected by visibility, which may differ depending on turbidity and darkness (Langford 1983) but may be enhanced by other stimuli such as light and sound (Maes et al. 2004).
    - Escape is a function of swimming ability, which is dependent on species (e.g., juvenile Chinook salmon are relatively good swimmers, delta smelt are relatively poor swimmers), body size (smaller fish generally swim at slower rates than larger fish), water temperature, body condition (Sprengel and Luchtenberg 1991), and other factors.
    - Increases in water velocity entering an intake (approach velocity) increase the risk of entrainment, with the speed past the intake (sweeping velocity, for which increases generally reduce the risk of being entrained) also being important and changing as a function of prevailing river.
    - Screening reduces the risk of entrainment by preventing fish from passing into an intake, although the risk of impingement[5] increases as approach velocity increases and sweeping velocity decreases—the effects of impingement on survival are affected by factors such as water temperature (Swanson et al. 2005).

Fish that are entrained may be salvaged if specialized collection facilities exist, such as those at the SWP/CVP south Delta export facilities (Brown et al. 1996). Survival of collection, handling, transport, and release back to the Delta depends on species sensitivity and the physical conditions during transport (e.g., temperature). Predation, which is analyzed in more detail in Appendix 5.F, *Biological Stressors on Covered Fish*, is a factor that also can greatly decrease survival of entrained fish at the south Delta export facilities and may affect fish approaching the north Delta intakes.

The conceptual model presented in Figure 5.B.2-1 introduces the idea that the HZI increases with the size of the diversion. Moyle and Israel (2005) noted that there are few data for entrainment in the Central Valley at locations other than the SWP/CVP south Delta export facilities, but that those that do exist suggest a nonlinear increase in entrainment as diversions increase. This reflects the increase in volume of the HZI. A nonlinear relationship between intake flow and entrainment is also characteristic of the SWP/CVP south Delta export facilities (Kimmerer 2008). Small intakes, such as agricultural diversions, have considerably smaller HZI that are restricted to the nearshore area. Many small diversions cumulatively may divert as much water as a single very large intake, but the entrainment rate of the agricultural diversions expressed as density of fish per unit volume diverted may be considerably less than that diverted by the single large intake. However, as noted above, predation at these many small diversions may be substantial.

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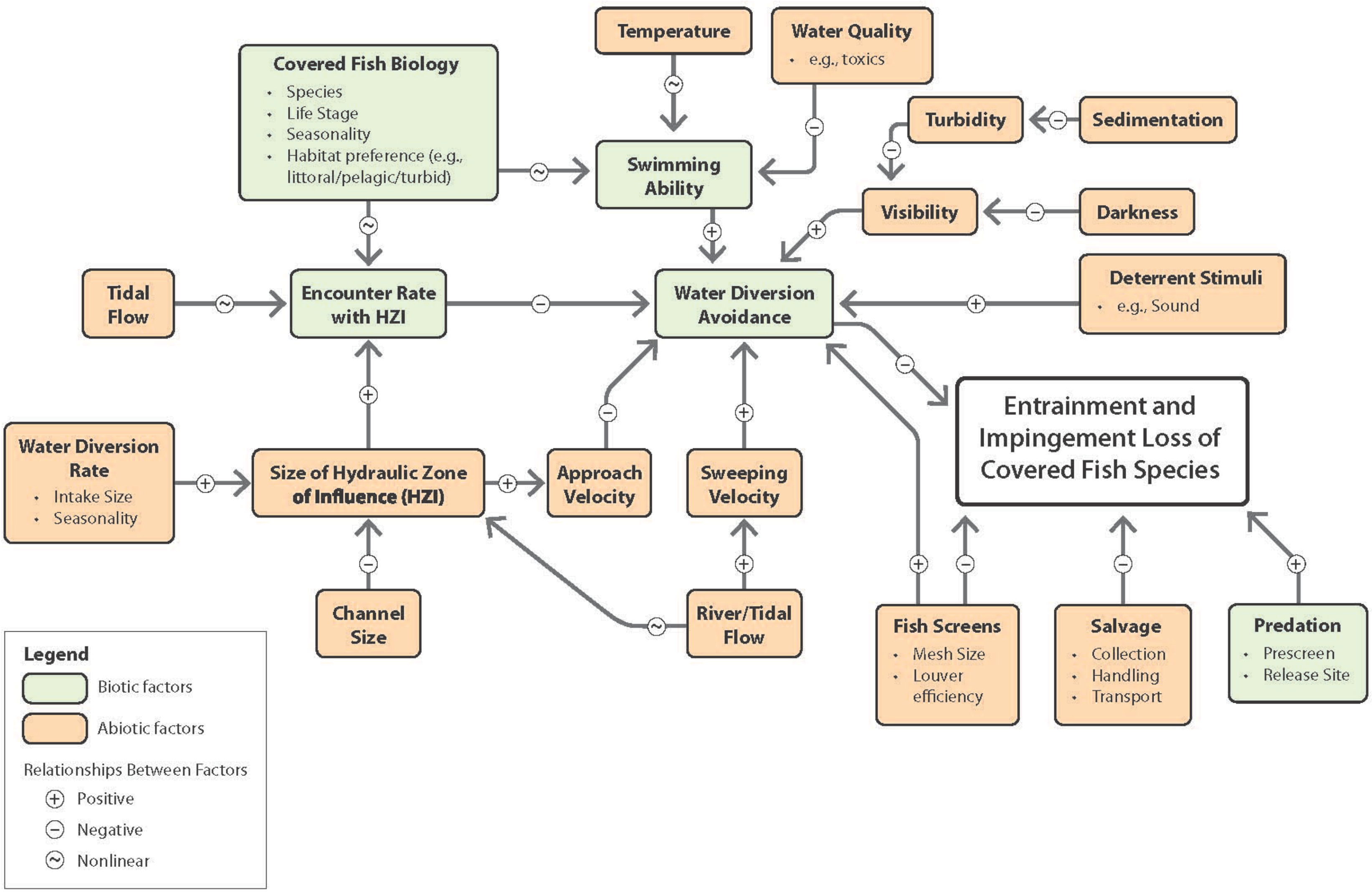
[4] The HZI is the region in a water body where the probability of entrainment is high (Richardson and Dixon 2004).

[5] Impingement is when aquatic organisms are pinned against screens or other parts of a water intake system.



1
2 **Figure 5.B.2-1. Conceptual Model of Biotic and Abiotic Factors Influencing Entrainment and Impingement Loss of Covered Fish Species**

5.B.2.2 Potential Importance of Entrainment

The overall importance of entrainment relative to specific species populations, and how the BDCP may affect populations, will be discussed under the topic of population-level effects of the BDCP in Chapter 5, *Effects Analysis*. This section will review information related to the historical pattern and numbers of fish entrained in the SWP and CVP south Delta facilities and the impact of recent regulatory changes on the estimated numbers of fish entrained. Information on population trends is discussed as needed to provide context for the entrainment numbers.

The importance of different environmental factors such as entrainment on the control and recovery of covered fish species reflects their life histories and physiological requirements. Exposure of fish to environmental stressors reflects the spatial and temporal movement of life stages through the study area and differences in habitat requirements for life stages (Appendix 2.A, *Covered Species Accounts*). Life stages of covered fish species reside in or pass through the Bay-Delta and may be at risk of entrainment (e.g., delta smelt, juvenile salmonids), whereas others (e.g., eggs of green sturgeon) do not occur in the Bay-Delta but may be entrained at agricultural diversions in natal rivers. Life stages of various species enter and use the Delta and become susceptible to entrainment at different times, resulting in differences in entrainment impacts (Grimaldo et al. 2009).

Entrainment of Delta fish in water diversions has been an important focus for scientific investigation in the Delta and a key consideration for management of water operations and fish conservation. The south Delta SWP and CVP facilities are the largest water diversions in the Delta, and have been the subject of most scientific investigation and management actions relating to entrainment. In the past, these facilities have entrained large numbers of Delta fish species. For example, tens to hundreds of thousands of covered fish such as Chinook salmon and delta smelt were salvaged annually at the facilities (Brown et al. 1996; Figure 5.B.2-2). The actual entrainment losses were likely several times greater than measured salvage, due to predation in Clifton Court Forebay (CCF) and the relatively low diversion efficiency of the louver screens (the percentage of fish that are successfully directed to holding tanks and counted) (Brown et al. 1996; Castillo et al. 2012). Larval fish entrainment is not well documented because larval fish are not salvaged, but may cause appreciable losses (Kimmerer 2008). Entrainment by agricultural diversions also occurs (Cook and Buffaloe 1998; Nobriga et al. 2004) but is not believed to be as substantial because of the small size of these intakes, although predation levels in the vicinity of the structures may be high (Vogel 2011).

In recent years, entrainment of pelagic species (e.g., delta smelt and longfin smelt) and other Delta fish from the south Delta facilities has been substantially reduced due to changes in export operations as well as declining abundance of some fish such as delta smelt (Kimmerer 2011).

Figure 5.B.2-2 compares total monthly and annual CVP and SWP salvage for several covered fish species (delta smelt, longfin smelt, Chinook salmon and splittail) from 1991 through 2010. Salvage is a variable proportion of entrainment, the actual proportion depending on louver efficiency, pre-screen loss levels, and many other factors, but is considered a reasonable index of total entrainment. Actual entrainment is always appreciably greater than salvage. Chinook salmon and delta smelt both had peak salvage levels in 1999 and 2000 but a sharp decline in more recent years.

The monthly and annual salvage varies from year to year because of changes in pumping and changes in the density of fish (number of fish per unit volume of water) in the vicinity of the diversions. Splittail and longfin smelt have shown high levels of salvage in some years. For example, large numbers of larval and juvenile splittail are entrained at the south Delta facilities during wet years, when splittail abundance is high, compared to low entrainment levels in dry years. The increased entrainment during wet years is a result of increased availability of inundated floodplain habitat and greater recruitment of young splittail. Conversely, entrainment of longfin smelt can be higher in dry years because the distribution of longfin smelt shifts further upstream and closer to the south Delta facilities (Sommer et al. 2007). Salvage has a seasonal pattern as well, with salvage of all four species concentrated in March through May.

These graphs show that, as noted above, the number of fish salvaged at CVP and SWP in recent years is greatly reduced from previous levels. This presumably reflects reduced abundance of fish, various pumping restrictions, and the use of new management techniques for avoiding entrainment through the monitoring of turbidity events and management of Old and Middle River (OMR) flows in the Central Delta. Nonetheless, entrainment remains a focus of regulatory concern because of its potential to affect fish populations. Thus, a key part of the BDCP effects analysis must evaluate effects on entrainment.

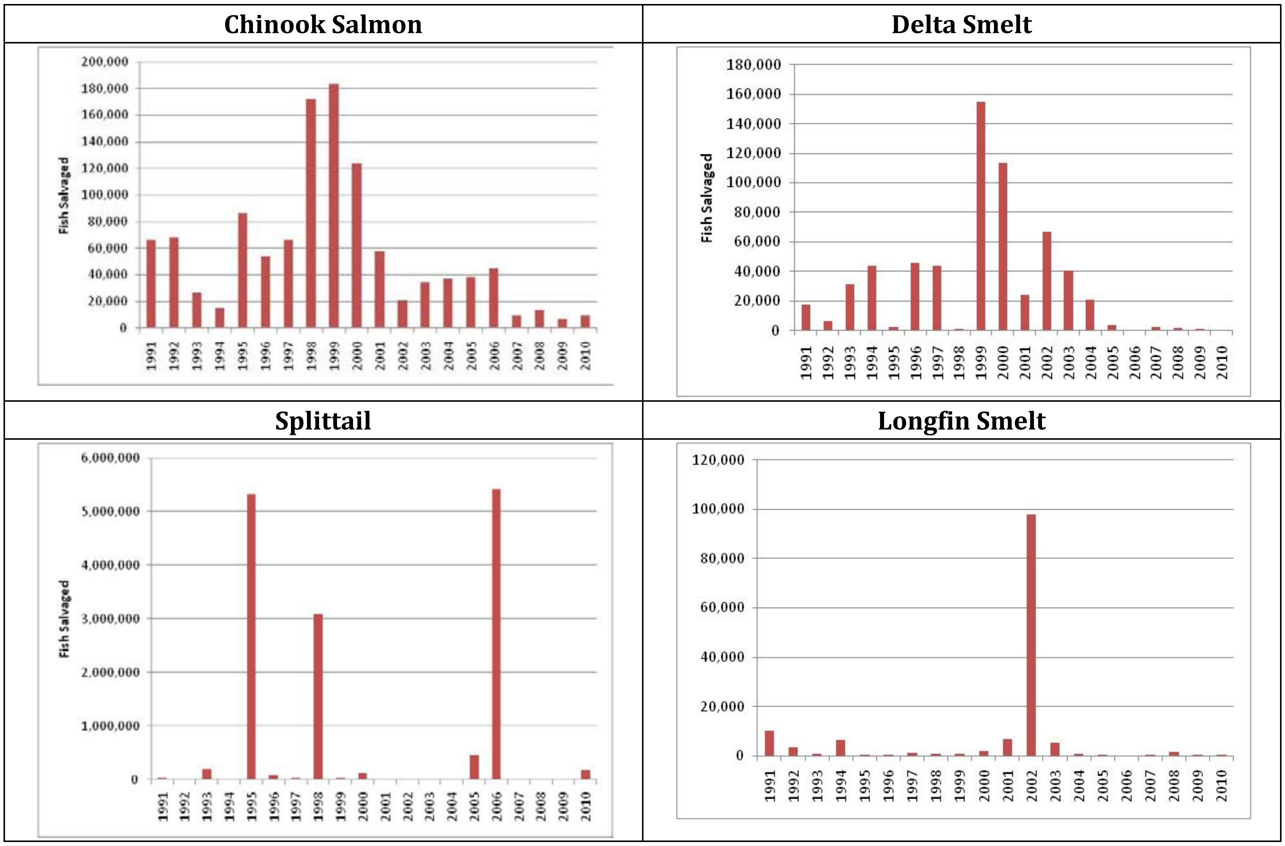


Figure 5.B.2-2. Combined Number of Fish Salvaged Annually at CVP and SWP South Delta Export Facilities, 1991–2010

Entrainment of fish does not necessarily mean they are killed. The fish salvage systems at the CVP Tracy Fish Facility and the SWP Skinner Fish Facility divert a portion of fish into a salvage system for collection and return to the Delta. These systems were designed primarily to salvage juvenile salmon and other fairly robust fish. Though delta smelt can survive the salvage process, they are more fragile and suffer greater mortality (Morinaka 2010). For the remainder of listed fish species, the proportion of fish killed by entrainment depends on factors such as predation and louver screening efficiency. Louver efficiency is 75% SWP and 47% at CVP (National Marine Fisheries Service 2009).

Few studies have estimated the proportion of covered fish species populations lost to entrainment. Kimmerer (2008) estimated the loss of larval and juvenile delta smelt for the years 1995 to 2006 at between 0 and 26% of the larval and juvenile population and from 1 to 22% of the adult delta smelt population, giving a total population loss of 1–38% (as reported by Miller [2011]), with wide confidence intervals around the estimates. Miller (2011) reassessed Kimmerer's (2008) analysis and identified a number of potential biases, most of which he argued may bias Kimmerer's estimates upwards. Miller (2011) concluded that a lower proportion of the delta smelt population (i.e., up to 15–30%) was lost to entrainment at the south Delta pumps than estimated by Kimmerer (2008). Kimmerer (2011) concurred with one aspect of Miller's reanalysis (downward adjustment of adult loss related to fish flux towards the south Delta export facilities) but rejected the other biases for which quantitative analyses were possible; a number of biases could not be addressed because any possible adjustments cannot be quantified. Kimmerer (2011) also noted that the reduced proportional entrainment losses in recent years may reflect reduced abundance of delta smelt in the south Delta. While there is considerable uncertainty and scientific dispute surrounding the proportion of the population that is lost to entrainment, both Miller's and Kimmerer's analyses suggested that appreciable proportions of the overall population of delta smelt may have been lost in some years. Recent studies have begun to shed light on some less well known aspects of entrainment and salvage that form important assumptions within the analyses of Kimmerer (2008) and Miller (2011). For example, experimental studies of SWP prescreen losses and fish facility efficiency by Castillo et al. (2012) estimated losses of adult delta smelt that ranged from similar to those assumed for adults at SWP-CVP by Kimmerer (2008) to nearly ten times higher than losses assumed by Kimmerer (2008).

The numbers and proportions of covered species such as delta smelt and listed Chinook salmon entrained in the south Delta pumps have been a consistent management concern, which has resulted in significant modification of regional water operations (U.S. Fish and Wildlife Service 2008; National Marine Fisheries Service 2009). Several recent analyses, including life cycle models used in Appendix 5.G, *Fish Life Cycle Models*, have demonstrated some reason for concern related to entrainment loss of covered fish species.

- Mac Nally and coauthors (2010) found weak statistical evidence for a negative relationship between fall abundance of delta smelt and spring south Delta exports (i.e., larval/juvenile entrainment) or winter south Delta exports (i.e., adult entrainment).
- Thomson and coauthors (2010) found that winter exports had a high probability of inclusion in models explaining variation in delta smelt abundance but could not explain the step change in abundance during the Pelagic Organism Decline (POD) of the 2000s.
- Maunder and Deriso (2011) found some statistical support for a statistical model of factors affecting delta smelt that included estimates of adult entrainment, although other competing models without adult entrainment included explain variations in delta smelt abundance more efficiently.
- Miller and coauthors (2012) found that survival of delta smelt from fall to summer was statistically negatively associated with total proportional entrainment of delta smelt (i.e., adults and larvae/juveniles from the next generation), although survival from fall to fall (i.e., the full life cycle) was not related to total entrainment.
- Newman and Brandes (2010) found that Chinook salmon smolts released in the interior Delta (Georgiana Slough) had relatively lower through-Delta survival than smolts released in the Sacramento River, and that the relative survival became lower as south Delta exports increased (although high variability in the data meant that other models excluding exports had similar

predictive ability); a form of this relationship is included in the Delta Passage Model (DPM) (Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*) and the Interactive Object-Oriented Simulation Model (IOS) winter-run Chinook salmon life cycle model (Appendix 5.G, *Fish Life Cycle Models*).

- The Oncorhynchus Bayesian Analysis (OBAN) salmon life cycle model (described in more detail in Appendix 5.G) demonstrated a significant negative relationship between winter-run Chinook salmon through-Delta survival and south Delta exports.
- Losses of winter-run Chinook salmon as a percentage of the juvenile production estimate averaged around 1% from 1993 to 2011, with a high of 5.4% in 2001 (Llaban, pers. comm.)

Analyses and statistical models have also pointed to multiple stressors other than entrainment that could explain the recent population declines in delta smelt and other pelagic fish species (Baxter et al. 2010; Maunder and Deriso 2011).

The relative importance of entrainment and other attributes was evaluated by a group of regional scientists through a series of conceptual models published by the DRERIP[6]. The DRERIP models provide a conceptual view of the life-history and habitat requirements of the species and a subjective ranking of stressors for the species. It is important to note that the DRERIP conceptual models generally were written prior to the USFWS (2008) and NMFS (2009) BiOps and do not reflect the pumping restrictions intended to reduce the effects of entrainment at the south Delta export facilities. The DRERIP model for delta smelt developed by Nobriga and Herbold (2009) ranked water exports (entrainment) and water transparency as the most important stressors on delta smelt at that time; food, competition and ecosystem effects also received high rankings. These rankings have not been updated to reflect the operational changes in pumping at the south Delta facilities.

The DRERIP rankings as well as the quantitative analyses such as those of Kimmerer (2008, 2011) and Miller (2011), while reflecting different assumptions and approaches, converge on a conclusion that entrainment of large numbers of covered fish species has occurred in the past during periods of high water exports from the CVP and SWP facilities. The importance of entrainment to short- and long-term population dynamics of delta smelt is not yet clear. It is also noted that the number of fish entrained has declined in recent years, which could be a result of decreasing populations as well as improved water operations management. Because entrainment is a function of water exports, it will continue to receive close scrutiny and a focus of efforts to reduce impacts of water operations on fish.

The BDCP includes new diversion facilities and operational rules to control and manage entrainment that work in conjunction with habitat restoration and other measures to recover the Delta ecosystem. The entrainment analyses presented in the sections below focus on how entrainment of covered fish species may change in the future as a result of implementation of *Conservation Measure (CM) 1 Water Facilities and Operation*, which consists of new conveyance facilities and operational rules designed to minimize entrainment.

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[6] <http://www.dfg.ca.gov/ERP/conceptual_models.asp>.

5.B.2.3 How the Bay Delta Conservation Plan May Affect Entrainment

As described in Chapter 3, Section 3.4, *Conservation Measures*, the BDCP proposes a number of alterations to water diversion facilities in the Plan Area that may change the effects of entrainment on covered fish species. These alterations include the following.

- As part of *CM1 Water Facilities and Operation*, reduction of exports at the SWP/CVP south Delta export facilities through construction and use of new north Delta intakes that would operate in tandem with south Delta export facilities as a dual conveyance facility.
- As part of CM1, management of flows and fish entry into the south Delta by installing and operating an operable gate at the head of Old River.
- As part of CM1, reduction of exports to the SWP NBA from the Barker Slough Pumping Plant by using a new alternative intake on the Sacramento River that would operate in tandem with the Barker Slough Pumping Plant.
- As part of *CM16 Nonphysical Fish Barriers*, installation of nonphysical barriers at the entrance to CCF and the Delta-Mendota Canal (DMC).
- As part of *CM21 Nonproject Diversions*, reduction in entrainment through removal, consolidation, relocation, reconfiguration, and screening at nonproject diversions (primarily agricultural diversions); in addition, there would be reduction of entrainment by agricultural diversions onto lands restored by the BDCP (and taken out of agricultural production) under *CM4 Tidal Natural Communities Restoration* within the BDCP restoration opportunity areas (ROAs).

5.B.3 Sources of Entrainment—Water Diversion Facility Descriptions

5.B.3.1 SWP South Delta Export Facilities

The SWP south Delta export facility consists of three major components: (1) CCF, (2) the SWP Harvey O. Banks Pumping Plant (SWP Banks) pumping facility, and (3) the John E. Skinner Delta Fish Protective Facility (Skinner fish protection facility).

5.B.3.1.1 Clifton Court Forebay

Water for the SWP south Delta export facilities is diverted into CCF and pumped at SWP Banks. CCF is a 2.6-mile-by-2.1-mile, 31,000-acre-foot regulatory reservoir located in the southwestern edge of the Delta in the South Delta subregion, about 10 miles northwest of the city of Tracy. Inflows from surrounding channels are controlled by five 22-foot-wide radial gates in the southeast of the forebay, which generally are operated based on the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water-level fluctuation in the south Delta by taking water in through the gates at times other than low tide. When a large head differential (difference in water surface elevation) exists between the outside and the inside of the gates, theoretical inflow can be as high as 15,000 cubic feet per second (cfs) for a short time and exceed 10 feet per second (ft/sec) (Kano 1990). Water is withdrawn from the forebay through a 0.8-mile-long rock-lined outlet channel paralleling the western edge, which originally connected Italian Slough to the California Aqueduct. The Skinner Fish Protective Facility fish screens at the southern end of the outlet channel separate the CCF from the channel leading to Banks and thence to the California Aqueduct. The CCF is notable for the large population of predatory fish such as striped bass, which once were estimated to number around 200,000 fish (Brown et al. 1996) (although the movement of fish into and out of the CCF probably resulted in an overestimate of abundance [Kano 1990]). These predators have been estimated to consume approximately 75% or more of the prey fish that are entrained into the CCF, based on mark-recapture studies (Gingras 1997; Clark et al. 2009; Castillo et al. 2012).

5.B.3.1.2 SWP Harvey O. Banks Pumping Plant

Banks is in the South Delta subregion about 8 miles northwest of Tracy and marks the beginning of the California Aqueduct. Banks provides the initial lift of water 244 feet into the aqueduct by means of 11 pumps, including two rated at 375-cfs capacity, five at 1,130-cfs capacity, and four at 1,067-cfs capacity. The nominal capacity of Banks is 10,300 cfs. The pumps can be operated at full capacity to enable diversions to use power in off-peak periods, typically 2200–0800 hours (Kano 1990).

5.B.3.1.3 John E. Skinner Delta Fish Protective Facility

The John E. Skinner Delta Fish Protective Facility is located at the head of the intake channel that connects CCF to Banks, and uses louvers to divert fish away from the pumps. Debris is directed away from the pumps by a 388-foot-long trash boom. Fish are diverted from the intake channel into bypasses by a series of metal louvers, 1 inch apart and set at 15° to the water flow, while the main flow of water continues through the louvers and toward the pumps. Fish pass through secondary systems of louvers and pipes into seven holding tanks, where a subsample (fish collected approximately 10–30 minutes out of every 2 hours) later is counted and recorded. Primary and secondary louver efficiency is a function of fish species, size, and approach velocity, with typical efficiencies of 70–95% for the primary and secondary louvers (Brown et al. 1996:1523). The salvaged fish then are driven in oxygenated tank trucks to several release sites in the West Delta subregion: Horseshoe Bend (Sacramento River), Sherman Island (San Joaquin River), and Antioch (a site shared with the Tracy Fish Collection Facility) (National Marine Fisheries Service 2009:351).

5.B.3.2 CVP South Delta Export Facilities

The CVP (south Delta export facility consists of two components: (1) C.W. “Bill” Jones Pumping Plant and (2) the Tracy Fish Facility.

5.B.3.2.1 C.W. “Bill” Jones Pumping Plant

The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles long (National Marine Fisheries Service 2009: Appendix A). Jones Pumping Plant has a permitted diversion capacity of 4,600 cfs with maximum pumping rates typically ranging from 4,500 to 4,300 cfs during the peak of the irrigation season and approximately 4,200 cfs during the winter nonirrigation season until construction and full operation of the DMC/California Aqueduct Intertie. The winter-time constraints at the Jones Pumping Plant are the result of a DMC freeboard constriction near O’Neill Forebay, O’Neill Pumping Plant capacity, and the current water demand in the upper sections of the DMC.

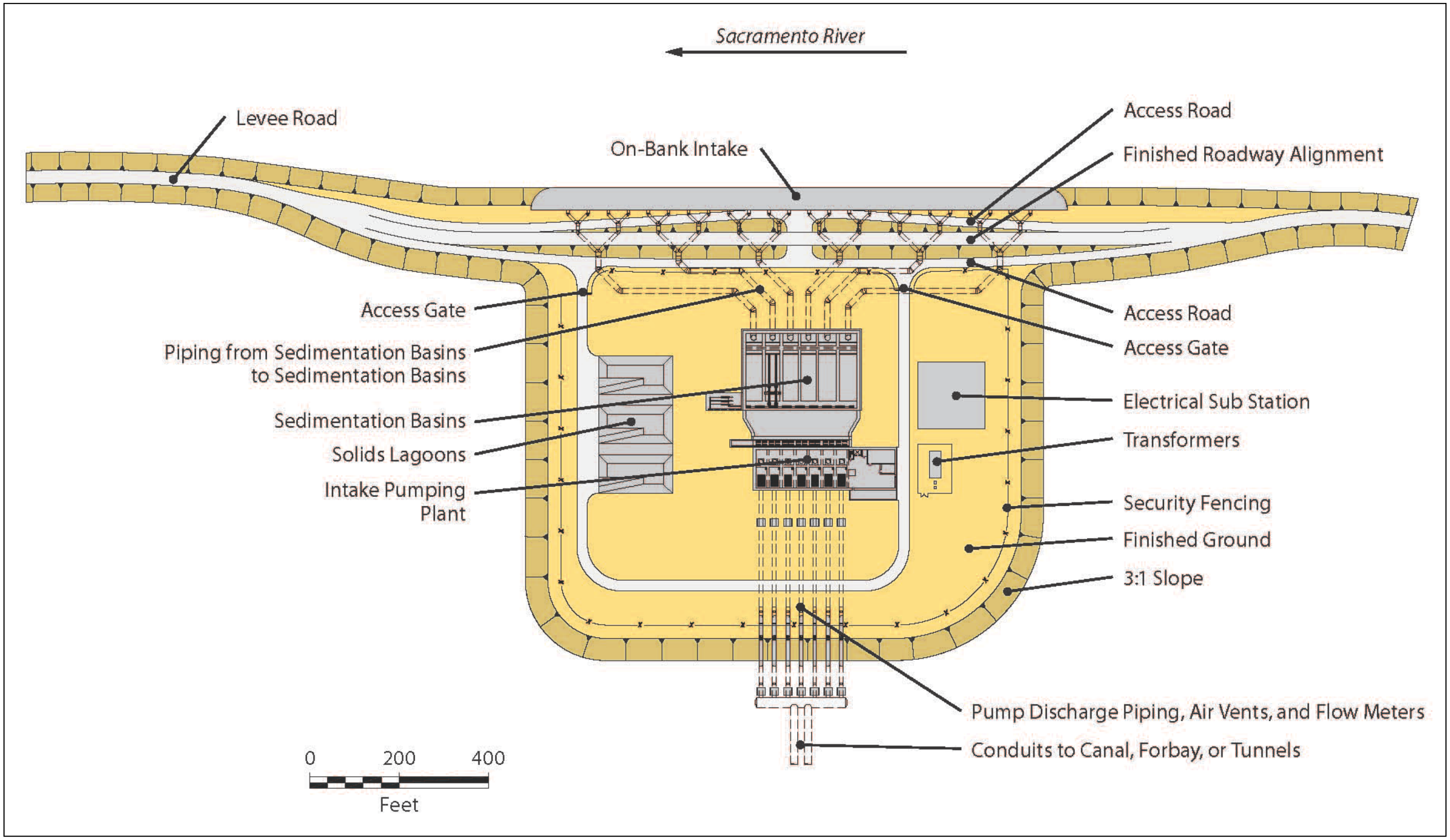
5.B.3.2.2 Tracy Fish Collection Facility

Off Old River (South Delta subregion), at the head of the intake channel to the Jones Pumping Plant, the Tracy Fish Collection Facility's louver screens intercept fish, which, in a salvage process similar to the John E. Skinner Delta Fish Protective Facility (described above), then are collected, held, and transported by tanker truck to release sites in the West Delta subregion: Horseshoe Bend (Sacramento River) and adjacent to the State Route 160 bridge in Antioch (National Marine Fisheries Service 2009:351). As with the John E. Skinner Delta Fish Protective Facility, the salvage of fish is less than 100% efficient: prescreen losses to predation are estimated at 15%; louver efficiency is around 50%; and collection, handling, and transport are 98% efficient (National Marine Fisheries Service 2009:352).

5.B.3.3 SWP/CVP North Delta Intakes

The SWP/CVP north Delta intakes do not presently exist but are proposed as part of *CM1 Water Facilities and Operation*. This system will consist of a new 9,000-cfs-capacity pumping facility with three intakes along the Sacramento River that would be connected to the existing south Delta facilities by two tunnels. The 15,000-cfs-capacity tunnels would allow gravity-driven transport of water from three new 3,000-cfs intakes on the left bank of the Sacramento River between river miles 37 and 41 that would be constructed during the near-term period of the Plan and would be completed before the commencement of the early long-term period. CM1 applies to operations of the dual conveyance system upon completion of construction of the new north Delta intakes. This system will increase flexibility of water operations and affect the amount of water exported from the existing south Delta pumps, with expected changes in the number of fish entrained by the south Delta export facilities. The three 3,000-cfs, on-bank intakes with positive barrier screens (Figure 5.B.3-1) would be constructed in the Hood area of the Sacramento River (North Delta subregion). Additional discussion of the selection of locations for the north Delta intakes is provided in Appendix 3.A, *Background on the Process of Developing the BDCP Conservation Measures*, Section 3.A.7.2. A number of potential intakes were investigated and those selected were numbers 2, 3, and 5, with screen lengths of 1,800 feet, 1,900 feet, and 1,950 feet, respectively. The screens would consist of vertical wedge-wire panels (1.75-millimeter [mm] mesh) that would be kept free of debris with a screen-cleaning system.

The north Delta intakes' design is intended to minimize entrainment effects on covered fish species and will reflect the best available technology for positive barrier screens. The intakes' location on the Sacramento River is above the range of major concentrations of delta smelt and along the side of the river (rather than intercepting the entire channel as is the case for the south Delta facilities), which should maintain sweeping river flow past the intakes and minimize hydrodynamic conditions suitable for predatory fish. The proposed positive barrier intake screens will be designed in collaboration with resource agency scientists to be in accordance with the California Department of Fish and Wildlife (CDFW) (California Department of Fish and Game 2000) and NMFS (1997) fish screen criteria, as well as the USFWS criterion for delta smelt. These criteria include, for fish screens in areas where delta smelt are known to occur, a screen mesh with opening (assuming a wedge-wire screen surface) of 1.75 mm and a maximum approach velocity of 0.2 ft/sec. The maximum approach velocity criterion for salmonid fry is 0.33 ft/sec. The screens will be built to meet the 0.33-ft/sec criterion but will be operated to meet the 0.2-ft/sec criterion in the presence of delta smelt. The sweeping velocity of water passing the intakes should be greater than the approach velocity under the NMFS (1997) criteria, and at least double the approach velocity per the CDFW (2000) criteria. Unused sections of the fish screens will be covered to provide operational flexibility as necessary.



Source: Adapted from TM 20-2 Rev 0 Proposed North Intake Facilities for the Draft EIRS, Figure O-5.
Note that length differs from actual proposed intakes.

Figure 5.B.3-1. Conceptual Intake Structure

5.B.3.4 SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake

The Barker Slough Pumping Plant is part of the SWP and diverts water from Barker Slough (Cache Slough subregion) into the NBA for delivery to municipal and industrial uses in Napa and Solano Counties. The NBA intake is located approximately 10 miles from the mainstem Sacramento River at the end of Barker Slough, just upstream. The maximum pumping capacity is 175 cfs (pipeline capacity). During the last few years, daily pumping rates have ranged between 0 and 140 cfs because of thick bio-film growth on the interior of the NBA pipeline that has resulted in reducing the effective diameter of the pipe (ESA 2009). Each of the 10 NBA pump bays is fitted individually with a positive-barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. This configuration is designed to exclude fish 25 mm or larger from being entrained. The bays tied to the two smaller units have an approach velocity of about 0.2 ft/sec. The larger units were designed for a 0.5-ft/sec approach velocity, but actual approach velocity is about 0.44 ft/sec. The screens routinely are cleaned to prevent excessive head loss, thereby minimizing increased localized approach velocities.

The NBA Alternative Intake is a new facility to be located on the Sacramento River upstream of the Sacramento Regional Wastewater Treatment Plant that will address some of the main concerns with the existing Barker Slough Pumping Plant (ESA 2009). Barker Slough provides habitat to both state- and federally listed species (including delta smelt and longfin smelt). In 2000, the CALFED Bay-Delta Program (CALFED) Record of Decision (ROD) concluded that relocation of the NBA intake out of Barker Slough was part of a comprehensive solution to improve the Delta because it would alleviate negative effects on critical habitat, including that of the delta smelt in the Cache Slough subregion (CALFED Bay-Delta Program 2000). Water quality in Barker Slough becomes degraded during and after rainfall events. The NBA pipeline section from the Barker Slough Pumping Plant to the North Bay Regional Treatment Plant has a design capacity of 175 cfs but, as noted above, the system can deliver a maximum of only about 140 cfs because of thick bio-film growth on the interior of the NBA pipeline. The Alternative Intake would be operated in conjunction with the existing NBA intake at Barker Slough. The Barker Slough Pumping Plant would be operated to divert and deliver water through the NBA up to its current pumping capacity of approximately 140 cfs, when acceptable water quality is available at Barker Slough and environmental concerns are not in effect. During the periods when the Barker Slough Pumping Plant cannot meet the water demand and/or the water quality in Barker Slough is not acceptable, or when there are concerns about listed fish, the Alternative Intake would be operated to help meet water demands. The Alternative Intake would be fitted with state-of-the-art, positive-barrier fish screens to minimize the risk of entrainment and impingement of listed fish species.

5.B.3.5 Agricultural Diversions

There are a large number of agricultural diversions in the Plan Area; Herren and Kawasaki (2001) documented more than 2,200 diversions (including nonagricultural diversions) in the Delta (Cache Slough, West Delta, East Delta, and South Delta subregions) and nearly 370 in Suisun Marsh (Suisun Marsh subregion). Nobriga and Herbold (2009) noted that the actual number may be notably smaller because of the difficulty in differentiating between intake pipes used to divert water and outfall pipes used to drain water off Delta islands. Diversions in the Delta consist mostly of siphons (45% by number) (Herren and Kawasaki 2001) with diversion flows that, after priming, are controlled by both valves in the pipes and differences in water elevations on the water and land sides of the levee (Nobriga et al. 2004). The other most common diversion types are vertical and centrifugal pumps, which contribute 19% and 17% of the total number (Herren and Kawasaki 2001). The great majority of diversions in Suisun Marsh (79% by number) are floodgates. 90% of the diversion intake sizes in the Delta measured between 12 and 24 inches, whereas 90% of Suisun Marsh floodgates had intake sizes between 36 and 48 inches. Fish screens on diversions in the Delta are very uncommon, with Herren and Kawasaki (2001) estimating that only 0.7% of diversions were screened to CDFW criteria.

5.B.4 Water Diversion Scenarios

Central to the analysis of entrainment is the question of how the BDCP may modify the environment by changing water diversions within the Study Area. Changes in water diversions under the evaluated starting operations (ESO) scenario that were modeled with CALSIM-II are reviewed in this section. Details of the modeling assumptions are provided in Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*, Attachment 5C.A, *CALSIM and DSM2 Modeling Results for the Evaluated Starting Operations Scenarios*.

In this section, differences in water diversions are assessed by comparing the amount of water diverted under several existing and future baseline scenarios (EBC1, EBC2, EBC2_ELT, EBC2_LLT) to the amount diverted under the ESO. Environmental and biological changes are evaluated for each of five water-year types at three points in time: existing, early long-term (ELT) and late long-term (LLT). ELT and LLT scenarios incorporate changes to climate expected in the Study Area over the 50-year term of the BDCP. In addition, there are two baseline conditions that reflect different regulatory standards.The modeled scenarios are as follows.

- **EBC1:** Existing biological conditions incorporating the USFWS (2008) and NMFS (2009) BiOps, omitting the Fall X2 requirement of the USFWS (2008) BiOp.
- **EBC2:** Existing biological conditions fully incorporating the USFWS (2008) and NMFS (2009) BiOps.
- **EBC2_ELT:** EBC2 projected into the early long-term, i.e., 11–15 years after the commencement of project implementation following completion of the proposed north Delta intakes and incorporating climate change assumptions for 2025.
- **EBC2_LLT:** EBC2 projected into the late long-term, i.e., following completion of project implementation and incorporating climate change assumptions for 2060.
- **ESO_ELT:** The evaluated starting operations including new north Delta intakes and reduced south Delta pumping (dual conveyance structure) in the early long-term.
- **ESO_LLT:** The evaluated starting operations in the late long-term.

The five water-year types are those in the 40-30-30 Sacramento River Basin Index (California Department of Water Resources 2009). Water-year types are not equally distributed within the 1922–2003 hydrologic sequence simulated with CALSIM. The proportion of different water-year types within the 82-year base period is as follows:

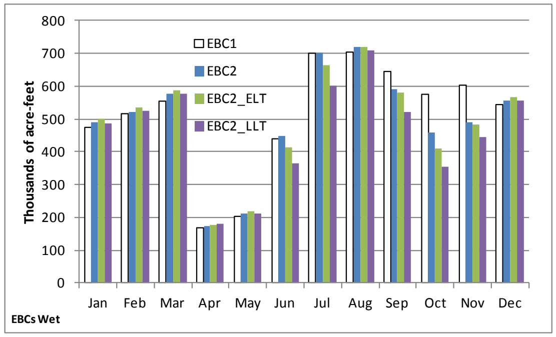
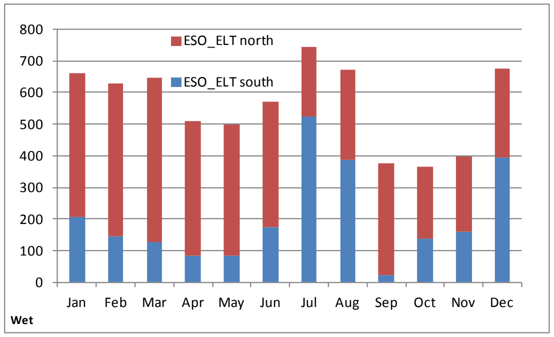
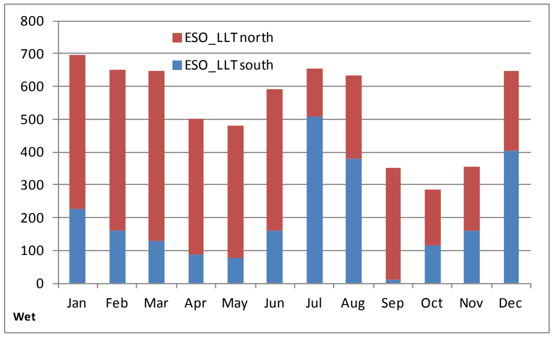
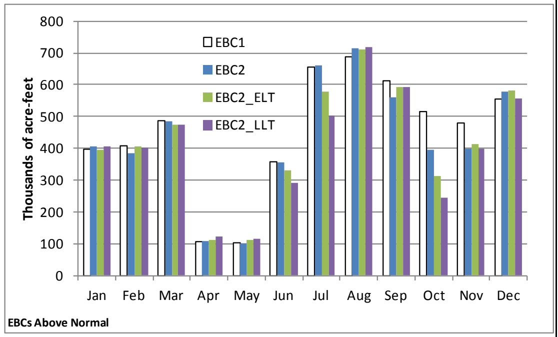
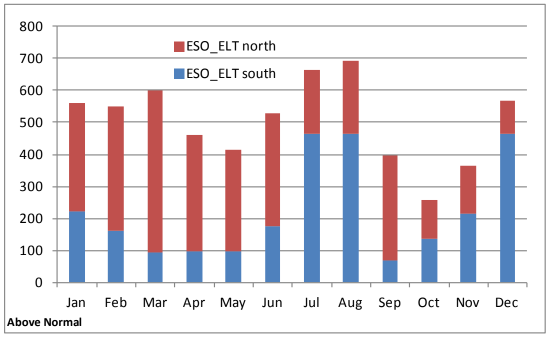
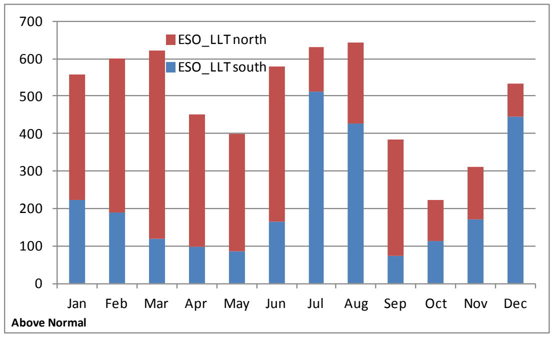
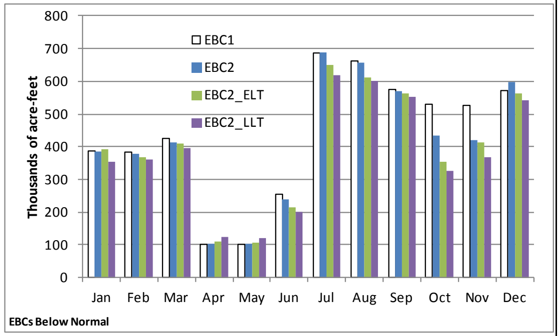
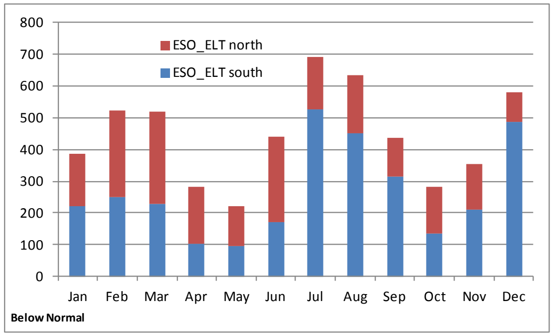
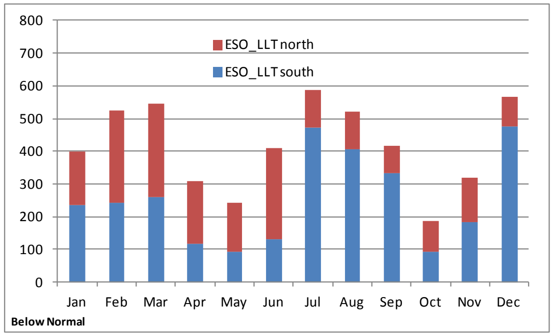
- Wet: 26 years (31%)
- Above normal: 12 years (15%)

- Below normal: 14 years (17%)
- Dry: 18 years (22%)
- Critical: 12 years (15%)

5.B.4.1 Relative Contribution of North and South Delta Intakes under the BDCP

The dual conveyance system is intended to provide increased flexibility in management of the SWP/CVP water export system in the Delta. Total pumping would proportionately shift between the north and the south Delta facilities in response to environmental requirements and water demands.

The distribution of pumping between the north and south Delta facilities is shown in Figure 5.B.4-1, which provides the results of CALSIM modeling analysis of the evaluated starting operations and the baseline scenarios. Under EBC scenarios, exports decline sharply in April and May in response to fish protection measures. Exports are higher in the fall under EBC1 compared to EBC2; fall exports following wet and above-normal years are limited under EBC2 in response to the fall X2 requirement of the USFWS (2008) BiOp. Note that the difference is seen not only in wet and above-normal years in Figure 5.B.4-1 because the figure is a summary by water year (i.e., October–September) and the Fall X2 action begins in the final month, September, of the water year triggering the action and continues into October–December of the next water year. Under the ESO, in the wetter water years (wet and above-normal water years, 46% of the water years), most of the combined total exports would come from the new north Delta facility and exports from the south Delta facility would be lower than existing biological conditions (Figure 5.B.4-1).The use of the north Delta pumps would be lower in the drier years with most pumping coming from the south Delta pumps in dry and critical water years (37% of the years). Less use of the north Delta pumps in drier water years reflects requirements to maintain adequate bypass flows at the north Delta diversions.

	Existing Biological Conditions (EBC) and Projected Future Conditions without the BDCP (EBC2_ELT and EBC2_LLT)	Evaluated Starting Operations Early Long-Term (ESO_ELT)	Evaluated Starting Operations Late Long-Term (ESO_LLT)
Wet (26 years)			
Above Normal (12 years)			
Below Normal (14 years)			

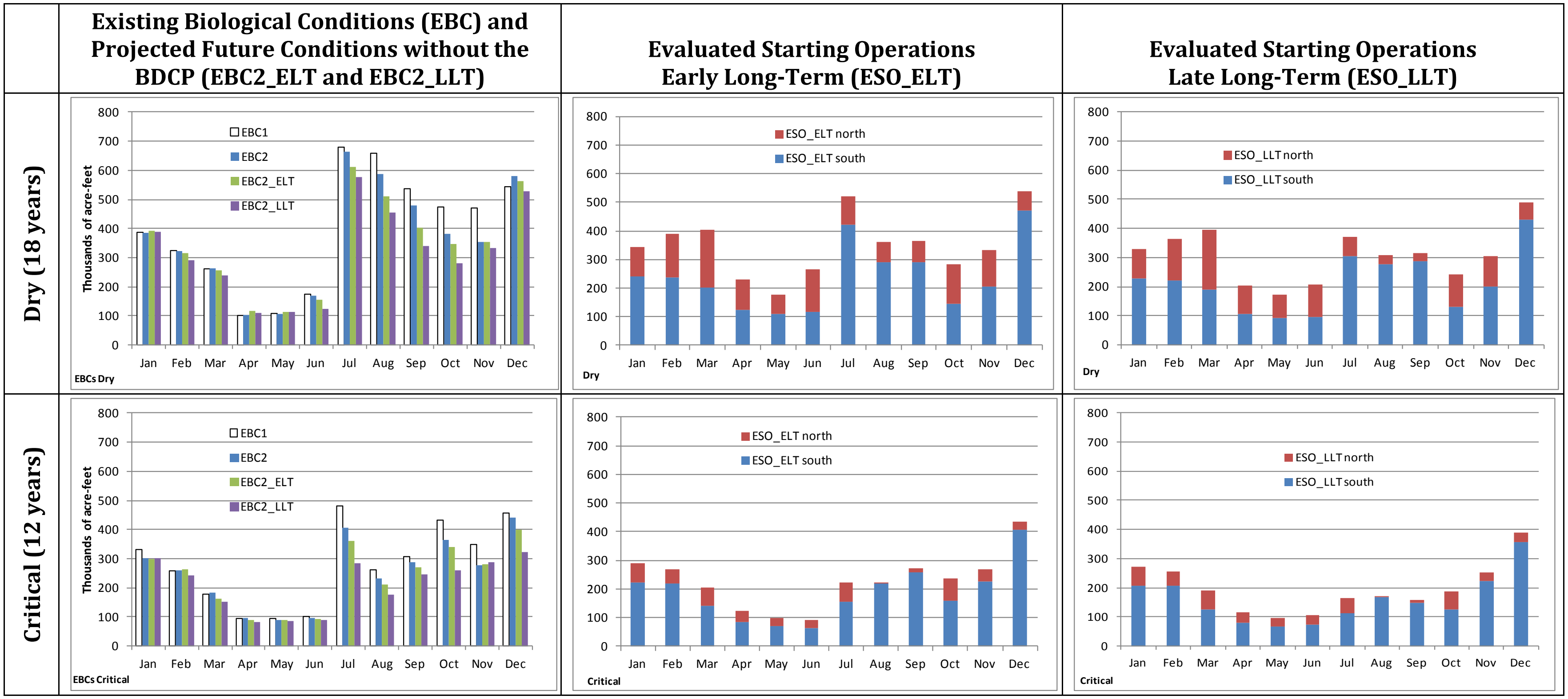
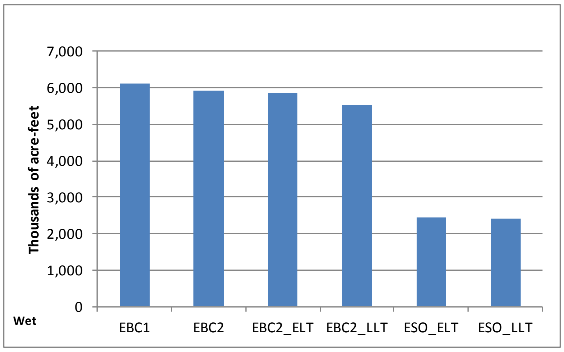
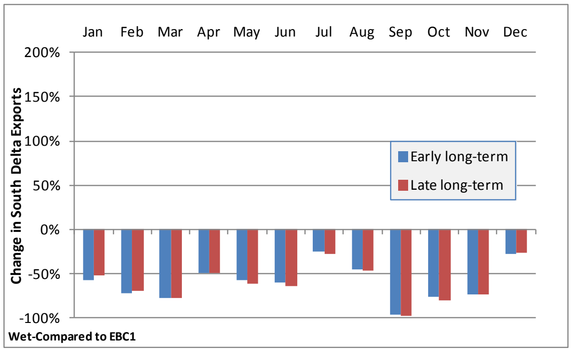


Figure 5.B.4-1. Average Modeled Water Exports (Thousands of Acre-Feet) under Existing Biological Conditions (South Delta Export Facilities Only) and Future Conditions without the BDCP (EBC2_ELT and EBC2_LLT) and under the Evaluated Starting Operations Scenarios (ESO_ELT and ESO_LLT) under Different Water-Year Types

5.B.4.2 Difference in Exports from the South Delta Pumps under the BDCP

The BDCP's evaluated starting operations would change the amount and pattern of exports from the south Delta pumps compared to existing conditions.

Figure 5.B.4-2 compares CALSIM results for the south Delta pumps alone to highlight the effects of the BDCP on the existing pattern of exports in the Delta. Under the BDCP, total exports from the south Delta pumps are appreciably lower because of the contribution of the north Delta pumps to total SWP/CVP exports. Under the evaluated starting operations, exports from the south Delta pumps would be lower in the wet water years in all months because of the use of the north Delta pumps compared to baseline conditions (Figure 5.B.4-2). Pumping is especially lower in the winter and spring months when entrainment of covered fish species such as delta smelt and Chinook salmon typically peaks. Compared to EBC scenarios, exports from the south Delta are on average lower under the evaluated starting operations in most months in all water-year types except during the spring period (Figure 5.B.4-2). Relative to EBC scenarios, the evaluated starting operations had similar, slightly lower, or slightly higher average south Delta exports in April and May.

<table>
<tr><th></th><th>Total South Delta Exports</th><th>Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC1 (Current)</th></tr>
<tr><td>Wet</td><td>
</td><td>
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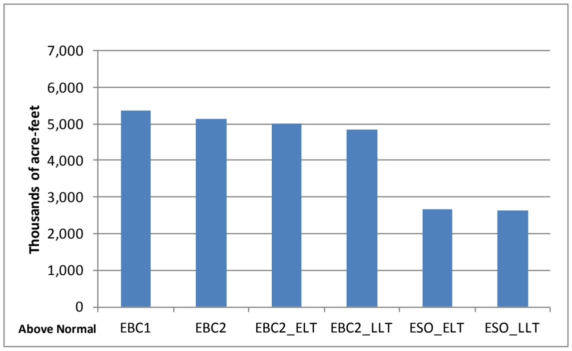
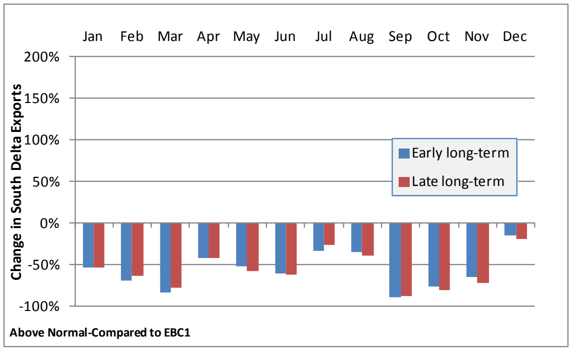
<tr><td>Above Normal</td><td>
</td><td>
</td></tr>
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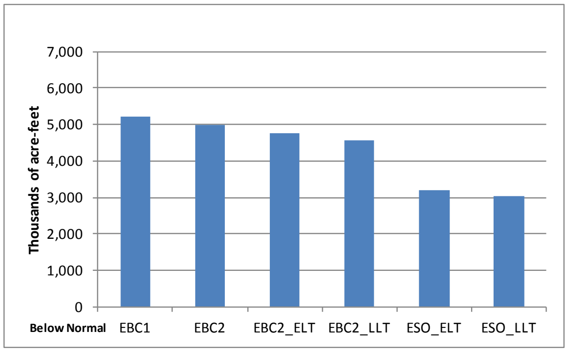
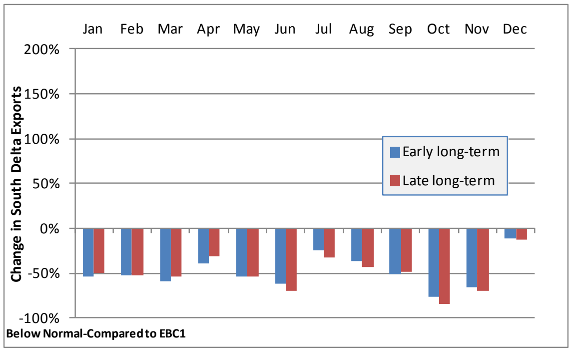
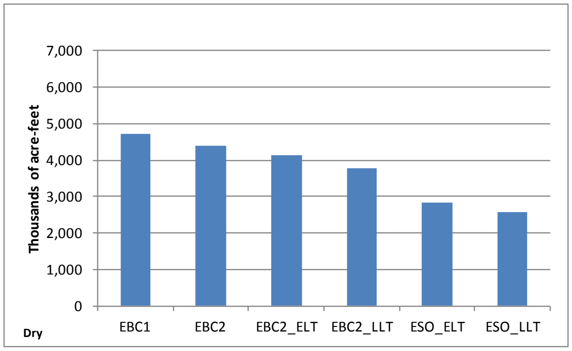
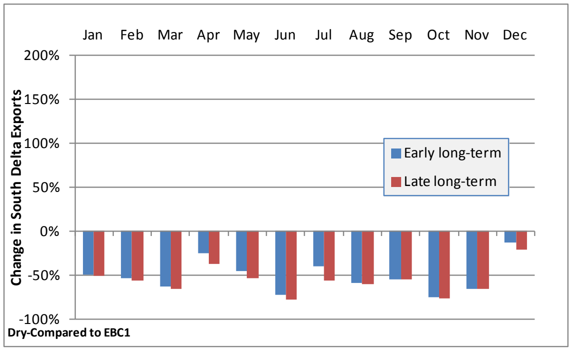
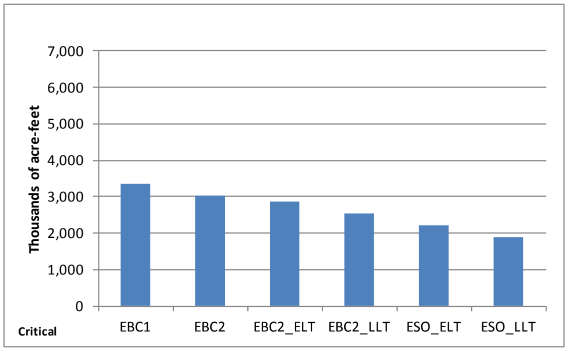
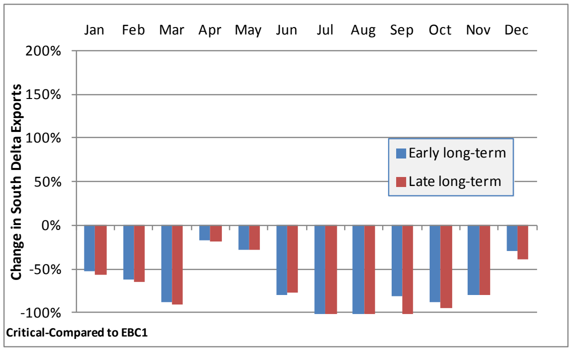
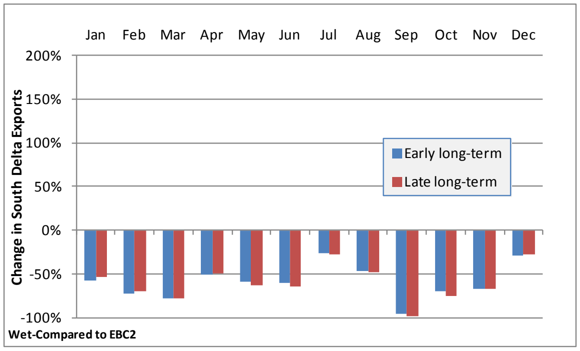
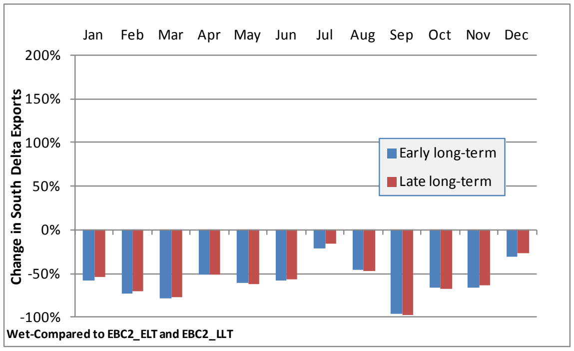
	Total South Delta Exports	Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC1 (Current)
Below Normal		
Dry		
Critical		

	Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC2 (Current)	Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC2_ELT and EBC2_LLT
Wet		

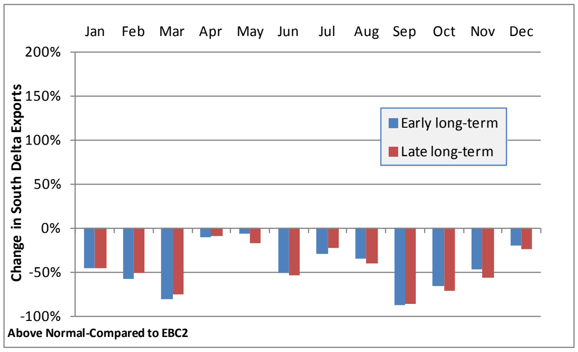
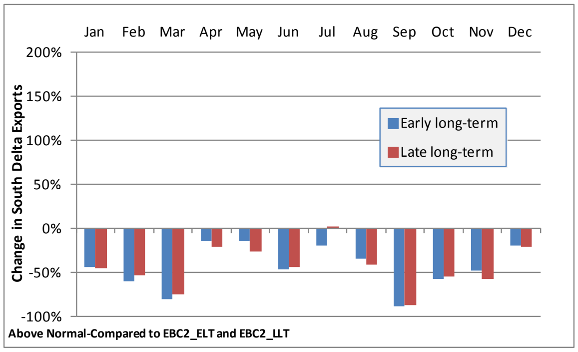
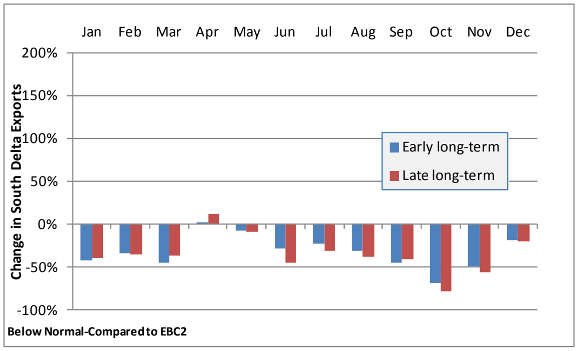
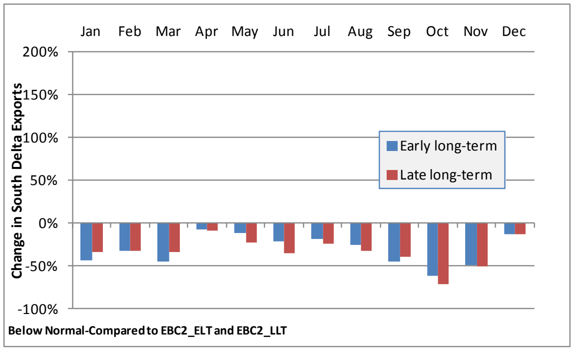
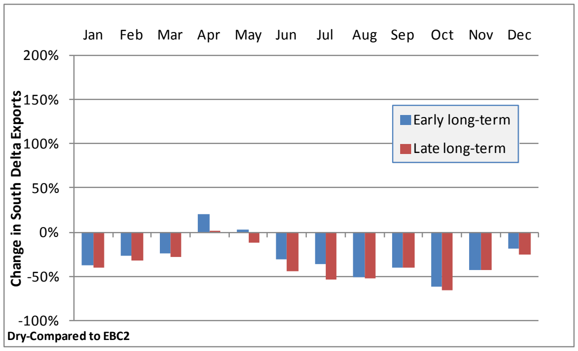
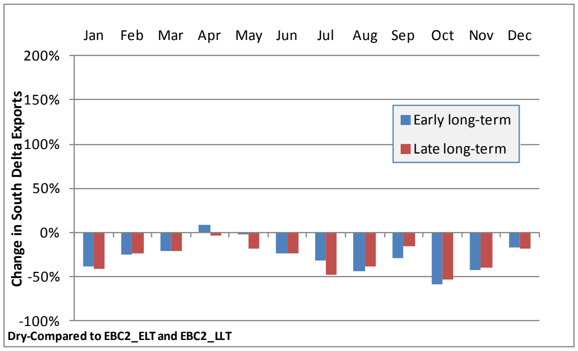
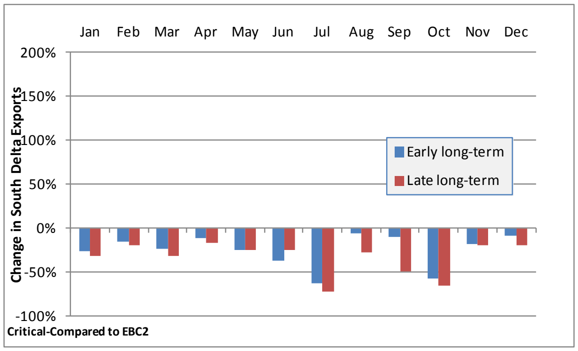
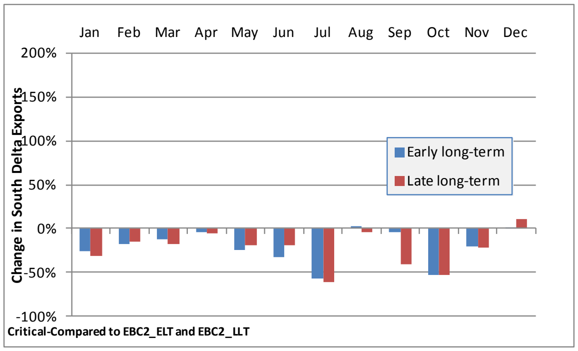
	Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC2 (Current)	Evaluated Starting Operations (ESO_ELT and ESO_LLT) compared to EBC2_ELT and EBC2_LLT
Above Normal	 Above Normal-Compared to EBC2	 Above Normal-Compared to EBC2_ELT and EBC2_LLT
Below Normal	 Below Normal-Compared to EBC2	 Below Normal-Compared to EBC2_ELT and EBC2_LLT
Dry	 Dry-Compared to EBC2	 Dry-Compared to EBC2_ELT and EBC2_LLT
Critical	 Critical-Compared to EBC2	 Critical-Compared to EBC2_ELT and EBC2_LLT

Figure 5.B.4-2. Percentage Change in South Delta Export Pumping under the Evaluated Starting Operations (ESO) Compared to Existing Biological Conditions (EBC)

5.B.4.3 Old and Middle River Flows

Changes to flow in OMR under the BDCP reflect changes in water export from the south Delta pumps discussed above. Pumping from the SWP/CVP facilities can reverse the normative average northerly flow in OMR and create an average southward flow toward the pumps. By convention, a positive OMR flow is the normative northern flow towards the San Francisco estuary while a negative OMR flow is reversed toward the pumping facilities. OMR flows, as discussed here, are tidally averaged. The amount and direction of OMR flow is important because of its relationship to entrainment of fish in the SWP and CVP facilities (Kimmerer 2008; Baxter et al. 2010). Under some conditions, such as high levels of turbidity, fish can be drawn toward the pumps by negative OMR flow.

Under baseline scenarios (EBC), OMR flows reflect limits imposed in the USFWS (2008) and NMFS (2009) BiOps that are applied through a real-time operations framework during the January to June period. Generally, OMR flow cannot be below (i.e., more negative) -5,000 cfs toward the south Delta export facilities during these months. Under other cases, the OMR flows can be restricted to greater than -2,000 cfs. There are no OMR restrictions in the July–December period. As a result of these restrictions, OMR flow in EBC1 and EBC2 base conditions from the January through June period is less negative (less movement toward the pumps) compared to the summer and fall periods when OMR becomes strongly negative in all water-year conditions (but many covered fish species are not in the vicinity of the south Delta facilities during these months). OMR flow is more strongly negative in the winter months under EBC1 compared to EBC2 because of flow restrictions during winter under the BiOps related to the position of X2.

Under the evaluated starting operations, average OMR flows generally are more positive in most months under all water-year conditions compared to existing biological conditions (Figure 5.B.4-3). This difference between the evaluated starting operations and the existing biological condition decreases in the drier water-year conditions as the system relies more heavily on the south Delta pumps. Under the wet water-year condition, the evaluated starting operations has appreciably greater average positive OMR flow relative to the existing biological conditions and results in strongly positive flow during the winter and spring period. However, in most water-year types except for wet and critical, the evaluated starting operations has somewhat lower (generally around 500–1,000 cfs) average OMR flows during the spring period (April and May) than existing biological conditions. This is the result of greater exports from the south Delta facilities during April and May under the evaluated starting operations (Figure 5.B.4-3). Average OMR flows under ESO scenarios in April–May range from around -1,400 cfs (ESO_ELT of dry years) to 2,200–2,300 cfs (ESO_ELT and ESO_LLT of wet years). Average OMR flows under EBC scenarios in April–May range from around -900 to -1,000 cfs (critical years) to 1,400–2,400 cfs (wet years).

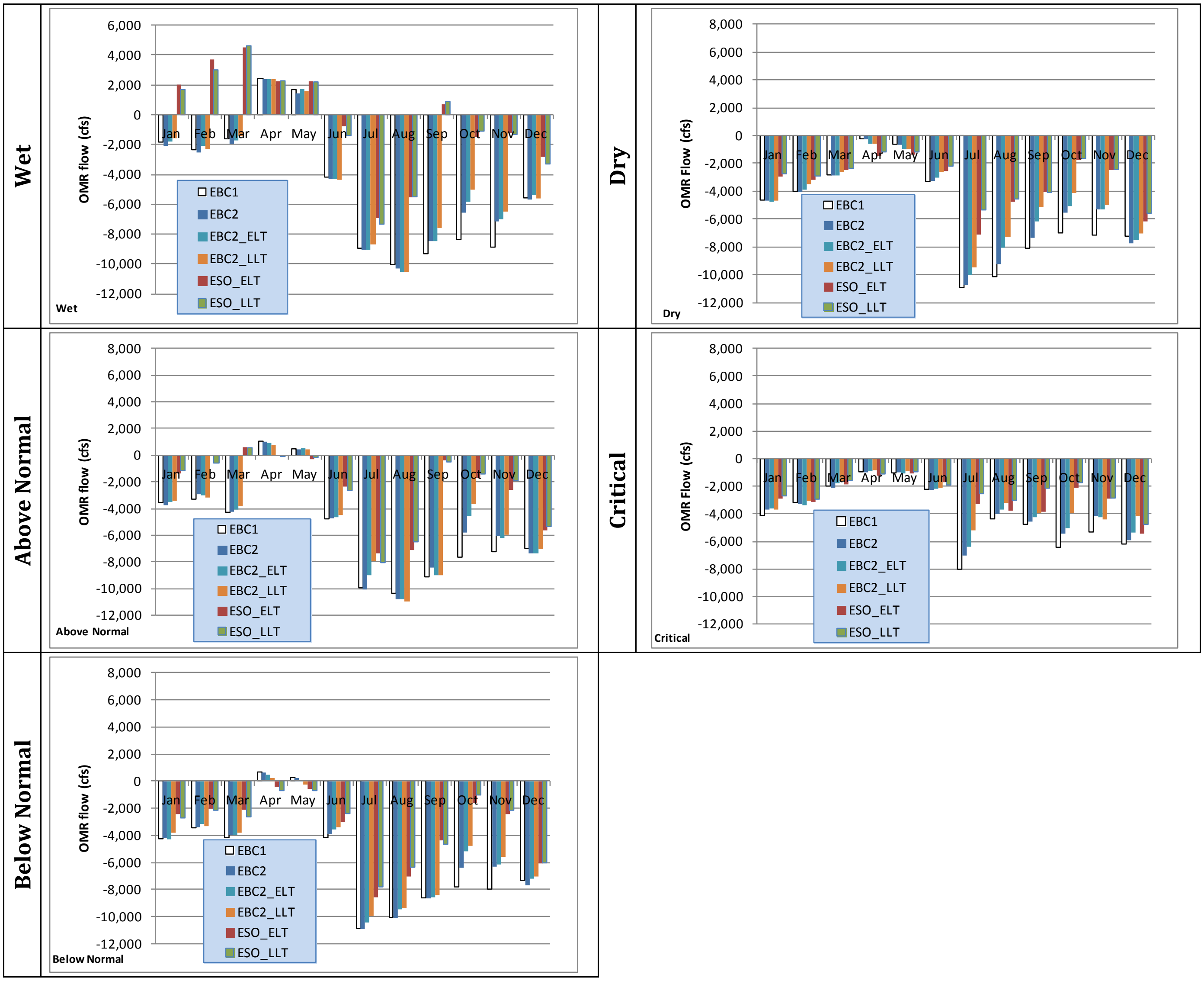


Figure 5.B.4-3. Flow (cfs) in Old and Middle Rivers under Existing Biological Conditions (EBC) and Evaluated Starting Operations (ESO) in the Early Long-Term (ELT) and Late Long-Term (LLT) Periods

5.B.4.4 Overall Difference in SWP/CVP Exports under the BDCP

Based on CALSIM analysis, the evaluated starting operations result in a greater amount of water exported from the Delta by the SWP and CVP projects (Figure 5.B.4-4). These changes vary across water-year types. On average, more water would be exported under the evaluated starting operations in wet, above-normal, and below-normal water-year types than under existing biological conditions, whereas similar or lower exports would occur under the evaluated starting operations in dry and critical years. Climate change was projected to reduce the amount of water exported, as shown by the progressively lower exports from EBC2 to EBC2_ELT to EBC2_LLT (i.e., from current conditions through 2025 and ultimately 2060). This is because of changes in water availability and the need to maintain water quality standards in the Delta in the face of rising sea level.

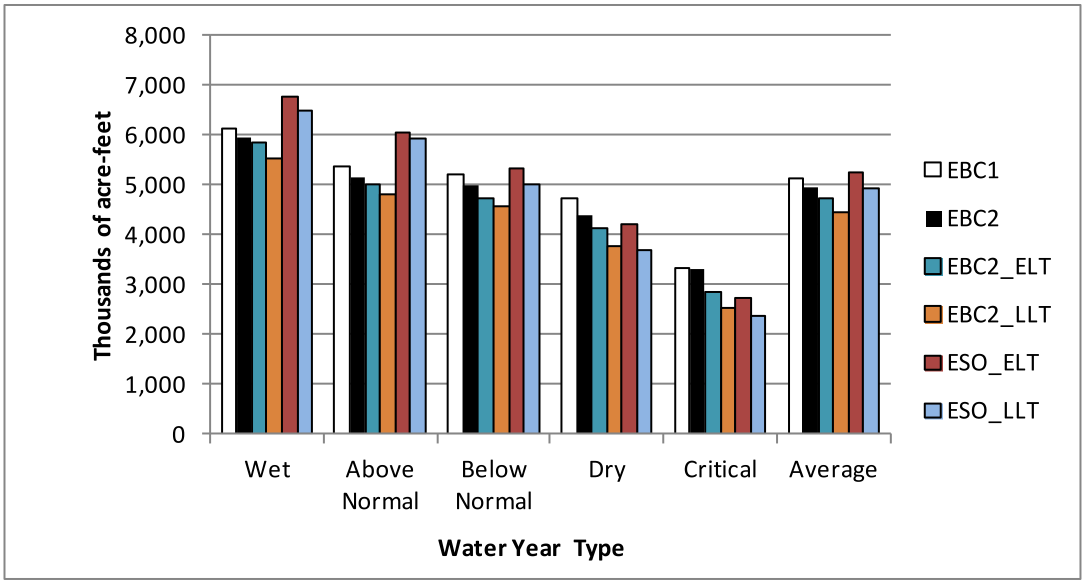


Figure 5.B.4-4. Total Exports from Combined North Delta and South Delta Pumping Facilities under the BDCP Evaluated Starting Operations (ESO) in the Early Long-Term (ELT) and Late Long-Term (LLT) Compared to the Existing Biological Condition (EBC) Baselines

5.B.4.5 Differences Between Evaluated Starting Operations, High-Outflow Scenario, and Low-Outflow Scenario

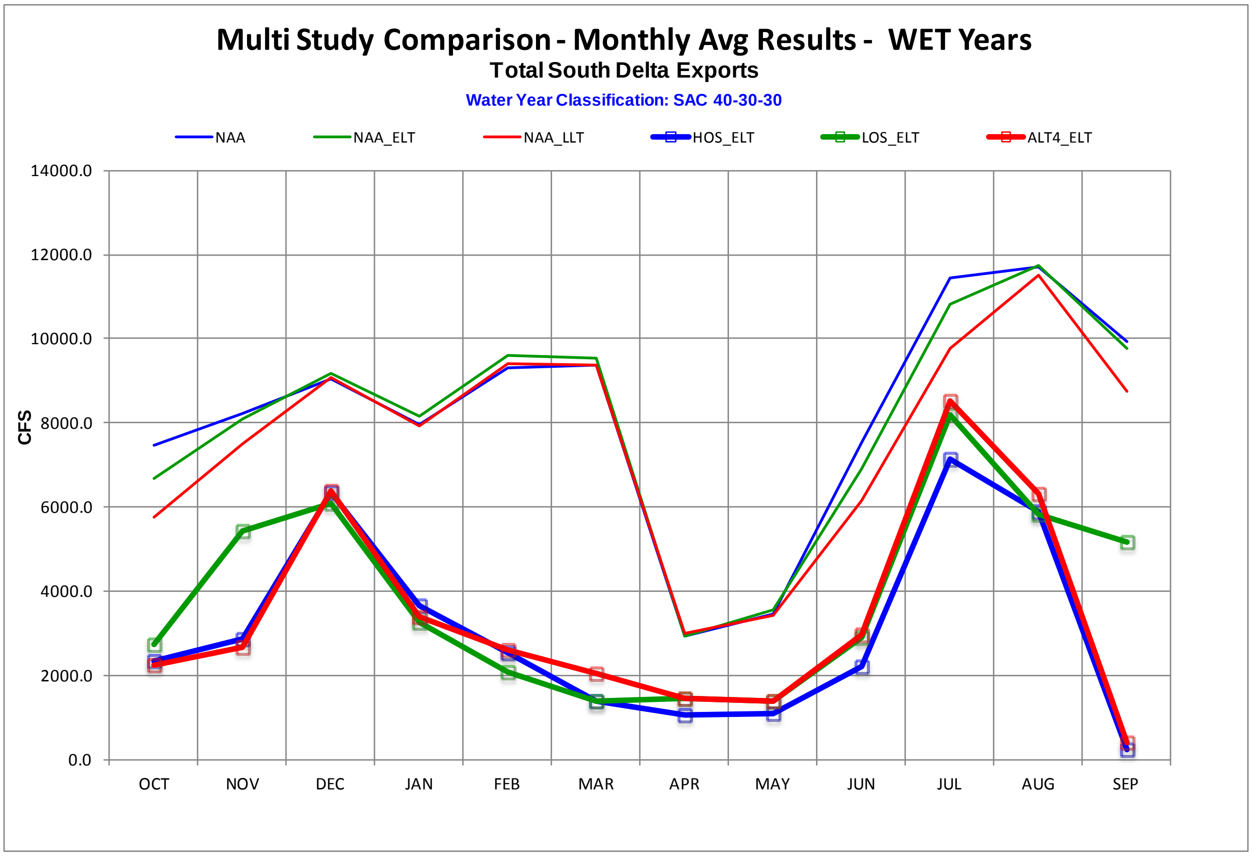
Figure 5.B.4-5 through Figure 5.B.4-34 show average monthly south Delta exports, Old and Middle River flows, and north Delta exports by water-year type for EBC2, EBC2_ELT, EBC2_LLT, ESO_ELT, and ESO_LLT; in addition, the high-outflow scenarios (HOS_ELT and HOS_LLT) and low-outflow scenarios (LOS_ELT and LOS_LLT) are presented. Note that water-year type follows the Sacramento Valley 40-30-30 classification and that the new water year begins in October; therefore, the October–December fall months are in the subsequent year to the first fall month (September). This means that the data do not reflect the management period used for the Fall X2 USFWS (2008) BiOp RPA, wherein the months of October–November receive flows based on the previous water year's designation.

Relative differences between ESO, HOS and LOS scenarios in exports or flows generally are consistent between the ELT and LLT time periods. Relative to ESO, the HOS and LOS scenarios generally have similar (LOS) or lower (HOS) average monthly south Delta exports from December to summer (June/July) in all water year types (Figures B.4-1 through B.4-14). Average south Delta exports under LOS scenarios are appreciably greater than the ESO scenarios in September of wet and above normal years (reflecting the lack of a Fall X2 outflow under the LOS) and are also greater in November of all water years (again, reflecting Fall X2 differences, but this time spread across all water years because of the water-year classification discussed above). Average LOS July south Delta exports in dry years are somewhat greater (~1,000 cfs) than ESO scenarios. Average HOS August south Delta exports were around 500–1,000 cfs greater than ESO flows.

Differences in average monthly OMR flows between scenarios (Figure 5.B.4-15 through Figure 5.B.4-24) reflect differences between scenarios in south Delta exports. During the main period of

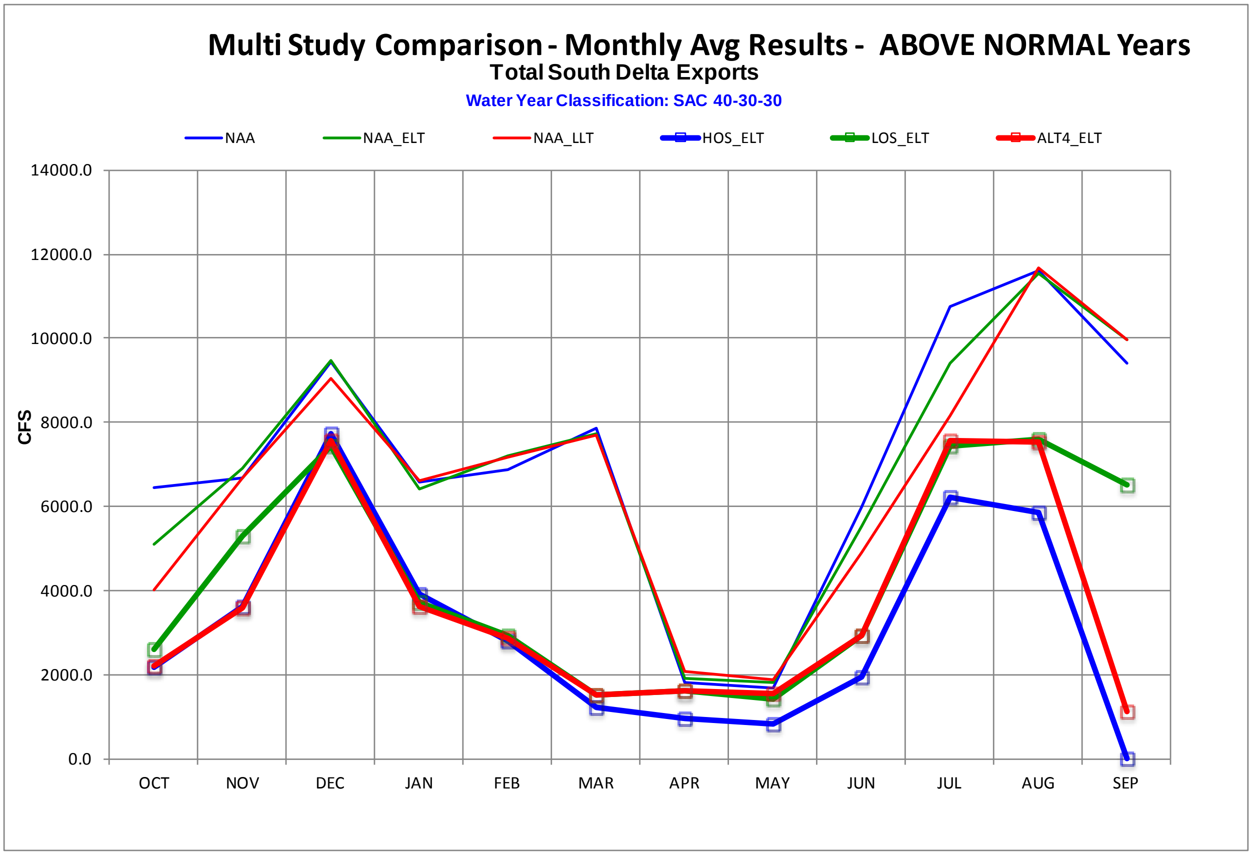
OMR regulation under the USFWS (2008) and NMFS (2009) BiOps (December–June), there is little difference between ESO and LOS scenarios in OMR flows. HOS scenarios have OMR flows similar to or greater than LOS and HOS scenarios, with the main differences occurring in March–May of above normal, below normal, and dry years, reflecting the greater spring outflow.

HOS scenarios generally have around 500–3,000 cfs lower average north Delta exports than the other scenarios during March–June of most water year types, except for critical water years, where there is relatively little difference between scenarios during these months (Figure 5.B.4-25 thorugh Figure 5.B.4-34). There generally are few differences in average monthly north Delta exports between ESO and LOS scenarios, with the main differences typically occurring in the fall (September–November) months.



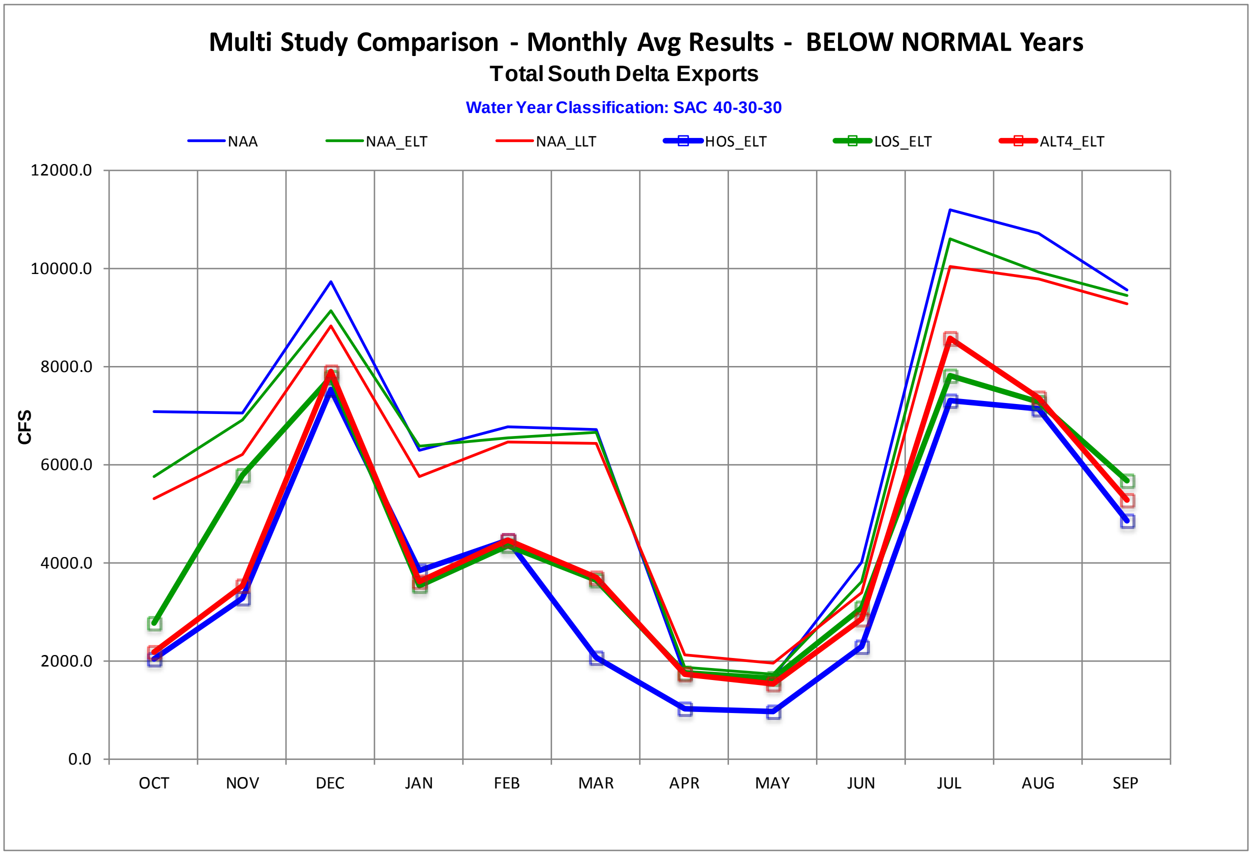
Legend nomenclature for existing biological conditions and evaluated starting operations scenarios follows BDCP EIR/EIS conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-5. Monthly Average Total South Delta Exports in Wet Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



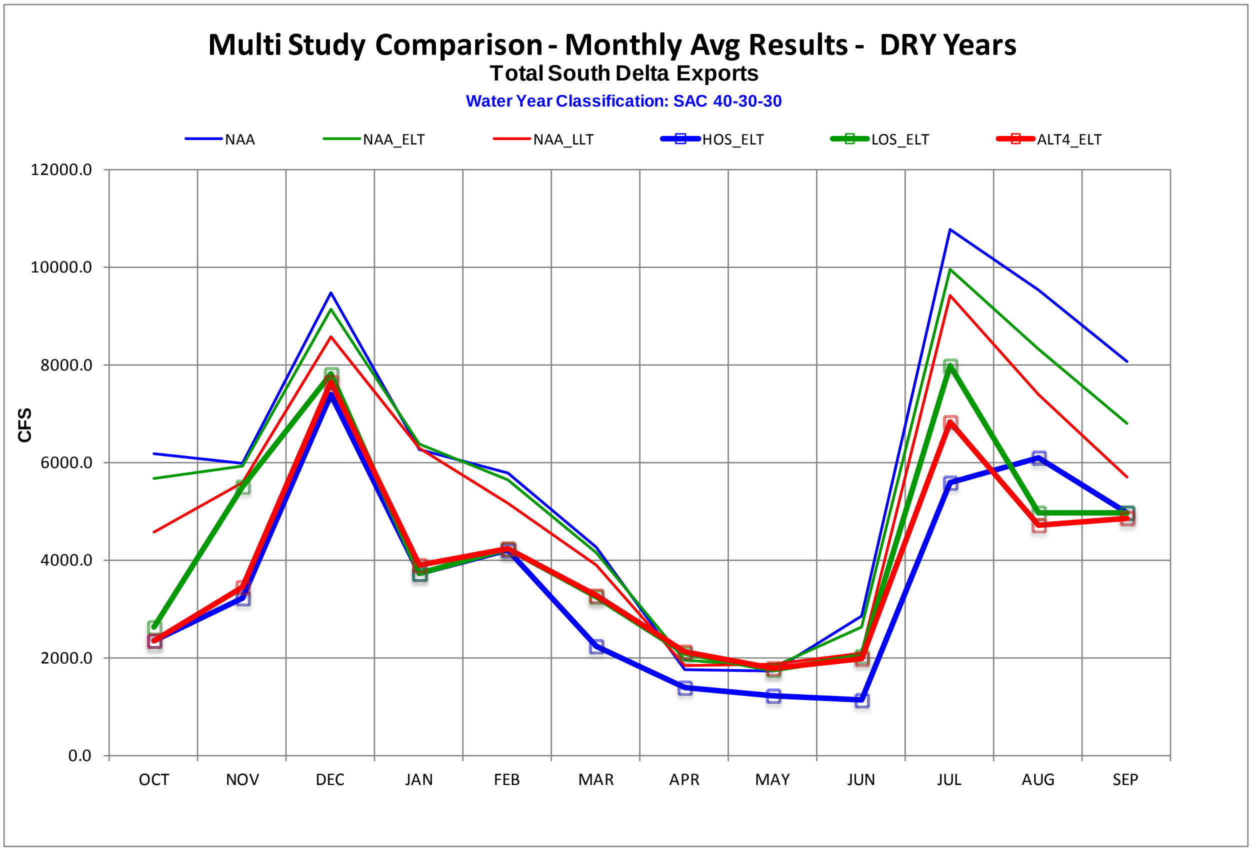
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-6. Monthly Average Total South Delta Exports in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



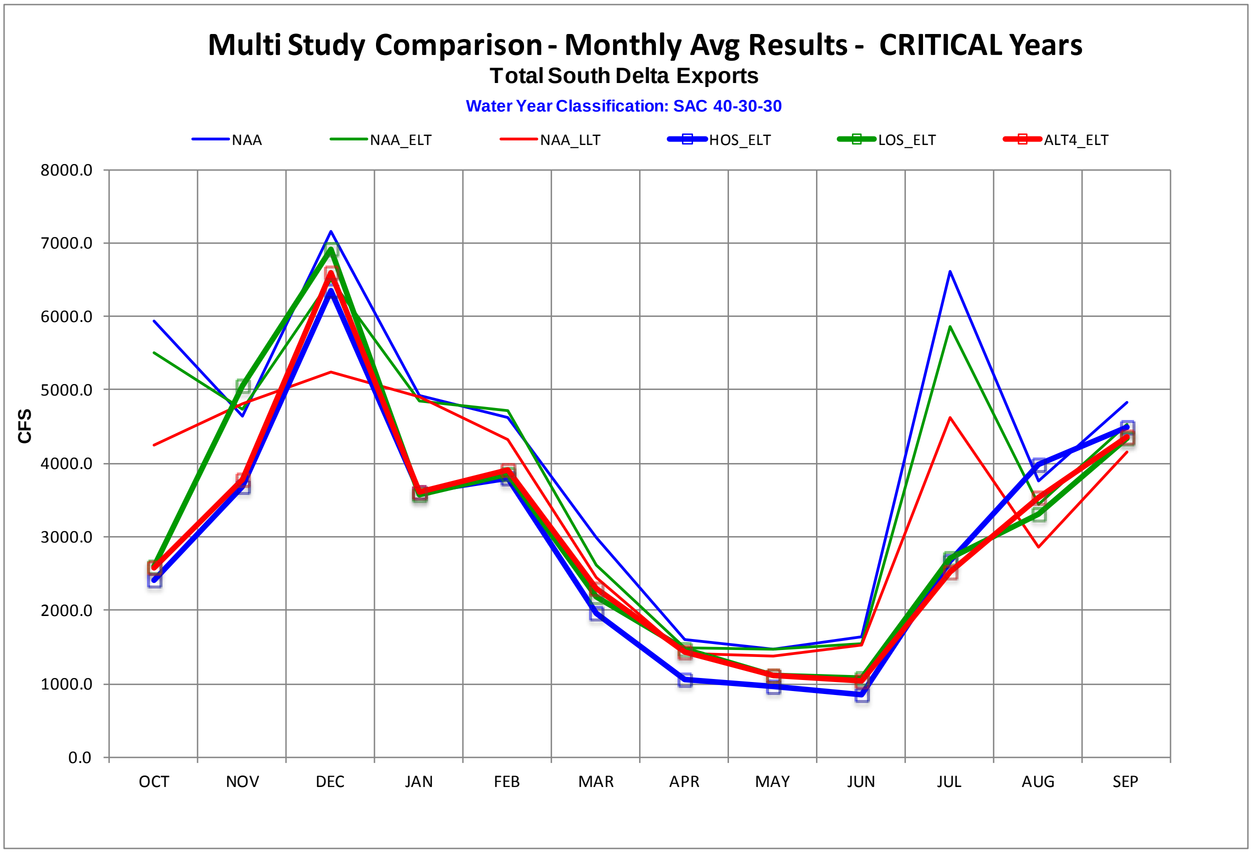
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-7. Monthly Average Total South Delta Exports in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



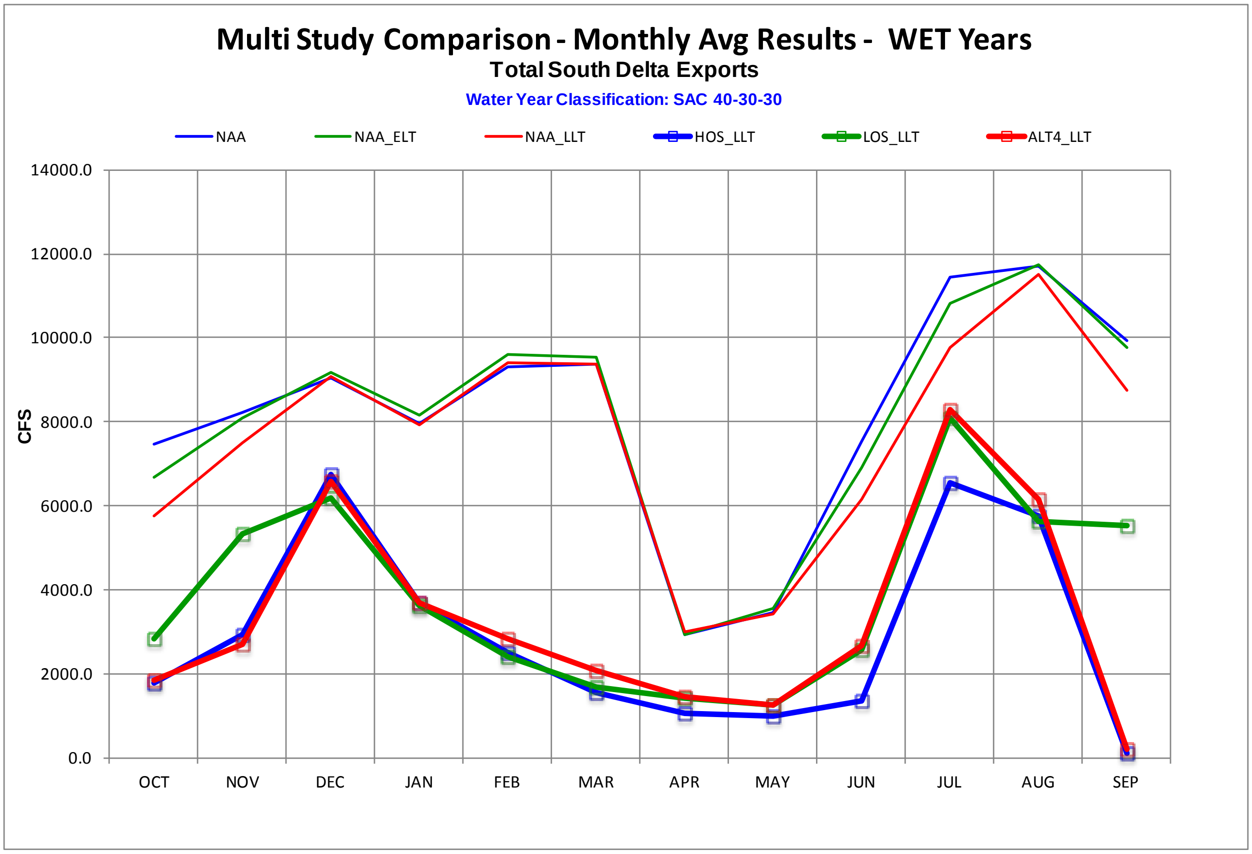
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-8. Monthly Average Total South Delta Exports in Dry Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



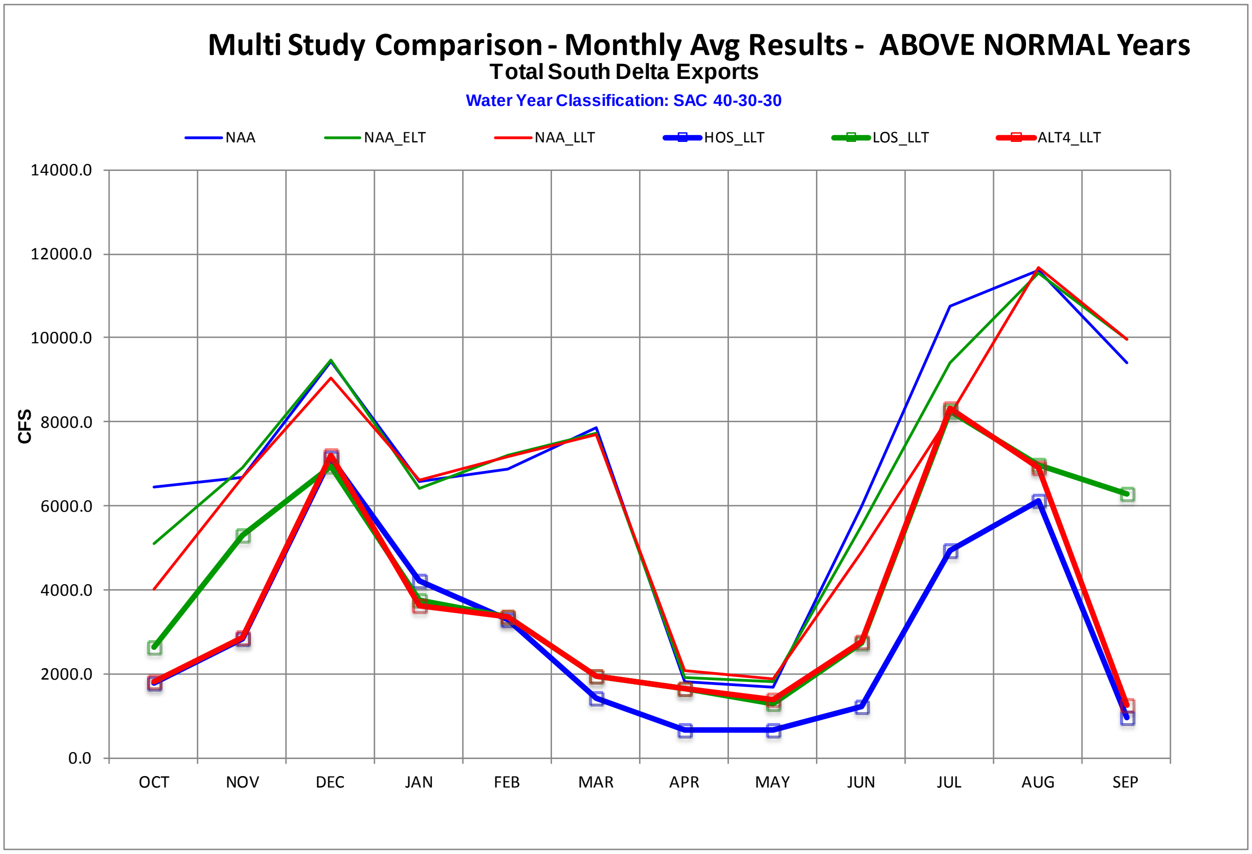
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-9. Monthly Average Total South Delta Exports in Critical Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



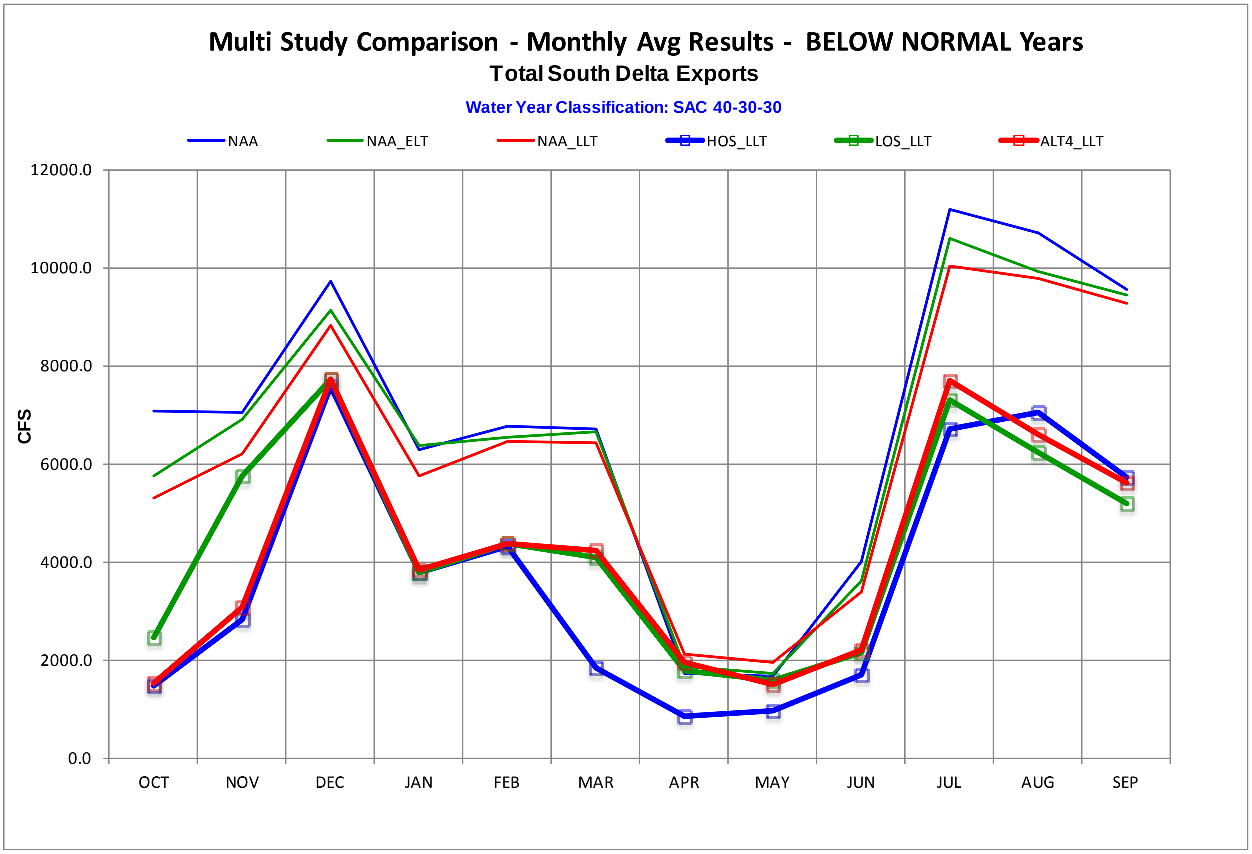
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-10. Monthly Average Total South Delta Exports in Wet Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



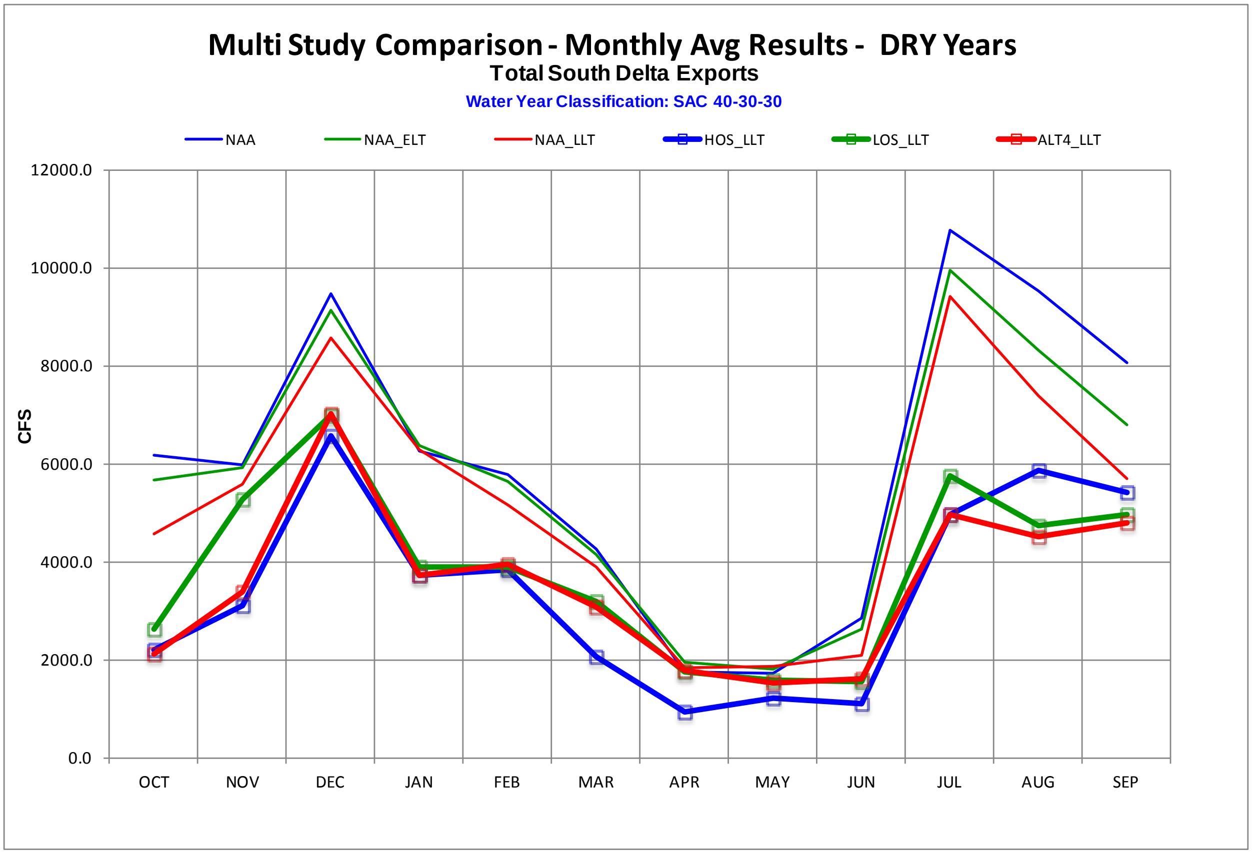
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-11. Monthly Average Total South Delta Exports in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



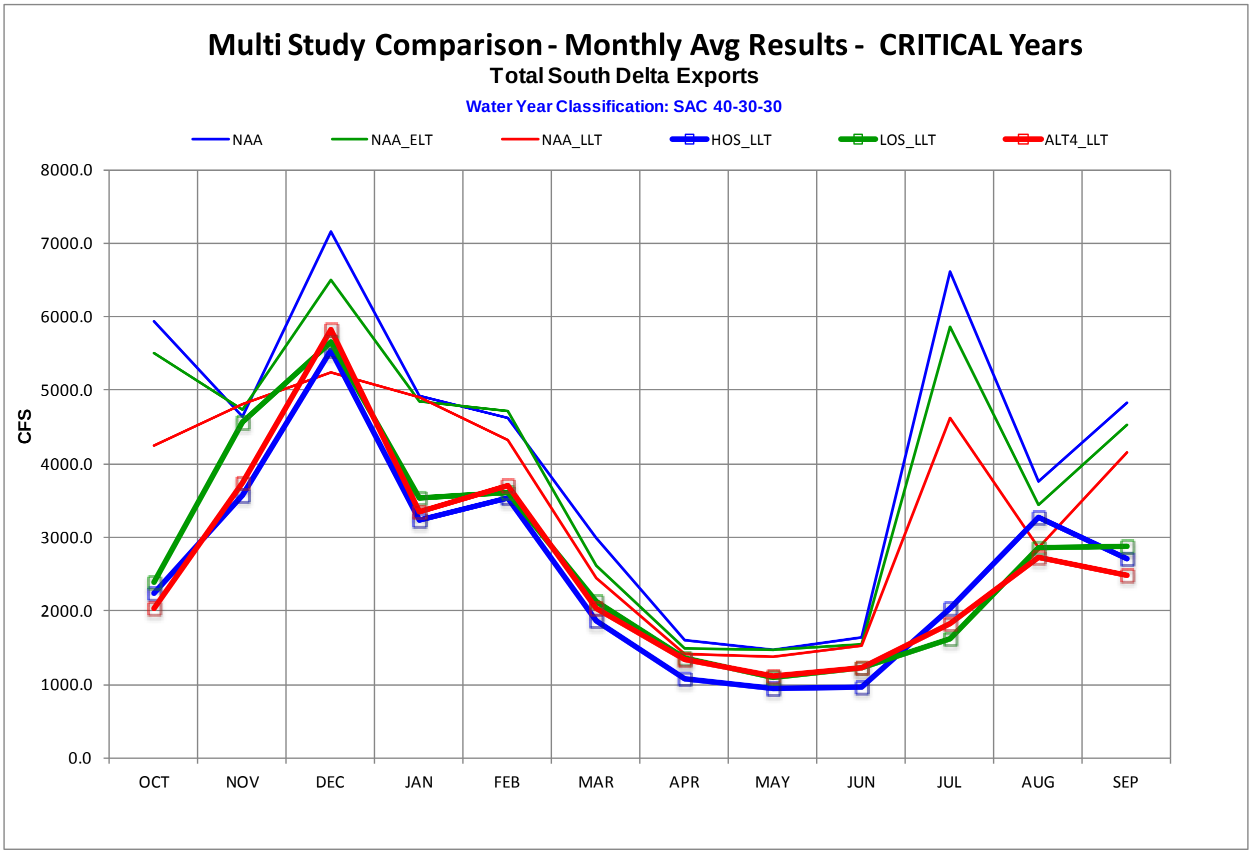
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-12. Monthly Average Total South Delta Exports in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



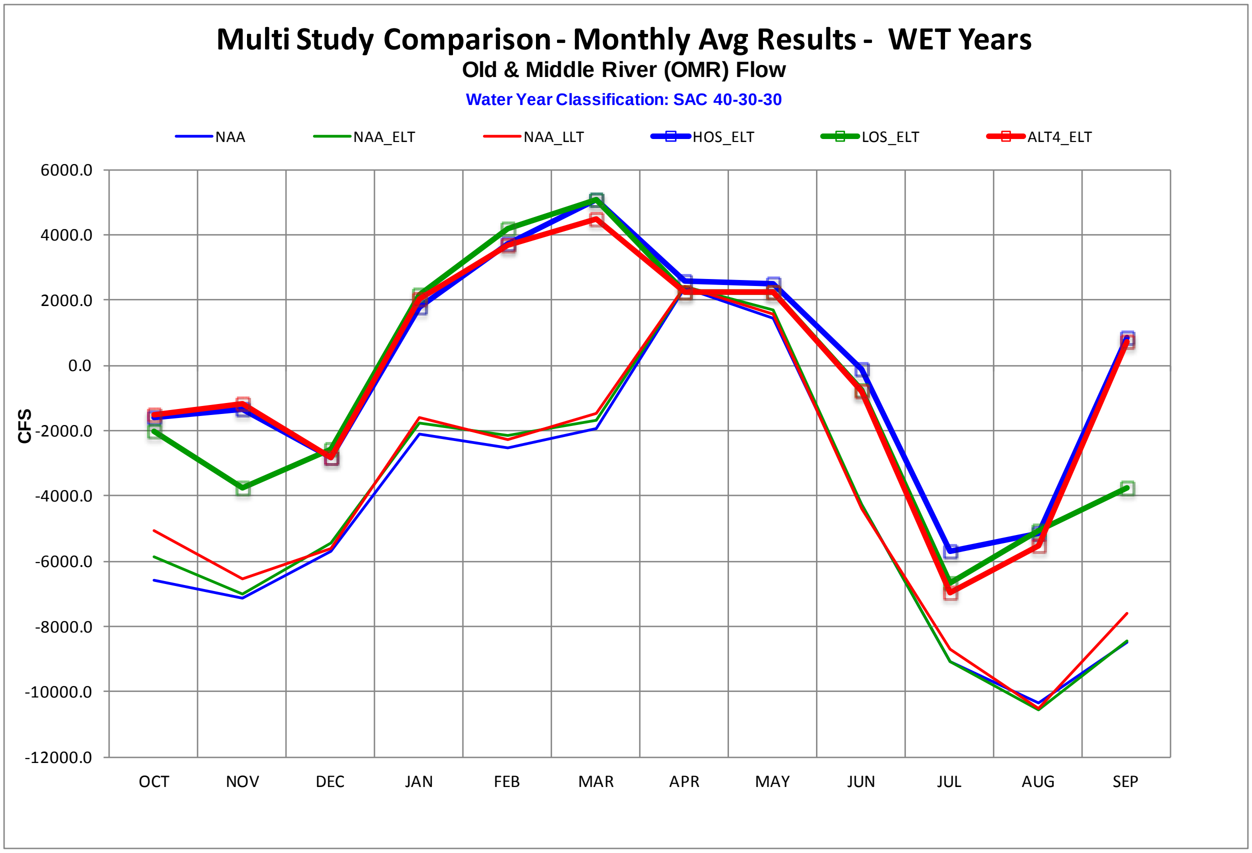
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-13. Monthly Average Total South Delta Exports in Dry Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



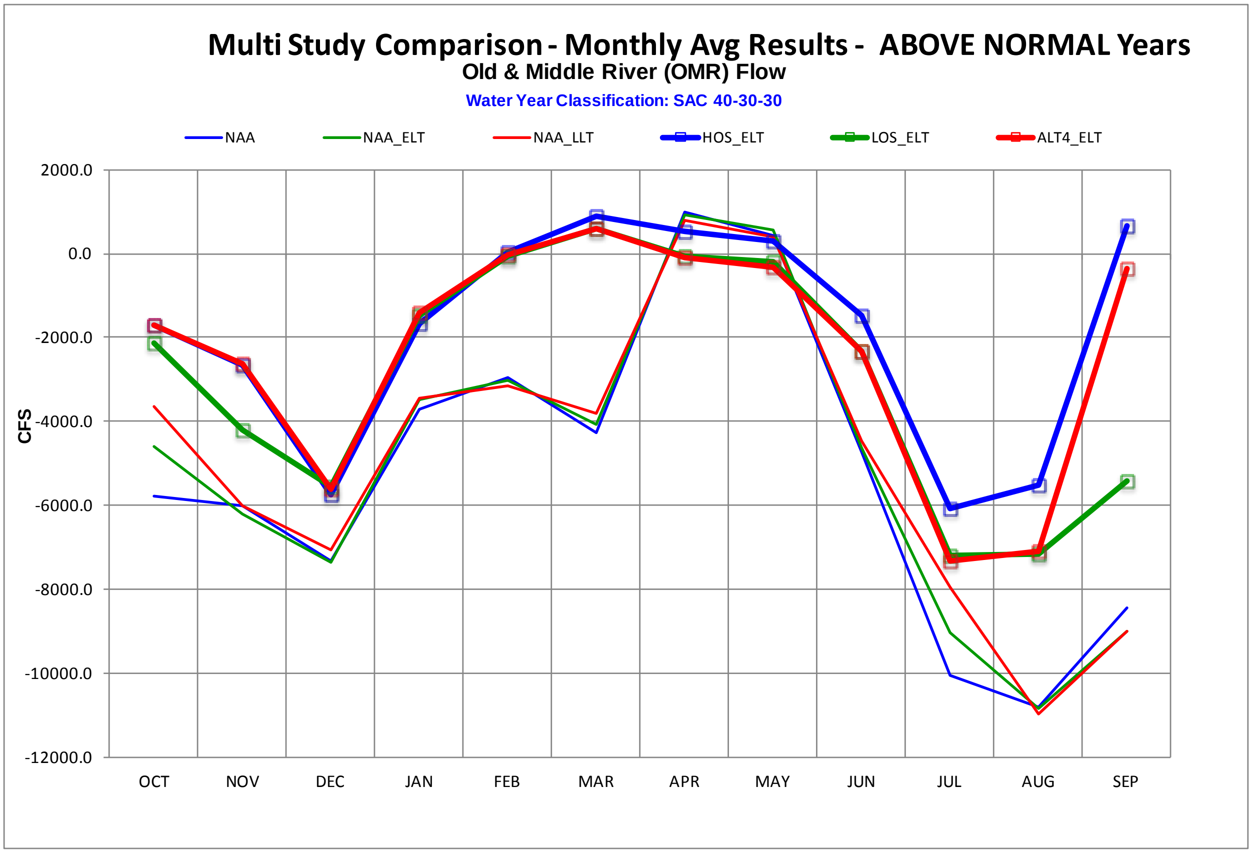
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-14. Monthly Average Total South Delta Exports in Critical Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



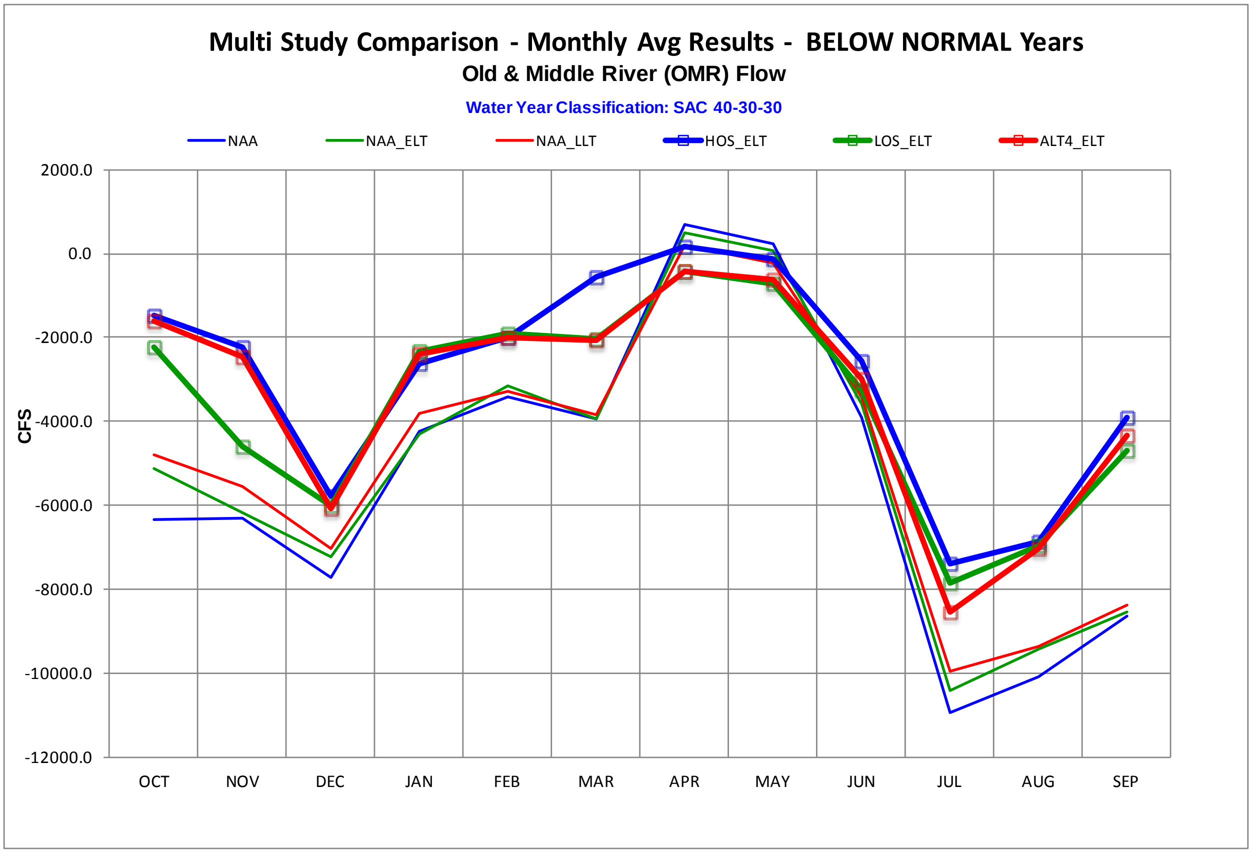
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-15. Monthly Average Old and Middle River Flows in Wet Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



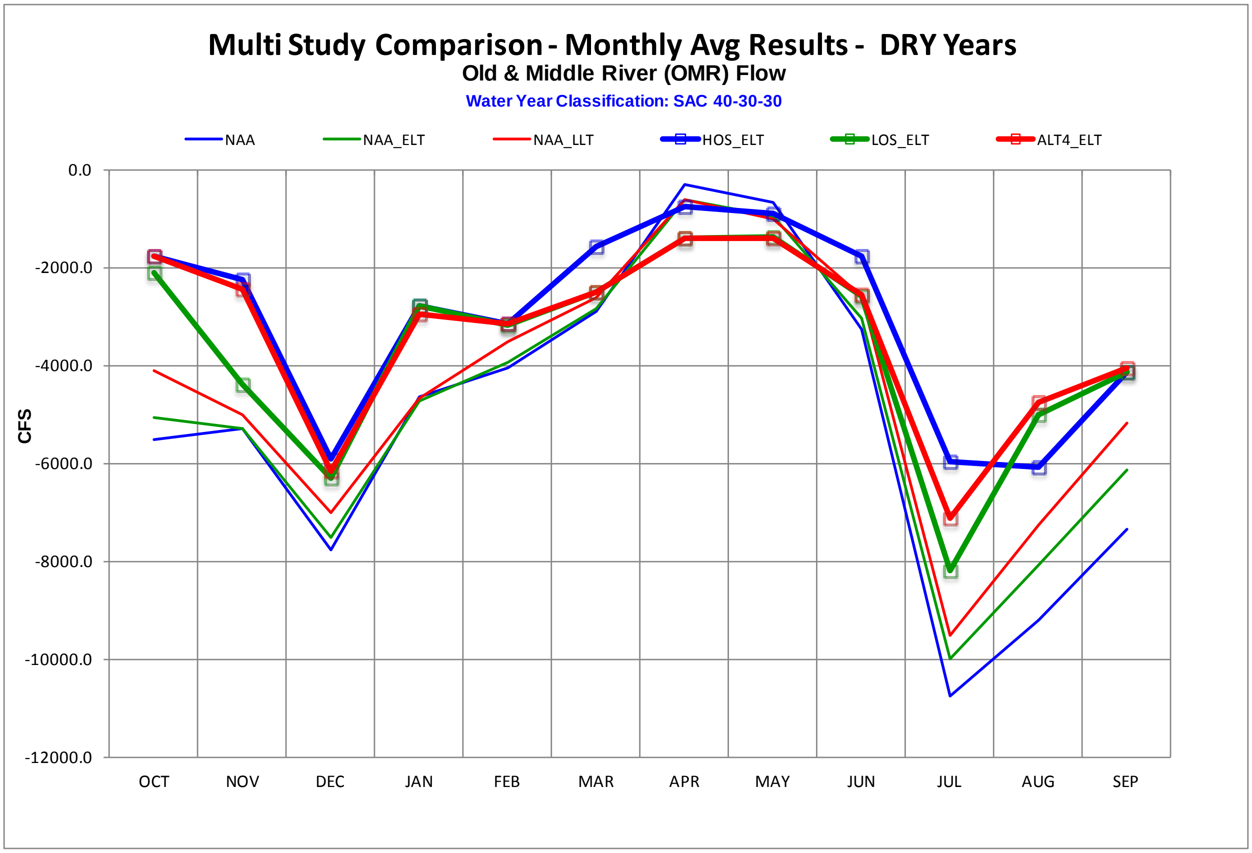
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-16. Monthly Average Old and Middle River Flows in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



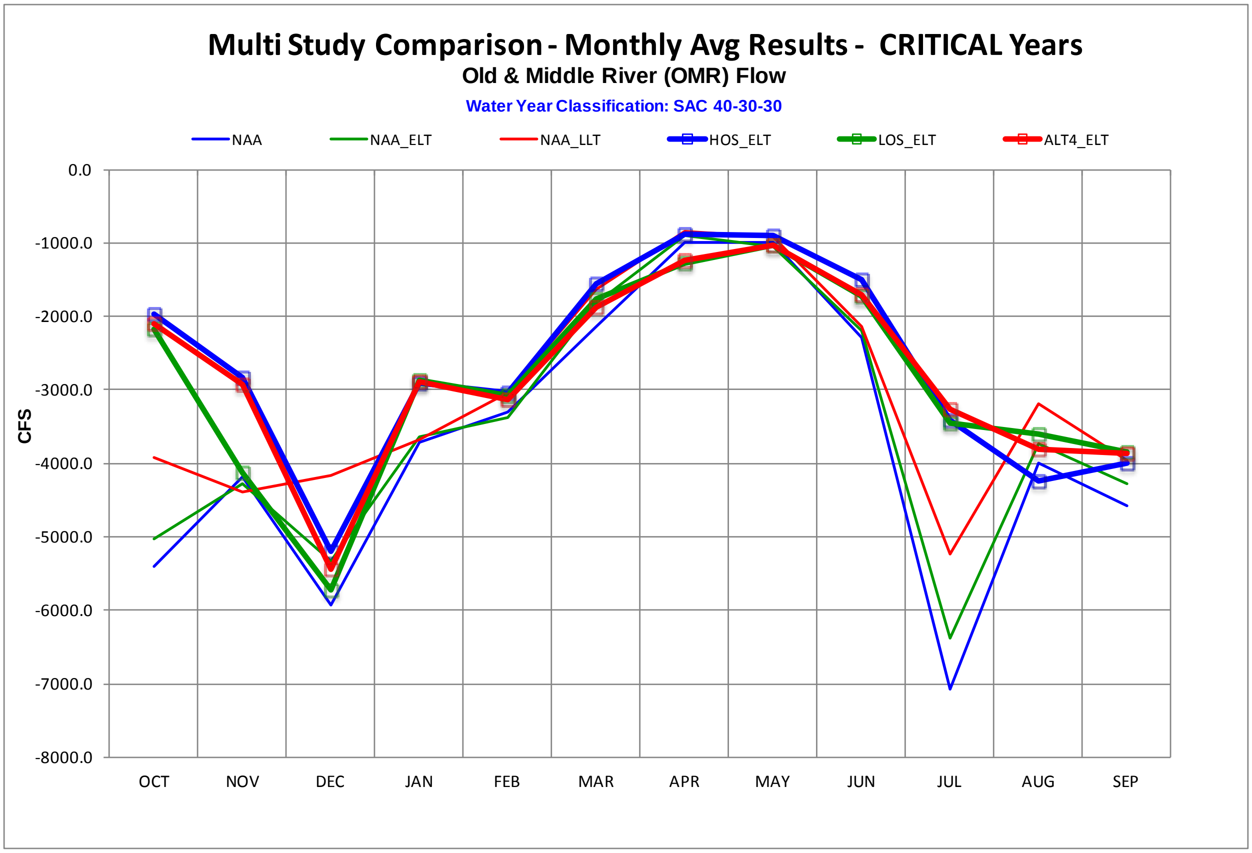
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-17. Monthly Average Old and Middle River Flows in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



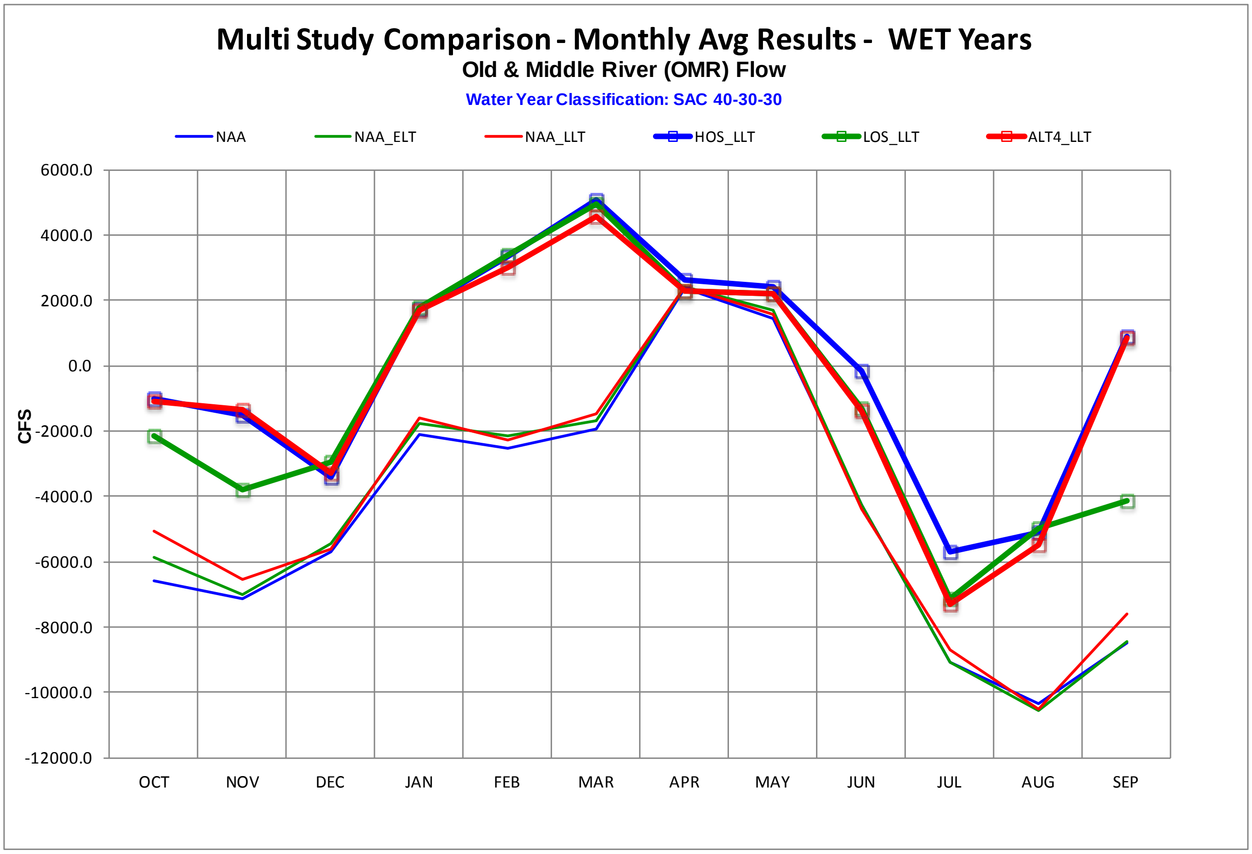
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-18. Monthly Average Old and Middle River Flows in Dry Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



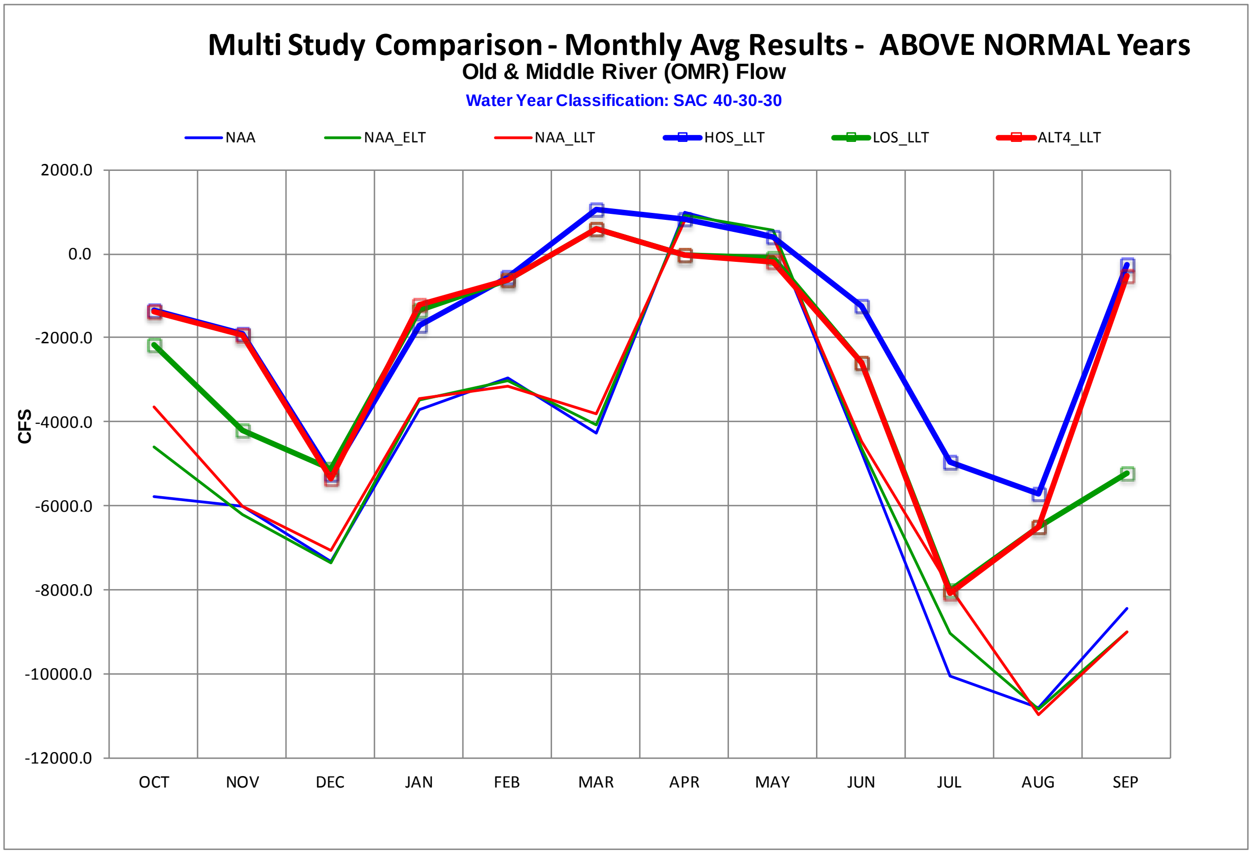
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT.

Figure 5.B.4-19. Monthly Average Old and Middle River Flows in Critical Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



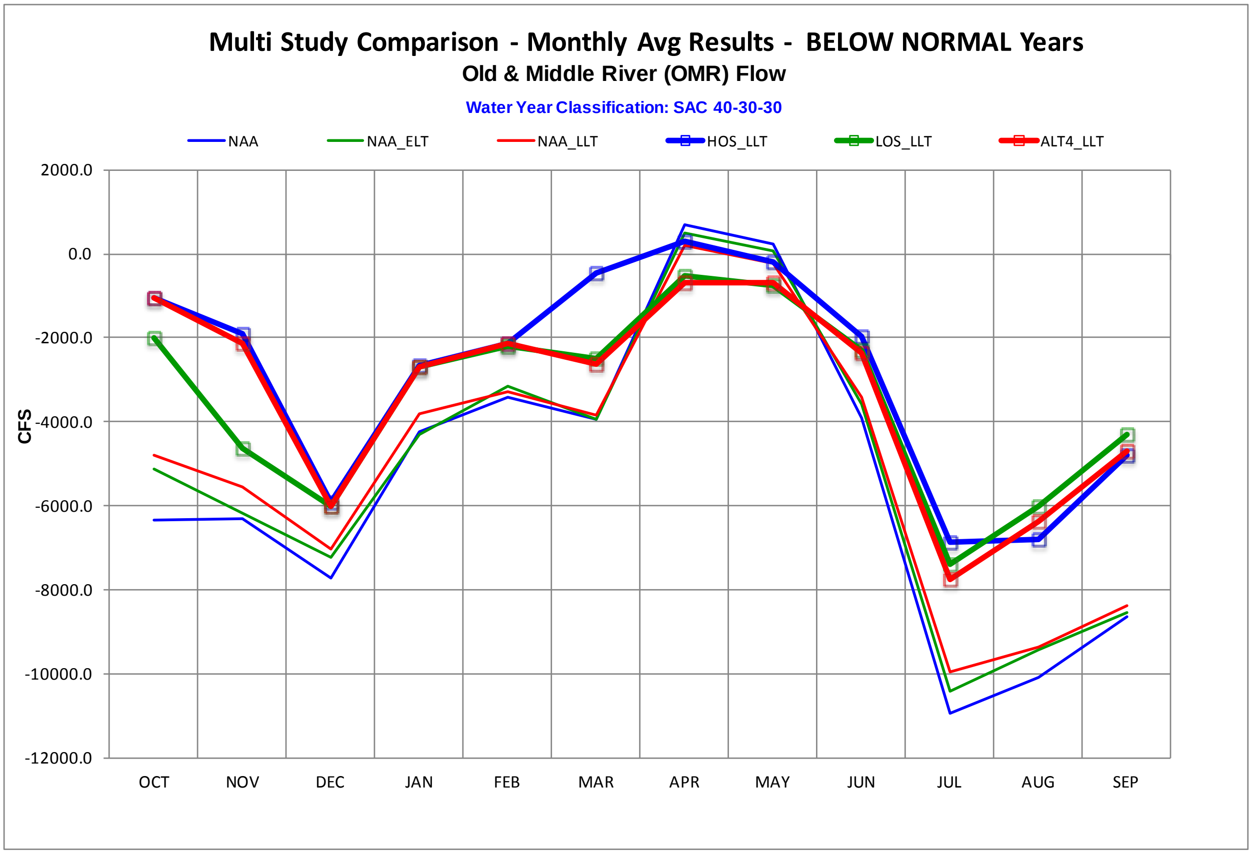
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-20. Monthly Average Old and Middle River Flows in Wet Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



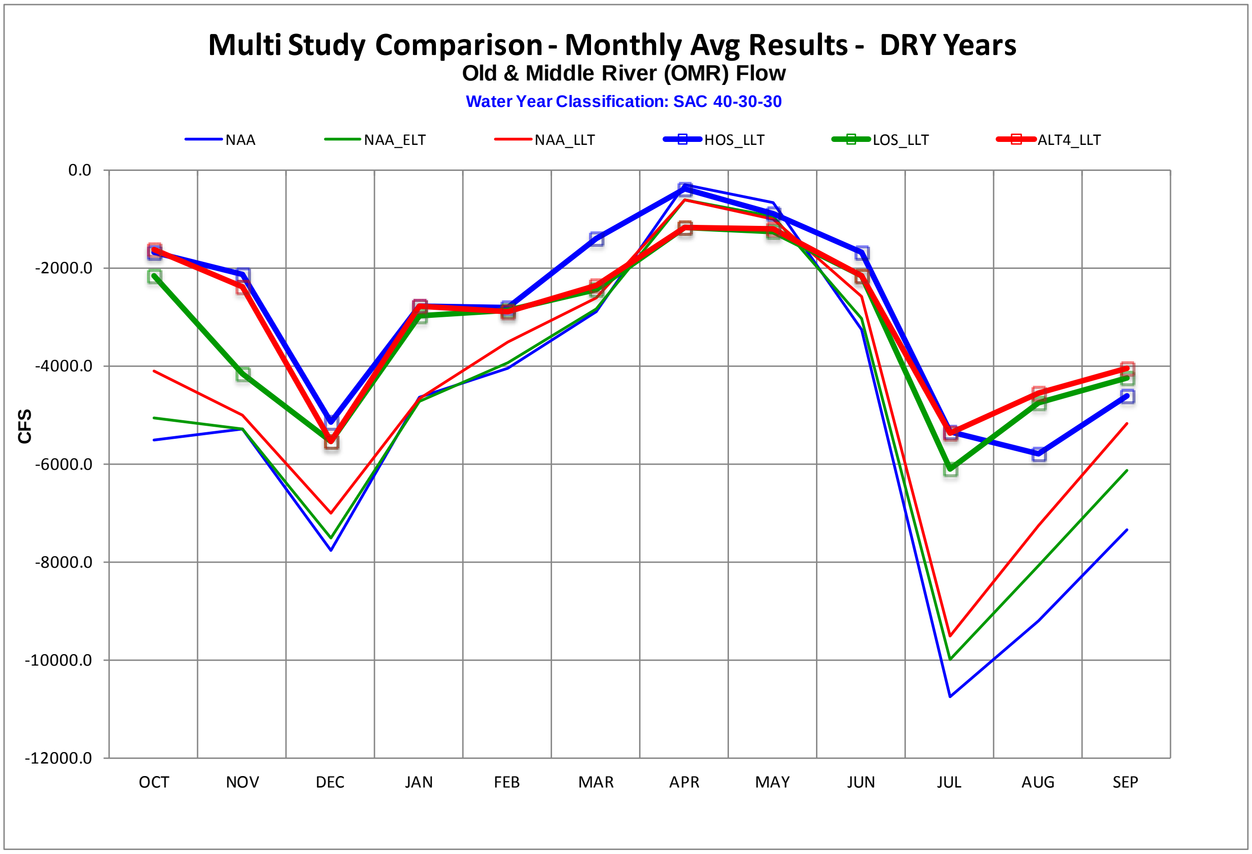
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-21. Monthly Average Old and Middle River Flows in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



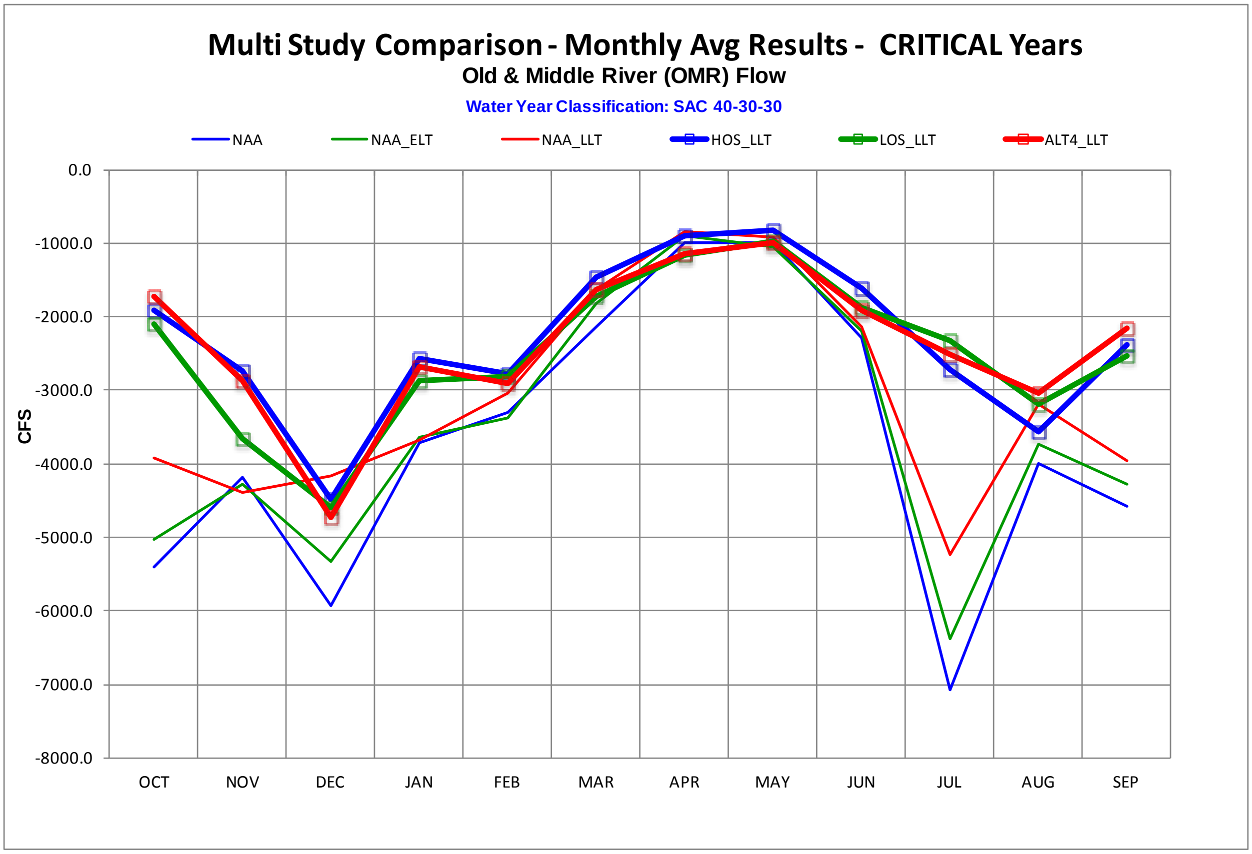
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-22. Monthly Average Old and Middle River Flows in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



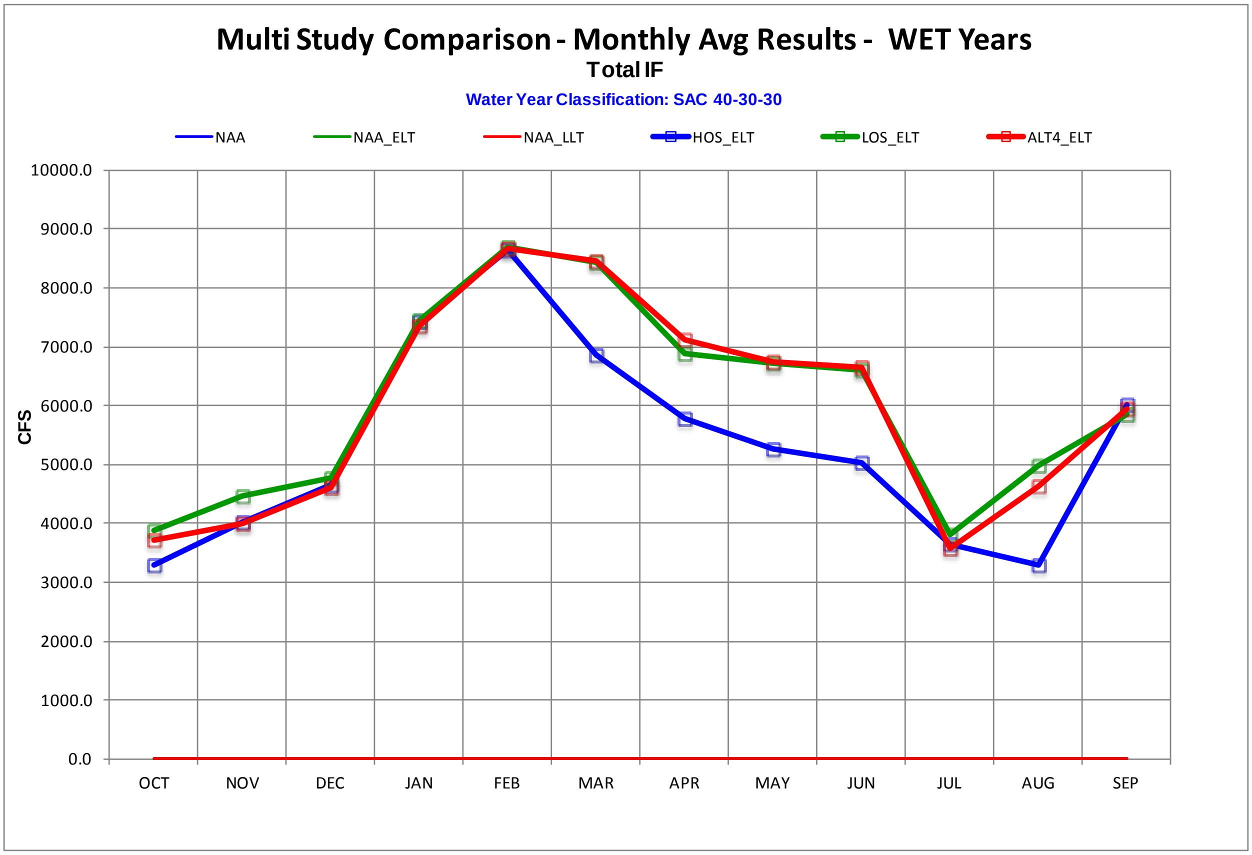
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-23. Monthly Average Old and Middle River Flows in Dry Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



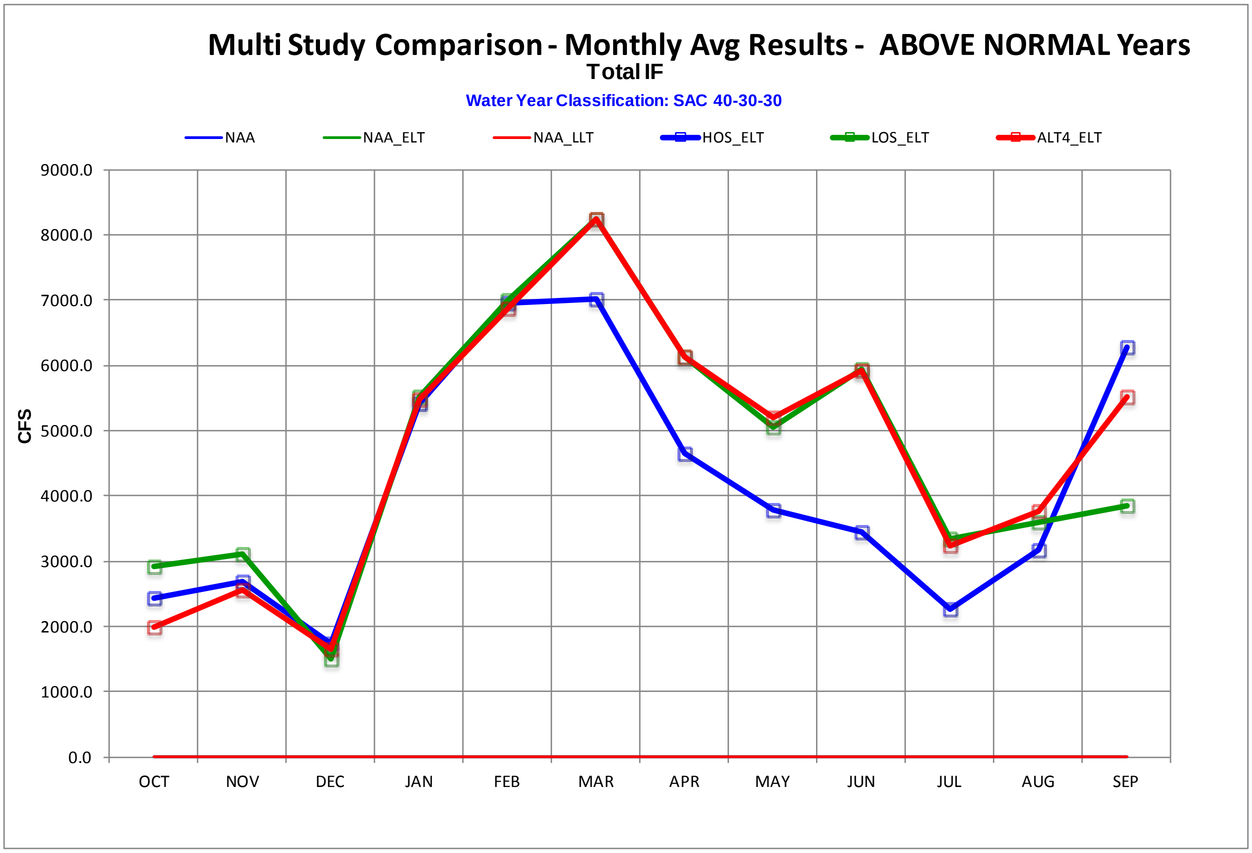
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT.

Figure 5.B.4-24. Monthly Average Old and Middle River Flows in Critical Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



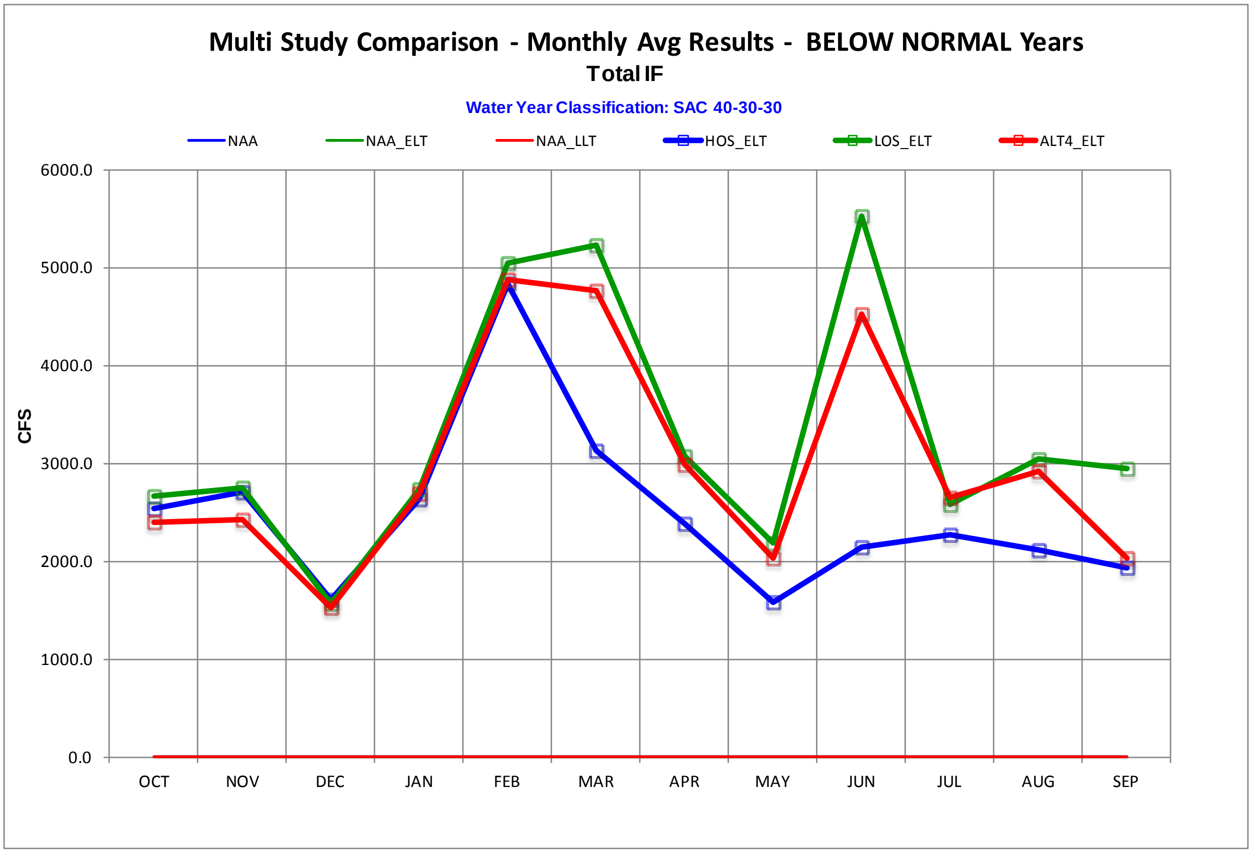
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT. Total IF = Total Isolated Facility.

Figure 5.B.4-25. Monthly Average North Delta Exports in Wet Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



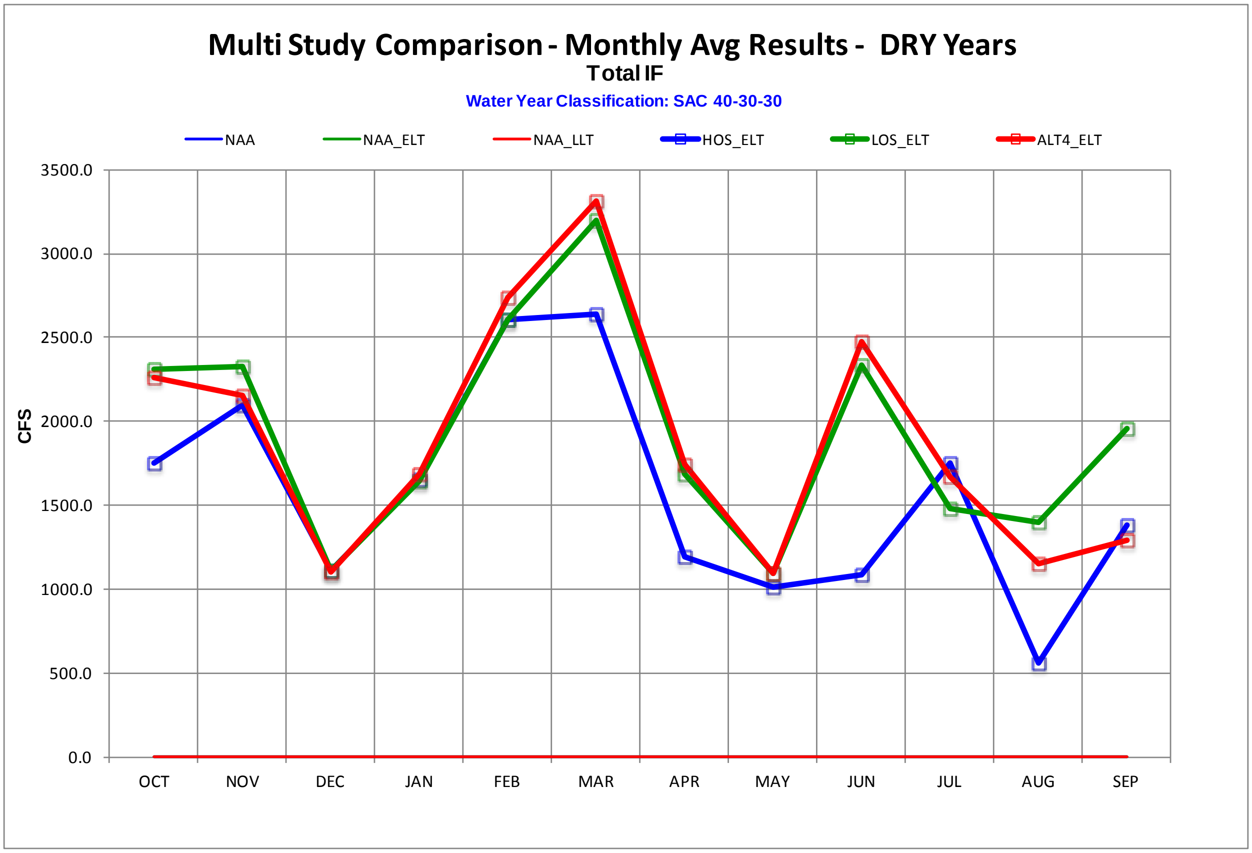
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT. Total IF = Total Isolated Facility.

Figure 5.B.4-26. Monthly Average North Delta Exports in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



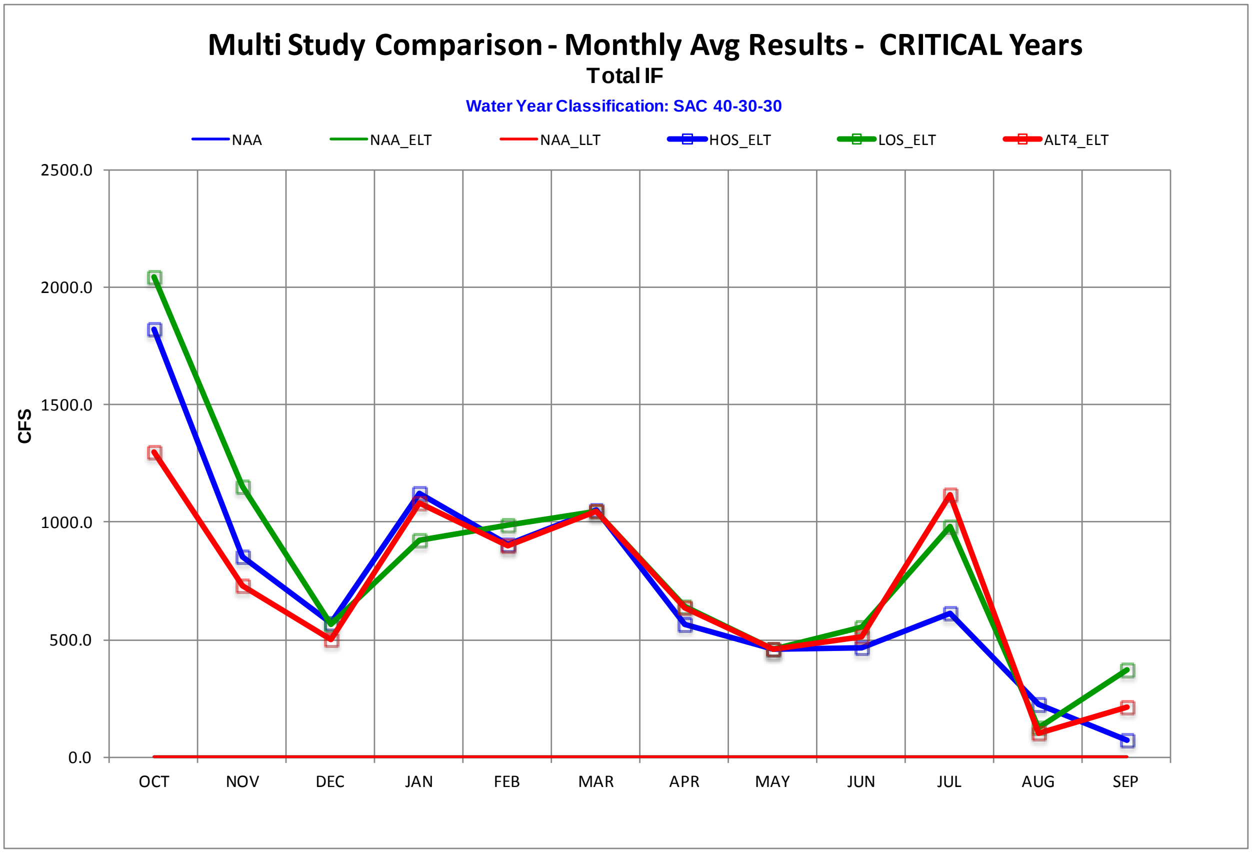
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT. Total IF = Total Isolated Facility.

Figure 5.B.4-27. Monthly Average North Delta Exports in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT]).



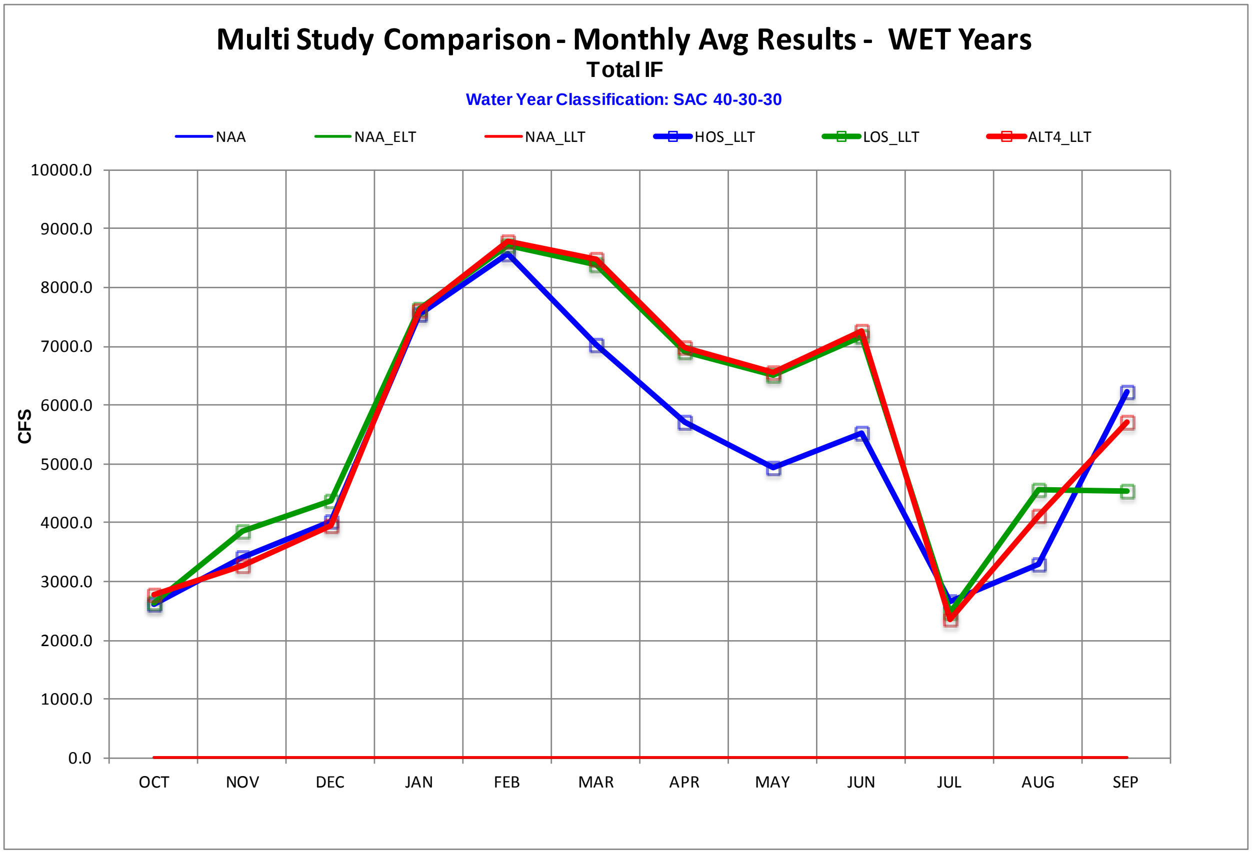
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT. Total IF = Total Isolated Facility.

Figure 5.B.4-28. Monthly Average North Delta Exports in Dry Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



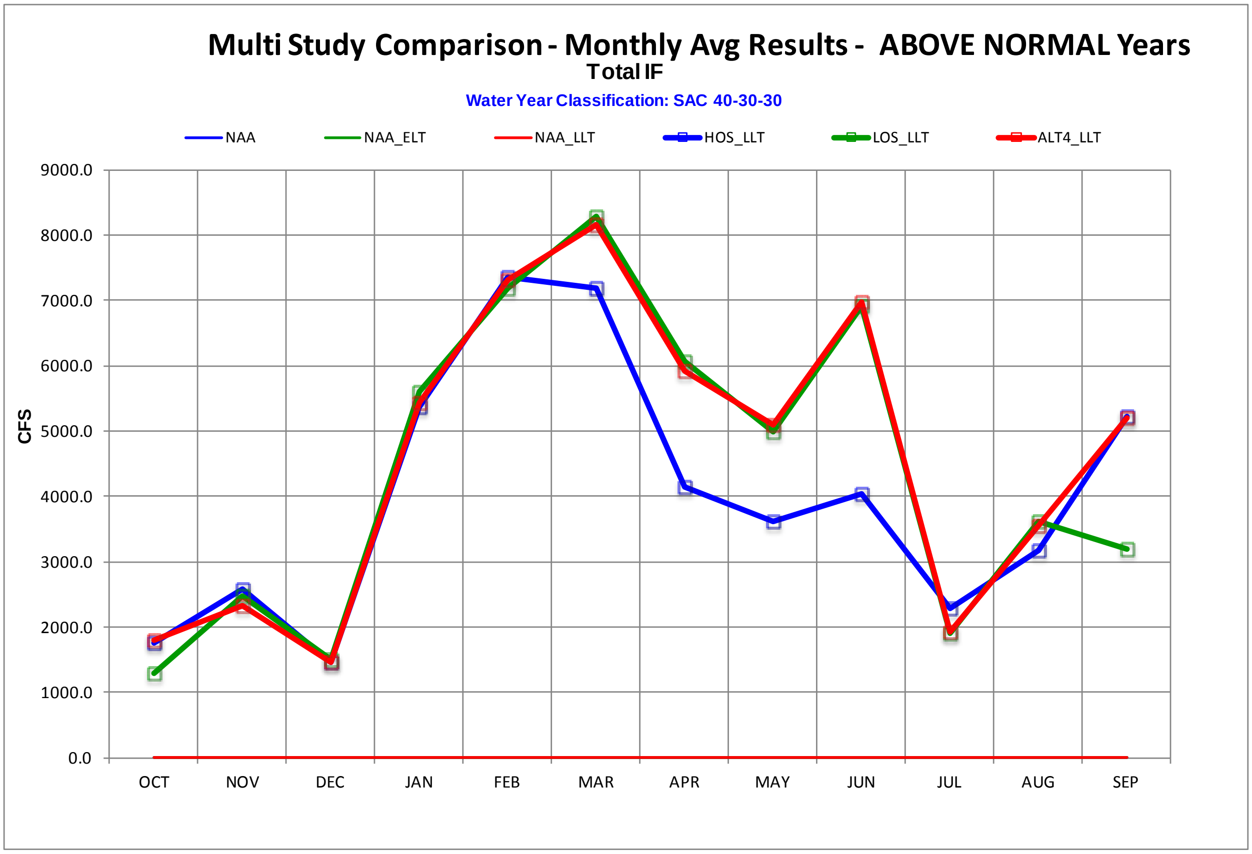
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_ELT = ESO_ELT. Total IF = Total Isolated Facility.

Figure 5.B.4-29. Monthly Average North Delta Exports in Critical Years from CALSIM Modeling for Existing Biological Conditions and Early Long-Term BDCP Scenarios (High-Outflow [HOS_ELT], Low-Outflow [LOS_ELT], and Evaluated Starting Operations [ALT4_ELT])



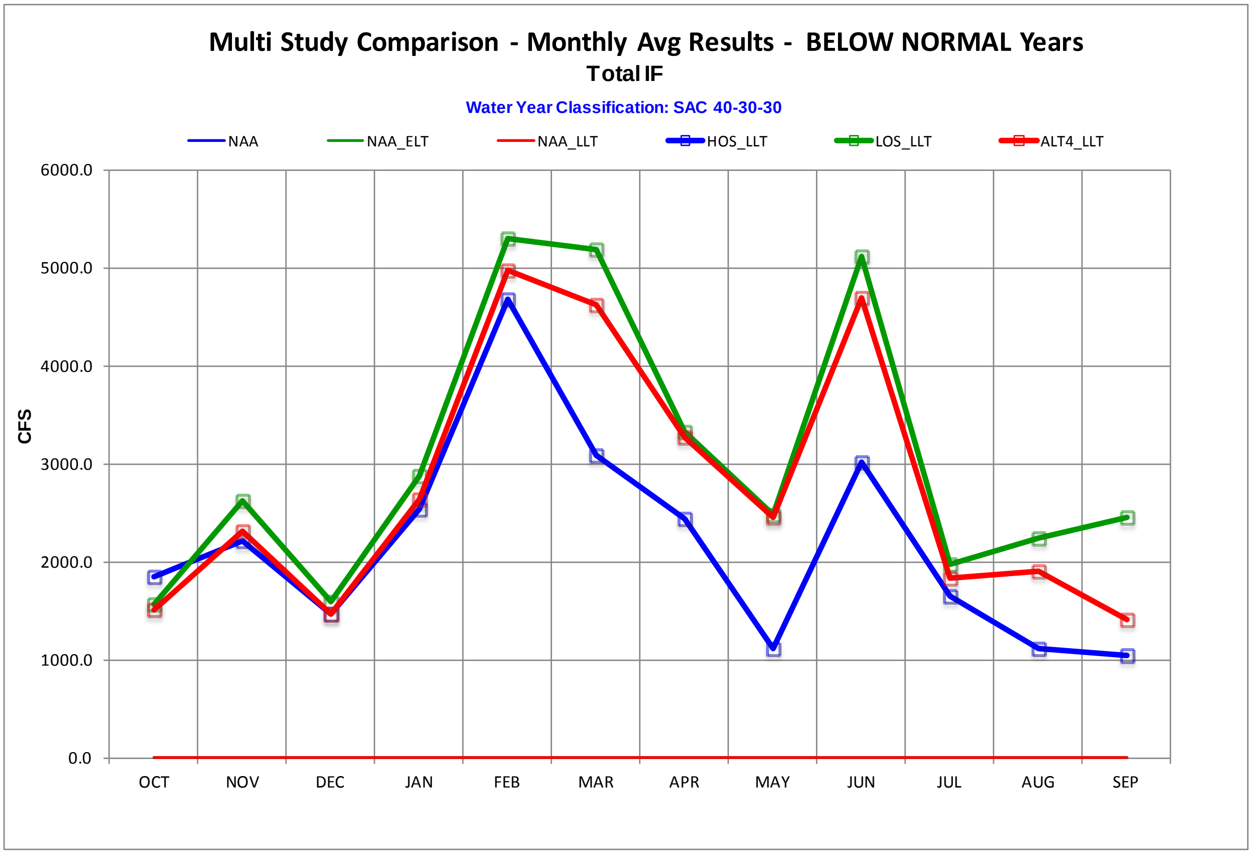
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT. Total IF = Total Isolated Facility.

Figure 5.B.4-30. Monthly Average Total North Delta Exports in Wet Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



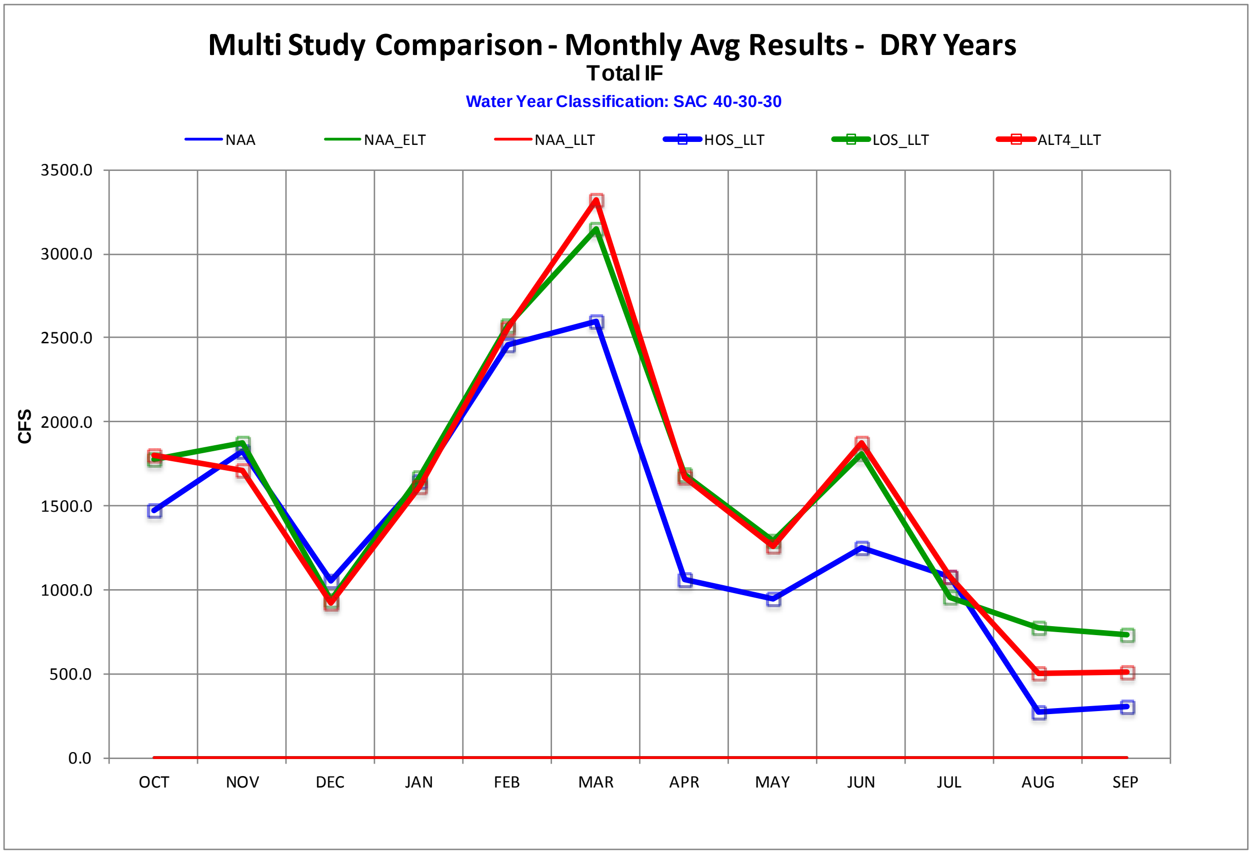
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT. Total IF = Total Isolated Facility.

Figure 5.B.4-31. Monthly Average Total North Delta Exports in Above Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



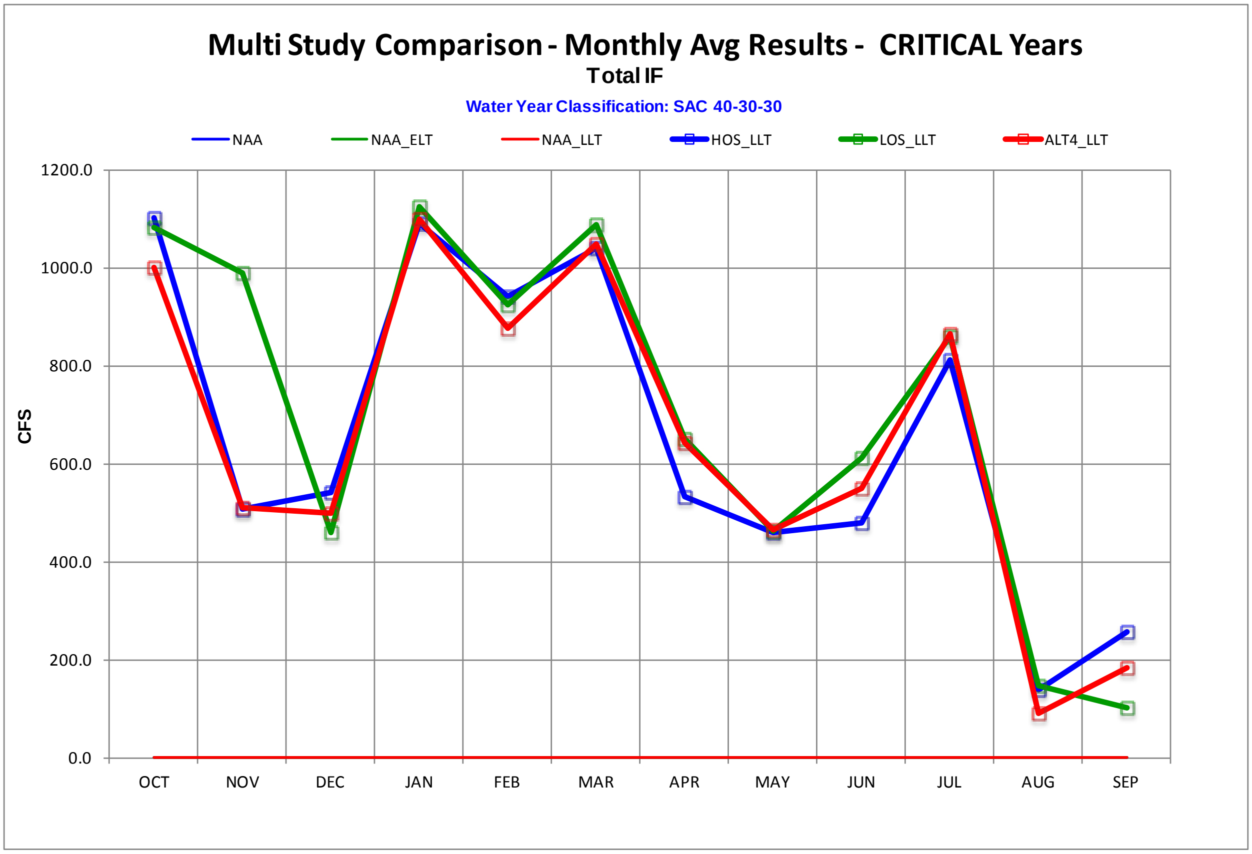
Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT. Total IF = Total Isolated Facility.

Figure 5.B.4-32. Monthly Average Total North Delta Exports in Below Normal Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT. Total IF = Total Isolated Facility.

Figure 5.B.4-33. Monthly Average Total North Delta Exports in Dry Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])



Legend Nomenclature for Existing Biological Conditions and Evaluated Starting Operations Scenarios Follows BDCP EIR/EIS Conventions: NAA = EBC2, NAA_ELT = EBC2_ELT, NAA_LLT = EBC2_LLT, ALT4_LLT = ESO_LLT. Total IF = Total Isolated Facility.

Figure 5.B.4-34. Monthly Average Total North Delta Exports in Critical Years from CALSIM Modeling for Existing Biological Conditions and Late Long-Term BDCP Scenarios (High-Outflow [HOS_LLT], Low-Outflow [LOS_LLT], and Evaluated Starting Operations [ALT4_LLT])

5.B.4.6 SWP North Bay Aqueduct (Barker Slough Pumping Plant and New Sacramento River Facility)

Monthly average diversions at the NBA Barker Slough Pumping Plant tend to be greatest in wetter years at around 110–130 cfs and least in critical years (60–70 cfs), although variable by month (Table 5.B.4-1). Average flows under the ESO tended to be around 10 cfs greater than EBC2 flows when comparing within the same time period (ELT or LLT). Modeling was not conducted to simulate the proportion of diversions that would be relocated to the new Alternative Intake on the Sacramento River.

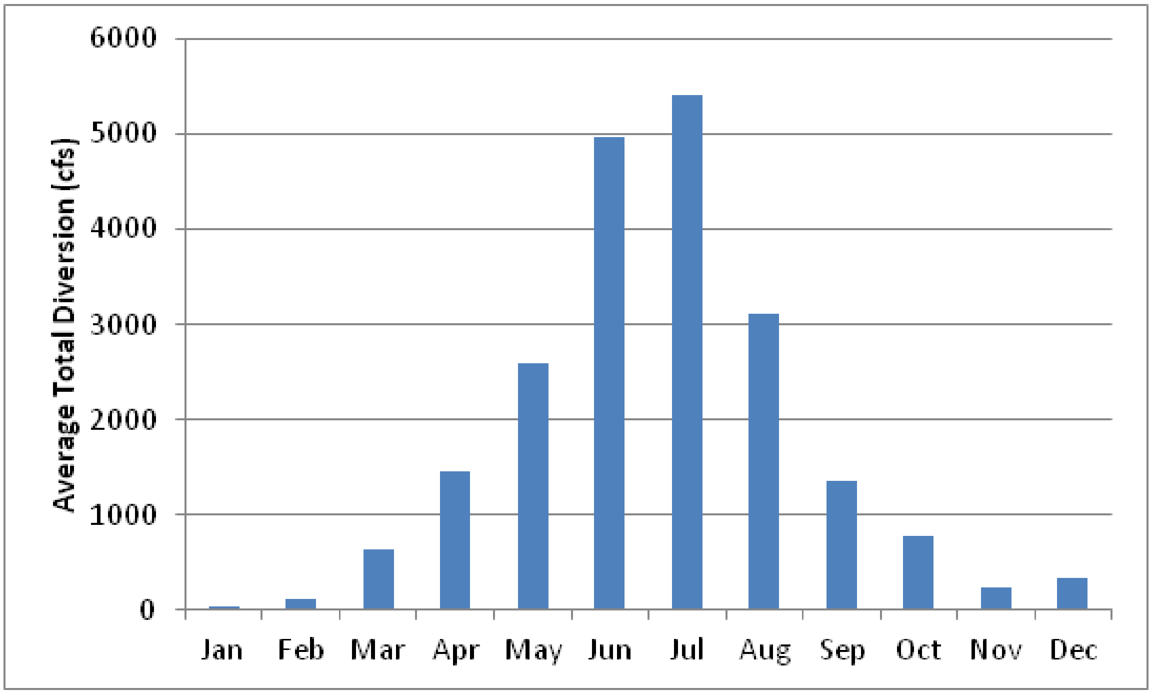
Table 5.B.4-1. Average Monthly North Bay Aqueduct Barker Slough Pumping Plant Diversions (Cubic Feet per Second) from DSM2 Modeling, Reported by Water-Year Type for Existing Biological Conditions (EBC) and Evaluated Starting Operations (ESO) in the Early Long-Term (ELT) and Late Long-Term (LLT)

Month	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
Wet (5 Years)						
Jan	155	102	91	92	106	95
Feb	154	101	113	101	107	107
Mar	76	122	122	111	130	130
Apr	94	141	141	134	141	141
May	100	142	142	137	142	143
Jun	113	146	142	139	119	150
Jul	91	147	149	150	157	155
Aug	113	139	141	134	166	116
Sep	123	130	131	124	137	134
Oct	101	130	129	125	107	105
Nov	103	140	140	139	139	139
Dec	100	139	132	130	123	117
Above Normal (2 Years)						
Jan	109	61	51	48	29	48
Feb	89	86	90	89	91	111
Mar	41	104	84	101	95	94
Apr	74	136	136	125	130	130
May	80	140	141	136	142	142
Jun	109	157	158	121	158	143
Jul	66	116	118	118	142	138
Aug	91	115	118	118	142	130
Sep	83	115	117	117	138	134
Oct	51	71	71	71	72	72
Nov	65	80	58	74	71	71
Dec	49	77	84	75	118	96
Below Normal (1 Year)						
Jan	158	84	81	79	79	79
Feb	157	96	93	88	88	87
Mar	127	136	125	91	91	85
Apr	105	141	141	129	107	119

Month	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
May	109	142	142	139	119	130
Jun	61	117	115	110	104	108
Jul	61	112	111	119	1	1
Aug	71	112	143	156	1	113
Sep	131	141	141	141	140	141
Oct	55	102	104	102	2	2
Nov	116	70	72	69	141	141
Dec	63	127	128	125	158	158
Dry (4 Years)						
Jan	142	94	85	84	81	80
Feb	122	91	71	90	69	88
Mar	128	87	85	84	83	81
Apr	124	95	96	68	79	79
May	57	80	72	70	88	77
Jun	58	77	79	75	131	118
Jul	49	50	50	50	50	50
Aug	84	84	87	87	73	87
Sep	24	26	25	20	114	92
Oct	92	96	87	95	98	65
Nov	72	75	76	74	96	91
Dec	100	127	130	127	135	136
Critical (5 Years)						
Jan	124	72	72	71	71	62
Feb	113	39	54	74	53	60
Mar	82	51	51	50	49	49
Apr	62	53	52	36	51	49
May	53	55	53	44	53	51
Jun	59	62	61	76	63	55
Jul	53	44	54	54	44	42
Aug	56	57	57	56	23	46
Sep	29	39	30	30	98	99
Oct	55	132	85	102	37	85
Nov	90	60	52	30	33	29
Dec	91	132	118	125	114	103

5.B.4.7 Agricultural Diversions

A typical pattern of assumed agricultural diversions for irrigation in Delta islands is shown in Figure 5.B.4-35. This highlights that diversions are minimal during the late fall and winter, with increases in spring up to maxima in early summer when irrigation of agricultural land is at its peak. The summer peaks average around 5,000 cfs in June and July (Figure 5.B.4-35).



Source: Based on Delta Island Consumptive Use values modeled in DSM2 for the Water Years 1975–1991 (Anderson 2003).

Figure 5.B.4-35. Monthly Average Total Delta Island Agricultural Diversions

Based on a hypothetical restoration scenario wherein diversions to agricultural islands are decommissioned under the BDCP, it is estimated that more than 100 diversions in the Plan Area would be removed within the first 15 years (ELT) and nearly 240 would be removed by 50 years (LLT). There is little information on the actual flows typically diverted by these intakes, but under the assumption that all intakes are of similar size, the habitat restoration would decrease diversions in the Plan Area by approximately 4.2% in the ELT and 12.4% in the LLT. This topic is discussed further in Section 5.B.6.4.1, *Particle Tracking Modeling*, results for delta smelt larvae. In addition and as described in Chapter 3, Section 3.4, *Conservation Measures*, *CM21 Nonproject Diversions* aims to support a number of actions intended to reduce entrainment at agricultural and other diversions (primarily those for waterfowl rearing habitat).

- Removal of individual diversions that have relatively large effects on covered fish species.
- Consolidation of multiple unscreened diversions to a single or fewer screened diversions placed in lower-value habitat.
- Relocation of diversions with substantial effects on covered species from high-value to lower-quality habitat, in conjunction with screening.
- Reconfiguration and screening of individual diversions in high-value habitat to take advantage of small-scale distribution patterns and behavior of covered fish species relative to the location of individual diversions in the channel.
- Voluntary alteration of the daily and seasonal timing of diversion operation.

5.B.5 Methods of Biological Analysis

5.B.5.1 Assess Species Exposure

To understand the rationale for selection of particular methods for each species and life stage, it is necessary to also understand the potential exposure to entrainment for each species and life stage. Table 5.B.5-1 shows whether or not each species and life stage is subject to entrainment at each of the potential intakes in the Plan Area.

Table 5.B.5-1. Potential Exposure of Covered Fish Species to Entrainment Locations in the Plan Area

Species	Life Stage	SWP/CVP South Delta Pumps	SWP/CVP North Delta Intake	SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake	Agricultural Diversions
Steelhead	Egg/alevin	Occur upstream of the Plan Area			
	Fry	Occur upstream of the Plan Area			
	Juvenile	X	X	X	X
	Adult	Large body size/strong swimming ability make entrainment very unlikely			
Winter-run Chinook salmon	Egg/alevin	Occur upstream of the Plan Area			
	Fry	Occur upstream or otherwise included under analysis of juveniles			
	Juvenile	X	X	X	X
	Adult	Large body size/strong swimming ability make entrainment very unlikely			
Spring-run Chinook salmon	Egg/alevin	Occur upstream of the Plan Area			
	Fry	Occur upstream or otherwise included under analysis of juveniles			
	Juvenile	X	X	X	X
	Adult	Large body size/strong swimming ability make entrainment very unlikely			
Fall-/late fall–run Chinook salmon	Egg/alevin	Occur upstream of the Plan Area			
	Fry	Occur upstream or otherwise included under analysis of juveniles			
	Juvenile	X	X	X	X
	Adult	Large body size/strong swimming ability make entrainment very unlikely			
Delta smelt	Egg/embryo	Adhere to substrates and therefore minimally subject to entrainment			
	Larva	X	X	X	X
	Juvenile	X	X	X	X
	Adult	X	X	X	X
Longfin smelt	Egg/embryo	Adhere to substrates and therefore minimally subject to entrainment			
	Larva	X	X	X	X
	Juvenile	X	X	X	X
	Adult	X	X	X	X
Sacramento splittail	Egg/embryo	Adhere to substrates and therefore minimally subject to entrainment			
	Larva	X	X	X	X
	Juvenile	X	X	X	X
	Adult	X	X	X	X
White sturgeon	Egg/embryo	Adhere to substrates and therefore minimally subject to entrainment			
	Larva	X	X	X	X
	Juvenile	X	X	X	X
	Adult	X	X	X	X

Species	Life Stage	SWP/CVP South Delta Pumps	SWP/CVP North Delta Intake	SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake	Agricultural Diversions
Green sturgeon	Egg/embryo	Occur upstream of the Plan Area			
	Larva	Occur upstream of the Plan Area			
	Juvenile	X	X	X	X
	Adult	X	X	X	X
Pacific lamprey	Egg/embryo	Occur upstream of the Plan Area			
	Ammocoete	Buried in the substrate but may be subject to entrainment when entering the Plan Area			
	Macropthalmia	X	X	X	X
	Adult	X	X	X	X
River lamprey	Egg/embryo	Occur upstream of the Plan Area			
	Ammocoete	Buried in the substrate but may be subject to entrainment when entering the Plan Area			
	Macropthalmia	X	X	X	X
	Adult	X	X	X	X

5.B.5.2 Overview of Assessment Methods

The assessment of entrainment effects for each species and life stage is based on a comparison between EBC1, and EBC2, EBC2_ELT, and EBC2_LLT and ESO_ELT and ESO_LLT. There are two primary data sources used (particle tracking and salvage data), but multiple methods were used to analyze entrainment based on the available data. Multiple methods are necessary to generate estimates of entrainment because no one method and/or model is applicable to all species and life stages. The methods used are summarized by species and life stage in Table 5.B.5-2. Each method has particular assumptions, benefits, and limitations, which are summarized in Section 5.B.5.3, *Summary of Methods Used*.

Several delta smelt entrainment analyses that were used in earlier drafts of the effects analysis are no longer included, based on commenter concerns and because these methods generally showed similar relative differences in entrainment between scenarios. To address these concerns and to be as concise as possible, the OMR flow proportional entrainment regressions replaced all of the previously used delta smelt entrainment methods for the south Delta export facilities, listed below.

- Salvage-density method (juveniles and adults).
- Proportional entrainment regressions (i.e., the so-called *Kimmerer* and *Adjusted Kimmerer/Miller* methods).
- Manly salvage estimation method (adults) (Manly 2011).
- DSM2 Particle Tracking Model (PTM): particle tracking modeling for the south Delta export facilities (larvae).

Additionally, the analysis for longfin smelt no longer includes use of a uniform distribution for PTM, which was not thought to reflect a realistic distribution. However, as described below, wetter and drier distributions have been retained.

Table 5.B.5-2. Methods Used to Analyze Entrainment Effects, by Entrainment Location, Species, and Life Stage

Entrainment Location or Species	Geographic Subregion or Life Stage	Salvage-Density Method	OMR Flow Proportional Entrainment Regressions	DSM2 PTM	DPM Proportional Salvage Estimates	Effectiveness of Nonphysical Barriers	North Delta Intakes Screening Effectiveness Analysis	North Delta Intakes Impingement/ Screen Contact	DRERIP Evaluation of Nonproject Diversions
SWP/CVP south Delta export facilities	South Delta Subregion	X	X	X	X	X			
SWP/CVP north Delta intake	North Delta Subregion			X			X	X	
SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake	Cache Slough Subregion			X					
Agricultural diversions	Plan Area			X					X
Steelhead	Juvenile	X			X	X	X	X	X
Winter-run Chinook salmon	Juvenile	X			X	X	X	X	X
Spring-run Chinook salmon	Juvenile	X			X	X	X	X	X
Fall-/late fall–run Chinook salmon	Juvenile	X			X	X	X	X	X
Delta smelt	Larvae		X	X		X	X		X
	Juvenile		X			X	X	X	X
	Adult		X			X	X	X	X
Longfin smelt	Larvae			X		X	X		X
	Juvenile	X				X	X		X
	Adult	X				X	X		X
Sacramento splittail	Juvenile	X				X	X	X	X
	Adult	X				X	X		X
White sturgeon	Egg/embryo						X		X
	Larvae					X	X		X
	Juvenile	X				X	X		X
Green sturgeon	Juvenile	X				X	X		X
Pacific lamprey	Ammocoete						X		
	Macropthalmia	X				X	X		
	Adult	X				X	X		
River lamprey	Ammocoete						X		
	Macropthalmia	X				X	X		
	Adult	X				X	X		

5.B.5.3 Summary of Methods Used

The various methods used to analyze entrainment are based on various assumptions and have benefits and limitations, as summarized in Table 5.B.5-3. Further discussion of these factors is provided in the descriptions of each method (Sections 5.B.5.4–5.B.5.10).

Table 5.B.5-3. Main Assumption, Benefits, and Limitations of Methods Used to Analyze Entrainment

Method	Description of Method	Main Assumptions	Benefits	Limitations
Salvage-Density Method	Uses historical salvage and flow data to predict indices of entrainment that may represent salvage or entrainment loss (i.e., salvage expanded to account for salvage-related losses such as predation and louver efficiency).	Changes in export flow would give a linearly proportional change in entrainment; salvage density (fish salvage per volume of water exported) in a given water-year type would be similar to levels observed historically for that water -year type. For some species, entrainment loss incorporates prescreen mortality, louver efficiency losses, and release mortality consistent with established values for these attributes.	Numerous data exist for all species. Method has been used before to analyze effects of other projects.	Assumes a linear relationship between flow and entrainment, which may not be justified. Estimates of numbers of fish entrained should be viewed as highly uncertain, and focus should be on relative change between scenarios. Historical salvage of some species could not be normalized to population abundances due to lack of appropriate population indices. Method does not account for possible changes in distribution of a species and is reliant on historically observed salvage numbers.
OMR Flow Proportional Entrainment Regressions	Estimates the proportion of the larval/juvenile and adult delta smelt population that would be lost to entrainment at the south Delta export facilities, based on initial estimates from Kimmerer (2008) that were related to OMR flows and X2 by USFWS (2008), and then adjusted by Kimmerer (2011)	Historical relationship between entrainment loss and flow and X2 will remain similar in the future; all delta smelt entrained at the south Delta export facilities are lost from the population.	Provides estimates of the overall proportion of the delta smelt population that is lost to entrainment (although these estimates are still best treated comparatively rather than in absolute terms).	Regressions are based on relatively few data points and on predictors averaged over several months, which may simplify underlying dynamics. The adult regression explains a relatively low proportion of the variance in the original data Some delta smelt may survive the salvage process and therefore loss estimates may be slightly higher than actually occurs (although the main loss at the SWP facility occurs across CCF, prior to salvage operations).

Method	**Description of Method**	**Main Assumptions**	**Benefits**	**Limitations**
DSM2 PTM	Estimates entrainment by various water diversions (south Delta and north Delta export facilities, North Bay Aqueduct, and agricultural diversion) of larval delta and longfin smelt that originate from various spawning locations using one-dimensional modeling of Delta hydrodynamics.	Simulated movement of particles is representative of the movement of weakly swimming smelt larvae. The DSM2 modeling grid for existing biological conditions has newly restored areas added to represent evaluated starting operations conditions in the early long-term and late long-term (Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*, and Attachment 5C.A, *CALSIM and DSM2 Modeling Results for the Evaluated Starting Operations Scenarios*).	Allows assessment of entrainment potential at numerous locations from a variety of starting points.	Assumes smelt larvae are passive particles without behaviors that may alter responses to flows rather than solely being carried by prevailing flows. Estimates of entrained numbers of larvae should be viewed with considerable caution, and focus should be on relative change between scenarios. One-dimensional modeling is best suited for shallow, channelized regions of the Plan Area and is less well suited to other areas such as Suisun Bay.
DPM Salvage Estimates	Uses relationships developed from CWT salvage data to estimate the proportion of Chinook salmon runs that would be salvaged at the south Delta export facilities as a result of changes in daily export flows.	For Sacramento River- and Mokelumne River-origin fish, daily proportional salvage is a function of daily south Delta exports (for fish having entered the interior Delta through Georgiana Slough/Delta Cross Channel or the Mokelumne River). For San Joaquin River-origin fish, salvage is a function of exports, proportion of fish going down Old River.	Provides estimates of overall proportions of migrating juvenile Chinook salmon runs that are salvaged at the south Delta export facilities (although estimates are best used comparatively between scenarios rather than as an estimate of absolute values), while accounting for movement down different Delta channels; allows differentiation of fall-run populations by Sacramento, San Joaquin, or Mokelumne river basins. Based on studies conducted within the Delta.	Many of the model assumptions are based on results from large, hatchery-reared fall-run Chinook salmon that may not be representative of smaller, wild-origin fish. Model is applicable only to migrating fish and not to those rearing in the Delta. Equations for estimating salvage have relatively low explanatory power for the data upon which they were derived.
Effectiveness of Nonphysical Barriers	Discusses results of recent studies at Georgiana Slough and Old River as well as literature studies to determine potential effectiveness of barriers at the entrances to the south Delta export facilities.	Nonphysical barriers would be installed at the south Delta entrance canals leading to CCF and the Delta-Mendota Canal. Main factors governing potential utility of nonphysical barriers include fish hearing ability, fish swimming ability, and fish position in the water column.	Based partly on Delta-specific studies.	Considerable uncertainty about velocities in barrier vicinity and potential predation. Qualitative discussion only.

Method	**Description of Method**	**Main Assumptions**	**Benefits**	**Limitations**
Screening Effectiveness Analysis (North Delta Intake)	Estimate of potential for screening based on different sizes of fish approaching the north Delta intakes	North Delta intake screen mesh size is 1.75 mm. Fish would be screened from entrainment based on published relationships (e.g., a comparison of fineness ratio [body depth/standard length] to mesh size).	Based on published literature for exclusion of fish at screened intakes, including some studies specific to species from the Plan Area.	Little is known of the occurrence of larval fish in the area and how fish may respond to such large intakes. Qualitative discussion based on likely sizes of fish that would be excluded.
Impingement and Screen Contact Analysis (North Delta Intake)	Uses laboratory-based studies to discuss potential for covered fish species to interact with proposed north Delta intake screens through screen contact and mortality or passage time.	Laboratory observations are reasonably representative of how fish would behave in the wild when encountering the proposed intake screens. Representative lengths of screen and a variety of different approach and sweeping velocities are presented to cover a broad range, although actual criteria for the fish screens have not been finalized.	Analysis is based on studies specifically conducted using covered fish species from the Plan Area, for which a wide range of test conditions were undertaken.	It is unknown the extent to which the laboratory studies would be representative of the conditions in the field. Some of the equations do not appear to work well for the long fish screens proposed for the north Delta. Some calculations require linkage of several equations with varying degrees of uncertainty at each step. Analysis is a general discussion because specific operational criteria and fish screen lengths have not been finalized. Detailed modeling to provide a better sense of velocities near the intakes during operations is underway.
DRERIP Analysis of Nonproject Diversions	Qualitative assessment of the population-level benefits of screening nonproject diversions that was previously proposed as a BDCP conservation measure	Qualitative discussion.	Represents the analysis of a panel of experts	Qualitative analysis only (however, estimates of number of diversions to be decommissioned as part of BDCP habitat restoration allow some context for the extent of entrainment reduction).

CCF = Clifton Court Forebay
CWT = coded wire tag
DPM = Delta Passage Model
DRERIP = Delta Regional Ecosystem Restoration Implementation Plan
OMR = Old and Middle River
PTM = Particle Tracking Model
ROA = restoration opportunity areas
SWP = State Water Project

5.B.5.4 Salvage-Density Method (SWP/CVP South Delta Export Facilities)

The salvage-density method relies on salvage data and was used to estimate changes in entrainment at the SWP/CVP export facilities. The same basic method has been used in recent effects analyses (e.g., the DMC/California Aqueduct Intertie [Bureau of Reclamation 2009]). This method applied to all covered species, although there are limitations for each species as described in detail below. For the BDCP effects analysis, a refinement of the method was used.

5.B.5.4.1 Preprocessing of Input Data

Historical monthly export data (acre-feet) for Water Years 1995–2009 were obtained from Reclamation's Central Valley Operations Total Tracy Pumping web page (http://www.usbr.gov/mp/cvo/vungvari/tracy_pump.pdf) and California Department of Water Resources' (DWR's) State Water Project Annual Reports of Operations (http://www.water.ca.gov/swp/operationscontrol/annual.cfm). Historical monthly salvage data for the water years 1995–2009 were provided by Sheila Greene (DWR) for all species (S. Greene pers. comm.). (Water Year 2009 was excluded for some species because the data were not complete.) These data are expanded salvage data, i.e., the extrapolated estimates of the total number of fish salvaged based on a subsample that was actually identified, counted, and measured. These data provided the basic estimates of fish density (number of fish salvaged per volume of water exported) that were subsequently multiplied by simulated export data for the CALSIM modeling period (1922–2003) to assess differences between ESO and EBC scenarios, as described in Section 5.B.5.4.3, *Entrainment Index Calculation*. It is acknowledged that expanded salvage estimates have inherent statistical error associated with the expansion of subsamples (see Jahn 2011) but, consistent with typical analyses employing these data (e.g., Grimaldo et al. 2009), this statistical error has not been accounted for in the current salvage-density method. The salvage-density method does not account for spatial distribution of the fish populations, which could differ between existing conditions and evaluated starting operations scenarios, and also assumes a linear relationship between entrainment and export flows. The assumption of a linear relationship is made because of the lack of information on how salvage would increase with increasing flows. One study that examined entrainment in relation to export rate was that of Kimmerer (2008), who showed for hatchery-released Chinook salmon that percentage salvage or percentage entrainment loss was roughly linear up to total south Delta export flows of around 250–275 cubic meters/sec (approximately 8,800–9,700 cfs), depending on assumptions regarding prescreen losses (Kimmerer 2008: Figures 9 and 10). For perspective on the current effects analysis modeling, the percentage of CALSIM-simulated months during the main entrainment period for Chinook salmon and other covered species (December–June) in which average total south Delta exports were below 8,800 cfs and 9,700 cfs were as follows.

- EBC1: 82% < 8,800 cfs, 88% < 9,700 cfs.
- EBC2: 82% < 8,800 cfs, 86% < 9,700 cfs.
- EBC2_ELT: 81% < 8,800 cfs, 86% < 9,700 cfs.
- EBC2_LLT: 83% < 8,800 cfs, 88% < 9,700 cfs.
- ESO_ELT: 96% < 8,800 cfs, 98% < 9,700 cfs.

- ESO_LLT: 96% < 8,800 cfs, 96% < 9,700 cfs.

The majority of months were below export flows at which Kimmerer's (2008) study of Chinook salmon suggested considerable nonlinear percentage salvage or entrainment loss would occur. Kimmerer's (2008) study does not provide an indication of export flow rates at which nonlinearity may occur for other species.

Juvenile Chinook salmon were divided into races based on fork length on the date of salvage, according to the Delta model of length at date (Brown et al. 1996). It should be noted that these divisions are not without considerable overlap between races, especially for juvenile spring-run and fall-run Chinook salmon; extrapolations of numbers of fish salvaged by race should be regarded cautiously, particularly given the relative abundance of the adult stocks from which the juveniles originate (e.g., fall-run are considerably more abundant than spring-run, and therefore the relative proportions salvaged should reflect such differences but may not when based on length criteria). Techniques such as such rapid, real-time DNA analysis are under development and may allow better classification of race in the future (Harvey 2011). Data for juvenile Chinook salmon salvage were extrapolated into total entrainment losses to reflect prescreen losses (75% at SWP and 15% at CVP), louver efficiency (size-specific equations based on primary water velocity through the intake screens [California Department of Water Resources and California Department of Fish and Game 1986: Appendix A]), and losses during transport to the release site (2% for younger fish, 0% for larger fish [California Department of Water Resources and California Department of Fish and Game 1986: Appendix A]). In similar fashion, steelhead and longfin smelt also had various entrainment losses applied: prescreen losses of 75% at SWP and 15% at CVP, louver losses of 50%, and transport losses of 2% (longfin smelt) or 0% (steelhead). Analyses of longfin smelt were divided into juveniles (March–June) and adults (December–March) based on seasonal occurrence. Lamprey are not identified to species during salvage, so analyses for Pacific and river lamprey are combined.

5.B.5.4.2 Normalization to Population Size

Salvage and loss data for analysis were normalized, where possible, by measures of annual population abundance in the year of entrainment. This step aimed to adjust the salvage and loss to account for the abundance of the population (e.g., a relatively high number of fish would be expected to be entrained in a year of relatively high abundance). Normalization was undertaken by multiplying the raw monthly salvage or loss in a given month by a factor to account for the relative size of the population in that year compared to the average population size over the years from which salvage or loss data were available. The factor was the average population size in the years from which salvage data were available (1996–2009 for most species) divided by the population size appropriate to the year of salvage (e.g., for juvenile Chinook salmon, normalization was to the adult run size estimate that spawned the cohort that was salvaged). The following datasets were used to normalize salvage and loss estimates.

- Winter-run Chinook salmon: juvenile production estimate (National Marine Fisheries Service 2009).
- Fall-/late fall–run and spring-run Chinook salmon: adult run size estimates from CDFW's GrandTab (California Department of Fish and Game 2010).
- Longfin smelt: fall midwater trawl index (Newman 2008a).

No normalization was undertaken for steelhead, Sacramento splittail, Pacific lamprey, river lamprey, or green sturgeon because there are no suitable indices of annual abundance for these species.

5.B.5.4.3 Entrainment Index Calculation

For each covered species in each month at each facility, density (fish per thousand acre-foot [taf]) as entrainment loss or expanded salvage was simply calculated as the total loss or expanded salvage for the facility divided by the total volume of water exported in that month. It is acknowledged that the assumption of a linear relationship between entrainment and flow may be an oversimplification given the evidence for nonlinear relationships (e.g., Kimmerer 2008) and so the method essentially functions as description of changes in flows weighted by seasonal changes in salvage density of covered species. The mean and 95% confidence interval entrainment index in each month of each water-year type was calculated as follows: the salvage or loss density for a given month in a given water-year type was multiplied by the CALSIM-modeled export volume for the same month for all of the water years of that water-year type. For example, there were 5 wet years (1996–1999, 2006) in the data used to calculate salvage or loss densities and there were 26 wet years in the CALSIM modeling of 1922–2003. Using the month of January as an example, there were five unique wet January salvage or loss densities calculated. Each of these was then multiplied by each of the 26 wet January export volumes from CALSIM, giving a sample size of 130 from which to calculate means and 95% confidence intervals. The calculation was not done for Pacific lamprey and river lamprey, for which water years were not divided.

Water years generally were based on the Sacramento Valley (40-30-30) classification. However for white and green sturgeon, calculations for both the Sacramento Valley and San Joaquin Valley (60-20-20) classifications were undertaken separately because the species occur in both basins and water-year designations for the period of salvage density data differ slightly (Table 5.B.5-4)[7].

For the sturgeons, two sets of water-year types from each classification (Sacramento Valley and San Joaquin Valley) were used: (1) wetter water years (wet and above-normal); and (2) drier water years (below-normal, dry, and critical). It is thought that wetter years contribute more to sturgeon year class strength (Fish 2010); therefore, more individuals may be exposed to entrainment at the south Delta facilities. During years of low rainfall, the reduction in suitability of other water quality factors (temperature and flow) may contribute to limited spawning, hatching, and survival of juvenile sturgeon; therefore, fewer individuals may be exposed to entrainment at the south Delta facilities. However, because juvenile sturgeon may occur in habitats in the vicinity of the south Delta export facilities for multiple years, a straight correlation of salvage and water-year type may not be sufficient. To account for the potential differences that may occur in both wetter and drier years, historical salvage data were divided into these two categories to estimate salvage under each model scenario.

The analysis was repeated for each scenario–time period combination (EBC1, EBC2, EBC2_ELT, EBC2_LLT, ESO_ELT, ESO_LLT) and for all years combined.

Although the salvage-density method does give estimates of entrainment loss or salvage in numbers of fish and there are a number of factors included in the calculations such as multipliers applied for

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[7] Although there is some similarity between designated water years for the Sacramento and San Joaquin systems, there are sufficient differences to justify independent salvage analyses (Table 5.B.5-4). From the period of 1995 to 2008 (the period of most appropriate salvage data for the analyses), water year classifications were different in five years (1999, 2003, 2004, 2005, and 2007). However, based on binned water years (W/AN compared to BN/D/C), the only difference occurs in 2003, which was designated as above-normal in the Sacramento and below-normal in the San Joaquin Valley.

prescreen loss and normalization to population size, it is most appropriate to view the results comparatively, i.e., to compare relative differences between scenarios as opposed to examining the estimates of total number of fish lost to entrainment or salvaged. In essence, the salvage-density method provides an entrainment index that reflects export pumping weighted by each covered species' seasonal pattern of abundance in the Plan Area, as reflected by historical salvage data.

Table 5.B.5-4. Water-Year Designations for the Sacramento and San Joaquin Watersheds, 1995–2008

Water Year	Sacramento Valley Classification	San Joaquin Valley Classification
1995	W	W
1996	W	W
1997	W	W
1998	W	W
1999	W	AN
2000	AN	AN
2001	D	D
2002	D	D
2003	AN	BN
2004	BN	D
2005	AN	W
2006	W	W
2007	D	C
2008	C	C

Data source: <http://cdec.water.ca.gov/cgi-progs/iodir/wsihist> on June 8, 2010.
W = wet, AN = above-normal, BN = below-normal, D = dry, C = critical.

5.B.5.4.4 Proportional Entrainment (Juvenile Chinook Salmon)

In addition to estimating relative magnitude of entrainment loss for each run under each model scenario, an index was developed of the relative magnitude of losses in comparison with a general index of juvenile population abundance to help provide an illustration of population-level context for assessing south Delta losses. As noted above, however, entrainment indices are best used comparatively rather than in terms of the actual magnitude of loss. For salmonids other than juvenile winter-run Chinook salmon, there is no annual estimate of juvenile production. For winter-run Chinook salmon, NMFS calculates a juvenile production estimate of juveniles passing Red Bluff Diversion Dam (RBDD); the mean value of this estimate from 1994 to 2009 was around 1 million fish. It is recognized that reproductive success of salmonids varies among years and watersheds in response to a variety of factors such as hydrologic conditions, spawning gravel quality and availability, exposure to elevated water temperatures, and other factors like hatchery management. Variation in these and other factors has not been included in the development of the broad index of juvenile production. Levels of mortality from predation and other sources vary for juvenile salmonids during their downstream migration to the Delta, which for winter-run Chinook salmon NMFS assumes is 50% of the upstream abundance at RBDD. The juvenile abundance estimates used in the present analysis are based on the assumption that overall juvenile production of all Chinook salmon races is proportional to overall adult escapement. The average annual percentage of adult in-river escapement attributable to each run during 1994–2009 is summarized in Table 5.B.5-5. Extrapolating from the estimate of 1 million winter-run Chinook salmon juveniles to the other

Chinook salmon runs in direct proportion to adult abundance gives an annual estimate of 50 million juvenile Chinook salmon, which becomes 25 million when the 50% mortality from upstream of the Delta is factored in (Table 5.B.5-5). Annual adult steelhead abundance estimates are not available, and hence no index of juvenile abundance was developed for Central Valley steelhead. Losses of juvenile Chinook salmon as estimated from the salvage-density method were expressed as percentages of the total juvenile abundance index for each run. As described above in Section 5.B.5.4.1, *Preprocessing of Input Data*, division of Chinook salmon juveniles into races was based on length-at-date criteria. This tends to overestimate the relative proportion of spring-run Chinook salmon juveniles in relation to fall-run juveniles because the lengths of these two runs are very similar and overlap considerably. Thus it is likely that many of the juvenile Chinook salmon classified as spring-run based on length criteria were actually fall-run, given the relative proportions of the two runs in total Central Valley adult escapement (Table 5.B.5-5).

Table 5.B.5-5. Summary of Information Used in Developing a General Index of Juvenile Chinook Salmon Abundance Estimates

Species	Winter-Run Chinook Salmon	Spring-Run Chinook Salmon	Fall-Run Chinook Salmon	Late Fall–Run Chinook Salmon
Percentage of adult escapement to Central Valley[1]	2	3	92	4
Upstream juvenile abundance index	1 million	1.5 million	46 million	2 million
Assumed juvenile abundance reaching Delta after 50% mortality	0.5 million	0.75 million	23 million	1 million

Source: California Department of Fish and Game GrandTab (2010).

[1] Percentages do not equal 100% as a result of rounding.

5.B.5.4.5 Sacramento Splittail

As with the basic salvage-density method for other species described above, total entrainment of splittail at the south Delta export facilities was computed as the product of the volume of water exported and the salvage density of the splittail. Salvage density is largely a function of the abundance and age structure of splittail present in the south Delta. The export rate directly affects per capita entrainment, i.e., the entrainment risk for an individual splittail. The age of splittail affects their vulnerability to entrainment at the south Delta facilities, with juvenile splittail being more vulnerable than adults (Moyle et al. 2004). Juvenile splittail are vulnerable to entrainment at the south Delta export facilities primarily from May through July, during their downstream emigration from floodplain rearing and spawning habitats (Figure 5.B.5-1), whereas adult splittail are vulnerable during their upstream migration, which typically occurs from December through March. A per capita index of entrainment is useful for evaluating how ESO changes in exports would affect entrainment independent of other factors, particularly effects on splittail abundance, whereas a total entrainment estimate is useful to evaluate how changes in exports and other covered activities (e.g., increased spawning and rearing habitat from *CM2 Yolo Bypass Fisheries Enhancement*) would affect entrainment.

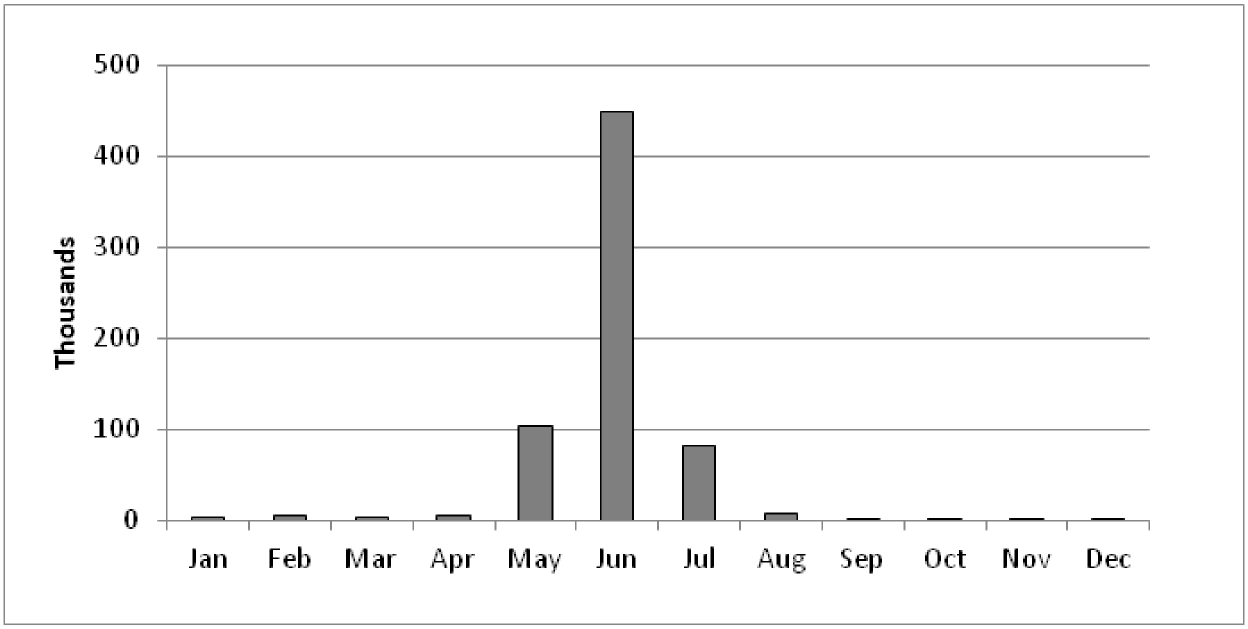


Figure 5.B.5-1. Average Expanded Splittail Salvage by Month (1980–2008)

An unknown percentage of the splittail entrained at the export facilities is salvaged and returned to the Delta, where an unknown proportion is lost to predation at release sites (Miranda et al. 2010). High losses to predation and other factors also occur before the juveniles reach the export pumps, particularly in CCF of the SWP facilities. Total export losses, including prescreen losses and losses during salvage operations, are thought to be four to five times the number of fish salvaged at the SWP facilities and 15 to 20% greater than the salvage losses at the CVP facilities, based on studies conducted on juvenile Chinook salmon (Gingras 1997; National Marine Fisheries Service 2009). However, because of the high uncertainty in these estimates, they were not included in the effects analysis for splittail. The entrainment indices, therefore, are properly considered to be estimates of expanded salvage rather than total export losses.

Salvage of adult splittail at CVP and SWP facilities in the south Delta often increases abruptly following the first flush of increased freshwater inflow following storms during December through March. Numbers salvaged are relatively high during years of high outflow and when exports are high, and are also likely to be high 1–3 years after years that produced strong year classes of splittail (California Department of Water Resources and Bureau of Reclamation 1994). Thus actual numbers of adult splittail entrained appear to be a complex function of (1) adult population size, (2) amount of pumping during winter months, (3) timing of pumping in relation to the hydrograph, and (4) total outflow (Moyle et al. 2004).

5.B.5.4.5.1 Per Capita Entrainment (Salvage) Index

Similar to the salvage-density method applied for other species (see above), indices of per capita salvage of juvenile and adult splittail, by water-year type, were computed as the product of the monthly averages of CALSIM modeling estimates of exports and observed average monthly salvage densities. The salvage-density averages were computed for each water-year type from the 1996–2010 period. By including the monthly average salvage densities, by water-year type, in the analyses, the per capita salvage indices account for month-to-month and year-type variations in the abundance and vulnerability of splittail. However, these indices, although they are computed as the product of export volume and salvage density, are not useful estimates of total salvage for the effects analysis because the salvage densities used for the computations are constant for all the scenarios and, therefore, do not account for potential effects of the covered activities on abundance (and therefore salvage density). As described below in Section 5.B.5.4.5.2, *Total Salvage Based on Yolo Bypass Inundation*, estimates of total salvage for juvenile splittail were computed by indirectly estimating effects of the scenarios on salvage densities. Total salvage estimates for adult splittail could not be computed.

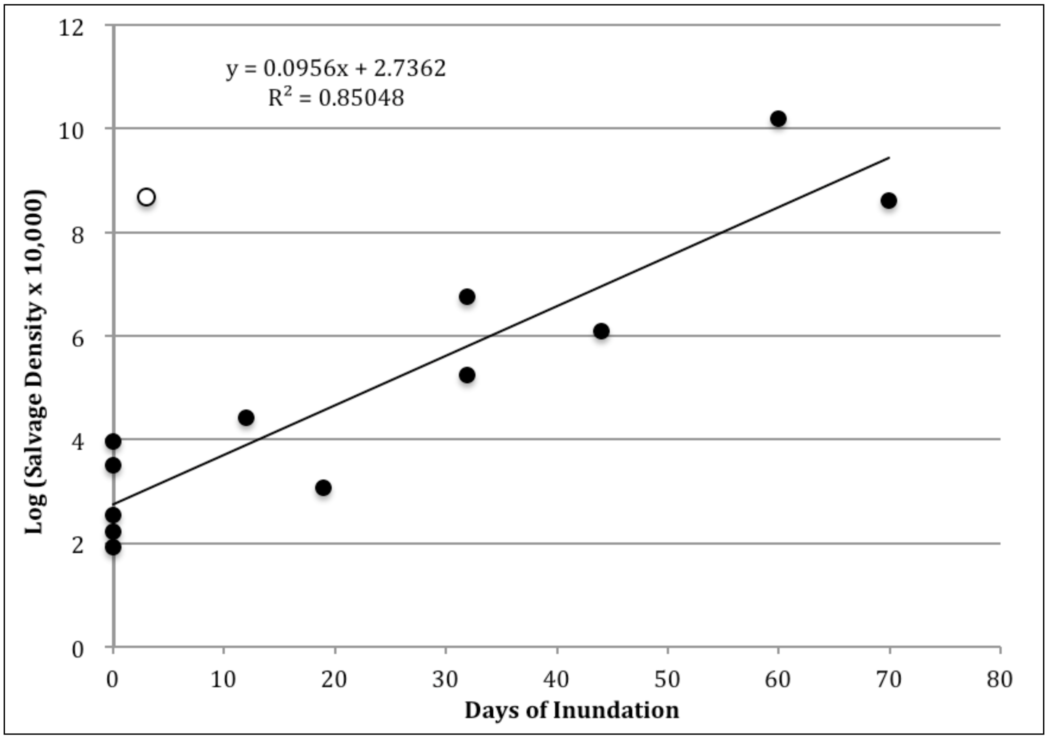
Monthly average SWP and CVP salvage densities were computed, by water-year type, from 1996–2010 salvage and export volume data from the export facilities with 95% confidence intervals. The confidence intervals were computed from the among-year variances. For juvenile splittail, the average salvage densities were computed for May, June, and July, whereas for adult splittail the salvage densities were computed for December, January, February, and March. The average 1996–2010 SWP and CVP salvage densities were multiplied by CALSIM modeling estimates of exports at each of the export facilities to estimate the per capita salvage indices. The export estimates for May–July were used for the juveniles and those for December–March were used for the adults. CALSIM modeling results for 1922–2003 were used to compute the mean salvage with 95% confidence intervals for each model run. Normalizing salvage by population size was not possible because there are no reliable estimates of splittail population size.

5.B.5.4.5.2 Total Salvage Based on Yolo Bypass Inundation

Total expanded salvage of juvenile (meaning young-of-the-year) splittail was estimated as the product of CALSIM modeling estimates of volume of water exported and estimated salvage density. As noted above, salvage density is a function of the abundance and age of splittail present in the south Delta. The abundance of juvenile splittail varies greatly from year to year and is highly correlated with the availability of inundated floodplain spawning and rearing habitat, particularly on the Yolo Bypass (Sommer et al. 1997; Feyrer et al. 2006). The Yolo Bypass is large relative to other floodplain habitats in the Central Valley, so habitat on the Yolo Bypass is believed to have a particularly large influence on recruitment of juvenile splittail. The availability of Yolo Bypass spawning and rearing habitat would be strongly influenced by *CM2 Yolo Bypass Fisheries Enhancement*, as demonstrated in Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*, Section 5.C.5.4.1.1, *Sacramento Splittail Habitat Area*. If salvage density—i.e., the number of fish per unit volume of water—is a function of abundance, salvage density also should be correlated with Yolo Bypass habitat availability.

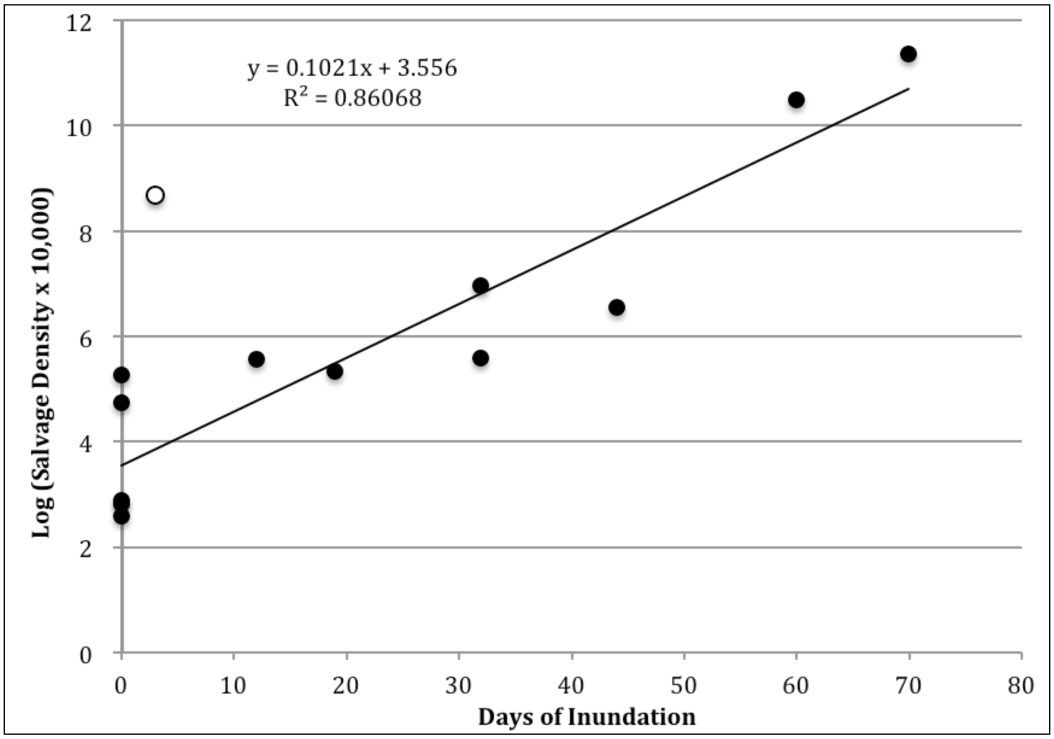
The relationship between salvage density of juvenile splittail and Yolo Bypass spawning and rearing habitat was estimated by regression analysis using annual average May–July salvage densities and number of days during February–June that the Yolo Bypass was inundated during 1996–2008. Most splittail spawning and early rearing occur during February–June (Sommer pers. comm.). The years 2009 and 2010 were not included in this analysis, as they were for the per capita salvage analyses, because days of inundation data were not available for these two years. Days of Yolo Bypass inundation were estimated from historical data on the number of days during which stage at Fremont Weir reached or exceeded 33.55 feet North American Vertical Datum (NAVD); at this stage, flow over the weir is 3,000 cfs and significant out-of-channel inundation begins (Bay Delta Conservation Plan Integration Team 2009). A log-linear regression (log of salvage density vs. days of inundation) was highly significant ($p < 0.01$) for both the SWP and CVP export facilities, indicating that salvage density increased exponentially with increases in the days of inundation (Figure 5.B.5-2 and Figure 5.B.5-3). The 2005 result for both facilities (open circle in the figures) was treated as an outlier and was excluded from the regression analyses. Salvage density was relatively high in 2005 despite the low number of days of Yolo Bypass inundation. However, 2005 was classified as an above-normal water year, which suggests that although flow in the Sacramento River was not high enough to cause much Fremont Weir overtopping, the Yolo Bypass may have received substantial flow from its west-side tributaries. Also, flows in the Sacramento River and its tributaries may have been high enough to provide substantial spawning and rearing habitat for splittail in areas other than the Yolo Bypass. The Sutter Bypass and flood terraces along the Sacramento River generally receive Sacramento River floodwater at lower flows than the Yolo Bypass (California Department of Water Resources 2010) and, therefore, probably produce much of the splittail young-of-year (YOY) recruitment that occurs in years with relatively few days of Yolo Bypass inundation. Inundated floodplains along the Cosumnes and San Joaquin Rivers also may contribute to YOY recruitment in years when the Yolo Bypass experiences little flooding.

The equations obtained from the regression analysis were used with CALSIM modeling estimates of daily February–June Fremont Weir flow, converted to days of inundation per year, to estimate annual average salvage densities at the SWP and CVP facilities under each of the EBC and ESO scenarios. These salvage density estimates then were multiplied by CALSIM modeling estimates of May–July total export volumes to estimate total salvage with 95% confidence intervals for each year of the CALSIM record. The confidence intervals were computed using the 95% confidence levels of the slope estimates of the regression.



Data from 2005 (open circle) were not included in the regression analysis, as discussed in the text.

Figure 5.B.5-2. Mean Annual Splittail Salvage Density at SWP vs. Number of Days of Yolo Bypass Inundation, 1996–2008



Data from 2005 (open circle) were not included in the regression analysis, as discussed in the text.

Figure 5.B.5-3. Mean Annual Splittail Salvage Density at CVP vs. Number of Days of Yolo Bypass Inundation, 1996–2008

This method for estimating total salvage has some limitations. For example, it does not provide a measure of splittail population size as a basis for evaluating the effect of entrainment on the population. Such a measure could be incorporated in the future, if available. Also, it is uncertain whether the relationship between days of inundation and salvage density that currently exists will continue to exist when the Yolo Bypass floods more frequently and at lower Sacramento River flows, as expected to occur with CM2. For instance, there is evidence from the historical record that years of high splittail YOY recruitment are followed by years of much lower recruitment, regardless of habitat conditions (Moyle et al. 2004), so increasing the frequency of years with high recruitment has the potential to affect the relationship with salvage that currently exists. The regression method could not be used to estimate total salvage for adult splittail because no basis for estimating the salvage densities of adult splittail for the different alternatives could be found.

5.B.5.5 Old and Middle River Flow Proportional Entrainment Regressions (SWP/CVP South Delta Export Facilities)

This method uses OMR flow data to estimate the proportion of fish populations that would be entrained. It has been applied to delta smelt in the USFWS (2008) BiOp and was used for analysis of the BDCP as described below. As discussed below, the method was not used for Chinook salmon because no statistically significant relationship was found between OMR flows and entrainment of these species.

5.B.5.5.1 Proportional Entrainment Loss Regressions: Delta Smelt

The proportion of the delta smelt population lost to entrainment at the south Delta export facilities was estimated for the various modeling scenarios with the regression equations used by USFWS (2008) for delta smelt. As noted below, the regression equations were based on the estimates of proportional entrainment by Kimmerer (2008), which are subject to uncertainty and scientific dispute (Kimmerer 2011; Miller 2011). Kimmerer's (2008) original estimates of entrainment loss had large confidence limits, which Kimmerer (2008: 24) noted could be reduced by additional sampling. Miller (2011) assessed the explicit and implicit assumptions of Kimmerer's estimation methods and surmised that for estimates of adult proportional entrainment, there were eight assumptions of which three may have biased the estimates upward, one may have estimated the bias downwards, and the remainder would not have resulted in bias. For larval-juvenile entrainment, Miller (2011) suggested that of ten assumptions made by Kimmerer (2008), eight of the assumptions would have resulted in upward bias and two would not have resulted in bias. Miller (2011) suggested methodological adjustments for four of the assumptions that could have resulted in bias of adult and juvenile proportional entrainment estimates, but was not able to quantify adjustments for eight of the potential assumptions leading to (upward) bias. In response to the quantifiable biases suggested by Miller (2011), Kimmerer (2011) concurred with one (leading to a downward adjustment of 24% of adult loss; see detail below in Section 5.B.5.5.1.2, *Adults*) and rejected the others. A number of assumptions that may introduce upward bias remain unresolved and contribute to uncertainty in the estimates, although they are the best available at the present time and in this effects analysis are used more to compare BDCP and existing conditions scenarios than to estimate loss rates.

The method of proportional entrainment loss by USFWS (2008) used two equations, one for larvae/juveniles and one for adults. The adult estimates incorporate a subsequent adjustment by Kimmerer (2011), in response to a bias identified by Miller (2011). The equations and the adjustment are described further below. The results for larvae/juveniles and adults were also combined to give an estimate of the proportion of the total population lost.

5.B.5.5.1.1 Larvae/Juveniles

For larval/juvenile delta smelt, a regression estimating percentage entrainment as a function of X2 and OMR flows was used to compare EBC and ESO scenarios. The relevant portions of the development of the regression described by USFWS (2008: 220) are as follows (section formatting has been applied to highlight the equation):

> Kimmerer (2008) proposed a method for estimating the percentage of the larval-juvenile delta smelt population entrained at Banks and Jones each year. These estimates were based on a combination of larval distribution data from the 20-mm survey, estimates of net efficiency in this survey, estimates of larval mortality rates, estimates of spawn timing, particle tracking simulations from DWR's DSM2 PTM, and estimates of Banks and Jones salvage efficiency for larvae of various sizes. Kimmerer estimated larval-juvenile entrainment for 1995–2005. We used Kimmerer's entrainment estimates to develop multiple regression models to predict the proportion of the larval-juvenile delta smelt population entrained based on a combination of X2 and OMR. Using Kimmerer's method, larval-juvenile [entrainment] is predicted to be 0 during periods of very high outflow. For instance, Kimmerer predicted entrainment loss was 0% in 1995 and 1998. For simplicity, we estimated the relationship between X2, OMR, and larval-juvenile entrainment without 1995 and 1998 in the model because the relationship between these variables is linear when only years that had entrainment higher than 0 were modeled. [W]e developed two separate models, one for the March–June averaging

> period and one for the April–May averaging period. The reason for using two spring averaging periods was to demonstrate that the conclusions are robust with regard to choice of averaging period; the predicted entrainment is very similar. The equations are:
>
> March–June % entrainment = (0.00933*March–June X2) – (0.0000207*March–June OMR) – 0.556
>
> and
>
> April–May % entrainment = (0.00839*April–May X2) – (0.000029*April–May OMR) – 0.487.
>
> The adjusted R^2 on these equations are 0.90 and 0.87, respectively. …Because the equations were based only on data that had non-zero entrainment, they predict entrainment proportions are negative during periods of very high outflow. The negative entrainment predictions were changed to 0% before summary analysis.

For this effects analysis, the March–June percentage entrainment regression was used. Average OMR flows for the months of March–June were obtained from CALSIM modeling of the 1922–2003 water-year simulation period; these flows were averaged by water year. X2 was also obtained from CALSIM results. Because X2 output in CALSIM for a given month actually indicates X2 at the end of the previous month, the CALSIM output months for X2 averaged for the analysis in each water year were April–July, which were assumed to represent the March–June period. Consistent with USFWS (2008: 220), estimates of negative entrainment were changed to 0 before data summary. To be consistent with the proportional entrainment equation for adults (described below), percentage entrainment (i.e., estimates ranging from 0 to 100%) of larvae/juveniles was converted to proportion of the population (i.e., estimates ranging from 0 to 1).

5.B.5.5.1.2 Adults

The proportion of the adult delta smelt population lost to entrainment at the south Delta export facilities also was estimated for the various modeling scenarios with a regression equation used by USFWS for delta smelt. The regression estimates proportional entrainment as a function of OMR flows. The relevant portions of the development of the regression described by USFWS (2008: 212) are as follows (section formatting has been applied to highlight the relevant equation):

> To quantitatively predict population losses of delta smelt, a suite of hydrodynamic variables were explored with adult entrainment loss estimates from Kimmerer (2008). Kimmerer (2008) calculated adult entrainment losses (December–March) using Kodiak trawl data for 2002–2005 and FMWT (November–December) for 1995–2005. For this analysis, the adult entrainment estimates from the FMWT estimates were used since they encompass a longer period by which to explore meaningful relationships. The model that explained adult entrainment losses (December–March) was the following:
>
> [proportional] adult entrainment loss = 6.243 – 0.000957*OMR Flow (December–March).
>
> The adjusted R^2 for this model was 0.36. … Note much of the variability in both the salvage and population loss model is left unexplained but the predictions in the models do follow the trend that salvage and population losses increase as OMR flows decrease. In part, the variation is not captured because adult salvage and entrainment is not solely explained by OMR flows. Entrainment is also related to the number of adults that migrate into the vicinity of Banks and Jones. Although WY type may sometimes affect the spawning distribution (Sweetnam 1999), there is wide, apparently random variation in the use of the Central and South Delta by spawning delta smelt. For example, there are years when a greater proportion of the smelt population moves into the vicinity of the export facilities, which may lead to larger salvage and population loss. Leaving aside differences due to

> spawning migration variability, the approach used here provides expected salvage and entrainment losses given an OMR flow.

Consistent with the larval/juvenile equation, the present analysis used estimates of OMR flow from CALSIM and negative estimates of proportional entrainment were changed to 0. Some of the unexplained variability in the adult delta smelt proportional entrainment regressions discussed by USFWS (2008: 212) is related to turbidity, which was found to be a significant predictor of salvage by Grimaldo et al. (2009). Turbidity modeling was not available to complement the OMR flows data from CALSIM, so the simpler approach used by USFWS (2008) was adopted for this effects analysis. It is acknowledged that this approach does not fully encompass all factors related to entrainment loss. Estimates of proportional entrainment loss solely based on OMR flow would be overestimates if turbidity in the south Delta was not sufficiently high to attract delta smelt into the area at the time of appreciably negative OMR flow. This potential bias is common to all scenarios examined in this effects analysis.

The estimates of adult delta smelt proportional entrainment loss calculated by Kimmerer (2008) were revisited by Miller (2011), who suggested that the estimates may have been biased high for several reasons. In response to Miller's (2011) reexamination of the Kimmerer (2008) entrainment estimates, Kimmerer reanalyzed the adult entrainment data and concluded (Kimmerer 2011: 4):

> Estimates of mean adult loss in Kimmerer (2008) should, therefore, be reduced by 24%.

Accordingly, the estimates of proportional entrainment loss calculated above for adults using the USFWS (2008) regression were reduced by 24%.

5.B.5.5.1.3 Total Population (Larvae/Juveniles and Adults Combined)

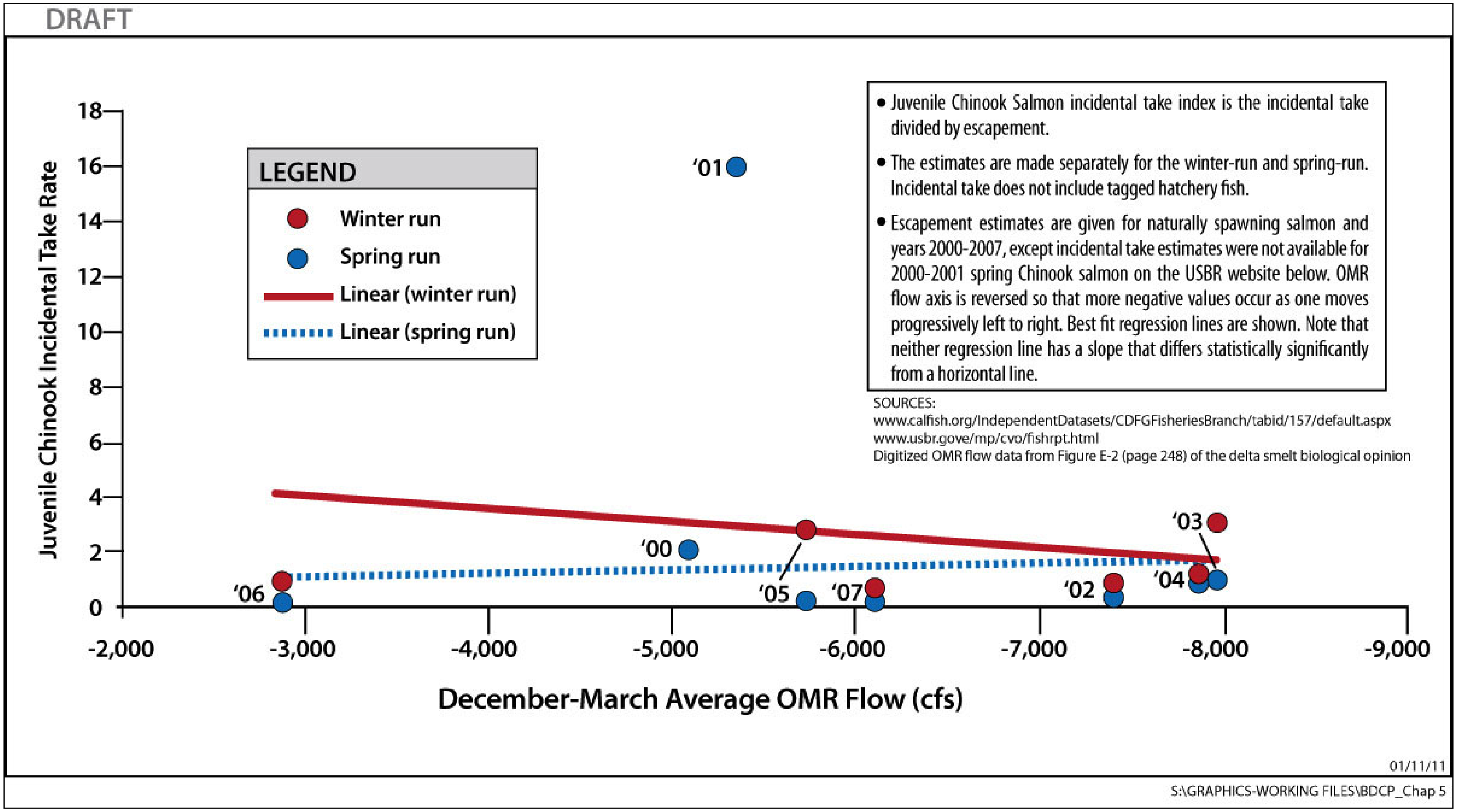
An estimate of the proportion of the total delta smelt population lost to entrainment in each water year was calculated from the estimates of the larval/juvenile and adult losses developed using the USFWS (2008) regressions, based on the equation of Miller (2011):

> Total proportion of population lost to entrainment = $1 - (1-p_A)\times(1-p_J)$

> where p_A is the proportion of adults lost to entrainment and p_J is the proportion of larvae/juveniles lost to entrainment.

5.B.5.5.2 Juvenile Winter-Run and Spring-Run Chinook Salmon Incidental Take Rate

For possible use in the effects analysis, relationships were investigated between juvenile Chinook salmon incidental take rate (entrainment loss divided by escapement size) at the SWP/CVP south Delta export facilities and OMR flows (Deriso 2010). The intention was to use any statistically significant regressions to estimate future juvenile losses. Results of the regression analyses did not reveal any statistically significant relationships (Figure 5.B.5-4), so the method was not used. Entrainment estimates for salmonids instead were based on the salvage-density method (described above) and proportional salvage as calculated in the DPM (described below).



- Juvenile Chinook Salmon incidental take index is the incidental take divided by escapement.
- The estimates are made separately for the winter-run and spring-run. Incidental take does not include tagged hatchery fish.
- Escapement estimates are given for naturally spawning salmon and years 2000-2007, except incidental take estimates were not available for 2000-2001 spring Chinook salmon on the USBR website below. OMR flow axis is reversed so that more negative values occur as one moves progressively left to right. Best fit regression lines are shown. Note that neither regression line has a slope that differs statistically significantly from a horizontal line.

SOURCES:
www.calfish.org/IndependentDatasets/CDFGFisheriesBranch/tabid/157/default.aspx
www.usbr.gove/mp/cvo/fishrpt.html
Digitized OMR flow data from Figure E-2 (page 248) of the delta smelt biological opinion

Source: Adapted from Deriso 2010.

Figure 5.B.5-4. Relationship between Average Monthly OMR Reverse Flows and a Normalized Juvenile Incidental Take Index for Winter-Run Chinook Salmon in December–March of 2000–2007

5.B.5.6 Particle Tracking Modeling: Larval Smelt Entrainment (SWP/CVP South Delta Export Facilities; SWP/CVP North Delta Intake; North Bay Aqueduct Barker Slough Pumping Plant; Agricultural Diversions)

5.B.5.6.1 Delta Smelt

DSM2 PTM was used to assess the potential for entrainment of delta smelt larvae by various types of water diversions in the Plan Area (i.e., the south Delta export facilities, agricultural diversions, and the NBA Barker Slough Pumping Plant; entrainment potential at the north Delta intakes also was assessed by consideration of PTM results but used a different approach, described below). The main approach assumed that the susceptibility of delta smelt larvae can be represented by entrainment of passive particles. Results of the simulation model do not represent the actual entrainment of larval delta smelt that may have occurred in the past or would occur in the future, but rather should be viewed as a comparative indicator of the relative risk of larval entrainment under existing biological conditions and the evaluated starting operations. For purposes of this effects analysis, those particles that were estimated to have entered the various water diversion locations included in the PTM outputs (e.g., south Delta export facilities, agricultural diversions, and NBA) are characterized as having been entrained.

Delta smelt starting distributions used in the PTM larval entrainment analysis were based on the CDFW 20-mm larval survey and were developed in association with M. Nobriga (USFWS Bay-Delta Office). This method paired observed delta smelt larval distributions with modeled hydrologic conditions from DSM2 PTM. Each pair was made by matching the observed Delta outflows of the first 20-mm survey that captured larval smelt (17 years of 20-mm surveys, 1995–2011) with the modeled Delta outflow of each defined hydrologic condition (27 hydrologic conditions).

The 20-mm survey samples multiple stations throughout the Delta fortnightly. The average length of delta smelt caught during each survey was averaged across all stations (8–10 surveys per year) (Table 5.B.5-6). The survey with mean fish length closest to 13 mm was chosen to represent the starting distribution of larval smelt in the Delta for that particular year (Table 5.B.5-6). During the period of record (1995–2011), the fourth survey was selected most frequently (range between the first and fifth surveys).

Once a survey date was chosen for a given year, the actual delta smelt catch during this survey was examined by station number (Table 5.B.5-7). Stations downstream of the confluence of the Sacramento and San Joaquin River confluence (in the Suisun Bay and Suisun Marsh subregions) were eliminated, as particles originating in these areas would not be subject to entrainment in the Delta and the PTM is better-suited for the channels of the Delta than for the open-estuary environment of Suisun Bay. Several stations in the Cache Slough area also were not included as they were introduced in 2008 and did not have data for the entire period from which starting distributions are calculated. A list of stations and count of delta smelt are provided in Table 5.B.5-7, along with the fish count not used to calculate the starting distribution, as a percentage of total fish caught during a given survey. Note that the percentage of larvae collected downstream of the Sacramento–San Joaquin confluence varies from zero to almost 100%, depending on water year. Delta smelt counts per station then were divided by contributing volume of a given station in acre-feet (Table 5.B.5-8), to remove spatial disparities, and percentages of the total number of delta smelt caught calculated by major region. The final annual starting distributions then were established by evenly distributing assigned percentages to each DSM2 PTM node (i.e., model particle insertion points) in a given area (Table 5.B.5-9).

Each of the 27 PTM hydroperiods was matched to one or more starting distributions based on the average monthly Delta outflow. Average monthly Delta outflow for the modeled PTM hydroperiods was based on CALSIM (EBC2 scenario) (Table 5.B.5-7). Average monthly Delta outflow during the selected 20-mm survey period was calculated from DAYFLOW. If the selected survey period spanned two months (usually April–May), outflow was provided for the month when most of the sampling occurred. This pairing resulted in a total of 38 combinations of hydroperiod and delta smelt distribution (Table 5.B.5-10). Particle entrainment analysis then was conducted for each matched hydroperiod, using the starting distributions summarized in Table 5.B.5-8. Note that in some cases (e.g., June 30, 1978), a single hydroperiod is matched to more than one starting distributions (Table 5.B.5-10). This reflects similar hydrology during several 20-mm surveys and allows differences in starting distributions to be considered with respect to the same hydrology. Results were summarized for 30-day and 60-day particle tracking periods.

Table 5.B.5-6. Delta Smelt Mean Length in 20-mm Larval Survey for Each Survey Period by Survey Year (1995–2011)

Year	Month of Selected Survey[1]	Mean Fish Length (mm) for Each Survey Period[2]								
		Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7	Survey 8	Survey 9
1995	April	**13.3**	19.2	19.9	19.0	21.1	21.0	21.2	24.2	–
1996	May	8.6	11.2	**14.5**	17.6	17.8	21.7	22.8	23.3	–
1997	May	7.8	9.8	12.2	**13.5**	17.2	23.5	24.9	25.4	25.5
1998	May	11.0	10.0	15.3	**14.2**	17.1	21.6	26.0	24.4	27.5
1999	April/May	10.2	**12.0**	15.8	20.3	19.1	18.9	21.4	23.2	–
2000	May	5.9	9.8	11.2	**12.5**	15.1	19.8	20.1	22.6	–
2001	May	7.5	8.6	10.6	11.5	**14.8**	21.2	23.6	25.6	–
2002	April/May	0.0	8.0	11.1	**13.9**	19.1	23.1	23.3	23.2	–
2003	May	6.3	10.2	10.8	**13.6**	16.4	19.7	20.4	20.3	–
2004	May	10.9	9.1	10.5	**16.8**	20.9	21.7	24.0	27.8	–
2005	April	6.7	11.0	11.7	**14.0**	14.9	20.1	22.2	24.8	20.8
2006	May	0.0	0.0	10.9	0.0	**13.8**	18.0	18.9	21.5	21.4
2007	April	5.6	6.3	9.5	**13.7**	12.3	22.0	21.6	25.0	27.7
2008	April/May	0.0	0.0	11.6	**14.1**	17.0	22.4	22.1	26.8	28.7
2009	April	0.0	0.0	9.4	**13.2**	10.9	18.0	23.6	21.8	23.5
2010	April	6.3	0.0	11.9	**13.4**	13.1	19.3	18.5	18.8	21.3
2011	April	6.0	5.0	8.5	**12.5**	16.7	15.8	16.7	19.2	20.8

[1] Month of survey period with mean delta smelt length approximately 13 mm.

[2] Average length of delta smelt caught at all stations, by survey number. Survey chosen to provide starting distribution values are highlighted in **red bold** font.

Table 5.B.5-7. Distribution of Larval Delta Smelt (Number of Smelt) in Selected Survey Period (Survey Number)

			Delta Smelt Count by Sampling Stations																			Number of Delta Smelt Caught at Other Stations		Percentage of Total Count Not Considered for Starting Distribution	
			West Delta/ Sacramento–San Joaquin Confluence				West Delta/Lower Sacramento River				Cache Slough and North Delta			West Delta/Lower San Joaquin River					South Delta		East Delta				
Year	Selected Survey Number1	Average Monthly Outflow (cfs)2	508	513	520	801	704	705	706	707	711	716	719	804	809	812	815	901	902–915	918	919	Cache Slough Stations	Downstream of Confluence	Cache Slough Stations	Downstream of Confluence
1995	1	90,837	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	7	0.0	63.6
1996	3	46,021	51	110	65	41	11	4	4	–	–	–	–	8	20	8	3	5	0	1	1	0	567	0.0	63.1
1997	4	12,257	–	3	26	2	8	12	14	–	7	6	–	32	13	6	5	5	4	–	5	0	66	0.0	30.8
1998	4	67,612	1	–	1	–	–	–	2	–	–	–	–	12	–	–	–	–	–	–	–	0	43	0.0	72.9
1999	2	35,509	3	1	–	8	4	–	–	–	–	–	–	15	–	–	18	7	45	–	–	0	127	0.0	55.7
2000	4	22,057	1	18	9	18	–	1	1	–	1	3	–	8	–	1	1	–	18	21	1	0	46	0.0	31.1
2001	5	9,612	–	1	–	–	3	14	5	11	1	5	–	–	28	49	13	13	11	1	10	0	8	0.0	4.6
2002	4	13,483	–	–	–	–	–	5	1	–	1	1	–	4	1	3	5	2	14	1	1	0	1	0.0	2.5
2003	4	41,877	1	1	1	2	–	1	–	–	–	2	–	4	1	–	–	1	8	–	–	0	7	0.0	24.1
2004	4	12,354	–	7	–	13	1	8	3	2	–	2	–	5	87	6	26	4	3	2	–	0	20	0.0	10.6
2005	4	29,876	2	7	2	1	–	–	1	–	–	1	–	–	–	–	1	–	2	1	–	0	50	0.0	73.5
2006	5	82,004	–	–	–	–	–	1	–	–	1	3	–	1	–	–	1	–	–	–	–	0	242	0.0	97.2
2007	4	11,235	–	–	–	–	–	–	1	–	1	–	–	–	–	–		–	–	–	–	0	1	0.0	33.3
2008	4	9,482	–	–	–	1	1	–	–	–	–	–	2	1	–	1	2	–	3	–	–	10	0	47.6	0.0
2009	4	11,944	–	–	–	–	–	1	–	–	–	1	12	–	–	–	1	–	2	–	–	4	1	18.2	4.5
2010	4	25,102	–	2	1	1	–	–	1	–	–	2	38	1	–	–	1	–	1	–	–	16	4	23.5	5.9
2011	4	84,981	–	–	1	–	–	–	–	–	–	1	39	–	–	–	–	–	–	–	–	4	120	2.4	72.7

[1] The first survey of the year when mean delta smelt length was closest to 13 mm.

[2] Average monthly Delta outflow calculated from observed vales in DAYFLOW. If the selected 5-day survey period occurred in two months, the predominant month was chosen for the mean flow.

1 **Table 5.B.5-8. Area of Water Represented by Each 20-mm Survey Station**

Station	Area (acres)	Station	Area (acres)
508	2,296	812	1,767
513	1,703	815	4,023
520	438	901	3,822
801	2,226	902	1,744
704	605	906	1,780
705	277	910	1,925
706	931	912	1,225
707	1,859	914	1,554
711	1,994	915	1,146
716	3,110*	918	1,601
719	3,110*		
804	1,195	919	2,043
809	1,392		

Source: Saha 2008.
*Acreage for Station 716 was split between Stations 716 and 719.

2

Table 5.B.5-9. Percentage of Particles at PTM Insertion Location Used as Starting Distributions in the Delta Smelt Particle Tracking Analysis

Subregion(s)/ Area	**Average Monthly Outflow in cfs:**	**9,482**	**9,612**	**11,235**	**11,944**	**12,257**	**12,354**	**13,483**	**22,057**	**25,102**	**29,876**	**35,509**	**46,021**	**67,612**
	Insertion Location	**Percentage of Particles**												
West Delta/ Sacramento–San Joaquin Confluence	Sacramento River at Sherman Lake	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65
	Sacramento River at Port Chicago	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65
	San Joaquin River downstream of Dutch Slough	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65
	Sacramento River at Pittsburg	16.52	7.72	1.65	0	8.21	0	0.11	2.65	0	6.55	2.65	19.9	3.65
West Delta/ Lower Sacramento River	Threemile Slough	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12
	Sacramento River at Rio Vista	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12
	Sacramento River downstream of Decker Island	1.30	0.67	4.24	8.76	6.96	10.64	9.10	2.35	6.00	4.13	2.35	2.13	2.12
Cache Slough and North Delta	Miner Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Sacramento Deep Water Ship Channel	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Cache Slough at Shag Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Cache Slough at Liberty Island	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Lindsey Slough at Barker Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Sacramento River at Sacramento	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Sacramento River at Sutter Slough	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Sacramento River at Ryde	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
	Sacramento River near Cache Slough confluence	0.32	0.35	0.06	5.86	1.26	1.05	0.40	0	9.11	0.60	0	0	0
West Delta/ San Joaquin River	San Joaquin River at Potato Slough	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34
	San Joaquin River at Twitchell Island	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34
	San Joaquin River near Jersey Point	0.80	2.86	25.12	7.00	10.87	11.13	19.73	17.80	0	13.16	17.80	4.24	26.34

Subregion(s)/ Area	**Average Monthly Outflow in cfs:**	**9,482**	**9,612**	**11,235**	**11,944**	**12,257**	**12,354**	**13,483**	**22,057**	**25,102**	**29,876**	**35,509**	**46,021**	**67,612**
	Insertion Location	**Percentage of Particles**												
West Delta and South Delta	San Joaquin River downstream of Rough and Ready Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	San Joaquin River at Buckley Cove	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	San Joaquin River near Medford Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Old River near Victoria Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Old River at Railroad Cut	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Old River near Quimby Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Middle River at Victoria Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Middle River u/s of Mildred Island	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Grant Line Canal	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
	Frank's Tract East	2.47	5.50	0.47	0	0.07	2.34	0.50	2.89	0	1.66	2.89	0.10	0
East Delta	Little Potato Slough	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0
	Mokelumne River downstream of Cosumnes confluence	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0
	South Fork Mokelumne	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0
	Mokelumne River downstream of Georgiana confluence	0	0.08	0	0	0.26	0.30	0.74	0.00	0	0	0	0.03	0
	North Fork Mokelumne	0	0.08	0	0	0.26	0.30	0.74	0	0	0	0	0.03	0
	Georgiana Slough	0	0.08	0	0	0.26	0.30	0.74	0	0	0	0	0.03	0

Table 5.B.5-10. Pairings of PTM Hydroperiods (DSM2–PTM) and Delta Smelt Starting Distributions (20-mm Larval Survey) for Larval Delta Smelt Entrainment Analysis

Starting Distribution/Hydroperiod	DSM2 Modeled Data		Larval Delta Smelt Distribution		Percent Difference in Outflow
	Modeled Hydroperiod	Modeled Delta Outflow[1]	Year of 20-mm Survey	Observed Delta Outflow[2]	
1. 2008 Dist/Dec 1923	12/31/1923	4,500	2008	9,482	110.7%
2. 2008 Dist/Jun 1940	6/30/1940	6,166	2008	9,482	53.8%
3. 2008 Dist/Jun 1934	6/30/1934	7,100	2008	9,482	33.5%
4. 2008 Dist/Apr 1929	4/30/1929	8,019	2008	9,482	18.2%
5. 2008 Dist/May 1966	5/31/1966	9,759	2008	9,482	-2.8%
6. 2001 Dist/May 1966			2001	9,612	-1.5%
7. 2007 Dist/Feb 1948	2/29/1948	11,145	2007	11,235	0.8%
8. 2009 Dist/Feb 1948			2009	11,944	7.2%
9. 1997 Dist/Feb 1948			1997	12,257	10.0%
10. 2004 Dist/Feb 1948			2004	12,354	10.8%
11. 2007 Dist/Jun 1978	6/30/1978	12,346	2007	11,235	-9.0%
12. 2009 Dist/Jun 1978			2009	11,944	-3.3%
13. 1997 Dist/Jun 1978			1997	12,257	-0.7%
14. 2004 Dist/Jun 1978			2004	12,354	0.1%
15. 2002 Dist/Jun 1978			2002	13,483	9.2%
16. 1997 Dist/Apr 1970	4/30/1970	13,369	1997	12,257	-8.3%
17. 2004 Dist/Apr 1970			2004	12,354	-7.6%
18. 2002 Dist/Apr 1970			2002	13,483	0.9%
19. 2002 Dist/Mar 1961	3/31/1961	13,725	2002	13,483	-1.8%
20. 2000 Dist/May 1937	5/31/1937	20,349	2000	22,057	8.4%
21. 2000 Dist/May 1935	5/31/1935	20,628	2000	22,057	6.9%
22. 2000 Dist/Feb 2003	2/28/2003	21,852	2000	22,057	0.9%
23. 2000 Dist/Mar 2001	3/31/2001	22,272	2000	22,057	-1.0%
24. 2000 Dist/Jun 1993	6/30/1993	22,451	2000	22,057	-1.8%
25. 2000 Dist/Mar 1942	3/31/1942	23,456	2000	22,057	-6.0%
26. 2010 Dist/Jan 1966	1/31/1966	24,810	2010	25,102	1.2%
27. 2010 Dist/Apr 1986	4/30/1986	27,195	2010	25,102	-7.7%
28. 2005 Dist/Apr 1986			2005	29,876	9.9%
29. 2005 Dist/May 1963	5/31/1963	30,035	2005	29,876	-0.5%
30. 1999 Dist/Mar 1993	3/31/1993	34,327	1999	35,509	3.4%
31. 1999 Dist/Dec 2002	12/31/2002	35,239	1999	35,509	0.8%
32. 1999 Dist/Jun 1952	6/30/1952	37,199	1999	35,509	-4.5%
33. 1996 Dist/Apr 1996	4/30/1996	45,853	1996	46,021	0.4%
34. 1996 Dist/May 1941	5/31/1941	47,347	1996	46,021	-2.8%
35. 1996 Dist/Jan 1971	1/31/1971	47,872	1996	46,021	-3.9%
36. 1996 Dist/Apr 1927	4/30/1927	52,656	1996	46,021	-12.6%
37. 1996 Dist/Feb 1945	2/28/1945	52,920	1996	46,021	-13.0%
38. 1998 Dist/Feb 1940	2/29/1940	64,008	1998	67,612	5.6%

[1] Mean monthly Delta Outflow—EBC2 from CALSIM.

[2] Mean monthly Delta Outflow—at time of 20-mm survey, from DAYFLOW.

Existing surveys (Smelt Larval Survey, Spring Kodiak Trawl, or 20-mm surveys) do not sample far enough upstream to inform the risk of entrainment at the proposed north Delta Intakes (see also analysis for delta smelt in Section 5.B.6.2.2.1, *Occurrence near the Proposed North Delta Intakes*). In order to assess the risk of entrainment at the north Delta intakes, PTM results were examined for the closest available particle insertion sites upstream (Sacramento River at Sacramento) and downstream (Sacramento River at Sutter Slough) of the proposed intakes. The percentage of particles entrained at each particle insertion site over 60 days was plotted in relation to north Delta intake export flow expressed as a percentage of Sacramento River inflow at Freeport. This allowed the downstream extent of entrainment risk to be evaluated in relation to potential flow reversals that could entrain delta smelt larvae upstream as well as the risk to those larvae that would be present in the reach of the river where the proposed north Delta intakes would be located. This analysis was conducted using the full modeled set of 38 PTM scenarios in order to provide a broader range of export to inflows for comparison, i.e., the analysis included all months and not just the months during which delta smelt larvae would typically occur in upstream areas.

5.B.5.6.2 Longfin Smelt

Longfin smelt are thought to be influenced by tidal and net currents while migrating downstream. The basic approach outlined under larval delta smelt entrainment (Section 5.B.5.6.1, *Delta Smelt*) was used to evaluate the effects of the evaluated starting operations on larval longfin smelt entrainment. The PTM was used to assess potential longfin smelt entrainment during the larval/young juvenile period (December–June). Note that the PTM analysis, in common with the majority of analyses included in the BDCP effects analysis, is intended to be a comparison of different scenarios and as such relies on relative differences between scenarios. Assumptions regarding starting distributions of longfin smelt are common to all scenarios and are not intended to provide estimates of actual levels of entrainment loss. Starting distributions were separated into wetter and drier distributions because entrainment of longfin smelt larvae/young juveniles is greatest during dry and critical water years. Starting distributions for PTM runs for longfin smelt included the geographic distributions used in the CDFW 2081 permit for the long-term operations of the CVP and SWP (California Department of Fish and Game 2009; Figure 5.B.5-5). The temporal distributions contained in that document were not used, as the PTMs applied for BDCP analysis were not consistent with that approach. In this modeling, only the insertion points used in the 2081 permit were given weight in the analysis. The other insertion points included in the model were given weights of zero. The insertion points (with associated CDFW survey station numbers in parentheses) used were located in the following areas: Sacramento River (706), Cache Slough Area (711, 716), San Joaquin River (809, 812, 815), and the south Delta (906). Because of the relatively limited availability of data describing larval longfin smelt distributions, a sensitivity analysis was conducted for the starting distributions described here. This analysis provided a range of potential values for larval entrainment based on various assumptions regarding the distribution of longfin smelt.

The analysis is based on a comparative assessment of simulated particles whose fate was determined in the PTM to be transported to various final destinations (south Delta export facilities, North Bay Aqueduct, and agricultural diversions). As noted above for delta smelt, the results of the simulation model do not represent the actual entrainment of larval longfin smelt that may have occurred in the past or would occur in the future, but rather should be viewed as a comparative indicator of the relative risk of larval entrainment under existing biological conditions and the evaluated starting operations. For purposes of this effects analysis, those particles that were estimated to have entered the various water diversion locations included in the PTM outputs (e.g., south Delta export facilities, agricultural diversions, and North Bay Aqueduct) are characterized as having been entrained.

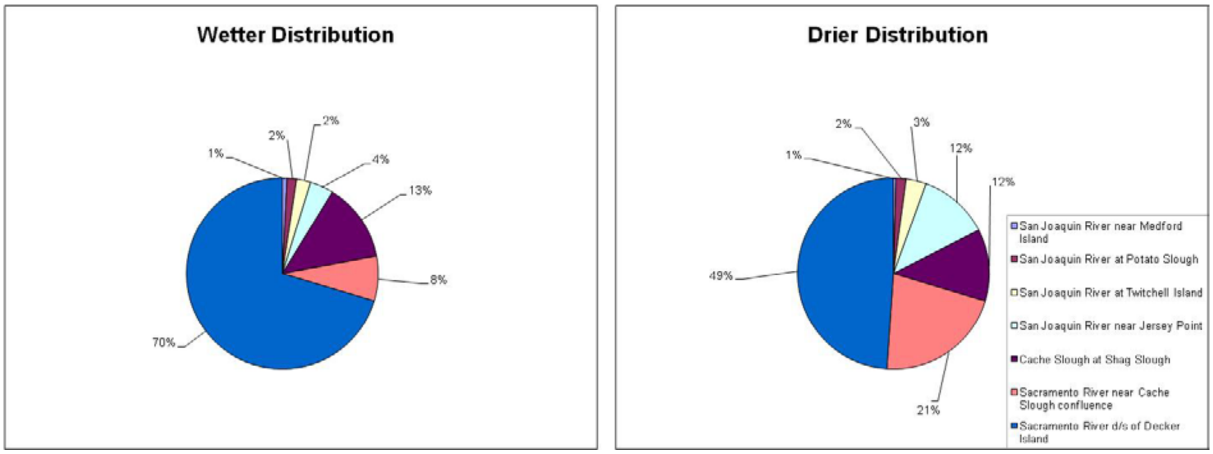


Figure 5.B.5-5. Distribution of Larval Longfin Smelt in Different Areas of the Delta

Historical salvage data indicate that juvenile and adult longfin smelt generally are salvaged in greater numbers at the SWP and CVP facilities in drier years. The larval longfin smelt PTM analysis included all months between December and June that were available for PTM runs, which resulted in 27 total hydroperiods, and the results of 30-day and 60-day PTM runs were summarized. Runs from drier periods may be more reflective of entrainment risk because a greater proportion of the population is within the hydrodynamic influence of the various water diversions in the West Delta, South Delta, Cache Slough, and North Delta subregions (i.e., the legal Delta). Given the uncertainty regarding larval longfin smelt distributions historically and in the future, the evaluation treats all PTM run periods equally. The wetter and drier distributions place around 1% of particles in the south Delta. Sensitivity analyses were used to address the potential for greater proportions of larval longfin smelt to be in the south Delta in the future (e.g., because of sea level rise and the need to move further upstream to spawn[8]): particle tracking runs with 2%, 10% and 15% of particles starting in the south Delta were also undertaken, by adapting the drier distribution (Table 5.B.5-11). Sensitivity analyses were undertaken only for 30-day tracking periods and did not include the EBC1 scenario.

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[8] It is unknown how longfin smelt would actually respond to shifts in salinity, but the sensitivity analysis is included to address the potential for greater occurrence further upstream. Note that longfin smelt spawning distribution includes not only the subregions of the legal Delta (i.e., Cache Slough, West Delta, South Delta, and North Delta) but also Suisun Marsh, Suisun Bay, the Napa River, and possibly tributaries of San Francisco Bay such as Coyote Creek (Rosenfield 2010:6). Such areas may also have longfin smelt moving further up into them in response to sea level rise.

Table 5.B.5-11. Starting Distributions Used to Examine the Sensitivity of Longfin Smelt Entrainment to Different Assumptions about the Percentage of Particles Starting in the South Delta (San Joaquin River near Medford Island)

	Original	2% in South Delta	10% in South Delta	15% in South Delta
San Joaquin River near Medford Island	1%	2%	10%	15%
San Joaquin River at Potato Slough	2%	2%	2%	2%
San Joaquin River at Twitchell Island	3%	3%	3%	3%
San Joaquin River near Jersey Point	12%	12%	11%	10%
Cache Slough at Shag Slough	12%	12%	11%	10%
Sacramento River near Cache Slough Confluence	21%	21%	19%	18%
Sacramento River downstream of Decker Island	49%	49%	45%	42%

As described above for delta smelt, existing surveys do not sample far enough upstream to inform the risk of entrainment at the proposed north Delta intakes because this reach is generally outside the main range of longfin smelt (see also analysis for longfin smelt in Section 5.B.6.2.3.1, *Occurrence near the Proposed North Delta Intakes*). The same methodology described above for delta smelt was used for longfin smelt, i.e., a comparison of the percentage of particles entrained from the Sacramento River at Sacramento (upstream of the intakes) and the Sacramento River at Sutter Slough (downstream of the intakes).

5.B.5.7 Delta Passage Model Salvage Estimates: Juvenile Chinook Salmon (SWP/CVP South Delta Export Facilities)

The DPM, described in more detail in Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*, provides estimates of the proportion of migrating Chinook salmon smolts (70-mm fork length and greater) salvaged at the SWP/CVP south Delta export facilities. Fish are divided by run and by river basin of origin (Sacramento, San Joaquin, or Mokelumne). The daily proportion of Chinook salmon smolts lost at the SWP/CVP south Delta export facilities was estimated by conducting an analysis of factors affecting the proportion of coded-wire-tagged (CWT) salmon recovered at the export salvage facilities from experimental releases. CWT recoveries used for analysis were expanded to account for subsampling that occurs at the export salvage facilities. For example, three CWT fish recovered in 6 hours of sampling would yield a salvage rate of 0.5 fish per hour. The expanded estimate of CWT fish for the corresponding 24-hour period would be 12 (0.5 fish per hour × 24 hours). However, expanded salvage loss estimates used for analysis here do not include prescreen predation mortality, for which a multiplier of several times may be necessary (Section 5.B.5.4, *Salvage-Density Method*). For fish entering the interior Delta from the Sacramento River (winter-run, spring-run, fall-run, and late fall–run) and Mokelumne River (fall-run), the daily proportion of fish salvaged was modeled using releases of CWT salmon into Georgiana Slough as part of the Delta Action 8 (DA8) experiments from Newman and Brandes (2009). A generalized linear model with a log-link function for the relationship between daily proportional salvage and total Delta exports was calculated:

$$\ln(\text{daily proportional salvage}) = -7.216+0.000266*\text{total exports}$$

$$R^2 = 0.30 \ (n = 15 \text{ observations})$$

This relationship was applied within the DPM to those fish entering the interior Delta through Georgiana Slough and the Delta Cross Channel. In contrast to the analysis conducted for San Joaquin River–origin fish (see below), no attempt was made to account for other factors (e.g., Sacramento River flow or proportion of flow entering Georgiana Slough) because DA8 CWT releases were made directly into Georgiana Slough.

Similar to the analysis for Sacramento River–origin fish, a relationship was developed for San Joaquin–origin Chinook salmon smolts (fall-run). As with the Sacramento River–origin smolts, a generalized linear model was used to examine factors explaining the proportion of CWT release groups recaptured at the pumping facilities. However, because these releases occurred upstream of the Delta, catch of those same CWT release groups in trawling at Chipps Island was included in the model, as well as factors such as Sacramento and San Joaquin flow, export levels, and proportion of flow entering Old River. For smolts entering the Delta from the San Joaquin River (San Joaquin fall-run), the daily proportion of fish salvaged was estimated using data from CWT smolts from Newman (2008b). Generalized linear models with a logit-link function for predicting proportional salvage resulted in a best-fit model that included the variables release location (location), number of CWT smolts recaptured in Chipps Island trawl surveys (chipps), mean 8-day flow (cfs) at Stockton following release (flow), total exports (exports), river temperature (Celsius) at release site (temp), and proportion of San Joaquin River flow in Old River (old):

$$\ln(\text{proportional salvage}) = B0+B1*\text{location}+B2*\text{chipps}+B3*\text{flow}+B4*\text{exports}+B5*\text{temp}+B6*\text{old}$$

Release location was held constant at Mossdale while Chipps catch and temperature were held at mean values in the model.

Therefore, daily proportional salvage changed as a function of daily San Joaquin River flow, total exports, and proportional Old River flow:

$$\ln(\text{daily proportional salvage}) = -5.46+0.862*(\text{location} = 3)+0.021*(\text{chipps} = 17.85)-0.000096*(\text{flow})+0.00019*\text{exports}-0.17*(\text{temp} = 17.12)+0.025*(\text{old})$$

$R^2 = 0.46$ (n = 82 observations)

For both Sacramento watershed– and San Joaquin watershed–origin fish, the daily proportional salvage was accumulated into a total annual salvage, which then was compared between the various scenarios for existing biological conditions and evaluated starting operations. Proportional salvage was expressed as a percentage of salmon smolts entering the Delta and as a percentage of total survival through the Delta. It should be noted that the salvage estimates from DPM were based on assumptions that only included changes in survival because of operations under the ESO of *CM1 Water Facilities and Operation* and *CM2 Yolo Bypass Fisheries Enhancement* and did not include other conservation measures such as nonphysical barriers, which could influence salvage and survival and are explored further in Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*.

5.B.5.8 Effectiveness of Nonphysical Fish Barriers (SWP/CVP South Delta Export Facilities)

CM16 Nonphysical Fish Barriers proposes installation and testing of nonphysical fish barriers at a number of locations in the Delta. Among the potential locations are the entrances to CCF (SWP south Delta export facilities) and the DMC (CVP south Delta export facilities). Nonphysical fish barriers consisting of combinations of bubble curtains, acoustic deterrence, and strobe lights have been tested since 2009 at various important channel divergences in the Delta (San Joaquin River–Old

River and Sacramento River–Georgiana Slough) with the primary goal of assessing effectiveness of the barriers in deterring downstream migrating Chinook salmon smolts from entering the interior Delta, where survival is relatively low. The nonphysical barriers function by enclosing unpleasant sound stimuli within a well-defined area enclosed by the bubble curtain. The main deterrent for the fish is the acoustic signal stimulus, with the bubble barrier and strobe lights enabling the fish to perceive where the sound is coming from in order to orient away from the stimuli (Bowen et al. 2009). Results from the head of Old River studies in 2009 suggest that deterrence (movement away from the barrier in response to the barrier's unpleasant stimuli, leading to avoidance of the less desirable migration pathway) may be high (~80%, although less at higher flows). Predation pressure, however, is very high at the head of Old River, especially around the nearby deep scour hole which serves as holding habitat for predators. Because of the elevated predation rates, overall survival of juvenile salmonids in 2009 was not improved even with the high deterrence effectiveness of the barrier. Higher flows in 2010 resulted in reduced effectiveness in deterring juvenile salmonids, as juveniles may have lacked the swimming ability to avoid the barrier and be effectively deterred from entering the Old River (Bowen et al. 2009; Bowen and Bark 2010).

The potential effectiveness of nonphysical barriers at the entrances to CCF and the DMC was assessed qualitatively based on several important factors, as follows.

- Water column position:
    - Depending on water depth, the bubble-generating apparatus may be close to the bottom (e.g., within 12 inches at the head of Old River) or in the midpoint of the water column (Sacramento River–Georgiana Slough) in order to preserve the integrity of the bubble barrier and the intensity of the acoustic stimuli.
    - This may influence the likelihood of fish encountering barriers or swimming beneath them.
    - Water depth at the entrances to the CCF and DMC are shallow enough to assume that the bubble-generating apparatus would be close to the bottom, as at head of Old River.
- Hearing ability:
    - Different fish species have different hearing abilities or sensitivities and so may be deterred to varying degrees.
- Escape ability:
    - Species and life stage of fish influence swimming ability and hence the ability to effectively orient away from and escape the unpleasant stimuli generated by the barrier.
    - Velocity through and parallel to the barrier interacts with swimming ability to determine escape ability; velocity data from DSM2 modeling of the DMC were used to inform escape ability assessment (such data were not available for CCF).
- Predation:
    - Installation of nonphysical barriers introduces new in-water structures to river channels that may serve as velocity refuges and ambush habitat for predatory fish.

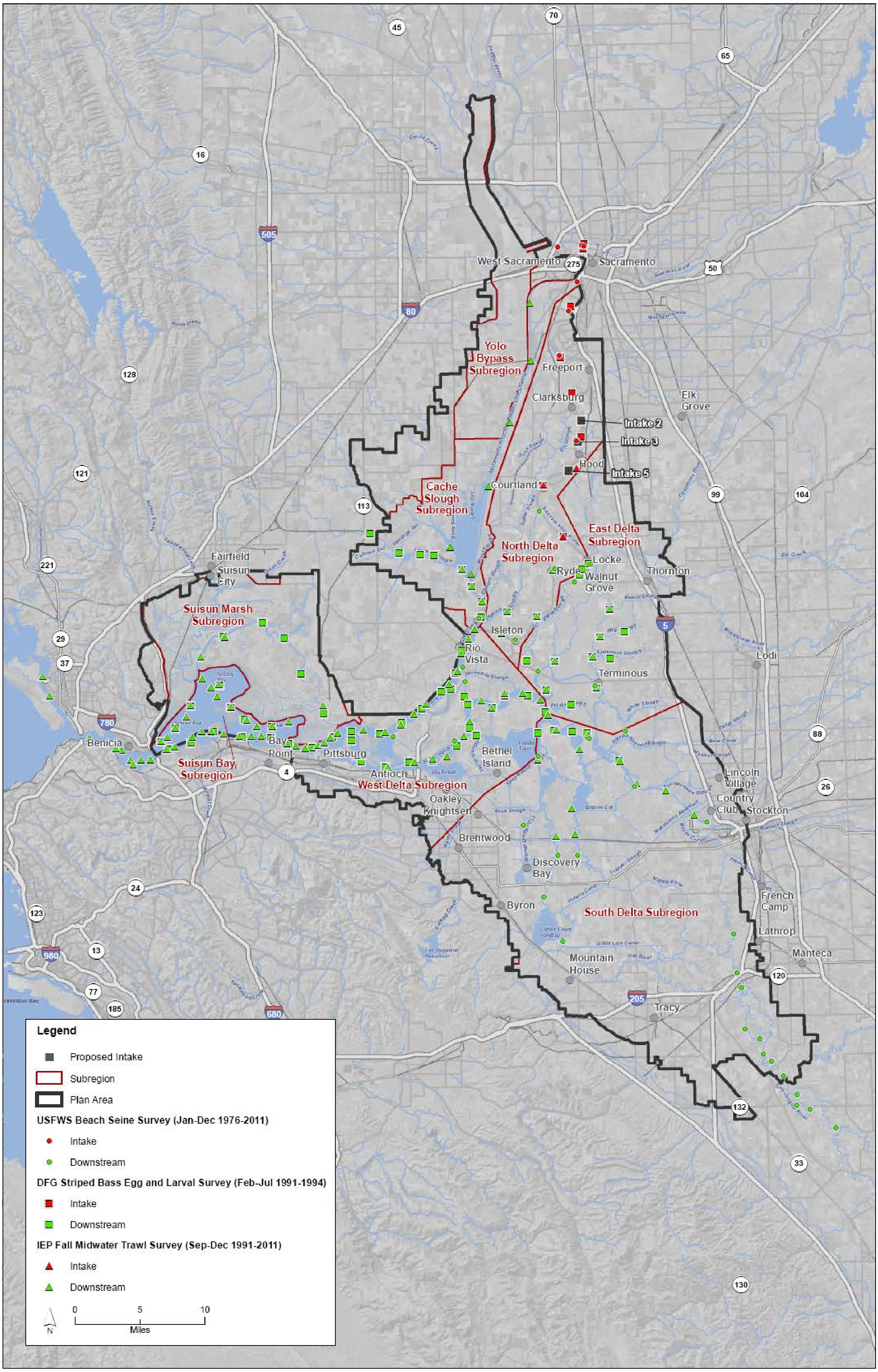
5.B.5.9 Entrainment and Impingement (SWP/CVP North Delta Intakes)

The north Delta intakes would be equipped with state-of-the-art positive-barrier fish screens. The fish screens would be designed and operated to appropriate approach velocity and screen mesh size (1.75 mm) criteria, although the exact velocity criteria have yet to be decided. The assessment of the risk of direct losses from entrainment and impingement on the north Delta fish screens was based on a qualitative assessment that considered screen design criteria, laboratory studies, and the probable sizes and distribution of covered fish species that may be exposed to the intakes. An analysis of potential predation on covered fish species at the proposed intakes is presented in Appendix 5.F, *Biological Stressors on Covered Fish*. As described above in Section 5.B.5.6, *Particle Tracking Modeling*, PTM results also were used to assess entrainment potential for delta smelt and longfin smelt larvae at the north Delta intakes.

5.B.5.9.1 Occurrence of Covered Species at the Proposed North Delta Intakes

Most covered fish species are anadromous and spawn in areas that are upstream of the proposed location of the north Delta diversion facilities. Accounts of the biology of each covered fish species are provided in Appendix 2.A, *Covered Species Accounts.* There is therefore potential for entrainment or impingement of various life stages, which was assessed qualitatively by literature review. Particular emphasis was placed on any known information regarding species distribution in nearshore or offshore areas to inform potential encounter with the proposed on-bank intakes. Modeling of the hydrodynamic zone of influence of the proposed north Delta intakes has not yet been undertaken. In order to provide a coarse perspective on the potential hydrodynamic zone of influence, the CALSIM-modeled proportion of river flow diverted at the proposed north Delta intakes was summarized as the percentage of flow.

Delta smelt and longfin smelt differ from other covered species in that their distribution and spawning areas are generally downstream of the proposed north Delta intakes (Moyle 2002). There is nevertheless the potential for entrainment and impingement of these species; accordingly, survey data that include the general vicinity of the proposed intakes were examined to inform the extent of exposure of the species. The survey data used included USFWS beach seine data (1976–2011, January–December), Interagency Ecological Program (IEP) fall midwater trawl data (1991–2010, September–December), and CDFW striped bass egg and larval survey data (1991–1994, February–July). For each of these surveys, stations on the Sacramento River between Georgiana Slough and approximately the northern limit of the Plan Area were designated as *intake* sites, for which occurrence of delta smelt and longfin smelt would indicate potential for entrainment or impingement (Figure 5.B.5-6). Summed catch data for these locations were then compared to other survey locations, which were designated as *downstream* sites.



Sources: Plan Area, DWR 2010; Subregion, ICF 2011; Beach Seine Survey, USFWS 2011; Striped Bass Egg and Larval Survey, DFG 1994; and IEP FMWT Survey, DFG-IEP 2011; Other FMWT Survey, DFG-IEP 2011; Hydrology, HDR 2011; Cities, U.S. Census Bureau 2010; Aerial Photograph, NAIP 2010.

Figure 5.B.5-6. Survey Station Locations Used to Assess the Potential Presence of Delta Smelt and Longfin Smelt in the Vicinity of the Proposed SWP/CVP North Delta Intakes

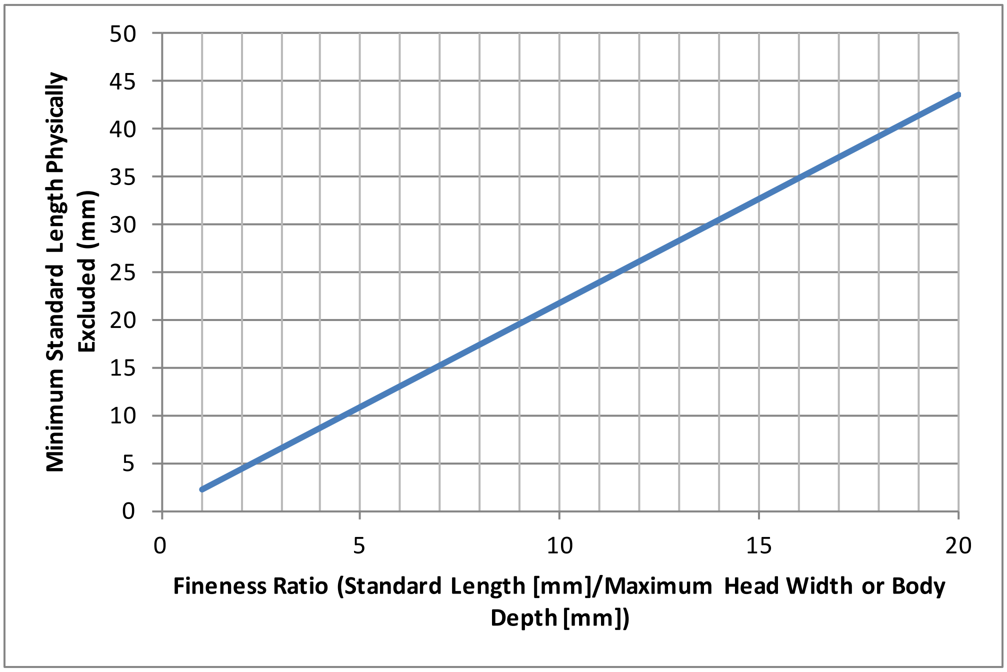
5.B.5.9.2 Entrainment

5.B.5.9.2.1 Screening Effectiveness Analysis

The size of larval and juvenile fish vulnerable to fish screen entrainment (i.e., passing through the screen) is a function of the slot opening of the screen mesh and the size (length and depth) of the fish (Turnpenny 1981; Margraf et al. 1985; Young et al. 1997). The analysis of the effectiveness of the north Delta intake screens in preventing entrainment was based on an assumed 1.75-mm smooth vertical wedgewire screen. The minimum size (standard length) of each covered fish species that would be entrained was estimated based on the equation originally formulated by Turnpenny (1981), as rearranged by Margraf and coauthors (1985) and presented by Young and coauthors (1997: 19; Figure 5.B.5-7):

$$SL = (0.06564 \times M + 1.199 \times M \times F)/(1 - 0.0209 \times M)$$

Where SL = standard length (mm), M = screen mesh size, F = fineness ratio (i.e., standard length/head width or body depth).



Based on equation provided by Young et al. 1997.

Figure 5.B.5-7. Minimum Standard Length of Fish Physically Excluded by 1.75-mm Vertical Wedgewire Screens

For most species, head width would be smaller than body depth and, given the vertical openings of the proposed screens, would be the most appropriate denominator for the fineness ratio. Fineness ratios for delta smelt were calculated from Young and coauthors (1997), using the formula relating head width to standard length.

$$\text{Head width (mm)} = -3.724 + (0.392 \times SL) - (0.006 \times SL^2) + (0.00004 \times SL^3)$$

This formula indicated a representative fineness ratio of around 10 would occur for delta smelt of around 20 mm or less. Fineness ratios for delta smelt were assumed to be representative of other covered species except sturgeons and lampreys. It is unlikely that the other covered fish species have greater fineness ratios than delta smelt—the other species tend to be similarly or more wider-headed than delta smelt, relative to body length—so that an assumption of a fineness ratio of 10 may be reasonable given that minimum size of entrainment increases with increasing fineness ratio. For juvenile sturgeons, body depth may be a more appropriate minimum measurement; this was estimated from juvenile sturgeon pictures presented by Wang (1986). Representative fineness ratios for each covered species are presented in Table 5.B.5-12. The estimated standard lengths of fish that could be entrained were then related to the sizes of fish typically occurring in the vicinity of the proposed north Delta diversions, based on literature and unpublished data. Recent entrainment monitoring data from the Freeport Regional Water Project intake were also considered (Kozlowski, pers. comm). The potential for entrainment of earlier life stages (e.g., eggs) was assessed based on existing literature and monitoring studies of distribution. Analyses for lamprey ammocoetes were based on the recent laboratory screening study by Rose and Mesa (2012), who examined entrainment through screens made of different materials and aperture sizes, including 1.75-mm vertical bar screens that are similar to those proposed for the north Delta intakes.

Table 5.B.5-12. Fineness Ratios of Larval/Early Juvenile Covered Fish Species Assumed in the Analysis of Entrainment at the Proposed SWP/CVP North Delta Intakes

Species	Fineness Ratio (Standard Length/Body Depth)
Steelhead	10
Chinook salmon	10
Delta smelt	10
Longfin smelt	10
Sacramento splittail	10
White sturgeon	5
Green sturgeon	5

5.B.5.9.3 Impingement and Screen Contact

The potential for effects of the proposed north Delta diversions in terms of impingement and screen contact primarily was assessed using the results of studies conducted at the University of California, Davis (UC Davis) Fish Treadmill Facility (Swanson et al. 2004a). These studies examined the effects of various approach and sweeping velocities during daytime and nighttime at different temperatures on covered fish species' swimming behavior and screen interactions, and were conducted for steelhead, Chinook salmon, delta smelt, Sacramento splittail, and green sturgeon. The effects analysis of the proposed north Delta intake screens is qualitative because sweeping velocities in the vicinity of the screens have not been modeled with simulated operation of the screens. As described above in Section 5.B.3.3, *SWP/CVP North Delta Intakes*, the three screened intakes at the proposed north Delta diversions would range from 1,800 to 1,950 feet long. CALSIM/DSM2 modeling of diversions at the proposed north Delta intakes assumed that diversions could only occur at sweeping velocities greater than or equal to 0.4 ft/sec, which corresponded to at least twice an approach velocity criterion of 0.2 ft/sec that has been required in areas where delta smelt occur. However, velocities in CALSIM/DSM2 are channel cross-section averages, and therefore would not represent the range of velocities that would occur across the channel, with lower velocities expected at the channel margins where the on-bank intakes would be (Pandey and Smith 2010). Three-dimensional modeling will further inform velocities that may occur in the vicinity of the north Delta diversions, allowing more detailed assessment of potential effects on covered fish species. Approach velocities of 0.2 ft/sec are likely to be required during delta smelt presence. Approach velocities of 0.33 ft/sec or less meet the criterion for Chinook salmon fry. Given that most species show differing responses to fish screens during the day compared to at night, different operating criteria may be adopted for day and night.

Various aspects of fish interactions with screens from equations derived from the UC Davis Fish Treadmill studies were modeled for several different environmental conditions that represent a range of conditions that could occur at the proposed north Delta intake screens. For each species for which equations were available (Chinook salmon, delta smelt, and Sacramento splittail), interactions were assessed for 800-foot and 2000-foot screen lengths, by day and night, at approach velocities of 0.2 and 0.33 ft/sec, and at sweeping velocities between 0.1 and 2 ft/sec. These screen lengths illustrate the potential effects on fish passing close to the entire length of the proposed intakes (around 2,000 feet), as well as those that may approach only a portion of an intake (800 feet, or less than half the length of a given intake). These two screen lengths originally were selected to encompass the minimum and maximum screen lengths considered during the development of alternative intake locations/dimensions. The analysis was limited to equations calculated for a temperature of 12°C, which according to DSM2 modeling for Freeport is similar to temperatures in February–March. Key terms in these analyses include approach velocity (water velocity towards and perpendicular to the screen face), sweeping velocity (water velocity parallel to the screen face), swimming velocity (velocity through the water but not over the bottom), and screen passage velocity (velocity of fish moving past the screen, either upstream or downstream). Note that the final quantities of interest (i.e., percentage mortality and number of screen contacts) in these analyses are estimated from a series of linked equations that explain different quantities of variation in the underlying experimental data. The analyses do not account for the potential propagation of uncertainty introduced from combination of the results of each regression. Note also that the experiments upon which the regressions are based were conducted in relatively benign laboratory conditions and do not account for environmental conditions that could influence fish swimming performance (e.g., water quality other than temperature, or reduced visibility during the day because of turbidity).

5.B.5.9.3.1 Juvenile Chinook Salmon (Screen Passage Time)

Swanson and coauthors (2004b) found that juvenile Chinook salmon mortality and injury rate in fish treadmill experiments were not statistically related to flow regime or screen contact rate. Although Swanson and coauthors (2004b) provide equations to estimate screen contact rate for juvenile Chinook salmon, preliminary calculations for this effects analysis suggested that these equations did not perform well for the lengths of screen contemplated for the proposed north Delta intakes. Screen passage time is another useful measure of potential effects on Chinook salmon, with shorter passage times being desirable. To illustrate the potential passage time at the proposed north Delta intake screens, screen passage time for juvenile Chinook salmon of the smallest (4.4 centimeters [cm] SL [Standard Length (mm)]) and largest (7.9 cm SL) sizes examined by Swanson and coauthors (2004b) was calculated by dividing screen length by screen passage velocity, based on Swanson et al.'s (2004b) equation for the latter.

> Screen passage velocity (cm/s) = 30.94 – 11.87(day/night; day =1, night = 2) - 1.32(sweeping velocity, cm/s) + 0.72(swimming velocity, cm/s) – 0.39(orientation, degrees) + 0.27(sweeping velocity × day/night); n = 124, $r^2 = 0.9064$, SEE = 6.56

Swimming velocity and orientation for the above equation were calculated using other equations from Swanson and coauthors (2004b):

Swimming velocity (cm/s) = 27.35 – 12.85(day/night; day =1, night = 2) - 1.25(standard length, cm) + 0.21(resultant water velocity [cm/s] × day/night); n = 142, $r^2 = 0.7517$, SEE = 4.09

Orientation (degrees) = 112.7 – 41.1(day/night, day = 1, night = 2) + 3.6(temperature, °C) – 1.4(resultant water velocity, cm/s) -1.1(swimming velocity, cm/s) – 0.3(flow angle, degrees) + 0.6(resultant water velocity × day/night); n = 124, $r^2 = 0.4877$, SEE = 18.8

In the above equations, resultant water velocity was calculated as the square root of (approach velocity^2 + sweeping velocity^2) and flow angle was calculated as the arctangent of (approach velocity)/(sweeping velocity), as described by Swanson and coauthors (2004b).

5.B.5.9.3.2 Juvenile and Adult Delta Smelt (Percentage Mortality)

For juvenile and adult delta smelt (4.6–6.3 cm SL), calculations were made of percentage mortality based on the equations of Swanson and coauthors (2005). Note that 'percentage mortality' only refers to the delta smelt occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones occurring near the river margins where the on-bank intakes would be sited.

48-hour % mortality (day) = -26.59 + 171.90(contact rate, contacts/fish/min) + 1.31(temperature, °C) + 1.04(approach velocity, cm/s); n= 56, $r^2 = 0.4815$, SEE = 13.31

48-hour % mortality (night) = -35.09 + 7.63(contact rate, contacts/fish/min) + 1.75(temperature, °C) + 2.16(approach velocity, cm/s) + 0.05(approach velocity × sweeping velocity, cm/s); n= 56, $r^2 = 0.7667$, SEE = 13.77

Contact rates in the above equations were calculated from the equations of Swanson and coauthors (2005).

Contact rate (day, contacts/fish/min) = 0.0035(approach velocity, cm/s) + 0.0001(approach velocity × sweeping velocity, cm/s); n = 95, $r^2 = 0.6454$, SEE = 0.0556

Contact rate (night, contacts/fish/min) = 0.0164(approach velocity, cm/s) + 0.0002(approach velocity × sweeping velocity, cm/s); n = 61, $r^2 = 0.4315$, SEE = 0.5405

Percentage mortality estimates assume a 2-hour screen exposure because this was the standard duration of the Fish Treadmill experiments. Mortality was adjusted to reflect estimated exposure duration. Exposure duration was estimated as a function of screen passage velocity, which was calculated from the equations of Swanson and coauthors (2005).

Screen passage velocity (day, cm/s) = -12.11 + 0.92(sweeping velocity, cm/s) + 1.32(swimming velocity, cm/s); n = 87, $r^2 = 0.9689$, SEE = 3.78

Screen passage velocity (night, cm/s) = -0.91(sweeping velocity, cm/s) + 0.36(swimming velocity, cm/s); n = 43, $r^2 = 0.9794$, SEE = 4.59

Screen passage velocity in the above equations was a function of swimming velocity, which again was estimated using the equations of Swanson and coauthors (2005).

Swimming velocity (day, cm/s) = 11.24 + 0.24(approach velocity, cm/s) + 0.09(sweeping velocity, cm/s) + 0.37 (temperature, °C); n = 87, $r^2 = 0.3412$, SEE = 4.30

Swimming velocity (night, cm/s) = 11.24 + 0.24(approach velocity, cm/s) + 0.09(sweeping velocity, cm/s) + 0.37 (temperature, °C); n = 87, $r^2 = 0.3412$, SEE = 4.30

5.B.5.9.3.3 Adult Delta Smelt (Number of Screen Contacts)

Screen contact rate has positive correlation with stress (measured as plasma cortisol) in adult delta smelt (Young et al. 2010). For adult delta smelt (>5 cm SL), calculations were made of the number of contacts with a screen based on the equations of Young and coauthors (2010). These experiments were only conducted during the day. Contact rate was calculated as follows.

Contact rate (contacts/fish/min) = 0.042 + 0.009(approach velocity, cm/s) – 0.001(sweeping velocity, cm/s); $r^2 = 0.421$

Total number of contacts was calculated as contact rate multiplied by exposure duration, which was calculated based on screen length and swimming velocity, with the latter estimated based on the equation of Young and coauthors (2010).

Swimming velocity (cm/s) = 14.283 + 0.459(approach velocity, cm/s) + 0.117(sweeping velocity, cm/s) – 0.003(approach velocity × sweeping velocity, cm/s); $r^2 = 0.410$

5.B.5.9.3.4 Juvenile Sacramento Splittail (Number of Screen Contacts)

For juvenile Sacramento splittail (4 cm and 6 cm SL), calculations were made of the number of contacts with a screen based on the equations of Swanson and coauthors (2004a). Contact rate for juvenile splittail was estimated as follows.

Contact rate (day, contacts/fish/min) = 0.093(standard length, cm) – 0.004(distance from screen, cm) – 0.024(approach velocity, cm/s) + 0.0001([sweeping velocity]^2, cm/s) + 0.0005(approach velocity × sweeping velocity, cm/s) – 0.002(standard length × sweeping velocity); n = 52, $r^2 = 0.7211$, SEE = 0.093

Contact rate (night, contacts/fish/min) = 1.80 – 0.053(approach velocity, cm/s) - 0.024 (sweeping velocity, cm/s) + 0.0002([sweeping velocity]^2, cm/s); n = 33, $r^2 = 0.6017$, SEE = 0.2814

For the daytime contact rate estimation, it was assumed that juvenile splittail were swimming 31 cm from the screen (distance from screen, above). Total number of contacts per fish was estimated from contact rate and exposure duration. Exposure duration was estimated from screen length and screen passage velocity, with the latter estimated using the equations of Swanson and coauthors (2004a):

Screen passage velocity (day, cm/s) = 77.83 – 1.26(sweeping velocity, cm/s) – 0.66(orientation, degrees); n = 55, $r^2 = 0.9299$, SEE = 12.41

Screen passage velocity (night, cm/s) = 24.24 – 0.90(sweeping velocity, cm/s) – 0.28(orientation, degrees); n = 17, $r^2 = 0.9541$, SEE = 5.61

Experimental observations generally suggested that juvenile splittail were positively rheotactic (i.e., swam downstream with flow; Swanson et al. 2004a), so the orientation in the above equations was set to 180 degrees.

5.B.5.9.3.5 Pacific and River Lamprey Ammocoetes and Macropthalmia

The above-described UC Davis Fish Treadmill experiments did not investigate fish screen effects on any life stages of Pacific or river lamprey. For this effects analysis, the studies of Ostrand (2007) and Rose and Mesa (2012) were used to provide some characterization of potential effects on these species. Ostrand (2007) examined impingement of Pacific lamprey macropthalmia (average size = 145-mm total length) on various screen types with different aperture sizes. Rose and Mesa (2012) tested Pacific lamprey ammocoetes' (28–153 mm total length) susceptibility to entrainment and impingement during exposure to various screens with an approach velocity of 12 cm/sec (0.4 ft/sec). The relevant aspects of these studies were discussed in relation to the potential effects of the proposed north Delta intakes for impingement and screen contact.

5.B.5.10 Agricultural Diversions (Cache Slough, North Delta, West Delta, East Delta, South Delta, and Suisun Marsh Subregions)

5.B.5.10.1 Particle Tracking Modeling and Proportional Reduction in Number of Intakes (Larval Smelt Entrainment)

As described above in Section 5.B.5.6, *Particle Tracking Modeling*, PTM was used to estimate entrainment of larval delta smelt and longfin smelt by agricultural diversions in the Delta. The potential reduction in entrainment caused by decommissioning of agricultural diversions in ROAs under the evaluated starting operations was estimated by enumerating the number of diversions in the ROAs that would be eliminated in the ELT and LLT and relating this to the total number of intakes in the Delta. Data on intake locations were obtained from the CDFW Passage Assessment Database (California Department of Fish and Game 2010). As the information about agricultural intake size and operations is generally lacking, it was assumed that the intakes were all of similar size and that the reduction in diversions and hence entrainment would be proportional to the percentage reduction in the number of intakes.

5.B.5.10.2 Delta Regional Ecosystem Restoration Implementation Plan Analysis of CM21 Nonproject Diversions

The 2009 DRERIP analysis of the formerly proposed BDCP Other Stressors Conservation Measure (OSCM) 21, Nonproject Diversions (Cavallo et al. 2009), was used to qualitatively assess the magnitude and certainty of positive effects of removing agricultural diversions during habitat restoration in the ROAs as well as the remaining elements of the current *CM21 Nonproject Diversions*, described in detail in Chapter 3, Section 3.4, *Conservation Measures*: removal of diversions that have relatively large effects on covered fish species; consolidation of multiple unscreened diversions; relocation of diversions in conjunction with screening; reconfiguration and screening of diversions; and voluntary alteration of the daily and seasonal timing of diversion operation. OSCM21, which is no longer a conservation measure proposed under the BDCP but is very similar to CM21, proposed to screen or alter priority (>50 cfs) unscreened nonproject (i.e., non–SWP/CVP) diversions in the Plan Area, primarily including agricultural diversions and diversions for waterfowl habitat. The analysis of the previously proposed OSCM21 is highly relevant to the present effects analysis of CM21 because the proposed measures are very similar, e.g., CM21 proposes to prioritize screening or alteration of larger intakes (>100 cfs).

5.B.5.11 Analysis of Potential Entrainment Differences Between Evaluated Starting Operations (ESO), High-Outflow Scenario (HOS), and Low-Outflow Scenario (LOS)

The methods discussed above for SWP/CVP export facilities south Delta entrainment were applied to the EBC and ESO scenarios. As discussed in Section 5.B.4.5, *Differences Between Evaluated Starting Operations, High-Outflow Scenario, and Low-Outflow Scenario*, there generally are few differences between ESO and LOS scenarios in exports during the main winter/spring period (December–June) of concern for most covered fish species. The potential for entrainment during this period under the HOS generally is lower than under the ESO because of lower exports and greater outflow. Rather than conducting the quantitative analyses of entrainment that were done for the ESO and EBC scenarios, the analysis of entrainment under LOS and HOS scenarios generally was qualitative for most species based on winter/spring exports under the LOS/HOS scenarios being similar or lower. The exception to this was larval/juvenile delta smelt, for which estimates of proportional entrainment loss are a function of March–June OMR flow and outflow (X2) (see Section 5.B.5.5.1.1, *Larvae/Juveniles*). The analysis was rerun to compare differences in proportional entrainment between ESO, HOS, and LOS scenarios. Also included in the analysis for delta smelt were the total population proportional entrainment losses, which are the combination of adult losses (December–March, during which OMR flow varies relatively little) and larval/juvenile losses using Miller's (2011) formula and the adult loss adjustment of Kimmerer (2011).

The seasonal distribution of some covered fish species (late fall–run Chinook salmon, white sturgeon, and green sturgeon) has more overlap than other covered species with the fall period during which exports differ because of Fall X2 requirements. Therefore, the salvage-density method was used to compare differences in entrainment index among the ESO, HOS, and LOS scenarios for these species. For late fall–run Chinook salmon, only the analyses related to normalized population data were undertaken because the relative difference between scenarios is very minor for normalized and nonnormalized results. For the sturgeons, only the analyses for the Sacramento Valley water year classification were undertaken because there is little relative difference between the results for the Sacramento and San Joaquin classifications.

5.B.6 Results

5.B.6.1 SWP/CVP South Delta Export Facilities (South Delta Subregion)

The results of the entrainment analyses for the SWP/CVP south Delta export facilities are presented generally by species and life stage and analysis method. However, the analysis of effectiveness of nonphysical barriers is presented at the end of the species-specific sections as all species are discussed together.

5.B.6.1.1 Steelhead (Juvenile)

5.B.6.1.1.1 Salvage-Density Method

The basic seasonal pattern of salvage of steelhead upon which the salvage-density method is based is presented in Figure 5.B.6-1, although note that this is an average of all years combined and does not account for water-year differences. Entrainment peaks in February at both SWP and CVP facilities and is also relatively high in January and March.

Estimated losses for juvenile steelhead were approximately four times greater at the SWP export facility compared to the CVP export facilities (Table 5.B.6-1 through Table 5.B.6-6), with losses at both facilities generally from 1,000 to 10,000 fish per year. Losses were greatest in above-normal and below-normal years and least in critical water years.

Over all years, there was a decrease in entrainment loss of juvenile steelhead under ESO scenarios compared to EBC scenarios that was quite consistent regardless of the comparison made and ranged from 4,500 to 4,800 fish (51–52% reduction at both facilities combined; Table 5.B.6-7). Decreases under EBC scenarios were greatest in wet (~4,200–4,400 fish; 66–68% reduction), above-normal (~7,000–7,800 fish; 54–58% reduction), and below-normal years (~3,600–4,700 fish; 33–39% reduction). In dry and critical years losses were around 900–2,200 lower under ESO scenarios compared to EBC scenarios (16–29%) (Table 5.B.6-7).

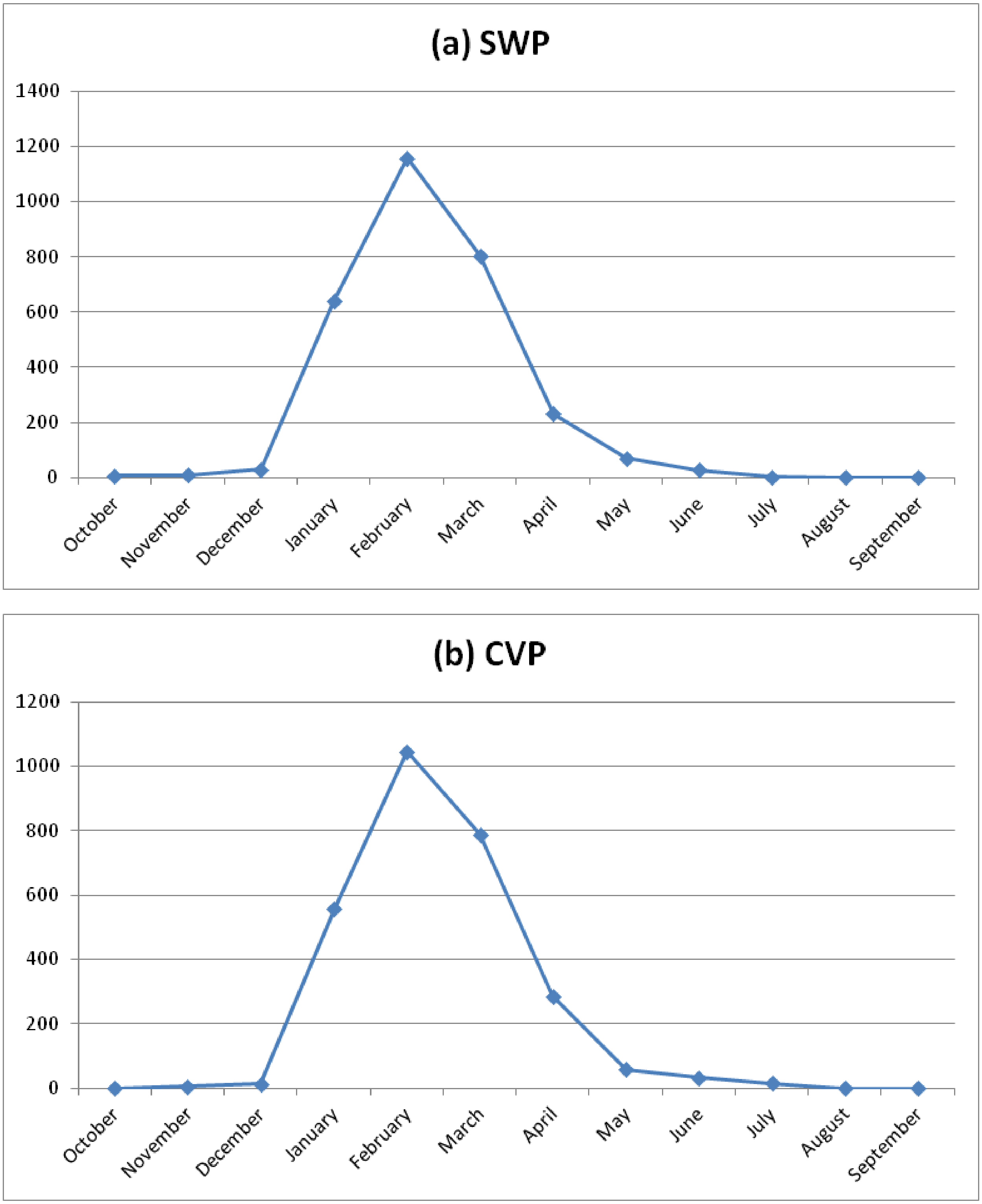


Figure 5.B.6-1. Mean Monthly Salvage of Juvenile Steelhead Calculated from Observed Salvage Monitoring at the (a) SWP and (b) CVP South Delta Export Facilities, Water Years 1996–2009

Table 5.B.6-1. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	***Avg***	**±**	***95% CI***	***Avg***	**±**	***95% CI***	***Avg***	**±**	***95% CI***	***Avg***	**±**	***95% CI***	***Avg***	**±**	***95% CI***	***Avg***	**±**	***95% CI***
(a) SWP																		
October	25	±	3	18	±	2	16	±	2	12	±	2	6	±	1	5	±	1
November	28	±	4	20	±	3	19	±	3	18	±	3	9	±	1	9	±	2
December	121	±	13	122	±	13	119	±	13	117	±	13	79	±	9	81	±	9
January	1,459	±	152	1,485	±	158	1,507	±	163	1,487	±	159	673	±	78	636	±	72
February	3,628	±	246	3,689	±	253	3,748	±	261	3,491	±	245	1,601	±	121	1,518	±	116
March	2,654	±	189	2,711	±	197	2,713	±	201	2,632	±	198	823	±	65	913	±	76
April	389	±	24	404	±	26	414	±	27	429	±	27	269	±	14	259	±	13
May	230	±	16	238	±	19	252	±	19	254	±	19	133	±	7	124	±	6
June	100	±	10	100	±	11	95	±	10	83	±	9	43	±	4	39	±	4
July	18	±	2	17	±	2	17	±	2	15	±	2	10	±	1	9	±	1
August	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0
September	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
Annual Average	8,654	±	440	8,805	±	458	8,902	±	473	8,541	±	454	3,645	±	186	3,593	±	184
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	5	±	1	5	±	1	5	±	1	5	±	1	1	±	0	1	±	0
December	16	±	2	17	±	2	16	±	2	15	±	2	8	±	1	7	±	1
January	478	±	60	472	±	60	474	±	60	457	±	59	155	±	22	168	±	24
February	938	±	58	902	±	57	911	±	58	922	±	59	258	±	21	285	±	22
March	789	±	50	788	±	50	772	±	50	754	±	50	199	±	16	189	±	15
April	153	±	9	151	±	9	158	±	10	161	±	10	72	±	4	70	±	4
May	52	±	3	52	±	3	53	±	3	52	±	3	21	±	1	19	±	1
June	25	±	3	25	±	3	22	±	3	20	±	3	8	±	1	7	±	1
July	17	±	3	16	±	3	14	±	3	12	±	2	7	±	1	6	±	1
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,473	±	109	2,428	±	110	2,426	±	110	2,398	±	111	729	±	38	752	±	39

Table 5.B.6-2. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

Month	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI
(a) SWP																		
October	64	±	13	47	±	10	40	±	9	33	±	7	14	±	3	12	±	3
November	14	±	5	10	±	4	10	±	4	9	±	4	3	±	2	3	±	2
December	37	±	9	38	±	9	39	±	9	39	±	9	24	±	6	27	±	6
January	1,209	±	398	1,240	±	415	1,287	±	427	1,242	±	414	465	±	185	453	±	164
February	1,496	±	265	1,511	±	271	1,568	±	281	1,490	±	270	518	±	135	449	±	117
March	1,409	±	236	1,483	±	251	1,514	±	255	1,461	±	250	274	±	82	313	±	94
April	440	±	90	463	±	98	467	±	98	478	±	99	205	±	34	205	±	34
May	315	±	77	345	±	87	354	±	88	342	±	87	127	±	23	117	±	23
June	240	±	53	249	±	55	224	±	50	204	±	45	97	±	22	86	±	19
July	5	±	2	5	±	2	5	±	2	4	±	2	3	±	1	4	±	1
August	3	±	1	3	±	1	3	±	1	3	±	1	1	±	1	1	±	1
September	4	±	1	4	±	1	4	±	1	3	±	1	0	±	0	0	±	0
Annual Average	5,235	±	663	5,397	±	698	5,514	±	714	5,309	±	697	1,731	±	291	1,669	±	262
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	3	±	1	3	±	1	3	±	1	3	±	1	1	±	1	1	±	1
December	5	±	1	5	±	1	5	±	1	5	±	1	4	±	1	4	±	1
January	161	±	35	168	±	38	170	±	38	167	±	37	83	±	22	100	±	27
February	219	±	34	220	±	35	225	±	35	230	±	36	40	±	13	70	±	20
March	379	±	88	383	±	91	388	±	92	393	±	93	106	±	42	92	±	33
April	105	±	20	105	±	20	106	±	20	108	±	20	58	±	10	60	±	11
May	51	±	9	50	±	9	52	±	9	50	±	9	23	±	3	20	±	3
June	45	±	12	45	±	12	42	±	11	37	±	10	18	±	5	17	±	5
July	29	±	9	29	±	9	25	±	8	21	±	7	24	±	8	21	±	7
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	996	±	96	1,008	±	99	1,016	±	100	1,014	±	101	356	±	46	383	±	47

Table 5.B.6-3. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	7	±	3	5	±	2	4	±	2	3	±	1	2	±	1	1	±	1
November	37	±	20	26	±	16	26	±	15	27	±	17	16	±	10	13	±	9
December	312	±	110	319	±	113	318	±	112	319	±	112	250	±	85	240	±	82
January	3,161	±	1,183	3,417	±	1,364	3,585	±	1,471	3,477	±	1,403	2,040	±	820	1,567	±	608
February	4,889	±	1,415	4,908	±	1,453	5,007	±	1,529	4,909	±	1,467	1,582	±	697	2,091	±	775
March	2,107	±	266	2,058	±	252	2,107	±	280	2,154	±	346	403	±	64	558	±	135
April	292	±	31	290	±	31	309	±	33	343	±	34	270	±	41	254	±	41
May	155	±	29	155	±	29	174	±	36	182	±	36	151	±	36	144	±	32
June	91	±	18	87	±	18	89	±	17	74	±	12	44	±	7	42	±	7
July	9	±	4	9	±	4	8	±	4	7	±	4	6	±	3	7	±	4
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	11,059	±	1,780	11,274	±	1,932	11,625	±	2,157	11,493	±	2,055	4,763	±	947	4,918	±	941
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	7	±	2	7	±	2	7	±	2	7	±	2	3	±	1	3	±	1
December	29	±	9	31	±	10	32	±	10	29	±	10	26	±	9	25	±	9
January	853	±	337	817	±	319	718	±	295	801	±	322	403	±	203	541	±	257
February	597	±	107	522	±	118	572	±	121	584	±	113	297	±	81	311	±	80
March	361	±	36	366	±	39	343	±	41	328	±	45	71	±	16	81	±	27
April	57	±	8	57	±	8	59	±	9	64	±	9	50	±	9	53	±	10
May	35	±	5	35	±	5	37	±	6	38	±	6	32	±	6	26	±	5
June	6	±	3	6	±	3	5	±	3	5	±	2	3	±	1	3	±	1
July	2	±	1	3	±	1	2	±	1	1	±	1	2	±	1	2	±	1
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,947	±	382	1,843	±	369	1,774	±	367	1,857	±	378	885	±	246	1,043	±	283

Table 5.B.6-4. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	103	±	19	108	±	17	99	±	18	99	±	20	84	±	14	89	±	23
January	406	±	49	423	±	65	431	±	72	396	±	93	227	±	73	255	±	66
February	5,688	±	1,662	5,812	±	1,729	6,233	±	1,939	5,258	±	1,451	3,955	±	915	3,553	±	1,220
March	2,990	±	602	3,034	±	674	3,052	±	709	2,827	±	701	1,433	±	227	1,842	±	409
April	40	±	4	40	±	4	44	±	6	53	±	9	42	±	10	46	±	9
May	69	±	7	69	±	8	74	±	11	87	±	14	66	±	12	65	±	13
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	9,296	±	2,180	9,485	±	2,380	9,933	±	2,620	8,720	±	2,068	5,807	±	823	5,851	±	1,480
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	8	±	0	8	±	1	8	±	1	8	±	1	7	±	1	6	±	1
January	53	±	6	51	±	7	51	±	7	45	±	9	31	±	8	31	±	8
February	1,816	±	370	1,692	±	334	1,398	±	352	1,728	±	373	1,058	±	373	1,173	±	299
March	647	±	112	588	±	106	572	±	106	583	±	135	392	±	90	392	±	102
April	30	±	2	30	±	2	32	±	4	34	±	5	29	±	6	33	±	7
May	29	±	2	29	±	3	30	±	2	32	±	4	26	±	5	26	±	5
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,583	±	457	2,398	±	405	2,091	±	441	2,429	±	439	1,543	±	450	1,661	±	316

Table 5.B.6-5. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

Month	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI
(a) SWP																		
October	2	±	1	2	±	1	1	±	1	1	±	0	1	±	0	1	±	0
November	39	±	18	26	±	12	25	±	12	22	±	12	15	±	8	15	±	9
December	83	±	32	85	±	33	83	±	33	79	±	32	64	±	25	60	±	24
January	578	±	115	568	±	113	562	±	113	590	±	118	371	±	86	353	±	85
February	2,387	±	610	2,382	±	626	2,251	±	585	2,035	±	548	1,688	±	438	1,563	±	439
March	2,613	±	530	2,591	±	520	2,440	±	485	2,413	±	471	1,975	±	407	1,852	±	374
April	374	±	57	398	±	60	424	±	75	404	±	76	464	±	76	399	±	73
May	165	±	23	161	±	22	181	±	27	186	±	27	165	±	23	143	±	22
June	10	±	5	11	±	5	10	±	5	8	±	4	6	±	3	5	±	3
July	18	±	5	18	±	5	17	±	5	16	±	5	11	±	4	8	±	3
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	6,270	±	1,237	6,242	±	1,236	5,995	±	1,164	5,755	±	1,113	4,761	±	922	4,400	±	862
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	2	±	1	2	±	1	2	±	1	2	±	1	1	±	1	1	±	1
December	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1
January	46	±	11	46	±	11	48	±	12	45	±	11	28	±	8	26	±	8
February	504	±	116	507	±	113	513	±	117	475	±	114	383	±	91	363	±	89
March	569	±	102	579	±	101	586	±	100	517	±	92	445	±	86	424	±	83
April	117	±	21	114	±	21	133	±	26	126	±	24	142	±	28	118	±	26
May	13	±	3	13	±	3	12	±	3	12	±	3	13	±	3	11	±	3
June	6	±	1	6	±	1	5	±	1	4	±	0	5	±	1	4	±	1
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,259	±	217	1,269	±	218	1,301	±	219	1,183	±	205	1,018	±	179	947	±	170

Table 5.B.6-6. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Steelhead for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

Month	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	185	±	40	173	±	45	159	±	50	175	±	35	118	±	46	105	±	49
February	3,501	±	904	3,840	±	1,019	3,583	±	734	3,499	±	889	3078	±	743	3,020	±	523
March	731	±	210	727	±	246	642	±	212	616	±	228	580	±	137	520	±	162
April	208	±	73	216	±	69	191	±	58	170	±	47	193	±	61	183	±	66
May	170	±	26	158	±	31	164	±	31	148	±	48	103	±	44	104	±	45
June	57	±	15	55	±	16	52	±	14	45	±	14	33	±	8	42	±	12
July	79	±	15	69	±	19	62	±	19	46	±	20	16	±	10	9	±	5
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	4,932	±	1,050	5,238	±	1,123	4,854	±	935	4,699	±	1,076	4121	±	805	3,983	±	624
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	200	±	33	177	±	36	185	±	37	173	±	42	139	±	36	134	±	36
February	572	±	134	517	±	150	585	±	126	501	±	135	469	±	81	424	±	108
March	113	±	37	122	±	44	105	±	35	96	±	34	88	±	30	78	±	31
April	44	±	5	43	±	4	41	±	5	41	±	5	38	±	7	35	±	8
May	8	±	1	8	±	0	7	±	1	7	±	0	6	±	1	6	±	1
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	937	±	169	866	±	200	924	±	163	819	±	179	741	±	110	677	±	124

Table 5.B.6-7. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Steelhead Entrainment Index (Number of Fish Lost, Based on Nonnormalized Data) at the SWP and CVP Salvage Facilities during All Water Years

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-640 (-64%)	-613 (-62%)	-651 (-65%)	-624 (-62%)	-660 (-65%)	-631 (-62%)
Above Normal	-1,061 (-55%)	-904 (-46%)	-958 (-52%)	-800 (-43%)	-889 (-50%)	-814 (-44%)
Below Normal	-1,040 (-40%)	-923 (-36%)	-855 (-36%)	-738 (-31%)	-548 (-26%)	-769 (-32%)
Dry	-241 (-19%)	-311 (-25%)	-251 (-20%)	-321 (-25%)	-283 (-22%)	-236 (-20%)
Critical	-196 (-21%)	-259 (-28%)	-125 (-14%)	-189 (-22%)	-183 (-20%)	-141 (-17%)
All Years	-692 (-49%)	-669 (-47%)	-667 (-48%)	-643 (-46%)	-666 (-48%)	-626 (-45%)
SWP						
Wet	-3,503 (-67%)	-3,566 (-68%)	-3,666 (-68%)	-3,729 (-69%)	-3,783 (-69%)	-3,640 (-69%)
Above Normal	-6,297 (-57%)	-6,142 (-56%)	-6,511 (-58%)	-6,356 (-56%)	-6,862 (-59%)	-6,575 (-57%)
Below Normal	-3,489 (-38%)	-3,445 (-37%)	-3,678 (-39%)	-3,634 (-38%)	-4,127 (-42%)	-2,869 (-33%)
Dry	-1,510 (-24%)	-1,870 (-30%)	-1,481 (-24%)	-1,841 (-30%)	-1,234 (-21%)	-1,355 (-24%)
Critical	-811 (-16%)	-949 (-19%)	-1,117 (-21%)	-1,255 (-24%)	-733 (-15%)	-716 (-15%)
All Years	-3,928 (-52%)	-3,979 (-53%)	-4,060 (-53%)	-4,112 (-53%)	-4,145 (-53%)	-3,880 (-52%)
Combined Losses						
Wet	-4,143 (-66%)	-4,179 (-67%)	-4,318 (-67%)	-4,353 (-68%)	-4,443 (-68%)	-4,271 (-68%)
Above Normal	-7,358 (-57%)	-7,045 (-54%)	-7,469 (-57%)	-7,157 (-55%)	-7,752 (-58%)	-7,389 (-55%)
Below Normal	-4,529 (-38%)	-4,368 (-37%)	-4,533 (-38%)	-4,372 (-37%)	-4,674 (-39%)	-3,638 (-33%)
Dry	-1,750 (-23%)	-2,181 (-29%)	-1,732 (-23%)	-2,163 (-29%)	-1,517 (-21%)	-1,591 (-23%)
Critical	-1,007 (-17%)	-1,208 (-21%)	-1,242 (-20%)	-1,444 (-24%)	-917 (-16%)	-858 (-16%)
All Years	-4,620 (-51%)	-4,648 (-52%)	-4,727 (-52%)	-4,755 (-52%)	-4,810 (-52%)	-4,506 (-51%)

Note: Negative values indicate lower entrainment loss under evaluated starting operations than under existing biological conditions scenarios.

5.B.6.1.2 Winter-Run Chinook Salmon (Juvenile)

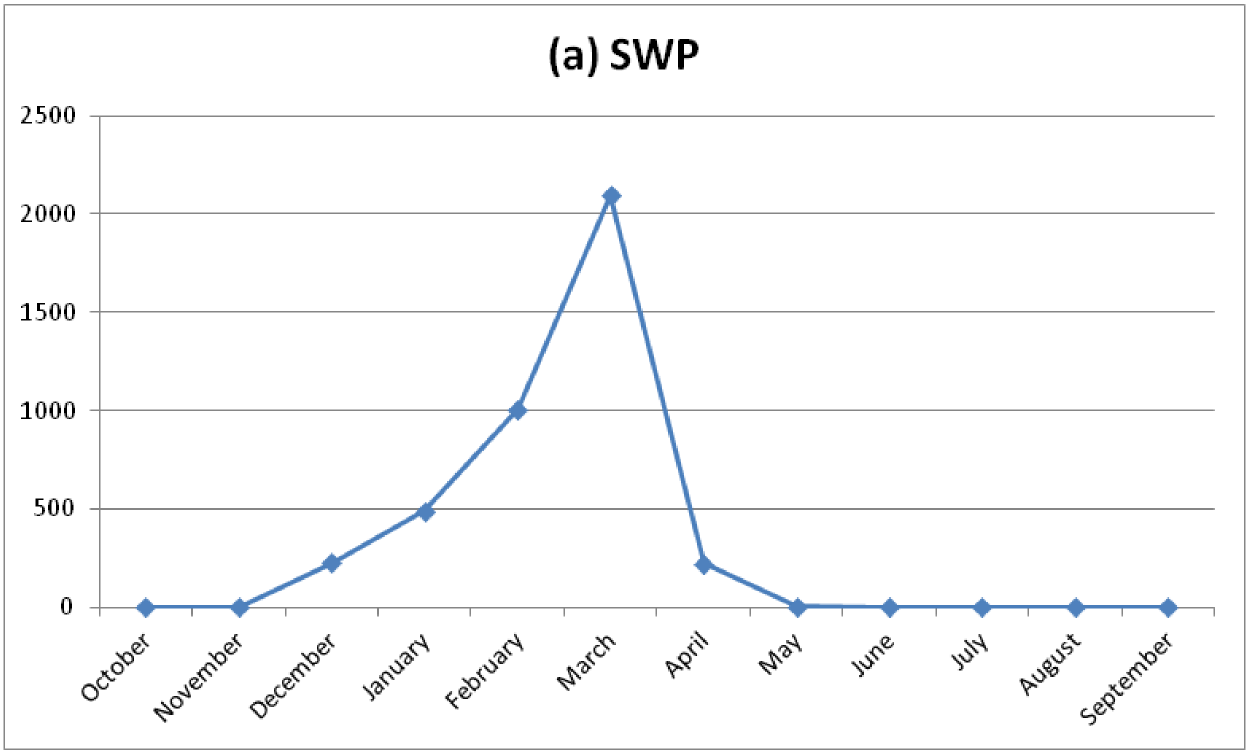
5.B.6.1.2.1 Salvage-Density Method

The basic seasonal pattern of entrainment of juvenile winter-run Chinook salmon upon which the salvage-density method is based is presented in Figure 5.B.6-2, although note that this is an average of all years combined and does not account for water-year differences. Losses began to occur in December and climbed to peaks in March at both facilities, before sharply declining in April.

In general, estimated losses of winter-run Chinook salmon in the SWP facility were approximately five to ten times greater than those estimated for the CVP export facility (Table 5.B.6-8 through Table 5.B.6-19). Normalization of the data to adult population size increased the estimated entrainment loss relative to nonnormalized data for wet, above-normal, and below-normal years; decreased entrainment loss for dry years; and resulted in little change to entrainment loss in critical years. This summary of the main results focuses only on normalized data. Estimated annual losses at SWP across all water years averaged around 6,000 fish under EBC scenarios and 2,700–2,800 fish under ESO scenarios; for the CVP, the annual average loss was around 830–860 fish under EBC and 440 fish under ESO (Table 5.B.6-8). Losses were greatest in wet years (>10,000 fish at SWP, >1,300 fish at CVP under EBC scenarios) and decreased with reduced flows (e.g., <1,000 fish at SWP in critical years) (Table 5.B.6-9 through Table 5.B.6-13).

As with steelhead, differences in entrainment loss of juvenile winter-run Chinook salmon between EBC and ESO scenarios were greatest in wet and above-normal years, with reductions at both facilities under ESO scenarios compared to EBC scenarios of ~4,000–8,700 fish (60–70% reduction) (Table 5.B.6-20). Across all water years, reductions under ESO scenarios compared to EBC scenarios were estimated to be on the order of 3,500–3,700 fish (52–54% reduction). This reflected estimates of entrainment loss under ESO scenarios in dry and critical water years that were smaller changes under ESO relative to EBC (14–30% change).

Under the assumption that the annual number of winter-run Chinook salmon juveniles approaching the Delta was 500,000 fish, the percentage of the population lost to entrainment across all years averaged around 1.4% under EBC scenarios and decreased to 0.6% under ESO scenarios (Table 5.B.6-22). In wet years, EBC entrainment losses of 2.3–2.4% were reduced to 0.7% under ESO scenarios (Table 5.B.6-23). Proportional losses in above-normal years (EBC: 1.3%; ESO: 0.5%) and below-normal years (EBC: 1.4–1.5%; ESO: 0.8–0.9%) also suggested appreciable decreases under ESO scenarios relative to EBC scenarios (Table 5.B.6-24 and Table 5.B.6-25). There was less difference between EBC and ESO proportional entrainment loss of winter-run Chinook salmon juveniles in dry (EBC: 0.7–0.75%; ESO: 0.5–0.6%) and critical years (Table 5.B.6-26 and Table 5.B.6-27). Nonnormalized estimates were generally lower, as noted above (Table 5.B.6-28 through Table 5.B.6-33).



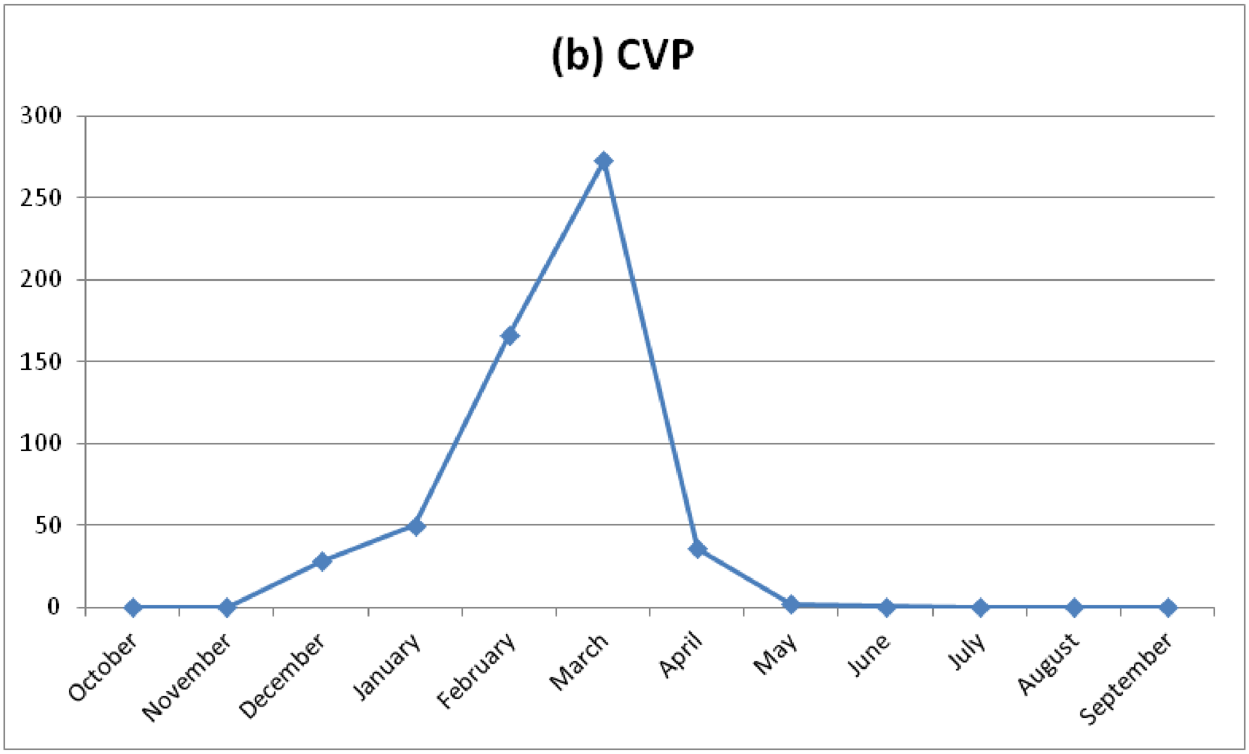


Figure 5.B.6-2. Mean Monthly Entrainment Loss of Juvenile Winter-Run Chinook Salmon Calculated from Observed Salvage Monitoring at the (a) SWP and (b) CVP South Delta Export Facilities, Water Years 1996–2008

Table 5.B.6-8. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	303	±	37	306	±	37	298	±	37	293	±	36	225	±	27	231	±	29
January	1,175	±	148	1,196	±	154	1,215	±	159	1,199	±	155	619	±	87	586	±	80
February	1,284	±	135	1,306	±	139	1,327	±	143	1,236	±	134	648	±	74	614	±	71
March	2,909	±	209	2,971	±	217	2,974	±	222	2,885	±	219	1,031	±	82	1,143	±	96
April	274	±	45	285	±	47	292	±	48	302	±	50	216	±	31	209	±	31
May	6	±	2	6	±	2	6	±	2	6	±	2	4	±	1	4	±	1
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	5,951	±	357	6,070	±	372	6,112	±	382	5,920	±	372	2,743	±	167	2,787	±	172
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	53	±	4	56	±	4	55	±	4	50	±	4	48	±	4	43	±	4
January	88	±	7	87	±	8	87	±	8	84	±	7	50	±	5	54	±	5
February	201	±	12	193	±	12	195	±	12	198	±	12	96	±	8	106	±	8
March	462	±	29	462	±	30	453	±	29	442	±	30	2	±	16	193	±	16
April	51	±	6	50	±	5	53	±	6	53	±	6	41	±	4	41	±	4
May	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	857	±	37	850	±	38	844	±	38	828	±	39	439	±	23	437	±	22

Table 5.B.6-9. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	402	±	142	413	±	147	425	±	151	430	±	153	263	±	95	291	±	105
January	2,548	±	797	2,614	±	833	2,712	±	857	2,618	±	829	981	±	372	955	±	330
February	695	±	218	702	±	222	729	±	230	692	±	221	241	±	101	209	±	87
March	5,542	±	946	5,833	±	1,006	5,958	±	1,024	5,748	±	1,003	1,078	±	328	1,233	±	373
April	862	±	284	907	±	307	913	±	309	935	±	312	402	±	116	401	±	115
May	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	10,050	±	1,436	10,471	±	1,519	10,739	±	1,542	10,426	±	1,513	2,965	±	561	3,089	±	569
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	99	±	16	100	±	17	100	±	17	95	±	16	79	±	14	76	±	14
January	138	±	34	144	±	37	145	±	37	143	±	36	71	±	21	85	±	26
February	178	±	34	179	±	35	183	±	35	187	±	36	33	±	12	57	±	19
March	811	±	127	820	±	132	830	±	133	841	±	135	227	±	68	198	±	53
April	102	±	29	102	±	29	103	±	29	105	±	29	57	±	15	58	±	16
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,328	±	129	1,344	±	134	1,362	±	136	1,373	±	138	466	±	75	474	±	68

Table 5.B.6-10. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	369	±	183	377	±	187	376	±	185	377	±	185	295	±	141	284	±	137
January	771	±	258	833	±	299	874	±	323	848	±	308	497	±	180	382	±	133
February	2,708	±	1,222	2,718	±	1,245	2,773	±	1,297	2,719	±	1,253	876	±	542	1158	±	624
March	2,067	±	717	2,019	±	696	2,067	±	727	2,113	±	787	395	±	147	547	±	244
April	75	±	24	75	±	24	80	±	26	89	±	28	70	±	24	66	±	24
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	5,990	±	2,099	6,022	±	2,123	6,169	±	2,244	6,145	±	2,229	2,133	±	723	2,437	±	882
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	19	±	9	21	±	10	21	±	10	19	±	9	17	±	9	16	±	9
January	55	±	15	53	±	14	47	±	13	52	±	14	26	±	10	35	±	12
February	186	±	73	163	±	71	178	±	76	182	±	74	93	±	45	97	±	46
March	320	±	118	324	±	121	304	±	116	291	±	115	62	±	29	72	±	42
April	50	±	23	50	±	23	52	±	25	56	±	26	44	±	22	46	±	23
May	3	±	2	3	±	2	4	±	2	4	±	2	3	±	2	3	±	1
June	1	±	1	1	±	1	1	±	1	1	±	1	1	±	0	1	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	635	±	219	615	±	218	606	±	219	604	±	219	245	±	96	269	±	99

Table 5.B.6-11. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	100	±	19	105	±	16	96	±	17	96	±	19	82	±	14	87	±	22
January	403	±	48	419	±	64	427	±	72	393	±	92	225	±	73	253	±	65
February	2,206	±	645	2,254	±	671	2,418	±	752	2,039	±	563	1,534	±	355	1,378	±	473
March	3,530	±	710	3,582	±	796	3,604	±	838	3,338	±	828	1,692	±	268	2,175	±	482
April	18	±	2	18	±	2	20	±	3	23	±	4	19	±	4	20	±	4
May	52	±	6	52	±	6	56	±	8	65	±	11	50	±	9	49	±	10
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	6,309	±	1,294	6,430	±	1,454	6,620	±	1,567	5,955	±	1,327	3,601	±	319	3,962	±	851
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	49	±	1	51	±	3	49	±	4	46	±	6	44	±	6	39	±	8
January	84	±	10	81	±	11	82	±	11	72	±	14	50	±	13	50	±	13
February	344	±	70	321	±	63	265	±	67	328	±	71	201	±	71	222	±	57
March	387	±	67	351	±	63	342	±	63	348	±	81	234	±	54	234	±	61
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	864	±	130	804	±	120	738	±	127	793	±	128	528	±	121	545	±	89

Table 5.B.6-12. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	267	±	82	277	±	85	269	±	85	257	±	84	206	±	63	195	±	62
January	147	±	18	145	±	18	143	±	18	150	±	19	94	±	16	90	±	16
February	872	±	250	871	±	257	823	±	240	744	±	225	617	±	180	571	±	181
March	1,743	±	471	1,728	±	463	1,628	±	433	1,610	±	422	1,318	±	361	1,235	±	333
April	67	±	9	71	±	9	76	±	12	72	±	13	83	±	12	72	±	12
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,097	±	679	3,092	±	676	2,939	±	631	2,833	±	605	2,318	±	511	2,163	±	471
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	38	±	5	42	±	6	41	±	6	37	±	6	38	±	6	33	±	6
January	65	±	10	65	±	10	68	±	11	64	±	10	39	±	8	37	±	8
February	247	±	51	248	±	49	251	±	51	233	±	51	187	±	41	177	±	40
March	317	±	62	323	±	62	326	±	61	288	±	56	248	±	53	236	±	51
April	27	±	3	26	±	3	30	±	4	29	±	4	33	±	5	27	±	4
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	693	±	109	704	±	110	716	±	109	650	±	104	544	±	89	511	±	86

Table 5.B.6-13. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	137	±	30	128	±	33	118	±	37	129	±	26	87	±	34	77	±	36
February	264	±	68	290	±	77	271	±	55	264	±	67	232	±	56	228	±	40
March	507	±	145	504	±	171	445	±	147	427	±	158	402	±	95	361	±	112
April	25	±	9	26	±	8	23	±	7	20	±	6	23	±	7	22	±	8
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	933	±	199	948	±	218	857	±	198	841	±	212	745	±	110	688	±	145
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	39	±	6	34	±	7	36	±	7	34	±	8	27	±	7	26	±	7
February	106	±	25	96	±	28	108	±	23	93	±	25	87	±	15	79	±	20
March	184	±	59	197	±	72	170	±	56	155	±	55	143	±	49	126	±	49
April	4	±	0	4	±	0	4	±	0	4	±	0	3	±	1	3	±	1
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	332	±	77	331	±	93	318	±	74	285	±	71	260	±	56	233	±	57

Table 5.B.6-14. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	230	±	28	232	±	28	226	±	28	222	±	28	171	±	21	175	±	22
January	332	±	21	338	±	22	344	±	23	339	±	22	175	±	13	166	±	12
February	778	±	72	791	±	74	803	±	76	748	±	71	392	±	40	372	±	38
March	1,685	±	154	1,721	±	160	1,722	±	162	1,671	±	160	597	±	60	662	±	69
April	87	±	9	90	±	10	92	±	10	95	±	10	68	±	6	66	±	6
May	5	±	1	5	±	1	5	±	1	5	±	1	3	±	1	3	±	1
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,116	±	221	3,177	±	230	3,193	±	235	3,080	±	228	1,407	±	95	1,444	±	100
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	28	±	2	30	±	2	29	±	2	26	±	2	25	±	2	23	±	2
January	42	±	2	41	±	2	42	±	2	40	±	2	24	±	1	26	±	2
February	132	±	10	127	±	10	128	±	10	130	±	10	63	±	6	70	±	6
March	235	±	13	234	±	13	230	±	13	224	±	13	103	±	7	98	±	7
April	18	±	1	18	±	1	18	±	1	19	±	1	15	±	1	14	±	1
May	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	456	±	23	452	±	23	449	±	23	441	±	23	231	±	13	231	±	13

Table 5.B.6-15. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	63	±	15	65	±	16	67	±	16	68	±	16	41	±	10	46	±	11
January	399	±	93	409	±	98	424	±	100	410	±	97	153	±	45	149	±	39
February	220	±	51	222	±	53	231	±	54	219	±	52	76	±	25	66	±	21
March	1,400	±	207	1,473	±	221	1,505	±	224	1,452	±	220	272	±	76	311	±	86
April	183	±	59	192	±	64	194	±	64	199	±	64	85	±	24	85	±	24
May	5	±	2	5	±	3	5	±	3	5	±	3	2	±	1	2	±	1
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,269	±	244	2,367	±	261	2,426	±	264	2,352	±	261	631	±	97	659	±	102
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	25	±	5	26	±	5	26	±	5	24	±	5	20	±	4	20	±	4
January	25	±	4	26	±	5	26	±	5	26	±	5	13	±	3	15	±	4
February	52	±	7	53	±	7	54	±	8	55	±	8	10	±	3	17	±	5
March	188	±	22	190	±	23	192	±	24	195	±	24	53	±	14	46	±	11
April	19	±	6	19	±	6	19	±	6	19	±	6	10	±	3	11	±	3
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	309	±	25	313	±	26	317	±	26	320	±	27	106	±	15	108	±	14

Table 5.B.6-16. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	509	±	252	519	±	257	517	±	255	519	±	255	407	±	195	391	±	189
January	479	±	134	518	±	157	543	±	171	527	±	162	309	±	95	237	±	70
February	1,045	±	279	1,049	±	288	1,070	±	303	1,049	±	291	338	±	141	447	±	156
March	1,120	±	160	1,094	±	153	1,120	±	167	1,145	±	201	214	±	37	297	±	75
April	47	±	6	47	±	6	50	±	6	55	±	6	44	±	7	41	±	7
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,200	±	604	3,227	±	625	3,300	±	660	3,295	±	652	1,311	±	307	1,413	±	317
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	26	±	13	28	±	14	29	±	14	26	±	13	23	±	12	22	±	12
January	40	±	6	38	±	5	33	±	6	37	±	6	19	±	5	25	±	6
February	84	±	18	73	±	19	80	±	20	82	±	19	42	±	13	44	±	13
March	156	±	24	158	±	25	148	±	25	142	±	26	31	±	8	35	±	13
April	15	±	6	15	±	6	16	±	6	17	±	7	13	±	6	14	±	6
May	5	±	2	5	±	2	5	±	2	5	±	3	4	±	2	3	±	2
June	2	±	1	2	±	1	2	±	1	1	±	1	1	±	0	1	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	327	±	53	319	±	55	312	±	57	310	±	56	132	±	32	144	±	31

Table 5.B.6-17. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	N/A	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	N/A	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	64	±	12	67	±	10	61	±	11	62	±	12	52	±	9	56	±	14
January	258	±	31	269	±	41	274	±	46	252	±	59	144	±	47	162	±	42
February	1,413	±	413	1,444	±	430	1,548	±	482	1,306	±	360	983	±	227	883	±	303
March	2,261	±	455	2,294	±	510	2,308	±	536	2,138	±	530	1,083	±	172	1,393	±	309
April	11	±	1	11	±	1	12	±	2	15	±	2	12	±	3	13	±	3
May	33	±	4	33	±	4	36	±	5	42	±	7	32	±	6	31	±	6
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	4,040	±	829	4,118	±	931	4,240	±	1,004	3,814	±	850	2,306	±	204	2,537	±	545
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	31	±	1	33	±	2	32	±	3	29	±	4	28	±	4	25	±	5
January	54	±	6	52	±	7	52	±	7	46	±	9	32	±	8	32	±	8
February	221	±	45	205	±	40	170	±	43	210	±	45	129	±	45	142	±	36
March	248	±	43	225	±	40	219	±	40	223	±	52	150	±	35	150	±	39
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	553	±	83	515	±	77	473	±	81	508	±	82	338	±	78	349	±	57

Table 5.B.6-18. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	403	±	129	417	±	133	405	±	134	387	±	131	310	±	99	294	±	98
January	195	±	29	191	±	29	189	±	28	199	±	30	125	±	24	119	±	24
February	1,096	±	349	1,094	±	357	1,034	±	334	934	±	312	775	±	250	718	±	250
March	2,179	±	657	2,160	±	646	2,035	±	604	2,012	±	589	1,647	±	502	1,544	±	464
April	75	±	6	80	±	6	85	±	10	81	±	11	93	±	9	80	±	11
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,948	±	958	3,942	±	954	3,748	±	892	3,613	±	856	2,950	±	720	2,755	±	664
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	44	±	7	49	±	7	47	±	7	44	±	7	44	±	7	39	±	7
January	72	±	11	72	±	11	76	±	12	71	±	11	43	±	9	41	±	9
February	272	±	62	273	±	60	276	±	62	256	±	62	206	±	49	195	±	48
March	333	±	49	340	±	48	343	±	46	303	±	44	261	±	43	249	±	42
April	30	±	1	29	±	1	34	±	2	32	±	2	36	±	3	30	±	4
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	751	±	99	763	±	98	776	±	97	705	±	95	590	±	80	554	±	77

Table 5.B.6-19. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Winter-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	114	±	25	107	±	28	98	±	31	108	±	22	73	±	28	65	±	30
February	221	±	57	243	±	64	226	±	46	221	±	56	195	±	47	191	±	33
March	424	±	122	422	±	143	373	±	123	357	±	132	337	±	79	302	±	94
April	21	±	7	22	±	7	19	±	6	17	±	5	19	±	6	19	±	7
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	781	±	166	793	±	183	717	±	166	704	±	178	623	±	92	576	±	121
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	32	±	5	29	±	6	30	±	6	28	±	7	23	±	6	22	±	6
February	88	±	21	80	±	23	91	±	19	78	±	21	73	±	13	66	±	17
March	154	±	50	165	±	60	143	±	47	130	±	46	120	±	41	105	±	41
April	3	±	0	3	±	0	3	±	0	3	±	0	3	±	1	3	±	1
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	278	±	64	277	±	78	266	±	62	238	±	60	218	±	47	195	±	48

Table 5.B.6-20. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Winter-Run Chinook Salmon Entrainment Index (Number of Fish Lost, Based on Normalized Data) at the SWP and CVP Salvage Facilities during All Water Years

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-862 (-65%)	-854 (-64%)	-878 (-65%)	-871 (-65%)	-896 (-66%)	-899 (-65%)
Above Normal	-389 (-61%)	-365 (-58%)	-369 (-60%)	-345 (-56%)	-361 (-60%)	-335 (-55%)
Below Normal	-336 (-39%)	-319 (-37%)	-276 (-34%)	-259 (-32%)	-210 (-28%)	-248 (-31%)
Dry	-149 (-21%)	-182 (-26%)	-160 (-23%)	-194 (-27%)	-172 (-24%)	-140 (-21%)
Critical	-72 (-22%)	-99 (-30%)	-71 (-21%)	-97 (-29%)	-58 (-18%)	-52 (-18%)
All Years	-418 (-49%)	-419 (-49%)	-411 (-48%)	-413 (-49%)	-405 (-48%)	-391 (-47%)
SWP						
Wet	-7,086 (-71%)	-6,962 (-69%)	-7,506 (-72%)	-7,383 (-71%)	-7,774 (-72%)	-7,338 (-70%)
Above Normal	-3,857 (-64%)	-3,553 (-59%)	-3,889 (-65%)	-3,585 (-60%)	-4,036 (-65%)	-3,708 (-60%)
Below Normal	-2,708 (-43%)	-2,347 (-37%)	-2,829 (-44%)	-2,468 (-38%)	-3,020 (-46%)	-1,993 (-33%)
Dry	-779 (-25%)	-934 (-30%)	-774 (-25%)	-929 (-30%)	-621 (-21%)	-670 (-24%)
Critical	-188 (-20%)	-245 (-26%)	-203 (-21%)	-260 (-27%)	-112 (-13%)	-153 (-18%)
All Years	-3,208 (-54%)	-3,164 (-53%)	-3,326 (-55%)	-3,283 (-54%)	-3,368 (-55%)	-3,133 (-53%)
Combined Losses						
Wet	-7,947 (-70%)	-7,816 (-69%)	-8,385 (-71%)	-8,253 (-70%)	-8,670 (-72%)	-8,237 (-70%)
Above Normal	-4,246 (-64%)	-3,919 (-59%)	-4,258 (-64%)	-3,931 (-59%)	-4,396 (-65%)	-4,043 (-60%)
Below Normal	-3,044 (-42%)	-2,666 (-37%)	-3,105 (-43%)	-2,727 (-38%)	-3,230 (-44%)	-2,241 (-33%)
Dry	-928 (-24%)	-1,116 (-29%)	-934 (-25%)	-1,122 (-30%)	-793 (-22%)	-809 (-23%)
Critical	-260 (-21%)	-343 (-27%)	-273 (-21%)	-357 (-28%)	-170 (-14%)	-205 (-18%)
All Years	-3,625 (-53%)	-3,584 (-53%)	-3,737 (-54%)	-3,696 (-53%)	-3,773 (-54%)	-3,524 (-52%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations than under existing biological conditions scenarios.						

Table 5.B.6-21. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Winter-Run Chinook Salmon Entrainment Index (Number of Fish Lost, Based on Nonnormalized Data) at the SWP and CVP Salvage Facilities during All Water Years

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-203 (-66%)	-201 (-65%)	-207 (-66%)	-205 (-65%)	-211 (-67%)	-212 (-66%)
Above Normal	-195 (-60%)	-183 (-56%)	-187 (-59%)	-175 (-55%)	-180 (-58%)	-166 (-54%)
Below Normal	-215 (-39%)	-204 (-37%)	-177 (-34%)	-166 (-32%)	-134 (-28%)	-159 (-31%)
Dry	-161 (-21%)	-197 (-26%)	-173 (-23%)	-210 (-27%)	-186 (-24%)	-152 (-22%)
Critical	-60 (-22%)	-82 (-30%)	-59 (-21%)	-81 (-29%)	-49 (-18%)	-43 (-18%)
All Years	-225 (-49%)	-225 (-49%)	-221 (-49%)	-221 (-49%)	-218 (-49%)	-210 (-48%)
SWP						
Wet	-1,639 (-72%)	-1,610 (-71%)	-1,737 (-73%)	-1,708 (-72%)	-1,796 (-74%)	-1,693 (-72%)
Above Normal	-1,888 (-59%)	-1,787 (-56%)	-1,915 (-59%)	-1,814 (-56%)	-1,989 (-60%)	-1,883 (-57%)
Below Normal	-1,734 (-43%)	-1,503 (-37%)	-1,812 (-44%)	-1,580 (-38%)	-1,934 (-46%)	-1,277 (-33%)
Dry	-997 (-25%)	-1,193 (-30%)	-992 (-25%)	-1,188 (-30%)	-798 (-21%)	-858 (-24%)
Critical	-157 (-20%)	-205 (-26%)	-170 (-21%)	-217 (-27%)	-93 (-13%)	-128 (-18%)
All Years	-1,709 (-55%)	-1,672 (-54%)	-1,770 (-56%)	-1,733 (-55%)	-1,786 (-56%)	-1,637 (-53%)
Combined Losses						
Wet	-1,842 (-71%)	-1,811 (-70%)	-1,944 (-73%)	-1,913 (-71%)	-2,007 (-73%)	-1,904 (-71%)
Above Normal	-2,083 (-59%)	-1,970 (-56%)	-2,102 (-59%)	-1,989 (-56%)	-2,169 (-60%)	-2,049 (-57%)
Below Normal	-1,949 (-42%)	-1,707 (-37%)	-1,989 (-43%)	-1,746 (-38%)	-2,068 (-44%)	-1,436 (-33%)
Dry	-1,158 (-25%)	-1,390 (-30%)	-1,165 (-25%)	-1,397 (-30%)	-984 (-22%)	-1,010 (-23%)
Critical	-217 (-21%)	-287 (-27%)	-229 (-21%)	-299 (-28%)	-142 (-14%)	-171 (-18%)
All Years	-1,934 (-54%)	-1,897 (-53%)	-1,991 (-55%)	-1,953 (-54%)	-2,004 (-55%)	-1,846 (-52%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations than under existing biological conditions scenarios.						

Table 5.B.6-22. Average Annual Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	5,951	6,070	6,112	5,920	2,743	2,787
CVP Jones	857	850	844	828	439	437
Combined	6,808	6,920	6,956	6,748	3,182	3,224
Percentage of winter-run juvenile index of abundance	1.36%	1.38%	1.39%	1.35%	0.64%	0.64%

Table 5.B.6-23. Wet Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	10,050	10,471	10,739	10,426	2,965	3,089
CVP Jones	1,328	1,344	1,362	1,373	466	474
Combined	11,378	11,816	12,101	11,799	3,431	3,562
Percentage of winter-run juvenile index of abundance	2.28%	2.36%	2.42%	2.36%	0.69%	0.71%

Table 5.B.6-24. Above-Normal Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	5,990	6,022	6,169	6,145	2,133	2,437
CVP Jones	635	615	606	604	245	269
Combined	6,625	6,637	6,775	6,749	2,379	2,706
Percentage of winter-run juvenile index of abundance	1.32%	1.33%	1.35%	1.35%	0.48%	0.54%

Table 5.B.6-25. Below-Normal Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	6,309	6,430	6,620	5,955	3,601	3,962
CVP Jones	864	804	738	793	528	545
Combined	7,172	7,234	7,358	6,748	4,129	4,507
Percentage of winter-run juvenile index of abundance	1.43%	1.45%	1.47%	1.35%	0.83%	0.90%

Table 5.B.6-26. Dry Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	3,097	3,092	2,939	2,833	2,318	2,163
CVP Jones	693	704	716	650	544	511
Combined	3,790	3,796	3,655	3,483	2,862	2,674
Percentage of winter-run juvenile index of abundance	0.76%	0.76%	0.73%	0.70%	0.57%	0.53%

Table 5.B.6-27. Critical Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	933	948	857	841	745	688
CVP Jones	332	331	318	285	260	233
Combined	1,265	1,278	1,175	1,126	1,005	921
Percentage of winter-run juvenile index of abundance	0.25%	0.26%	0.23%	0.23%	0.20%	0.18%

Table 5.B.6-28. Average Annual Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	3,116	3,177	3,193	3,080	1,407	1,444
CVP Jones	456	452	449	441	231	231
Combined	3,572	3,628	3,642	3,521	1,638	1,675
Percentage of winter-run juvenile index of abundance	0.71%	0.73%	0.73%	0.70%	0.33%	0.34%

Table 5.B.6-29. Wet Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	2,269	2,367	2,426	2,352	630	659
CVP Jones	309	313	317	320	106	108
Combined	2,578	2,680	2,743	2,672	736	767
Percentage of winter-run juvenile index of abundance	0.52%	0.54%	0.55%	0.53%	0.15%	0.15%

Table 5.B.6-30. Above-Normal Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	3,200	3,227	3,300	3,295	1,311	1,413
CVP Jones	327	319	312	310	132	144
Combined	3,527	3,546	3,613	3,605	1,444	1,557
Percentage of winter-run juvenile index of abundance	0.71%	0.71%	0.72%	0.72%	0.29%	0.31%

Table 5.B.6-31. Below-Normal Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	4,040	4,118	4,240	3,814	2,306	2,537
CVP Jones	553	515	473	508	338	349
Combined	4,594	4,633	4,712	4,322	2,644	2,886
Percentage of winter-run juvenile index of abundance	0.92%	0.93%	0.94%	0.86%	0.53%	0.58%

Table 5.B.6-32. Dry Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	3,948	3,942	3,748	3,613	2,950	2,755
CVP Jones	751	763	776	705	590	553
Combined	4,698	4,706	4,524	4,318	3,540	3,308
Percentage of winter-run juvenile index of abundance	0.94%	0.94%	0.90%	0.86%	0.71%	0.66%

Table 5.B.6-33. Critical Year Juvenile Winter-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	781	793	717	704	623	576
CVP Jones	278	277	266	238	218	195
Combined	1,058	1,070	983	942	841	771
Percentage of winter-run juvenile index of abundance	0.21%	0.21%	0.20%	0.19%	0.17%	0.15%

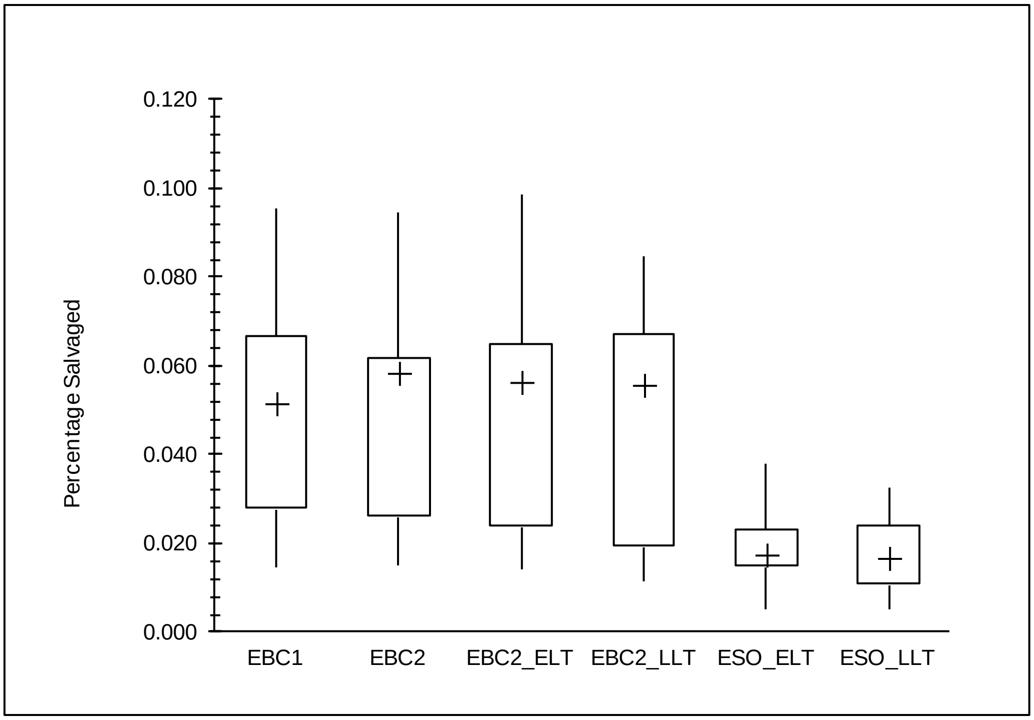
5.B.6.1.2.2 Delta Passage Model Salvage Estimates

Percentage of Smolts Salvaged

The estimated percentage of winter-run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged ~0.05% for EBC scenarios, and ~0.02% for ESO scenarios (Table 5.B.6-34). The medians were similar to the means (Figure 5.B.6-3). Percentage salvage in individual years ranged from appreciably less than 0.01 (ESO scenarios in 1983–1984, wet years) to nearly 0.1 (EBC scenarios in 1982, a wet year). Average percentage salvage was 60–65% lower under ESO scenarios compared with EBC scenarios in relative terms, or ~0.03% lower in absolute terms (Table 5.B.6-35).

Table 5.B.6-34. Estimated Percentage of Winter-Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.067	0.061	0.060	0.056	0.035	0.033
1977 (C)	0.021	0.015	0.015	0.013	0.015	0.011
1978 (AN)	0.065	0.064	0.064	0.062	0.016	0.014
1979 (BN)	0.075	0.088	0.084	0.082	0.038	0.029
1980 (AN)	0.059	0.060	0.055	0.046	0.019	0.019
1981 (D)	0.048	0.055	0.056	0.055	0.025	0.023
1982 (W)	0.095	0.095	0.099	0.085	0.015	0.016
1983 (W)	0.042	0.060	0.061	0.070	0.005	0.008
1984 (W)	0.067	0.066	0.068	0.066	0.006	0.005
1985 (D)	0.055	0.058	0.057	0.056	0.023	0.022
1986 (W)	0.067	0.059	0.095	0.080	0.022	0.017
1987 (D)	0.047	0.050	0.049	0.046	0.034	0.028
1988 (C)	0.021	0.020	0.022	0.020	0.016	0.014
1989 (D)	0.020	0.023	0.022	0.017	0.016	0.011
1990 (C)	0.030	0.028	0.024	0.018	0.021	0.029
1991 (C)	0.015	0.015	0.014	0.011	0.012	0.009
Average	0.050	0.051	0.053	0.049	0.020	0.018



Box and whisker plot shows salvage distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage salvage.

Figure 5.B.6-3. Winter-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

1 **Table 5.B.6-35. Difference in Estimated Percentage of Winter-Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export**
2 **Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios**

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.032 (-48%)	-0.034 (-51%)	-0.026 (-43%)	-0.028 (-46%)	-0.026 (-43%)	-0.024 (-42%)
1977 (C)	-0.006 (-28%)	-0.010 (-48%)	0.000 (-2%)	-0.004 (-29%)	0.000 (1%)	-0.002 (-18%)
1978 (AN)	-0.050 (-76%)	-0.051 (-78%)	-0.048 (-76%)	-0.050 (-78%)	-0.049 (-76%)	-0.047 (-77%)
1979 (BN)	-0.037 (-49%)	-0.046 (-62%)	-0.050 (-57%)	-0.059 (-67%)	-0.046 (-55%)	-0.054 (-65%)
1980 (AN)	-0.041 (-69%)	-0.040 (-68%)	-0.042 (-69%)	-0.041 (-68%)	-0.036 (-66%)	-0.027 (-58%)
1981 (D)	-0.023 (-49%)	-0.025 (-53%)	-0.031 (-55%)	-0.033 (-59%)	-0.031 (-56%)	-0.033 (-59%)
1982 (W)	-0.080 (-84%)	-0.079 (-83%)	-0.080 (-84%)	-0.079 (-83%)	-0.084 (-85%)	-0.069 (-81%)
1983 (W)	-0.036 (-87%)	-0.034 (-81%)	-0.055 (-91%)	-0.052 (-87%)	-0.056 (-91%)	-0.063 (-89%)
1984 (W)	-0.061 (-92%)	-0.062 (-92%)	-0.061 (-92%)	-0.061 (-92%)	-0.062 (-92%)	-0.061 (-92%)
1985 (D)	-0.033 (-59%)	-0.033 (-60%)	-0.035 (-61%)	-0.036 (-62%)	-0.034 (-60%)	-0.034 (-61%)
1986 (W)	-0.044 (-67%)	-0.049 (-74%)	-0.037 (-62%)	-0.041 (-70%)	-0.072 (-77%)	-0.062 (-78%)
1987 (D)	-0.014 (-29%)	-0.019 (-40%)	-0.016 (-33%)	-0.022 (-43%)	-0.015 (-31%)	-0.018 (-38%)
1988 (C)	-0.005 (-24%)	-0.007 (-35%)	-0.005 (-22%)	-0.007 (-34%)	-0.007 (-29%)	-0.007 (-33%)
1989 (D)	-0.003 (-16%)	-0.009 (-43%)	-0.007 (-29%)	-0.012 (-52%)	-0.006 (-26%)	-0.006 (-33%)
1990 (C)	-0.009 (-30%)	-0.001 (-4%)	-0.006 (-22%)	0.002 (5%)	-0.003 (-12%)	0.012 (65%)
1991 (C)	-0.002 (-16%)	-0.006 (-41%)	-0.003 (-17%)	-0.006 (-42%)	-0.002 (-13%)	-0.003 (-24%)
Average	-0.030 (-60%)	-0.032 (-64%)	-0.031 (-61%)	-0.033 (-65%)	-0.033 (-62%)	-0.031 (-63%)

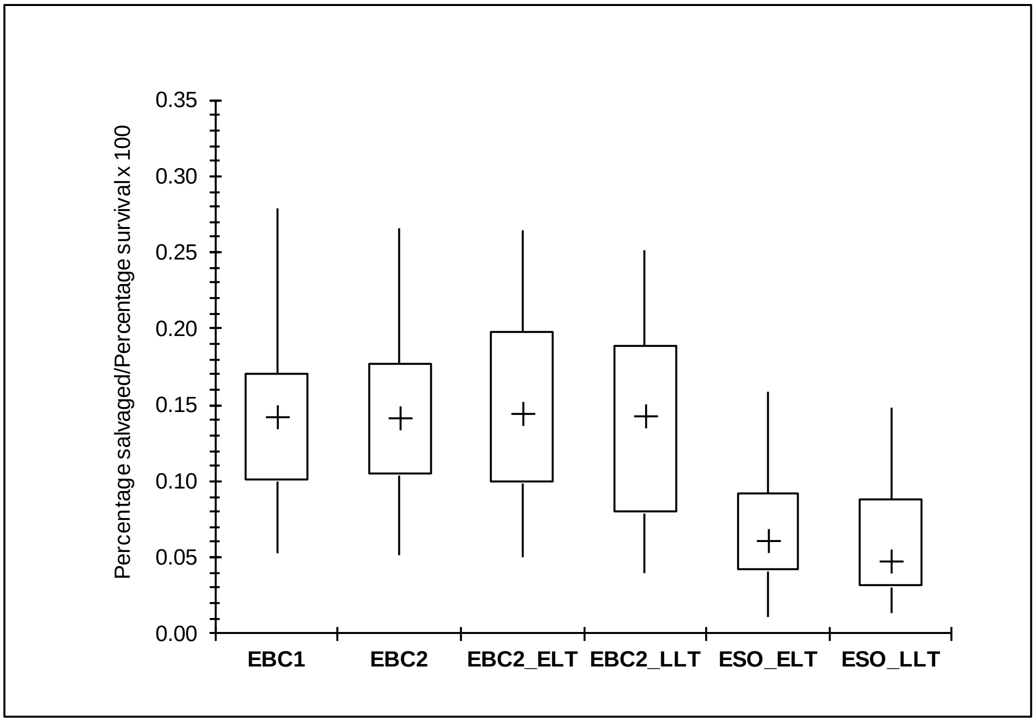
3

Smolt Salvage as a Percentage of Through-Delta Survival

Patterns of winter-run Chinook salmon smolt salvage percentage as a percentage of through-Delta survival percentage generally were similar to those seen for the patterns of salvage percentage described above in Table 5.B.6-34. The estimated salvage/survival percentage averaged 0.14–0.15% for EBC scenarios, and 0.06–0.07% for ESO scenarios (Table 5.B.6-36; Figure 5.B.6-4). Percentage salvage/survival in individual years ranged from around 0.01% (ESO scenarios in 1983–1984) to around 0.22–0.28% or more (EBC scenarios in 1976 and 1979). Average percentage salvage/survival was 53–58% lower under ESO scenarios compared with EBC scenarios in relative terms, or 0.08% lower in absolute terms (Table 5.B.6-37).

Table 5.B.6-36. Estimated Winter-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.28	0.27	0.26	0.25	0.16	0.15
1977 (C)	0.11	0.08	0.08	0.07	0.08	0.05
1978 (AN)	0.14	0.14	0.14	0.13	0.04	0.03
1979 (BN)	0.22	0.26	0.25	0.25	0.13	0.10
1980 (AN)	0.14	0.14	0.13	0.11	0.04	0.05
1981 (D)	0.14	0.17	0.18	0.18	0.09	0.08
1982 (W)	0.19	0.18	0.19	0.17	0.03	0.03
1983 (W)	0.08	0.12	0.12	0.14	0.01	0.02
1984 (W)	0.15	0.15	0.15	0.15	0.01	0.01
1985 (D)	0.19	0.21	0.21	0.21	0.09	0.08
1986 (W)	0.17	0.15	0.24	0.20	0.06	0.04
1987 (D)	0.16	0.16	0.16	0.15	0.12	0.10
1988 (C)	0.08	0.08	0.09	0.08	0.07	0.06
1989 (D)	0.06	0.07	0.07	0.05	0.05	0.04
1990 (C)	0.13	0.11	0.10	0.07	0.09	0.12
1991 (C)	0.05	0.05	0.05	0.04	0.05	0.03
Average	0.14	0.15	0.15	0.14	0.07	0.06



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-4. Winter-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-37. Difference in Estimated Winter-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.12 (-43%)	-0.13 (-47%)	-0.11 (-40%)	-0.12 (-44%)	-0.11 (-40%)	-0.10 (-41%)
1977 (C)	-0.03 (-27%)	-0.06 (-53%)	0.00 (-2%)	-0.03 (-37%)	0.00 (2%)	-0.02 (-24%)
1978 (AN)	-0.11 (-75%)	-0.11 (-77%)	-0.10 (-74%)	-0.11 (-77%)	-0.10 (-74%)	-0.10 (-76%)
1979 (BN)	-0.09 (-42%)	-0.12 (-55%)	-0.14 (-51%)	-0.17 (-63%)	-0.12 (-49%)	-0.15 (-60%)
1980 (AN)	-0.09 (-67%)	-0.09 (-67%)	-0.09 (-68%)	-0.09 (-67%)	-0.08 (-65%)	-0.06 (-57%)
1981 (D)	-0.05 (-36%)	-0.06 (-42%)	-0.08 (-47%)	-0.09 (-52%)	-0.09 (-50%)	-0.10 (-54%)
1982 (W)	-0.16 (-84%)	-0.16 (-83%)	-0.16 (-84%)	-0.15 (-83%)	-0.16 (-85%)	-0.14 (-81%)
1983 (W)	-0.07 (-87%)	-0.06 (-81%)	-0.11 (-91%)	-0.10 (-87%)	-0.11 (-91%)	-0.12 (-89%)
1984 (W)	-0.14 (-91%)	-0.14 (-91%)	-0.14 (-91%)	-0.14 (-91%)	-0.14 (-91%)	-0.14 (-91%)
1985 (D)	-0.11 (-55%)	-0.11 (-56%)	-0.12 (-59%)	-0.12 (-60%)	-0.12 (-59%)	-0.13 (-60%)
1986 (W)	-0.11 (-67%)	-0.12 (-74%)	-0.09 (-62%)	-0.10 (-71%)	-0.18 (-77%)	-0.16 (-79%)
1987 (D)	-0.03 (-22%)	-0.06 (-36%)	-0.04 (-26%)	-0.06 (-39%)	-0.04 (-25%)	-0.05 (-34%)
1988 (C)	-0.01 (-18%)	-0.03 (-32%)	-0.01 (-17%)	-0.03 (-32%)	-0.02 (-27%)	-0.03 (-33%)
1989 (D)	-0.01 (-12%)	-0.02 (-40%)	-0.02 (-24%)	-0.03 (-49%)	-0.01 (-21%)	-0.01 (-29%)
1990 (C)	-0.03 (-28%)	-0.01 (-5%)	-0.02 (-20%)	0.01 (5%)	-0.01 (-10%)	0.05 (61%)
1991 (C)	-0.01 (-11%)	-0.02 (-38%)	0.00 (-9%)	-0.02 (-38%)	0.00 (-7%)	-0.01 (-20%)
Average	-0.07 (-51%)	-0.08 (-57%)	-0.08 (-53%)	-0.08 (-58%)	-0.08 (-54%)	-0.08 (-56%)

5.B.6.1.3 Spring-Run Chinook Salmon (Juvenile)

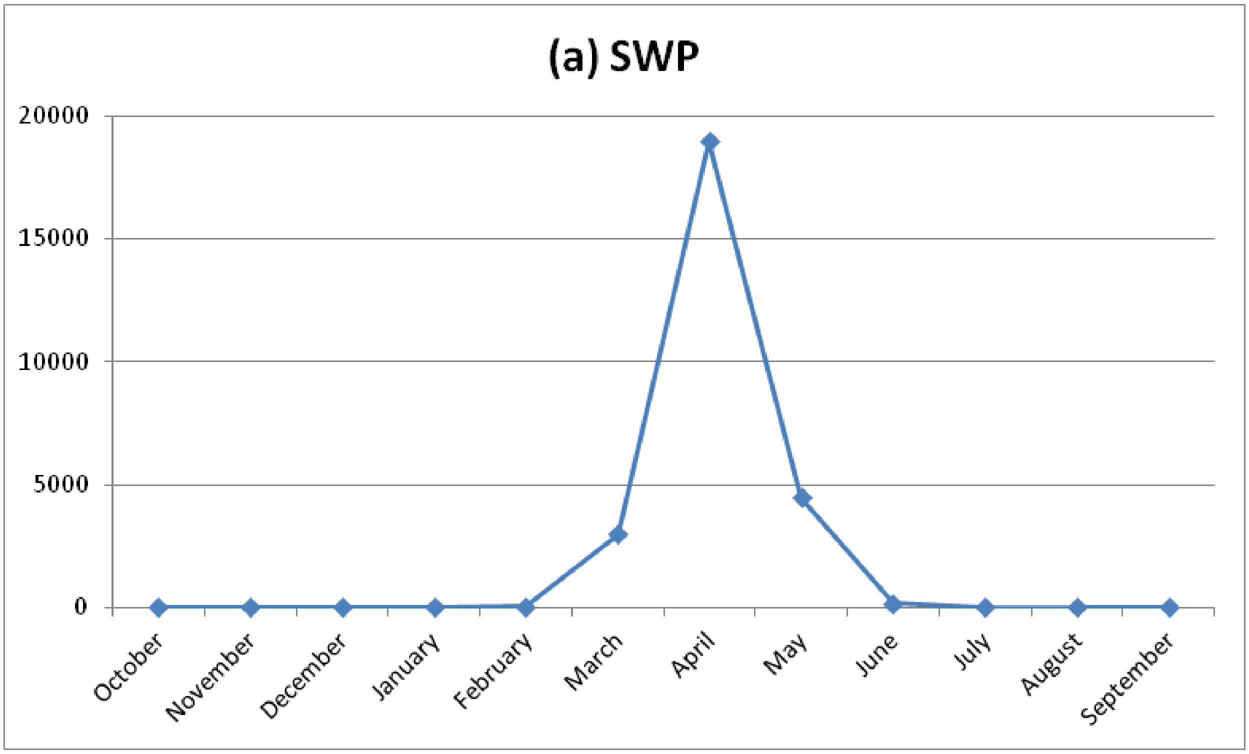
5.B.6.1.3.1 Salvage-Density Method

The basic seasonal pattern of entrainment of juvenile spring-run Chinook salmon upon which the salvage-density method is based is presented in Figure 5.B.6-5, although note that this is an average of all years combined and does not account for water-year differences. Note also that there is considerable overlap in the entrainment of juvenile spring-run and fall-run Chinook salmon and there is difficulty discerning race based solely on length-at-date criteria, the same criteria used to generate Figure 5.B.6-5. Logic dictates that loss of juvenile spring-run Chinook salmon should be substantially numerically lower than that of juvenile fall-run Chinook salmon because the spawning population of spring-run Chinook salmon is considerably lower than that of fall-run Chinook salmon. This is not the case (compare Figure 5.B.6-5 and Figure 5.B.6-8) and suggests that the length-at-date criteria do not allow perfect classification of race by length. Therefore the seasonal entrainment pattern is the best index of entrainment, as opposed to the actual numbers of fish. At both SWP and CVP facilities, entrainment loss peaks in April and is also relatively high in March and May.

In general, estimated losses of spring-run Chinook salmon at the SWP facility were greater than those estimated for the CVP export facility (Table 5.B.6-38 through Table 5.B.6-49). Normalization of the data to adult population size increased the estimated entrainment loss relative to nonnormalized data for wet, dry, and critical water years and resulted in little change to entrainment loss in above-normal and below-normal years. This summary of the main results focuses only on normalized data. Estimated annual losses at SWP across all water years averaged around 23,000–24,000 fish under EBC scenarios and 14,000–15,000 under EBC scenarios; for the CVP, the annual average loss was around 15,000 fish under EBC and 9,000–10,000 fish under ESO. Losses were greatest in wet years (at each facility: >40,000 fish under EBC and 17,000–18,000 under ESO) and were lowest in below-normal years (5,000–6,000 fish at SWP and 1,000 fish at CVP under EBC scenarios; 4,000–5,000 fish at SWP and 800 fish at CVP under ESO scenarios) (Table 5.B.6-39 and Table 5.B.6-41).

Differences in entrainment loss of juvenile spring-run Chinook salmon between EBC and ESO scenarios were greatest in wet years, with reductions at both facilities under ESO scenarios compared to EBC scenarios of ~54,000–58,000 fish (61–63% reduction) (Table 5.B.6-50). Differences between EBC and ESO scenarios were least in dry years (8% increase to 11% decrease). In all water years combined, reductions under ESO scenarios compared to EBC scenarios were estimated to be on the order of 13,000–16,000 fish (36–40% reduction).

Under the assumption that the annual number of juvenile spring-run Chinook salmon juveniles approaching the Delta was 750,000 fish, the percentage of the population lost to entrainment across all years averaged around 5.0–5.3% under EBC scenarios and decreased to 3.2–3.3% under ESO scenarios (Table 5.B.6-51). In wet years, EBC entrainment losses of ~12% were reduced to around 4.5% under ESO scenarios (Table 5.B.6-52). Proportional losses in the remaining water-year types generally were lower under ESO scenarios compared to EBC scenarios in the remaining water-year types (Table 5.B.6-53 through Table 5.B.6-56), although in dry years average proportional loss under the ESO_ELT scenario was marginally greater than under the EBC scenarios. Nonnormalized estimates were generally lower, as noted above (Table 5.B.6-57 through Table 5.B.6-63).



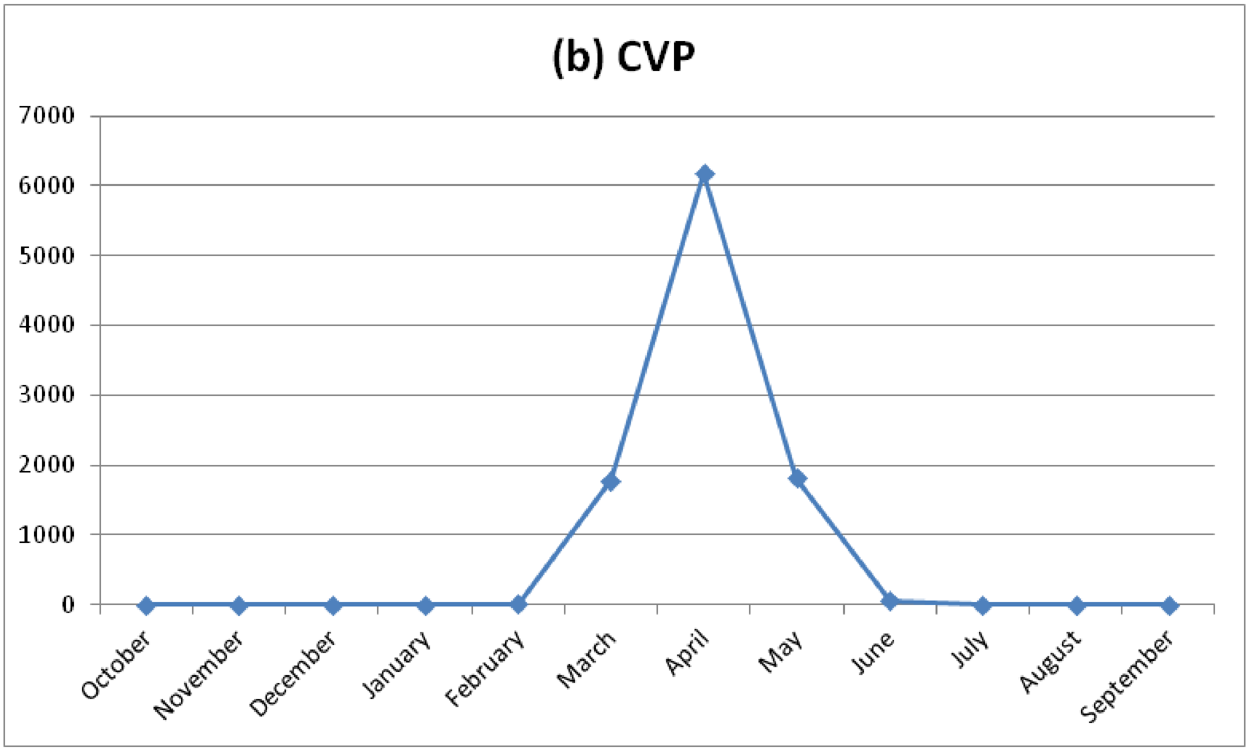


Figure 5.B.6-5. Mean Monthly Entrainment Loss of Juvenile Spring-Run Chinook Salmon Calculated from Observed Salvage Monitoring at the (a) SWP and (b) CVP South Delta Export Facilities, Water Years 1996–2008

Table 5.B.6-38. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	24	±	5	17	±	4	15	±	3	12	±	3	6	±	1	5	±	1
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	109	±	17	111	±	17	113	±	18	105	±	16	55	±	9	52	±	9
March	5,588	±	793	5,708	±	821	5,713	±	833	5,542	±	818	1,981	±	304	2,196	±	349
April	11,403	±	1,218	11,838	±	1,295	12,135	±	1,325	12,547	±	1,359	8,986	±	833	8,676	±	817
May	5,126	±	474	5,308	±	529	5,623	±	542	5,663	±	541	3,394	±	230	3,155	±	221
June	467	±	96	466	±	98	441	±	91	389	±	80	229	±	45	206	±	40
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	2	±	1	2	±	1	2	±	0	2	±	0	1	±	0	1	±	0
Annual Average	22,721	±	2,042	23,452	±	2,164	24,043	±	2,204	24,262	±	2,221	14,652	±	1,147	14,292	±	1,150
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	24	±	3	23	±	3	23	±	3	23	±	3	11	±	2	13	±	2
March	5,462	±	782	5,453	±	788	5,346	±	776	5,216	±	775	2,393	±	406	2,276	±	384
April	6,291	±	609	6,232	±	604	6,529	±	631	6,629	±	641	5,150	±	491	5,038	±	486
May	3,190	±	619	3,171	±	615	3,234	±	635	3,197	±	622	2,233	±	378	2,004	±	345
June	144	±	29	143	±	29	126	±	26	114	±	23	75	±	15	65	±	13
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	15,112	±	1,874	15,024	±	1,864	15,260	±	1,895	15,182	±	1,894	9,863	±	1,169	9,396	±	1,109

Table 5.B.6-39. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	71	±	26	52	±	20	45	±	17	37	±	14	15	±	6	13	±	6
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	316	±	91	319	±	93	331	±	96	315	±	92	109	±	43	95	±	37
March	13,998	±	4,556	14,734	±	4,828	15,049	±	4,918	14,519	±	4,793	2,723	±	1,367	3,115	±	1,556
April	19,859	±	6,601	20,894	±	7,133	21,050	±	7,172	21,562	±	7,241	9,258	±	2,690	9,237	±	2,679
May	9,480	±	2,202	10,390	±	2,505	10,652	±	2,526	10,293	±	2,508	3,819	±	638	3,517	±	645
June	1,699	±	587	1,762	±	610	1,587	±	554	1,442	±	494	683	±	242	607	±	207
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	45,423	±	10,815	48,151	±	11,629	48,715	±	11,742	48,168	±	11,708	16,608	±	3,735	16,584	±	3,938
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	58	±	12	58	±	12	60	±	12	61	±	12	11	±	4	19	±	6
March	16,340	±	3,772	16,521	±	3,899	16,737	±	3,938	16,957	±	3,991	4,570	±	1,796	3,989	±	1,425
April	15,272	±	3,281	15,229	±	3,271	15,409	±	3,305	15,744	±	3,359	8,467	±	1,725	8,668	±	1,804
May	10,941	±	4,045	10,900	±	4,027	11,307	±	4,182	10,830	±	4,036	4,900	±	1,586	4,406	±	1,464
June	541	±	165	543	±	166	509	±	157	443	±	138	215	±	69	199	±	65
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	43,152	±	10,203	43,251	±	10,146	44,021	±	10,396	44,036	±	10,428	18,162	±	4,396	17,279	±	4,063

Table 5.B.6-40. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	4	±	2	4	±	2	4	±	2	4	±	2	2	±	1	2	±	1
February	82	±	35	83	±	35	84	±	37	83	±	35	27	±	16	35	±	18
March	5,434	±	1,249	5,309	±	1,206	5,435	±	1,276	5,558	±	1,424	1039	±	265	1439	±	472
April	12,425	±	4,101	12,357	±	4,074	13,137	±	4,338	14,591	±	4,742	11479	±	4119	10835	±	3980
May	2,341	±	330	2,338	±	328	2,617	±	433	2,737	±	417	2282	±	444	2170	±	386
June	104	±	36	100	±	36	102	±	34	85	±	27	51	±	16	49	±	15
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	12	±	6	12	±	6	12	±	6	12	±	6	2	±	2	1	±	2
Annual Average	20,403	±	5,463	20,204	±	5,399	21,392	±	5,769	23,070	±	6,237	14883	±	4611	14532	±	4563
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	4	±	2	4	±	2	3	±	2	3	±	2	2	±	1	2	±	1
February	20	±	9	17	±	9	19	±	9	19	±	9	10	±	5	10	±	6
March	1,597	±	213	1,620	±	226	1,517	±	227	1,454	±	240	312	±	77	360	±	125
April	4,104	±	1,308	4,082	±	1,300	4,276	±	1,369	4,599	±	1,473	3580	±	1276	3802	±	1330
May	560	±	155	560	±	155	600	±	177	613	±	177	505	±	165	413	±	137
June	12	±	6	12	±	6	10	±	5	10	±	5	6	±	3	5	±	3
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	6,297	±	1,403	6,295	±	1,401	6,425	±	1,473	6,698	±	1,580	4414	±	1314	4593	±	1370

Table 5.B.6-41. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	12	±	1	13	±	2	13	±	2	12	±	3	7	±	2	8	±	2
February	32	±	9	32	±	10	35	±	11	29	±	8	22	±	5	20	±	7
March	2,269	±	457	2,302	±	511	2,316	±	538	2,145	±	532	1087	±	172	1398	±	310
April	2,219	±	237	2,214	±	248	2,447	±	336	2,916	±	476	2320	±	535	2554	±	517
May	834	±	91	833	±	99	901	±	130	1,053	±	174	804	±	146	788	±	156
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	5,365	±	664	5,394	±	723	5,712	±	713	6,155	±	684	4239	±	692	4767	±	537
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	517	±	90	470	±	84	457	±	85	466	±	108	313	±	72	313	±	81
April	372	±	29	371	±	31	396	±	48	419	±	62	357	±	77	406	±	82
May	118	±	9	118	±	10	119	±	8	127	±	16	105	±	19	103	±	20
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,007	±	79	959	±	80	972	±	82	1,012	±	111	776	±	126	821	±	141

Table 5.B.6-42. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	1,535	±	571	1,522	±	562	1,433	±	527	1,417	±	515	1160	±	436	1088	±	404
April	7,301	±	2,484	7,771	±	2,618	8,278	±	3,030	7,873	±	2,997	9058	±	3174	7790	±	2918
May	4,973	±	1,618	4,842	±	1,576	5,431	±	1,842	5,605	±	1,856	4974	±	1638	4306	±	1491
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	13,809	±	4,512	14,135	±	4,628	15,142	±	5,224	14,896	±	5,158	15192	±	5073	13184	±	4494
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	4	±	1	4	±	1	4	±	2	4	±	1	2	±	1	2	±	1
February	1	±	1	1	±	1	1	±	1	1	±	1	1	±	1	1	±	0
March	536	±	180	546	±	181	552	±	180	487	±	163	420	±	148	399	±	142
April	2,006	±	453	1,953	±	439	2,284	±	537	2,165	±	505	2439	±	596	2018	±	538
May	90	±	12	89	±	12	87	±	12	88	±	12	91	±	13	77	±	13
June	3	±	1	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,639	±	623	2,596	±	616	2,931	±	704	2,747	±	648	2954	±	730	2499	±	651

Table 5.B.6-43. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	210	±	60	209	±	71	184	±	61	177	±	65	167	±	39	149	±	47
April	4,076	±	1,441	4,243	±	1,344	3,746	±	1,146	3,327	±	930	3784	±	1192	3596	±	1286
May	4,581	±	698	4,246	±	829	4,410	±	837	3,996	±	1,288	2779	±	1182	2809	±	1215
June	129	±	33	125	±	35	118	±	33	101	±	31	75	±	17	94	±	28
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	8,996	±	1,627	8,822	±	1,616	8,459	±	1,787	7,600	±	1,885	6804	±	1973	6648	±	1688
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	102	±	33	109	±	40	95	±	31	86	±	31	79	±	27	70	±	27
April	1,698	±	189	1,667	±	169	1,603	±	187	1,588	±	193	1489	±	288	1356	±	312
May	1,076	±	74	1,047	±	64	1,010	±	92	976	±	64	879	±	140	862	±	113
June	5	±	0	4	±	0	4	±	0	5	±	1	3	±	1	3	±	1
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,880	±	248	2,828	±	218	2,711	±	271	2,655	±	250	2450	±	396	2291	±	395

Table 5.B.6-44. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	4	±	1	3	±	1	2	±	1	2	±	0	1	±	0	1	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
December	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	71	±	8	72	±	8	73	±	8	68	±	8	36	±	4	34	±	4
March	2,875	±	238	2,937	±	248	2,939	±	252	2,851	±	249	1,019	±	93	1,130	±	108
April	7,930	±	626	8,233	±	668	8,439	±	683	8,726	±	700	6,249	±	414	6,034	±	408
May	3,836	±	367	3,972	±	409	4,208	±	419	4,238	±	418	2,540	±	180	2,361	±	172
June	135	±	16	135	±	17	128	±	15	112	±	14	66	±	8	60	±	7
July	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
August	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
September	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0
Annual Average	14,854	±	983	15,354	±	1,064	15,792	±	1,089	16,001	±	1,101	9,912	±	574	9,620	±	560
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
November	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
December	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	2	±	0
February	12	±	1	12	±	1	12	±	1	12	±	1	6	±	1	6	±	1
March	1,528	±	142	1,526	±	144	1,496	±	141	1,459	±	142	669	±	76	637	±	72
April	3,235	±	188	3,204	±	187	3,357	±	195	3,409	±	198	2,648	±	150	2,590	±	150
May	1,113	±	108	1,107	±	107	1,129	±	111	1,116	±	108	779	±	63	700	±	58
June	44	±	5	43	±	5	38	±	5	35	±	4	23	±	3	20	±	2
July	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
August	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
September	0	±	0	0	±	0	0	±	0	0	±	0	-	±	-	-	±	-
Annual Average	5,934	±	343	5,894	±	341	6,033	±	349	6,032	±	352	4,127	±	226	3,954	±	218

Table 5.B.6-45. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	11	±	4	8	±	3	7	±	3	6	±	2	2	±	1	2	±	1
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	197	±	38	199	±	39	206	±	41	196	±	39	68	±	19	59	±	17
March	5,071	±	1,176	5,338	±	1,248	5,452	±	1,270	5,260	±	1,240	987	±	374	1,128	±	426
April	12,796	±	2,886	13,462	±	3,139	13,563	±	3,155	13,893	±	3,174	5,965	±	1,130	5,951	±	1125
May	7,152	±	2,125	7,839	±	2,405	8,036	±	2,430	7,765	±	2,405	2,881	±	654	2,654	±	648
June	391	±	90	405	±	93	365	±	85	332	±	75	157	±	37	140	±	31
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	25,618	±	4,738	27,251	±	5,249	27,630	±	5,297	27,452	±	5,292	10,061	±	1,744	9,934	±	1730
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	26	±	3	26	±	3	27	±	3	27	±	3	5	±	1	8	±	2
March	3,608	±	661	3,648	±	687	3,696	±	693	3,745	±	703	1,009	±	336	881	±	265
April	6,302	±	859	6,285	±	856	6,359	±	864	6,497	±	876	3494	±	437	3577	±	463
May	3,209	±	627	3,197	±	624	3,316	±	648	3,177	±	628	1437	±	228	1292	±	214
June	153	±	27	153	±	27	144	±	25	125	±	23	61	±	12	56	±	11
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	13,298	±	1,529	13,309	±	1,512	13,541	±	1,552	13,570	±	1,570	6,006	±	693	5,814	±	656

Table 5.B.6-46. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	5	±	3	5	±	3	6	±	3	5	±	3	3	±	2	2	±	1
February	59	±	21	59	±	22	60	±	23	59	±	22	19	±	10	25	±	11
March	4,910	±	934	4,797	±	899	4,910	±	960	5,022	±	1,097	939	±	203	1,301	±	380
April	9,852	±	2,432	9,798	±	2,415	10,416	±	2,573	11,569	±	2,795	9,102	±	2,516	8,591	±	2,449
May	2,124	±	183	2,122	±	182	2,375	±	283	2,483	±	255	2,071	±	319	1,969	±	265
June	94	±	36	90	±	36	92	±	35	76	±	27	45	±	16	44	±	15
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	8	±	4	8	±	4	8	±	4	8	±	4	1	±	2	1	±	1
Annual Average	17,051	±	3,124	16,879	±	3,079	17,867	±	3,310	19,223	±	3,575	12,181	±	2,725	11,933	±	2,730
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	5	±	2	5	±	2	4	±	2	5	±	2	2	±	1	3	±	2
February	14	±	6	12	±	6	13	±	6	14	±	6	7	±	4	7	±	4
March	1,500	±	188	1,520	±	201	1,424	±	203	1,365	±	217	293	±	70	337	±	116
April	3,154	±	752	3,138	±	747	3,286	±	788	3,534	±	848	2,752	±	763	2,922	±	790
May	525	±	158	525	±	158	562	±	180	575	±	180	473	±	166	387	±	138
June	12	±	6	12	±	6	10	±	5	10	±	5	6	±	3	6	±	3
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	5,210	±	732	5,212	±	734	5,300	±	788	5,502	±	854	3,533	±	774	3,663	±	801

Table 5.B.6-47. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	11	±	1	12	±	2	12	±	2	11	±	3	6	±	2	7	±	2
February	29	±	9	30	±	9	32	±	10	27	±	7	20	±	5	18	±	6
March	2,096	±	422	2,127	±	472	2,139	±	497	1,981	±	492	1,004	±	159	1,291	±	286
April	2,050	±	219	2,045	±	229	2,260	±	311	2,693	±	440	2,143	±	494	2,359	±	477
May	770	±	84	769	±	92	833	±	120	973	±	160	742	±	134	728	±	144
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	4,956	±	613	4,982	±	668	5,276	±	658	5,685	±	632	3,916	±	639	4,403	±	496
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	477	±	83	434	±	78	422	±	78	430	±	99	289	±	67	289	±	75
April	344	±	27	343	±	29	366	±	44	387	±	57	330	±	71	375	±	76
May	109	±	8	109	±	9	110	±	8	118	±	15	97	±	18	95	±	19
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	930	±	73	886	±	74	898	±	75	935	±	102	716	±	117	759	±	130

Table 5.B.6-48. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	957	±	318	949	±	312	894	±	293	884	±	286	723	±	243	678	±	224
April	4,655	±	1,353	4,955	±	1,424	5,278	±	1,666	5,020	±	1,655	5,776	±	1,735	4,967	±	1,608
May	3,219	±	871	3,134	±	849	3,515	±	999	3,628	±	1,003	3,220	±	884	2,787	±	811
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	8,831	±	2,440	9,038	±	2,503	9,687	±	2,848	9,532	±	2,813	9,719	±	2,752	8,433	±	2,446
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	5	±	2	5	±	2	6	±	2	5	±	2	3	±	1	3	±	1
February	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1	1	±	1
March	364	±	98	371	±	98	375	±	98	331	±	89	285	±	81	271	±	78
April	1,533	±	229	1,493	±	222	1,746	±	280	1,655	±	261	1,864	±	318	1,542	±	300
May	79	±	10	79	±	10	78	±	10	78	±	10	81	±	11	68	±	11
June	4	±	1	3	±	1	3	±	1	2	±	1	3	±	1	2	±	1
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,987	±	316	1,953	±	312	2,208	±	362	2,073	±	330	2,236	±	385	1,888	±	353

Table 5.B.6-49. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Spring-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	157	±	45	156	±	53	138	±	46	132	±	49	124	±	29	112	±	35
April	3,044	±	1,076	3,168	±	1,004	2,797	±	856	2,484	±	694	2,826	±	890	2,685	±	960
May	3,421	±	521	3,171	±	619	3,293	±	625	2,984	±	962	2,075	±	883	2,098	±	907
June	97	±	25	93	±	26	88	±	24	75	±	23	56	±	13	70	±	21
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	6,718	±	1,215	6,588	±	1,207	6,317	±	1,334	5,675	±	1,408	5,081	±	1,473	4,965	±	1,261
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	76	±	25	82	±	30	71	±	23	64	±	23	59	±	20	52	±	21
April	1,268	±	141	1,245	±	126	1,197	±	140	1,186	±	144	1,112	±	215	1,013	±	233
May	803	±	55	782	±	48	754	±	69	729	±	48	656	±	104	644	±	85
June	3	±	0	3	±	0	3	±	0	3	±	1	2	±	1	3	±	1
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,151	±	185	2,112	±	162	2,025	±	203	1,983	±	187	1,829	±	295	1,711	±	295

Table 5.B.6-50. Average Annual Juvenile Spring-Run Chinook Salmon Losses in Each Water-Year Type Calculated Using Normalized Salvage Densities for Facilities Model Scenarios at the CVP, SWP, and Combined CVP/SWP South Delta Export Facilities

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-24,990 (-58%)	-25,873 (-60%)	-25,089 (-58%)	-25,972 (-60%)	-25,859 (-59%)	-26,756 (-61%)
Above Normal	-1,883 (-30%)	-1,704 (-27%)	-1,881 (-30%)	-1,702 (-27%)	-2,011 (-31%)	-2,106 (-31%)
Below Normal	-231 (-23%)	-185 (-18%)	-184 (-19%)	-138 (-14%)	-197 (-20%)	-191 (-19%)
Dry	315 (12%)	-141 (-5%)	358 (14%)	-97 (-4%)	23 (1%)	-248 (-9%)
Critical	-430 (-15%)	-589 (-20%)	-379 (-13%)	-538 (-19%)	-262 (-10%)	-364 (-14%)
All Years	-5,249 (-35%)	-5,715 (-38%)	-5,160 (-34%)	-5,627 (-37%)	-5,396 (-35%)	-5,785 (-38%)
SWP						
Wet	-28,815 (-63%)	-28,839 (-63%)	-31,544 (-66%)	-31,568 (-66%)	-32,107 (-66%)	-31,584 (-66%)
Above Normal	-5,520 (-27%)	-5,871 (-29%)	-5,321 (-26%)	-5,672 (-28%)	-6,510 (-30%)	-8,538 (-37%)
Below Normal	-1,126 (-21%)	-598 (-11%)	-1,154 (-21%)	-626 (-12%)	-1,472 (-26%)	-1,388 (-23%)
Dry	1,383 (10%)	-625 (-5%)	1,058 (7%)	-951 (-7%)	51 (0%)	-1,712 (-11%)
Critical	-2,192 (-24%)	-2,348 (-26%)	-2,018 (-23%)	-2,174 (-25%)	-1,655 (-20%)	-952 (-13%)
All Years	-8,069 (-36%)	-8,429 (-37%)	-8,800 (-38%)	-9,160 (-39%)	-9,392 (-39%)	-9,970 (-41%)
Combined Losses						
Wet	-53,805 (-61%)	-54,712 (-62%)	-56,633 (-62%)	-57,539 (-63%)	-57,967 (-63%)	-58,340 (-63%)
Above Normal	-7,403 (-28%)	-7,576 (-28%)	-7,202 (-27%)	-7,375 (-28%)	-8,520 (-31%)	-10,644 (-36%)
Below Normal	-1,357 (-21%)	-784 (-12%)	-1,338 (-21%)	-764 (-12%)	-1,669 (-25%)	-1,579 (-22%)
Dry	1,698 (10%)	-766 (-5%)	1,416 (8%)	-1,048 (-6%)	74 (0%)	-1,960 (-11%)
Critical	-2,622 (-22%)	-2,937 (-25%)	-2,397 (-21%)	-2,712 (-23%)	-1,916 (-17%)	-1,316 (-13%)
All Years	-13,318 (-35%)	-14,145 (-37%)	-13,960 (-36%)	-14,787 (-38%)	-14,788 (-38%)	-15,755 (-40%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-51. Average Annual Juvenile Spring-Run Chinook Salmon Losses in Each Water-Year Type Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the CVP, SWP, and Combined CVP/SWP South Delta Export Facilities

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-7,292 (-55%)	-7,484 (-56%)	-7,303 (-55%)	-7,495 (-56%)	-7,535 (-56%)	-7,756 (-57%)
Above Normal	-1,677 (-32%)	-1,547 (-30%)	-1,679 (-32%)	-1,550 (-30%)	-1,768 (-33%)	-1,840 (-33%)
Below Normal	-214 (-23%)	-171 (-18%)	-170 (-19%)	-128 (-14%)	-182 (-20%)	-176 (-19%)
Dry	249 (13%)	-99 (-5%)	283 (15%)	-65 (-3%)	28 (1%)	-185 (-9%)
Critical	-321 (-15%)	-440 (-20%)	-283 (-13%)	-401 (-19%)	-195 (-10%)	-272 (-14%)
All Years	-1,807 (-30%)	-1,980 (-33%)	-1,767 (-30%)	-1,940 (-33%)	-1,907 (-32%)	-2,078 (-34%)
SWP						
Wet	-15,557 (-61%)	-15,683 (-61%)	-17,191 (-63%)	-17,317 (-64%)	-17,569 (-64%)	-17,518 (-64%)
Above Normal	-4,870 (-29%)	-5,118 (-30%)	-4,698 (-28%)	-4,946 (-29%)	-5,687 (-32%)	-7,290 (-38%)
Below Normal	-1,040 (-21%)	-552 (-11%)	-1,066 (-21%)	-579 (-12%)	-1,360 (-26%)	-1,282 (-23%)
Dry	887 (10%)	-399 (-5%)	681 (8%)	-605 (-7%)	32 (0%)	-1,099 (-12%)
Critical	-1,637 (-24%)	-1,753 (-26%)	-1,507 (-23%)	-1,624 (-25%)	-1,236 (-20%)	-711 (-13%)
All Years	-4,942 (-33%)	-5,234 (-35%)	-5,442 (-35%)	-5,734 (-37%)	-5,880 (-37%)	-6,381 (-40%)
Combined Losses						
Wet	-22,849 (-59%)	-23,167 (-60%)	-24,494 (-60%)	-24,812 (-61%)	-25,105 (-61%)	-25,274 (-62%)
Above Normal	-6,547 (-29%)	-6,666 (-30%)	-6,378 (-29%)	-6,496 (-29%)	-7,454 (-32%)	-9,130 (-37%)
Below Normal	-1,254 (-21%)	-724 (-12%)	-1,236 (-21%)	-706 (-12%)	-1,541 (-25%)	-1,458 (-22%)
Dry	1,136 (11%)	-498 (-5%)	964 (9%)	-670 (-6%)	60 (1%)	-1,284 (-11%)
Critical	-1,958 (-22%)	-2,193 (-25%)	-1,790 (-21%)	-2,025 (-23%)	-1,431 (-17%)	-983 (-13%)
All Years	-6,749 (-32%)	-7,214 (-35%)	-7,209 (-34%)	-7,674 (-36%)	-7,787 (-36%)	-8,459 (-38%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-52. Average Annual Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	22,721	23,452	24,043	24,262	14,652	14,292
CVP Jones	15,112	15,024	15,260	15,182	9,863	9,396
Combined	37,833	38,476	39,303	39,443	24,515	23,689
Percentage of spring-run juvenile index of abundance	5.04%	5.13%	5.24%	5.26%	3.27%	3.16%

Table 5.B.6-53. Wet Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	45,423	48,151	48,715	48,168	16,608	16,584
CVP Jones	43,152	43,251	44,021	44,036	18,162	17,279
Combined	88,575	91,402	92,736	92,203	34,770	33,863
Percentage of spring-run juvenile index of abundance	11.81%	12.19%	12.36%	12.29%	4.64%	4.52%

Table 5.B.6-54. Above-Normal Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	20,403	20,204	21,392	23,070	14,883	14,532
CVP Jones	6,297	6,295	6,425	6,698	4,414	4,593
Combined	26,700	26,499	27,817	29,768	19,297	19,124
Percentage of spring-run juvenile index of abundance	3.56%	3.53%	3.71%	3.97%	2.57%	2.55%

Table 5.B.6-55. Below-Normal Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	5,365	5,394	5,712	6,155	4,239	4,767
CVP Jones	1,007	959	972	1,012	775	821
Combined	6,372	6,353	6,684	7,167	5,015	5,589
Percentage of spring-run juvenile index of abundance	0.85%	0.85%	0.89%	0.96%	0.67%	0.75%

Table 5.B.6-56. Dry Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	13,809	14,135	15,142	14,896	15,192	13,184
CVP Jones	2,639	2,596	2,931	2,747	2,954	2,499
Combined	16,449	16,731	18,073	17,642	18,147	15,683
Percentage of spring-run juvenile index of abundance	2.19%	2.23%	2.41%	2.35%	2.42%	2.09%

Table 5.B.6-57. Critical Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	8,996	8,822	8,459	7,600	6,804	6,648
CVP Jones	2,880	2,828	2,711	2,655	2,450	2,291
Combined	11,876	11,650	11,170	10,255	9,253	8,939
Percentage of spring-run juvenile index of abundance	1.58%	1.55%	1.49%	1.37%	1.23%	1.19%

Table 5.B.6-58. Average Annual Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	14,854	15,354	15,792	16,001	9,912	9,620
CVP Jones	5,934	5,894	6,033	6,032	4,127	3,954
Combined	20,788	21,248	21,826	22,033	14,039	13,574
Percentage of spring-run juvenile index of abundance	2.77%	2.83%	2.91%	2.94%	1.87%	1.81%

Table 5.B.6-59. Wet Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	25,618	27,251	27,630	27,452	10,061	9,934
CVP Jones	13,298	13,309	13,541	13,570	6,006	5,814
Combined	38,916	40,560	41,171	41,022	16,066	15,748
Percentage of spring-run juvenile index of abundance	5.19%	5.41%	5.49%	5.47%	2.14%	2.10%

Table 5.B.6-60. Above-Normal Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	17,051	16,879	17,867	19,223	12,181	11,933
CVP Jones	5,210	5,212	5,300	5,502	3,533	3,663
Combined	22,261	22,091	23,168	24,725	15,714	15,595
Percentage of spring-run juvenile index of abundance	2.97%	2.95%	3.09%	3.30%	2.10%	2.08%

Table 5.B.6-61. Below-Normal Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	4,956	4,982	5,276	5,685	3,916	4,403
CVP Jones	930	886	898	935	716	759
Combined	5,886	5,868	6,174	6,620	4,632	5,162
Percentage of spring-run juvenile index of abundance	0.78%	0.78%	0.82%	0.88%	0.62%	0.69%

Table 5.B.6-62. Dry Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	8,831	9,038	9,687	9,532	9,719	8,433
CVP Jones	1,987	1,953	2,208	2,073	2,236	1,888
Combined	10,819	10,991	11,895	11,604	11,955	10,321
Percentage of spring-run juvenile index of abundance	1.44%	1.47%	1.59%	1.55%	1.59%	1.38%

Table 5.B.6-63. Critical Year Juvenile Spring-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	6,718	6,588	6,317	5,675	5,081	4,965
CVP Jones	2,151	2,112	2,025	1,983	1,829	1,711
Combined	8,869	8,700	8,342	7,658	6,910	6,675
Percentage of spring-run juvenile index of abundance	1.18%	1.16%	1.11%	1.02%	0.92%	0.89%

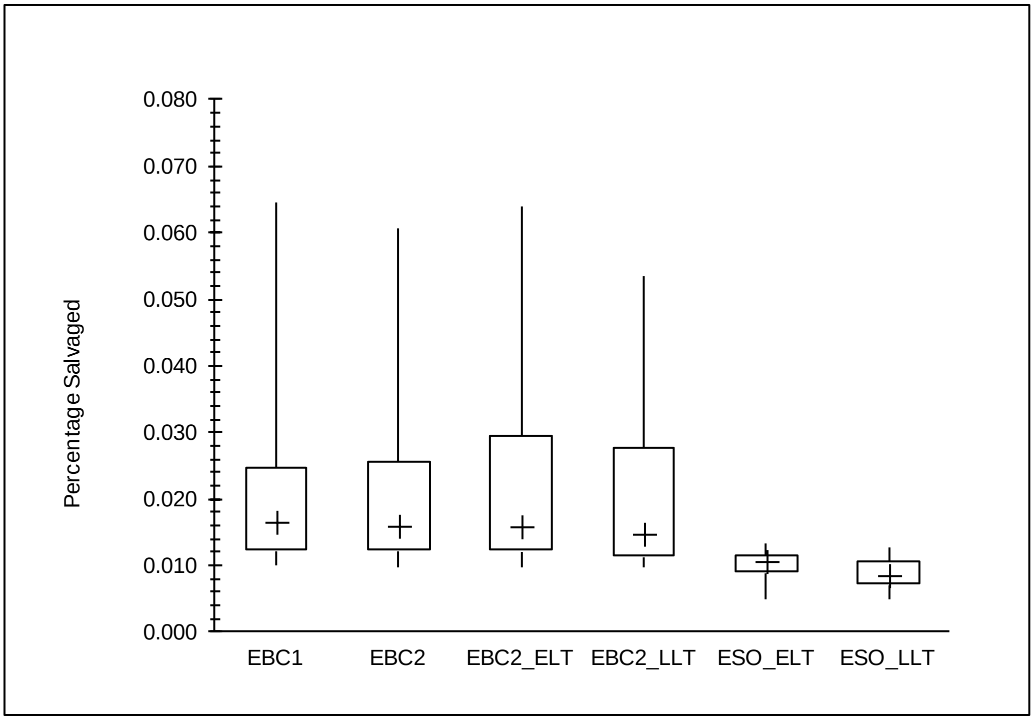
5.B.6.1.3.2 Delta Passage Model Salvage Estimates

Percentage of Smolts Salvaged

The estimated percentage of spring-run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged 0.021–0.022% for EBC scenarios, and 0.009–0.010% for ESO scenarios (Table 5.B.6-64). The data were somewhat skewed upward for EBC scenarios, with medians of 0.015–0.016% (Figure 5.B.6-6). Percentage salvage in individual years ranged from 0.005 (ESO scenarios in 1983, a wet year) to 0.054–0.064 (EBC scenarios in 1982, also a wet year). Average difference in percentage salvage was 53–58% lower under ESO scenarios compared with EBC scenarios in relative terms, which was 0.011–0.012% lower in absolute terms (Table 5.B.6-65).

Table 5.B.6-64. Estimated Percentage of Spring-Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.017	0.016	0.016	0.015	0.012	0.011
1977 (C)	0.011	0.011	0.011	0.010	0.009	0.007
1978 (AN)	0.031	0.030	0.032	0.031	0.007	0.006
1979 (BN)	0.025	0.025	0.023	0.023	0.012	0.013
1980 (AN)	0.016	0.017	0.017	0.017	0.009	0.008
1981 (D)	0.017	0.016	0.015	0.015	0.011	0.010
1982 (W)	0.065	0.061	0.064	0.054	0.011	0.011
1983 (W)	0.024	0.040	0.038	0.039	0.005	0.005
1984 (W)	0.027	0.028	0.029	0.027	0.008	0.007
1985 (D)	0.016	0.016	0.016	0.015	0.012	0.012
1986 (W)	0.025	0.021	0.038	0.039	0.012	0.008
1987 (D)	0.012	0.014	0.013	0.012	0.013	0.011
1988 (C)	0.012	0.012	0.012	0.011	0.010	0.009
1989 (D)	0.013	0.013	0.012	0.012	0.010	0.007
1990 (C)	0.010	0.010	0.010	0.010	0.009	0.007
1991 (C)	0.012	0.012	0.012	0.012	0.011	0.010
Average	0.021	0.021	0.022	0.021	0.010	0.009



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-6. Spring-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

Table 5.B.6-65. Difference in Estimated Percentage of Spring-Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

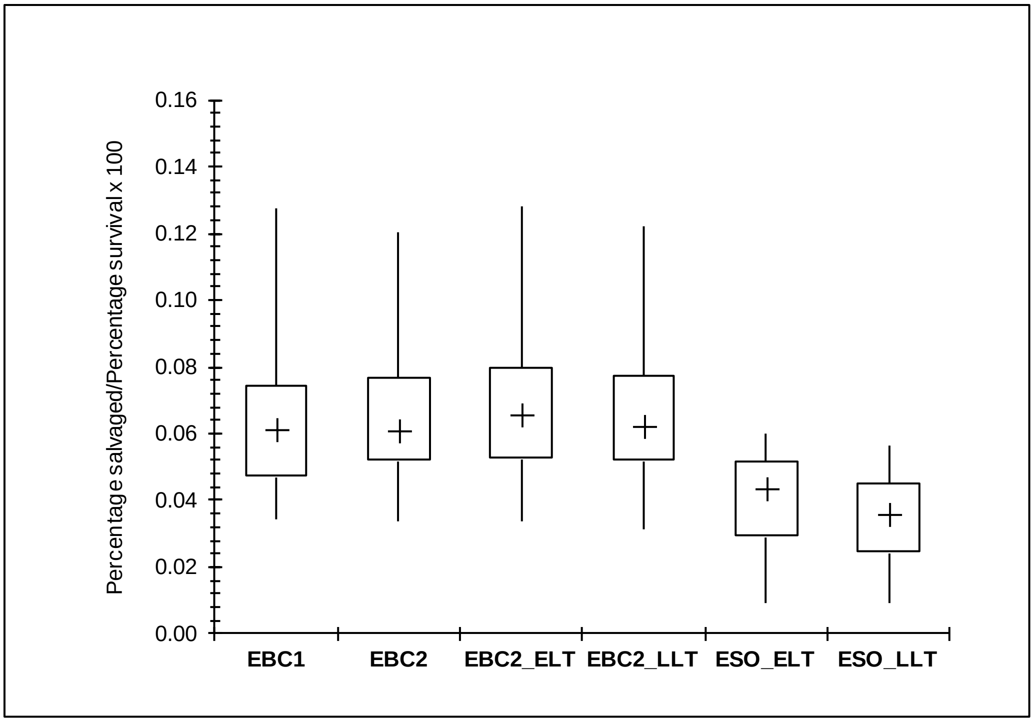
Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.005 (-30%)	-0.006 (-36%)	-0.005 (-27%)	-0.006 (-34%)	-0.004 (-24%)	-0.004 (-25%)
1977 (C)	-0.001 (-12%)	-0.003 (-30%)	-0.001 (-13%)	-0.003 (-31%)	-0.001 (-13%)	-0.003 (-26%)
1978 (AN)	-0.024 (-79%)	-0.024 (-79%)	-0.024 (-79%)	-0.024 (-79%)	-0.025 (-79%)	-0.024 (-79%)
1979 (BN)	-0.014 (-54%)	-0.013 (-50%)	-0.013 (-53%)	-0.013 (-50%)	-0.012 (-50%)	-0.010 (-45%)
1980 (AN)	-0.008 (-46%)	-0.008 (-50%)	-0.008 (-48%)	-0.009 (-52%)	-0.009 (-49%)	-0.009 (-53%)
1981 (D)	-0.006 (-35%)	-0.007 (-40%)	-0.005 (-29%)	-0.005 (-34%)	-0.004 (-26%)	-0.005 (-30%)
1982 (W)	-0.053 (-83%)	-0.054 (-84%)	-0.050 (-82%)	-0.050 (-83%)	-0.053 (-83%)	-0.043 (-80%)
1983 (W)	-0.019 (-79%)	-0.019 (-79%)	-0.035 (-87%)	-0.035 (-88%)	-0.033 (-87%)	-0.034 (-87%)
1984 (W)	-0.019 (-70%)	-0.020 (-73%)	-0.020 (-71%)	-0.020 (-73%)	-0.021 (-72%)	-0.019 (-73%)
1985 (D)	-0.004 (-26%)	-0.004 (-24%)	-0.004 (-26%)	-0.004 (-24%)	-0.005 (-29%)	-0.003 (-20%)
1986 (W)	-0.013 (-51%)	-0.016 (-65%)	-0.009 (-43%)	-0.012 (-59%)	-0.026 (-69%)	-0.031 (-78%)
1987 (D)	0.001 (8%)	-0.001 (-8%)	0.000 (-1%)	-0.002 (-16%)	0.000 (1%)	-0.001 (-4%)
1988 (C)	-0.003 (-23%)	-0.004 (-29%)	-0.003 (-21%)	-0.003 (-28%)	-0.002 (-21%)	-0.003 (-23%)
1989 (D)	-0.002 (-19%)	-0.005 (-43%)	-0.002 (-18%)	-0.005 (-42%)	-0.002 (-17%)	-0.004 (-38%)
1990 (C)	-0.001 (-8%)	-0.003 (-32%)	-0.001 (-7%)	-0.003 (-31%)	-0.001 (-6%)	-0.003 (-31%)
1991 (C)	-0.001 (-5%)	-0.002 (-15%)	-0.001 (-5%)	-0.002 (-15%)	0.000 (-4%)	-0.002 (-13%)
Average	-0.011 (-52%)	-0.012 (-57%)	-0.011 (-53%)	-0.012 (-58%)	-0.012 (-55%)	-0.012 (-58%)

Smolt Salvage as a Percentage of Through-Delta Survival

Patterns of spring-run Chinook salmon smolt salvage percentage as a percentage of through-Delta survival percentage generally were similar to those seen for the patterns of salvage percentage described above in Table 5.B.6-64. The estimated salvage/survival percentage averaged 0.07% for EBC scenarios, and 0.03-0.04% for ESO scenarios (Table 5.B.6-66; Figure 5.B.6-7). Percentage salvage/survival in individual years ranged from around 0.01% (ESO scenarios in 1983) up to 0.13% (EBC2_ELT scenario in 1982). Percentage salvage/survival was on average 40–49% lower under ESO scenarios compared with EBC scenarios in relative terms, which was 0.03% lower in absolute terms (Table 5.B.6-67).

Table 5.B.6-66. Estimated Spring-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.09	0.08	0.08	0.07	0.06	0.05
1977 (C)	0.06	0.06	0.06	0.06	0.05	0.04
1978 (AN)	0.06	0.06	0.07	0.07	0.02	0.02
1979 (BN)	0.10	0.10	0.09	0.09	0.05	0.06
1980 (AN)	0.05	0.05	0.05	0.05	0.03	0.03
1981 (D)	0.06	0.06	0.06	0.06	0.05	0.04
1982 (W)	0.13	0.12	0.13	0.11	0.02	0.02
1983 (W)	0.04	0.07	0.07	0.07	0.01	0.01
1984 (W)	0.08	0.09	0.09	0.09	0.03	0.03
1985 (D)	0.06	0.06	0.07	0.06	0.05	0.05
1986 (W)	0.07	0.06	0.11	0.12	0.04	0.03
1987 (D)	0.05	0.05	0.05	0.05	0.05	0.04
1988 (C)	0.07	0.07	0.07	0.06	0.05	0.05
1989 (D)	0.03	0.03	0.03	0.03	0.03	0.02
1990 (C)	0.04	0.04	0.04	0.04	0.04	0.03
1991 (C)	0.04	0.04	0.04	0.04	0.05	0.04
Average	0.07	0.07	0.07	0.07	0.04	0.03



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-7. Spring-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-67. Difference in Estimated Spring-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.03 (-30%)	-0.04 (-41%)	-0.03 (-30%)	-0.03 (-41%)	-0.02 (-21%)	-0.02 (-25%)
1977 (C)	-0.01 (-13%)	-0.02 (-31%)	-0.01 (-14%)	-0.02 (-32%)	-0.01 (-14%)	-0.02 (-29%)
1978 (AN)	-0.05 (-73%)	-0.05 (-72%)	-0.04 (-73%)	-0.04 (-72%)	-0.05 (-74%)	-0.05 (-74%)
1979 (BN)	-0.04 (-46%)	-0.04 (-41%)	-0.05 (-48%)	-0.04 (-43%)	-0.04 (-45%)	-0.04 (-40%)
1980 (AN)	-0.02 (-38%)	-0.02 (-43%)	-0.02 (-40%)	-0.02 (-45%)	-0.02 (-42%)	-0.03 (-48%)
1981 (D)	-0.01 (-23%)	-0.02 (-31%)	-0.01 (-17%)	-0.01 (-26%)	-0.01 (-20%)	-0.02 (-28%)
1982 (W)	-0.11 (-83%)	-0.11 (-83%)	-0.10 (-81%)	-0.10 (-82%)	-0.11 (-83%)	-0.09 (-80%)
1983 (W)	-0.04 (-79%)	-0.04 (-79%)	-0.06 (-87%)	-0.06 (-87%)	-0.06 (-87%)	-0.06 (-87%)
1984 (W)	-0.06 (-66%)	-0.06 (-69%)	-0.06 (-67%)	-0.06 (-70%)	-0.06 (-69%)	-0.06 (-71%)
1985 (D)	-0.01 (-20%)	-0.01 (-20%)	-0.01 (-21%)	-0.01 (-21%)	-0.02 (-26%)	-0.01 (-21%)
1986 (W)	-0.03 (-46%)	-0.04 (-61%)	-0.02 (-36%)	-0.03 (-54%)	-0.07 (-66%)	-0.09 (-77%)
1987 (D)	0.01 (13%)	0.00 (-8%)	0.00 (4%)	-0.01 (-16%)	0.00 (6%)	0.00 (-4%)
1988 (C)	-0.01 (-21%)	-0.02 (-29%)	-0.01 (-20%)	-0.02 (-28%)	-0.01 (-20%)	-0.02 (-25%)
1989 (D)	0.00 (-14%)	-0.01 (-42%)	0.00 (-12%)	-0.01 (-40%)	0.00 (-12%)	-0.01 (-36%)
1990 (C)	0.00 (-6%)	-0.01 (-30%)	0.00 (-6%)	-0.01 (-30%)	0.00 (-7%)	-0.01 (-31%)
1991 (C)	0.00 (3%)	0.00 (-7%)	0.00 (4%)	0.00 (-6%)	0.00 (3%)	0.00 (-3%)
Average	-0.03 (-40%)	-0.03 (-47%)	-0.03 (-40%)	-0.03 (-48%)	-0.03 (-44%)	-0.03 (-49%)

5.B.6.1.4 Fall-Run/Late Fall–Run Chinook Salmon (Juvenile)

5.B.6.1.4.1 Salvage-Density Method

The basic seasonal pattern of entrainment of juvenile fall-run and late fall–run Chinook salmon upon which the salvage-density method is based is presented in Figure 5.B.6-8 and Figure 5.B.6-9, although note that this is an average of all years combined and does not account for water-year differences. As noted above for spring-run Chinook salmon juveniles, the seasonal entrainment pattern is the best index of entrainment, as opposed to the actual numbers of fish, because of the overlap between fall-run and spring-run juvenile Chinook salmon and the length-at-date criteria used to characterize race. Entrainment loss of fall-run Chinook salmon peaks in May at both the SWP and CVP facilities, and there is a second, almost as large, peak in February at the CVP facility.

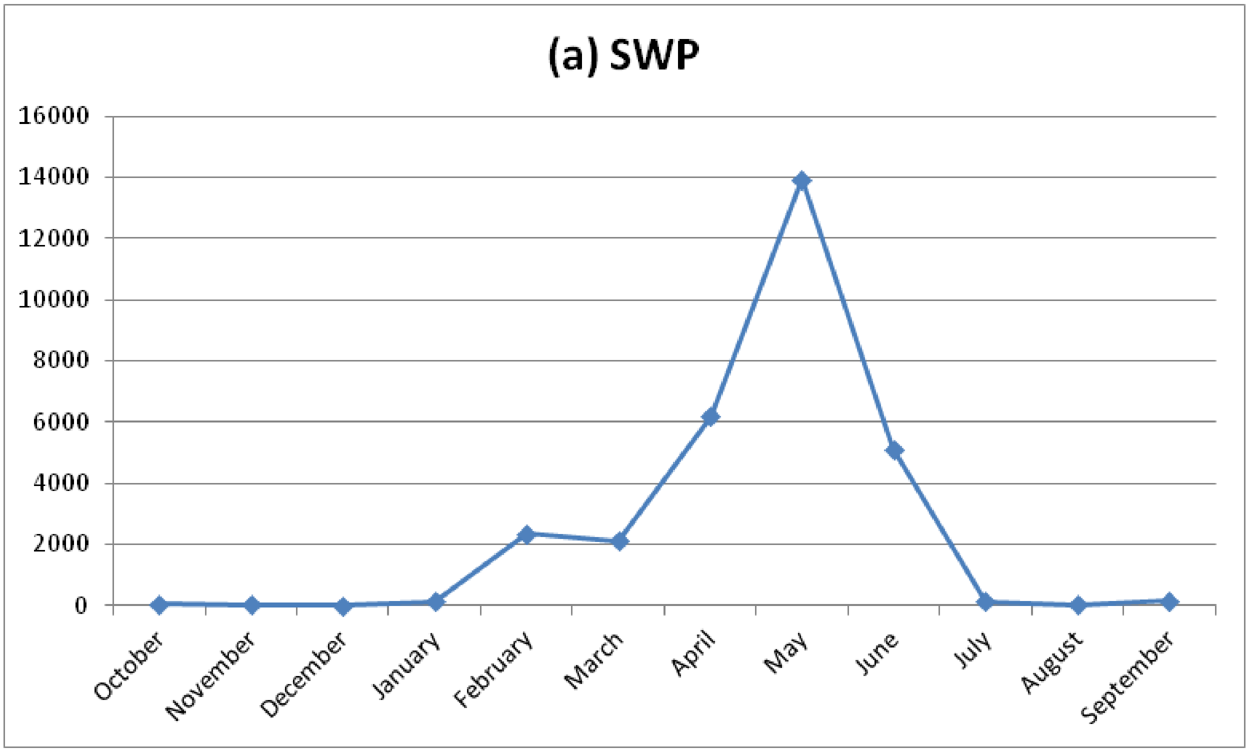
In general, estimated losses of fall-run Chinook salmon were approximately 1.5–3 times greater at the SWP export facilities compared to the CVP export facility (Table 5.B.6-68 to Table 5.B.6-79). Estimated losses of late fall–run Chinook salmon varied between the two facilities, with entrainment loss at CVP generally being lower than at SWP but not in all water-year types (Table 5.B.6-80 to Table 5.B.6-85). For fall-run Chinook salmon, normalization of the data to adult population size increased the estimated entrainment loss relative to nonnormalized data for wet and critical water years; decreased the estimated entrainment loss in below-normal and dry years; and resulted in little change to entrainment loss in above-normal years. For late fall–run Chinook salmon, normalization of the data to adult population size increased the estimated entrainment loss relative to nonnormalized data for wet and critical water years; decreased the estimated entrainment loss in above-normal years; and resulted in little change to entrainment loss in below-normal and dry years. This summary of the main results focuses only on normalized data.

For fall-run Chinook salmon, estimated annual losses at SWP across all water years averaged around 36,000 fish per year under EBC scenarios and 20,000–21,000 fish under ESO scenarios; for the CVP, the annual average loss was around 19,000 fish under EBC and 11,000 fish under ESO (Table 5.B.6-68). Losses of fall-run Chinook salmon were greatest in wet years (SWP: 77,000–82,000 fish under EBC and 27,000–30,000 under ESO; CVP: 50,000 under EBC and 18,000–20,000 under ESO) and were lowest in below-normal years at SWP (8,000 fish under EBC and 6,000 fish under ESO scenarios; Table 5.B.6-71) and in dry years at CVP (2,500–2,700 fish under EBC and 2,300–2,700 under ESO; Table 5.B.6-72). For late fall–run Chinook salmon, estimated annual losses at SWP across all water years averaged nearly 900 fish under EBC scenarios and 450–470 under ESO scenarios; for the CVP, the annual average loss was around 1,000 fish under EBC and 770–830 fish under ESO (Table 5.B.6-80). Entrainment losses of late fall–run Chinook salmon were greatest in wet years (SWP: 2,600–2,800 fish under EBC and 950–1,000 fish under ESO; CVP: 3,200–3,400 fish under EBC and 2,200–2,300 fish under ESO (Table 5.B.6-81). Entrainment loss in other water-year types was one or two orders of magnitude lower than in wet years (Table 5.B.6-82 to Table 5.B.6-85).

Differences in entrainment loss of juvenile fall-run Chinook salmon between EBC and ESO scenarios were greatest in wet years, with reductions at both facilities under ESO scenarios compared to EBC scenarios of ~80,000–86,000 fish (63–64% reduction) (Table 5.B.6-92). Entrainment loss in above-normal, below-normal, and critical water years was around 3,100–14,000 lower under ESO scenarios compared with EBC scenarios (21–42% lower), whereas in dry years there was the least difference between EBC and ESO scenarios (ranging from 5% lower under EBC to 17% lower under ESO). Across all water years, reductions under ESO scenarios compared to EBC scenarios were estimated to be on the order of 23,000–24,000 fish (41–44% reduction). Differences in entrainment loss of juvenile late fall–run Chinook salmon between EBC and ESO scenarios were also greatest in wet years, with reductions at both facilities under ESO scenarios compared to EBC scenarios of ~2,700–2,900 fish (46–48% reduction) (Table 5.B.6-94). Decreases in entrainment loss under ESO scenarios relative to EBC scenarios were also evident in above-normal years (220–260 fish; 38–45% reduction). Changes in entrainment loss in other water-year types generally amounted to tens of fish, with relative change of 16–45% lower entrainment under ESO compared with EBC. Across all water years, reductions of entrainment loss of juvenile late fall–run Chinook salmon under ESO scenarios compared to EBC scenarios were estimated to be around 630–750 fish (33–38% reduction).

Under the assumption that the annual number of juvenile fall-run Chinook salmon juveniles approaching the Delta was 23 million fish, the percentage of the population lost to entrainment across all years averaged 0.24% under EBC scenarios and decreased to 0.13–0.14% under ESO scenarios (Table 5.B.6-96). In wet years, EBC entrainment losses of just under 0.6% were reduced to just over 0.2% or less under ESO scenarios (Table 5.B.6-97). Proportional losses in the remaining water years ranged from quite similar between EBC and ESO scenarios in dry years to ESO being just over half of EBC in above-normal years (Table 5.B.6-98 to Table 5.B.6-101). Nonnormalized estimates were generally lower, as noted above (Table 5.B.6-102 to Table 5.B.6-107). Assuming that 1 million juvenile late fall–run Chinook salmon entered the Delta, the percentage of the juvenile population lost to entrainment at the SWP/CVP south Delta export facilities across all years was around 0.2% under EBC scenarios and 0.12–0.13% under ESO scenarios (Table 5.B.6-108). The percentage of all juveniles lost to entrainment was greatest in wet years: 0.6% under EBC scenarios and just over 0.3% under ESO scenarios (Table 5.B.6-109). The proportions of the population lost to entrainment in all other water-year types was well below 0.1% in EBC and ESO scenarios (Table

5.B.6-110 to Table 5.B.6-113). Nonnormalized data suggested an even smaller proportion of the population was lost to entrainment (Table 5.B.6-114 to Table 5.B.6-119).



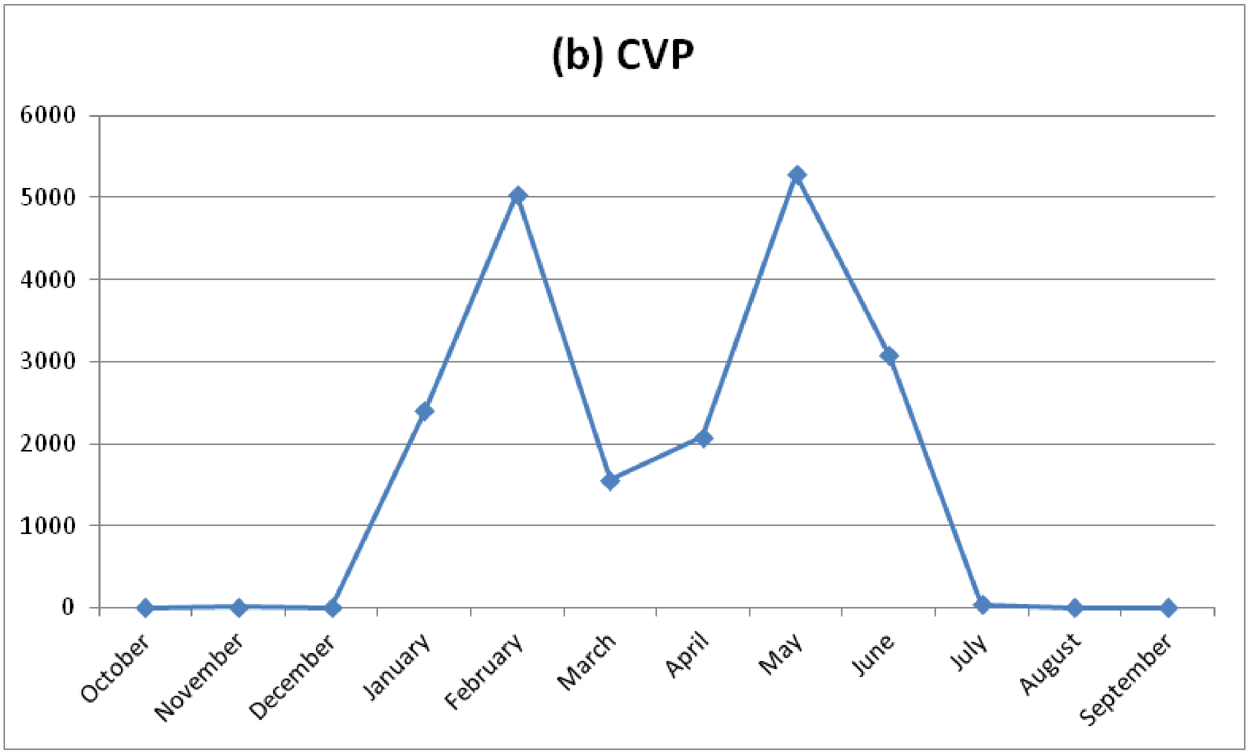


Figure 5.B.6-8. Mean Monthly Entrainment Loss of Juvenile Fall-Run Chinook Salmon Calculated from Observed Salvage Monitoring at the (a) SWP and (b) CVP South Delta Export Facilities, Water Years 1996–2008

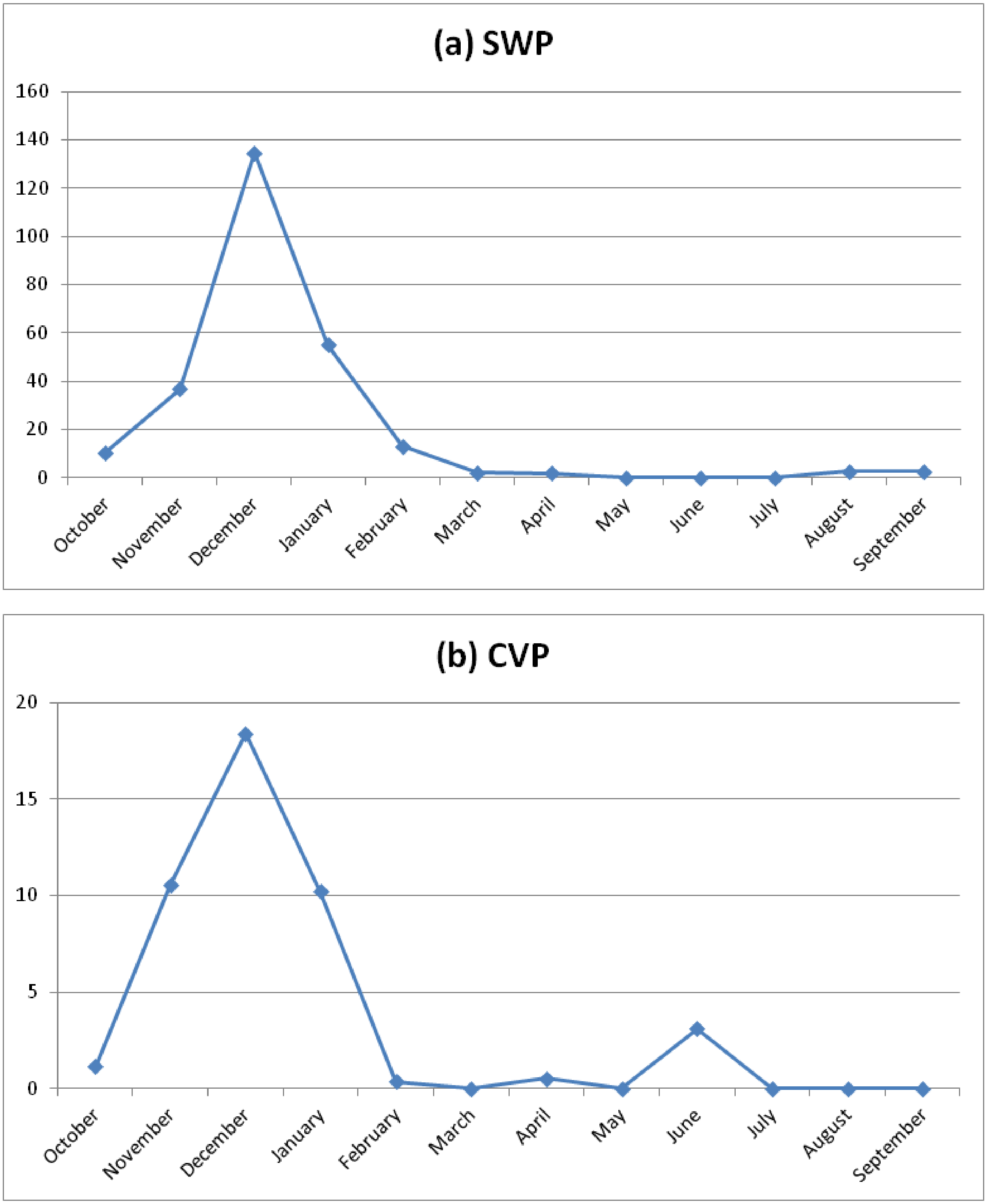


Figure 5.B.6-9. Mean Monthly Entrainment Loss of Juvenile Late Fall–Run Chinook Salmon Calculated from Observed Salvage Monitoring at the (a) SWP and (b) CVP South Delta Export Facilities, Water Years 1996–2008

Table 5.B.6-68. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	52	±	10	37	±	7	32	±	6	25	±	5	13	±	3	11	±	2
November	43	±	6	30	±	5	29	±	5	28	±	5	15	±	3	15	±	3
December	5	±	1	6	±	1	5	±	1	5	±	1	4	±	1	4	±	1
January	335	±	37	341	±	39	346	±	40	341	±	39	176	±	22	167	±	20
February	6,008	±	851	6,108	±	871	6,206	±	896	5,781	±	838	3,030	±	463	2,874	±	442
March	2,059	±	246	2,103	±	255	2,105	±	259	2,042	±	255	730	±	95	809	±	109
April	3,130	±	399	3,250	±	424	3,331	±	433	3,445	±	445	2,467	±	276	2382	±	271
May	17,653	±	2,096	18,279	±	2,321	19,364	±	2,386	19,503	±	2,381	11,687	±	1,068	10,866	±	1,019
June	5,619	±	482	5,605	±	492	5,311	±	455	4,679	±	399	2,752	±	220	2479	±	196
July	231	±	22	228	±	22	219	±	21	203	±	20	145	±	17	138	±	17
August	31	±	5	30	±	5	30	±	5	28	±	5	15	±	3	14	±	3
September	138	±	24	128	±	22	125	±	22	115	±	20	40	±	9	33	±	8
Annual Average	35,304	±	3,307	36,145	±	3,553	37,103	±	3,631	36,197	±	3,550	21,074	±	1,706	19,791	±	1,628
(b) CVP																		
October	10	±	1	9	±	1	8	±	1	7	±	1	3	±	0	2	±	0
November	16	±	2	15	±	2	15	±	2	14	±	2	7	±	1	6	±	1
December	2	±	0	3	±	0	2	±	0	2	±	0	2	±	0	2	±	0
January	2,163	±	393	2,139	±	393	2,146	±	397	2,071	±	387	1,219	±	249	1,326	±	272
February	5,660	±	696	5,442	±	682	5,498	±	688	5,566	±	701	2,713	±	401	2,991	±	428
March	1,383	±	118	1,380	±	120	1,353	±	118	1,321	±	118	606	±	64	576	±	60
April	1,439	±	148	1,426	±	147	1,494	±	154	1,517	±	156	1,178	±	120	1,152	±	119
May	5,600	±	588	5,566	±	585	5,677	±	605	5,613	±	592	3,920	±	348	3,519	±	318
June	3,137	±	342	3,113	±	341	2,755	±	312	2,480	±	279	1,633	±	172	1,415	±	155
July	56	±	8	54	±	8	47	±	7	40	±	7	42	±	7	36	±	6
August	4	±	1	4	±	1	4	±	1	4	±	1	3	±	1	3	±	1
September	7	±	1	7	±	1	6	±	1	6	±	1	3	±	1	3	±	1
Annual Average	19,478	±	1,763	19,159	±	1,738	19,006	±	1,746	18,640	±	1,730	11,329	±	997	11,031	±	988

Table 5.B.6-69. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	18	±	5	13	±	4	11	±	3	9	±	3	4	±	1	3	±	1
November	131	±	30	95	±	24	93	±	24	86	±	23	29	±	11	32	±	12
December	7	±	3	7	±	3	8	±	3	8	±	3	5	±	2	5	±	2
January	645	±	95	661	±	100	686	±	103	662	±	100	248	±	50	242	±	42
February	17,059	±	4,449	17,239	±	4,546	17,882	±	4,707	16,989	±	4,515	5,903	±	2,106	5,117	±	1,822
March	3,935	±	1,316	4,142	±	1,395	4,231	±	1,421	4,082	±	1,385	766	±	394	876	±	448
April	3,860	±	1,627	4,061	±	1,755	4,091	±	1,765	4,191	±	1,784	1799	±	671	1,795	±	669
May	36,643	±	13,102	40,161	±	14,793	41,174	±	14,963	39,786	±	14,779	14,762	±	4,145	13,595	±	4,068
June	14,664	±	2,113	15,209	±	2,197	13,698	±	2,008	12,443	±	1,762	5,895	±	886	5,243	±	733
July	567	±	72	572	±	72	566	±	72	531	±	69	392	±	67	419	±	68
August	67	±	23	69	±	24	69	±	24	68	±	23	30	±	14	25	±	11
September	95	±	23	90	±	22	89	±	22	80	±	20	6	±	4	3	±	2
Annual Average	77,691	±	19,041	82,318	±	20,964	82,598	±	21,243	78,934	±	20,653	29,839	±	6,560	27,354	±	6,256
(b) CVP																		
October	23	±	5	20	±	4	19	±	4	17	±	4	6	±	2	5	±	2
November	41	±	8	38	±	8	38	±	8	36	±	8	13	±	5	13	±	4
December	6	±	2	6	±	2	6	±	2	6	±	2	5	±	1	5	±	1
January	5,852	±	1,774	6,113	±	1,886	6,166	±	1,903	6,069	±	1,875	3,001	±	1,087	3,611	±	1,310
February	14,501	±	3,152	14,544	±	3,208	14,899	±	3,259	15,251	±	3,333	2,658	±	1,077	4,623	±	1,669
March	2,251	±	485	2,276	±	501	2,306	±	506	2,336	±	513	630	±	235	549	±	186
April	2,585	±	825	2,577	±	822	2,608	±	831	2,665	±	846	1,433	±	439	1,467	±	457
May	13,837	±	3,500	13,785	±	3,484	14,300	±	3,619	13,697	±	3,498	6,197	±	1,329	5,573	±	1,235
June	11,016	±	1,567	11,052	±	1,580	10,358	±	1,508	9,009	±	1,349	4,374	±	692	4,042	±	659
July	151	±	38	151	±	38	132	±	34	112	±	31	126	±	34	108	±	30
August	11	±	3	11	±	3	11	±	3	11	±	3	8	±	3	8	±	3
September	4	±	1	3	±	1	3	±	1	3	±	1	0	±	0	0	±	0
Annual Average	50,277	±	8,457	50,578	±	8,419	50,846	±	8,602	49,211	±	8,601	18,449	±	3,088	20,005	±	3,632

Table 5.B.6-70. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	11	±	6	12	±	6	12	±	6	12	±	6	9	±	4	9	±	4
January	16	±	5	18	±	6	18	±	6	18	±	6	11	±	3	8	±	3
February	5,431	±	2,530	5,451	±	2,578	5,561	±	2,685	5,452	±	2,594	1,757	±	1,116	2,322	±	1,288
March	2,440	±	1,018	2,384	±	989	2,440	±	1,030	2,496	±	1,106	467	±	206	646	±	336
April	1,804	±	645	1,794	±	641	1,907	±	682	2,118	±	747	1,666	±	644	1,573	±	622
May	7,183	±	1,540	7,175	±	1,536	8,031	±	1,884	8,398	±	1,879	7,003	±	1,821	6,659	±	1,633
June	5,699	±	1,880	5,490	±	1,861	5,595	±	1,792	4,628	±	1,393	2,761	±	808	2,654	±	777
July	83	±	25	83	±	25	79	±	24	71	±	23	55	±	23	69	±	25
August	25	±	12	26	±	12	26	±	12	26	±	12	15	±	9	13	±	8
September	527	±	250	516	±	247	541	±	256	532	±	254	93	±	98	58	±	75
Annual Average	23,219	±	7,300	22,949	±	7,208	24,210	±	7,651	23,751	±	7,325	13,835	±	3,946	14,011	±	4,005
(b) CVP																		
October	1	±	1	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
November	4	±	2	4	±	2	4	±	2	4	±	2	2	±	1	2	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	158	±	58	152	±	55	133	±	51	149	±	56	75	±	36	101	±	45
February	4,192	±	1,706	3,669	±	1,653	4,016	±	1,755	4,101	±	1,721	2,086	±	1,042	2,182	±	1,055
March	1,481	±	451	1,502	±	464	1,407	±	445	1,348	±	443	289	±	116	333	±	169
April	860	±	240	855	±	239	896	±	251	963	±	271	750	±	238	797	±	247
May	2,220	±	512	2,217	±	511	2,375	±	595	2,429	±	592	1,999	±	566	1,636	±	470
June	695	±	178	712	±	172	592	±	156	568	±	145	343	±	85	311	±	81
July	17	±	5	18	±	5	13	±	4	10	±	4	14	±	4	12	±	4
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	28	±	13	23	±	11	25	±	12	26	±	13	1	±	1	4	±	5
Annual Average	9,657	±	2,969	9,153	±	2,896	9,463	±	3,019	9,599	±	3,024	5,558	±	1,838	5,377	±	1,706

Table 5.B.6-71. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	43	±	13	44	±	13	47	±	15	40	±	11	30	±	7	27	±	9
March	3,907	±	786	3,964	±	881	3,988	±	927	3,693	±	916	1,872	±	297	2,407	±	534
April	1,365	±	146	1,362	±	153	1,505	±	207	1,794	±	293	1,427	±	329	1,571	±	318
May	2,130	±	232	2,128	±	253	2,303	±	331	2,691	±	444	2,054	±	372	2,014	±	398
June	288	±	48	252	±	59	257	±	45	242	±	50	184	±	31	148	±	43
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	7,733	±	1,028	7,750	±	1,124	8,100	±	1,085	8,460	±	1,002	5,567	±	750	6,167	±	643
(b) CVP																		
October	5	±	1	5	±	1	4	±	1	4	±	1	1	±	0	1	±	1
November	6	±	0	5	±	1	6	±	0	5	±	1	2	±	1	2	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	7	±	1	7	±	1	7	±	1	6	±	1	4	±	1	4	±	1
February	117	±	24	109	±	21	90	±	23	111	±	24	68	±	24	75	±	19
March	4,465	±	773	4,059	±	729	3,948	±	730	4,022	±	930	2,704	±	623	2,702	±	703
April	327	±	26	327	±	27	349	±	42	369	±	55	315	±	68	357	±	72
May	844	±	64	848	±	73	852	±	60	912	±	116	752	±	136	737	±	146
June	89	±	15	88	±	12	70	±	12	65	±	11	62	±	10	46	±	13
July	5	±	0	5	±	0	4	±	0	4	±	0	4	±	1	3	±	1
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	5,865	±	763	5,452	±	721	5,329	±	724	5,498	±	899	3,912	±	710	3,928	±	781

Table 5.B.6-72. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	171	±	75	125	±	52	114	±	47	81	±	36	53	±	21	45	±	20
November	13	±	5	8	±	4	8	±	4	7	±	4	5	±	3	5	±	3
December	1	±	0	1	±	1	1	±	1	1	±	0	1	±	0	1	±	0
January	8	±	3	7	±	3	7	±	3	8	±	3	5	±	2	5	±	2
February	17	±	4	17	±	4	16	±	4	15	±	4	12	±	3	11	±	3
March	590	±	232	585	±	229	551	±	214	545	±	210	446	±	177	418	±	164
April	4,639	±	1,727	4,938	±	1,822	5,260	±	2,098	5,003	±	2,070	5,756	±	2,203	4,950	±	2,017
May	11,589	±	3,336	11,282	±	3,251	12,654	±	3,814	13,060	±	3,835	11,590	±	3,382	10,033	±	3,094
June	52	±	13	54	±	13	53	±	13	42	±	10	33	±	9	28	±	8
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	15	±	6	13	±	5	12	±	5	11	±	5	6	±	2	6	±	3
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	17,094	±	5,209	17,032	±	5,235	18,676	±	6,040	18,772	±	5,967	17,905	±	5,615	15,502	±	4,937
(b) CVP																		
October	4	±	1	3	±	1	3	±	1	3	±	1	1	±	1	1	±	1
November	2	±	1	2	±	1	2	±	1	2	±	1	1	±	1	1	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	24	±	9	24	±	9	25	±	10	24	±	9	14	±	6	14	±	6
February	25	±	5	25	±	5	25	±	5	23	±	5	19	±	4	18	±	4
March	310	±	118	316	±	119	320	±	119	282	±	107	243	±	97	231	±	93
April	1,174	±	365	1,143	±	354	1,337	±	427	1,267	±	402	1,427	±	470	1,181	±	416
May	806	±	69	798	±	67	787	±	65	787	±	68	817	±	80	689	±	85
June	202	±	27	186	±	26	160	±	24	129	±	17	147	±	22	115	±	20
July	2	±	1	1	±	1	1	±	1	1	±	0	1	±	0	1	±	0
August	3	±	1	3	±	1	2	±	1	2	±	1	2	±	1	2	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,551	±	521	2,502	±	514	2,662	±	581	2,520	±	545	2,673	±	608	2,253	±	532

Table 5.B.6-73. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	171	±	44	188	±	50	175	±	36	171	±	43	151	±	36	148	±	26
March	80	±	23	80	±	27	71	±	23	68	±	25	64	±	15	57	±	18
April	1,304	±	461	1,357	±	430	1,198	±	366	1,064	±	297	1,210	±	381	1,150	±	411
May	23,573	±	3,591	21,851	±	4,267	22,693	±	4,309	20,562	±	6,628	14,298	±	6,082	14,456	±	6,252
June	4,072	±	1,046	3,926	±	1,105	3,723	±	1,026	3,167	±	968	2,353	±	543	2,958	±	882
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	29,200	±	3,818	27,402	±	4,135	27,860	±	4,760	25,032	±	6,864	18,076	±	6,438	18,769	±	6,347
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	10	±	2	9	±	2	9	±	2	9	±	2	7	±	2	7	±	2
February	120	±	28	109	±	32	123	±	26	105	±	28	99	±	17	89	±	23
March	80	±	26	86	±	31	74	±	25	68	±	24	62	±	21	55	±	22
April	1,193	±	133	1,171	±	119	1,126	±	131	1,116	±	135	1,046	±	202	953	±	219
May	9,903	±	682	9,640	±	593	9,296	±	850	8,986	±	588	8,087	±	1,286	7,933	±	1,042
June	387	±	30	374	±	16	350	±	27	399	±	87	254	±	92	284	±	108
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	11,693	±	766	11,389	±	675	10,979	±	982	10,683	±	727	9,555	±	1,478	9,320	±	1,256

Table 5.B.6-74. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	61	±	13	44	±	9	37	±	8	30	±	7	16	±	3	13	±	3
November	34	±	5	23	±	4	23	±	4	22	±	4	12	±	2	12	±	2
December	5	±	1	5	±	1	5	±	1	5	±	1	4	±	1	4	±	1
January	272	±	32	277	±	34	281	±	35	278	±	34	143	±	19	136	±	18
February	4,199	±	509	4,269	±	522	4,338	±	537	4,041	±	502	2,118	±	279	2,008	±	266
March	1,711	±	170	1,748	±	177	1,749	±	180	1,697	±	177	606	±	66	672	±	76
April	2,903	±	422	3,014	±	447	3,089	±	458	3,194	±	470	2,288	±	294	2,209	±	288
May	12,769	±	1,300	13,222	±	1,446	14,007	±	1,483	14,108	±	1,480	8,454	±	645	7,860	±	618
June	3,919	±	345	3,910	±	352	3,704	±	326	3,264	±	286	1,920	±	158	1,729	±	141
July	188	±	19	185	±	19	177	±	18	165	±	18	117	±	15	112	±	15
August	22	±	3	21	±	3	21	±	3	20	±	3	11	±	2	10	±	2
September	131	±	25	122	±	23	119	±	23	110	±	21	38	±	9	31	±	8
Annual Average	26,213	±	2,034	26,839	±	2,200	27,551	±	2,248	26,932	±	2,209	15,725	±	1,058	14,795	±	1,009
(b) CVP																		
October	9	±	1	8	±	1	7	±	1	7	±	1	3	±	0	2	±	0
November	12	±	1	11	±	1	12	±	1	11	±	1	5	±	1	5	±	1
December	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0
January	1,953	±	373	1,931	±	373	1,938	±	377	1,870	±	367	1,101	±	236	1,198	±	258
February	4,302	±	514	4,136	±	504	4,179	±	509	4,230	±	518	2,062	±	297	2,273	±	316
March	1,291	±	115	1,289	±	116	1,264	±	114	1,233	±	115	566	±	62	538	±	58
April	1,113	±	98	1,102	±	97	1,155	±	102	1,172	±	103	911	±	79	891	±	78
May	3,618	±	304	3,596	±	302	3,667	±	313	3,626	±	306	2,533	±	174	2,273	±	160
June	2,232	±	238	2,215	±	238	1,960	±	217	1,764	±	195	1,162	±	120	1,007	±	108
July	42	±	6	41	±	6	36	±	5	31	±	5	32	±	5	27	±	5
August	3	±	0	3	±	0	3	±	0	3	±	0	2	±	0	2	±	0
September	8	±	1	7	±	1	7	±	1	6	±	1	3	±	1	3	±	1
Annual Average	14,585	±	1,247	14,343	±	1,230	14,229	±	1,233	13,955	±	1,221	8,380	±	697	8,220	±	704

Table 5.B.6-75. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	10	±	3	8	±	2	7	±	2	5	±	1	2	±	1	2	±	1
November	98	±	25	71	±	20	70	±	20	64	±	20	22	±	9	24	±	10
December	6	±	2	7	±	2	7	±	3	7	±	3	4	±	2	5	±	2
January	479	±	71	491	±	75	509	±	77	492	±	74	184	±	37	179	±	31
February	10,434	±	2,351	10,544	±	2,405	10,937	±	2,490	10,391	±	2,390	3,611	±	1,139	3,130	±	986
March	1,986	±	640	2,090	±	678	2,135	±	690	2,060	±	673	386	±	192	442	±	219
April	1,960	±	793	2,062	±	855	2,077	±	860	2,128	±	869	914	±	326	912	±	325
May	21,650	±	6,406	23,729	±	7,250	24,327	±	7,325	23,507	±	7,248	8,722	±	1,971	8,033	±	1,952
June	10,618	±	1,479	11,013	±	1,538	9,919	±	1,407	9,011	±	1,233	4,269	±	621	3,797	±	513
July	452	±	69	455	±	69	451	±	68	422	±	65	312	±	61	333	±	62
August	33	±	11	34	±	12	34	±	12	33	±	11	15	±	7	12	±	6
September	56	±	11	52	±	11	52	±	10	46	±	10	3	±	2	2	±	1
Annual Average	47,782	±	9,003	50,555	±	9,965	50,525	±	10,102	48,167	±	9,825	18,444	±	3,048	16,869	±	2,924
(b) CVP																		
October	19	±	4	17	±	4	16	±	3	14	±	3	5	±	1	4	±	1
November	28	±	6	27	±	6	26	±	6	25	±	5	9	±	3	9	±	3
December	6	±	1	6	±	1	6	±	1	5	±	1	5	±	1	4	±	1
January	5,262	±	1,701	5,496	±	1,807	5,544	±	1,823	5,457	±	1,796	2,698	±	1,038	3,247	±	1,250
February	10,170	±	2,298	10,200	±	2,338	10,449	±	2,376	10,695	±	2,430	1,864	±	777	3,242	±	1,206
March	1,528	±	321	1,545	±	333	1,565	±	336	1,586	±	341	427	±	157	373	±	124
April	1,445	±	399	1,441	±	398	1,458	±	402	1,489	±	409	801	±	212	820	±	220
May	9,012	±	1,821	8,978	±	1,812	9,313	±	1,883	8,921	±	1,823	4,036	±	667	3,629	±	625
June	7,777	±	1,082	7,802	±	1,091	7,312	±	1,042	6,360	±	933	3,088	±	479	2,854	±	456
July	112	±	27	112	±	27	98	±	25	84	±	23	94	±	24	80	±	21
August	6	±	2	6	±	2	6	±	2	6	±	2	4	±	1	5	±	1
September	3	±	1	3	±	1	3	±	1	2	±	1	0	±	0	0	±	0
Annual Average	35,367	±	5,719	35,633	±	5,744	35,796	±	5,853	34,644	±	5,866	13,030	±	2,157	14,268	±	2,644

Table 5.B.6-76. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	12	±	6	12	±	6	12	±	6	12	±	6	10	±	5	9	±	5
January	14	±	4	15	±	5	16	±	5	16	±	5	9	±	3	7	±	2
February	5,666	±	2,675	5,687	±	2,726	5,802	±	2,838	5,688	±	2,743	1,833	±	1,178	2,423	±	1,361
March	2,548	±	1,076	2,489	±	1,045	2,548	±	1,088	2,606	±	1,168	487	±	218	675	±	354
April	1,953	±	666	1,942	±	662	2,065	±	705	2,294	±	771	1,804	±	668	1,703	±	645
May	7,539	±	1,403	7,531	±	1,399	8,430	±	1,748	8,815	±	1,728	7,351	±	1,718	6,990	±	1,528
June	5,605	±	1,956	5,400	±	1,934	5,503	±	1,867	4,552	±	1,457	2,715	±	847	2,611	±	814
July	80	±	27	81	±	27	77	±	26	69	±	25	53	±	24	67	±	26
August	26	±	12	27	±	13	28	±	13	28	±	13	16	±	9	14	±	8
September	556	±	264	544	±	260	570	±	270	561	±	268	98	±	104	61	±	79
Annual Average	24,000	±	7,602	23,730	±	7,503	25,050	±	7,953	24,640	±	7,607	14,376	±	4,012	14,559	±	4,092
(b) CVP																		
October	2	±	1	2	±	1	2	±	1	1	±	1	1	±	0	1	±	0
November	5	±	2	4	±	2	5	±	2	4	±	2	2	±	1	2	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	162	±	62	156	±	59	137	±	54	153	±	59	77	±	38	103	±	48
February	4,386	±	1,798	3,838	±	1,742	4,201	±	1,849	4,290	±	1,813	2,182	±	1,097	2,283	±	1,111
March	1,476	±	476	1,496	±	489	1,402	±	469	1,343	±	465	288	±	121	332	±	175
April	911	±	243	906	±	242	949	±	255	1,021	±	274	795	±	242	844	±	252
May	2,180	±	488	2,178	±	487	2,333	±	568	2,386	±	565	1,963	±	543	1,607	±	451
June	664	±	171	680	±	166	566	±	150	543	±	140	328	±	82	297	±	78
July	15	±	4	15	±	4	11	±	3	9	±	3	12	±	4	10	±	3
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	30	±	14	25	±	12	27	±	13	27	±	13	1	±	1	4	±	6
Annual Average	9,831	±	3,117	9,301	±	3,036	9,632	±	3,164	9,777	±	3,169	5,648	±	1,910	5,482	±	1,779

Table 5.B.6-77. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI	Avg	±	95% CI
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	59	±	17	60	±	18	64	±	20	54	±	15	41	±	9	37	±	13
March	5,311	±	1,069	5,389	±	1,197	5,422	±	1,260	5,021	±	1,246	2,545	±	404	3,272	±	726
April	1,856	±	198	1,852	±	207	2,047	±	281	2,439	±	399	1,940	±	447	2,136	±	432
May	2,896	±	316	2,893	±	345	3,131	±	450	3,659	±	603	2,792	±	505	2,738	±	541
June	392	±	66	343	±	80	349	±	61	329	±	68	250	±	42	201	±	58
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	10,514	±	1,398	10,537	±	1,529	11,013	±	1,476	11,503	±	1,363	7,569	±	1,020	8,385	±	874
(b) CVP																		
October	7	±	1	7	±	1	6	±	1	5	±	1	2	±	1	1	±	1
November	8	±	0	7	±	1	8	±	1	7	±	1	3	±	2	3	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	10	±	1	10	±	1	10	±	1	9	±	2	6	±	2	6	±	2
February	159	±	32	148	±	29	122	±	31	151	±	33	92	±	33	102	±	26
March	6,070	±	1,051	5,518	±	991	5,368	±	992	5,469	±	1,264	3,676	±	847	3,674	±	956
April	445	±	35	444	±	37	474	±	57	501	±	74	428	±	92	485	±	98
May	1,148	±	88	1,152	±	99	1,158	±	81	1,239	±	158	1,022	±	185	1,002	±	198
June	121	±	20	120	±	16	95	±	16	89	±	14	84	±	14	62	±	18
July	7	±	0	7	±	0	6	±	1	5	±	1	5	±	1	5	±	1
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	7,974	±	1,038	7,412	±	981	7,246	±	984	7,475	±	1,223	5,319	±	965	5,340	±	1,062

Table 5.B.6-78. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	214	±	93	157	±	65	142	±	58	101	±	45	66	±	27	57	±	25
November	16	±	7	10	±	5	10	±	5	9	±	5	6	±	3	6	±	3
December	2	±	1	2	±	1	2	±	1	1	±	1	1	±	1	1	±	1
January	12	±	5	12	±	5	12	±	5	13	±	5	8	±	3	8	±	3
February	24	±	5	24	±	5	23	±	5	21	±	5	17	±	4	16	±	4
March	728	±	292	722	±	288	680	±	270	672	±	264	550	±	223	516	±	207
April	5,701	±	2,180	6,068	±	2,299	6,463	±	2,644	6,148	±	2,608	7,073	±	2,778	6,083	±	2,542
May	14,632	±	4,192	14,245	±	4,084	15,977	±	4,793	16,490	±	4,819	14,634	±	4,249	12,668	±	3,888
June	51	±	13	54	±	13	52	±	13	42	±	10	32	±	9	27	±	8
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	25	±	10	21	±	9	20	±	8	17	±	8	9	±	4	10	±	4
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	21,404	±	6,546	21,315	±	6,580	23,381	±	7,589	23,514	±	7,497	22,396	±	7,057	19,391	±	6,205
(b) CVP																		
October	5	±	2	4	±	2	4	±	1	3	±	1	1	±	1	1	±	1
November	2	±	1	2	±	1	2	±	1	2	±	1	1	±	1	1	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	39	±	15	39	±	15	41	±	16	38	±	15	24	±	10	22	±	10
February	32	±	6	32	±	6	32	±	7	30	±	7	24	±	5	23	±	5
March	384	±	149	392	±	150	396	±	149	350	±	135	301	±	122	287	±	117
April	1,439	±	462	1,401	±	449	1,638	±	542	1,553	±	510	1,749	±	595	1,447	±	525
May	966	±	126	957	±	124	944	±	121	944	±	123	980	±	136	827	±	132
June	207	±	21	191	±	20	164	±	20	132	±	12	151	±	18	118	±	17
July	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1	1	±	1
August	5	±	1	4	±	1	4	±	1	3	±	1	3	±	1	2	±	1
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,081	±	686	3,024	±	676	3,226	±	759	3,057	±	712	3,235	±	792	2,730	±	690

Table 5.B.6-79. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Fall-Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	37	±	9	40	±	11	38	±	8	37	±	9	32	±	8	32	±	6
March	17	±	5	17	±	6	15	±	5	15	±	5	14	±	3	12	±	4
April	280	±	99	291	±	92	257	±	79	228	±	64	260	±	82	247	±	88
May	5,061	±	771	4,691	±	916	4,872	±	925	4,415	±	1,423	3,070	±	1,306	3,104	±	1,342
June	874	±	225	843	±	237	799	±	220	680	±	208	505	±	117	635	±	189
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	6,269	±	820	5,883	±	888	5,981	±	1,022	5,374	±	1,474	3,881	±	1,382	4,030	±	1,363
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0
February	26	±	6	23	±	7	26	±	6	23	±	6	21	±	4	19	±	5
March	17	±	6	18	±	7	16	±	5	15	±	5	13	±	5	12	±	5
April	256	±	29	251	±	26	242	±	28	240	±	29	225	±	43	205	±	47
May	2,126	±	146	2,070	±	127	1,996	±	183	1,929	±	126	1,736	±	276	1,703	±	224
June	83	±	6	80	±	3	75	±	6	86	±	19	55	±	20	61	±	23
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	2,510	±	164	2,445	±	145	2,357	±	211	2,294	±	156	2,051	±	317	2,001	±	270

Table 5.B.6-80. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	17	±	3	12	±	2	10	±	2	8	±	1	4	±	1	4	±	1
November	26	±	4	18	±	3	17	±	3	17	±	3	9	±	2	9	±	2
December	83	±	7	84	±	7	82	±	7	80	±	7	62	±	5	63	±	6
January	598	±	120	609	±	125	619	±	128	610	±	126	315	±	70	298	±	64
February	156	±	32	159	±	33	161	±	33	150	±	31	79	±	17	75	±	16
March	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	4	±	1	4	±	1	4	±	1	4	±	1	2	±	1	2	±	1
September	4	±	1	3	±	1	3	±	1	3	±	1	1	±	0	1	±	0
Annual Average	890	±	148	892	±	154	899	±	158	875	±	153	474	±	81	453	±	76
(b) CVP																		
October	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
November	13	±	2	12	±	2	12	±	2	11	±	1	6	±	1	5	±	1
December	695	±	142	736	±	151	719	±	148	653	±	139	628	±	131	563	±	123
January	150	±	30	148	±	30	149	±	30	143	±	29	84	±	19	92	±	21
February	13	±	3	12	±	2	12	±	2	12	±	3	6	±	1	7	±	2
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	74	±	17	74	±	17	77	±	18	78	±	18	61	±	14	60	±	14
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	94	±	21	93	±	21	82	±	19	74	±	17	49	±	11	42	±	10
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,039	±	208	1,076	±	216	1,052	±	212	974	±	200	834	±	170	768	±	161

Table 5.B.6-81. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	34	±	12	25	±	9	21	±	8	18	±	7	7	±	3	6	±	3
November	2	±	1	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
December	64	±	20	66	±	21	68	±	21	69	±	22	42	±	13	46	±	15
January	1,620	±	611	1,662	±	637	1,724	±	656	1,664	±	635	624	±	282	607	±	251
February	456	±	167	461	±	171	478	±	177	454	±	169	158	±	76	137	±	66
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	12	±	4	12	±	4	12	±	4	12	±	4	5	±	2	4	±	2
September	3	±	1	2	±	1	2	±	1	2	±	1	0	±	0	0	±	0
Annual Average	2,664	±	925	2,712	±	962	2,807	±	989	2,698	±	956	999	±	409	950	±	361
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	16	±	5	15	±	5	15	±	5	14	±	5	5	±	3	5	±	3
December	1,689	±	585	1,706	±	596	1,709	±	598	1,631	±	578	1356	±	483	1,297	±	481
January	367	±	126	383	±	134	386	±	135	380	±	133	188	±	77	226	±	93
February	33	±	12	33	±	12	34	±	12	35	±	12	6	±	4	11	±	6
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	234	±	92	233	±	92	236	±	92	241	±	94	130	±	49	133	±	51
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	324	±	116	325	±	117	304	±	111	265	±	98	129	±	49	119	±	46
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	3,319	±	1,107	3,361	±	1,127	3,347	±	1,124	3,199	±	1,081	2261	±	771	2,232	±	787

Table 5.B.6-82. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	15	±	8	10	±	5	8	±	4	6	±	3	4	±	2	3	±	2
November	70	±	37	49	±	30	49	±	29	51	±	33	31	±	19	25	±	18
December	163	±	34	166	±	34	166	±	34	166	±	34	130	±	25	125	±	24
January	173	±	51	188	±	59	197	±	64	191	±	61	112	±	36	86	±	26
February	51	±	25	52	±	25	53	±	26	52	±	25	17	±	11	22	±	13
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	12	±	6	12	±	6	12	±	6	12	±	6	2	±	2	1	±	2
Annual Average	485	±	142	477	±	142	485	±	146	478	±	142	295	±	76	263	±	66
(b) CVP																		
October	3	±	2	3	±	1	2	±	1	2	±	1	1	±	1	1	±	1
November	21	±	11	21	±	11	22	±	11	20	±	10	10	±	6	8	±	6
December	31	±	7	34	±	7	34	±	7	31	±	7	28	±	7	26	±	7
January	17	±	5	16	±	5	14	±	5	16	±	5	8	±	3	11	±	4
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	17	±	9	18	±	9	15	±	7	14	±	7	8	±	4	8	±	4
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	90	±	22	92	±	22	88	±	22	83	±	20	55	±	13	53	±	11

Table 5.B.6-83. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	38	±	5	39	±	6	40	±	7	37	±	9	21	±	7	24	±	6
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	38	±	5	39	±	6	40	±	7	37	±	9	21	±	7	24	±	6
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	18	±	2	17	±	2	17	±	2	15	±	3	11	±	3	11	±	3
February	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	18	±	2	18	±	2	18	±	2	16	±	3	11	±	3	11	±	3

Table 5.B.6-84. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	3	±	1	2	±	1	2	±	1	1	±	1	1	±	0	1	±	0
November	25	±	11	16	±	7	15	±	7	14	±	8	10	±	5	10	±	5
December	75	±	25	77	±	25	75	±	25	72	±	25	58	±	19	54	±	19
January	5	±	2	5	±	2	5	±	2	5	±	2	3	±	1	3	±	1
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	3	±	1	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1
April	3	±	1	3	±	1	3	±	1	3	±	1	4	±	2	3	±	1
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	112	±	39	106	±	36	103	±	36	98	±	34	77	±	25	73	±	25
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	5	±	2	5	±	2	5	±	2	5	±	2	3	±	1	3	±	1
December	19	±	7	21	±	8	20	±	8	18	±	7	19	±	7	16	±	7
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	24	±	9	26	±	10	25	±	10	23	±	9	21	±	8	19	±	8

Table 5.B.6-85. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	84	±	18	78	±	20	72	±	22	79	±	16	53	±	21	47	±	22
February	42	±	11	46	±	12	43	±	9	42	±	11	37	±	9	37	±	6
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	126	±	24	125	±	30	115	±	27	121	±	25	91	±	23	84	±	26
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	30	±	5	32	±	5	30	±	5	23	±	7	31	±	4	24	±	7
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	8	±	2	7	±	2	8	±	2	7	±	2	7	±	1	6	±	2
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	38	±	7	40	±	7	38	±	7	30	±	9	38	±	5	30	±	8

Table 5.B.6-86. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	10	±	2	7	±	1	6	±	1	5	±	1	3	±	0	2	±	0
November	34	±	4	24	±	3	23	±	3	22	±	3	12	±	2	12	±	2
December	117	±	13	118	±	14	115	±	13	113	±	13	87	±	10	89	±	11
January	134	±	23	136	±	24	138	±	25	137	±	24	71	±	13	67	±	12
February	9	±	2	9	±	2	10	±	2	9	±	2	5	±	1	4	±	1
March	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
September	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
Annual Average	312	±	29	302	±	29	300	±	30	292	±	29	180	±	18	178	±	17
(b) CVP																		
October	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
November	11	±	1	10	±	1	11	±	1	10	±	1	5	±	1	4	±	1
December	19	±	1	20	±	1	19	±	1	18	±	1	17	±	1	15	±	1
January	8	±	1	8	±	1	8	±	1	8	±	1	5	±	1	5	±	1
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	42	±	2	42	±	2	42	±	2	39	±	2	28	±	2	26	±	2

Table 5.B.6-87. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	21	±	8	15	±	6	13	±	5	11	±	4	5	±	2	4	±	2
November	49	±	15	35	±	12	35	±	12	32	±	12	11	±	6	12	±	6
December	185	±	56	189	±	58	195	±	59	197	±	60	121	±	38	133	±	41
January	46	±	14	47	±	15	49	±	15	47	±	15	18	±	7	17	±	6
February	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	7	±	2	7	±	3	7	±	3	7	±	3	3	±	2	3	±	1
September	2	±	1	2	±	1	2	±	1	1	±	0	0	±	0	0	±	0
Annual Average	310	±	56	297	±	58	302	±	59	297	±	60	158	±	37	169	±	41
(b) CVP																		
October	2	±	1	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
November	18	±	3	17	±	3	16	±	3	15	±	3	6	±	2	6	±	2
December	21	±	3	21	±	3	21	±	3	20	±	3	17	±	2	16	±	2
January	13	±	3	14	±	3	14	±	3	14	±	3	7	±	2	8	±	2
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	55	±	4	55	±	5	54	±	5	52	±	5	31	±	3	31	±	4

Table 5.B.6-88. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	10	±	5	7	±	3	5	±	3	4	±	2	2	±	1	2	±	1
November	44	±	24	31	±	19	31	±	19	32	±	21	20	±	12	16	±	11
December	90	±	20	92	±	20	92	±	20	92	±	20	72	±	15	69	±	15
January	96	±	31	104	±	36	109	±	39	105	±	37	62	±	22	48	±	16
February	32	±	16	32	±	16	33	±	17	32	±	16	10	±	7	14	±	8
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	8	±	4	8	±	4	8	±	4	8	±	4	1	±	1	1	±	1
Annual Average	280	±	92	273	±	91	278	±	94	274	±	91	167	±	49	149	±	43
(b) CVP																		
October	2	±	1	2	±	1	1	±	1	1	±	1	1	±	0	1	±	0
November	14	±	7	13	±	7	14	±	7	13	±	7	6	±	4	5	±	4
December	18	±	4	19	±	4	20	±	5	18	±	4	16	±	4	15	±	4
January	11	±	4	11	±	4	10	±	4	11	±	4	5	±	3	7	±	3
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	11	±	5	11	±	5	9	±	5	9	±	4	5	±	3	5	±	3
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	56	±	14	56	±	15	54	±	14	51	±	13	33	±	9	33	±	7

Table 5.B.6-89. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	24	±	3	25	±	4	25	±	4	23	±	5	13	±	4	15	±	4
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	24	±	3	25	±	4	25	±	4	23	±	5	13	±	4	15	±	4
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	11	±	1	11	±	2	11	±	1	10	±	2	7	±	2	7	±	2
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	12	±	1	11	±	2	11	±	2	10	±	2	7	±	2	7	±	2

Table 5.B.6-90. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	4	±	2	3	±	1	2	±	1	2	±	1	1	±	0	1	±	0
November	34	±	15	22	±	10	22	±	10	19	±	10	13	±	7	13	±	7
December	116	±	33	120	±	34	117	±	34	112	±	34	90	±	25	85	±	25
January	7	±	3	7	±	3	7	±	3	7	±	3	4	±	2	4	±	2
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	3	±	1	3	±	1	3	±	1	3	±	1	3	±	1	3	±	1
April	4	±	2	4	±	2	5	±	2	5	±	2	5	±	2	5	±	2
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	169	±	52	160	±	48	155	±	48	147	±	46	116	±	34	110	±	33
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	8	±	3	7	±	3	7	±	3	7	±	3	4	±	2	4	±	2
December	26	±	10	29	±	11	28	±	11	26	±	10	26	±	10	23	±	10
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	34	±	13	36	±	14	35	±	13	32	±	13	30	±	11	26	±	11

Table 5.B.6-91. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Nonnormalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Six Model Scenarios at the SWP and CVP Salvage Facilities for Critical Water Years

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	24	±	5	22	±	6	21	±	6	23	±	4	15	±	6	14	±	6
February	12	±	3	13	±	4	12	±	3	12	±	3	11	±	3	10	±	2
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	36	±	7	36	±	9	33	±	8	35	±	7	26	±	7	24	±	7
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	9	±	2	9	±	1	9	±	2	6	±	2	9	±	1	7	±	2
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	2	±	1	2	±	1	2	±	1	2	±	1	2	±	0	2	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	11	±	2	11	±	2	11	±	2	9	±	2	11	±	1	9	±	2

1 **Table 5.B.6-92. Average Annual Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios**
2 **at the SWP and CVP South Delta Export Facilities**

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-31,828 (-63%)	-30,272 (-60%)	-32,129 (-64%)	-30,574 (-60%)	-32,397 (-64%)	-29,206 (-59%)
Above Normal	-4,099 (-42%)	-4,280 (-44%)	-3,595 (-39%)	-3,777 (-41%)	-3,905 (-41%)	-4,223 (-44%)
Below Normal	-1,953 (-33%)	-1,938 (-33%)	-1,540 (-28%)	-1,524 (-28%)	-1,418 (-27%)	-1,570 (-29%)
Dry	122 (5%)	-298 (-12%)	171 (7%)	-249 (-10%)	11 (0%)	-267 (-11%)
Critical	-2,138 (-18%)	-2,373 (-20%)	-1,834 (-16%)	-2,069 (-18%)	-1,424 (-13%)	-1,362 (-13%)
All Years	-8,149 (-42%)	-8,447 (-43%)	-7,830 (-41%)	-8,127 (-42%)	-7,678 (-40%)	-7,609 (-41%)
SWP						
Wet	-47,852 (-62%)	-50,337 (-65%)	-52,479 (-64%)	-54,964 (-67%)	-52,758 (-64%)	-51,580 (-65%)
Above Normal	-9,384 (-40%)	-9,208 (-40%)	-9,114 (-40%)	-8,938 (-39%)	-10,375 (-43%)	-9,740 (-41%)
Below Normal	-2,166 (-28%)	-1,566 (-20%)	-2,184 (-28%)	-1,583 (-20%)	-2,533 (-31%)	-2,293 (-27%)
Dry	811 (5%)	-1592 (-9%)	873 (5%)	-1,530 (-9%)	-771 (-4%)	-3,270 (-17%)
Critical	-11,124 (-38%)	-10,431 (-36%)	-9,326 (-34%)	-8,633 (-32%)	-9,784 (-35%)	-6,263 (-25%)
All Years	-14,230 (-40%)	-15,514 (-44%)	-15,071 (-42%)	-16,354 (-45%)	-16,029 (-43%)	-16,407 (-45%)
Combined Losses						
Wet	-79,680 (-62%)	-80,609 (-63%)	-84,608 (-64%)	-85,538 (-64%)	-85,155 (-64%)	-80,786 (-63%)
Above Normal	-13,483 (-41%)	-13,488 (-41%)	-12,709 (-40%)	-12,714 (-40%)	-14,279 (-42%)	-13,962 (-42%)
Below Normal	-4,120 (-30%)	-3,504 (-26%)	-3,724 (-28%)	-3,108 (-24%)	-3,951 (-29%)	-3,864 (-28%)
Dry	933 (5%)	-1,890 (-10%)	1,044 (5%)	-1,779 (-9%)	-760 (-4%)	-3,538 (-17%)
Critical	-13,262 (-32%)	-12,803 (-31%)	-11,160 (-29%)	-10,702 (-28%)	-11,208 (-29%)	-7,626 (-21%)
All Years	-22,380 (-41%)	-23,960 (-44%)	-22,901 (-41%)	-24,481 (-44%)	-23,707 (-42%)	-24,016 (-44%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

3

Table 5.B.6-93. Average Annual Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-22,337 (-63%)	-21,100 (-60%)	-22,603 (-63%)	-21,366 (-60%)	-22,766 (-64%)	-20,377 (-59%)
Above Normal	-4,183 (-43%)	-4,349 (-44%)	-3,653 (-39%)	-3,819 (-41%)	-3,984 (-41%)	-4,295 (-44%)
Below Normal	-2,656 (-33%)	-2,635 (-33%)	-2,094 (-28%)	-2,072 (-28%)	-1,927 (-27%)	-2,135 (-29%)
Dry	154 (5%)	-352 (-11%)	211 (7%)	-295 (-10%)	9 (0%)	-328 (-11%)
Critical	-459 (-18%)	-509 (-20%)	-394 (-16%)	-444 (-18%)	-306 (-13%)	-293 (-13%)
All Years	-6,205 (-43%)	-6,365 (-44%)	-5,963 (-42%)	-6,123 (-43%)	-5,849 (-41%)	-5,735 (-41%)
SWP						
Wet	-29,337 (-61%)	-30,913 (-65%)	-32,111 (-64%)	-33,686 (-67%)	-32,080 (-63%)	-31,298 (-65%)
Above Normal	-9,624 (-40%)	-9,441 (-39%)	-9,354 (-39%)	-9,171 (-39%)	-10,674 (-43%)	-10,081 (-41%)
Below Normal	-2,946 (-28%)	-2,129 (-20%)	-2,969 (-28%)	-2,153 (-20%)	-3,444 (-31%)	-3,118 (-27%)
Dry	992 (5%)	-2,013 (-9%)	1,081 (5%)	-1,924 (-9%)	-984 (-4%)	-4,123 (-18%)
Critical	-2,388 (-38%)	-2,239 (-36%)	-2,002 (-34%)	-1,853 (-32%)	-2,101 (-35%)	-1,345 (-25%)
All Years	-10,488 (-40%)	-11,418 (-44%)	-11,114 (-41%)	-12,044 (-45%)	-11,825 (-43%)	-12,137 (-45%)
Combined Losses						
Wet	-51,675 (-62%)	-52,013 (-63%)	-54,714 (-63%)	-55,052 (-64%)	-54,847 (-64%)	-51,675 (-62%)
Above Normal	-13,808 (-41%)	-13,790 (-41%)	-13,008 (-39%)	-12,990 (-39%)	-14,658 (-42%)	-14,376 (-42%)
Below Normal	-5,602 (-30%)	-4,764 (-26%)	-5,063 (-28%)	-4,225 (-24%)	-5,372 (-29%)	-5,253 (-28%)
Dry	1,146 (5%)	-2,365 (-10%)	1,292 (5%)	-2,218 (-9%)	-976 (-4%)	-4,451 (-17%)
Critical	-2,847 (-32%)	-2,749 (-31%)	-2,396 (-29%)	-2,298 (-28%)	-2,406 (-29%)	-1,637 (-21%)
All Years	-16,693 (-41%)	-17,783 (-44%)	-17,077 (-41%)	-18,167 (-44%)	-17,674 (-42%)	-17,872 (-44%)

Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.

Table 5.B.6-94. Average Annual Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-1,058 (-32%)	-1,087 (-33%)	-1,100 (-33%)	-1,129 (-34%)	-1,086 (-32%)	-966 (-30%)
Above Normal	-35 (-39%)	-37 (-41%)	-37 (-40%)	-38 (-42%)	-33 (-37%)	-30 (-36%)
Below Normal	-8 (-41%)	-7 (-40%)	-7 (-39%)	-7 (-38%)	-7 (-39%)	-5 (-30%)
Dry	-3 (-12%)	-5 (-21%)	-4 (-17%)	-7 (-26%)	-4 (-15%)	-4 (-18%)
Critical	0 (0%)	-8 (-22%)	-2 (-4%)	-10 (-25%)	-0.3 (-1%)	0 (0%)
All Years	-205 (-20%)	-271 (-26%)	-241 (-22%)	-307 (-29%)	-218 (-21%)	-205 (-21%)
SWP						
Wet	-1,666 (-63%)	-1,714 (-64%)	-1,713 (-63%)	-1,762 (-65%)	-1,809 (-64%)	-1,748 (-65%)
Above Normal	-189 (-39%)	-222 (-46%)	-181 (-38%)	-214 (-45%)	-190 (-39%)	-215 (-45%)
Below Normal	-17 (-44%)	-14 (-37%)	-18 (-46%)	-16 (-40%)	-19 (-47%)	-13 (-36%)
Dry	-36 (-32%)	-40 (-35%)	-29 (-28%)	-33 (-31%)	-26 (-26%)	-25 (-25%)
Critical	-35 (-28%)	-42 (-34%)	-34 (-27%)	-41 (-33%)	-25 (-21%)	-38 (-31%)
All Years	-416 (-47%)	-437 (-49%)	-418 (-47%)	-439 (-49%)	-425 (-47%)	-422 (-48%)
Combined Losses						
Wet	-2,724 (-46%)	-2,801 (-47%)	-2,813 (-46%)	-2,891 (-48%)	-2,895 (-47%)	-2,714 (-46%)
Above Normal	-225 (-39%)	-259 (-45%)	-218 (-38%)	-252 (-44%)	-223 (-39%)	-245 (-44%)
Below Normal	-24 (-43%)	-21 (-38%)	-25 (-44%)	-22 (-39%)	-26 (-45%)	-18 (-34%)
Dry	-39 (-28%)	-45 (-33%)	-34 (-26%)	-40 (-30%)	-30 (-23%)	-29 (-24%)
Critical	-35 (-22%)	-51 (-31%)	-36 (-22%)	-51 (-31%)	-25 (-16%)	-38 (-25%)
All Years	-622 (-32%)	-708 (-37%)	-659 (-34%)	-746 (-38%)	-643 (-33%)	-627 (-34%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-95. Average Annual Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

Water-Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
CVP						
Wet	-25 (-45%)	-24 (-44%)	-24 (-44%)	-24 (-44%)	-24 (-44%)	-21 (-41%)
Above Normal	-22 (-40%)	-23 (-42%)	-23 (-41%)	-24 (-42%)	-21 (-38%)	-19 (-36%)
Below Normal	-5 (-41%)	-5 (-40%)	-4 (-39%)	-4 (-38%)	-4 (-39%)	-3 (-30%)
Dry	-4 (-12%)	-7 (-21%)	-6 (-17%)	-9 (-26%)	-5 (-15%)	-6 (-18%)
Critical	0 (0%)	-2 (-22%)	-0.5 (-4%)	-3 (-25%)	-0.1 (-1%)	0 (0%)
All Years	-14 (-33%)	-16 (-38%)	-14 (-33%)	-16 (-38%)	-13 (-32%)	-12 (-32%)
SWP						
Wet	-153 (-49%)	-141 (-46%)	-140 (-47%)	-128 (-43%)	-145 (-48%)	-128 (-43%)
Above Normal	-112 (-40%)	-130 (-47%)	-106 (-39%)	-124 (-45%)	-110 (-40%)	-124 (-45%)
Below Normal	-11 (-44%)	-9 (-37%)	-12 (-46%)	-10 (-40%)	-12 (-47%)	-8 (-36%)
Dry	-53 (-31%)	-58 (-35%)	-44 (-27%)	-50 (-31%)	-39 (-25%)	-37 (-25%)
Critical	-10 (-28%)	-12 (-34%)	-10 (-27%)	-12 (-33%)	-7 (-21%)	-11 (-31%)
All Years	-131 (-42%)	-134 (-43%)	-122 (-40%)	-124 (-41%)	-119 (-40%)	-115 (-39%)
Combined Losses						
Wet	-178 (-49%)	-166 (-45%)	-164 (-47%)	-152 (-43%)	-169 (-47%)	-149 (-43%)
Above Normal	-134 (-40%)	-154 (-46%)	-129 (-39%)	-148 (-45%)	-131 (-39%)	-143 (-44%)
Below Normal	-15 (-43%)	-14 (-38%)	-16 (-44%)	-14 (-39%)	-16 (-45%)	-11 (-34%)
Dry	-57 (-28%)	-66 (-33%)	-50 (-26%)	-59 (-30%)	-44 (-23%)	-43 (-24%)
Critical	-10 (-22%)	-14 (-31%)	-10 (-22%)	-15 (-31%)	-7 (-16%)	-11 (-25%)
All Years	-145 (-41%)	-150 (-42%)	-136 (-39%)	-141 (-41%)	-133 (-39%)	-127 (-38%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-96. Average Annual Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	35,304	36,145	37,103	36,197	21,074	19,791
CVP Jones	19,478	19,159	19,006	18,640	11,329	11,031
Combined	54,782	55,303	56,109	54,838	32,403	30,822
Percentage of fall-run juvenile index of abundance	0.24%	0.24%	0.24%	0.24%	0.14%	0.13%

Table 5.B.6-97. Wet Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	77,691	82,318	82,598	78,934	29,839	27,354
CVP Jones	50,277	50,578	50,846	49,211	18,449	20,005
Combined	127,968	132,897	133,443	128,145	48,288	47,359
Percentage of fall-run juvenile index of abundance	0.56%	0.58%	0.58%	0.56%	0.21%	0.21%

Table 5.B.6-98. Above-Normal Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	23,219	22,949	24,210	23,751	13,835	14,011
CVP Jones	9,657	9,153	9,463	9,599	5,558	5,377
Combined	32,876	32,102	33,672	33,350	19,393	19,388
Percentage of fall-run juvenile index of abundance	0.14%	0.14%	0.15%	0.15%	0.08%	0.08%

Table 5.B.6-99. Below-Normal Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	7,733	7,750	8,100	8,460	5,567	6,167
CVP Jones	5,865	5,452	5,329	5,498	3,912	3,928
Combined	13,598	13,202	13,429	13,958	9,478	10,095
Percentage of fall-run juvenile index of abundance	0.06%	0.06%	0.06%	0.06%	0.04%	0.04%

Table 5.B.6-100. Dry Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	17,094	17,032	18,676	18,772	17,905	15,502
CVP Jones	2,551	2,502	2,662	2,520	2,673	2,253
Combined	19,645	19,534	21,338	21,292	20,578	17,755
Percentage of fall-run juvenile index of abundance	0.09%	0.08%	0.09%	0.09%	0.09%	0.08%

Table 5.B.6-101. Critical Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	29,200	27,402	27,860	25,032	18,076	18,769
CVP Jones	11,693	11,389	10,979	10,683	9,555	9,320
Combined	40,893	38,791	38,839	35,715	27,631	28,089
Percentage of fall-run juvenile index of abundance	0.18%	0.17%	0.17%	0.16%	0.12%	0.12%

Table 5.B.6-102. Average Annual Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	26,213	26,839	27,551	26,932	15,725	14,795
CVP Jones	14,585	14,343	14,229	13,955	8,380	8,220
Combined	40,799	41,183	41,780	40,887	24,106	23,015
Percentage of fall-run juvenile index of abundance	0.18%	0.18%	0.18%	0.18%	0.10%	0.10%

Table 5.B.6-103. Wet Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	47,782	50,555	50,525	48,167	18,444	16,869
CVP Jones	35,367	35,633	35,796	34,644	13,030	14,268
Combined	83,149	86,189	86,321	82,812	31,475	31,137
Percentage of fall-run juvenile index of abundance	0.36%	0.37%	0.38%	0.36%	0.14%	0.14%

Table 5.B.6-104. Above-Normal Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	24,000	23,730	25,050	24,640	14,376	14,559
CVP Jones	9,831	9,301	9,632	9,777	5,648	5,482
Combined	33,831	33,031	34,682	34,417	20,024	20,041
Percentage of fall-run juvenile index of abundance	0.15%	0.14%	0.15%	0.15%	0.09%	0.09%

Table 5.B.6-105. Below-Normal Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	10,514	10,537	11,013	11,503	7,568	8,385
CVP Jones	7,974	7,412	7,246	7,475	5,319	5,340
Combined	18,488	17,950	18,259	18,978	12,887	13,725
Percentage of fall-run juvenile index of abundance	0.08%	0.08%	0.08%	0.08%	0.06%	0.06%

Table 5.B.6-106. Dry Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	21,404	21,315	23,381	23,514	22,396	19,391
CVP Jones	3,081	3,024	3,226	3,057	3,235	2,729
Combined	24,485	24,339	26,607	26,571	25,631	22,121
Percentage of fall-run juvenile index of abundance	0.11%	0.11%	0.12%	0.12%	0.11%	0.10%

Table 5.B.6-107. Critical Year Juvenile Fall-Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	6,269	5,883	5,981	5,374	3,881	4,030
CVP Jones	2,510	2,445	2,357	2,294	2,051	2,001
Combined	8,779	8,328	8,338	7,668	5,932	6,031
Percentage of fall-run juvenile index of abundance	0.04%	0.04%	0.04%	0.03%	0.03%	0.03%

Table 5.B.6-108. Average Annual Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	890	892	899	875	474	453
CVP Jones	1,039	1,076	1,052	974	834	768
Combined	1,929	1,967	1,951	1,848	1,308	1,221
Percentage of late fall–run juvenile index of abundance	0.19%	0.20%	0.20%	0.18%	0.13%	0.12%

Table 5.B.6-109. Wet Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	2,664	2,712	2,807	2,698	999	950
CVP Jones	3,319	3,361	3,347	3,199	2,261	2,232
Combined	5,983	6,073	6,154	5,897	3,260	3,182
Percentage of late fall–run juvenile index of abundance	0.60%	0.61%	0.62%	0.59%	0.33%	0.32%

Table 5.B.6-110. Above-Normal Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	485	477	485	478	295	263
CVP Jones	90	92	88	83	55	53
Combined	575	568	573	561	350	316
Percentage of late fall–run juvenile index of abundance	0.06%	0.06%	0.06%	0.06%	0.04%	0.03%

Table 5.B.6-111. Below-Normal Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	38	39	40	37	21	24
CVP Jones	18	18	18	16	11	11
Combined	56	57	58	52	32	35
Percentage of late fall–run juvenile index of abundance	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%

Table 5.B.6-112. Dry Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	112	106	103	98	77	73
CVP Jones	24	26	25	23	21	19
Combined	137	131	128	121	98	92
Percentage of late fall–run juvenile index of abundance	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%

Table 5.B.6-113. Critical Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Normalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	126	125	115	121	90	84
CVP Jones	38	40	38	30	38	30
Combined	164	164	154	151	129	114
Percentage of late fall–run juvenile index of abundance	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%

Table 5.B.6-114. Average Annual Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	312	302	300	292	180	178
CVP Jones	42	42	42	39	28	26
Combined	354	344	341	331	209	204
Percentage of late fall–run juvenile index of abundance	0.04%	0.03%	0.03%	0.03%	0.02%	0.02%

Table 5.B.6-115. Wet Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	310	297	302	297	158	169
CVP Jones	55	55	54	52	30	31
Combined	366	352	356	349	188	200
Percentage of late fall–run juvenile index of abundance	0.04%	0.04%	0.04%	0.03%	0.02%	0.02%

Table 5.B.6-116. Above-Normal Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	280	273	278	274	167	149
CVP Jones	56	56	54	51	33	33
Combined	335	330	332	325	201	182
Percentage of late fall–run juvenile index of abundance	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%

Table 5.B.6-117. Below-Normal Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	24	25	25	23	13	15
CVP Jones	12	11	11	10	7	7
Combined	36	36	37	33	20	22
Percentage of late fall–run juvenile index of abundance	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 5.B.6-118. Dry Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	169	160	155	147	116	110
CVP Jones	34	36	35	32	29	26
Combined	202	195	190	180	145	136
Percentage of late fall–run juvenile index of abundance	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%

Table 5.B.6-119. Critical Year Juvenile Late Fall–Run Chinook Salmon Losses Calculated Using Nonnormalized Salvage Densities for Model Scenarios at the SWP and CVP South Delta Export Facilities

	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
SWP Banks	36	36	33	35	26	24
CVP Jones	11	11	11	9	11	9
Combined	47	47	44	43	37	32
Percentage of late fall–run juvenile index of abundance	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

5.B.6.1.4.2 Delta Passage Model Salvage Estimates

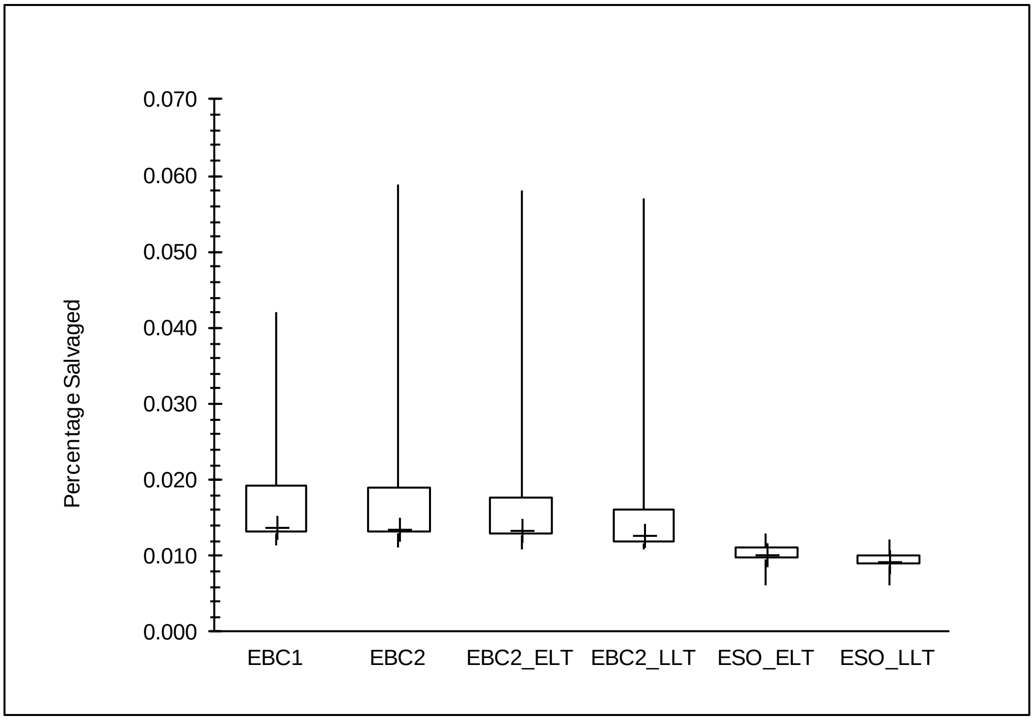
Sacramento River-Origin Fall-Run Chinook Salmon

Percentage of Smolts Salvaged

The estimated percentage of Sacramento River-origin fall-run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged 0.018–0.019% for EBC scenarios, and 0.009-0.010% for ESO scenarios (Table 5.B.6-120). The data were skewed upward for EBC scenarios, with medians of 0.010-0.014% (Figure 5.B.6-10). Percentage salvage in individual years ranged from around 0.006% (ESO scenarios in 1983) to around 0.06% (EBC scenarios in 1983). The difference in percentage salvage between EBC and ESO scenarios averaged 45–51% lower under ESO scenarios compared with EBC scenarios in relative terms, or 0.008–0.010% lower in absolute terms (Table 5.B.6-121).

Table 5.B.6-120. Estimated Percentage of Sacramento River-Origin Fall-Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.013	0.013	0.012	0.012	0.011	0.009
1977 (C)	0.013	0.013	0.013	0.011	0.010	0.009
1978 (AN)	0.024	0.023	0.023	0.022	0.009	0.008
1979 (BN)	0.015	0.014	0.014	0.014	0.011	0.010
1980 (AN)	0.019	0.019	0.017	0.016	0.010	0.009
1981 (D)	0.014	0.014	0.013	0.013	0.013	0.012
1982 (W)	0.042	0.042	0.039	0.036	0.011	0.011
1983 (W)	0.033	0.059	0.058	0.057	0.006	0.006
1984 (W)	0.013	0.013	0.013	0.013	0.010	0.009
1985 (D)	0.013	0.013	0.013	0.012	0.010	0.010
1986 (W)	0.021	0.020	0.019	0.016	0.010	0.009
1987 (D)	0.015	0.014	0.014	0.012	0.011	0.010
1988 (C)	0.014	0.013	0.013	0.012	0.010	0.009
1989 (D)	0.013	0.013	0.013	0.012	0.012	0.010
1990 (C)	0.011	0.011	0.011	0.011	0.010	0.008
1991 (C)	0.014	0.014	0.014	0.014	0.012	0.011
Average	0.018	0.019	0.019	0.018	0.010	0.009



Box and whisker plot shows salvage distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage salvage.

Figure 5.B.6-10. Sacramento River-Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

Table 5.B.6-121. Difference in Estimated Percentage of Sacramento River-Origin Fall-Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

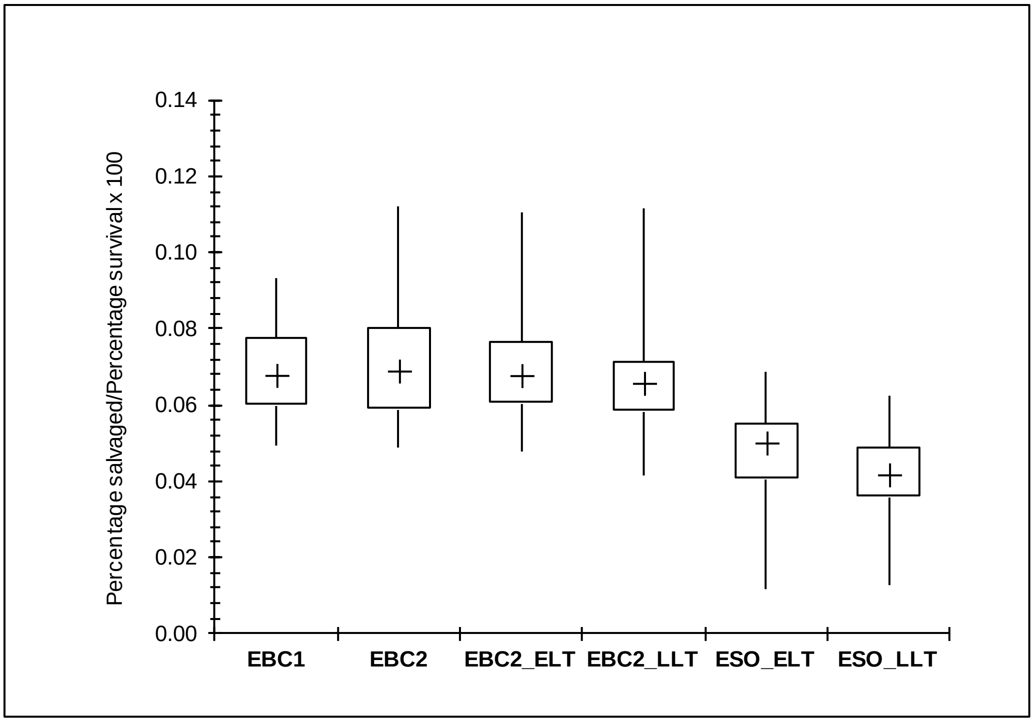
Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.003 (-20%)	-0.004 (-30%)	-0.003 (-19%)	-0.004 (-29%)	-0.002 (-14%)	-0.003 (-22%)
1977 (C)	-0.003 (-20%)	-0.004 (-29%)	-0.003 (-22%)	-0.004 (-30%)	-0.003 (-23%)	-0.002 (-20%)
1978 (AN)	-0.016 (-64%)	-0.016 (-66%)	-0.015 (-63%)	-0.015 (-65%)	-0.015 (-63%)	-0.014 (-63%)
1979 (BN)	-0.004 (-29%)	-0.005 (-36%)	-0.003 (-22%)	-0.004 (-30%)	-0.003 (-21%)	-0.004 (-28%)
1980 (AN)	-0.009 (-47%)	-0.010 (-52%)	-0.009 (-46%)	-0.010 (-52%)	-0.007 (-42%)	-0.007 (-43%)
1981 (D)	-0.001 (-5%)	-0.002 (-12%)	-0.001 (-4%)	-0.002 (-12%)	0.000 (-2%)	-0.001 (-6%)
1982 (W)	-0.031 (-74%)	-0.031 (-75%)	-0.031 (-74%)	-0.031 (-75%)	-0.028 (-72%)	-0.026 (-71%)
1983 (W)	-0.027 (-81%)	-0.027 (-81%)	-0.053 (-90%)	-0.053 (-90%)	-0.052 (-89%)	-0.051 (-89%)
1984 (W)	-0.003 (-21%)	-0.003 (-27%)	-0.003 (-21%)	-0.003 (-27%)	-0.003 (-20%)	-0.004 (-28%)
1985 (D)	-0.003 (-21%)	-0.003 (-26%)	-0.003 (-21%)	-0.003 (-26%)	-0.003 (-20%)	-0.002 (-18%)
1986 (W)	-0.011 (-52%)	-0.012 (-56%)	-0.010 (-51%)	-0.011 (-56%)	-0.009 (-48%)	-0.007 (-45%)
1987 (D)	-0.003 (-21%)	-0.004 (-29%)	-0.003 (-20%)	-0.004 (-28%)	-0.002 (-16%)	-0.002 (-13%)
1988 (C)	-0.004 (-28%)	-0.005 (-33%)	-0.003 (-25%)	-0.004 (-31%)	-0.003 (-24%)	-0.003 (-25%)
1989 (D)	-0.002 (-14%)	-0.004 (-27%)	-0.002 (-14%)	-0.003 (-26%)	-0.002 (-13%)	-0.002 (-17%)
1990 (C)	-0.001 (-13%)	-0.003 (-28%)	-0.001 (-12%)	-0.003 (-28%)	-0.001 (-11%)	-0.003 (-26%)
1991 (C)	-0.002 (-12%)	-0.003 (-19%)	-0.001 (-10%)	-0.002 (-17%)	-0.002 (-11%)	-0.003 (-18%)
Average	-0.008 (-42%)	-0.008 (-47%)	-0.009 (-46%)	-0.010 (-51%)	-0.008 (-45%)	-0.008 (-47%)
Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Smolt Salvage as a Percentage of Through-Delta Survival

Smolt salvage percentage of Sacramento River-origin fall-run Chinook salmon expressed as a percentage of total through-Delta survival percentage averaged 0.07 for EBC scenarios and 0.04-0.05 for ESO scenarios (Table 5.B.6-122; Figure 5.B.6-11). Percentage salvage/survival ranged from 0.01 (ESO scenarios in 1983) to 0.11(EBC scenarios in 1983). Differences in average percentage salvage/survival between ESO scenarios and EBC scenarios ranged from 0.02% (33% relative difference) lower under ESO_ELT compared to EBC2_ELT, to 0.03% (42% relative difference) lower under ESO_LLT compared to EBC2 (Table 5.B.6-123).

Table 5.B.6-122. Estimated Sacramento River-Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.09	0.08	0.06	0.06	0.06	0.04
1977 (C)	0.07	0.07	0.08	0.07	0.06	0.05
1978 (AN)	0.07	0.07	0.07	0.07	0.03	0.03
1979 (BN)	0.06	0.06	0.06	0.06	0.05	0.05
1980 (AN)	0.07	0.07	0.07	0.06	0.04	0.04
1981 (D)	0.07	0.07	0.07	0.07	0.07	0.06
1982 (W)	0.09	0.09	0.09	0.09	0.03	0.03
1983 (W)	0.06	0.11	0.11	0.11	0.01	0.01
1984 (W)	0.06	0.06	0.06	0.07	0.05	0.05
1985 (D)	0.05	0.05	0.06	0.05	0.05	0.04
1986 (W)	0.08	0.08	0.08	0.07	0.04	0.04
1987 (D)	0.07	0.07	0.06	0.05	0.05	0.04
1988 (C)	0.08	0.07	0.07	0.07	0.06	0.05
1989 (D)	0.05	0.05	0.05	0.04	0.04	0.03
1990 (C)	0.06	0.06	0.06	0.06	0.05	0.04
1991 (C)	0.08	0.08	0.08	0.08	0.07	0.06
Average	0.07	0.07	0.07	0.07	0.05	0.04



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-11. Sacramento River-Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-123. Difference in Estimated Sacramento River-Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.03 (-36%)	-0.05 (-52%)	-0.03 (-35%)	-0.04 (-51%)	-0.01 (-9%)	-0.02 (-27%)
1977 (C)	-0.02 (-24%)	-0.02 (-33%)	-0.02 (-25%)	-0.02 (-33%)	-0.02 (-26%)	-0.02 (-25%)
1978 (AN)	-0.03 (-52%)	-0.04 (-54%)	-0.03 (-51%)	-0.03 (-52%)	-0.04 (-55%)	-0.04 (-56%)
1979 (BN)	-0.01 (-20%)	-0.01 (-21%)	-0.01 (-14%)	-0.01 (-15%)	-0.01 (-18%)	-0.02 (-25%)
1980 (AN)	-0.03 (-42%)	-0.03 (-48%)	-0.03 (-42%)	-0.03 (-47%)	-0.03 (-39%)	-0.03 (-42%)
1981 (D)	0.00 (-1%)	-0.01 (-19%)	0.00 (-1%)	-0.01 (-18%)	0.00 (-2%)	-0.01 (-16%)
1982 (W)	-0.06 (-69%)	-0.06 (-68%)	-0.06 (-69%)	-0.06 (-68%)	-0.06 (-68%)	-0.06 (-67%)
1983 (W)	-0.05 (-81%)	-0.05 (-79%)	-0.10 (-89%)	-0.10 (-89%)	-0.10 (-89%)	-0.10 (-89%)
1984 (W)	-0.01 (-12%)	-0.01 (-18%)	-0.01 (-13%)	-0.01 (-19%)	-0.01 (-16%)	-0.02 (-30%)
1985 (D)	-0.01 (-12%)	-0.02 (-28%)	-0.01 (-12%)	-0.02 (-28%)	-0.01 (-18%)	-0.01 (-22%)
1986 (W)	-0.04 (-47%)	-0.04 (-51%)	-0.04 (-47%)	-0.04 (-51%)	-0.04 (-46%)	-0.03 (-45%)
1987 (D)	-0.02 (-22%)	-0.02 (-36%)	-0.01 (-21%)	-0.02 (-35%)	-0.01 (-15%)	-0.01 (-17%)
1988 (C)	-0.02 (-28%)	-0.03 (-34%)	-0.02 (-26%)	-0.02 (-32%)	-0.02 (-24%)	-0.02 (-28%)
1989 (D)	-0.01 (-16%)	-0.02 (-32%)	-0.01 (-16%)	-0.02 (-31%)	-0.01 (-14%)	-0.01 (-19%)
1990 (C)	-0.01 (-11%)	-0.02 (-27%)	-0.01 (-10%)	-0.01 (-26%)	-0.01 (-13%)	-0.02 (-29%)
1991 (C)	-0.01 (-15%)	-0.02 (-23%)	-0.01 (-13%)	-0.02 (-21%)	-0.01 (-14%)	-0.02 (-20%)
Average	-0.02 (-32%)	-0.03 (-40%)	-0.02 (-34%)	-0.03 (-42%)	-0.02 (-33%)	-0.03 (-39%)
Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

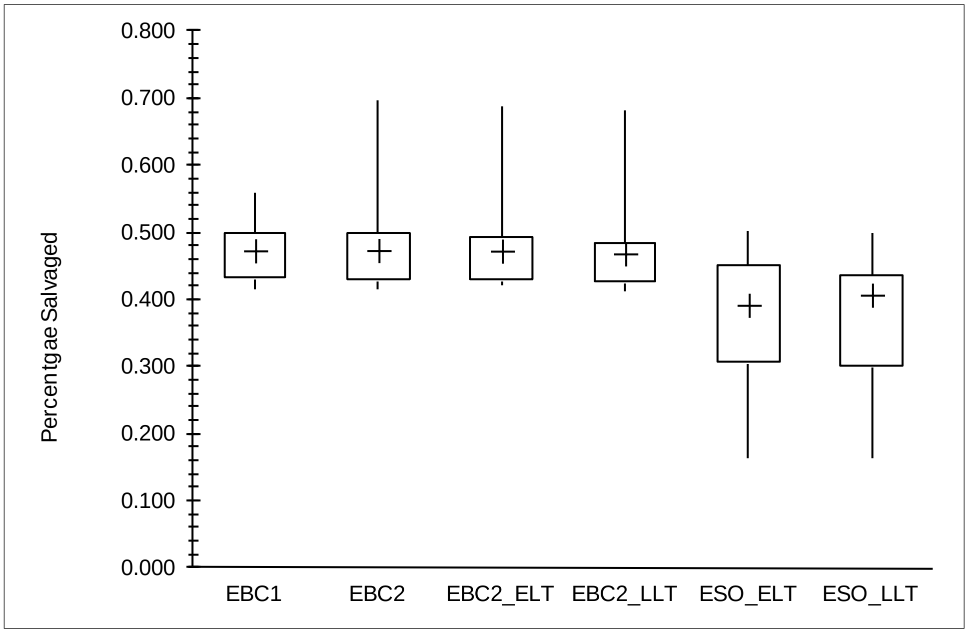
San Joaquin River–Origin Fall-Run Chinook Salmon

Percentage of Smolts Salvaged

The estimated percentage of San Joaquin River-origin fall-run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged 0.47–0.48% for EBC scenarios, and around 0.37% for ESO scenarios (Table 5.B.6-124; Figure 5.B.6-12). Percentage salvage in individual years ranged from ~0.16% (ESO scenarios in 1983) to almost 0.7% (EBC scenarios in 1983). The difference in percentage salvage between EBC and ESO scenarios averaged 22–24% lower under ESO scenarios compared with EBC scenarios in relative terms, or 0.10–0.11% lower in absolute terms (Table 5.B.6-125).

Table 5.B.6-124. Estimated Percentage of San Joaquin River–Origin Fall-Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.496	0.493	0.492	0.481	0.436	0.431
1977 (C)	0.447	0.459	0.463	0.429	0.422	0.403
1978 (AN)	0.426	0.424	0.429	0.427	0.257	0.265
1979 (BN)	0.431	0.422	0.420	0.411	0.338	0.334
1980 (AN)	0.426	0.426	0.421	0.419	0.305	0.303
1981 (D)	0.476	0.475	0.467	0.470	0.449	0.446
1982 (W)	0.560	0.559	0.546	0.539	0.245	0.252
1983 (W)	0.468	0.696	0.688	0.682	0.164	0.162
1984 (W)	0.415	0.416	0.421	0.423	0.344	0.345
1985 (D)	0.472	0.472	0.474	0.463	0.371	0.419
1986 (W)	0.434	0.431	0.429	0.424	0.306	0.297
1987 (D)	0.510	0.508	0.490	0.472	0.462	0.455
1988 (C)	0.506	0.496	0.493	0.467	0.413	0.411
1989 (D)	0.513	0.509	0.510	0.494	0.500	0.456
1990 (C)	0.474	0.471	0.471	0.471	0.462	0.422
1991 (C)	0.488	0.486	0.488	0.488	0.503	0.497
Average	0.471	0.484	0.481	0.473	0.374	0.369



Box and whisker plot shows salvage distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage salvage.

Figure 5.B.6-12. San Joaquin River–Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

Table 5.B.6-125. Difference in Estimated Percentage of San Joaquin River–Origin Fall-Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.060 (-12%)	-0.064 (-13%)	-0.058 (-12%)	-0.062 (-13%)	-0.056 (-11%)	-0.050 (-10%)
1977 (C)	-0.026 (-6%)	-0.044 (-10%)	-0.038 (-8%)	-0.056 (-12%)	-0.042 (-9%)	-0.025 (-6%)
1978 (AN)	-0.169 (-40%)	-0.161 (-38%)	-0.167 (-39%)	-0.159 (-38%)	-0.172 (-40%)	-0.162 (-38%)
1979 (BN)	-0.093 (-22%)	-0.097 (-23%)	-0.084 (-20%)	-0.088 (-21%)	-0.082 (-19%)	-0.077 (-19%)
1980 (AN)	-0.121 (-28%)	-0.124 (-29%)	-0.121 (-28%)	-0.123 (-29%)	-0.116 (-28%)	-0.117 (-28%)
1981 (D)	-0.027 (-6%)	-0.030 (-6%)	-0.026 (-6%)	-0.029 (-6%)	-0.018 (-4%)	-0.024 (-5%)
1982 (W)	-0.315 (-56%)	-0.307 (-55%)	-0.314 (-56%)	-0.307 (-55%)	-0.301 (-55%)	-0.287 (-53%)
1983 (W)	-0.304 (-65%)	-0.306 (-65%)	-0.533 (-76%)	-0.534 (-77%)	-0.525 (-76%)	-0.520 (-76%)
1984 (W)	-0.071 (-17%)	-0.071 (-17%)	-0.072 (-17%)	-0.071 (-17%)	-0.077 (-18%)	-0.079 (-19%)
1985 (D)	-0.101 (-21%)	-0.053 (-11%)	-0.101 (-21%)	-0.053 (-11%)	-0.103 (-22%)	-0.044 (-9%)
1986 (W)	-0.127 (-29%)	-0.137 (-31%)	-0.124 (-29%)	-0.133 (-31%)	-0.123 (-29%)	-0.127 (-30%)
1987 (D)	-0.048 (-9%)	-0.056 (-11%)	-0.046 (-9%)	-0.053 (-10%)	-0.028 (-6%)	-0.018 (-4%)
1988 (C)	-0.093 (-18%)	-0.095 (-19%)	-0.082 (-17%)	-0.085 (-17%)	-0.080 (-16%)	-0.056 (-12%)
1989 (D)	-0.013 (-3%)	-0.057 (-11%)	-0.009 (-2%)	-0.053 (-10%)	-0.010 (-2%)	-0.038 (-8%)
1990 (C)	-0.012 (-3%)	-0.052 (-11%)	-0.009 (-2%)	-0.049 (-10%)	-0.009 (-2%)	-0.050 (-11%)
1991 (C)	0.016 (3%)	0.010 (2%)	0.017 (4%)	0.012 (2%)	0.015 (3%)	0.009 (2%)
Average	-0.098 (-21%)	-0.103 (-22%)	-0.110 (-23%)	-0.115 (-24%)	-0.108 (-22%)	-0.104 (-22%)

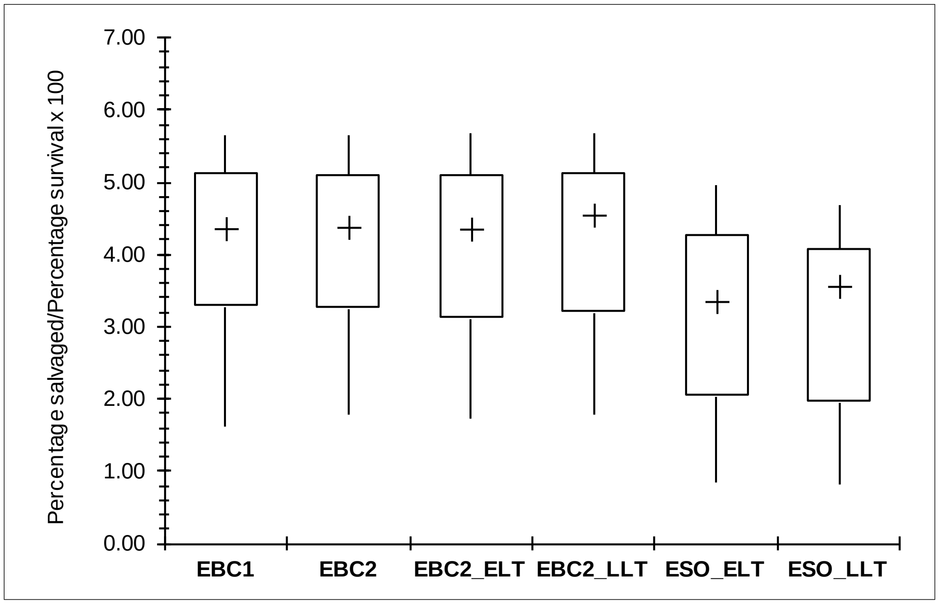
Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

Smolt Salvage as a Percentage of Through-Delta Survival

Smolt salvage percentage of San Joaquin River-origin fall-run Chinook salmon expressed as a percentage of total through-Delta survival percentage averaged 4.07–4.09 for EBC scenarios and 3.11–3.18 for ESO scenarios (Table 5.B.6-126; Figure 5.B.6-13). Percentage salvage/survival ranged from 0.82 (ESO_ELT in 1983) to over 5 (EBC scenarios in several years). Average differences between ESO scenarios and EBC scenarios were around 1% lower under ESO scenarios (22–24% in relative terms) (Table 5.B.6-127). As discussed in the Delta Passage Model results section of Appendix 5.C, *Flow, Passage, Salinity, and Turbidity*, simulated through-Delta survival under ESO scenarios may be lower than under EBC scenarios in some years because of the assumed positive relationship between exports and survival, irrespective of salvage. Nevertheless, the results presented here suggest that entrainment, expressed as salvage percentage, is relatively lower than any associated change in survival because of changes in south Delta export pumping. This results in the salvage: survival percentage generally being lower under the ESO scenarios.

Table 5.B.6-126. Estimated San Joaquin River–Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	5.11	5.10	5.13	5.12	4.17	4.06
1977 (C)	4.90	5.00	5.06	4.80	4.20	3.94
1978 (AN)	2.51	2.52	2.21	2.28	1.61	1.68
1979 (BN)	3.62	3.58	3.62	3.68	2.53	2.52
1980 (AN)	3.43	3.42	3.23	3.23	1.95	1.92
1981 (D)	4.34	4.37	4.48	4.57	3.57	3.52
1982 (W)	1.78	1.78	1.74	1.79	1.05	1.10
1983 (W)	1.60	2.02	1.97	1.92	0.86	0.82
1984 (W)	3.86	3.87	3.98	4.02	2.68	2.70
1985 (D)	4.39	4.39	4.23	4.53	3.14	3.61
1986 (W)	2.88	2.88	2.89	3.17	2.11	1.99
1987 (D)	5.37	5.39	5.34	5.32	4.50	4.39
1988 (C)	5.14	5.09	5.09	4.92	4.10	4.01
1989 (D)	5.65	5.64	5.68	5.67	4.94	4.61
1990 (C)	5.09	5.09	5.10	5.12	4.56	4.17
1991 (C)	5.25	5.25	5.30	5.33	4.89	4.69
Average	4.06	4.09	4.07	4.09	3.18	3.11



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-13. San Joaquin River–Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-127. Difference in Estimated San Joaquin River–Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO_ELT vs. EBC2	ESO_LLT vs. EBC2	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT
1976 (C)	-0.94 (-18%)	-1.05 (-21%)	-0.94 (-18%)	-1.05 (-20%)	-0.96 (-19%)	-1.06 (-21%)
1977 (C)	-0.70 (-14%)	-0.95 (-19%)	-0.80 (-16%)	-1.06 (-21%)	-0.86 (-17%)	-0.86 (-18%)
1978 (AN)	-0.90 (-36%)	-0.83 (-33%)	-0.91 (-36%)	-0.84 (-33%)	-0.60 (-27%)	-0.60 (-26%)
1979 (BN)	-1.09 (-30%)	-1.10 (-30%)	-1.05 (-29%)	-1.06 (-30%)	-1.09 (-30%)	-1.16 (-31%)
1980 (AN)	-1.47 (-43%)	-1.50 (-44%)	-1.47 (-43%)	-1.50 (-44%)	-1.28 (-40%)	-1.31 (-41%)
1981 (D)	-0.77 (-18%)	-0.82 (-19%)	-0.80 (-18%)	-0.85 (-20%)	-0.91 (-20%)	-1.06 (-23%)
1982 (W)	-0.73 (-41%)	-0.68 (-38%)	-0.73 (-41%)	-0.68 (-38%)	-0.69 (-40%)	-0.69 (-39%)
1983 (W)	-0.75 (-47%)	-0.78 (-49%)	-1.16 (-57%)	-1.19 (-59%)	-1.11 (-56%)	-1.09 (-57%)
1984 (W)	-1.18 (-31%)	-1.16 (-30%)	-1.19 (-31%)	-1.17 (-30%)	-1.30 (-33%)	-1.33 (-33%)
1985 (D)	-1.25 (-28%)	-0.78 (-18%)	-1.25 (-29%)	-0.78 (-18%)	-1.09 (-26%)	-0.91 (-20%)
1986 (W)	-0.77 (-27%)	-0.90 (-31%)	-0.77 (-27%)	-0.89 (-31%)	-0.78 (-27%)	-1.19 (-37%)
1987 (D)	-0.87 (-16%)	-0.98 (-18%)	-0.88 (-16%)	-1.00 (-19%)	-0.84 (-16%)	-0.93 (-17%)
1988 (C)	-1.05 (-20%)	-1.13 (-22%)	-0.99 (-19%)	-1.08 (-21%)	-1.00 (-20%)	-0.91 (-18%)
1989 (D)	-0.70 (-12%)	-1.04 (-18%)	-0.70 (-12%)	-1.03 (-18%)	-0.73 (-13%)	-1.06 (-19%)
1990 (C)	-0.53 (-10%)	-0.92 (-18%)	-0.52 (-10%)	-0.91 (-18%)	-0.54 (-11%)	-0.95 (-18%)
1991 (C)	-0.36 (-7%)	-0.55 (-11%)	-0.36 (-7%)	-0.56 (-11%)	-0.41 (-8%)	-0.63 (-12%)
Average	-0.88 (-22%)	-0.95 (-23%)	-0.91 (-22%)	-0.98 (-24%)	-0.89 (-22%)	-0.98 (-24%)

Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

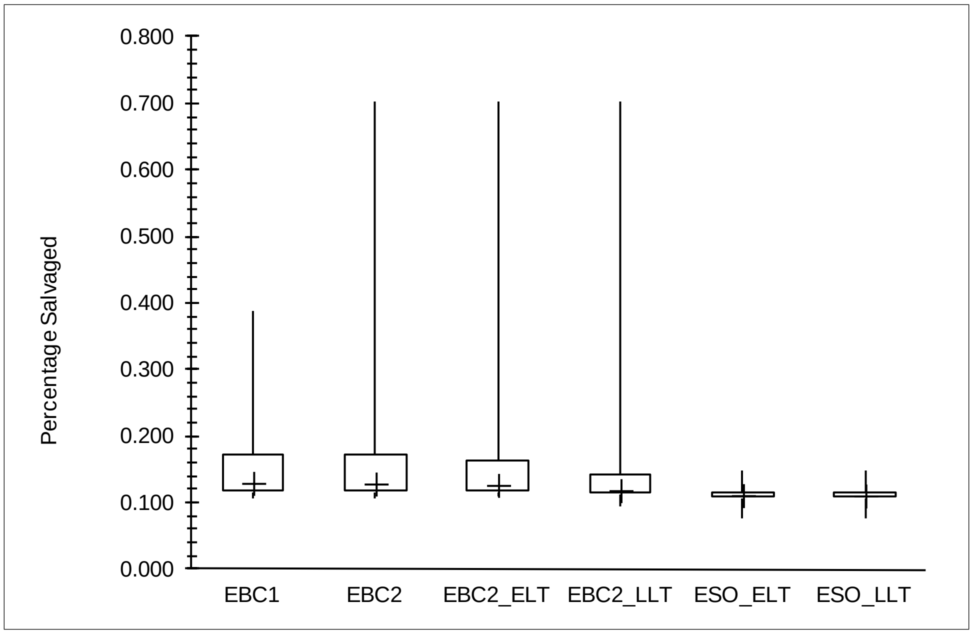
Mokelumne River–Origin Fall-Run Chinook Salmon

Percentage of Smolts Salvaged

The estimated percentage of Mokelumne River-origin fall-run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged 0.17–0.18% for EBC scenarios, and 0.11% for ESO scenarios (Table 5.B.6-128). For EBC scenarios, the data were highly skewed, with percentage loss of around 0.3% to over 0.7% occurring in 1982–1983; the medians for EBC scenarios were 0.12–0.13 and were slightly higher than the medians for ESO scenarios (0.11) (Figure 5.B.6-14). Percentage salvage in individual years ranged from less than 0.08% (ESO scenarios in 1983) to over 0.7% (EBC scenarios also in 1983). The average difference in percentage salvage between EBC and ESO scenarios was 0.06–0.07% lower salvage under the ESO scenarios, which represented a relative difference of 35–40% less (Table 5.B.6-129). However, as noted above, the data were quite skewed. Comparison of medians suggested that percentage salvage under ESO scenarios was 0.01–0.02% (6–14% in relative terms) lower than under EBC scenarios (Table 5.B.6-129).

Table 5.B.6-128. Estimated Percentage of Mokelumne River-Origin Fall-Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.116	0.116	0.117	0.116	0.110	0.110
1977 (C)	0.106	0.108	0.109	0.094	0.102	0.099
1978 (AN)	0.212	0.204	0.222	0.203	0.107	0.106
1979 (BN)	0.150	0.139	0.134	0.126	0.118	0.113
1980 (AN)	0.165	0.164	0.160	0.150	0.116	0.115
1981 (D)	0.132	0.131	0.122	0.121	0.147	0.147
1982 (W)	0.345	0.346	0.311	0.285	0.115	0.117
1983 (W)	0.388	0.702	0.703	0.703	0.076	0.076
1984 (W)	0.120	0.121	0.120	0.121	0.110	0.110
1985 (D)	0.126	0.126	0.129	0.115	0.110	0.113
1986 (W)	0.198	0.194	0.175	0.140	0.116	0.112
1987 (D)	0.140	0.138	0.128	0.116	0.111	0.109
1988 (C)	0.124	0.119	0.117	0.103	0.098	0.099
1989 (D)	0.127	0.126	0.126	0.116	0.125	0.123
1990 (C)	0.114	0.112	0.112	0.112	0.112	0.108
1991 (C)	0.117	0.115	0.116	0.117	0.121	0.122
Average	0.168	0.185	0.181	0.171	0.112	0.111



Box and whisker plot shows salvage distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage salvage.

Figure 5.B.6-14. Mokelumne River-Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

Table 5.B.6-129. Difference in Estimated Percentage of Mokelumne River-Origin Fall-Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

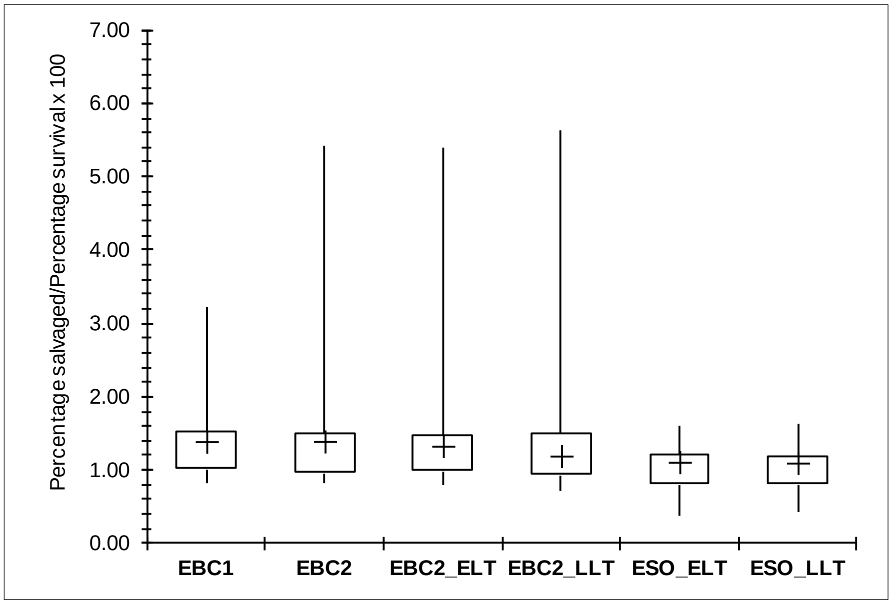
Water-Year (Type)	ESO_ELT vs. EBC1	ESO_LLT vs. EBC1	ESO _ELT vs. EBC2	ESO _LLT vs. EBC2	ESO _ELT vs. EBC2_ELT	ESO _LLT vs. EBC2_LLT
1976 (C)	-0.006 (-5%)	-0.006 (-6%)	-0.006 (-5%)	-0.006 (-5%)	-0.008 (-6%)	-0.007 (-6%)
1977 (C)	-0.004 (-4%)	-0.007 (-7%)	-0.006 (-6%)	-0.009 (-8%)	-0.008 (-7%)	0.004 (5%)
1978 (AN)	-0.104 (-49%)	-0.105 (-50%)	-0.097 (-47%)	-0.098 (-48%)	-0.114 (-52%)	-0.096 (-48%)
1979 (BN)	-0.032 (-21%)	-0.037 (-24%)	-0.021 (-15%)	-0.025 (-18%)	-0.016 (-12%)	-0.012 (-10%)
1980 (AN)	-0.049 (-30%)	-0.050 (-30%)	-0.048 (-29%)	-0.049 (-30%)	-0.044 (-27%)	-0.035 (-23%)
1981 (D)	0.015 (11%)	0.015 (11%)	0.016 (12%)	0.016 (12%)	0.025 (20%)	0.026 (21%)
1982 (W)	-0.230 (-67%)	-0.228 (-66%)	-0.231 (-67%)	-0.229 (-66%)	-0.196 (-63%)	-0.168 (-59%)
1983 (W)	-0.312 (-80%)	-0.312 (-80%)	-0.627 (-89%)	-0.626 (-89%)	-0.627 (-89%)	-0.626 (-89%)
1984 (W)	-0.010 (-9%)	-0.011 (-9%)	-0.011 (-9%)	-0.011 (-9%)	-0.010 (-8%)	-0.011 (-9%)
1985 (D)	-0.016 (-13%)	-0.013 (-11%)	-0.016 (-13%)	-0.014 (-11%)	-0.019 (-15%)	-0.002 (-2%)
1986 (W)	-0.082 (-41%)	-0.086 (-43%)	-0.078 (-40%)	-0.083 (-42%)	-0.059 (-34%)	-0.029 (-20%)
1987 (D)	-0.029 (-21%)	-0.031 (-22%)	-0.027 (-19%)	-0.028 (-21%)	-0.017 (-13%)	-0.007 (-6%)
1988 (C)	-0.026 (-21%)	-0.025 (-20%)	-0.021 (-17%)	-0.020 (-17%)	-0.019 (-16%)	-0.004 (-4%)
1989 (D)	-0.002 (-2%)	-0.004 (-4%)	-0.001 (-1%)	-0.003 (-2%)	-0.001 (-1%)	0.006 (5%)
1990 (C)	-0.002 (-2%)	-0.006 (-5%)	0.000 (0%)	-0.003 (-3%)	0.000 (0%)	-0.003 (-3%)
1991 (C)	0.004 (3%)	0.005 (4%)	0.006 (5%)	0.007 (6%)	0.005 (5%)	0.006 (5%)
Average	-0.055 (-33%)	-0.056 (-34%)	-0.073 (-39%)	-0.074 (-40%)	-0.069 (-38%)	-0.060 (-35%)
Median	-0.02 (-16%)	-0.02 (-15%)	-0.02 (-14%)	-0.02 (-13%)	-0.02 (-13%)	-0.01 (-6%)
Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Smolt Salvage as a Percentage of Through-Delta Survival

Smolt salvage percentage of Mokelumne River-origin fall-run Chinook salmon expressed as a percentage of total through-Delta survival percentage averaged 1.11–1.16 for EBC scenarios and 0.73 for ESO scenarios (Table 5.B.6-130, Figure 5.B.6-15). Percentage salvage/survival ranged from ~0.3% (ESO scenarios in 1983) to almost 4% (EBC scenarios in 1983). Percentage salvage/survival under ESO scenarios averaged 0.39–0.43% (35–37% in relative terms) less than percentage survival under EBC scenarios (Table 5.B.6-131), although as noted above for the salvage data alone the results were somewhat skewed. Comparison of medians showed there to be a smaller difference: 0.07–0.14% less (7–15% in relative terms) under ESO scenarios.

Table 5.B.6-130. Estimated Mokelumne River-Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.98	0.97	0.91	0.88	0.87	0.82
1977 (C)	0.56	0.57	0.58	0.49	0.53	0.51
1978 (AN)	1.89	1.84	2.17	2.03	1.00	1.00
1979 (BN)	0.81	0.76	0.74	0.70	0.66	0.64
1980 (AN)	0.74	0.74	0.74	0.71	0.53	0.53
1981 (D)	0.63	0.62	0.57	0.57	0.74	0.72
1982 (W)	2.10	2.11	1.99	2.07	0.76	0.86
1983 (W)	1.79	3.65	3.64	3.80	0.26	0.30
1984 (W)	0.97	0.98	0.99	1.01	0.91	0.92
1985 (D)	0.90	0.90	0.94	0.81	0.79	0.77
1986 (W)	1.04	1.03	0.93	0.74	0.58	0.56
1987 (D)	1.12	1.10	1.00	0.87	0.86	0.82
1988 (C)	1.03	0.98	0.96	0.83	0.79	0.80
1989 (D)	0.60	0.59	0.58	0.53	0.58	0.57
1990 (C)	0.83	0.81	0.81	0.82	0.83	0.81
1991 (C)	0.96	0.94	0.95	0.97	1.01	1.03
Average	1.06	1.16	1.16	1.11	0.73	0.73



Box and whisker plot shows distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-15. Mokelumne River-Origin Fall-Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-131. Difference in Estimated Mokelumne River-Origin Fall-Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO _LLT vs. EBC1	ESO _ELT vs. EBC2	ESO _LLT vs. EBC2	ESO _ELT vs. EBC2_ELT	ESO _LLT vs. EBC2_LLT
1976 (C)	-0.11 (-11%)	-0.16 (-17%)	-0.10 (-10%)	-0.16 (-16%)	-0.03 (-4%)	-0.06 (-7%)
1977 (C)	-0.03 (-5%)	-0.05 (-8%)	-0.04 (-7%)	-0.06 (-10%)	-0.05 (-8%)	0.03 (6%)
1978 (AN)	-0.88 (-47%)	-0.89 (-47%)	-0.84 (-46%)	-0.84 (-46%)	-1.17 (-54%)	-1.03 (-51%)
1979 (BN)	-0.16 (-20%)	-0.18 (-22%)	-0.11 (-14%)	-0.12 (-16%)	-0.09 (-12%)	-0.06 (-9%)
1980 (AN)	-0.21 (-29%)	-0.22 (-29%)	-0.21 (-28%)	-0.21 (-29%)	-0.21 (-29%)	-0.18 (-26%)
1981 (D)	0.11 (18%)	0.09 (15%)	0.12 (19%)	0.10 (15%)	0.17 (29%)	0.15 (27%)
1982 (W)	-1.34 (-64%)	-1.24 (-59%)	-1.36 (-64%)	-1.25 (-59%)	-1.23 (-62%)	-1.21 (-58%)
1983 (W)	-1.53 (-85%)	-1.49 (-83%)	-3.39 (-93%)	-3.35 (-92%)	-3.38 (-93%)	-3.50 (-92%)
1984 (W)	-0.06 (-6%)	-0.04 (-5%)	-0.06 (-6%)	-0.05 (-5%)	-0.07 (-7%)	-0.09 (-9%)
1985 (D)	-0.11 (-12%)	-0.12 (-14%)	-0.11 (-12%)	-0.12 (-14%)	-0.15 (-16%)	-0.04 (-4%)
1986 (W)	-0.46 (-44%)	-0.48 (-46%)	-0.45 (-44%)	-0.47 (-45%)	-0.36 (-38%)	-0.18 (-24%)
1987 (D)	-0.26 (-23%)	-0.30 (-27%)	-0.24 (-22%)	-0.28 (-26%)	-0.14 (-14%)	-0.05 (-6%)
1988 (C)	-0.24 (-23%)	-0.23 (-22%)	-0.19 (-19%)	-0.18 (-18%)	-0.17 (-17%)	-0.03 (-4%)
1989 (D)	-0.01 (-2%)	-0.03 (-5%)	0.00 (-1%)	-0.02 (-4%)	0.00 (1%)	0.04 (7%)
1990 (C)	0.01 (1%)	-0.01 (-2%)	0.03 (3%)	0.01 (1%)	0.02 (2%)	-0.01 (-1%)
1991 (C)	0.05 (5%)	0.07 (7%)	0.06 (7%)	0.08 (9%)	0.05 (6%)	0.06 (6%)
Average	-0.33 (-31%)	-0.33 (-31%)	-0.43 (-37%)	-0.43 (-37%)	-0.43 (-37%)	-0.39 (-35%)
Median	-0.13 (-14%)	-0.17 (-18%)	-0.11 (-11%)	-0.14 (-15%)	-0.12 (-12%)	-0.06 (-7%)

Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

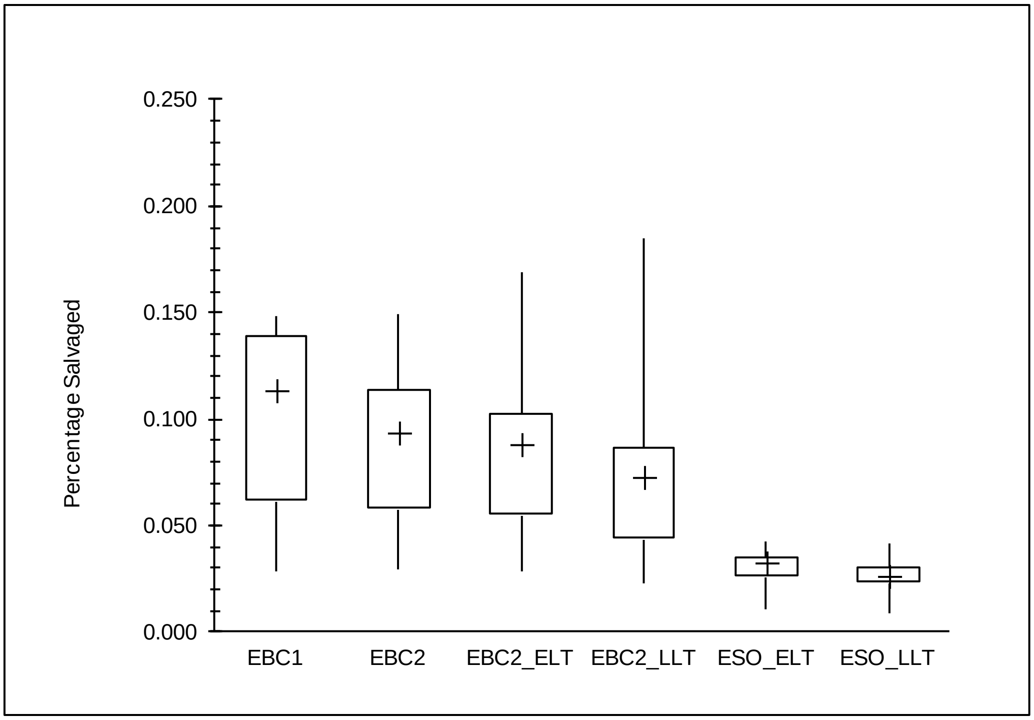
Late Fall–Run Chinook Salmon

Percentage of Smolts Salvaged

The estimated percentage of late fall–run Chinook salmon smolts salvaged at the SWP/CVP south Delta export facilities averaged around 0.07–0.09% for EBC scenarios, and ~0.03% for ESO scenarios (Table 5.B.6-132). Percentages in individual years ranged from 0.01 (ESO scenarios in 1984) to around 0.15-0.19 (EBC scenarios in 1983) (Figure 5.B.6-16). The percentage salvage was 0.05–0.06% less on average under ESO scenarios than EBC scenarios, which corresponded to a relative difference of 63–74% (Table 5.B.6-133).

Table 5.B.6-132. Estimated Percentage of Late Fall–Run Chinook Salmon Smolts Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.149	0.090	0.084	0.071	0.040	0.033
1977 (C)	0.045	0.033	0.029	0.036	0.027	0.017
1978 (AN)	0.070	0.075	0.073	0.072	0.041	0.025
1979 (BN)	0.140	0.112	0.100	0.093	0.042	0.024
1980 (AN)	0.138	0.131	0.102	0.085	0.033	0.028
1981 (D)	0.118	0.097	0.095	0.074	0.029	0.025
1982 (W)	0.114	0.117	0.111	0.095	0.033	0.024
1983 (W)	0.102	0.149	0.169	0.185	0.011	0.029
1984 (W)	0.114	0.112	0.105	0.084	0.011	0.009
1985 (D)	0.146	0.125	0.122	0.092	0.035	0.033
1986 (W)	0.139	0.113	0.093	0.074	0.031	0.028
1987 (D)	0.143	0.063	0.056	0.054	0.038	0.033
1988 (C)	0.050	0.038	0.038	0.032	0.027	0.024
1989 (D)	0.056	0.059	0.054	0.048	0.035	0.029
1990 (C)	0.065	0.057	0.064	0.037	0.033	0.041
1991 (C)	0.029	0.029	0.031	0.023	0.025	0.014
Average	0.101	0.088	0.083	0.072	0.031	0.026



Box and whisker plot shows salvage distribution across all modeled years. Median is marked with "+," upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage salvage.

Figure 5.B.6-16. Late Fall–Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities, Based on Delta Passage Model Results

Table 5.B.6-133. Difference in Estimated Percentage of Late Fall–Run Chinook Salmon Smolts Salvaged at the SWP/CVP South Delta Export Facilities from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO _LLT vs. EBC1	ESO _ELT vs. EBC2	ESO _LLT vs. EBC2	ESO _ELT vs. EBC2_ELT	ESO _LLT vs. EBC2_LLT
1976 (C)	-0.109 (-73%)	-0.116 (-78%)	-0.051 (-56%)	-0.058 (-64%)	-0.044 (-53%)	-0.038 (-54%)
1977 (C)	-0.019 (-42%)	-0.028 (-62%)	-0.006 (-19%)	-0.016 (-48%)	-0.002 (-8%)	-0.019 (-52%)
1978 (AN)	-0.030 (-42%)	-0.046 (-65%)	-0.035 (-46%)	-0.051 (-67%)	-0.033 (-45%)	-0.047 (-66%)
1979 (BN)	-0.098 (-70%)	-0.115 (-83%)	-0.070 (-62%)	-0.088 (-78%)	-0.058 (-58%)	-0.069 (-74%)
1980 (AN)	-0.106 (-76%)	-0.111 (-80%)	-0.099 (-75%)	-0.104 (-79%)	-0.069 (-68%)	-0.057 (-67%)
1981 (D)	-0.088 (-75%)	-0.092 (-78%)	-0.068 (-70%)	-0.072 (-74%)	-0.066 (-69%)	-0.049 (-66%)
1982 (W)	-0.081 (-71%)	-0.090 (-79%)	-0.085 (-72%)	-0.094 (-80%)	-0.078 (-70%)	-0.071 (-75%)
1983 (W)	-0.092 (-90%)	-0.073 (-72%)	-0.139 (-93%)	-0.120 (-81%)	-0.159 (-94%)	-0.156 (-84%)
1984 (W)	-0.102 (-90%)	-0.104 (-92%)	-0.100 (-90%)	-0.102 (-92%)	-0.093 (-89%)	-0.075 (-89%)
1985 (D)	-0.111 (-76%)	-0.112 (-77%)	-0.090 (-72%)	-0.092 (-73%)	-0.088 (-72%)	-0.059 (-64%)
1986 (W)	-0.107 (-77%)	-0.111 (-80%)	-0.082 (-72%)	-0.085 (-75%)	-0.061 (-66%)	-0.046 (-62%)
1987 (D)	-0.105 (-73%)	-0.110 (-77%)	-0.025 (-39%)	-0.030 (-48%)	-0.018 (-32%)	-0.022 (-40%)
1988 (C)	-0.023 (-47%)	-0.026 (-53%)	-0.011 (-29%)	-0.014 (-37%)	-0.012 (-30%)	-0.009 (-27%)
1989 (D)	-0.022 (-38%)	-0.027 (-48%)	-0.024 (-41%)	-0.030 (-50%)	-0.020 (-36%)	-0.018 (-39%)
1990 (C)	-0.032 (-49%)	-0.023 (-36%)	-0.024 (-42%)	-0.016 (-27%)	-0.031 (-48%)	0.005 (13%)
1991 (C)	-0.004 (-14%)	-0.015 (-51%)	-0.004 (-15%)	-0.015 (-52%)	-0.006 (-20%)	-0.009 (-40%)
Average	-0.070 (-70%)	-0.075 (-74%)	-0.057 (-65%)	-0.062 (-70%)	-0.052 (-63%)	-0.046 (-64%)

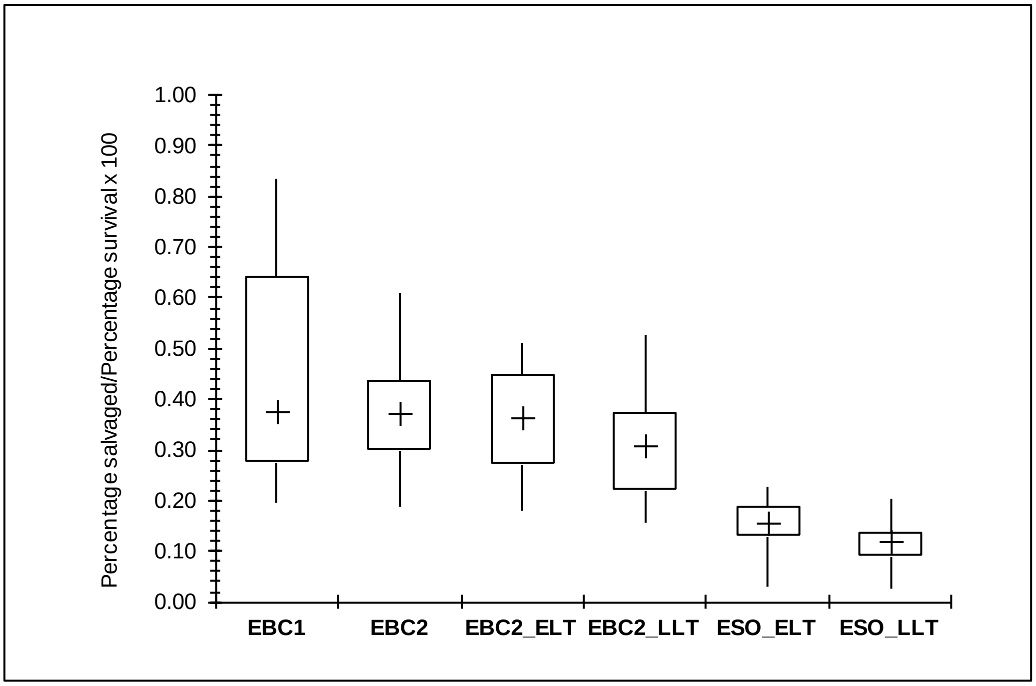
Note: Negative values indicate lower salvage under evaluated starting operations scenarios (ESO_ELT and ESO_LLT) than under existing conditions (EBC1 and EBC2) and future conditions without the BDCP (EBC2_ELT and EBC2_LLT).

Smolt Salvage as a Percentage of Through-Delta Survival

Smolt salvage percentage of late fall–run Chinook salmon expressed as a percentage of total through-Delta survival percentage averaged 0.28–0.34% for EBC scenarios and 0.10–0.13% for ESO scenarios (Table 5.B.6-134; Figure 5.B.6-17). Percentage salvage/survival ranged from 0.02% under ESO scenarios in 1984 to over 0.43–0.53% under EBC scenarios in 1979. Average differences between ESO scenarios and EBC scenarios ranged from 0.17% (62% relative difference) lower under ESO_LLT compared to EBC2_LLT, to 0.24% (69% relative difference) lower under ESO_LLT compared to EBC2 (Table 5.B.6-135).

Table 5.B.6-134. Estimated Late Fall–Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage, from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
1976 (C)	0.75	0.36	0.36	0.31	0.21	0.16
1977 (C)	0.28	0.21	0.18	0.21	0.16	0.09
1978 (AN)	0.37	0.40	0.39	0.38	0.21	0.12
1979 (BN)	0.83	0.57	0.51	0.46	0.23	0.13
1980 (AN)	0.62	0.61	0.48	0.39	0.16	0.11
1981 (D)	0.59	0.47	0.44	0.35	0.14	0.12
1982 (W)	0.37	0.38	0.37	0.31	0.11	0.08
1983 (W)	0.26	0.39	0.46	0.53	0.03	0.09
1984 (W)	0.28	0.28	0.27	0.22	0.03	0.03
1985 (D)	0.53	0.42	0.41	0.32	0.13	0.13
1986 (W)	0.69	0.56	0.46	0.37	0.15	0.13
1987 (D)	0.83	0.31	0.28	0.26	0.19	0.15
1988 (C)	0.23	0.19	0.19	0.16	0.13	0.11
1989 (D)	0.33	0.34	0.31	0.27	0.19	0.16
1990 (C)	0.38	0.33	0.35	0.20	0.17	0.20
1991 (C)	0.20	0.19	0.21	0.16	0.15	0.08
Average	0.47	0.38	0.36	0.31	0.15	0.12



Box and whisker plot shows distribution across all modeled years. Median is marked with “+,” upper and lower boundaries of the box indicate 75th and 25th percentiles, and upper and lower whiskers indicate maximum and minimum percentage.

Figure 5.B.6-17. Late Fall–Run Chinook Salmon Percentage of Smolts Salvaged at the South Delta Export Facilities as a Percentage of Total Through-Delta Survival, Based on Delta Passage Model Results

Table 5.B.6-135. Difference in Estimated Late Fall–Run Chinook Salmon Smolt Percentage Entering the Delta Salvaged at the SWP/CVP South Delta Export Facilities as a Percentage of the Total Through-Delta Survival Percentage from Delta Passage Model Runs of DSM2-Simulated Water Years 1976–1991 for the Six Model Scenarios

Water-Year (Type)	ESO_ELT vs. EBC1	ESO _LLT vs. EBC1	ESO _ELT vs. EBC2	ESO _LLT vs. EBC2	ESO _ELT vs. EBC2_ELT	ESO _LLT vs. EBC2_LLT
1976 (C)	-0.54 (-72%)	-0.59 (-78%)	-0.15 (-41%)	-0.20 (-55%)	-0.15 (-41%)	-0.14 (-47%)
1977 (C)	-0.12 (-44%)	-0.19 (-67%)	-0.06 (-26%)	-0.12 (-56%)	-0.02 (-11%)	-0.12 (-57%)
1978 (AN)	-0.16 (-42%)	-0.24 (-67%)	-0.19 (-47%)	-0.28 (-69%)	-0.18 (-46%)	-0.25 (-67%)
1979 (BN)	-0.60 (-72%)	-0.70 (-85%)	-0.35 (-60%)	-0.45 (-78%)	-0.28 (-55%)	-0.34 (-72%)
1980 (AN)	-0.46 (-74%)	-0.51 (-82%)	-0.45 (-74%)	-0.50 (-81%)	-0.32 (-66%)	-0.28 (-71%)
1981 (D)	-0.45 (-76%)	-0.47 (-80%)	-0.32 (-69%)	-0.35 (-75%)	-0.30 (-68%)	-0.23 (-66%)
1982 (W)	-0.27 (-72%)	-0.30 (-80%)	-0.28 (-72%)	-0.31 (-80%)	-0.26 (-71%)	-0.23 (-75%)
1983 (W)	-0.22 (-87%)	-0.16 (-64%)	-0.35 (-91%)	-0.29 (-76%)	-0.42 (-93%)	-0.44 (-83%)
1984 (W)	-0.25 (-89%)	-0.25 (-91%)	-0.24 (-88%)	-0.25 (-91%)	-0.24 (-88%)	-0.20 (-89%)
1985 (D)	-0.39 (-74%)	-0.40 (-75%)	-0.29 (-68%)	-0.30 (-70%)	-0.28 (-67%)	-0.19 (-60%)
1986 (W)	-0.54 (-78%)	-0.56 (-81%)	-0.41 (-73%)	-0.43 (-76%)	-0.31 (-67%)	-0.24 (-65%)
1987 (D)	-0.65 (-77%)	-0.69 (-82%)	-0.13 (-40%)	-0.16 (-52%)	-0.09 (-32%)	-0.11 (-42%)
1988 (C)	-0.10 (-44%)	-0.13 (-53%)	-0.06 (-31%)	-0.08 (-42%)	-0.06 (-32%)	-0.05 (-32%)
1989 (D)	-0.13 (-41%)	-0.17 (-51%)	-0.15 (-44%)	-0.18 (-53%)	-0.12 (-39%)	-0.11 (-41%)
1990 (C)	-0.21 (-55%)	-0.18 (-47%)	-0.16 (-49%)	-0.13 (-39%)	-0.18 (-51%)	0.00 (2%)
1991 (C)	-0.04 (-23%)	-0.12 (-60%)	-0.04 (-21%)	-0.11 (-59%)	-0.06 (-28%)	-0.08 (-49%)
Average	-0.32 (-68%)	-0.35 (-75%)	-0.23 (-60%)	-0.26 (-69%)	-0.21 (-58%)	-0.19 (-61%)

Note: Negative values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

5.B.6.1.5 Delta Smelt

5.B.6.1.5.1 Larva/Juvenile (Proportional Entrainment Loss Regression)

The average annual proportions of larval/juvenile delta smelt population lost at the south Delta export facilities, as estimated from the regression equation described in Section 5.B.5.5.1.1, *Larvae/Juveniles*. that was based on CALSIM estimates of average March–June OMR flows and X2, are given in Figure 5.B.6-18 for each of the study scenarios for all years combined and for each water-year type. The proportion of larvae/juveniles lost under EBC2 was estimated to be essentially the same for EBC in the near-term with (EBC2) and without (EBC1) Fall X2 requirements, and ranges from around 0.04 in wet years to nearly 0.25 in dry years. The average annual proportion lost to entrainment under EBC2 increased under the model simulations of future conditions (EBC2_ELT and EBC2_LLT), most notably in wet, above-normal, and below-normal years. This was primarily a result of X2 moving upstream with sea level rise, resulting in more delta smelt larvae/juveniles being susceptible to entrainment by the south Delta export facilities.

In comparison with EBC2, the evaluated starting operations scenarios showed variable differences. Across all water-year types combined, average proportional entrainment was similar or marginally higher under ESO scenarios than under EBC scenarios (Table 5.B.6-136), at 0.13–0.14 (Figure 5.B.6-18). Differences in average entrainment loss between ESO_ELT and EBC scenarios were greatest in below-normal and dry years, for which entrainment loss under ESO_ELT was around 0.01–0.02 (7–9%) higher than under the EBC2 scenario. In other water-year types, the differences in average entrainment between ESO_ELT and EBC2 generally were 0.01 (a relative difference of 10%) or less. Average entrainment under ESO_LLT was greater than under EBC2, ranging from less than 0.01 (9%) greater above-normal years to 0.03 (21%) greater in below-normal years. Accounting for climate change and comparing ESO scenarios with EBC scenarios during the same future time periods, average entrainment loss under ESO_ELT and ESO_LLT was very similar to average entrainment loss to under EBC2_ELT and EBC2_LLT when averaged over all water years (Table 5.B.6-136). This indicates that much of the difference between ESO scenarios and EBC2 was driven by X2 being further upstream as a result of climate change, as noted above in the discussion of the differences between EBC2, EBC2_ELT, and EBC2_LLT. Differences in average entrainment loss for future scenarios ranged from around 0.01–0.02 (16–24%) lower entrainment under ESO_ELT/ESO_LLT compared to EBC2_ELT/EBC2_LLT in wet and above-normal years, to similar or up to 0.01 (1–4%) greater entrainment under the ESO scenarios in the remaining water years.

Proportional entrainment loss of larval/juvenile delta smelt during the simulated 1922–2003 water years was estimated to be 0 in around 10–12% of years under EBC scenarios and 13–16% of years under ESO (Figure 5.B.6-19). Median entrainment was 0.12–0.15 for EBC scenarios and was also 0.12–0.15 for ESO scenarios. Maximum proportional entrainment loss ranged from around 0.28 (EBC2_ELT and ESO_ELT) to 0.30 (EBC2).

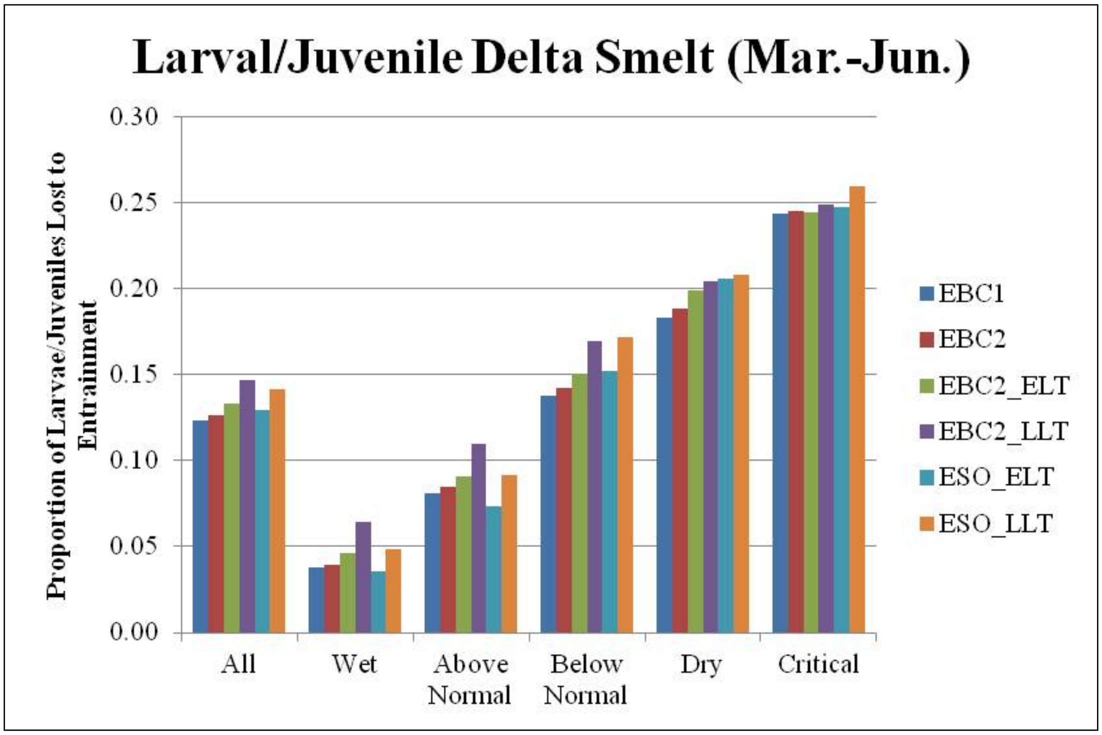


Figure 5.B.6-18. Average Annual Estimated Proportion of the Larval/Juvenile Delta Smelt Population Lost to Entrainment at the SWP/CVP South Delta Export Facilities by Water-Year Type and All Years Combined for the Study Scenarios, Based on the Proportional Entrainment Regression

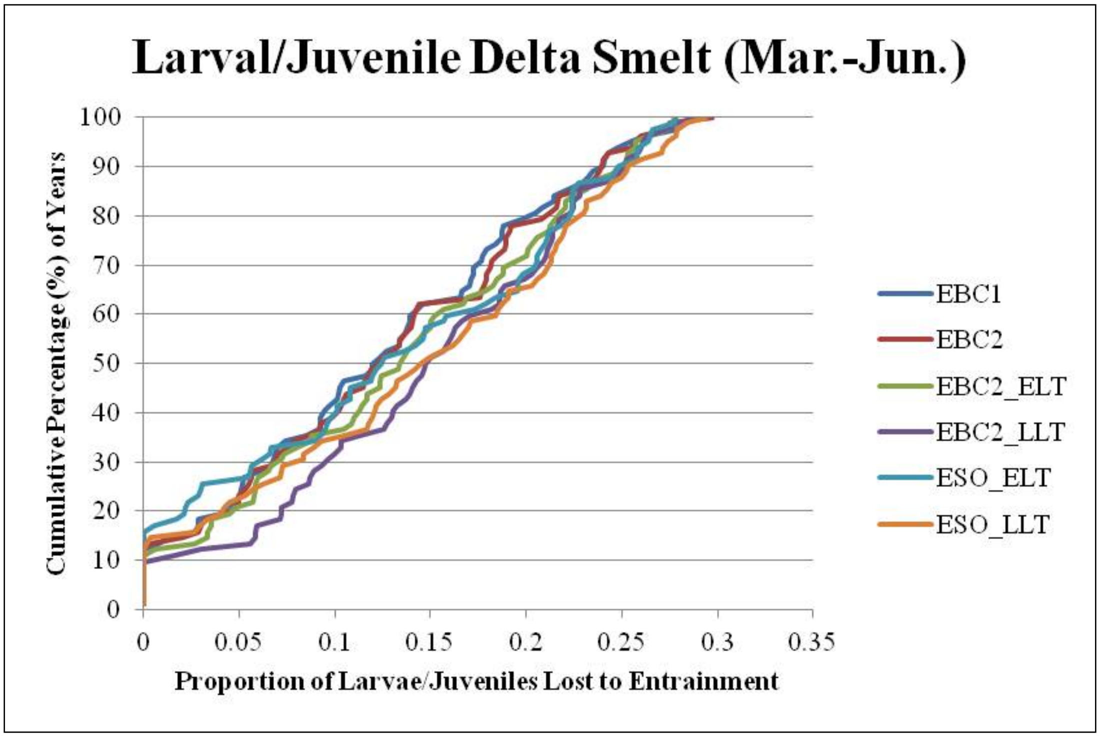


Figure 5.B.6-19. Estimated Annual Proportional Entrainment Loss of Larval/Juvenile Delta Smelt at SWP/CVP South Delta Export Facilities by Cumulative Percentage of Years for the Study Scenarios, Based on the Proportional Entrainment Regression

Table 5.B.6-136. Difference in Average Annual Proportional Entrainment Loss of Larval/Juvenile Delta Smelt at SWP/CVP South Delta Export Facilities by Water-Year Type for the Existing Biological Condition and Evaluated Starting Operations, Based on the Proportional Entrainment Regression

Water Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
All	0.006 (5%)	0.018 (15%)	0.003 (2%)	0.015 (12%)	-0.004 (-3%)	-0.005 (-3%)
Wet	-0.002 (-6%)	0.011 (28%)	-0.004 (-9%)	0.009 (23%)	-0.011 (-23%)	-0.016 (-24%)
Above Normal	-0.008 (-10%)	0.011 (14%)	-0.012 (-14%)	0.007 (9%)	-0.017 (-19%)	-0.018 (-16%)
Below Normal	0.014 (10%)	0.034 (25%)	0.010 (7%)	0.030 (21%)	0.001 (1%)	0.003 (1%)
Dry	0.022 (12%)	0.024 (13%)	0.017 (9%)	0.020 (10%)	0.006 (3%)	0.004 (2%)
Critical	0.004 (1%)	0.015 (6%)	0.003 (1%)	0.014 (6%)	0.003 (1%)	0.011 (4%)
Note: Negative values indicated lower entrainment loss under the evaluated starting operations than under existing biological conditions.						

5.B.6.1.5.2 Adult (Proportional Entrainment Loss Regression)

Proportional entrainment loss of adult delta smelt in December–March calculated as a function of OMR flows using the proportional entrainment regression described in Section 5.B.5.5.1.2, *Adults*, was estimated to be appreciably lower under the evaluated starting operations scenarios than under existing biological conditions (Figure 5.B.6-20, Figure 5.B.6-21, and Table 5.B.6-137). Averaged across all water-year types, proportional entrainment loss averaged between 0.07 and 0.08 for EBC scenarios and just over 0.06 for ESO scenarios, i.e., around 0.02 (20%) lower under ESO scenarios.

The relative differences in proportional entrainment loss between scenarios were greatest in wet years, in which ESO scenarios averaged losses of around 0.04; these losses were around 0.03 (around 40%) lower than the average losses under EBC scenarios. The large differences reflected the modeled ability to export water from the proposed north Delta diversion under ESO scenarios during wetter years, leading to greater OMR flows because of reduced south Delta exports. In contrast, there would be a relatively greater reliance on the south Delta export facilities under ESO scenarios as water-year type becomes drier in order to meet flow bypass requirements at the proposed north Delta diversion. Thus, in critical water years, differences in average proportional entrainment between EBC and ESO scenarios were close to zero (Table 5.B.6-137).

Proportional entrainment loss of adult delta smelt for ESO scenarios was estimated to be below 0.05 in around 21–22% of years and below 0.10 in all years (Figure 5.B.6-21). In contrast, EBC scenarios had proportional entrainment loss of adult delta smelt below 0.05 in 5–6% of years, whereas proportional entrainment loss below 0.10 occurred in all years. Median proportional entrainment was around 0.08–0.082 for EBC scenarios and around 0.067 for ESO scenarios.

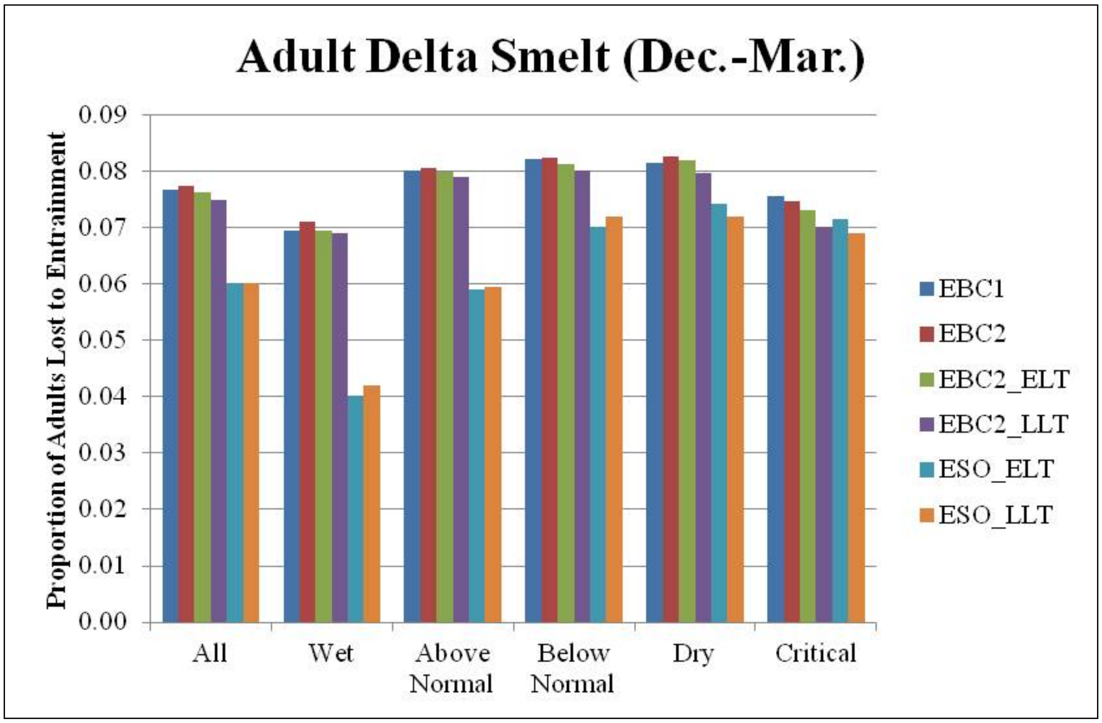


Figure 5.B.6-20. Average Annual Estimated Proportion of the Adult Delta Smelt Population Lost to Entrainment at the SWP/CVP South Delta Export Facilities by Water-Year Type and All Years Combined for the Study Scenarios, Based on the Proportional Entrainment Regression

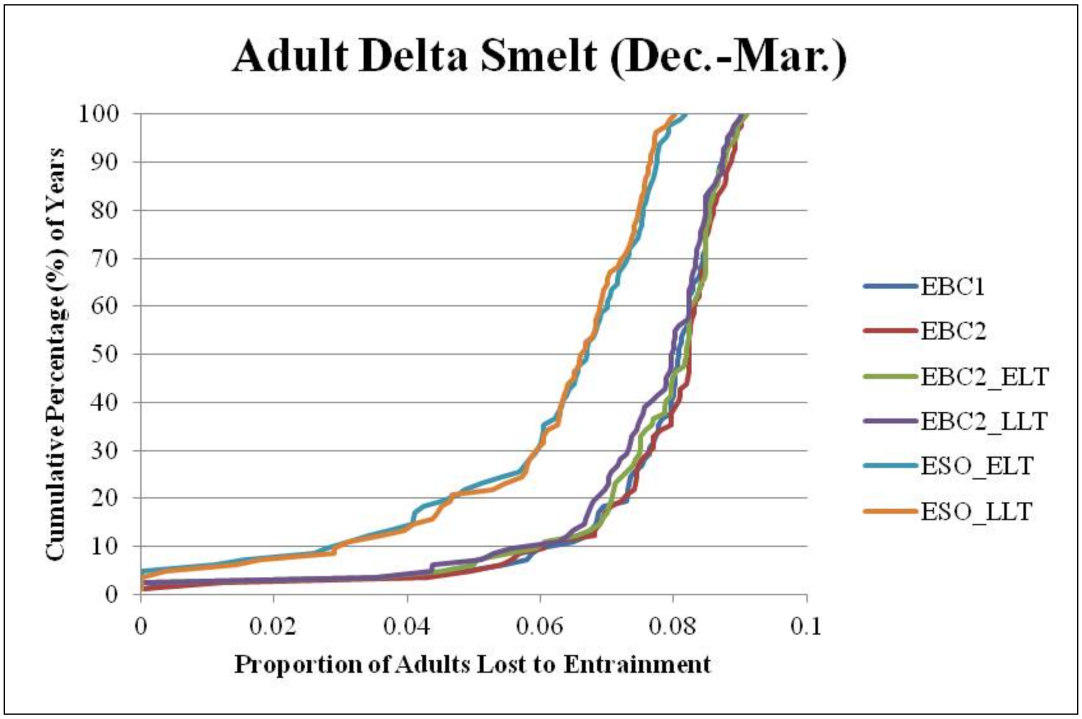


Figure 5.B.6-21. Estimated Annual Proportional Entrainment Loss of Adult Delta Smelt at SWP/CVP South Delta Export Facilities by Cumulative Percentage of Years for the Study Scenarios, Based on the Proportional Entrainment Regression

Table 5.B.6-137. Difference in Average Annual Proportional Entrainment Loss of Adult Delta Smelt at SWP/CVP South Delta Export Facilities by Water-Year Type for the Existing Biological Condition and Evaluated Starting Operations, Based on the Proportional Entrainment Regression

Water Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
All	-0.017 (-22%)	-0.017 (-22%)	-0.017 (-22%)	-0.017 (-22%)	-0.016 (-21%)	-0.015 (-20%)
Wet	-0.029 (-42%)	-0.028 (-40%)	-0.031 (-43%)	-0.029 (-41%)	-0.029 (-42%)	-0.027 (-39%)
Above Normal	-0.021 (-26%)	-0.021 (-26%)	-0.022 (-27%)	-0.021 (-26%)	-0.021 (-26%)	-0.020 (-25%)
Below Normal	-0.012 (-15%)	-0.010 (-13%)	-0.012 (-15%)	-0.011 (-13%)	-0.011 (-14%)	-0.008 (-10%)
Dry	-0.007 (-9%)	-0.009 (-11%)	-0.008 (-10%)	-0.010 (-13%)	-0.008 (-9%)	-0.008 (-10%)
Critical	-0.004 (-5%)	-0.006 (-9%)	-0.003 (-4%)	-0.006 (-8%)	-0.002 (-2%)	-0.001 (-2%)
Note: Negative values indicated lower entrainment loss under the evaluated starting operations than under existing biological conditions.						

5.B.6.1.5.3 Total Population (Larvae/Juveniles and Adults Combined)

Combination of the estimates of larval/juvenile and adult delta smelt proportional entrainment loss using Miller's (2011) equation (described in Section 5.B.5.5.1.3, *Total Population*) gave estimates of total delta smelt population loss for ESO scenarios that averaged 0.19–0.20 across all water years (Figure 5.B.6-22). These estimates were slightly lower (<0.01 to 0.02; 1–10%) than the estimates for EBC scenarios (Table 5.B.6-138). In wet years, average proportional entrainment loss under the ESO scenarios was appreciably lower (0.02–0.04; 18–32%) than average proportional entrainment under the EBC scenarios. The same general pattern was observed in above-normal years although with less difference (0.014–0.038; 8–22%) in entrainment loss between ESO and EBC scenarios. In the remaining water-year types, average proportional entrainment loss generally was similar or marginally greater (up to 0.02; 9%) under ESO scenarios than under EBC scenarios. As discussed for larval/juvenile and adult delta smelt, these patterns reflect the modeled greater use of the south Delta export facilities relative to the proposed north Delta diversion in drier years, when flow bypass requirements limit export pumping at the proposed north Delta diversion. There was also an apparent effect of climate change because differences between EBC2 and ESO scenarios in below-normal and dry years were lower when comparing within the same time periods (i.e., ELT and LLT), as opposed to comparing ESO scenarios with current EBC scenarios (i.e., EBC2).

Proportional entrainment loss estimates for the total delta smelt population under EBC2 scenarios were below 0.05 in only 3 years (<3%) of the 82-year simulation period and below 0.10 in less than 13% of years (Figure 5.B.6-23). In contrast, proportional losses under ESO scenarios were below 0.05 in around 10–15% of years and below 0.10 in around 23–27% of years. These differences again reflect the ability to have relatively low export pumping from the south Delta in wetter years under ESO scenarios compared with EBC scenarios. In the generally drier 50% of years, there is more reliance on the south Delta export facilities for ESO scenarios, which gives proportional entrainment estimates that are closer between ESO and EBC scenarios: for example, in less than 25% of years proportional entrainment was greater than around 0.27–0.30 under EBC scenarios and greater than 0.28–0.29 under ESO scenarios. Maximum estimated proportional entrainment loss was around 0.36–0.39 under EBC scenarios and 0.35–0.36 under ESO scenarios (Figure 5.B.6-23).

It is important to note that the modeling of delta smelt entrainment loss for larvae/juveniles, adults, and the total population solely reflects differences attributable to simulated differences in south Delta export pumping (which influences OMR flows) and X2 (which is a function of both south Delta and north Delta export pumping, as well as assumptions about sea level rise). Although appreciable proportions of the delta smelt population were estimated to be entrained under all scenarios (EBC and ESO), it is important to note that there is currently real-time monitoring and pumping adjustments through the interagency Smelt Working Group under Existing Biological Conditions, which would continue under *CM1 Water Facilities and Operation*. Thus it is likely that weekly adjustments to export pumping would be made in response to factors that are difficult to simulate, such as fish distribution, and which introduce further uncertainty in the results of the modeling. Nevertheless, the results serve as a useful indicator of the relative differences in potential entrainment because of differences in water export operations under EBC and ESO scenarios.

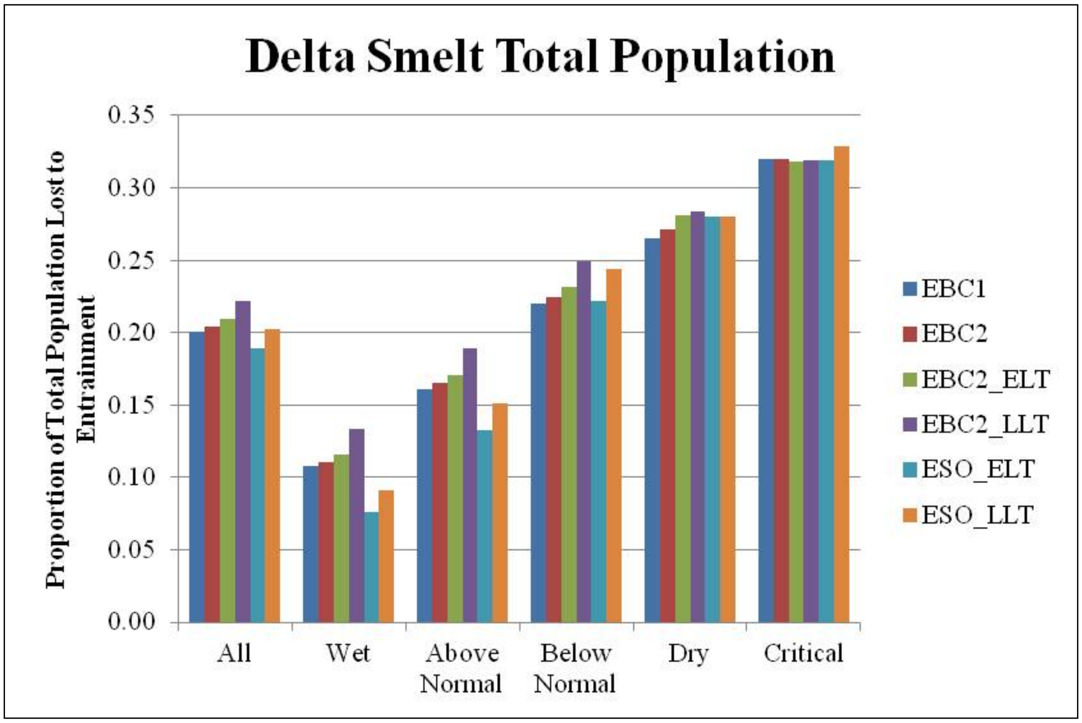


Figure 5.B.6-22. Average Annual Estimated Proportion of the Total Delta Smelt Population Lost to Entrainment at the SWP/CVP South Delta Export Facilities by Water-Year Type and All Years Combined for the Study Scenarios, Based on the Proportional Entrainment Regressions for Larvae/Juveniles and Adults

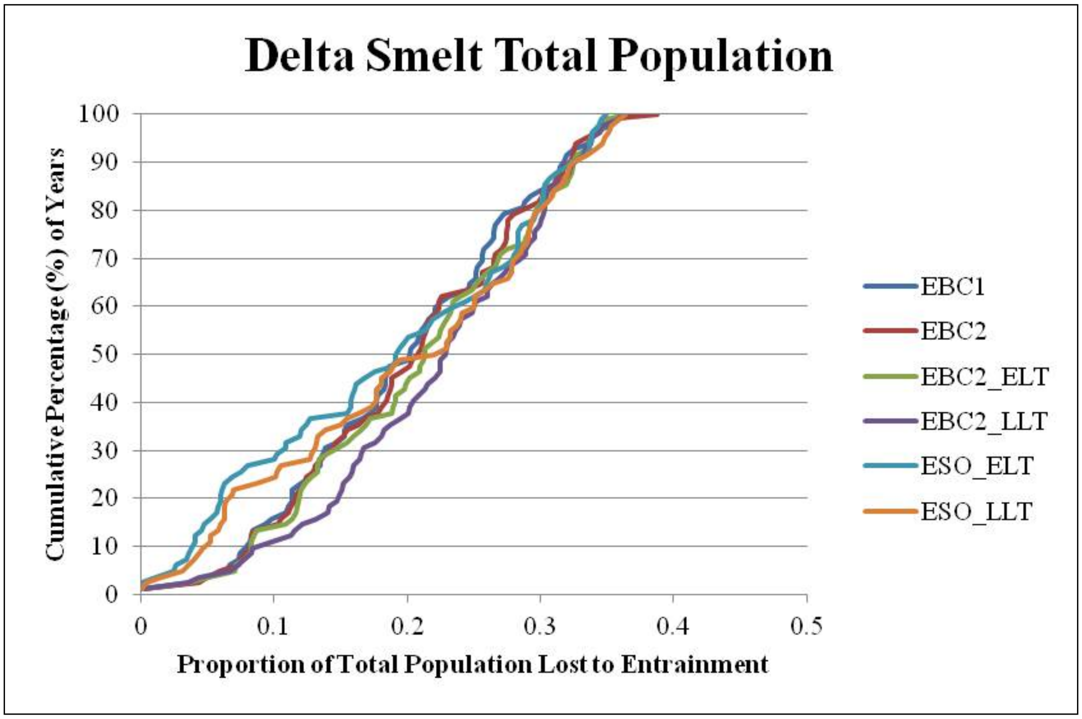


Figure 5.B.6-23. Estimated Annual Proportional Entrainment Loss of the Total Delta Smelt Population at SWP/CVP South Delta Export Facilities by Cumulative Percentage of Years for the Study Scenarios, Based on the Proportional Entrainment Regressions for Larvae/Juveniles and Adults

Table 5.B.6-138. Difference in Average Annual Proportional Entrainment Loss of the Total Delta Smelt Population at SWP/CVP South Delta Export Facilities by Water-Year Type for the Existing Biological Condition and Evaluated Starting Operations, Based on the Proportional Entrainment Regressions for Larvae/Juveniles and Adults

Water Year Type	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
All	-0.011 (-5%)	0.002 (1%)	-0.014 (-7%)	-0.002 (-1%)	-0.020 (-10%)	-0.019 (-9%)
Wet	-0.032 (-29%)	-0.017 (-16%)	-0.035 (-31%)	-0.020 (-18%)	-0.040 (-34%)	-0.043 (-32%)
Above Normal	-0.029 (-18%)	-0.010 (-6%)	-0.033 (-20%)	-0.014 (-8%)	-0.038 (-22%)	-0.038 (-20%)
Below Normal	0.002 (1%)	0.024 (11%)	-0.002 (-1%)	0.019 (9%)	-0.010 (-4%)	-0.006 (-2%)
Dry	0.015 (6%)	0.015 (6%)	0.009 (3%)	0.009 (3%)	-0.001 (0%)	-0.004 (-1%)
Critical	0.0 (0%)	0.009 (3%)	-0.001 (0%)	0.009 (3%)	0.001 (0%)	0.010 (3%)
Note: Negative values indicated lower entrainment loss under the evaluated starting operations than under existing biological conditions.						

5.B.6.1.6 Longfin Smelt

5.B.6.1.6.1 Larva

Particle Tracking Modeling

Based on the DSM2 PTM results using the wetter starting distribution, on average 0.9–1.1% of particles representing longfin smelt larvae were entrained at the south Delta export facilities after 30 days for the EBC scenarios, compared to average entrainment of 0.4–0.7% under ESO scenarios (Table 5.B.6-139). Of the 28 hydroperiods modeled in the analysis, ESO scenarios had lower entrainment than EBC scenarios in over half of comparisons and higher entrainment than ESO scenarios in 7–18% of comparisons, depending on scenarios compared (Table 5.B.6-140). There was no difference in entrainment between ESO and EBC scenarios for around one quarter of comparisons, generally because no entrainment had occurred under any scenario. On average, there was 0.2–0.6% (22–59% in relative terms) lower entrainment of particles under the ESO scenarios compared to the EBC scenarios. Relative differences between scenarios for the drier starting distribution were similar to those for the wetter starting distribution, and absolute estimates of particle loss at the south Delta export facilities were greater under the drier starting distribution because a greater proportion of particles was started at locations closer to the south Delta export facilities (Table 5.B.6-141 and Table 5.B.6-142).

The 60-day PTM results had a lower proportion of runs with no entrainment than the 30-day runs, reflecting the longer period for particles to become entrained. Entrainment averaged 1.4–1.8% under EBC scenarios and 1.0–1.4% for ESO scenarios for the wetter starting distribution (Table 5.B.6-143), for average differences of 0.16–0.84% (11–46% in relative terms) lower under EBC scenarios (Table 5.B.6-144). Entrainment under ESO scenarios was lower than under EBC scenarios in around two thirds of comparisons and higher in one quarter of comparisons. Similar patterns were observed for the 60-day runs under the drier starting distribution (Table 5.B.6-145 and Table 5.B.6-146), although, of course, the levels of entrainment were higher than for the 30-day results because the period of particle exposure to potential entrainment was longer.

Sensitivity analyses of the 30-day PTM runs that adapted the drier starting distribution to shift 2–15% of the particles to the south Delta gave patterns of results similar to the original 30-day starting distribution runs (Table 5.B.6-147 through Table 5.B.6-152). A greater proportion of particles in the south Delta led to greater entrainment for all scenarios under these runs, but as the proportion of particles starting in the south Delta was increased, so the ESO scenarios had relatively lower entrainment than the EBC scenarios.

Table 5.B.6-139. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	6.3	3.7	3.0	1.6	5.3	2.3
June 1940	6,166	1.6	1.6	1.7	1.5	0.9	1.0
June 1934	7,100	0.7	0.5	0.3	0.5	0.1	0.0
April 1929	8,019	0.2	0.2	0.2	0.0	0.1	0.2
May 1966	9,759	0.0	0.0	0.0	0.1	0.2	0.2
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.5	0.5	0.9	1.0	0.0	0.0
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	4.5	4.4	2.3	2.2	2.2	2.1
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	2.6	2.6	2.4	2.4	1.4	0.0
March 2001	22,272	0.9	1.0	1.0	0.9	0.8	0.8
June 1993	22,451	1.2	1.2	1.0	1.2	0.0	0.1
March 1942	23,456	0.7	0.8	0.6	0.7	0.0	0.0
January 1966	24,810	1.6	1.7	1.7	2.0	0.0	0.0
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.0	0.0	0.0	0.0
March 1993	34,327	1.2	1.3	1.0	1.0	0.0	0.0
December 2002	35,239	6.1	6.1	5.1	5.0	6.8	4.5
June 1952	37,199	0.2	0.2	0.3	0.9	0.0	0.0
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	1.3	1.3	1.2	1.1	0.0	0.0
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	2.0	1.9	1.5	1.1	1.1	0.7
February 1940	64,008	0.4	0.4	0.3	0.3	0.3	0.2
Average		1.2	1.1	0.9	0.9	0.7	0.4

Table 5.B.6-140. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.98 (-16%)	-4.00 (-63%)	1.64 (45%)	-1.37 (-37%)	2.27 (75%)	0.74 (47%)
June 1940	6,166	-0.70 (-44%)	-0.64 (-40%)	-0.74 (-45%)	-0.67 (-41%)	-0.77 (-46%)	-0.57 (-37%)
June 1934	7,100	-0.55 (-81%)	-0.65 (-95%)	-0.33 (-71%)	-0.43 (-92%)	-0.16 (-55%)	-0.50 (-93%)
April 1929	8,019	-0.10 (-40%)	-0.09 (-37%)	-0.06 (-30%)	-0.05 (-25%)	-0.03 (-19%)	0.14 (1180%)
May 1966	9,759	0.18 (14897%)	0.16 (13584%)	0.18 (44890%)	0.16 (40953%)	0.17 (1664%)	0.09 (136%)
February 1948	11,145	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (0%)
June 1978	12,346	-0.45 (-99%)	-0.42 (-92%)	-0.49 (-99%)	-0.46 (-92%)	-0.85 (-100%)	-0.93 (-96%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	-2.30 (-52%)	-2.39 (-53%)	-2.26 (-51%)	-2.35 (-53%)	-0.10 (-4%)	-0.15 (-7%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-1.14 (-44%)	-2.57 (-100%)	-1.13 (-44%)	-2.56 (-100%)	-1.02 (-42%)	-2.39 (-100%)
March 2001	22,272	-0.13 (-14%)	-0.10 (-11%)	-0.18 (-18%)	-0.14 (-15%)	-0.24 (-23%)	-0.10 (-11%)
June 1993	22,451	-1.23 (-99%)	-1.16 (-94%)	-1.16 (-99%)	-1.09 (-94%)	-0.99 (-99%)	-1.10 (-94%)
March 1942	23,456	-0.74 (-100%)	-0.74 (-100%)	-0.79 (-100%)	-0.79 (-100%)	-0.64 (-100%)	-0.73 (-100%)
January 1966	24,810	-1.65 (-100%)	-1.63 (-99%)	-1.68 (-100%)	-1.67 (-99%)	-1.73 (-100%)	-1.96 (-99%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
March 1993	34,327	-1.24 (-100%)	-1.23 (-100%)	-1.27 (-100%)	-1.27 (-100%)	-0.96 (-100%)	-0.98 (-100%)
December 2002	35,239	0.68 (11%)	-1.56 (-26%)	0.62 (10%)	-1.62 (-26%)	1.63 (32%)	-0.47 (-9%)
June 1952	37,199	-0.22 (-100%)	-0.22 (-100%)	-0.24 (-100%)	-0.24 (-100%)	-0.34 (-100%)	-0.89 (-100%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
January 1971	47,872	-1.28 (-98%)	-1.29 (-99%)	-1.28 (-98%)	-1.29 (-99%)	-1.18 (-98%)	-1.13 (-99%)
April 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1945	52,920	-0.85 (-43%)	-1.28 (-65%)	-0.81 (-42%)	-1.24 (-65%)	-0.36 (-24%)	-0.44 (-40%)
February 1940	64,008	-0.09 (-25%)	-0.16 (-45%)	-0.09 (-25%)	-0.16 (-45%)	-0.06 (-18%)	-0.12 (-37%)
Average		-0.47 (-40%)	-0.74 (-62%)	-0.37 (-34%)	-0.64 (-59%)	-0.20 (-22%)	-0.43 (-49%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-141. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	9.0	5.0	4.0	2.0	6.3	3.1
June 1940	6,166	1.9	2.0	2.0	1.8	1.0	1.1
June 1934	7,100	0.9	0.6	0.4	0.7	0.1	0.0
April 1929	8,019	0.3	0.2	0.2	0.0	0.2	0.2
May 1966	9,759	0.0	0.0	0.0	0.1	0.2	0.2
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.5	0.5	1.0	1.1	0.0	0.0
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	6.1	6.1	2.8	2.9	2.7	2.5
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	3.0	3.0	2.8	2.9	1.4	0.0
March 2001	22,272	1.0	1.0	1.1	1.0	0.8	0.8
June 1993	22,451	1.4	1.3	1.1	1.3	0.0	0.1
March 1942	23,456	0.7	0.8	0.6	0.7	0.0	0.0
January 1966	24,810	1.9	2.0	2.1	2.5	0.0	0.0
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.0	0.0	0.0	0.0
March 1993	34,327	1.2	1.3	0.9	0.9	0.0	0.0
December 2002	35,239	7.9	8.1	6.8	6.8	7.8	6.4
June 1952	37,199	0.2	0.2	0.3	0.9	0.0	0.0
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	1.3	1.3	1.1	1.1	0.0	0.0
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	2.4	2.2	1.7	1.2	1.1	0.7
February 1940	64,008	0.3	0.3	0.2	0.2	0.2	0.2
Average		1.5	1.3	1.1	1.0	0.8	0.6

Table 5.B.6-142. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-2.64 (-29%)	-5.88 (-66%)	1.32 (26%)	-1.92 (-38%)	2.32 (58%)	1.11 (56%)
June 1940	6,166	-0.92 (-48%)	-0.85 (-44%)	-0.95 (-49%)	-0.88 (-45%)	-1.01 (-50%)	-0.72 (-40%)
June 1934	7,100	-0.71 (-83%)	-0.80 (-94%)	-0.43 (-75%)	-0.52 (-91%)	-0.21 (-60%)	-0.61 (-93%)
April 1929	8,019	-0.12 (-45%)	-0.10 (-37%)	-0.08 (-34%)	-0.06 (-25%)	-0.03 (-17%)	0.16 (1441%)
May 1966	9,759	0.19 (22391%)	0.18 (21098%)	0.19 (89864%)	0.18 (84691%)	0.18 (1736%)	0.10 (128%)
February 1948	11,145	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (0%)
June 1978	12,346	-0.49 (-100%)	-0.46 (-94%)	-0.53 (-100%)	-0.51 (-94%)	-0.96 (-100%)	-1.08 (-97%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	-3.42 (-56%)	-3.59 (-59%)	-3.41 (-56%)	-3.58 (-59%)	-0.06 (-2%)	-0.40 (-14%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-1.64 (-54%)	-3.01 (-100%)	-1.58 (-53%)	-2.96 (-100%)	-1.46 (-51%)	-2.86 (-100%)
March 2001	22,272	-0.13 (-13%)	-0.15 (-15%)	-0.19 (-18%)	-0.21 (-20%)	-0.25 (-23%)	-0.20 (-19%)
June 1993	22,451	-1.41 (-100%)	-1.35 (-96%)	-1.30 (-100%)	-1.24 (-95%)	-1.11 (-100%)	-1.27 (-95%)
March 1942	23,456	-0.72 (-100%)	-0.72 (-100%)	-0.76 (-100%)	-0.76 (-100%)	-0.62 (-100%)	-0.72 (-100%)
January 1966	24,810	-1.94 (-100%)	-1.93 (-100%)	-2.04 (-100%)	-2.03 (-100%)	-2.11 (-100%)	-2.48 (-100%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
March 1993	34,327	-1.22 (-100%)	-1.22 (-100%)	-1.27 (-100%)	-1.27 (-100%)	-0.90 (-100%)	-0.92 (-100%)
December 2002	35,239	-0.08 (-1%)	-1.47 (-19%)	-0.32 (-4%)	-1.70 (-21%)	1.00 (15%)	-0.34 (-5%)
June 1952	37,199	-0.19 (-100%)	-0.19 (-100%)	-0.21 (-100%)	-0.21 (-100%)	-0.31 (-100%)	-0.93 (-100%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
January 1971	47,872	-1.23 (-98%)	-1.24 (-99%)	-1.25 (-98%)	-1.26 (-99%)	-1.12 (-98%)	-1.08 (-99%)
April 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1945	52,920	-1.21 (-51%)	-1.66 (-70%)	-1.07 (-48%)	-1.51 (-68%)	-0.52 (-31%)	-0.54 (-43%)
February 1940	64,008	-0.07 (-27%)	-0.12 (-44%)	-0.08 (-28%)	-0.13 (-45%)	-0.04 (-17%)	-0.09 (-37%)
Average		-0.67 (-45%)	-0.91 (-62%)	-0.52 (-39%)	-0.76 (-57%)	-0.27 (-25%)	-0.48 (-46%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

1 **Table 5.B.6-143. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for**
2 **60-Day DSM2-PTM Simulation, Wetter Starting Distribution**

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	7.7	11.2	7.8	5.2	12.0	4.9
June 1940	6,166	5.3	5.5	4.0	2.0	2.5	3.3
June 1934	7,100	1.1	1.3	0.9	1.3	0.9	0.8
April 1929	8,019	0.2	0.3	0.5	0.3	0.4	0.5
May 1966	9,759	0.7	0.8	0.8	0.7	0.5	0.7
February 1948	11,145	0.8	0.9	1.0	1.3	0.7	0.7
June 1978	12,346	0.8	0.7	2.2	1.6	1.8	2.6
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	5.3	5.5	2.9	3.0	3.3	2.9
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.1	0.1	0.1	0.1	0.1	0.0
February 2003	21,852	3.7	3.8	3.5	3.8	1.9	0.2
March 2001	22,272	1.1	1.0	1.3	1.2	1.2	1.2
June 1993	22,451	1.7	2.0	1.6	2.4	0.5	1.1
March 1942	23,456	0.8	0.8	0.7	0.8	0.0	0.0
January 1966	24,810	2.2	2.1	2.3	2.8	0.1	0.2
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.1	0.1	0.1	0.1	0.1
March 1993	34,327	1.3	1.3	1.0	1.0	0.0	0.0
December 2002	35,239	7.5	7.3	6.4	6.2	8.9	6.0
June 1952	37,199	0.3	0.3	0.4	1.3	0.0	0.2
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	1.5	1.5	1.4	1.3	0.1	0.0
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	2.2	2.3	1.8	1.5	1.2	0.8
February 1940	64,008	0.4	0.4	0.4	0.4	0.3	0.2
Average		1.7	1.8	1.5	1.4	1.4	1.0

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Table 5.B.6-144. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 60-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	4.25 (55%)	-2.84 (-37%)	0.77 (7%)	-6.32 (-56%)	4.20 (54%)	-0.30 (-6%)
June 1940	6,166	-2.77 (-52%)	-2.00 (-38%)	-2.95 (-54%)	-2.19 (-40%)	-1.45 (-36%)	1.28 (63%)
June 1934	7,100	-0.24 (-21%)	-0.39 (-34%)	-0.44 (-33%)	-0.60 (-44%)	0.01 (2%)	-0.57 (-43%)
April 1929	8,019	0.20 (86%)	0.23 (99%)	0.18 (69%)	0.21 (81%)	-0.10 (-19%)	0.19 (67%)
May 1966	9,759	-0.15 (-22%)	-0.01 (-1%)	-0.24 (-31%)	-0.09 (-12%)	-0.25 (-32%)	-0.03 (-4%)
February 1948	11,145	-0.10 (-12%)	-0.13 (-16%)	-0.13 (-15%)	-0.17 (-19%)	-0.23 (-23%)	-0.58 (-45%)
June 1978	12,346	1.04 (128%)	1.75 (216%)	1.13 (158%)	1.85 (258%)	-0.36 (-16%)	0.93 (57%)
April 1970	13,369	0.02 (7800%)	0.02 (8700%)	0.02 (Inf.)	0.02 (Inf.)	0.02 (Inf.)	0.02 (Inf.)
March 1961	13,725	-2.05 (-38%)	-2.41 (-45%)	-2.16 (-40%)	-2.53 (-46%)	0.38 (13%)	-0.12 (-4%)
May 1937	20,349	0.02 (208%)	0.00 (-44%)	0.01 (56%)	-0.01 (-72%)	0.01 (49%)	-0.01 (-73%)
May 1935	20,628	0.02 (24%)	-0.09 (-100%)	0.03 (33%)	-0.08 (-100%)	0.04 (55%)	-0.11 (-100%)
February 2003	21,852	-1.83 (-50%)	-3.44 (-93%)	-1.95 (-51%)	-3.55 (-94%)	-1.63 (-47%)	-3.59 (-94%)
March 2001	22,272	0.09 (9%)	0.14 (13%)	0.14 (14%)	0.18 (18%)	-0.16 (-12%)	0.04 (4%)
June 1993	22,451	-1.24 (-71%)	-0.67 (-38%)	-1.47 (-74%)	-0.90 (-46%)	-1.05 (-67%)	-1.35 (-56%)
March 1942	23,456	-0.80 (-100%)	-0.80 (-100%)	-0.76 (-100%)	-0.76 (-100%)	-0.65 (-100%)	-0.75 (-100%)
January 1966	24,810	-2.13 (-96%)	-2.02 (-91%)	-2.00 (-96%)	-1.88 (-90%)	-2.21 (-96%)	-2.57 (-93%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.01 (18%)	0.02 (37%)	0.00 (3%)	0.01 (19%)	-0.03 (-35%)	-0.03 (-36%)
March 1993	34,327	-1.31 (-99%)	-1.29 (-97%)	-1.25 (-99%)	-1.23 (-97%)	-0.98 (-99%)	-0.98 (-97%)
December 2002	35,239	1.45 (19%)	-1.49 (-20%)	1.56 (21%)	-1.38 (-19%)	2.47 (38%)	-0.28 (-4%)
June 1952	37,199	-0.27 (-96%)	-0.10 (-37%)	-0.24 (-96%)	-0.08 (-30%)	-0.42 (-98%)	-1.16 (-87%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (-100%)	0.00 (-90%)	0.00 (-100%)	0.00 (-87%)	0.00 (-100%)	0.00 (-86%)
January 1971	47,872	-1.44 (-96%)	-1.46 (-97%)	-1.43 (-96%)	-1.45 (-97%)	-1.31 (-95%)	-1.29 (-96%)
April 1927	52,656	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1945	52,920	-1.03 (-47%)	-1.34 (-61%)	-1.10 (-49%)	-1.41 (-63%)	-0.62 (-35%)	-0.69 (-45%)
February 1940	64,008	-0.13 (-32%)	-0.20 (-50%)	-0.12 (-31%)	-0.20 (-50%)	-0.09 (-25%)	-0.15 (-43%)
Average		-0.31 (-19%)	-0.69 (-41%)	-0.46 (-25%)	-0.84 (-46%)	-0.16 (-11%)	-0.45 (-31%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

1 **Table 5.B.6-145. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for**
2 **60-Day DSM2-PTM Simulation, Drier Starting Distribution**

Modeled Hydroperiod	**Modeled Delta Outflow (cfs)**	**EBC1**	**EBC2**	**EBC2_ELT**	**EBC2_LLT**	**ESO_ELT**	**ESO_LLT**
December 1923	4,500	10.6	15.5	10.7	6.9	14.3	6.9
June 1940	6,166	7.1	7.3	5.4	2.5	3.2	4.5
June 1934	7,100	1.4	1.8	1.1	1.6	1.1	0.9
April 1929	8,019	0.3	0.3	0.6	0.3	0.5	0.5
May 1966	9,759	0.9	0.9	1.0	0.8	0.6	0.8
February 1948	11,145	0.9	1.0	1.2	1.6	0.9	0.9
June 1978	12,346	1.0	0.9	3.0	2.1	2.2	3.4
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	7.6	7.7	3.7	4.1	4.4	3.8
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.1	0.1	0.1	0.1	0.1	0.0
February 2003	21,852	4.5	4.7	4.3	4.9	1.8	0.2
March 2001	22,272	1.1	1.1	1.4	1.3	1.3	1.3
June 1993	22,451	2.1	2.5	1.9	3.2	0.6	1.4
March 1942	23,456	0.8	0.7	0.6	0.7	0.0	0.0
January 1966	24,810	2.8	2.5	2.9	3.6	0.1	0.2
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.1	0.1	0.0	0.1
March 1993	34,327	1.3	1.3	0.9	1.0	0.0	0.0
December 2002	35,239	9.9	9.7	8.6	8.6	10.2	8.7
June 1952	37,199	0.3	0.2	0.4	1.4	0.0	0.2
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	1.5	1.4	1.3	1.3	0.0	0.0
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	2.5	2.7	2.0	1.7	1.2	0.8
February 1940	64,008	0.3	0.3	0.3	0.3	0.2	0.2
Average		2.1	2.3	1.9	1.8	1.6	1.3

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Table 5.B.6-146. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 60-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	3.70 (35%)	-3.74 (-35%)	-1.24 (-8%)	-8.69 (-56%)	3.60 (34%)	-0.02 (0%)
June 1940	6,166	-3.90 (-55%)	-2.58 (-36%)	-4.11 (-56%)	-2.79 (-38%)	-2.20 (-41%)	2.00 (80%)
June 1934	7,100	-0.40 (-27%)	-0.53 (-37%)	-0.70 (-40%)	-0.84 (-48%)	-0.06 (-6%)	-0.72 (-44%)
April 1929	8,019	0.21 (81%)	0.26 (100%)	0.18 (62%)	0.23 (79%)	-0.15 (-24%)	0.20 (60%)
May 1966	9,759	-0.28 (-31%)	-0.08 (-9%)	-0.33 (-35%)	-0.14 (-15%)	-0.42 (-41%)	-0.04 (-4%)
February 1948	11,145	-0.04 (-5%)	-0.05 (-5%)	-0.12 (-12%)	-0.13 (-13%)	-0.30 (-25%)	-0.73 (-45%)
June 1978	12,346	1.20 (117%)	2.39 (233%)	1.30 (141%)	2.49 (270%)	-0.80 (-27%)	1.33 (63%)
April 1970	13,369	0.01 (13200%)	0.01 (13400%)	0.01 (Inf.)	0.01 (Inf.)	0.01 (Inf.)	0.01 (Inf.)
March 1961	13,725	-3.17 (-42%)	-3.79 (-50%)	-3.24 (-42%)	-3.86 (-50%)	0.72 (19%)	-0.27 (-7%)
May 1937	20,349	0.02 (185%)	-0.01 (-65%)	0.01 (47%)	-0.02 (-82%)	0.01 (42%)	-0.02 (-84%)
May 1935	20,628	0.03 (37%)	-0.08 (-100%)	0.03 (38%)	-0.08 (-100%)	0.04 (61%)	-0.12 (-100%)
February 2003	21,852	-2.70 (-60%)	-4.28 (-95%)	-2.85 (-61%)	-4.44 (-95%)	-2.48 (-58%)	-4.67 (-95%)
March 2001	22,272	0.14 (13%)	0.14 (12%)	0.20 (19%)	0.20 (19%)	-0.18 (-12%)	-0.02 (-1%)
June 1993	22,451	-1.50 (-70%)	-0.74 (-35%)	-1.82 (-74%)	-1.06 (-43%)	-1.27 (-66%)	-1.79 (-56%)
March 1942	23,456	-0.77 (-100%)	-0.77 (-100%)	-0.74 (-100%)	-0.74 (-100%)	-0.63 (-100%)	-0.74 (-100%)
January 1966	24,810	-2.71 (-97%)	-2.60 (-93%)	-2.44 (-97%)	-2.33 (-92%)	-2.78 (-97%)	-3.42 (-95%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.01 (43%)	0.02 (48%)	0.01 (18%)	0.01 (22%)	-0.02 (-29%)	-0.04 (-43%)
March 1993	34,327	-1.32 (-99%)	-1.31 (-98%)	-1.24 (-99%)	-1.23 (-98%)	-0.92 (-99%)	-0.92 (-97%)
December 2002	35,239	0.32 (3%)	-1.22 (-12%)	0.50 (5%)	-1.04 (-11%)	1.64 (19%)	0.06 (1%)
June 1952	37,199	-0.24 (-95%)	-0.07 (-26%)	-0.21 (-94%)	-0.04 (-17%)	-0.39 (-97%)	-1.26 (-87%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (-100%)	0.00 (-93%)	0.00 (-100%)	0.00 (-93%)	0.00 (-100%)	0.00 (-92%)
January 1971	47,872	-1.43 (-97%)	-1.43 (-97%)	-1.40 (-97%)	-1.41 (-97%)	-1.27 (-96%)	-1.25 (-97%)
April 1927	52,656	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1945	52,920	-1.33 (-53%)	-1.68 (-67%)	-1.51 (-56%)	-1.87 (-69%)	-0.80 (-40%)	-0.89 (-52%)
February 1940	64,008	-0.11 (-34%)	-0.16 (-51%)	-0.10 (-33%)	-0.15 (-50%)	-0.06 (-24%)	-0.12 (-43%)
Average		-0.53 (-25%)	-0.83 (-39%)	-0.73 (-32%)	-1.03 (-44%)	-0.32 (-17%)	-0.50 (-28%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-147. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	10.3	6.2	5.1	2.7	7.5	4.0
June 1940	6,166	2.9	2.9	3.0	2.7	1.6	1.8
June 1934	7,100	1.2	0.8	0.5	0.9	0.2	0.1
April 1929	8,019	0.4	0.4	0.3	0.0	0.3	0.3
May 1966	9,759	0.0	0.0	0.0	0.1	0.3	0.3
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.8	1.0	1.5	1.8	0.0	0.1
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	7.4	7.4	3.8	3.9	3.8	3.6
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	4.3	4.3	4.1	4.1	2.2	0.0
March 2001	22,272	1.7	1.8	1.9	1.7	1.5	1.6
June 1993	22,451	2.3	2.1	1.8	2.1	0.0	0.1
March 1942	23,456	1.3	1.4	1.2	1.3	0.0	0.0
January 1966	24,810	3.0	3.1	3.1	3.5	0.0	0.0
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.0	0.0	0.0	0.0
March 1993	34,327	2.2	2.3	1.8	1.8	0.0	0.0
December 2002	35,239	9.2	9.4	8.1	8.0	9.1	7.6
June 1952	37,199	0.4	0.5	0.6	1.6	0.0	0.0
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	2.4	2.4	2.2	2.1	0.0	0.0
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	3.4	3.2	2.5	1.9	1.8	1.1
February 1940	64,008	0.7	0.7	0.7	0.7	0.6	0.4
Average		2.0	1.8	1.6	1.5	1.1	0.8

Table 5.B.6-148. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-2.84 (-28%)	-6.25 (-61%)	1.28 (21%)	-2.14 (-35%)	2.37 (46%)	1.31 (48%)
June 1940	6,166	-1.28 (-44%)	-1.11 (-39%)	-1.30 (-45%)	-1.13 (-39%)	-1.36 (-46%)	-0.97 (-36%)
June 1934	7,100	-0.99 (-81%)	-1.15 (-94%)	-0.59 (-72%)	-0.75 (-91%)	-0.29 (-56%)	-0.85 (-92%)
April 1929	8,019	-0.17 (-39%)	-0.15 (-34%)	-0.11 (-29%)	-0.09 (-23%)	-0.03 (-11%)	0.27 (1001%)
May 1966	9,759	0.34 (13776%)	0.29 (11762%)	0.35 (34521%)	0.29 (29494%)	0.33 (1555%)	0.16 (114%)
February 1948	11,145	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (0%)
June 1978	12,346	-0.84 (-99%)	-0.77 (-91%)	-0.96 (-99%)	-0.89 (-92%)	-1.50 (-99%)	-1.70 (-96%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	-3.64 (-49%)	-3.85 (-52%)	-3.61 (-49%)	-3.83 (-52%)	0.00 (0%)	-0.30 (-8%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-2.06 (-48%)	-4.26 (-100%)	-2.06 (-48%)	-4.26 (-100%)	-1.91 (-46%)	-4.08 (-100%)
March 2001	22,272	-0.23 (-13%)	-0.18 (-10%)	-0.32 (-18%)	-0.27 (-15%)	-0.39 (-20%)	-0.19 (-11%)
June 1993	22,451	-2.25 (-99%)	-2.12 (-93%)	-2.11 (-99%)	-1.98 (-93%)	-1.83 (-99%)	-1.96 (-93%)
March 1942	23,456	-1.34 (-100%)	-1.34 (-100%)	-1.38 (-100%)	-1.38 (-100%)	-1.17 (-100%)	-1.28 (-100%)
January 1966	24,810	-2.96 (-100%)	-2.94 (-99%)	-3.06 (-100%)	-3.04 (-99%)	-3.12 (-100%)	-3.51 (-99%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
March 1993	34,327	-2.22 (-100%)	-2.21 (-100%)	-2.26 (-100%)	-2.25 (-100%)	-1.77 (-100%)	-1.80 (-100%)
December 2002	35,239	-0.17 (-2%)	-1.61 (-17%)	-0.39 (-4%)	-1.82 (-19%)	0.98 (12%)	-0.41 (-5%)
June 1952	37,199	-0.43 (-100%)	-0.43 (-100%)	-0.46 (-100%)	-0.46 (-100%)	-0.64 (-100%)	-1.57 (-100%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
January 1971	47,872	-2.36 (-99%)	-2.36 (-99%)	-2.39 (-99%)	-2.39 (-99%)	-2.19 (-99%)	-2.07 (-99%)
April 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1945	52,920	-1.58 (-47%)	-2.23 (-66%)	-1.41 (-44%)	-2.06 (-65%)	-0.72 (-29%)	-0.80 (-42%)
February 1940	64,008	-0.19 (-25%)	-0.34 (-46%)	-0.19 (-25%)	-0.34 (-46%)	-0.14 (-20%)	-0.25 (-39%)
Average		-0.93 (-47%)	-1.22 (-61%)	-0.78 (-42%)	-1.07 (-58%)	-0.50 (-32%)	-0.74 (-49%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-149. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	17.1	12.1	10.6	6.5	13.2	8.8
June 1940	6,166	7.6	7.6	7.7	7.5	4.5	5.2
June 1934	7,100	3.1	2.1	1.4	2.3	0.7	0.2
April 1929	8,019	1.3	1.1	0.9	0.1	0.8	0.9
May 1966	9,759	0.0	0.0	0.1	0.4	1.1	0.9
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	2.6	3.1	4.3	5.1	0.0	0.3
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	14.0	13.9	8.9	8.6	9.2	8.8
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	10.6	10.8	10.5	10.2	6.3	0.0
March 2001	22,272	5.5	5.8	5.9	5.4	4.8	5.2
June 1993	22,451	6.5	6.2	5.5	6.0	0.1	0.6
March 1942	23,456	4.4	4.4	3.9	4.1	0.0	0.0
January 1966	24,810	8.0	8.2	8.2	8.8	0.0	0.1
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.0	0.0	0.0	0.0
March 1993	34,327	7.1	7.2	6.1	6.1	0.0	0.0
December 2002	35,239	15.9	16.1	14.4	14.4	15.2	13.6
June 1952	37,199	1.6	1.7	2.3	4.8	0.0	0.0
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	8.0	8.1	7.6	7.1	0.1	0.1
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	8.3	8.0	6.6	5.3	4.8	3.1
February 1940	64,008	3.1	3.0	2.9	2.7	2.3	1.6
Average		4.6	4.4	4.0	3.9	2.3	1.8

Table 5.B.6-150. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-3.95 (-23%)	-8.31 (-48%)	1.07 (9%)	-3.28 (-27%)	2.60 (25%)	2.31 (36%)
June 1940	6,166	-3.10 (-41%)	-2.47 (-32%)	-3.08 (-41%)	-2.44 (-32%)	-3.16 (-41%)	-2.32 (-31%)
June 1934	7,100	-2.38 (-78%)	-2.88 (-94%)	-1.38 (-67%)	-1.89 (-91%)	-0.72 (-51%)	-2.11 (-92%)
April 1929	8,019	-0.44 (-34%)	-0.39 (-30%)	-0.29 (-26%)	-0.24 (-21%)	-0.05 (-6%)	0.79 (743%)
May 1966	9,759	1.10 (10554%)	0.85 (8083%)	1.11 (22177%)	0.85 (17009%)	1.04 (1441%)	0.43 (99%)
February 1948	11,145	0.01 (Inf.)	0.00 (Inf.)	0.01 (Inf.)	0.00 (Inf.)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	-2.57 (-99%)	-2.32 (-89%)	-3.04 (-99%)	-2.78 (-90%)	-4.22 (-99%)	-4.76 (-94%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	-4.81 (-34%)	-5.28 (-38%)	-4.71 (-34%)	-5.18 (-37%)	0.30 (3%)	0.16 (2%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-4.27 (-40%)	-10.55 (-100%)	-4.52 (-42%)	-10.79 (-100%)	-4.23 (-40%)	-10.19 (-100%)
March 2001	22,272	-0.75 (-14%)	-0.36 (-7%)	-1.04 (-18%)	-0.65 (-11%)	-1.09 (-19%)	-0.20 (-4%)
June 1993	22,451	-6.44 (-99%)	-5.93 (-91%)	-6.15 (-99%)	-5.64 (-91%)	-5.39 (-99%)	-5.43 (-90%)
March 1942	23,456	-4.39 (-100%)	-4.39 (-100%)	-4.42 (-100%)	-4.43 (-100%)	-3.90 (-100%)	-4.06 (-100%)
January 1966	24,810	-8.02 (-100%)	-7.93 (-99%)	-8.14 (-100%)	-8.05 (-99%)	-8.15 (-100%)	-8.69 (-99%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
March 1993	34,327	-7.13 (-100%)	-7.12 (-100%)	-7.16 (-100%)	-7.15 (-100%)	-6.06 (-100%)	-6.12 (-100%)
December 2002	35,239	-0.63 (-4%)	-2.24 (-14%)	-0.82 (-5%)	-2.43 (-15%)	0.87 (6%)	-0.76 (-5%)
June 1952	37,199	-1.57 (-100%)	-1.57 (-100%)	-1.67 (-100%)	-1.67 (-100%)	-2.25 (-100%)	-4.78 (-100%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
January 1971	47,872	-7.95 (-99%)	-7.90 (-99%)	-8.03 (-99%)	-7.98 (-99%)	-7.50 (-99%)	-6.95 (-98%)
April 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1945	52,920	-3.51 (-42%)	-5.19 (-63%)	-3.20 (-40%)	-4.88 (-61%)	-1.85 (-28%)	-2.19 (-42%)
February 1940	64,008	-0.77 (-25%)	-1.46 (-48%)	-0.75 (-25%)	-1.44 (-47%)	-0.64 (-22%)	-1.09 (-41%)
Average		-2.28 (-49%)	-2.79 (-61%)	-2.08 (-47%)	-2.59 (-59%)	-1.64 (-41%)	-2.07 (-53%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-151. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	21.4	15.8	14.0	8.9	16.8	11.8
June 1940	6,166	10.6	10.5	10.6	10.4	6.3	7.3
June 1934	7,100	4.2	2.8	1.9	3.1	1.0	0.2
April 1929	8,019	1.8	1.6	1.3	0.2	1.2	1.3
May 1966	9,759	0.0	0.0	0.1	0.6	1.6	1.2
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	3.7	4.4	6.0	7.1	0.1	0.4
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	18.2	18.0	12.1	11.6	12.6	12.0
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	14.5	14.9	14.5	14.0	8.8	0.0
March 2001	22,272	7.9	8.3	8.3	7.6	6.8	7.4
June 1993	22,451	9.2	8.8	7.7	8.4	0.1	0.8
March 1942	23,456	6.3	6.3	5.6	5.8	0.0	0.0
January 1966	24,810	11.2	11.3	11.3	12.1	0.0	0.2
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.0	0.0	0.0	0.0	0.0
March 1993	34,327	10.2	10.2	8.7	8.8	0.0	0.0
December 2002	35,239	20.0	20.2	18.3	18.4	19.1	17.4
June 1952	37,199	2.3	2.4	3.3	6.8	0.0	0.0
April 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
January 1971	47,872	11.5	11.6	10.9	10.2	0.1	0.2
April 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
February 1945	52,920	11.3	10.9	9.2	7.4	6.6	4.3
February 1940	64,008	4.5	4.5	4.3	4.0	3.4	2.3
Average		6.3	6.0	5.5	5.4	3.1	2.5

Table 5.B.6-152. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the South Delta Export Facilities for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-4.65 (-22%)	-9.59 (-45%)	0.94 (6%)	-4.00 (-25%)	2.75 (20%)	2.94 (33%)
June 1940	6,166	-4.24 (-40%)	-3.31 (-31%)	-4.19 (-40%)	-3.26 (-31%)	-4.29 (-40%)	-3.16 (-30%)
June 1934	7,100	-3.24 (-77%)	-3.96 (-94%)	-1.88 (-66%)	-2.60 (-91%)	-0.98 (-51%)	-2.89 (-92%)
April 1929	8,019	-0.61 (-34%)	-0.54 (-30%)	-0.40 (-25%)	-0.33 (-21%)	-0.06 (-5%)	1.11 (715%)
May 1966	9,759	1.58 (10229%)	1.19 (7711%)	1.59 (21149%)	1.20 (15969%)	1.49 (1427%)	0.59 (97%)
February 1948	11,145	0.01 (Inf.)	0.00 (Inf.)	0.01 (Inf.)	0.00 (Inf.)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	-3.66 (-98%)	-3.28 (-88%)	-4.34 (-99%)	-3.97 (-90%)	-5.92 (-99%)	-6.67 (-94%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	-5.55 (-31%)	-6.17 (-34%)	-5.39 (-30%)	-6.02 (-33%)	0.49 (4%)	0.45 (4%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-5.66 (-39%)	-14.48 (-100%)	-6.06 (-41%)	-14.88 (-100%)	-5.68 (-39%)	-14.00 (-100%)
March 2001	22,272	-1.08 (-14%)	-0.48 (-6%)	-1.49 (-18%)	-0.89 (-11%)	-1.52 (-18%)	-0.21 (-3%)
June 1993	22,451	-9.06 (-99%)	-8.31 (-91%)	-8.68 (-99%)	-7.93 (-90%)	-7.62 (-99%)	-7.59 (-90%)
March 1942	23,456	-6.29 (-100%)	-6.29 (-100%)	-6.33 (-100%)	-6.33 (-100%)	-5.61 (-100%)	-5.80 (-100%)
January 1966	24,810	-11.18 (-100%)	-11.04 (-99%)	-11.32 (-100%)	-11.18 (-99%)	-11.29 (-100%)	-11.93 (-99%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
March 1993	34,327	-10.20 (-100%)	-10.18 (-100%)	-10.23 (-100%)	-10.21 (-100%)	-8.74 (-100%)	-8.82 (-100%)
December 2002	35,239	-0.93 (-5%)	-2.64 (-13%)	-1.09 (-5%)	-2.80 (-14%)	0.80 (4%)	-0.98 (-5%)
June 1952	37,199	-2.28 (-100%)	-2.28 (-100%)	-2.43 (-100%)	-2.43 (-100%)	-3.26 (-100%)	-6.78 (-100%)
April 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
January 1971	47,872	-11.45 (-99%)	-11.37 (-99%)	-11.56 (-99%)	-11.48 (-99%)	-10.82 (-99%)	-10.01 (-98%)
April 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1945	52,920	-4.72 (-42%)	-7.04 (-62%)	-4.32 (-39%)	-6.64 (-61%)	-2.55 (-28%)	-3.06 (-42%)
February 1940	64,008	-1.13 (-25%)	-2.16 (-48%)	-1.10 (-25%)	-2.12 (-48%)	-0.95 (-22%)	-1.61 (-41%)
Average		-3.12 (-50%)	-3.78 (-60%)	-2.90 (-48%)	-3.55 (-59%)	-2.36 (-43%)	-2.91 (-54%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

5.B.6.1.6.2 Juvenile

Salvage-Density Method

The estimated entrainment loss of juvenile longfin smelt in March–June had two notable features: loss was considerably (1–2 orders of magnitude) greater at SWP than at CVP (Table 5.B.6-153), and loss varied considerably among water years, with highest loss (hundreds of thousands of fish) occurring in dry and critical years, and several orders of magnitude lower loss in other water-year types (Table 5.B.6-154 to Table 5.B.6-164). Across all years, average entrainment loss was estimated to be lower under ESO scenarios relative to EBC2 scenarios by around 95,000–123,000 fish (34–42% lower under ESO scenarios) (Table 5.B.6-159). In low-flow (dry and critical) years, when most entrainment of juvenile longfin smelt would occur, differences in entrainment loss under ESO scenarios compared to EBC scenarios ranged from almost 19,000 more fish (4% more) lost under ESO_ELT vs. EBC2 in dry years to almost 174,000 fish (32%) lower entrainment losses under ESO_ELT vs. EBC2_ELT in critical years (Table 5.B.6-163 and Table 5.B.6-164).

Table 5.B.6-153. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	824	±	186	842	±	193	843	±	195	817	±	192	292	±	71	324	±	81
April	32,281	±	4,998	33,512	±	5,297	34,352	±	5,420	35,520	±	5,565	25,439	±	3,493	24,561	±	3,417
May	211,218	±	46,497	218,709	±	51,015	231,690	±	52,648	233,356	±	52,616	139,832	±	24,876	130,005	±	23,607
June	4,502	±	960	4,491	±	974	4,256	±	907	3,750	±	796	2,205	±	447	1,987	±	401
CVP																		
March	487	±	70	487	±	71	477	±	69	465	±	69	214	±	36	203	±	34
April	7,464	±	1,332	7,394	±	1,321	7,746	±	1,380	7,865	±	1,403	6,111	±	1,077	5,977	±	1,064
May	11,089	±	2,338	11,022	±	2,325	11,241	±	2,399	11,114	±	2,350	7,762	±	1,433	6,968	±	1,305
June	56	±	13	56	±	13	49	±	12	44	±	11	29	±	7	25	±	6

Table 5.B.6-154. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	6	±	2	6	±	2	6	±	2	6	±	2	1		1	1		1
April	62,540	±	28,139	65,799	±	30,331	66,291	±	30,502	67,902	±	30,837	29,156		11,635	29,088	±	11,592
May	1,061	±	501	1,163	±	564	1,192	±	571	1,152	±	563	427		162	394		158
June	69	±	17	71	±	18	64	±	16	58	±	14	28		7	25		6
(b) CVP																		
March	0	±	0	0	±	0	0	±	0	0	±	0	0		0	0		0
April	13	±	4	13	±	4	13	±	4	13	±	4	7		2	7		2
May	66	±	27	66	±	27	68	±	28	65	±	27	30		11	27		10
June	1	±	0	1	±	0	1	±	0	1	±	0	0		0	0		0

Table 5.B.6-155. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	30	±	15	29	±	14	30	±	15	30	±	16	6	±	3	8	±	5
April	232	±	63	231	±	62	245	±	66	273	±	72	215	±	64	203	±	62
May	1,431	±	533	1,430	±	532	1,600	±	626	1,673	±	637	1,395	±	580	1,327	±	533
June	977	±	441	941	±	434	959	±	424	793	±	335	473	±	196	455	±	188
(b) CVP																		
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0.0	0	±	0
April	602	±	272	599	±	271	627	±	285	674	±	306	525	±	259	558	±	271
May	1,249	±	597	1,248	±	596	1,337	±	665	1,367	±	671	1,125	±	599.3	921	±	495
June	6	±	3	6	±	3	5	±	3	5	±	2	3	±	1	3	±	1

Table 5.B.6-156. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for Below-Normal Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	839	±	91	838	±	100	907	±	130	1,060	±	175	809	±	146	794	±	157
June	730	±	122	640	±	149	651	±	114	614	±	126	466	±	78	375	±	108
(b) CVP																		
March	171	±	30	155	±	28	151	±	28	154	±	36	103	±	24	103	±	27
April	305	±	24	304	±	25	325	±	39	344	±	51	293	±	63	333	±	67
May	1,029	±	78	1,033	±	88	1,038	±	73	1,111	±	141	916	±	166	899	±	178
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0

1 **Table 5.B.6-157. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin**
2 **Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for Dry Water Years**

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	46	±	18	46	±	18	43	±	17	43	±	17	35	±	14	33	±	13
April	32,535	±	13,860	34,631	±	14,636	36,889	±	16,671	35,086	±	16,376	40,367	±	17,604	34,717	±	15,988
May	445,135	±	182,963	433,365	±	178,221	486,050	±	206,441	501,670	±	209,102	45,194	±	84,725	85,384	±	66,405
June	7,780	±	3,344	8,184	±	3,444	7,909	±	3,323	6,330	±	2,639	4,898	±	2,253	4,135	±	1,967
(b) CVP																		
March	700	±	272	713	±	274	721	±	273	636	±	246	548	±	222	522	±	212.2
April	17,363	±	7,049	16,905	±	6,847	19,770	±	8,209	18,739	±	7,741	21,105	±	8,962	17,466	±	7,816
May	25,960	±	10,498	25,706	±	10,368	25,352	±	10,208	25,367	±	10,253	26,328	±	10,828	22,205	±	9,540
June	123	±	53	114	±	49	98	±	44	79	±	33	90	±	40	71	±	32.5

3

4 **Table 5.B.6-158. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Juvenile Longfin Smelt**
5 **for Six Model Scenarios at the SWP and CVP Salvage Facilities in March–June for Critical Water Years**

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
March	4,643	±	1,332	4,614	±	1,562	4,079	±	1,348	3,912	±	1,445	3,683	±	868	3,304	±	1,027.0
April	48,870	±	17,278	50,870	±	16,112	44,915	±	13,740	39,886	±	11,147	45,370	±	14,296	43,112	±	15,414.6
May	478,363	±	72,876	443,429	±	86,594	460,509	±	87,445	417,265	±	134,503	90,153	±	23,414	93,352	±	26,867.2
June	1,348	±	346	1,299	±	366	1,232	±	339	1,048	±	320	779	±	180	979	±	292.0
(b) CVP																		
March	1,323	±	427	1,420	±	517	1,228	±	406	1,117	±	398	1,030	±	351	907	±	356
April	17,728	±	1,974	17,408	±	1,767	16,736	±	1,951	16,581	±	2,011	15,545	±	3,005	14,156	±	3,259
May	15,194	±	1,046	14,791	±	910	14,262	±	1,304	13,788	±	903	12,409	±	1,974	12,172	±	1,599
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0

6

Table 5.B.6-159. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during All Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-806 (-61%)	-784 (-60%)	-823 (-62%)	-801 (-60%)	-814 (-62%)	-756 (-59%)
April	-8,195 (-21%)	-9,207 (-23%)	-9,357 (-23%)	-10,369 (-25%)	-10,549 (-25%)	-12,848 (-30%)
May	-74,713 (-34%)	-85,334 (-38%)	-82,137 (-36%)	-92,758 (-40%)	-95,336 (-39%)	-107,498 (-44%)
June	-2,324 (-51%)	-2,546 (-56%)	-2,313 (-51%)	-2,535 (-56%)	-2,071 (-48%)	-1,782 (-47%)
Average (March–June)	-86,038 (-32%)	-97,872 (-37%)	-94,629 (-34%)	-106,464 (-39%)	-108,770 (-37%)	-122,883 (-42%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-160. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during Wet Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-5 (-81%)	-5 (-78%)	-5 (-82%)	-5 (-79%)	-5 (-82%)	-5 (-79%)
April	-33,390 (-53%)	-33,457 (-53%)	-36,649 (-56%)	-36,716 (-56%)	-37,141 (-56%)	-38,820 (-57%)
May	-670 (-59%)	-707 (-63%)	-771 (-63%)	-808 (-66%)	-803 (-64%)	-797 (-65%)
June	-42 (-60%)	-45 (-64%)	-44 (-61%)	-47 (-65%)	-37 (-57%)	-34 (-58%)
Average (March–June)	-34,106 (-53%)	-34,213 (-54%)	-37,469 (-56%)	-37,576 (-56%)	-37,987 (-56%)	-39,655 (-57%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-161. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during Above-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-24 (-81%)	-22 (-74%)	-23 (-80%)	-21 (-73%)	-24 (-81%)	-23 (-74%)
April	-94 (-11%)	-74 (-9%)	-90 (-11%)	-70 (-8%)	-133 (-15%)	-187 (-20%)
May	-160 (-6%)	-433 (-16%)	-158 (-6%)	-430 (-16%)	-417 (-14%)	-793 (-26%)
June	-507 (-52%)	-525 (-53%)	-471 (-50%)	-490 (-52%)	-488 (-51%)	-341 (-43%)
Average (March–June)	-785 (-17%)	-1,054 (-23%)	-742 (-17%)	-1011 (-23%)	-1062 (-22%)	-1343 (-28%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-162. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during Below-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-67 (-39%)	-67 (-39%)	-52 (-33%)	-52 (-33%)	-48 (-32%)	-51 (-33%)
April	-12 (-4%)	28 (9%)	-11 (-4%)	28 (9%)	-32 (-10%)	-11 (-3%)
May	-143 (-8%)	-176 (-9%)	-146 (-8%)	-180 (-10%)	-221 (-11%)	-480 (-22%)
June	-264 (-36%)	-355 (-49%)	-174 (-27%)	-265 (-41%)	-184 (-28%)	-238 (-39%)
Average (March–June)	-486 (-16%)	-571 (-19%)	-383 (-13%)	-468 (-16%)	-484 (-16%)	-779 (-24%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-163. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during Dry Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-163 (-22%)	-192 (-26%)	-176 (-23%)	-205 (-27%)	-181 (-24%)	-125 (-18%)
April	11,573 (23%)	2,285 (5%)	9,935 (19%)	647 (1%)	4,812 (8%)	-1,642 (-3%)
May	426 (0%)	-63,506 (-13%)	12,450 (3%)	-51,482 (-11%)	-39,880 (-8%)	-119,448 (-23%)
June	-2,915 (-37%)	-3,698 (-47%)	-3,310 (-40%)	-4,092 (-49%)	-3,019 (-38%)	-2,203 (-34%)
Average (March–June)	8,921 (2%)	-65,111 (-12%)	18,899 (4%)	-55,132 (-11%)	-38,267 (-7%)	-123,418 (-21%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-164. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in March–June during Critical Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
March	-1,252 (-21%)	-1,755 (-29%)	-1,320 (-22%)	-1,823 (-30%)	-593 (-11%)	-818 (-16%)
April	-5,682 (-9%)	-9,330 (-14%)	-7,363 (-11%)	-11,010 (-16%)	-735 (-1%)	801 (1%)
May	-190,996 (-39%)	-188,033 (-38%)	-155,658 (-34%)	-152,696 (-33%)	-172,211 (-36%)	-125,529 (-29%)
June	-569 (-42%)	-369 (-27%)	-521 (-40%)	-320 (-25%)	-453 (-37%)	-69 (-7%)
Average (March–June)	-198,499 (-35%)	-199,486 (-35%)	-164,861 (-31%)	-165,849 (-31%)	-173,992 (-32%)	-125,616 (-25%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.6.3 Adult

Salvage-Density Method

Estimated entrainment loss of adult longfin smelt from December to March, which was based on modeling of historical salvage data and simulated export flows, was higher at the SWP facility than the CVP facility and averaged around 3,600 fish for EBC scenarios and around 1,700–1,800 fish for ESO scenarios when averaged across all water years (Table 5.B.6-165). Losses generally were higher in drier water-year types and ranged from tens or hundreds of fish in wet and above-normal years to thousands or tens of thousands of fish in below-normal, dry, and critical years (Table 5.B.6-165to Table 5.B.6-170). Averaged across all water years, around 1,900 (52–53%) fewer longfin smelt adults were lost under the ESO scenarios compared to EBC scenarios (Table 5.B.6-171). Relative differences between ESO and EBC scenarios were greatest in wet years (53–58% lower under ESO scenarios), although the absolute differences were least (around 70–80 fish less under ESO scenarios) (Table 5.B.6-172). This reflected the modeled lower reliance on the south Delta export facilities for water supply. In other water-year types, the relative difference between scenarios ranged from 42–50% less entrainment loss under ESO scenarios in above-normal years to 18–32% less entrainment loss under ESO scenarios relative to EBC scenarios in dry and critical years (Table 5.B.6-173 to Table 5.B.6-176).

Table 5.B.6-165. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	14	±	2	14	±	2	14	±	2	14	±	2	11		2	11		2
January	1,389	±	239	1,413	±	249	1,435	±	256	1,416	±	250	732		139	692		128
February	498	±	110	507	±	112	515	±	115	479	±	108	251		59	238		57
March	824	±	186	842	±	193	843	±	195	817	±	192	292		71	324		81
(b) CVP																		
December	137	±	25	145	±	26	142	±	26	129	±	24	124		23	111		21
January	92	±	9	91	±	9	91	±	9	88	±	9	52		6	56		6
February	167	±	34	161	±	33	162	±	33	164	±	34	81		19	88		20
March	487	±	70	487	±	71	477	±	69	465	±	69	214		36	203		34

Table 5.B.6-166. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	9	±	3	10	±	4	10	±	4	10	±	4	6		2	7		3
January	43	±	13	44	±	14	46	±	14	44	±	14	17		6	16		5
February	5	±	2	5	±	2	6	±	2	5	±	2	2		1	2		1
March	6	±	2	6	±	2	6	±	2	6	±	2	1		1	1		1
(b) CVP																		
December	21	±	7	21	±	7	21	±	7	20	±	7	17		6	16		6
January	19	±	6	20	±	7	20	±	7	19	±	7	10		4	12		5
February	26	±	6	26	±	6	26	±	6	27	±	7	5		2	8		3
March	0	±	0	0	±	0	0	±	0	0	±	0	0		0	0		0

1 **Table 5.B.6-167. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt for**
2 **Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Above-Normal Water Years**

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	54	±	27	55	±	27	55	±	27	55	±	27	43		21	42		20
January	436	±	199	472	±	227	495	±	244	480	±	233	282		136	216		102
February	29	±	11	29	±	11	29	±	12	29	±	11	9		5	12		6
March	30	±	15	29	±	14	30	±	15	30	±	16	6		3	8		5
(b) CVP																		
December	29	±	14	31	±	15	32	±	15	28	±	14	26		14	25		13
January	73	±	20	70	±	19	61	±	18	68	±	19	34		13	46		16
February	0	±	0	0	±	0	0	±	0	0	±	0	0		0	0		0
March	0	±	0	0	±	0	0	±	0	0	±	0	0		0	0		0

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4 **Table 5.B.6-168. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt**
5 **for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Below-Normal Years**

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	1,486	±	178	1,548	±	236	1,578	±	264	1,451	±	341	830	±	269	933	±	241
February	226	±	66	230	±	69	247	±	77	208	±	58	157	±	36	141	±	48
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
(b) CVP																		
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0.0	0.0	±	0
January	57	±	7	54	±	8	55	±	7	48	±	9	33	±	9	34	±	9
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	171	±	30	155	±	28	151	±	28	154	±	36	103	±	24	103	±	27

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Table 5.B.6-169. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI
(a) SWP																		
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	299	±	122	293	±	120	290	±	119	305	±	125	191	±	86	183	±	84
February	8	±	4	8	±	4	8	±	3	7	±	3	6	±	3	6	±	3
March	46	±	18	46	±	18	43	±	17	43	±	17	35	±	14	33	±	13
(b) CVP																		
December	22	±	8	25	±	8	24	±	8	22	±	8	22	±	8	19	±	7
January	106	±	40	106	±	40	111	±	42	104	±	40	64	±	27	61	±	27
February	20	±	6	20	±	6	20	±	7	19	±	6	15	±	5	14	±	5
March	700	±	272	713	±	274	721	±	273	636	±	246	548	±	222	522	±	212

Table 5.B.6-170. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI]) of Adult Longfin Smelt for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI	Avg.	±	95% CI
(a) SWP																		
December	0	±	0	0	±	0	0	±	0	0	±	0	0		0	0		0
January	11,161	±	2,430	10,446	±	2,692	9,604	±	3,002	10,563	±	2,098	7,119		2,746	6,305		2,932
February	3,840	±	992	4,212	±	1,117	3,931	±	805	3,838	±	975	3,376		815.3	3,313		574
March	4,643	±	1,332	4,614	±	1,562	4,079	±	1,348	3,912	±	1,445	3,683		867.7	3,304		1,027
(b) CVP																		
December	1,396	±	247	1,508	±	236	1,396	±	247	1,053	±	337	1,462		186	1,107		329
January	440	±	72	391	±	79	408	±	81	382	±	93	306		79	295		79
February	1,584	±	372	1,431	±	415	1,621	±	348	1,389	±	375	1,299		225	1,176		300
March	1,323	±	427	1,420	±	517	1,228	±	406	1,117	±	398	1,030		351	907		356

Table 5.B.6-171. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during All Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-17 (-11%)	-29 (-19%)	-25 (-16%)	-38 (-24%)	-21 (-14%)	-21 (-15%)
January	-697 (-47%)	-732 (-49%)	-721 (-48%)	-756 (-50%)	-743 (-49%)	-755 (-50%)
February	-334 (-50%)	-339 (-51%)	-336 (-50%)	-341 (-51%)	-346 (-51%)	-317 (-49%)
March	-806 (-61%)	-784 (-60%)	-823 (-62%)	-801 (-60%)	-814 (-62%)	-756 (-59%)
Average (December–March)	-1,854 (-51%)	-1,885 (-52%)	-1,904 (-52%)	-1,935 (-53%)	-1,924 (-52%)	-1,849 (-52%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-172. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during Wet Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-7 (-24%)	-7 (-25%)	-8 (-26%)	-8 (-26%)	-8 (-26%)	-7 (-24%)
January	-36 (-58%)	-34 (-55%)	-38 (-59%)	-36 (-57%)	-39 (-60%)	-36 (-57%)
February	-24 (-79%)	-21 (-68%)	-25 (-79%)	-21 (-69%)	-25 (-80%)	-23 (-70%)
March	-5 (-81%)	-5 (-78%)	-5 (-82%)	-5 (-79%)	-5 (-82%)	-5 (-79%)
Average (December–March)	-72 (-56%)	-67 (-52%)	-75 (-57%)	-70 (-53%)	-78 (-58%)	-71 (-53%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-173. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during Above-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-14 (-17%)	-17 (-21%)	-17 (-20%)	-20 (-24%)	-18 (-20%)	-18 (-21%)
January	-193 (-38%)	-247 (-48%)	-226 (-42%)	-279 (-52%)	-240 (-43%)	-286 (-52%)
February	-19 (-68%)	-16 (-57%)	-19 (-68%)	-17 (-57%)	-20 (-68%)	-17 (-57%)
March	-24 (-81%)	-22 (-74%)	-23 (-80%)	-21 (-73%)	-24 (-81%)	-23 (-74%)
Average (December–March)	-251 (-39%)	-302 (-46%)	-286 (-42%)	-337 (-49%)	-302 (-43%)	-342 (-50%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-174. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during Below-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	-679 (-44%)	-576 (-37%)	-739 (-46%)	-636 (-40%)	-769 (-47%)	-532 (-36%)
February	-69 (-30%)	-85 (-38%)	-74 (-32%)	-90 (-39%)	-90 (-37%)	-68 (-32%)
March	-67 (-39%)	-67 (-39%)	-52 (-33%)	-52 (-33%)	-48 (-32%)	-51 (-33%)
Average (December–March)	-815 (-42%)	-728 (-38%)	-865 (-43%)	-777 (-39%)	-907 (-45%)	-650 (-35%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-175. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during Dry Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-0.3 (-1%)	-3 (-12%)	-3 (-11%)	-5 (-21%)	-2 (-7%)	-2 (-11%)
January	-149 (-37%)	-161 (-40%)	-145 (-36%)	-157 (-39%)	-147 (-36%)	-166 (-41%)
February	-7 (-26%)	-8 (-30%)	-7 (-26%)	-9 (-30%)	-7 (-25%)	-6 (-24%)
March	-163 (-22%)	-192 (-26%)	-176 (-23%)	-205 (-27%)	-181 (-24%)	-125 (-18%)
Average (December–March)	-320 (-27%)	-364 (-30%)	-331 (-27%)	-375 (-31%)	-336 (-28%)	-299 (-26%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-176. Estimated Absolute and Percent Differences between Model Scenarios in Adult Longfin Smelt Entrainment Index (Number of Fish Lost) at the SWP and CVP Salvage Facilities in December–March during Critical Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	65 (5%)	-289 (-21%)	-46 (-3%)	-401 (-27%)	65 (5%)	54 (5%)
January	-4,176 (-36%)	-5,001 (-43%)	-3,412 (-31%)	-4,236 (-39%)	-2,587 (-26%)	-4,345 (-40%)
February	-749 (-14%)	-936 (-17%)	-967 (-17%)	-1,154 (-20%)	-876 (-16%)	-738 (-14%)
March	-1,252 (-21%)	-1,755 (-29%)	-1,320 (-22%)	-1,823 (-30%)	-593 (-11%)	-818 (-16%)
Average (December–March)	-6,112 (-25%)	-7981 (-33%)	-5,745 (-24%)	-7,614 (-32%)	-3,991 (-18%)	-5,847 (-26%)
Note: Negative values indicate lower entrainment loss under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.7 Sacramento Splittail

5.B.6.1.7.1 Juvenile

Salvage-Density Method

Per Capita Entrainment (Salvage) Index

Across all water years, May–July salvage of juvenile Sacramento splittail under the evaluated starting operations (ESO_ELT and ESO_LLT) generally was estimated to be more than two times as high at the CVP facilities as at the SWP facilities (Table 5.B.6-177), with the differences in salvage estimates between the facilities diminishing with lower Delta inflow (Table 5.B.6-178 to Table 5.B.6-182). Salvage estimates ranged from averages of several hundred thousand or over 1 million fish in wet water years through tens of thousands in above-normal and thousands in below-normal years, to hundreds or just over 1,000 in dry and critical water years.

Salvage generally was estimated to decrease under ESO scenarios relative to EBC scenarios, reflecting the general decrease in SWP/CVP south Delta pumping. Across all water years, reductions in estimated salvage under ESO scenarios compared to EBC scenarios at both facilities ranged from around 35% to 50% (Table 5.B.6-177). The relative percentage difference results for wet years were greater than those in other years and ranged from 38% to 59% (Table 5.B.6-178). In the remaining water-year types, average reductions in salvage under ESO relative to EBC generally were in the range of around 10–50% (Table 5.B.6-177 to Table 5.B.6-182).

Table 5.B.6-177. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, All Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	148,704	121,983	175,426			
EBC2	147,294	120,521	174,066			
EBC2_ELT	141,441	115,840	167,041			
EBC2_LLT	129,448	105,659	153,236			
ESO_ELT	86,009	68,558	103,460	-42.2	-41.6	-39.2
ESO_LLT	80,607	63,878	97,336	-45.8	-45.3	-37.7
CVP						
EBC1	398,437	329,130	467,744			
EBC2	394,372	325,494	463,249			
EBC2_ELT	350,845	287,916	413,773			
EBC2_LLT	316,146	259,492	372,800			
ESO_ELT	226,145	187,402	264,888	-43.2	-42.7	-35.5
ESO_LLT	196,047	161,347	230,747	-50.8	-50.3	-38.0
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-178. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Wet Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference ESO_ELT or ESO_LLT vs. EBC1	Percent Difference ESO_ELT or ESO_LLT vs. EBC2	Percent Difference ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	483,850	345,668	622,033			
EBC2	494,843	353,600	636,086			
EBC2_ELT	470,567	335,451	605,683			
EBC2_LLT	435,611	310,608	560,614			
ESO_ELT	269,359	181,123	357,595	-44.3	-45.6	-42.8
ESO_LLT	271,782	185,165	358,400	-43.8	-45.1	-37.6
CVP						
EBC1	1,513,922	1,106,717	1,921,127			
EBC2	1,518,213	1,108,799	1,927,627			
EBC2_ELT	1,418,643	1,030,663	1,806,622			
EBC2_LLT	1,237,842	891,919	1,583,766			
ESO_ELT	691,744	496,216	887,272	-54.3	-54.4	-51.2
ESO_LLT	627,226	446,201	808,250	-58.6	-58.7	-49.3
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-179. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Above-Normal Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference ESO_ELT or ESO_LLT vs. EBC1	Percent Difference ESO_ELT or ESO_LLT vs. EBC2	Percent Difference ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	31,729	23,256	40,201			
EBC2	31,055	22,607	39,502			
EBC2_ELT	32,244	23,601	40,887			
EBC2_LLT	29,187	21,640	36,734			
ESO_ELT	20,527	14,667	26,388	-35.3	-33.9	-36.3
ESO_LLT	20,486	14,897	26,075	-35.4	-34.0	-29.8
CVP						
EBC1	100,947	61,573	140,321			
EBC2	102,964	63,862	142,066			
EBC2_ELT	88,977	53,720	124,234			
EBC2_LLT	85,657	52,356	118,958			
ESO_ELT	58,047	35,652	80,441	-42.5	-43.6	-34.8
ESO_LLT	51,171	30,731	71,611	-49.3	-50.3	-40.3
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-180. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Below-Normal Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	1,262	1,112	1,412			
EBC2	1,204	1,031	1,378			
EBC2_ELT	1,262	1,084	1,440			
EBC2_LLT	1,356	1,134	1,578			
ESO_ELT	1,040	845	1,235	-17.6	-13.6	-17.6
ESO_LLT	956	728	1,184	-24.2	-20.6	-29.5
CVP						
EBC1	8,720	7,834	9,607			
EBC2	8,721	7,860	9,581			
EBC2_ELT	8,132	7,344	8,921			
EBC2_LLT	8,309	7,190	9,428			
ESO_ELT	7,153	5,841	8,465	-18.0	-18.0	-12.0
ESO_LLT	6,543	5,076	8,009	-25.0	-25.0	-21.3
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-181. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Dry Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	565	493	638			
EBC2	567	494	640			
EBC2_ELT	546	472	620			
EBC2_LLT	508	436	579			
ESO_ELT	369	295	442	-34.8	-35.0	-32.5
ESO_LLT	282	216	348	-50.2	-50.3	-44.5
CVP						
EBC1	1,440	1,068	1,812			
EBC2	1,348	999	1,698			
EBC2_ELT	1,186	867	1,504			
EBC2_LLT	1,007	753	1,261			
ESO_ELT	1,057	755	1,358	-26.6	-21.6	-10.9
ESO_LLT	832	574	1,090	-42.2	-38.3	-17.4
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-182. Estimated Average May–July Salvage of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Critical Water Years

Scenario	**Mean**	**Lower 95% Confidence Limit**	**Upper 95% Confidence Limit**	**Percent Difference**		
				ESO_ELT or ESO_LLT vs. EBC1	**ESO_ELT or ESO_LLT vs. EBC2**	**ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT**
SWP						
EBC1	882	731	1,033			
EBC2	801	619	983			
EBC2_ELT	792	609	976			
EBC2_LLT	678	440	916			
ESO_ELT	408	225	592	-53.7	-49.0	-48.5
ESO_LLT	390	219	561	-55.8	-51.3	-42.5
CVP						
EBC1	449	377	522			
EBC2	416	359	473			
EBC2_ELT	384	322	446			
EBC2_LLT	396	310	482			
ESO_ELT	312	212	413	-30.5	-24.9	-18.7
ESO_LLT	314	202	426	-30.0	-24.4	-20.5
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Total Salvage Based on Yolo Bypass Inundation

In contrast to estimates of salvage from the per capita method described above, salvage estimated from days of Yolo Bypass inundation generally was estimated to increase considerably under ESO scenarios relative to EBC scenarios, reflecting the increased inundation of the Yolo Bypass under ESO scenarios that would lead to greater abundance of juvenile splittail. Across all water years, increases in estimated salvage under ESO scenarios compared to EBC scenarios at both facilities ranged from around 330% to 700% (Table 5.B.6-183). In wet years the percentage increase ranged from around 390% to 670% (Table 5.B.6-184). Increases in estimated salvage under ESO were greatest in above-normal years at around 1,000–2,700% more than EBC scenarios (Table 5.B.6-185). There were reductions in average salvage under ESO scenarios compared to EBC scenarios at the SWP facility in critical water years ranging from 44% to 60%; there were relatively low increases of 12% to 45% at the CVP facility in critical water years (Table 5.B.6-188). In the remaining water-year types (below-normal and dry), average increases in salvage under ESO relative to EBC ranged from around 50% to 750% (Table 5.B.6-186 to Table 5.B.6-188).

Table 5.B.6-183. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, All Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference: ESO_ELT or ESO_LLT vs. EBC1	Percent Difference: ESO_ELT or ESO_LLT vs. EBC2	Percent Difference: ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	83,624	14,360	542,685			
EBC2	83,478	14,298	544,432			
EBC2_ELT	105,898	16,530	755,720			
EBC2_LLT	103,472	15,733	764,249			
ESO_ELT	530,634	46,999	6,742,724	534.5	535.7	401.1
ESO_LLT	449,369	43,750	4,972,286	437.4	438.3	334.3
CVP						
EBC1	228,858	36,065	1,586,281			
EBC2	219,401	34,632	1,526,739			
EBC2_ELT	286,081	40,549	2,201,328			
EBC2_LLT	266,720	36,716	2,126,640			
ESO_ELT	1,763,256	141,479	24,741,429	670.5	703.7	516.3
ESO_LLT	1,345,264	118,666	16,289,778	487.8	513.2	404.4
Note: Positive difference values indicate higher salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-184. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Wet Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference: ESO_ELT or ESO_LLT vs. EBC1	Percent Difference: ESO_ELT or ESO_LLT vs. EBC2	Percent Difference: ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	254,765	41,077	1,687,146			
EBC2	255,695	41,256	1,698,444			
EBC2_ELT	324,979	47,942	2,359,587			
EBC2_LLT	318,407	45,875	2,389,338			
ESO_ELT	1,583,347	132,352	20,650,077	521.5	519.2	387.2
ESO_LLT	1,304,776	119,923	14,845,785	412.1	410.3	309.8
CVP						
EBC1	705,094	106,321	4,955,113			
EBC2	677,301	102,260	4,777,179			
EBC2_ELT	886,964	121,103	6,900,704			
EBC2_LLT	828,112	109,978	6,670,218			
ESO_ELT	5,218,242	397,274	75,263,516	640.1	670.4	488.3
ESO_LLT	4,003,657	338,116	49,505,997	467.8	491.1	383.5
Note: Positive difference values indicate higher salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-185. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Above-Normal Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	15,665	5,646	48,683			
EBC2	12,819	4,982	36,339			
EBC2_ELT	15,923	5,804	47,604			
EBC2_LLT	13,796	5,038	41,644			
ESO_ELT	182,262	28,194	1,301,892	1,063.5	1,321.9	1,044.7
ESO_LLT	234,998	34,613	1,793,016	1,400.1	1,733.3	1,603.4
CVP						
EBC1	30,106	10,551	96,718			
EBC2	25,931	9,788	75,601			
EBC2_ELT	27,597	9,796	84,397			
EBC2_LLT	23,370	8,164	74,137			
ESO_ELT	715,222	93,535	5,926,773	2275.7	2658.1	2491.7
ESO_LLT	501,303	69,715	4,013,865	1565.1	1833.2	2045.0
Note: Positive difference values indicate higher salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-186. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Below-Normal Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	1,284	1,150	1,458			
EBC2	1,212	1,095	1,366			
EBC2_ELT	1,316	1,148	1,553			
EBC2_LLT	1,223	1,093	1,399			
ESO_ELT	8,458	3,471	22,483	558.6	597.9	542.6
ESO_LLT	5,150	2,405	11,964	301.1	325.0	321.3
CVP						
EBC1	2,132	1,904	2,430			
EBC2	2,108	1,884	2,405			
EBC2_ELT	2,055	1,760	2,475			
EBC2_LLT	1,762	1,552	2,051			
ESO_ELT	17,389	6,743	48,569	715.5	724.7	746.3
ESO_LLT	10,172	4,522	24,768	377.1	382.4	477.4
Note: Positive difference values indicate higher salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-187. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Dry Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	1,074	983	1,209			
EBC2	1,069	978	1,204			
EBC2_ELT	1,007	927	1,126			
EBC2_LLT	1,020	916	1,177			
ESO_ELT	2,029	1,291	3,362	88.8	89.7	101.5
ESO_LLT	1,617	1,003	2,767	50.5	51.2	58.6
CVP						
EBC1	1,808	1,635	2,065			
EBC2	1,744	1,570	2,005			
EBC2_ELT	1,649	1,452	1,955			
EBC2_LLT	1,517	1,324	1,816			
ESO_ELT	4,167	2,544	7,209	130.5	139.0	152.7
ESO_LLT	2,694	1,734	4,466	49.0	54.5	77.6
Note: Positive difference values indicate higher salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-188. Estimated Average May–July Salvage (Estimated from Number of Days of Yolo Bypass Inundation) of Juvenile Sacramento Splittail at the South Delta SWP and CVP Export Facilities under Each Model Scenario and Percentage Difference between Model Scenarios, Critical Water Years

Scenario	Mean	Lower 95% Confidence Limit	Upper 95% Confidence Limit	Percent Difference		
				ESO_ELT or ESO_LLT vs. EBC1	ESO_ELT or ESO_LLT vs. EBC2	ESO_ELT or ESO_LLT vs. EBC2_ELT or EBC2_LLT
SWP						
EBC1	666	666	666			
EBC2	590	590	590			
EBC2_ELT	544	544	544			
EBC2_LLT	425	425	425			
ESO_ELT	243	219	280	-63.5	-58.8	-55.4
ESO_LLT	239	201	298	-64.2	-59.5	-43.8
CVP						
EBC1	856	856	856			
EBC2	745	745	745			
EBC2_ELT	666	666	666			
EBC2_LLT	647	647	647			
ESO_ELT	964	791	1,230	12.6	29.3	44.7
ESO_LLT	836	708	1,030	-2.3	12.1	29.3
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.7.2 Adult

Salvage-Density Method (per Capita Entrainment [Salvage] Index)

The main entrainment period for adult Sacramento splittail occurs from December to March, and the entrainment analyses were focused on this period. General trends in estimated salvage for adult Sacramento splittail include higher salvage at SWP than CVP and decreasing salvage as water years become drier (Table 5.B.6-189 to Table 5.B.6-194). Salvage under the ESO scenarios was lower than EBC scenarios, but the differences decreased as water years become drier.

Over all water years, differences between EBC and ESO scenarios were quite consistent, with decreases under ESO scenarios compared to EBC scenarios of 52–54% (1,800–1,900 adult Sacramento splittail; Table 5.B.6-195). Decreases under ESO scenarios compared to EBC scenarios were found for wet years (2,800–3,000, 70–72%; Table 5.B.6-196), above-normal years (2,900–3,300, 62–68%; Table 5.B.6-197), below-normal years (1,000–1,300, 32–40%; Table 5.B.6-198), dry years (620–800 fish, 26–32%; Table 5.B.6-199), and critical years (500–830 fish, 15–24%; Table 5.B.6-200).

Table 5.B.6-189. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	128	±	14	129	±	14	126	±	14	124	±	14	95	±	10	98	±	11
January	322	±	23	327	±	24	332	±	25	328	±	24	170	±	14	160	±	13
February	741	±	60	753	±	61	766	±	64	713	±	59	374	±	33	354	±	32
March	1203	±	94	1228	±	98	1229	±	100	1193	±	99	426	±	37	473	±	43
(b) CVP																		
December	47	±	4	50	±	5	49	±	4	44	±	4	43	±	4	38	±	4
January	285	±	16	281	±	17	282	±	17	272	±	16	160	±	11	174	±	12
February	255	±	16	245	±	16	248	±	16	251	±	17	122	±	10	135	±	11
March	507	±	41	506	±	41	496	±	41	484	±	41	222	±	22	211	±	21

Table 5.B.6-190. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Wet Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	178	±	58	182	±	60	188	±	62	190	±	63	116	±	39	128	±	43
January	241	±	43	247	±	45	256	±	46	247	±	45	93	±	22	90	±	19
February	423	±	70	427	±	72	443	±	74	421	±	72	146	±	36	127	±	32
March	1,289	±	265	1,357	±	281	1,386	±	286	1,337	±	280	251	±	87	287	±	99
(b) CVP																		
December	61	±	12	62	±	12	62	±	12	59	±	12	50	±	10	47	±	10
January	256	±	46	267	±	49	270	±	50	265	±	49	131	±	30	158	±	36
February	418	±	56	420	±	58	430	±	59	440	±	60	77	±	23	133	±	35
March	1,093	±	204	1,105	±	212	1,120	±	214	1,134	±	217	306	±	103	267	±	81

Table 5.B.6-191. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Above-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	105	±	23	107	±	24	107	±	23	107	±	23	84	±	17	81	±	17
January	375	±	94	405	±	112	425	±	122	413	±	116	242	±	68	186	±	49
February	840	±	349	843	±	356	860	±	371	843	±	359	272	±	157	359	±	180
March	2,201	±	895	2,151	±	869	2,202	±	905	2,251	±	973	421	±	181	583	±	296
(b) CVP																		
December	27	±	7	29	±	7	29	±	8	26	±	7	24	±	7	23	±	7
January	462	±	104	443	±	97	389	±	94	435	±	100	219	±	72	294	±	89
February	359	±	122	314	±	120	343	±	127	351	±	123	178	±	76	187	±	77
March	453	±	64	459	±	68	430	±	68	412	±	71	89	±	22	102	±	36

Table 5.B.6-192. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Below-Normal Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	81	±	15	84	±	13	78	±	14	78	±	16	66	±	11	70	±	18
January	196	±	23	204	±	31	208	±	35	191	±	45	109	±	35	123	±	32
February	952	±	278	973	±	289	1,043	±	325	880	±	243	662	±	153	595	±	204
March	881	±	177	894	±	199	900	±	209	833	±	207	422	±	67	543	±	120
(b) CVP																		
December	24	±	1	25	±	2	24	±	2	22	±	3	21	±	2.8	19	±	4
January	338	±	40	324	±	45	327	±	44	287	±	56	199	±	51.5	201	±	53
February	99	±	20	92	±	18	76	±	19	94	±	20	57	±	20.2	64	±	16
March	811	±	140	737	±	132	717	±	133	730	±	169	491	±	113.1	491	±	128

Table 5.B.6-193. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Dry Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	179	±	57	185	±	59	180	±	59	172	±	58	138	±	43	130	±	43
January	427	±	148	419	±	146	415	±	145	436	±	152	274	±	106	261	±	104
February	599	±	148	598	±	153	565	±	143	511	±	135	424	±	107	393	±	109
March	667	±	182	662	±	179	623	±	167	616	±	163	504	±	139	473	±	129
(b) CVP																		
December	87	±	31	97	±	35	93	±	34	86	±	33	86	±	31	77	±	30
January	213	±	77	215	±	78	225	±	82	210	±	78	129	±	53	122	±	53
February	86	±	22	87	±	21	88	±	22	81	±	22	65	±	18	62	±	17
March	189	±	38	192	±	37	194	±	37	172	±	34	148	±	32	141	±	31

Table 5.B.6-194. Estimated Mean Monthly Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Adult Sacramento Splittail for Six Model Scenarios at the SWP and CVP Salvage Facilities in December–March for Critical Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
December	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A
January	154	±	34	144	±	37	133	±	42	146	±	29	99	±	38	87	±	41
February	1,724	±	445	1,891	±	502	1,765	±	361	1,723	±	438	1,516	±	366	1,487	±	258
March	791	±	227	786	±	266	695	±	230	667	±	246	628	±	148	563	±	175
(b) CVP																		
December	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A	0	±	N/A
January	337	±	55	299	±	60	312	±	62	292	±	71	234	±	60	226	±	60
February	270	±	63	244	±	71	277	±	59	237	±	64	222	±	38	201	±	51
March	69	±	22	74	±	27	64	±	21	58	±	21	54	±	18	47	±	19

Table 5.B.6-195. Estimated Absolute and Percent Differences between Model Scenarios in Adult Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities in December–March during All Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-37 (-21%)	-39 (-22%)	-41 (-23%)	-43 (-24%)	-37 (-21%)	-32 (-19%)
January	-276 (-46%)	-271 (-45%)	-279 (-46%)	-274 (-45%)	-285 (-46%)	-266 (-44%)
February	-500 (-50%)	-507 (-51%)	-503 (-50%)	-510 (-51%)	-517 (-51%)	-475 (-49%)
March	-1,061 (-62%)	-1,026 (-60%)	-1,086 (-63%)	-1,051 (-61%)	-1,077 (-62%)	-993 (-59%)
Average (December–March)	-1,875 (-54%)	-1,843 (-53%)	-1,909 (-54%)	-1,877 (-53%)	-1,916 (-54%)	-1,765 (-52%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-196. Estimated Absolute and Percent Differences between Model Scenarios in Adult Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities in December–March during Wet Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-73 (-31%)	-63 (-27%)	-79 (-32%)	-69 (-28%)	-84 (-34%)	-74 (-30%)
January	-273 (-55%)	-248 (-50%)	-290 (-56%)	-266 (-52%)	-302 (-57%)	-265 (-52%)
February	-618 (-73%)	-581 (-69%)	-624 (-74%)	-587 (-69%)	-650 (-74%)	-601 (-70%)
March	-1,826 (-77%)	-,1829 (-77%)	-1,906 (-77%)	-1,909 (-78%)	-1,949 (-78%)	-1,918 (-78%)
Average (December–March)	-2,790 (-70%)	-2,722 (-69%)	-2,899 (-71%)	-2,830 (-70%)	-2,986 (-72%)	-2,857 (-70%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-197. Estimated Absolute and Percent Differences between Model Scenarios in Adult Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities in December–March during Above-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-24 (-18%)	-29 (-22%)	-28 (-21%)	-33 (-24%)	-28 (-21%)	-30 (-23%)
January	-377 (-45%)	-358 (-43%)	-388 (-46%)	-369 (-44%)	-354 (-43%)	-368 (-43%)
February	-748 (-62%)	-653 (-54%)	-707 (-61%)	-611 (-53%)	-753 (-63%)	-648 (-54%)
March	-2,145 (-81%)	-1,969 (-74%)	-2,100 (-80%)	-1,925 (-74%)	-2,122 (-81%)	-1,979 (-74%)
Average (December–March)	-3,294 (-68%)	-3,009 (-62%)	-3,223 (-68%)	-2,938 (-62%)	-3,258 (-68%)	-3,024 (-63%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-198. Estimated Absolute and Percent Differences between Model Scenarios in Adult Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities in December–March during Below-Normal Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-17 (-17%)	-16 (-15%)	-22 (-20%)	-21 (-19%)	-15 (-14%)	-11 (-11%)
January	-225 (-42%)	-209 (-39%)	-220 (-42%)	-204 (-39%)	-227 (-42%)	-155 (-32%)
February	-331 (-32%)	-392 (-37%)	-345 (-32%)	-406 (-38%)	-400 (-36%)	-315 (-32%)
March	-779 (-46%)	-658 (-39%)	-718 (-44%)	-598 (-37%)	-703 (-44%)	-530 (-34%)
Average (December–March)	-1,352 (-40%)	-1,276 (-38%)	-1,305 (-39%)	-1,228 (-37%)	-1,344 (-40%)	-1,011 (-32%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-199. Estimated Absolute and Percent Differences between Model Scenarios in Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Dry Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	-42 (-16%)	-59 (-22%)	-58 (-21%)	-76 (-27%)	-49 (-18%)	-51 (-20%)
January	-238 (-37%)	-257 (-40%)	-232 (-37%)	-251 (-40%)	-238 (-37%)	-262 (-41%)
February	-196 (-29%)	-231 (-34%)	-196 (-29%)	-230 (-34%)	-164 (-25%)	-138 (-23%)
March	-204 (-24%)	-242 (-28%)	-202 (-24%)	-240 (-28%)	-165 (-20%)	-174 (-22%)
Average (December–March)	-680 (-28%)	-790 (-32%)	-687 (-28%)	-797 (-32%)	-616 (-26%)	-625 (-27%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Table 5.B.6-200. Estimated Absolute and Percent Differences between Model Scenarios in Sacramento Splittail Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Critical Water Years

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
January	-159 (-32%)	-178 (-36%)	-111 (-25%)	-130 (-29%)	-113 (-25%)	-125 (-29%)
February	-257 (-13%)	-307 (-15%)	-398 (-19%)	-447 (-21%)	-304 (-15%)	-272 (-14%)
March	-179 (-21%)	-250 (-29%)	-179 (-21%)	-250 (-29%)	-78 (-10%)	-115 (-16%)
Average (December–March)	-594 (-18%)	-735 (-22%)	-687 (-20%)	-828 (-24%)	-494 (-15%)	-512 (-16%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.8 White Sturgeon (Juvenile)

5.B.6.1.8.1 Salvage-Density Method

Analysis Based on Sacramento Valley Water Year–Type Classification

Wetter Year Analysis

The mean entrainment indices for white sturgeon at the SWP and CVP export facilities based on Sacramento Valley wet and above-normal water-year types are estimated to be variable throughout the year (Figure 5.B.6-24, Figure 5.B.6-25, and Table 5.B.6-201). The SWP salvage estimates suggest peaks in November and February under all model scenarios (although more pronounced under EBC scenarios) and lows in April and May. Salvage is estimated to peak in October and November at the CVP facility under all model scenarios. Total annual average salvage of juvenile white sturgeon at SWP was estimated around 130–140 fish under EBC scenarios and just under 60 fish under the two ESO scenarios. At the CVP, EBC scenario annual salvage ranged from 110 to 125 white sturgeon, and ESO scenario salvage was about 50 white sturgeon.

Reductions in salvage under ESO scenarios compared to EBC scenarios ranged from very little change in April–June (7 or fewer fish per month) to considerable changes in November (12–30 fewer fish, or ~25–62% reduction) (Table 5.B.6-202). The overall annual average reduction in salvage of juvenile white sturgeon from EBC scenarios to ESO scenarios was estimated to be around 125–150 fish (46–58% reduction).

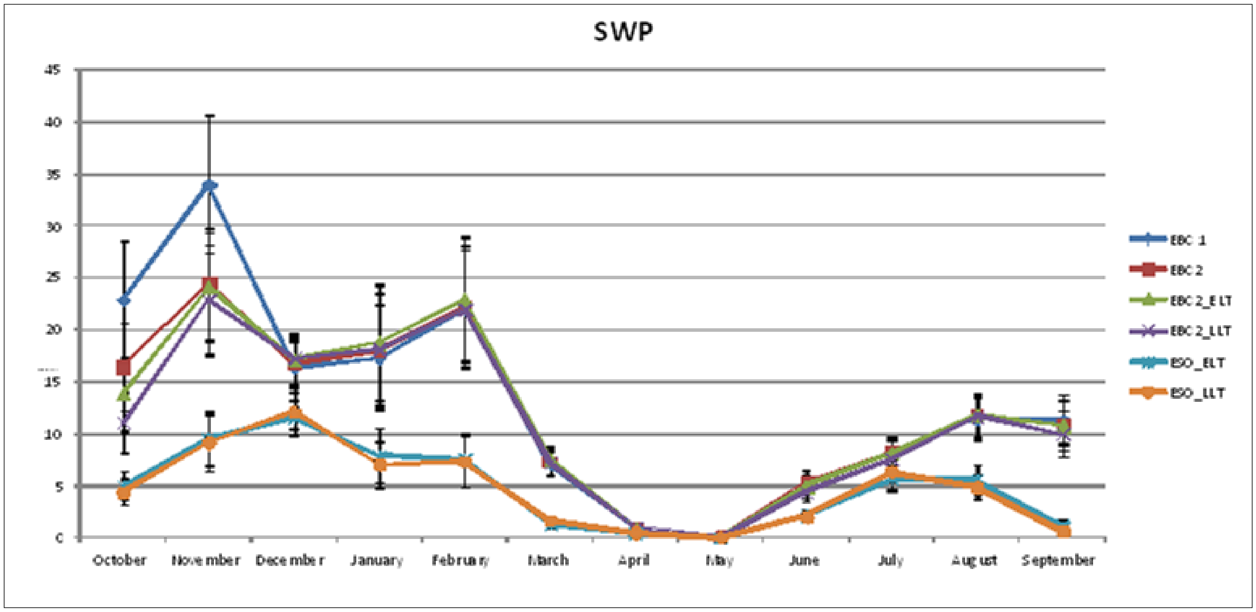

Figure 5.B.6-24. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

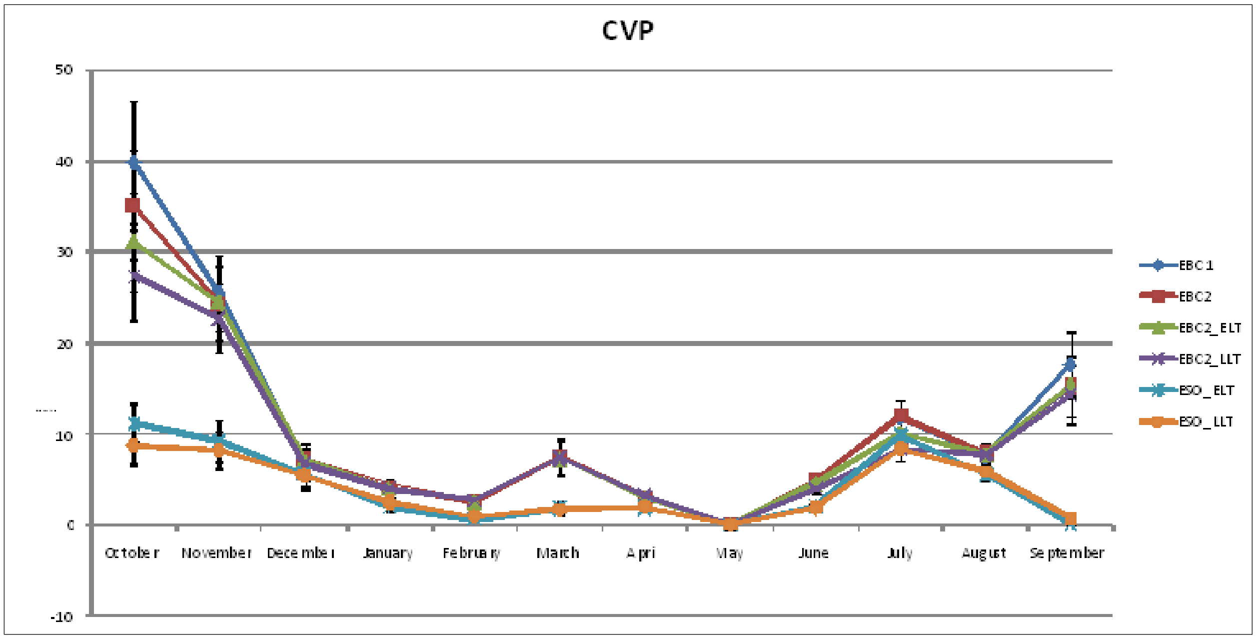

Figure 5.B.6-25. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

Table 5.B.6-201. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	23	±	6	16	±	4	14	±	4	11	±	3	5	±	1	4	±	1
November	34	±	7	24	±	5	24	±	5	23	±	5	10	±	3	9	±	3
December	16	±	2	17	±	2	17	±	2	17	±	3	12	±	2	12	±	2
January	17	±	5	18	±	5	19	±	6	18	±	5	8	±	3	7	±	2
February	22	±	6	22	±	6	23	±	6	22	±	6	8	±	3	7	±	2
March	7	±	1	7	±	1	7	±	1	7	±	1	1	±	0	2	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	5	±	1	5	±	1	5	±	1	4	±	1	2	±	1	2	±	0
July	8	±	1	8	±	1	8	±	1	8	±	1	6	±	1	6	±	1
August	11	±	2	12	±	2	12	±	2	12	±	2	6	±	1	5	±	1
September	11	±	2	11	±	2	11	±	2	10	±	2	1	±	1	1	±	0
Annual Average	157	±	18	142	±	17	141	±	16	133	±	15	58	±	7	56	±	7
(b) CVP																		
October	40	±	7	35	±	6	31	±	5	27	±	5	11	±	2	9	±	2
November	25	±	4	24	±	4	24	±	4	23	±	4	9	±	2	8	±	2
December	7	±	2	7	±	2	7	±	2	7	±	2	6	±	1	5	±	1
January	4	±	1	4	±	1	4	±	1	4	±	1	2	±	0	3	±	1
February	3	±	1	3	±	1	3	±	1	3	±	1	1	±	0	1	±	0
March	7	±	2	7	±	2	7	±	2	7	±	2	2	±	1	2	±	1
April	3	±	1	3	±	1	3	±	1	3	±	1	2	±	0	2	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	5	±	1	5	±	1	5	±	1	4	±	1	2	±	0	2	±	0
July	12	±	2	12	±	2	10	±	2	8	±	1	10	±	2	9	±	1
August	8	±	1	8	±	1	8	±	1	8	±	1	6	±	1	6	±	1
September	18	±	4	15	±	3	15	±	3	14	±	3	0	±	0	1	±	1
Annual Average	132	±	16	124	±	16	118	±	15	109	±	14	51	±	7	47	±	7

Table 5.B.6-202. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-46 (-74%)	-50 (-79%)	-35 (-68%)	-38 (-75%)	-29 (-64%)	-25 (-66%)
November	-41 (-69%)	-42 (-71%)	-30 (-62%)	-31 (-64%)	-30 (-62%)	-28 (-62%)
December	-6 (-26%)	-6 (-25%)	-7 (-28%)	-6 (-27%)	-7 (-29%)	-6 (-27%)
January	-12 (-54%)	-12 (-55%)	-12 (-55%)	-13 (-57%)	-13 (-57%)	-13 (-57%)
February	-16 (-67%)	-16 (-66%)	-17 (-67%)	-16 (-66%)	-17 (-68%)	-16 (-66%)
March	-11 (-78%)	-11 (-76%)	-12 (-78%)	-11 (-77%)	-12 (-78%)	-11 (-77%)
April	-2 (-38%)	-1 (-37%)	-2 (-39%)	-1 (-37%)	-2 (-40%)	-2 (-41%)
May	0 (-46%)	0 (-53%)	0 (-46%)	0 (-53%)	0 (-48%)	0 (-54%)
June	-6 (-58%)	-6 (-61%)	-6 (-58%)	-6 (-62%)	-5 (-54%)	-4 (-53%)
July	-5 (-24%)	-5 (-27%)	-5 (-24%)	-6 (-27%)	-3 (-15%)	-1 (-7%)
August	-8 (-41%)	-8 (-44%)	-8 (-42%)	-9 (-45%)	-8 (-42%)	-9 (-44%)
September	-28 (-96%)	-28 (-95%)	-25 (-95%)	-25 (-95%)	-25 (-95%)	-23 (-94%)
Annual Average	-46 (-74%)	-50 (-79%)	-35 (-68%)	-38 (-75%)	-29 (-64%)	-25 (-66%)

Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

Drier Year Analysis

Overall salvage of white sturgeon juveniles was estimated to be considerably lower in drier years than wetter years. The SWP salvage estimates suggest peaks in December and August under all model scenarios (Figure 5.B.6-26), with small differences between scenarios. Salvage is estimated to peak in February–April and July–August at the CVP facility under all model scenarios (Figure 5.B.6-27). Total annual average salvage of juvenile white sturgeon at SWP was estimated to be 22–24 fish per year under EBC scenarios and 16 fish under ESO scenarios (Table 5.B.6-203). At the CVP, EBC scenario total annual salvage ranged from 12 to 13 white sturgeon, and ESO scenario salvage was 9–10 white sturgeon.

Reductions in salvage at both facilities combined under ESO scenarios compared to EBC scenarios were low throughout the year (fewer than 4 white sturgeon per month, with many months of no change) (Table 5.B.6-204). The overall annual average decrease in salvage under ESO scenarios compared to EBC scenarios ranged from 9 to 13 white sturgeon (26–34% reductions).

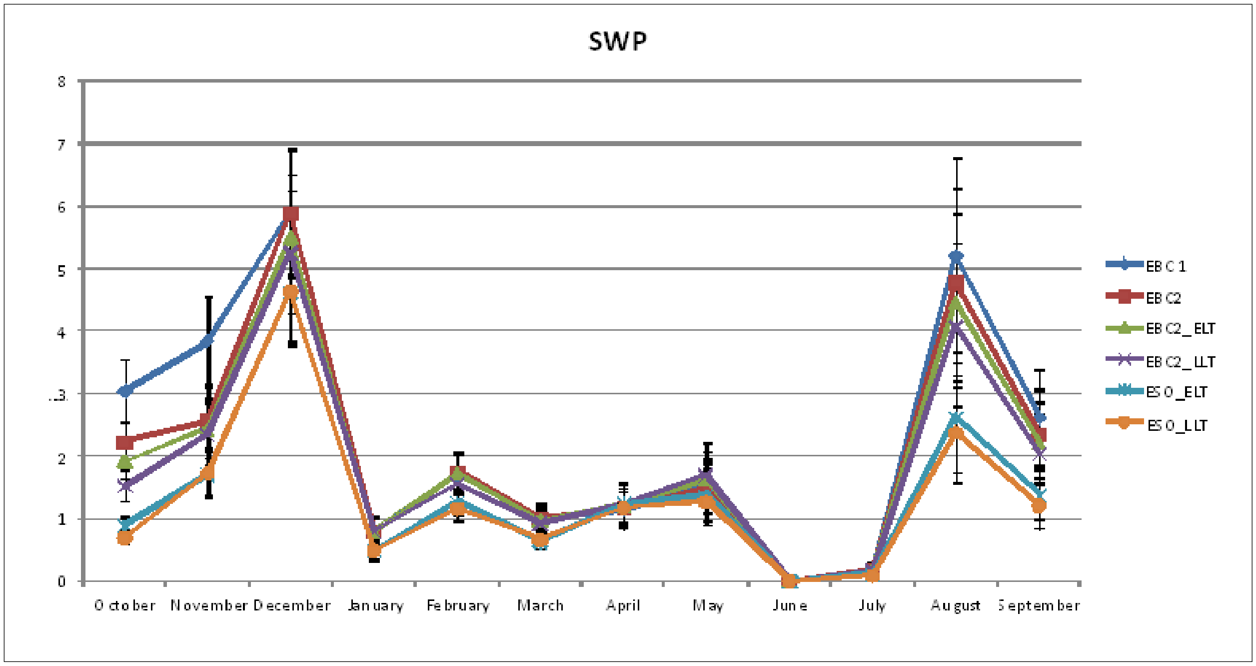

Figure 5.B.6-26. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification)

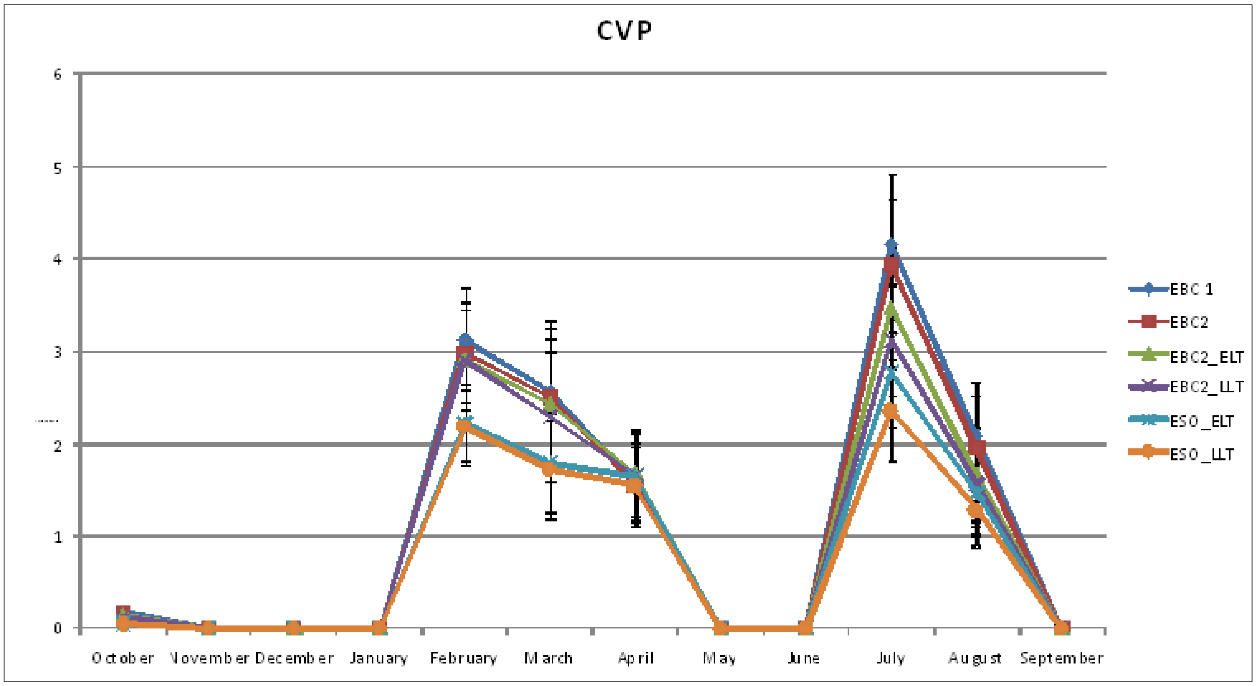

Figure 5.B.6-27. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification)

Table 5.B.6-203. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (Sacramento Valley Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	3	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
November	4	±	1	3	±	1	2	±	0	2	±	0	2	±	0	2	±	0
December	6	±	1	6	±	1	6	±	1	5	±	1	5	±	1	5	±	1
January	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
February	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
March	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	2	±	0	1	±	0	2	±	0	2	±	0	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	5	±	2	5	±	1	4	±	1	4	±	1	3	±	1	2	±	1
September	3	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
Annual Average	27	±	3	24	±	3	23	±	3	22	±	2	16	±	2	16	±	2
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	3	±	1	3	±	1	3	±	1	3	±	1	2	±	0	2	±	0
March	3	±	1	2	±	1	2	±	1	2	±	1	2	±	1	2	±	1
April	2	±	0	2	±	0	2	±	0	2	±	0	2	±	1	2	±	1
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	4	±	1	4	±	1	3	±	1	3	±	1	3	±	1	2	±	1
August	2	±	1	2	±	1	2	±	1	2	±	0	2	±	1	1	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	14	±	2	13	±	2	12	±	2	12	±	2	10	±	2	9	±	2

Table 5.B.6-204. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (Sacramento Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-2 (-71%)	-2 (-77%)	-1 (-60%)	-2 (-69%)	-1 (-54%)	-1 (-55%)
November	-2 (-55%)	-2 (-55%)	-1 (-33%)	-1 (-32%)	-1 (-30%)	-1 (-26%)
December	-1 (-22%)	-1 (-21%)	-1 (-22%)	-1 (-21%)	-1 (-16%)	-1 (-12%)
January	-0.3 (-39%)	-0.3 (-39%)	-0.3 (-38%)	-0.3 (-39%)	-0.3 (-37%)	-0.3 (-39%)
February	-1 (-28%)	-1 (-31%)	-1 (-27%)	-1 (-29%)	-1 (-25%)	-1 (-25%)
March	-1 (-32%)	-1 (-33%)	-1 (-31%)	-1 (-32%)	-1 (-28%)	-1 (-26%)
April	0.2 (7%)	0.02 (1%)	0.2 (6%)	0 (0%)	0 (0%)	-0.2 (-6%)
May	-0.2 (-10%)	-0.3 (-17%)	-0.1 (-8%)	-0.2 (-14%)	-0.2 (-15%)	-0.4 (-25%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	-1 (-34%)	-2 (-44%)	-1 (-30%)	-2 (-41%)	-1 (-21%)	-1 (-26%)
August	-3 (-44%)	-4 (-50%)	-3 (-39%)	-3 (-46%)	-2 (-33%)	-2 (-35%)
September	-1 (-47%)	-1 (-54%)	-1 (-41%)	-1 (-48%)	-1 (-37%)	-1 (-40%)
Annual Average	-14 (-35%)	-16 (-39%)	-11 (-30%)	-13 (-34%)	-9 (-26%)	-9 (-26%)

Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

Analysis Based on San Joaquin Valley Water Year–Type Classification

Wetter Year Analysis

The mean entrainment indices for white sturgeon at the SWP and CVP export facilities based on San Joaquin Valley wet and above-normal water-year types were estimated to be variable throughout the year (Figure 5.B.6-28, Figure 5.B.6-29, and Table 5.B.6-205). The SWP salvage estimates suggest peaks in November (all model scenarios) and February (EBC scenarios) and lows in April and May (all scenarios). Salvage was estimated to peak in October and November at the CVP facility under all model scenarios. Total annual average salvage of juvenile white sturgeon at SWP was estimated to be around 150–160 fish under EBC scenarios and just under 70 fish under the two ESO scenarios. At the CVP, EBC scenario average annual salvage ranged from 120 to 140 white sturgeon, and ESO scenario salvage was around 60 white sturgeon.

Reductions in salvage under ESO scenarios compared to EBC scenarios ranged from very little change in April–May (0–2 fewer fish per month) to considerable changes in September–November (around 25–40 fewer fish, or 55–90% reduction) (Table 5.B.6-206). The overall annual average reduction in salvage of juvenile white sturgeon from EBC scenarios to ESO scenarios was estimated to be around 150–180 fish (54–59% reduction).

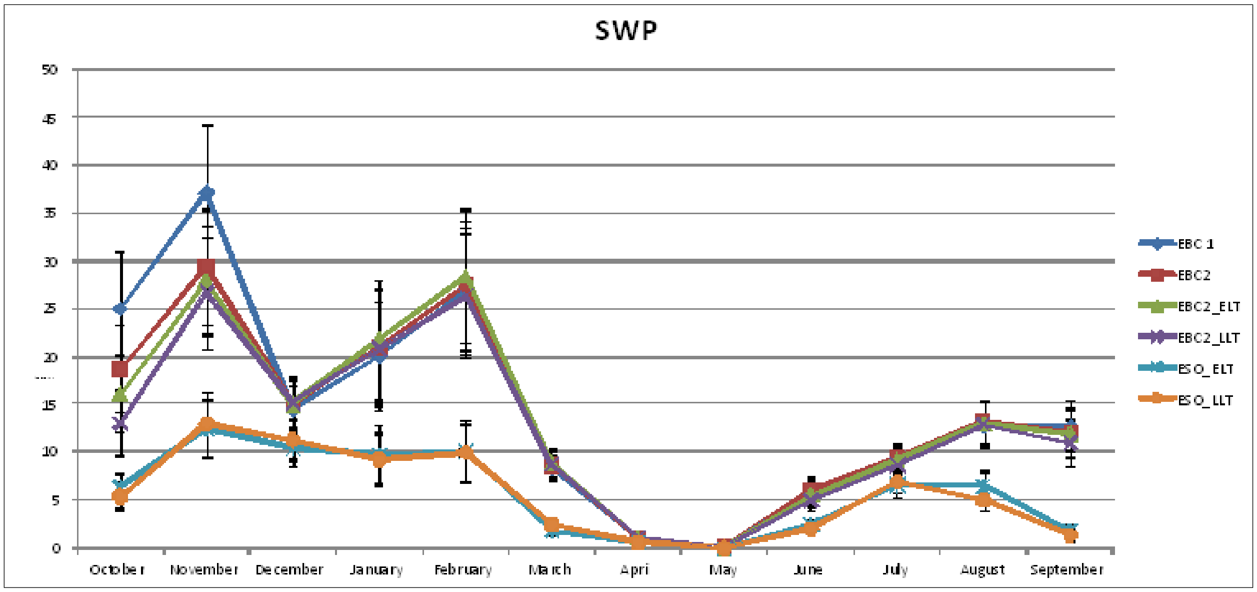

Figure 5.B.6-28. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

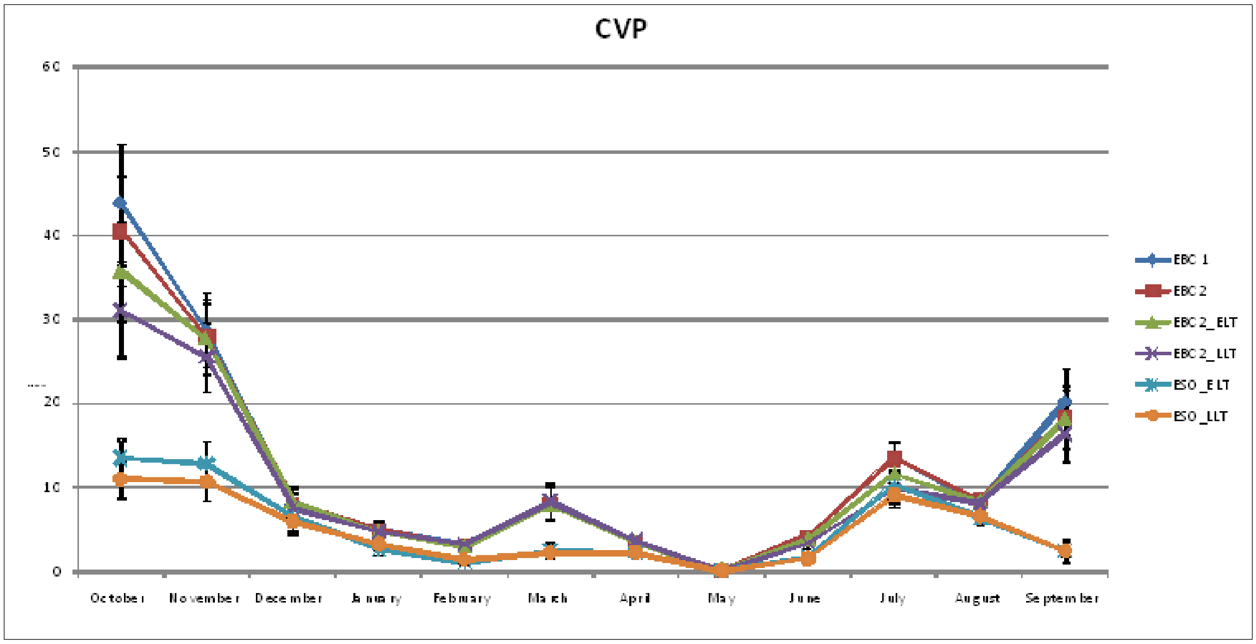

Figure 5.B.6-29. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

Table 5.B.6-205. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (San Joaquin Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	25	±	6	19	±	5	16	±	4	13	±	3	6	±	2	5	±	1
November	37	±	7	29	±	6	28	±	6	27	±	6	13	±	3	13	±	3
December	15	±	3	15	±	3	15	±	3	15	±	3	11	±	2	11	±	2
January	20	±	6	21	±	6	22	±	6	21	±	6	10	±	3	9	±	3
February	27	±	7	27	±	7	29	±	7	26	±	7	10	±	3	10	±	3
March	8	±	1	9	±	1	9	±	1	9	±	1	2	±	0	2	±	1
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	6	±	1	6	±	1	6	±	1	5	±	1	3	±	1	2	±	0
July	9	±	1	10	±	1	9	±	1	9	±	1	7	±	1	7	±	1
August	13	±	2	13	±	2	13	±	2	13	±	2	7	±	2	5	±	1
September	13	±	3	12	±	2	12	±	2	11	±	2	2	±	1	1	±	1
Annual Average	174	±	19	162	±	18	159	±	18	150	±	17	69	±	8	67	±	8
(b) CVP																		
October	44	±	7	40	±	7	36	±	6	31	±	5	14	±	2	11	±	2
November	29	±	4	28	±	4	28	±	4	25	±	4	13	±	3	11	±	2
December	8	±	2	8	±	2	8	±	2	8	±	2	7	±	2	6	±	2
January	5	±	1	5	±	1	5	±	1	5	±	1	3	±	1	3	±	1
February	3	±	1	3	±	1	3	±	1	3	±	1	1	±	0	1	±	0
March	8	±	2	8	±	2	8	±	2	8	±	2	2	±	1	2	±	1
April	3	±	1	3	±	1	4	±	1	4	±	1	2	±	0	2	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	4	±	1	4	±	1	4	±	1	3	±	1	2	±	0	2	±	0
July	13	±	2	13	±	2	12	±	2	10	±	2	10	±	2	9	±	2
August	8	±	1	8	±	1	8	±	1	8	±	1	6	±	1	7	±	1
September	20	±	4	18	±	4	18	±	4	16	±	3	2	±	1	2	±	1
Annual Average	146	±	17	140	±	17	132	±	15	121	±	14	62	±	8	56	±	7

Table 5.B.6-206. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-49 (-71%)	-52 (-76%)	-39 (-67%)	-43 (-72%)	-32 (-62%)	-28 (-63%)
November	-41 (-62%)	-42 (-64%)	-32 (-56%)	-34 (-59%)	-30 (-54%)	-29 (-55%)
December	-5 (-24%)	-5 (-23%)	-6 (-27%)	-6 (-25%)	-6 (-27%)	-5 (-24%)
January	-12 (-50%)	-12 (-50%)	-13 (-52%)	-13 (-52%)	-14 (-53%)	-13 (-51%)
February	-19 (-63%)	-19 (-62%)	-19 (-64%)	-19 (-63%)	-20 (-65%)	-18 (-62%)
March	-12 (-74%)	-12 (-72%)	-12 (-74%)	-12 (-72%)	-13 (-75%)	-12 (-73%)
April	-2 (-38%)	-2 (-37%)	-2 (-38%)	-2 (-38%)	-2 (-39%)	-2 (-41%)
May	-0.1 (-47%)	-0.1 (-52%)	-0.1 (-47%)	-0.1 (-52%)	-0.1 (-49%)	-0.1 (-52%)
June	-6 (-58%)	-7 (-65%)	-6 (-58%)	-7 (-65%)	-5 (-54%)	-5 (-57%)
July	-6 (-26%)	-7 (-30%)	-6 (-26%)	-7 (-30%)	-4 (-19%)	-2 (-13%)
August	-8 (-39%)	-10 (-45%)	-9 (-41%)	-10 (-46%)	-8 (-40%)	-9 (-45%)
September	-29 (-87%)	-29 (-89%)	-26 (-86%)	-27 (-88%)	-26 (-86%)	-24 (-86%)
Annual Average	-189 (-59%)	-197 (-61%)	-171 (-57%)	-179 (-59%)	-161 (-55%)	-148 (-54%)

Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

Drier Year Analysis

Overall salvage of white sturgeon juveniles was estimated to be considerably lower in drier years than wetter years. The SWP salvage estimates suggest peaks in December and August under all model scenarios (Figure 5.B.6-30). Salvage is estimated to peak in February–April and July–August at the CVP facility under all model scenarios (Figure 5.B.6-31). Total annual average salvage of juvenile white sturgeon at SWP was estimated to be 22–24 fish per year under EBC scenarios and 16–17 fish per year under ESO scenarios (Table 5.B.6-207). At CVP, EBC scenario total annual salvage ranged from 10 to 12 white sturgeon, and ESO scenario salvage was 8–9 white sturgeon.

Changes in salvage at both facilities combined under ESO scenarios compared to EBC scenarios were usually lower salvage under ESO scenarios and were low throughout the year (fewer than 3 white sturgeon per month, with several months of little change) (Table 5.B.6-208). The overall annual average decrease in salvage under ESO scenarios compared to EBC scenarios ranged from 8 to 12 white sturgeon (25–34% reductions).

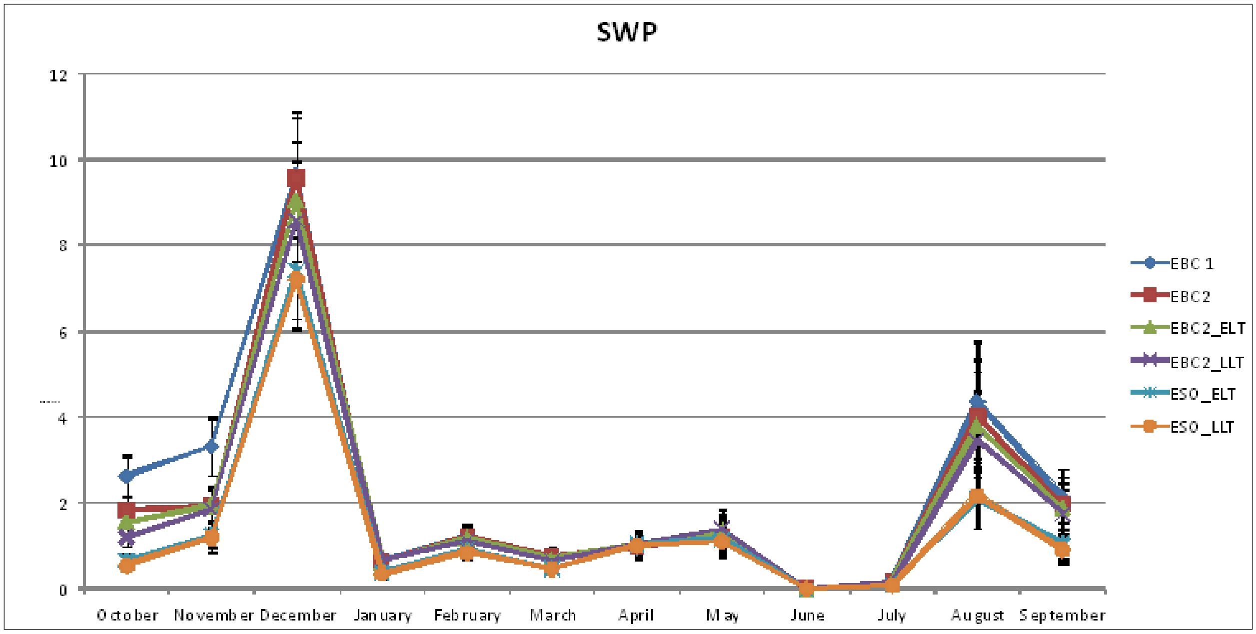

Figure 5.B.6-30. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Below-Normal, Dry, and Critical Years (San Joaquin Valley Water Year–Type Classification)

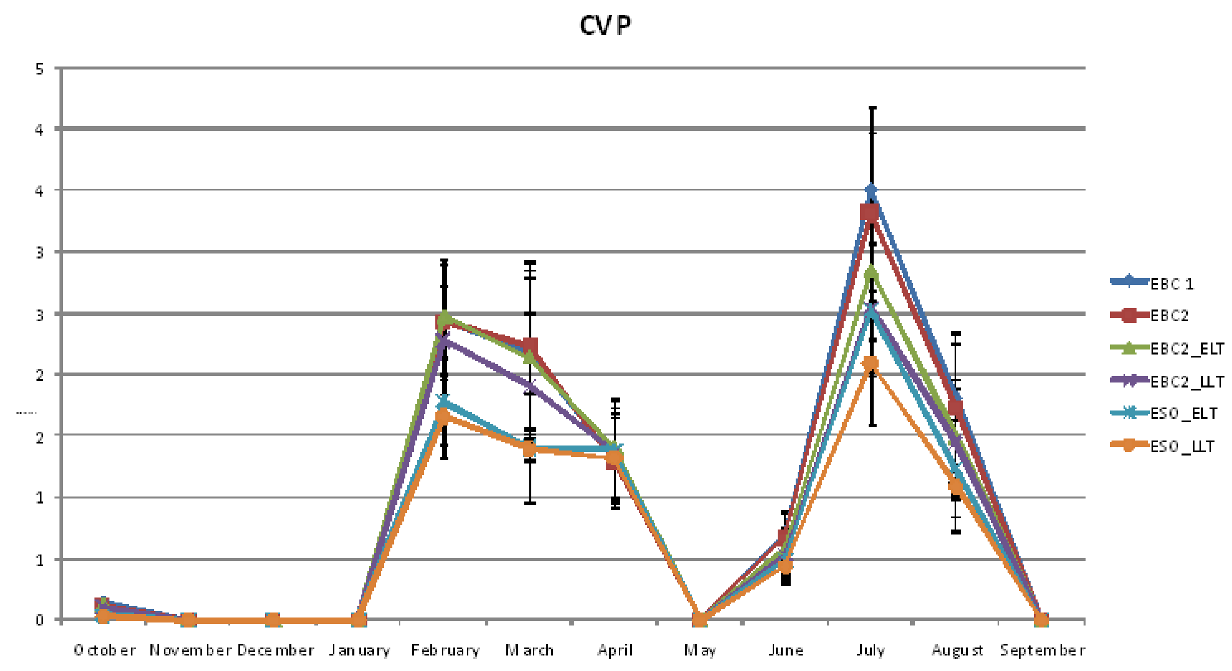

Figure 5.B.6-31. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Below-Normal, Dry, and Critical Years (San Joaquin Valley Water Year–Type Classification)

Table 5.B.6-207. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (San Joaquin Valley Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(b) SWP																		
October	3	±	0	2	±	0	2	±	0	1	±	0	1	±	0	1	±	0
November	3	±	1	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
December	10	±	1	10	±	1	9	±	1	9	±	1	7	±	1	7	±	1
January	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
February	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
March	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	4	±	1	4	±	1	4	±	1	3	±	1	2	±	1	2	±	1
September	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
Annual Average	27	±	3	24	±	2	23	±	2	22	±	2	17	±	2	16	±	2
(c) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0
March	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0
July	4	±	1	3	±	1	3	±	1	3	±	1	3	±	1	2	±	1
August	2	±	1	2	±	1	1	±	0	1	±	0	1	±	0	1	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	12	±	2	12	±	2	11	±	2	10	±	2	9	±	1	8	±	1

Table 5.B.6-208. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (San Joaquin Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-2 (-74%)	-2 (-79%)	-1 (-64%)	-1 (-71%)	-1 (-57%)	-1 (-56%)
November	-2 (-62%)	-2 (-64%)	-1 (-35%)	-1 (-38%)	-1 (-35%)	-1 (-36%)
December	-2 (-23%)	-2 (-25%)	-2 (-23%)	-2 (-25%)	-2 (-18%)	-1 (-16%)
January	-0.3 (-42%)	-0.3 (-45%)	-0.3 (-41%)	-0.3 (-44%)	-0.3 (-40%)	-0.3 (-45%)
February	-1 (-26%)	-1 (-32%)	-1 (-26%)	-1 (-32%)	-1 (-26%)	-1 (-27%)
March	-1 (-36%)	-1 (-37%)	-1 (-37%)	-1 (-38%)	-1 (-33%)	-1 (-27%)
April	0.2 (8%)	0.1 (2%)	0.2 (7%)	0.05 (2%)	0.02 (1%)	-0.1 (-4%)
May	-0.1 (-8%)	-0.2 (-13%)	-0.1 (-5%)	-0.1 (-10%)	-0.2 (-14%)	-0.3 (-23%)
June	-0.2 (-29%)	-0.2 (-35%)	-0.2 (-28%)	-0.2 (-35%)	-0.1 (-15%)	-0.1 (-16%)
July	-1 (-29%)	-2 (-41%)	-1 (-25%)	-1 (-38%)	-0.4 (-13%)	-1 (-19%)
August	-3 (-46%)	-3 (-47%)	-2 (-42%)	-2 (-43%)	-2 (-37%)	-2 (-33%)
September	-1 (-51%)	-1 (-59%)	-1 (-47%)	-1 (-55%)	-1 (-44%)	-1 (-49%)
Annual Average	-14 (-35%)	-15 (-39%)	-11 (-30%)	-12 (-34%)	-9 (-26%)	-8 (-25%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.9 Green Sturgeon (Juvenile)

5.B.6.1.9.1 Salvage-Density Method

Analysis Based on Sacramento Valley Water Year–Type Classification

Wetter Year Analysis

The mean entrainment indices for green sturgeon at the SWP and CVP export facilities based on Sacramento Valley wet and above-normal water-year types were estimated to be variable throughout the year (Figure 5.B.6-32, Figure 5.B.6-33, and Table 5.B.6-209). The SWP salvage estimates suggested a peak in August under all model scenarios (although more pronounced under EBC scenarios) and a second peak under all scenarios in February. Salvage was estimated to peak in July at the CVP facility under all model scenarios. Total annual average salvage of juvenile green sturgeon at SWP was estimated around 70 fish under all EBC scenarios and 25 or less fish under the two ESO scenarios. Differences between EBC and ESO were less at the CVP, where EBC scenario salvage ranged from 37 to 43 green sturgeon and ESO scenario salvage was around 22–24 green sturgeon.

Reductions in salvage under ESO scenarios compared to EBC scenarios ranged from very little change in December-January and March–June (0–2 fewer fish per month) to considerable changes in February (around 18–19 fewer green sturgeon, or a 67% reduction) (Table 5.B.6-210). The overall annual average reduction in salvage of juvenile green sturgeon from EBC scenarios to ESO scenarios was around 60–70 fish (57–61% reduction).

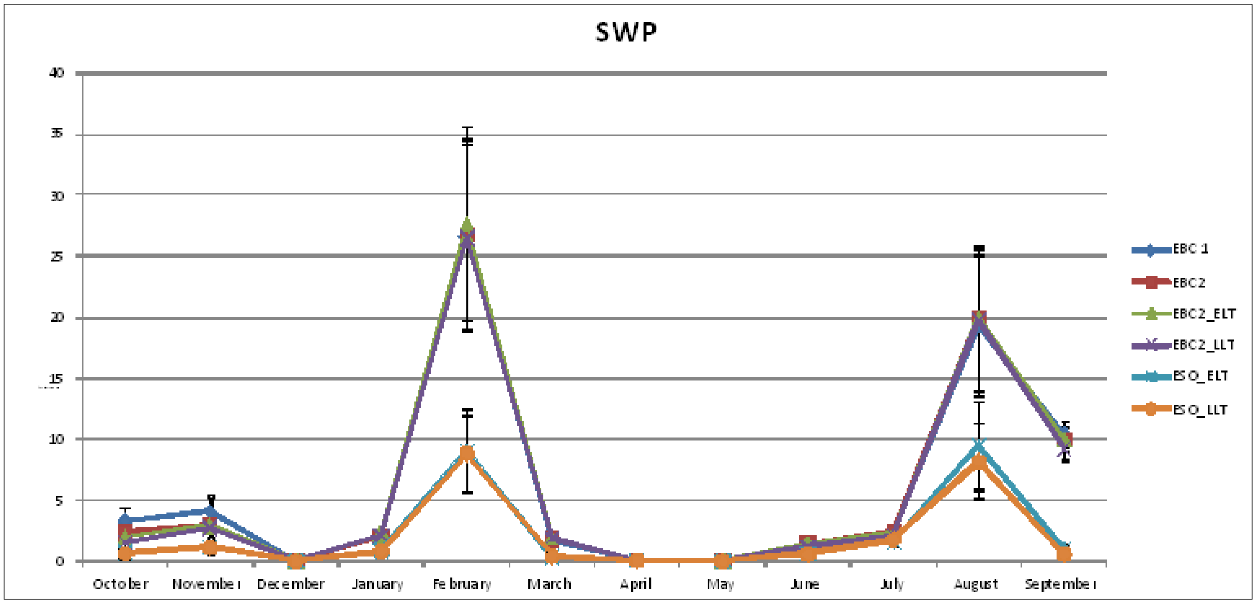

Figure 5.B.6-32. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

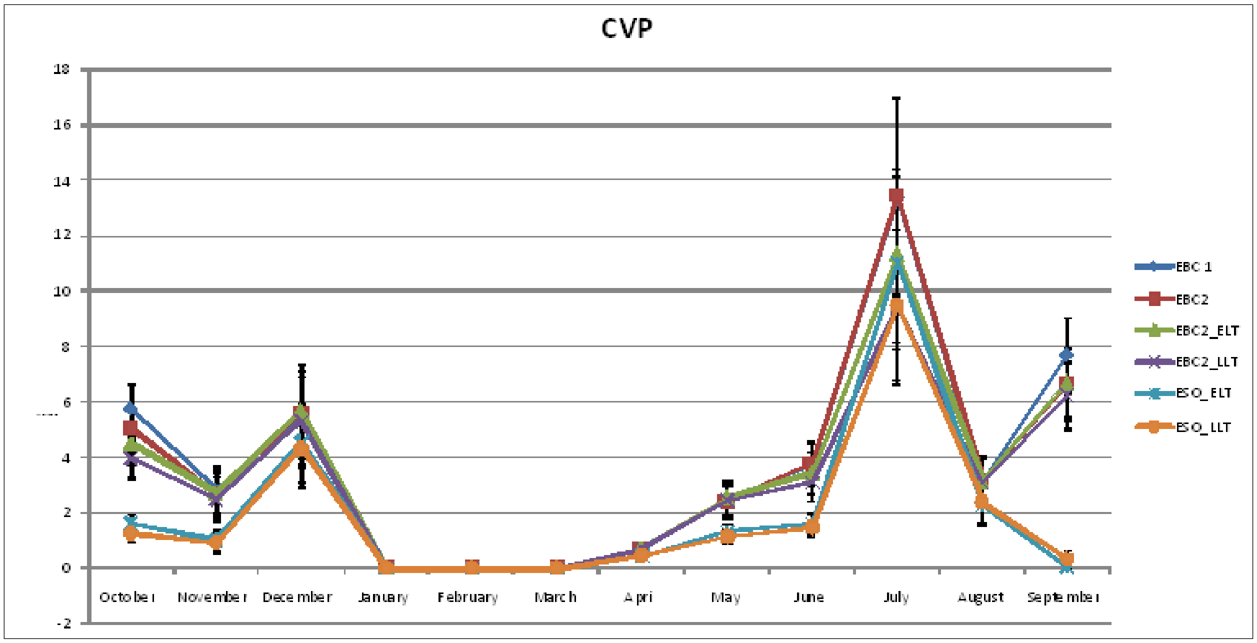

Figure 5.B.6-33. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

Table 5.B.6-209. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	3	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
November	4	±	1	3	±	1	3	±	1	3	±	1	1	±	1	1	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	27	±	8	27	±	8	28	±	8	26	±	8	9	±	3	9	±	3
March	2	±	1	2	±	1	2	±	1	2	±	1	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
July	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0	2	±	0
August	19	±	6	20	±	6	20	±	6	20	±	6	10	±	4	8	±	3
September	10	±	1	10	±	1	10	±	1	9	±	1	1	±	0	1	±	0
Annual Average	71	±	9	70	±	9	70	±	9	67	±	9	25	±	5	23	±	4
(b) CVP																		
October	6	±	1	5	±	1	4	±	1	4	±	1	2	±	0	1	±	0
November	3	±	1	3	±	1	3	±	1	3	±	1	1	±	0	1	±	0
December	5	±	2	6	±	2	6	±	2	5	±	2	5	±	1	4	±	1
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
May	2	±	1	2	±	1	3	±	1	2	±	1	1	±	0	1	±	0
June	4	±	1	4	±	1	3	±	1	3	±	1	2	±	0	2	±	0
July	13	±	4	13	±	4	11	±	3	9	±	3	11	±	3	10	±	3
August	3	±	1	3	±	1	3	±	1	3	±	1	2	±	1	2	±	1
September	8	±	1	7	±	1	7	±	1	6	±	1	0	±	0	0	±	0
Annual Average	45	±	7	43	±	6	41	±	6	37	±	5	24	±	4	22	±	4

Table 5.B.6-210. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-7 (-74%)	-7 (-79%)	-5 (-68%)	-6 (-75%)	-4 (-64%)	-4 (-66%)
November	-5 (-69%)	-5 (-71%)	-3 (-62%)	-4 (-64%)	-3 (-62%)	-3 (-62%)
December	-1 (-17%)	-1 (-21%)	-1 (-19%)	-1 (-23%)	-1 (-20%)	-1 (-18%)
January	-1 (-55%)	-1 (-59%)	-1 (-56%)	-1 (-61%)	-1 (-58%)	-1 (-61%)
February	-18 (-66%)	-18 (-67%)	-18 (-66%)	-18 (-67%)	-19 (-67%)	-18 (-67%)
March	-1 (-81%)	-1 (-77%)	-2 (-81%)	-1 (-77%)	-2 (-82%)	-1 (-77%)
April	-0.3 (-38%)	-0.3 (-36%)	-0.3 (-38%)	-0.3 (-36%)	-0.3 (-39%)	-0.3 (-39%)
May	-1 (-46%)	-1 (-53%)	-1 (-46%)	-1 (-53%)	-1 (-48%)	-1 (-54%)
June	-3 (-58%)	-3 (-61%)	-3 (-58%)	-3 (-62%)	-3 (-54%)	-2 (-53%)
July	-3 (-20%)	-4 (-28%)	-3 (-20%)	-5 (-29%)	-1 (-7%)	-0.3 (-3%)
August	-11 (-47%)	-12 (-53%)	-11 (-49%)	-12 (-54%)	-11 (-49%)	-12 (-54%)
September	-17 (-94%)	-17 (-95%)	-16 (-94%)	-16 (-95%)	-16 (-94%)	-15 (-94%)
Annual Average	-68 (-58%)	-72 (-62%)	-65 (-57%)	-69 (-61%)	-62 (-56%)	-59 (-57%)

Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.

Drier Year Analysis

Overall salvage of green sturgeon juveniles was estimated to be considerably lower in drier years than wetter years. The SWP salvage estimates suggested peaks in December and March under all model scenarios (Figure 5.B.6-34). Salvage was estimated to peak in October and November at the CVP facility (Figure 5.B.6-35). Total annual average salvage of juvenile green sturgeon at SWP was estimated to be around 12–14 fish under all EBC scenarios and 10–11 fish under the two ESO scenarios (Table 5.B.6-211). At CVP, EBC scenario total annual salvage ranged from 29 to 34 green sturgeon and ESO scenario salvage was 16–18 green sturgeon.

Reductions in salvage at both facilities combined under ESO scenarios compared to EBC scenarios were low throughout the year (fewer than 10 green sturgeon per month, with many months of no change) (Table 5.B.6-212). The overall annual average decrease in salvage under ESO scenarios compared to EBC scenarios ranged from 15 to 21 green sturgeon (37–44% reductions).

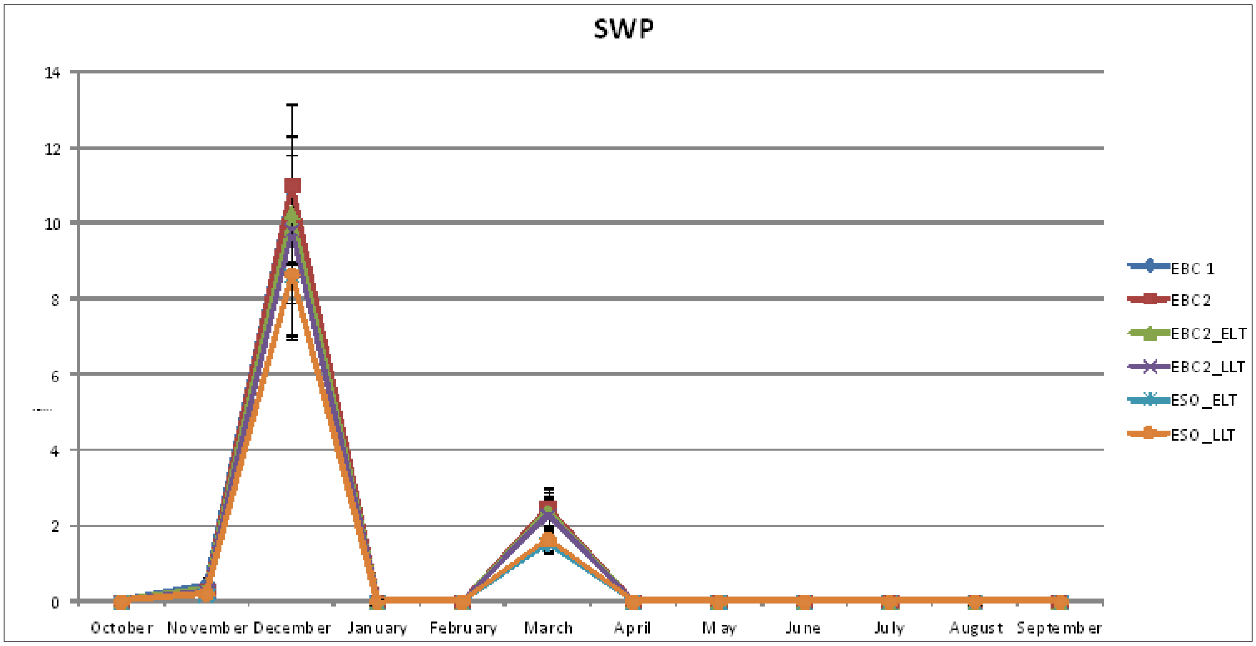

Figure 5.B.6-34. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification)

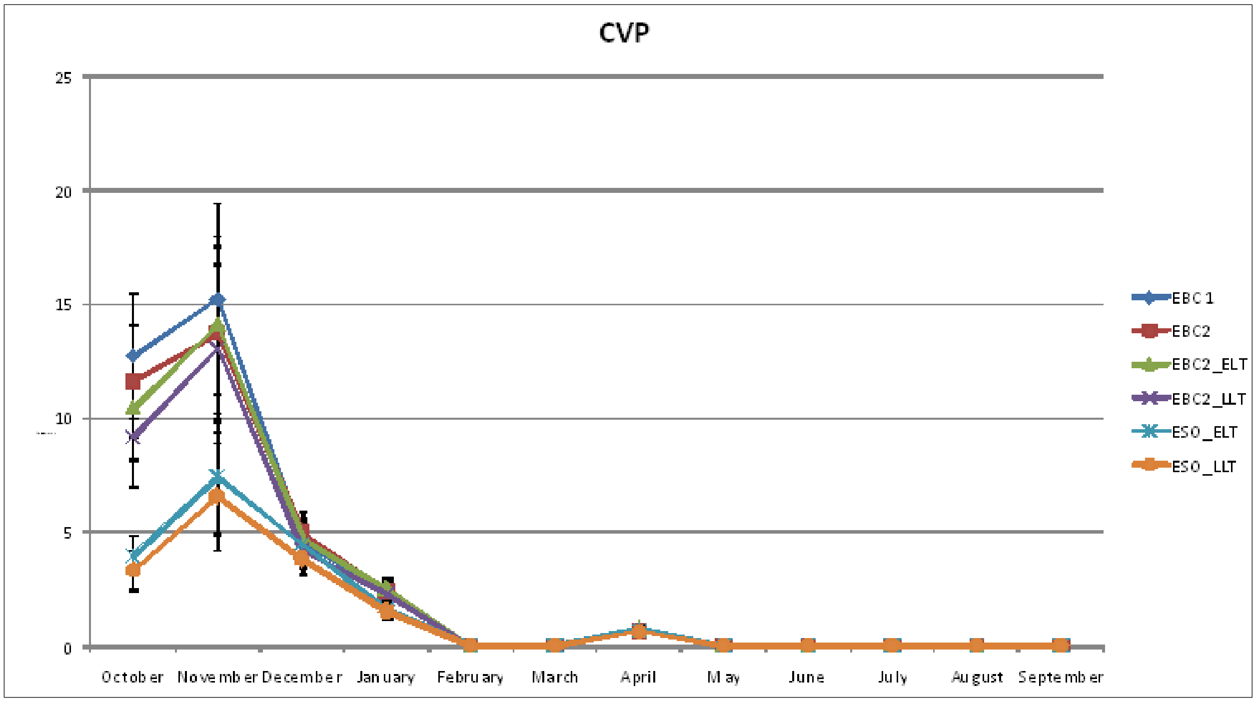

Figure 5.B.6-35. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification)

Table 5.B.6-211. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (Sacramento Valley Water Year–Type Classification)

Month	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
	Avg.	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
November	0.5	±	0.1	0.3	±	0.1	0.3	±	0.1	0.3	±	0.1	0	±	0	0	±	0
December	11.0	±	2.1	11.0	±	2.1	10.3	±	2.0	9.8	±	2.0	9	±	2	9	±	2
January	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
February	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
March	2.5	±	0.5	2.5	±	0.5	2.4	±	0.5	2.3	±	0.5	2	±	0	2	±	0
April	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
May	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
June	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
July	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
August	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
September	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
Annual Average	14.0	±	2.4	13.8	±	2.5	13.0	±	2.3	12.4	±	2.3	10	±	2	11	±	2
(b) CVP																		
October	12.8	±	2.7	11.8	±	2.5	10.5	±	2.3	9.2	±	2.1	4	±	1	3	±	1
November	15.2	±	4.2	14.1	±	3.9	14.1	±	3.9	13.0	±	3.7	7	±	3	7	±	2
December	4.6	±	0.8	4.8	±	0.8	4.8	±	0.8	4.2	±	0.8	5	±	1	4	±	1
January	2.5	±	0.5	2.5	±	0.5	2.5	±	0.5	2.3	±	0.4	2	±	0	2	±	0
February	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
March	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
April	0.7	±	0.2	0.7	±	0.2	0.7	±	0.2	0.7	±	0.2	1	±	0	1	±	0
May	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
June	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
July	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
August	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
September	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0	±	0	0	±	0
Annual Average	35.8	±	7.7	33.8	±	7.2	32.5	±	6.9	29.4	±	6.4	18	±	4	16	±	4

Table 5.B.6-212. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (Sacramento Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-9 (-69%)	-9 (-74%)	-8 (-66%)	-8 (-71%)	-6 (-62%)	-6 (-64%)
November	-8 (-51%)	-9 (-57%)	-6 (-45%)	-7 (-52%)	-7 (-47%)	-7 (-49%)
December	-3 (-16%)	-3 (-20%)	-3 (-18%)	-4 (-22%)	-2 (-13%)	-2 (-11%)
January	-1 (-38%)	-1 (-40%)	-1 (-35%)	-1 (-37%)	-1 (-37%)	-1 (-34%)
February	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
March	-1 (-37%)	-1 (-34%)	-1 (-37%)	-1 (-34%)	-1 (-35%)	-1 (-28%)
April	0.03 (4%)	-0.02 (-2%)	0.04 (6%)	-0.004 (-1%)	-0.01 (-2%)	-0.1 (-7%)
May	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Annual Average	-21 (-43%)	-23 (-47%)	-19 (-40%)	-21 (-44%)	-17 (-37%)	-15 (-37%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Analysis Based on San Joaquin Valley Water Year–Type Classification

Wetter Year Analysis

The mean entrainment indices for green sturgeon at the SWP and CVP export facilities based on San Joaquin Valley wet and above-normal water-year types were estimated to be variable throughout the year (Figure 5.B.6-36, Figure 5.B.6-37, and Table 5.B.6-213). The SWP salvage estimates suggest peaks in August and February under all model scenarios. Salvage was estimated to peak in July at the CVP facility under all model scenarios. Total annual average salvage of juvenile green sturgeon at SWP was estimated at around 75–80 fish under all EBC scenarios and 27–30 fish under the two ESO scenarios. Differences between EBC and ESO were less at the CVP, where EBC scenario salvage ranged from around 40–50 green sturgeon and ESO scenario salvage was around 25–27 green sturgeon.

Reductions in salvage under ESO scenarios compared to EBC scenarios ranged from very little change in March–June and December–January (0–4 fish per month) to considerable changes in February (around 20 fewer green sturgeon, or a >60% reduction) and August–September (12–17 fewer fish, or a 47–88% reduction) (Table 5.B.6-214). The overall annual average reduction in salvage of juvenile green sturgeon from EBC scenarios to ESO scenarios was around 65–77 fish (54–60%).

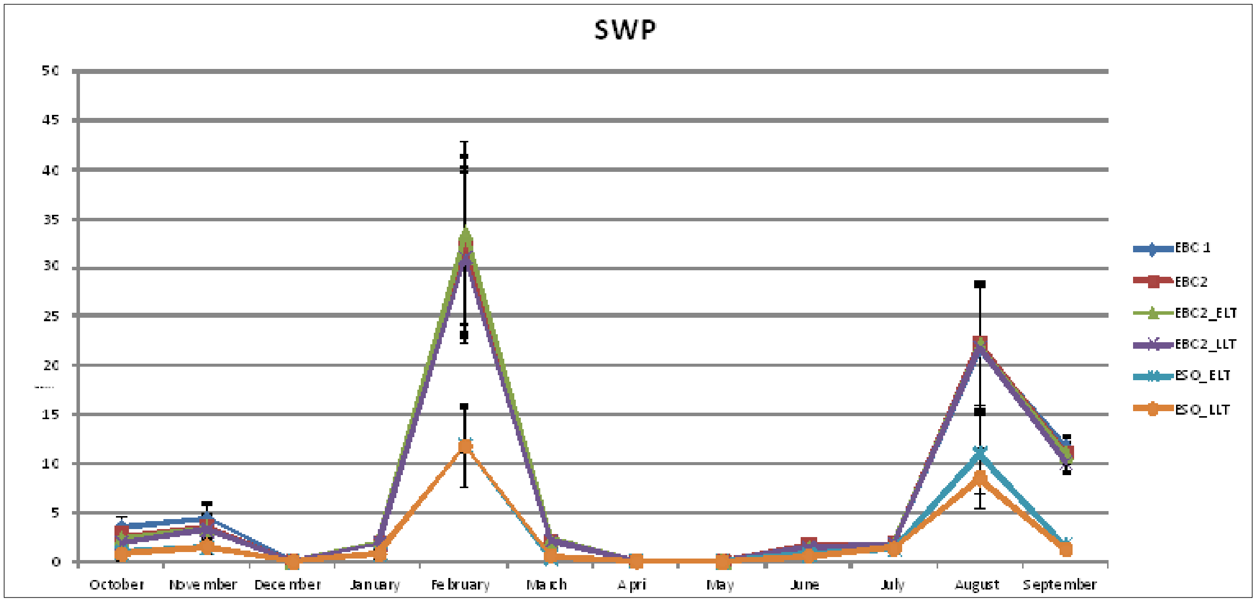

Figure 5.B.6-36. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

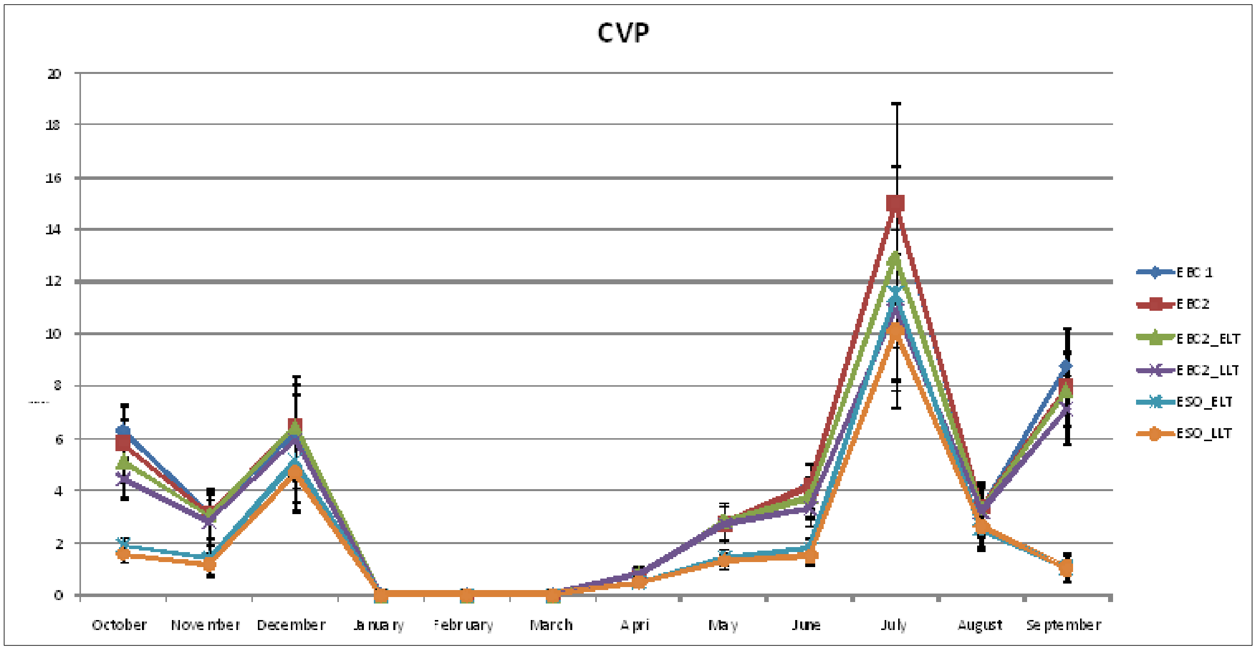

Figure 5.B.6-37. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

Table 5.B.6-213. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (San Joaquin Water Year–Type Classification)

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	4	±	1	3	±	1	2	±	1	2	±	1	1	±	0	1	±	0
November	5	±	1	4	±	1	3	±	1	3	±	1	2	±	1	2	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	32	±	9	32	±	9	34	±	9	31	±	9	12	±	4	12	±	4
March	2	±	1	2	±	1	2	±	1	2	±	1	1	±	0	1	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	2	±	1	2	±	1	2	±	0	1	±	0	1	±	0	1	±	0
July	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
August	22	±	6	22	±	6	22	±	6	22	±	6	11	±	4	9	±	3
September	12	±	1	11	±	1	11	±	1	10	±	1	2	±	0	1	±	0
Annual Average	81	±	10	80	±	10	80	±	11	75	±	10	30	±	6	27	±	5
(b) CVP																		
October	6	±	1	6	±	1	5	±	1	4	±	1	2	±	0	2	±	0
November	3	±	1	3	±	1	3	±	1	3	±	1	1	±	1	1	±	1
December	6	±	2	6	±	2	6	±	2	6	±	2	5	±	2	5	±	2
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	3	±	1	3	±	1	3	±	1	3	±	1	2	±	0	1	±	0
June	4	±	1	4	±	1	4	±	1	3	±	1	2	±	0	2	±	0
July	15	±	4	15	±	4	13	±	3	11	±	3	12	±	3	10	±	3
August	3	±	1	3	±	1	3	±	1	3	±	1	3	±	1	3	±	1
September	9	±	1	8	±	1	8	±	1	7	±	1	1	±	1	1	±	1
Annual Average	51	±	7	49	±	7	46	±	6	41	±	6	27	±	4	25	±	4

Table 5.B.6-214. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (San Joaquin Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-7 (-71%)	-8 (-76%)	-6 (-67%)	-6 (-72%)	-5 (-62%)	-4 (-63%)
November	-5 (-62%)	-5 (-64%)	-4 (-56%)	-4 (-59%)	-4 (-54%)	-3 (-54%)
December	-1 (-18%)	-2 (-25%)	-1 (-20%)	-2 (-27%)	-1 (-21%)	-1 (-21%)
January	-1 (-51%)	-1 (-54%)	-1 (-53%)	-1 (-56%)	-1 (-55%)	-1 (-56%)
February	-20 (-62%)	-20 (-63%)	-20 (-63%)	-21 (-64%)	-22 (-65%)	-19 (-62%)
March	-2 (-78%)	-2 (-71%)	-2 (-79%)	-2 (-72%)	-2 (-79%)	-2 (-72%)
April	0 (-37%)	0 (-37%)	0 (-37%)	0 (-37%)	0 (-39%)	0 (-40%)
May	-1 (-47%)	-1 (-52%)	-1 (-47%)	-1 (-52%)	-1 (-49%)	-1 (-52%)
June	-3 (-58%)	-4 (-64%)	-3 (-58%)	-4 (-64%)	-3 (-53%)	-3 (-56%)
July	-4 (-24%)	-5 (-32%)	-4 (-24%)	-5 (-32%)	-2 (-13%)	-1 (-9%)
August	-11 (-46%)	-14 (-56%)	-12 (-47%)	-15 (-57%)	-12 (-47%)	-14 (-56%)
September	-18 (-87%)	-18 (-89%)	-16 (-86%)	-17 (-88%)	-16 (-85%)	-15 (-87%)
Annual Average	-73 (-56%)	-79 (-61%)	-71 (-55%)	-77 (-60%)	-68 (-54%)	-65 (-56%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

Drier Year Analysis

Overall salvage of green sturgeon juveniles was estimated to be considerably lower in drier years than wetter years. The SWP salvage estimates suggested a peak in December under all model scenarios (Figure 5.B.6-38). Salvage was estimated to peak in October and November at the CVP facility under all model scenarios (Figure 5.B.6-39). Total annual average salvage of juvenile green sturgeon at SWP was estimated to be around 12–13 fish under all EBC scenarios and 9–10 fish under the two ESO scenarios (Table 5.B.6-215). At CVP, EBC scenario total annual salvage ranged from 25 to 27 green sturgeon and ESO scenario salvage was 13–14 green sturgeon.

Reductions in salvage at both facilities combined under ESO scenarios compared to EBC scenarios were low throughout the year (seven or fewer green sturgeon per month, with several months of no change) (Table 5.B.6-216). The overall annual average decrease in salvage under ESO scenarios compared to EBC scenarios ranged from 15 to 19 green sturgeon (41–46% reductions).

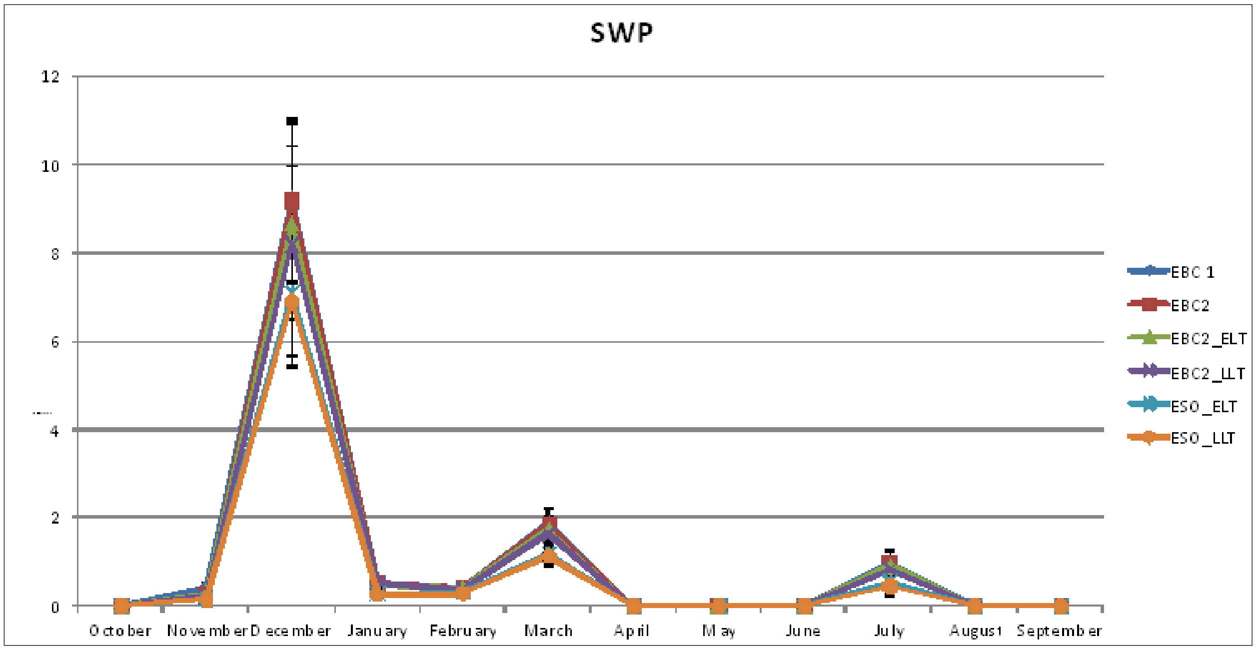

Figure 5.B.6-38. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the SWP Facility during Below-Normal, Dry, and Critical Years (San Joaquin Valley Water Year–Type Classification)

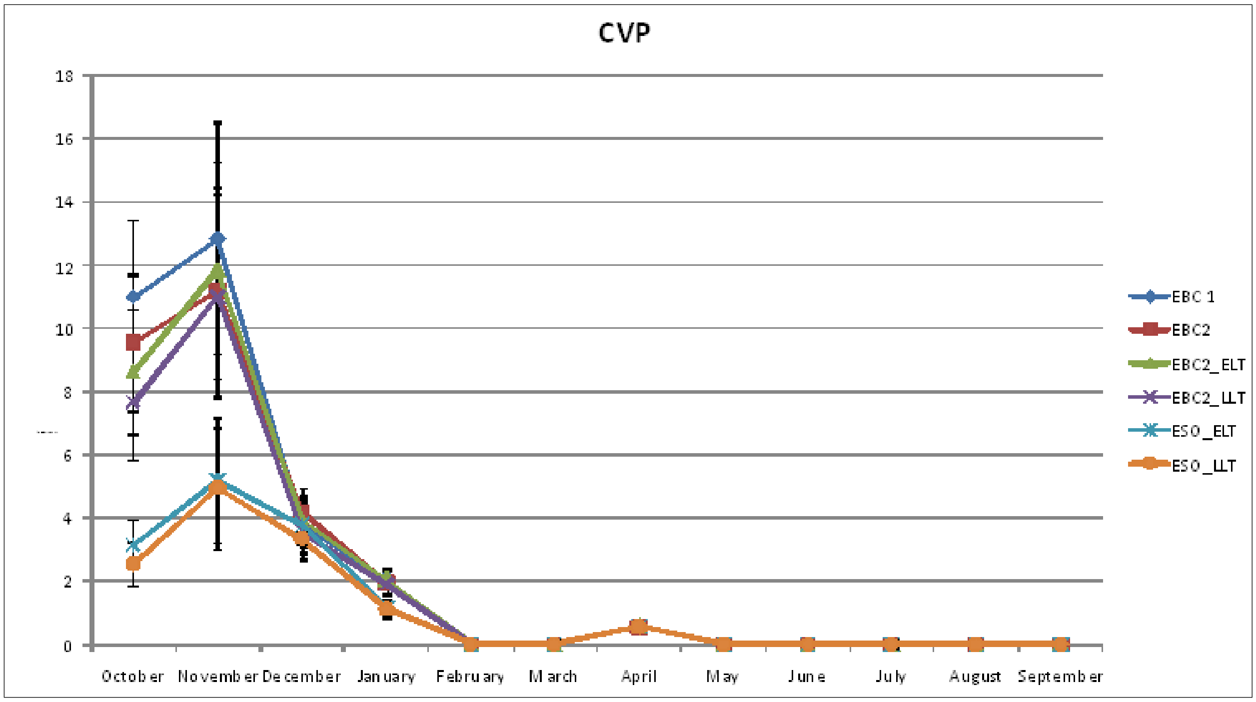

Figure 5.B.6-39. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals) at the CVP Facility during Below-Normal, Dry, and Critical Years (San Joaquin Valley Water Year–Type Classification)

Table 5.B.6-215. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (San Joaquin Valley Water Year–Type Classification)

	EBC1			**EBC2**			**EBC2_ELT**			**EBC2_LLT**			**ESO_ELT**			**ESO_LLT**		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	9	±	2	9	±	2	9	±	2	8	±	2	7	±	1	7	±	2
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	13	±	2	13	±	2	12	±	2	12	±	2	10	±	2	9	±	2
(b) CVP																		
October	11	±	2	10	±	2	9	±	2	8	±	2	3	±	1	3	±	1
November	13	±	4	11	±	3	12	±	3	11	±	3	5	±	2	5	±	2
December	4	±	1	4	±	1	4	±	1	4	±	1	4	±	1	3	±	1
January	2	±	0	2	±	0	2	±	0	2	±	0	1	±	0	1	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	30	±	7	27	±	6	27	±	6	25	±	6	14	±	3	13	±	3

Table 5.B.6-216. Estimated Absolute and Percent Differences between Model Scenarios in Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Water Years (San Joaquin Valley Water Year–Type Classification)

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-8 (-71%)	-8 (-77%)	-6 (-67%)	-7 (-73%)	-5 (-64%)	-5 (-67%)
November	-8 (-60%)	-8 (-62%)	-6 (-53%)	-6 (-55%)	-7 (-56%)	-6 (-55%)
December	-2 (-17%)	-3 (-22%)	-2 (-18%)	-3 (-23%)	-2 (-14%)	-2 (-13%)
January	-1 (-42%)	-1 (-45%)	-1 (-41%)	-1 (-43%)	-1 (-42%)	-1 (-42%)
February	-0.1 (-25%)	-0.1 (-32%)	-0.1 (-25%)	-0.1 (-32%)	-0.1 (-23%)	-0.1 (-26%)
March	-1 (-36%)	-1 (-39%)	-1 (-35%)	-1 (-38%)	-1 (-31%)	-0.5 (-30%)
April	0.03 (6%)	0 (0%)	0.04 (8%)	0.01 (2%)	-0.004 (-1%)	-0.03 (-4%)
May	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
June	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
July	-0.4 (-44%)	-1 (-54%)	-0.4 (-42%)	-1 (-53%)	-0.3 (-39%)	-0.4 (-46%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
September	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Annual Average	-20 (-46%)	-22 (-50%)	-17 (-42%)	-19 (-46%)	-16 (-41%)	-15 (-41%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

5.B.6.1.10 Pacific Lamprey and River Lamprey (Macropthalmia and Adult)

5.B.6.1.10.1 Salvage-Density Method

As described in Section 5.B.5.4.1, *Relative Contribution of North and South Delta Intakes under the BDCP*, the analysis for Pacific and river lamprey was combined because the CVP and SWP fish salvage facilities do not distinguish between the two species. Historical salvage density estimates indicate that lamprey are most vulnerable to south Delta entrainment in January through May, particularly during January and February (Table 5.B.6-217). CVP salvage is generally much higher than SWP salvage, particularly during peak salvage months. The large majority (approximately 85%) of salvaged lamprey are less than 200-mm fork length (California Department of Fish and Game, unpublished fish salvage data from the Delta FTP site), indicating that they are macropthalmia (or ammocoetes), with the rest adults.

Estimated average expanded salvage under EBC (all time periods) ranged from 0 in September at SWP to more than 1,300 at CVP in January, for a combined average annual total of around 3,320–3,340 lamprey at the SWP and CVP facilities (Table 5.B.6-218). The total annual estimated expanded salvage under the ESO scenarios (around 1,900 lamprey) was less than under EBC scenarios. The annual average reduction in entrainment under the ESO compared to EBC scenarios was 1,400–1,500 lamprey (41–45%) (Table 5.B.6-219).

Table 5.B.6-217. Historical Mean Monthly Lamprey Salvage (Fish per Thousand Acre-Feet with 95% Confidence Interval [CI]) at CVP and SWP Salvage Facilities during Water Years 1996–2009

Month	Statistic	SWP	CVP
October	Mean	0.0059	0.0230
	95% CI	0.0116	0.0323
November	Mean	0.0055	0.0637
	95% CI	0.0082	0.1070
December	Mean	0.3235	0.7040
	95% CI	0.4407	1.0845
January	Mean	1.7655	6.8667
	95% CI	1.4971	5.8455
February	Mean	0.3925	4.5775
	95% CI	0.3472	3.4801
March	Mean	0.3144	1.5220
	95% CI	0.2915	1.1108
April	Mean	0.1634	0.2693
	95% CI	0.1068	0.1366
May	Mean	0.4696	0.5540
	95% CI	0.3024	0.3163
June	Mean	0.1259	0.1798
	95% CI	0.1027	0.2128
July	Mean	0.0468	0.0416
	95% CI	0.0381	0.0467
August	Mean	0.0069	0.0129
	95% CI	0.0073	0.0144
September	Mean	0.0005	0.0138
	95% CI	0.0010	0.0154

Table 5.B.6-218. Estimated Mean Monthly and Annual Entrainment Index (Number of Fish as Expanded Salvage with 95% Confidence Interval [CI]) of Lamprey for Six Model Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC1			EBC2			EBC2_ELT			EBC2_LLT			ESO_ELT			ESO_LLT		
Month	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**	**Avg.**	**±**	**95% CI**
(a) SWP																		
October	2	±	0	1	±	0	1	±	0	1	±	0	0	±	0	0	±	0
November	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
December	98	±	15	99	±	15	97	±	15	95	±	15	73	±	11	75	±	12
January	377	±	38	384	±	39	390	±	41	385	±	40	199	±	22	188	±	20
February	88	±	10	90	±	10	91	±	10	85	±	9	45	±	5	42	±	5
March	73	±	8	75	±	9	75	±	9	72	±	9	26	±	3	29	±	4
April	10	±	1	10	±	1	11	±	1	11	±	1	8	±	1	8	±	1
May	31	±	3	32	±	4	34	±	4	34	±	4	21	±	2	19	±	2
June	19	±	2	19	±	2	18	±	2	15	±	2	9	±	1	8	±	1
July	19	±	2	19	±	2	18	±	2	17	±	2	12	±	1	11	±	1
August	3	±	0	3	±	0	2	±	0	2	±	0	1	±	0	1	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	721	±	52	732	±	54	737	±	55	719	±	54	394	±	32	382	±	30
(b) CVP																		
October	5	±	1	5	±	1	4	±	1	4	±	1	2	±	0	1	±	0
November	14	±	3	13	±	3	14	±	3	13	±	2	6	±	2	6	±	1
December	165	±	28	175	±	29	171	±	29	155	±	27	149	±	25	134	±	24
January	1331	±	125	1316	±	126	1320	±	127	1274	±	124	750	±	81	816	±	89
February	791	±	69	760	±	68	768	±	69	778	±	70	379	±	41	418	±	43
March	261	±	23	260	±	23	255	±	23	249	±	23	114	±	12	109	±	12
April	17	±	1	17	±	1	17	±	1	18	±	1	14	±	1	14	±	1
May	38	±	3	38	±	3	38	±	3	38	±	3	27	±	2	24	±	2
June	25	±	4	25	±	4	22	±	3	20	±	3	13	±	2	11	±	2
July	10	±	1	10	±	1	9	±	1	7	±	1	8	±	1	7	±	1
August	3	±	0	3	±	0	3	±	0	3	±	0	2	±	0	2	±	0
September	3	±	0	3	±	0	3	±	0	3	±	0	1	±	0	1	±	0
Annual Average	2664	±	173	2626	±	173	2625	±	175	2561	±	173	1,465	±	108	1,542	±	115

Table 5.B.6-219. Mean Difference in Estimated Average Monthly Lamprey Entrainment Index (Number of Fish and Percent Difference) between Model Scenarios at CVP and SWP Salvage Facilities Combined

Month	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
October	-5 (-71%)	-5 (-77%)	-4 (-66%)	-4 (-73%)	-3 (-62%)	-3 (-64%)
November	-9 (-58%)	-10 (-62%)	-8 (-54%)	-8 (-58%)	-8 (-54%)	-8 (-56%)
December	-41 (-16%)	-55 (-21%)	-52 (-19%)	-65 (-24%)	-45 (-17%)	-42 (-17%)
January	-759 (-44%)	-704 (-41%)	-751 (-44%)	-696 (-41%)	-761 (-45%)	-655 (-39%)
February	-456 (-52%)	-419 (-48%)	-427 (-50%)	-390 (-46%)	-436 (-51%)	-403 (-47%)
March	-194 (-58%)	-196 (-59%)	-195 (-58%)	-198 (-59%)	-190 (-58%)	-184 (-57%)
April	-5 (-19%)	-6 (-21%)	-5 (-20%)	-6 (-22%)	-6 (-23%)	-8 (-27%)
May	-22 (-32%)	-26 (-38%)	-23 (-33%)	-27 (-39%)	-25 (-35%)	-29 (-41%)
June	-22 (-49%)	-24 (-55%)	-21 (-49%)	-24 (-55%)	-18 (-44%)	-16 (-45%)
July	-10 (-33%)	-11 (-39%)	-9 (-32%)	-11 (-38%)	-7 (-27%)	-6 (-26%)
August	-2 (-38%)	-2 (-42%)	-2 (-37%)	-2 (-40%)	-2 (-33%)	-2 (-35%)
September	-2 (-66%)	-2 (-67%)	-2 (-64%)	-2 (-64%)	-2 (-62%)	-2 (-59%)
Annual Average	-1526 (-45%)	-1462 (-43%)	-1499 (-45%)	-1434 (-43%)	-1504 (-45%)	-1356 (-41%)
Note: Negative difference values indicate lower salvage under evaluated starting operations scenarios than under existing biological conditions scenarios.						

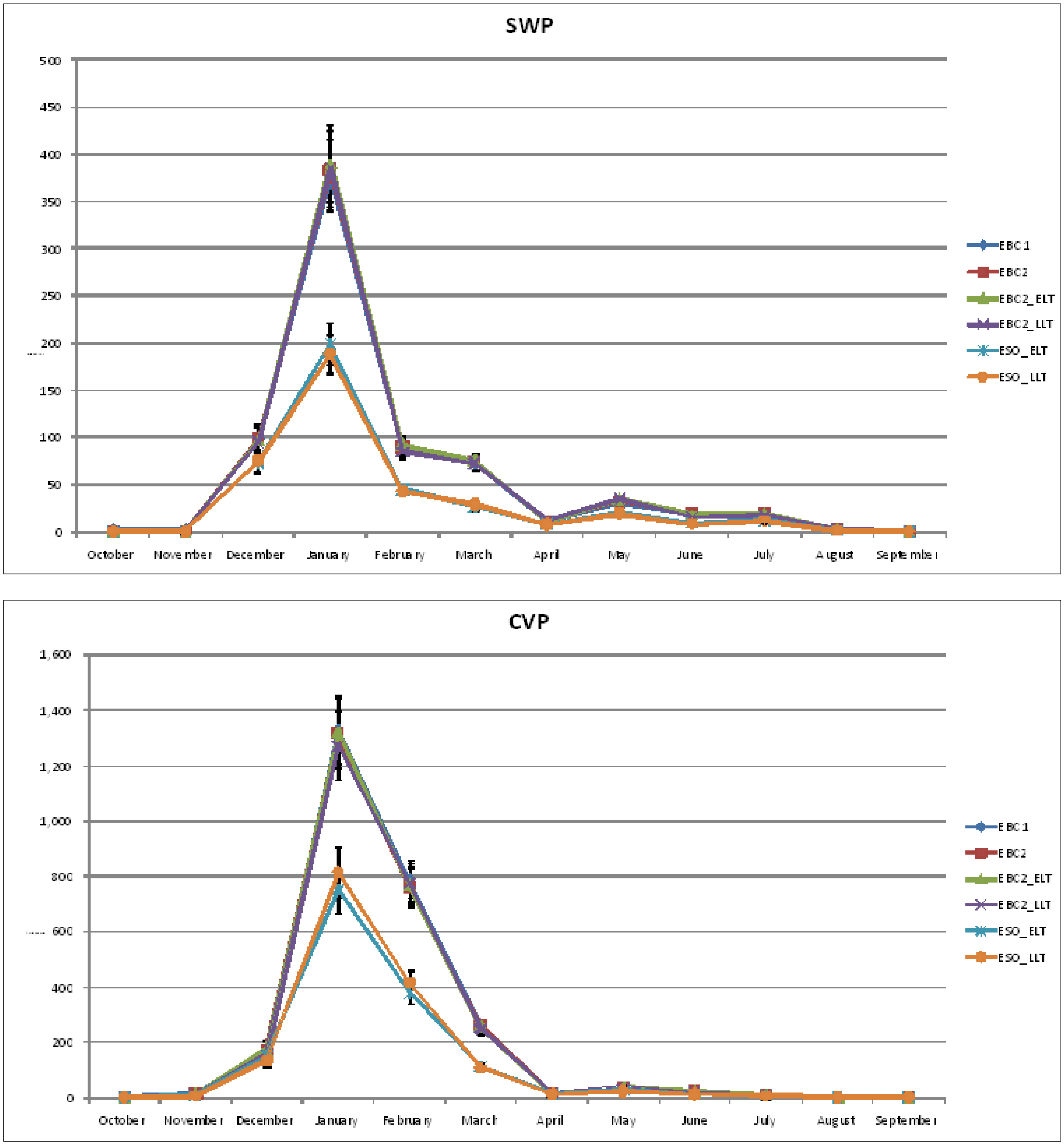

Figure 5.B.6-40. Historical Mean Monthly Lamprey Salvage (Fish per Thousand Acre-Feet with 95% Confidence Interval [CI]) at CVP and SWP Salvage Facilities for All Water Years

5.B.6.1.11 All Covered Fish Species

5.B.6.1.11.1 Effectiveness of Nonphysical Barriers

Water Column Position

Assuming that nonphysical barriers at the entrances to CCF and the DMC are situated close to the river bed, as seems appropriate based on the relatively shallow water, all covered fish species except for white and green sturgeon would be expected to encounter the barrier based on typical water column positions (Table 5.B.6-220). The sturgeons tend to be close to the bottom (Moyle 2002) and may pass beneath the barrier.

Hearing Ability

Most of the covered fish species, such as the salmonids and the smelts, have moderate hearing ability that laboratory and field studies have shown to be sensitive to the types of stimuli generated by the barriers (Bowen et al. 2008; Bowen et al. 2009; Bowen and Bark 2010) (Table 5.B.6-220). Sacramento splittail are cyprinids, a family of fish that is regarded as hearing specialists and therefore would be expected to be very sensitive to the acoustic stimuli of the nonphysical barriers (Nedwell et al. 2004). The sturgeons and lampreys have relatively low hearing ability and may not respond to the acoustic stimuli from the nonphysical barriers (Lovell et al. 2005; Turnpenny pers. comm.).

Escape Ability

Covered fish species may encounter nonphysical barriers and, if hearing ability (and visibility, which aids perception of where the noise is coming from) is sufficient, may respond to the acoustic stimuli. The ability to be deterred then rests upon escape ability, which is a function of swimming ability in relation to velocities through and past the barriers. Velocities at the CCF radial gates are very high (up to 20 ft/sec) when the gates are opened, whereas the velocities in the intake channel leading to the radial gates are less but still appreciable (up to ~3 ft/sec) (Clark et al. 2009). Velocities at the likely location of a nonphysical barrier at the divergence between the intake channel and Old River probably would be lower but would vary depending on the position of the radial gates, tidal flows, and river flows. Velocities at the entrance to the DMC in the vicinity of its divergence from Old River may not fluctuate as much because of the relatively constant pumping rate. DSM2 modeling results under the ESO_ELT and ESO_LLT scenarios during the main period of concern for covered fishes (December–June) showed that minimum daily velocity[9] in the DMC was 0 ft/sec in 15–17% of days, median minimum daily velocity was between 0.2 and 0.3 ft/sec, the 90th percentile minimum daily water velocity was between -0.8 and -1 ft/sec, and the most negative minimum daily velocities were around -1.3 to 1.5 ft/sec (Figure 5.B.6-41). Regardless of the actual velocities at the nonphysical barriers, some general conclusions about escape ability can be made. Larval smelts and larval Sacramento splittail would be the weakest of the covered fish species encountering the nonphysical barriers and would be unlikely to be deterred. Juvenile and adult smelts and Sacramento splittail would have better swimming ability (Table 5.B.6-221) but deterrence would vary depending on flow. Migrating juvenile Chinook salmon would be expected to have good swimming ability but still

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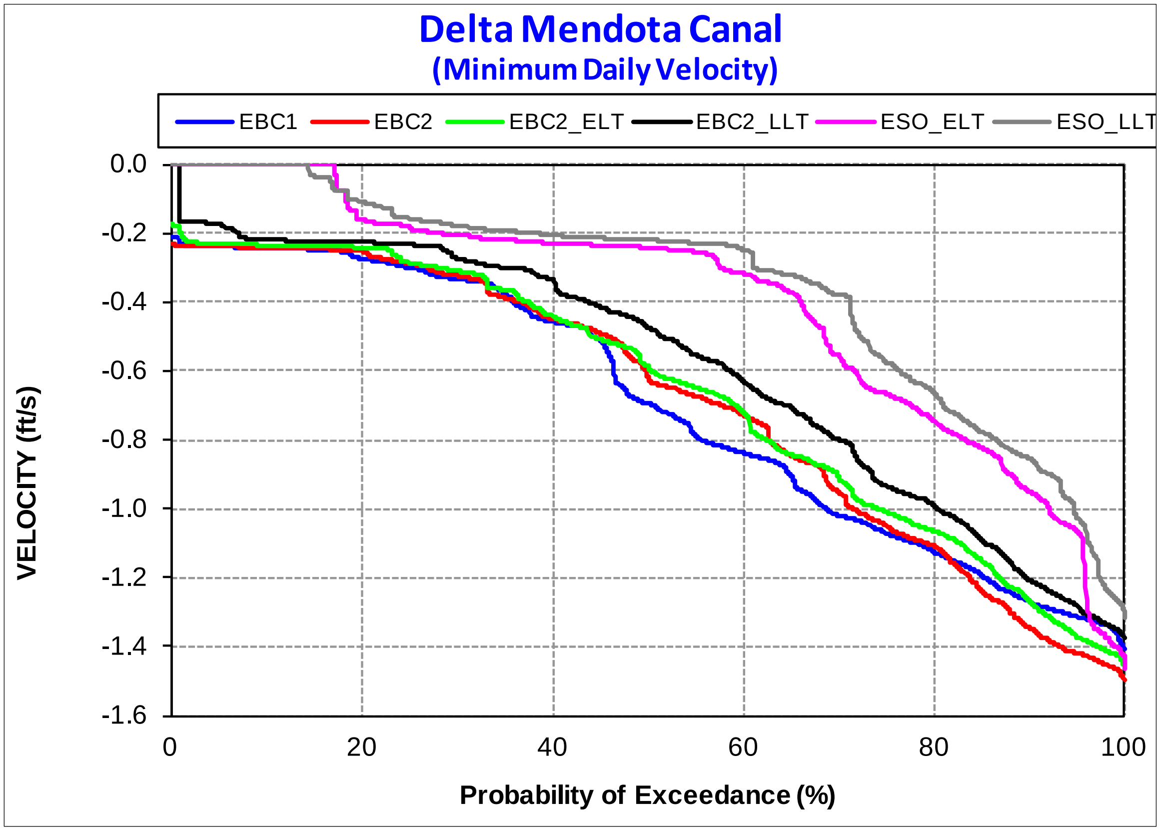
[9] Flow into the Delta-Mendota Canal from Old River is negative in DSM2, i.e., the greatest velocities have the most negative values.

would be subject to prevailing flows as far as barrier effectiveness. Adult Sacramento splittail and juvenile steelhead would be expected to have higher escape ability (Table 5.B.6-221). If the modeled velocities for the DMC (Figure 5.B.6-41) are a reasonable indication of velocities at a nonphysical barrier intended to reduce entrainment into the CVP export facilities, this suggests that deterrence may be possible based on swimming (escape) ability of delta smelt, Chinook salmon, and Sacramento splittail (Table 5.B.6-221). The escape ability of sturgeons and lampreys may not be relevant given the probable lack of response to the acoustic stimuli.



Note: More negative values indicate greater export water velocity caused by higher pumping.

Figure 5.B.6-41. Exceedance Plot of Minimum December–June Daily Water Velocity in the Delta-Mendota Canal (CVP South Delta Export Facility), as Modeled by DSM2 for Water Years 1976–1991

Table 5.B.6-220. Qualitative Assessment of Potential Effectiveness of Nonphysical Barriers on Covered Fish Species

Species	Life Stage	Water Column Position	Hearing Ability	Escape Ability	Overall Potential Barrier Effectiveness
Chinook salmon (all races)	Juvenile (Fry, smolts)	Upper	Moderate	High	High
Steelhead	Smolts	Upper	Moderate	High	High
Delta smelt	Larva	Upper	Moderate	Low	Low
	Juvenile	Upper	Moderate	Low–Moderate	Moderate
	Adult	Upper	Moderate	Moderate	Moderate
Longfin smelt	Larva	Upper	Moderate	Low	Low
	Juvenile	Upper	Moderate	Low–Moderate	Moderate
	Adult	Upper	Moderate	Moderate	High
Sacramento splittail	Larva	Upper	High	Low	Low
	Juvenile	Middle	High	Moderate	High
	Adult	Middle	High	High	High
White sturgeon	Larva	Upper	Low	Low	Low
	Juvenile	Lower	Low	High	Low
Green sturgeon	Juvenile	Lower	Low	High	Low
Pacific lamprey	Macropthalmia	Upper	Low	Low	Low
	Adult	Upper	Low	Low	Low
River lamprey	Macropthalmia	Upper	Low	Low	Low
	Adult	Upper	Low	Low	Low

Table 5.B.6-221. Swimming Ability of Covered Fish Species That May Respond to Acoustic Stimuli from Nonphysical Barriers

Species	Velocity
Longfin smelt	No information found
Delta smelt	Juveniles/adults 0.7–1.1 ft/s critical swimming speed (Swanson et al. 1998)
Chinook salmon	Underyearlings ~1.6 ft/s and yearlings ~2.1 ft/s at time of exhaustion, at ~8 mg/l dissolved oxygen (Davis et al. 1963)
Steelhead	Juvenile 2.2 ft/s critical swimming speed (Beamish 1978)
Sacramento splittail	Juvenile 0.66–1.31 ft/s critical swimming speed (Young and Cech 1996) Adult 1.31–2.07 ft/s critical swimming speed (Young and Cech 1996)

Predation

Predation in the south Delta and in particular in the vicinity of the fish salvage facilities is a notable issue for covered fish survival (Vogel 2011). Studies are ongoing to determine the influence of nonphysical barriers on predation characteristics at the head of Old River and Georgiana Slough. It is uncertain whether the potential benefits of deterrence of fish by nonphysical barriers at the entrances to CCF and the DMC may be offset by aggregations of predatory fish such as striped bass.

Overall Potential Effectiveness of Nonphysical Barriers

Considering species-specific factors such as water column position, hearing ability, and escape ability, nonphysical barriers at the entrances to CCF and the DMC have the most potential to considerably reduce entrainment of juvenile salmonids and juvenile and adult Sacramento splittail. There is somewhat less potential to reduce entrainment of juvenile and adult smelts, primarily because of lower escape ability. Insensitivity of sturgeons and lampreys makes them unlikely to benefit from nonphysical barriers. The potential importance of nonphysical barriers is that fish would not be subject to entrainment and the salvage process, which generally is quite inefficient. Prescreen predation in CCF in particular results in the majority of fish not being salvaged after entrainment. However the uncertainties associated with fish response to the barrier (particularly with respect to velocities) and the potential for predation associated with the barrier structure make it challenging to come to firm conclusions regarding the effectiveness of the measure.

Another fundamental issue is that hydrodynamics in the area may not be favorable for fish that have been deterred from entering CCF and the DMC: with net reverse flows toward the south Delta export facilities, fish intending to migrate downstream to the West Delta and Suisun Bay subregions may not be able to successfully leave the South Delta subregion. DSM2 modeling of the evaluated starting operations suggested that average daily flows in OMR combined would be negative (i.e., indicating net reversal) in around 75% of days from December to June (Figure 5.B.6-42). Targeted studies on nonphysical barrier effectiveness at these locations would allow determination of the benefits of the technology for enhancing survival of covered fish species.

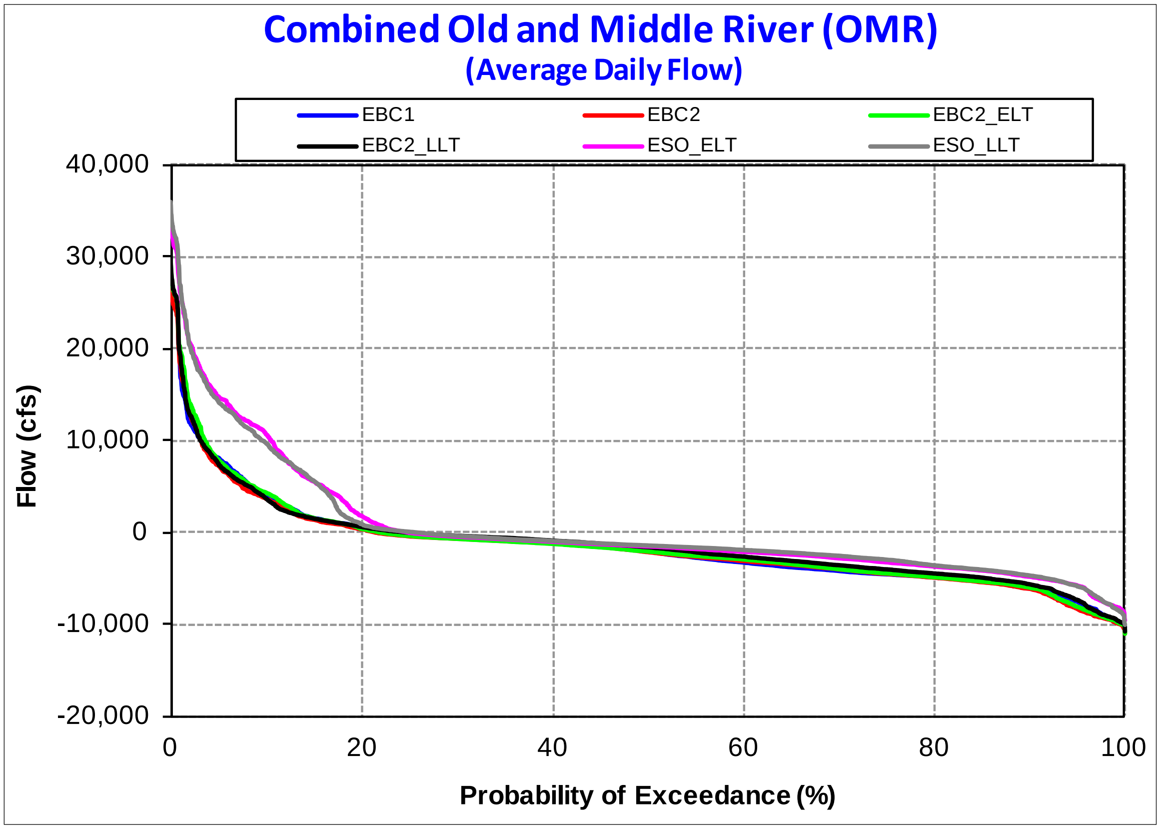


Figure 5.B.6-42. Exceedance Plot of Average December–June Daily Flow in Old and Middle Rivers, as Modeled by DSM2 for Water Years 1976–1991

5.B.6.2 SWP/CVP North Delta Intake (North Delta Subregion)

5.B.6.2.1 Salmonids (Juvenile)

5.B.6.2.1.1 Occurrence near the Proposed North Delta Intakes

Sacramento River-origin salmonids that do not enter the Yolo Bypass would pass through the reach of the river in the North Delta subregion containing the proposed north Delta intakes. Smaller salmonids that enter the Plan Area (e.g., Chinook salmon fry) may be more associated with shoreline habitat and therefore may be more likely to encounter the North Delta intakes than larger migrants such as Chinook salmon and steelhead smolts. However, as noted by Burau and coauthors (2007), larger migrant fish may also occur inshore during certain periods of the migration (e.g., holding during the day before continuing to migrate at night). The percentage of juvenile salmonids that may occur in the vicinity of the north Delta intakes and be susceptible to contact with the screens is uncertain. If half of fry migrate downstream close to one side of the river and half close to the other, then approximately half may be exposed to the intakes. Larger, actively migrating fish may be spread more across the channel width. However, acoustic studies have shown that channel configuration has an important influence on horizontal positioning of juvenile salmonids; more salmonids tend to be concentrated on the outside of river bends as a result of hydraulics (Blake and Horn 2006). This is important because siting considerations for the north Delta intakes include maintenance of adequate sweeping flows to enable fish passage and limit sediment accumulation; both of these factors mean that areas close to outside bends with adequate velocities are considered suitable for siting the intakes. This may mean that relatively more juvenile salmonids could pass in closer proximity to the intakes than with intakes sited in other areas, but sweeping velocity would be greater and therefore exposure time to the screens would be less.

The average monthly percentage of Freeport flow diverted at the north Delta intakes as modeled in CALSIM also may provide an indication of the hydrodynamic zone of influence of the intakes, although note that in CALSIM all diversions are considered as one without regard to the spacing of the intakes down the river. Therefore, for example, an average monthly diversion of 14% of Freeport flow (February in the ESO_ELT; Table 5.B.6-222) would be spread out over several intakes. In addition, real-time monitoring and adaptive management would be used to protect initial pulses of juvenile salmonids that are migrating downstream in response to upstream flow increases. Thus, increasing flows at Wilkins Slough have been shown to correlate with increased fish movement (e.g., winter-run Chinook salmon [Del Rosario et al. in press]) and would be used to adjust north Delta intake diversions accordingly.

Potential for predation at the three proposed north Delta intakes is analyzed in Appendix 5.F, *Biological Stressors on Covered Fish*. The summary of percentage of modeled Freeport flow diverted at the proposed north Delta intakes demonstrated that the greatest percentages would be in wet and above-normal years (Table 5.B.6-222 and Table 5.B.6-223). During the typical main salmonid migration and Delta occupancy period, December–June, an average of 7–30% of flow was modeled to be diverted in these year types (Table 5.B.6-222 and Table 5.B.6-223). The maintenance of adequate bypass flows in drier years would require considerably less flow to be diverted: during December–June, the average diversion was modeled as 4–7% in critical years and 6–16% in dry years (Table 5.B.6-222 and Table 5.B.6-223). These average (mean) flows generally are comparable to the median flows in the equivalent months and years, indicating that in around half of years, diversions would be above or below these values, ranging from a minimum of 0% to a maximum of 41% across all water years in the months of December–June (Table 5.B.6-222 and Table 5.B.6-223).

Table 5.B.6-222. Summary Statistics of CALSIM-Modeled Average Monthly North Delta Diversion (Cubic Feet Per Second) as a Percentage of Sacramento River at Freeport Flows (Cubic Feet Per Second), Evaluated Starting Operations in the Early Long-Term (ESO_ELT)

Water Year Type		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All	Maximum	50%	47%	18%	27%	35%	34%	37%	39%	41%	44%	47%	46%
	75th percentile	29%	29%	9%	16%	18%	23%	25%	23%	33%	20%	28%	27%
	Mean	21%	17%	8%	11%	14%	18%	17%	16%	22%	14%	19%	19%
	Median	22%	14%	6%	12%	13%	16%	17%	15%	24%	10%	17%	19%
	25th percentile	11%	7%	6%	6%	8%	12%	6%	6%	7%	2%	7%	12%
	Minimum	0%	0%	0%	0%	4%	6%	6%	4%	0%	0%	0%	0%
Wet	Maximum	50%	47%	18%	27%	35%	34%	37%	39%	41%	44%	47%	39%
	75th percentile	37%	32%	15%	17%	19%	29%	28%	31%	36%	32%	38%	28%
	Mean	28%	22%	12%	15%	17%	21%	22%	24%	30%	19%	31%	24%
	Median	28%	18%	12%	14%	14%	18%	22%	24%	32%	16%	29%	25%
	25th percentile	21%	12%	8%	12%	13%	15%	17%	16%	23%	7%	25%	19%
	Minimum	4%	2%	5%	6%	8%	7%	10%	11%	7%	1%	11%	11%
Above Normal	Maximum	37%	46%	16%	18%	34%	34%	36%	36%	40%	44%	38%	46%
	75th percentile	24%	24%	8%	16%	19%	23%	30%	28%	36%	20%	28%	36%
	Mean	17%	16%	7%	13%	16%	21%	25%	24%	30%	15%	23%	31%
	Median	19%	11%	6%	15%	14%	19%	27%	22%	32%	16%	22%	33%
	25th percentile	11%	5%	5%	11%	12%	15%	21%	20%	26%	8%	17%	25%
	Minimum	0%	0%	0%	6%	4%	13%	6%	17%	14%	0%	13%	18%
Below Normal	Maximum	46%	42%	17%	23%	28%	31%	29%	24%	40%	42%	38%	32%
	75th percentile	26%	30%	7%	15%	19%	26%	21%	18%	30%	22%	27%	21%
	Mean	20%	19%	7%	11%	16%	21%	15%	14%	24%	14%	20%	19%
	Median	22%	15%	6%	7%	15%	22%	14%	13%	26%	9%	18%	20%
	25th percentile	14%	9%	6%	6%	14%	15%	9%	9%	18%	2%	11%	14%
	Min	0%	0%	0%	5%	6%	7%	6%	6%	6%	1%	7%	10%
Dry	Max	38%	47%	17%	21%	27%	32%	27%	30%	34%	24%	19%	30%
	75th percentile	29%	19%	7%	10%	17%	21%	13%	7%	23%	14%	15%	18%
	Mean	19%	16%	6%	8%	12%	16%	11%	8%	15%	10%	10%	13%
	Median	21%	14%	6%	7%	10%	15%	7%	6%	9%	9%	8%	15%
	25th percentile	11%	9%	6%	6%	6%	8%	6%	6%	6%	6%	4%	7%
	Minimum	0%	0%	0%	0%	5%	6%	6%	6%	6%	0%	2%	0%
Critical	Maximum	34%	33%	6%	19%	10%	17%	7%	6%	6%	25%	4%	20%
	75th percentile	16%	11%	6%	6%	6%	6%	6%	6%	6%	18%	2%	1%
	Mean	12%	6%	4%	7%	6%	7%	6%	6%	5%	9%	1%	2%
	Median	9%	0%	6%	6%	6%	6%	6%	6%	6%	6%	0%	0%
	25th percentile	5%	0%	0%	6%	6%	6%	6%	5%	6%	0%	0%	0%
	Minimum	0%	0%	0%	0%	4%	6%	6%	4%	0%	0%	0%	0%

Table 5.B.6-223. Summary Statistics of CALSIM-Modeled Average Monthly North Delta Diversion (Cubic Feet Per Second) as a Percentage of Sacramento River at Freeport Flows (Cubic Feet Per Second), Evaluated Starting Operations in the Late Long-Term (ESO_LLT)

Water Year Type		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All	Maximum	50%	44%	17%	27%	35%	34%	37%	39%	40%	35%	43%	40%
	75th percentile	24%	21%	9%	16%	17%	23%	24%	26%	34%	14%	27%	23%
	Mean	21%	15%	7%	11%	14%	17%	17%	17%	22%	10%	16%	15%
	Median	22%	13%	6%	11%	13%	16%	16%	14%	28%	7%	15%	15%
	25th percentile	11%	5%	5%	6%	8%	11%	6%	6%	6%	3%	3%	3%
	Minimum	0%	0%	0%	0%	0%	6%	6%	3%	0%	0%	0%	0%
Wet	Maximum	50%	41%	17%	27%	32%	34%	37%	39%	39%	34%	43%	35%
	75th percentile	37%	26%	14%	18%	19%	28%	27%	34%	37%	17%	33%	27%
	Mean	28%	19%	11%	16%	17%	20%	22%	26%	32%	12%	28%	22%
	Median	28%	16%	11%	14%	14%	17%	21%	26%	33%	9%	29%	22%
	25th percentile	21%	12%	6%	12%	12%	14%	17%	18%	31%	4%	25%	16%
	Minimum	4%	0%	4%	6%	11%	11%	9%	6%	18%	1%	14%	12%
Above Normal	Maximum	37%	44%	9%	17%	35%	34%	32%	37%	40%	35%	35%	40%
	75th percentile	24%	19%	7%	16%	19%	23%	30%	30%	36%	14%	32%	33%
	Mean	17%	14%	6%	13%	17%	20%	24%	23%	32%	9%	23%	28%
	Median	19%	11%	6%	15%	15%	19%	26%	23%	33%	8%	22%	27%
	25th percentile	11%	0%	5%	12%	13%	15%	21%	18%	31%	1%	16%	21%
	Minimum	0%	0%	3%	6%	4%	13%	6%	11%	14%	1%	11%	16%
Below Normal	Maximum	46%	38%	16%	27%	32%	31%	30%	30%	36%	30%	29%	40%
	75th percentile	26%	27%	7%	12%	19%	26%	24%	21%	34%	18%	20%	18%
	Mean	20%	19%	7%	11%	16%	20%	17%	15%	24%	12%	14%	14%
	Median	22%	16%	6%	7%	15%	22%	17%	16%	30%	6%	15%	14%
	25th percentile	14%	10%	6%	6%	14%	14%	9%	6%	14%	3%	8%	4%
	Minimum	0%	0%	0%	5%	6%	7%	6%	6%	6%	1%	1%	2%
Dry	Maximum	38%	41%	16%	21%	20%	27%	25%	31%	34%	22%	9%	21%
	75th percentile	29%	16%	6%	9%	15%	20%	13%	9%	16%	11%	6%	9%
	Mean	19%	13%	5%	8%	11%	15%	11%	9%	12%	8%	4%	5%
	Median	21%	12%	6%	7%	10%	17%	7%	6%	7%	7%	4%	2%
	25th percentile	11%	6%	3%	6%	8%	7%	6%	6%	6%	5%	3%	0%
	Minimum	0%	0%	0%	0%	5%	6%	6%	5%	6%	0%	0%	0%
Critical	Maximum	34%	31%	6%	19%	11%	17%	7%	6%	6%	17%	3%	10%
	75th percentile	16%	3%	6%	7%	6%	6%	6%	6%	6%	12%	2%	2%
	Mean	12%	4%	4%	7%	6%	7%	6%	6%	5%	7%	1%	2%
	Median	9%	0%	5%	6%	6%	6%	6%	6%	6%	6%	0%	0%
	25th percentile	5%	0%	1%	6%	6%	6%	6%	5%	6%	1%	0%	0%
	Minimum	0%	0%	0%	0%	0%	6%	6%	3%	0%	0%	0%	0%

5.B.6.2.1.2 Entrainment (Screening Effectiveness Analysis)

Juvenile Chinook salmon at sizes of 30 mm or greater may occur in the vicinity of the north Delta intake structures (National Marine Fisheries Service 1997). Juvenile steelhead migrating downstream in the Sacramento River that would be exposed to the north Delta intakes typically range in length from approximately 150 to 250 mm. Based on body fineness ratios of 10 (Section 5.B.5.9.2.1, *Screening Effectiveness Analysis*), a fish screen equipped with a 1.75-mm screen slot opening would be estimated to be effective at excluding juvenile Chinook salmon of 22-mm standard length and greater, as well as juvenile steelhead, which are generally larger than Chinook salmon during their Delta residence (McEwan 2001). This suggests that little to no entrainment of salmonids is expected at the proposed north Delta diversions. It is noted, however, that one juvenile Chinook salmon of 32-mm fork length—standard length would be slightly shorter—was collected during entrainment monitoring at the Freeport Regional Water Project intake in January 2012 (Kozlowski 2012). This suggests that occasional entrainment of small Chinook salmon could occur at the north Delta intakes, although most would be expected to be excluded. As noted in Appendix 5.F, *Biological Stressors on Covered Fish*, there is potential for an increase in predation risks at the north Delta intakes if they create holding habitat for piscivorous fish.

5.B.6.2.1.3 Impingement, Screen Contact, and Screen Passage Time

Experimental studies at the UC Davis Fish Treadmill facility found that Chinook salmon experienced frequent contact with the simulated fish screen but were rarely impinged (defined as prolonged screen contacts >2.5 minutes) and impingement was not related to any of the experimental variables examined (Swanson et al. 2004b). The extent to which the relatively benign experimental environment is representative of Sacramento River conditions is uncertain, but the proposed intake screens would have a smooth screen surface (e.g., wedge-wire screen material), and routine (e.g., continuous) screen cleaning would provide additional protection to minimize screen surface impingement of juvenile Chinook salmon and steelhead. The smooth surface also would serve to reduce the risk of abrasion and scale loss for any fish that does come into contact with the screen (Swanson et al. 2004b).

Estimated screen passage times for juvenile Chinook salmon demonstrate the importance of adequate sweeping velocity and screen length at the proposed north Delta intake screens (Figure 5.B.6-43 and Figure 5.B.6-44). It should be noted that the equations of Swanson and coauthors (2004b) give very long screen passage times at certain sweeping velocity and approach velocity combinations, e.g., nearly 7,000 minutes for 4.4-cm fish along a 2,000-foot screen with approach and sweeping velocities of 0.33 cm/s (Figure 5.B.6-43). Such estimates are far in excess of the duration of the experimental trials (120 minutes) used to derive the data and therefore should be treated with caution. The peaks in the estimated screen passage times shown in Figure 5.B.6-43 and Figure 5.B.6-44 reflect the swimming response of the tested juvenile Chinook salmon and their general negative rheotaxis (swimming against the prevailing current). To the left of the peaks, swimming velocity was sufficient to give net upstream progress, so that in theory the fish would pass the screen in an upstream direction. To the right of the peaks, swimming velocity increases but does not keep up with the increase in sweeping velocity, resulting in fish passing the screen in a downstream direction. Very high estimated screen passage time at the peaks reflects fish that would be maintaining station in front of a screen for a long time. Larger fish have greater swimming ability, so their peak screen passage time is somewhat greater (Figure 5.B.6-44) than that of smaller fish (Figure 5.B.6-43). Swimming velocity is lower at night than during the day for a given set of flow conditions; this generally results in screen passage time decreasing as sweeping velocity increases over the full range of sweeping flows examined here, because screen passage velocity becomes more negative (i.e., fish move downstream more quickly). Longer screens increase screen passage time, e.g., passage past a 2,000-foot screen would be 2.5 times greater than passage past an 800-foot screen (Figure 5.B.6-43 and Figure 5.B.6-44). The equations of Swanson and coauthors (2004b) estimate that with an approach velocity of 0.33 ft/sec and sweeping velocity of at least twice this (i.e., CDFW [California Department of Fish and Game 2000] criteria for Chinook salmon fry), screen passage time would range from around 30 minutes (4.4-cm fish passing an 800-foot screen during the night) to nearly 5 hours (7.9-cm fish passing a 2,000-foot screen during the day). Chinook salmon migrating downstream close to shore may encounter several of the proposed intakes within a few hours, depending on travel time. Because of the lack of an established relationship between passage time, screen contact rate and injury or mortality, it is not possible to conclude with certainty what the effects of the north Delta intakes may be on juvenile Chinook salmon or indeed on juvenile steelhead, which Swanson and coauthors (2004b) noted behaved similarly in the Fish Treadmill tests. This uncertainty would be addressed with monitoring and targeted studies examining impingement and passage time along the intakes.

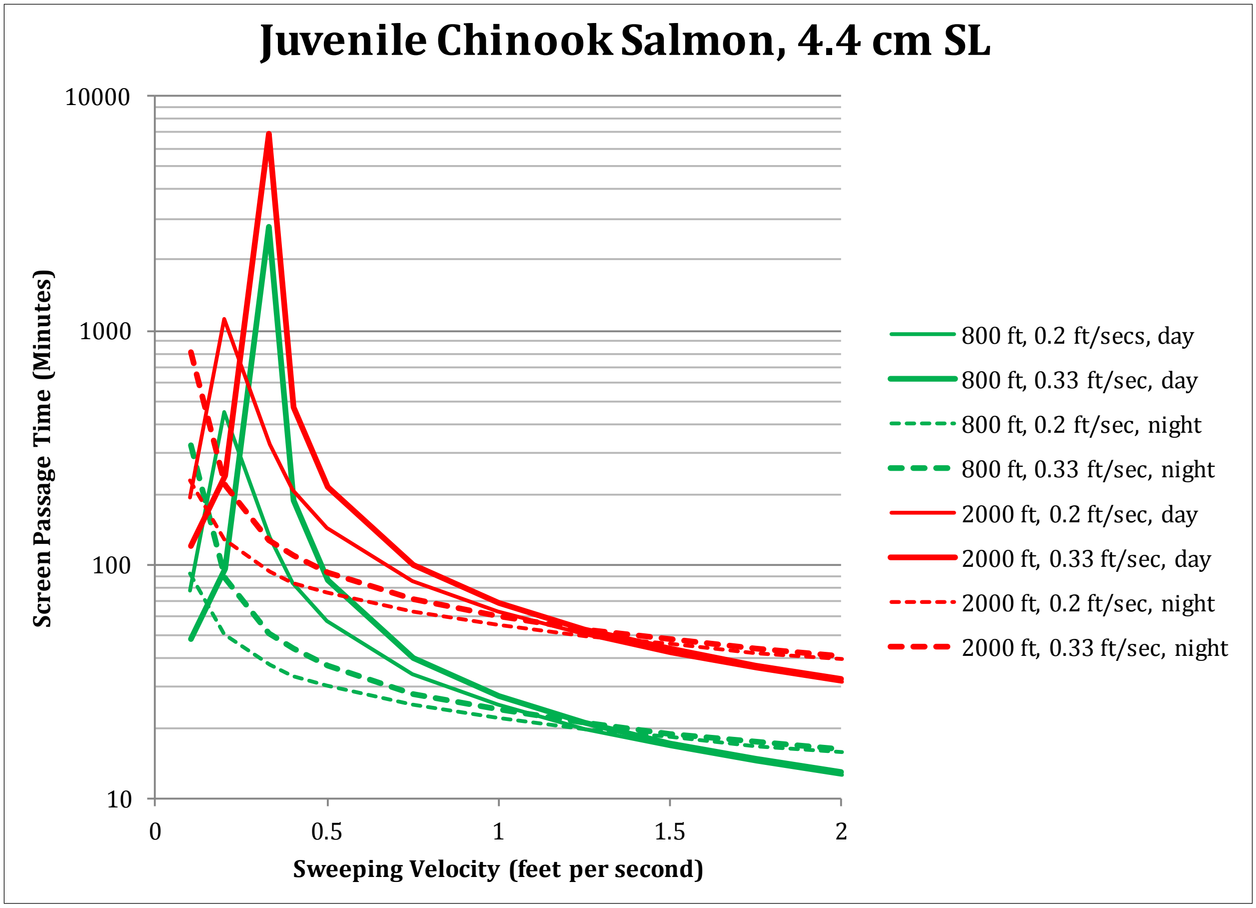


Figure 5.B.6-43. Estimated Screen Passage Time for Juvenile Chinook Salmon (4.4-cm Standard Length) Encountering an 800- or 2,000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 Feet per Second during the Day and Night

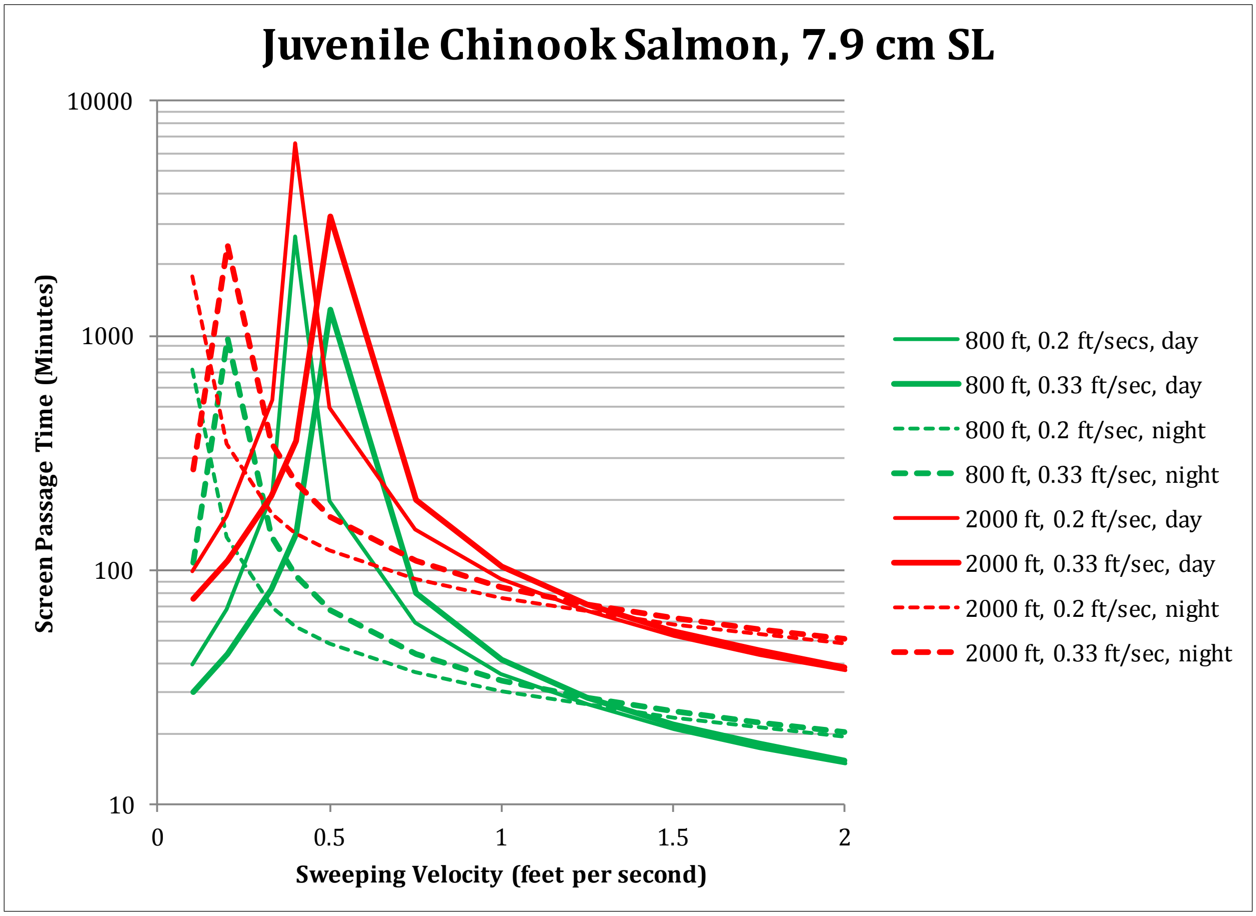


Figure 5.B.6-44. Estimated Screen Passage Time for Juvenile Chinook Salmon (7.9-cm Standard Length) Encountering an 800- or 2000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 Feet per Second during the Day and Night

5.B.6.2.2 Delta Smelt

5.B.6.2.2.1 Occurrence near the Proposed North Delta Intakes

In order for delta smelt to be at risk of entrainment or impingement at the north Delta intakes, they must be (1) in the vicinity of the proposed intakes in the Sacramento River near Hood (North Delta subregion); and (2) located in the channel cross-section closer to shore. Survey data that include the upper reaches of the North Delta subregion suggest that delta smelt are generally distributed downstream of the proposed north Delta intakes. During fall (September–December), very few delta smelt have been collected at the midwater trawl stations near the proposed intakes, with catches occurring in only 3 years since 1991 (Table 5.B.6-224). Relatively few delta smelt <60 mm FL (fork length) were collected during seining, and those were mostly collected downstream (Table 5.B.6-225). Catches of delta smelt ≥60 mm FL were greater than catches of smaller fish (although still low, particularly in recent years) and showed that catch per seine was comparable between the intake area and downstream areas (Table 5.B.6-226). The proportion of delta smelt ≥60 mm FL collected in the reach of the Sacramento River where the proposed intakes would be situated averaged slightly below one third of the total catch and was highly variable between years. It should be noted that seining is not extensive in some of the more important areas of delta smelt's current distribution (e.g., the Cache Slough subregion) and sampling in the South Delta subregion is quite common, where delta smelt distribution has declined over time (Nobriga et al. 2008) (Figure 5.B.5-6). Nevertheless, seine data do indicate that adult delta smelt occur in the reach of the river where the proposed north Delta intakes would be sited. Catch of delta smelt per cubic meter in the egg and larval survey in 1991–1994 was an order of magnitude lower in the vicinity of the proposed north Delta intakes than in downstream areas (Table 5.B.6-227), and total catch in the vicinity of the intakes was considerably less than total catch downstream. Overall, the results from the various surveys suggest that a low proportion of the delta smelt population would have the potential to occur in the reach of the Sacramento River where the north Delta intakes will be located (River Miles 37–41). There is uncertainty in the proportion of the population that could occur in this reach because, as noted above, existing seine surveys in this reach do not sample extensively within areas observed from other surveys to be important for the species (e.g., Cache Slough).

Delta smelt are generally regarded as occurring away from the shore and not associating with structure (Nobriga and Herbold 2009). Larval density in agricultural diversions was much lower than density in nearby trawling conducted away from the shore (Nobriga et al. 2004). Recent research suggests that adult delta smelt may use tidal currents to facilitate movement upstream by migrating to channel margins during ebb tides and into the channel during flood tides (Burau 2011). Depending on which side of the channel the fish move to, such behavior may place delta smelt close to the channel margins and potentially close to the proposed north Delta intakes. Flows towards the intakes may also increase the chance of delta smelt within the vicinity encountering the screen. The summary of percentage of flows diverted for salmonids (Table 5.B.6-222 and Table 5.B.6-223) also encompasses the main period of potential delta smelt occurrence near the proposed north Delta intakes. The extent to which delta smelt would occur near the on-bank intakes is uncertain; monitoring of the north Delta intakes would provide data to reduce this uncertainty.

Table 5.B.6-224. Number of Delta Smelt Collected and Catch per Trawl during the Fall Midwater Trawl Survey (September–December)

	Number of Samples		Total Caught		Proportion (Intake Area/Total)	Mean Catch Per Trawl	
Year	Intake Area	Downstream Area	Intake Area	Downstream Area		Intake Area	Downstream Area
1991	9	590	0	855	0.00	0.00	1.45
1992	21	685	0	223	0.00	0.00	0.33
1993	18	875	0	1040	0.00	0.00	1.19
1994	24	805	4	438	0.01	0.17	0.54
1995	21	713	0	924	0.00	0.00	1.30
1996	22	719	0	460	0.00	0.00	0.64
1997	18	626	1	345	0.00	0.06	0.55
1998	6	509	0	427	0.00	0.00	0.84
1999	12	532	0	997	0.00	0.00	1.87
2000	13	581	0	1126	0.00	0.00	1.94
2001	21	628	0	702	0.00	0.00	1.12
2002	9	356	0	143	0.00	0.00	0.40
2003	12	359	0	222	0.00	0.00	0.62
2004	12	357	0	170	0.00	0.00	0.48
2005	12	359	0	28	0.00	0.00	0.08
2006	8	351	0	39	0.00	0.00	0.11
2007	12	360	0	27	0.00	0.00	0.08
2008	12	356	0	22	0.00	0.00	0.06
2009	12	382	0	23	0.00	0.00	0.06
2010	12	384	1	49	0.02	0.08	0.13

Source: California Department of Fish and Game Delta FTP site.

1 **Table 5.B.6-225. Number of Delta Smelt (<60 mm Fork Length) Collected and Catch per Seine during**
2 **USFWS Seine Sampling in the Plan Area (January–December)**

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch Per Seine (Intake Area)	Catch Per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	0	124	0.00	0.00	0.98
1977	118	190	0	41	0.00	0.00	0.22
1978	72	147	224	213	0.51	3.11	1.45
1979	95	363	0	47	0.00	0.00	0.13
1980	104	440	0	3	0.00	0.00	0.01
1981	93	308	0	4	0.00	0.00	0.01
1982	101	321	0	1	0.00	0.00	0.00
1983	66	267	3	0	1.00	0.05	0.00
1984	66	256	1	3	0.25	0.02	0.01
1985	59	230	0	0	–	0.00	0.00
1986	33	168	0	0	–	0.00	0.00
1987	44	172	0	0	–	0.00	0.00
1988	43	164	0	0	–	0.00	0.00
1989	49	202	0	0	–	0.00	0.00
1990	19	52	0	0	–	0.00	0.00
1991	44	152	0	0	–	0.00	0.00
1992	103	338	0	0	–	0.00	0.00
1993	149	413	2	2	0.50	0.01	0.00
1994	215	731	2	13	0.13	0.01	0.02
1995	497	645	8	57	0.12	0.02	0.09
1996	646	782	0	13	0.00	0.00	0.02
1997	444	693	1	12	0.08	0.00	0.02
1998	360	782	0	7	0.00	0.00	0.01
1999	323	854	1	28	0.03	0.00	0.03
2000	372	826	0	18	0.00	0.00	0.02
2001	364	924	0	37	0.00	0.00	0.04
2002	331	1070	0	15	0.00	0.00	0.01
2003	332	1014	0	13	0.00	0.00	0.01
2004	359	1015	0	14	0.00	0.00	0.01
2005	386	1006	0	3	0.00	0.00	0.00
2006	324	928	0	21	0.00	0.00	0.02
2007	360	994	0	7	0.00	0.00	0.01
2008	341	950	0	0	–	0.00	0.00
2009	358	970	0	1	0.00	0.00	0.00
2010	359	850	1	0	1.00	0.00	0.00
2011	347	852	0	2	0.00	0.00	0.00
Mean	222	561	7	19	0.13	0.09	0.09
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	0	0	0.00	0.00	0.00
Median	182	543	0	3	0.00	0.00	0.01
75th percentile	359	872	0	16	0.10	0.00	0.02
95th percentile	457	1014	4	74	0.85	0.02	0.41
Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.).							

Table 5.B.6-226. Number of Delta Smelt (≥60 mm Fork Length) Collected and Catch per Seine during USFWS Seine Sampling in the Plan Area (January–December)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch Per Seine (Intake Area)	Catch Per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	10	187	0.05	0.34	1.48
1977	118	190	9	116	0.07	0.08	0.61
1978	72	147	36	124	0.22	0.50	0.84
1979	95	363	28	411	0.06	0.29	1.13
1980	104	440	1	38	0.03	0.01	0.09
1981	93	308	78	208	0.27	0.84	0.68
1982	101	321	14	115	0.11	0.14	0.36
1983	66	267	17	61	0.22	0.26	0.23
1984	66	256	14	10	0.58	0.21	0.04
1985	59	230	0	29	0.00	0.00	0.13
1986	33	168	1	19	0.05	0.03	0.11
1987	44	172	0	19	0.00	0.00	0.11
1988	43	164	0	3	0.00	0.00	0.02
1989	49	202	0	5	0.00	0.00	0.02
1990	19	52	0	0	–	0.00	0.00
1991	44	152	4	0	1.00	0.09	0.00
1992	103	338	4	15	0.21	0.04	0.04
1993	149	413	18	11	0.62	0.12	0.03
1994	215	731	1	72	0.01	0.00	0.10
1995	497	645	7	12	0.37	0.01	0.02
1996	646	782	5	53	0.09	0.01	0.07
1997	444	693	6	25	0.19	0.01	0.04
1998	360	782	9	65	0.12	0.03	0.08
1999	323	854	31	34	0.48	0.10	0.04
2000	372	826	16	60	0.21	0.04	0.07
2001	364	924	2	25	0.07	0.01	0.03
2002	331	1070	7	9	0.44	0.02	0.01
2003	332	1014	17	34	0.33	0.05	0.03
2004	359	1015	26	21	0.55	0.07	0.02
2005	386	1006	25	10	0.71	0.06	0.01
2006	324	928	5	52	0.09	0.02	0.06
2007	360	994	1	8	0.11	0.00	0.01
2008	341	950	1	0	1.00	0.00	0.00
2009	358	970	6	5	0.55	0.02	0.01
2010	359	850	26	6	0.81	0.07	0.01
2011	347	852	35	6	0.85	0.10	0.01
Mean	222	561	13	52	0.30	0.10	0.18
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	1	9	0.07	0.01	0.02
Median	182	543	7	23	0.21	0.03	0.04
75th percentile	359	872	17	60	0.51	0.10	0.11
95th percentile	457	1014	35	192	0.90	0.38	0.92

Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.).

Table 5.B.6-227. Number of Delta Smelt Larvae Collected and Catch per Cubic Meter during the CDFW Striped Bass Egg and Larval Survey in the Plan Area (February–July)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch Per Cubic Meter (Intake Area)	Catch Per Cubic Meter (Downstream)
	Intake Area	Downstream					
1991	217	1371	37	190	0.16	0.17	0.90
1992	355	2064	53	512	0.09	0.23	2.39
1993	261	2160	98	1431	0.06	0.45	8.21
1994	312	2348	32	2955	0.01	0.14	13.27
Mean	286	1986	55	1272	0.08	0.25	6.19

Source: California Department of Fish and Game Delta FTP site.

5.B.6.2.2.2 Entrainment

Screening Effectiveness

Potential entrainment of delta smelt at the proposed north Delta diversions would occur at sizes less than around 22-mm SL, based on a body fineness ratio of 10 (Section 5.B.5.9.2.1, *Screening Effectiveness Analysis*). As discussed further below, such sizes of delta smelt have been found in the vicinity of the proposed diversions (e.g., historical striped bass egg and larval survey data), although only a very small proportion of the population appears to occur there. The extent of larval delta smelt entrainment would be assessed using a monitoring program that may be similar to one that is currently being implemented at the Freeport Regional Water Authority intake just upstream of the proposed north Delta diversions (ICF International 2010, 2011). The first year of entrainment monitoring at Freeport was 2012 and no delta smelt were collected (Kozlowski pers. comm.); the results from that location will inform the potential extent of delta smelt entrainment at the proposed north Delta diversions, although it is noted that the proposed north Delta diversions are 6–10 miles downstream of Freeport. Delta smelt may occur more frequently in the north Delta diversions area under future climate conditions if sea level rise induces movement of the spawning population farther upstream than is currently typical.

Particle Tracking Modeling

As described above in Section 5.B.6.2.2.1, *Occurrence near the Proposed North Delta Intakes*, a relatively low proportion of delta smelt larvae was collected in the intake area (i.e., upstream of the divergence with the Delta Cross Channel/Georgiana Slough). PTM results showed that there was no entrainment of particles released in the Sacramento River at Sutter Slough over the range of north Delta exports to Sacramento River inflow examined (~1–37%;Figure 5.B.6-45). This suggests that the modeled evaluated starting operations avoid flow reversals that could entrain larvae upstream from within several miles of the proposed intake locations: the Sacramento River at Sutter Slough (River Mile 34) is only 3–7 miles downstream from the proposed north Delta intakes (Intake 2, 3, and 5, River Miles 37–41). Particles released in the Sacramento River at Sacramento were entrained at a rate in proportion to the percentage of flow diverted, suggesting that, for the range of diversion rates modeled, around 1% to almost 40% of larvae less than 22-mm standard length (see *Screening Effectiveness Analysis* above) occurring in the vicinity of the intakes could be entrained (Figure 5.B.6-45). This agrees with the approximate modeled CALSIM rates of diversion for the typical delta smelt larval period (March–June) that are shown in Table 5.B.6-222 and Table 5.B.6-223 in Section 5.B.6.2.2.1.

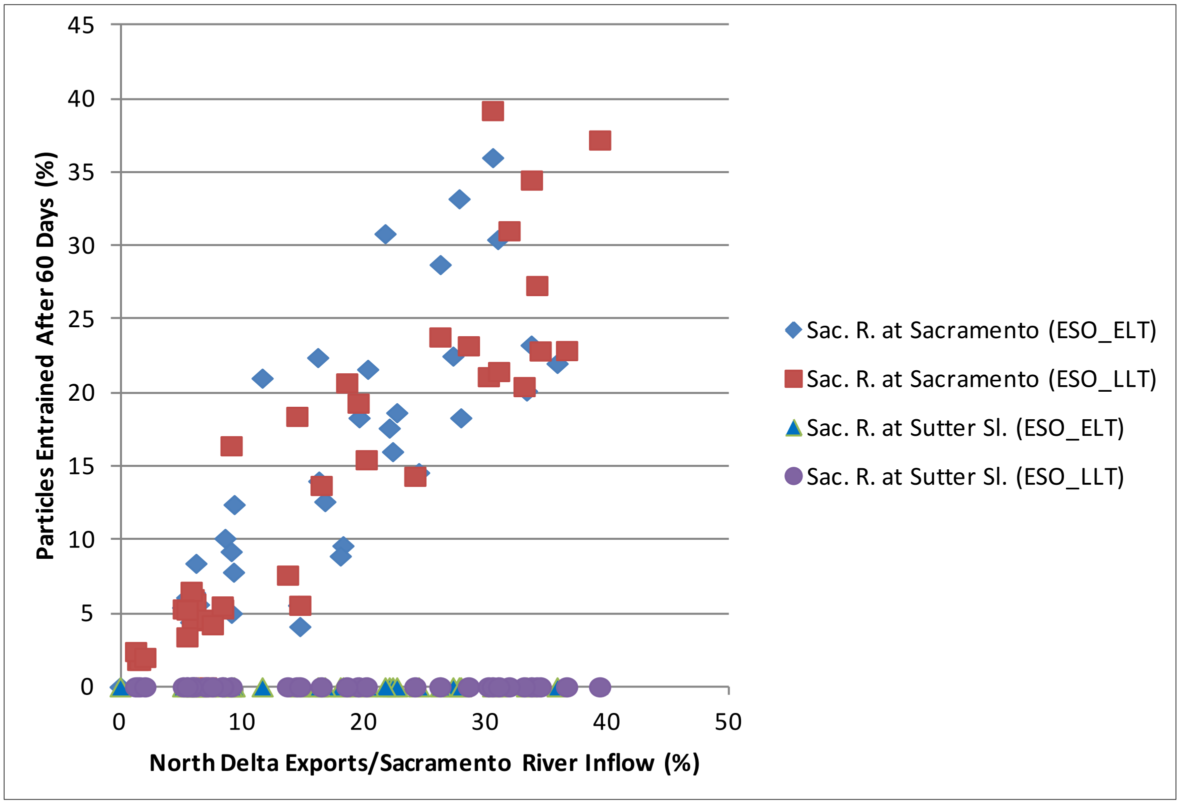
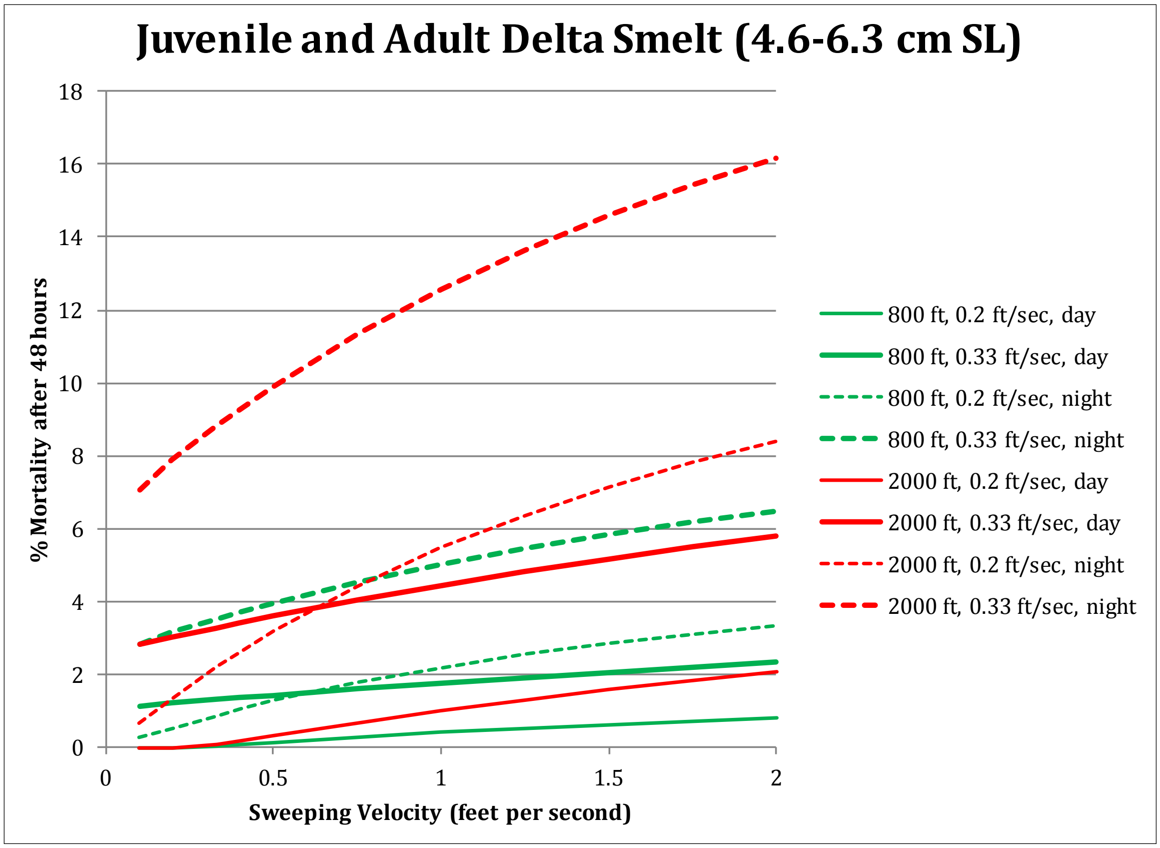


Figure 5.B.6-45. DSM2-PTM Model Results for Percentage of Particles Released in the Sacramento River at Sacramento or at Sutter Slough That Were Entrained at the North Delta Intakes, in Relation to North Delta Exports as a Percentage of Sacramento River Inflow to the Delta, for Evaluated Starting Operations (ESO) in the Early Long-Term (ELT) and Late Long-Term (LLT)

5.B.6.2.2.3 Impingement and Screen Contact

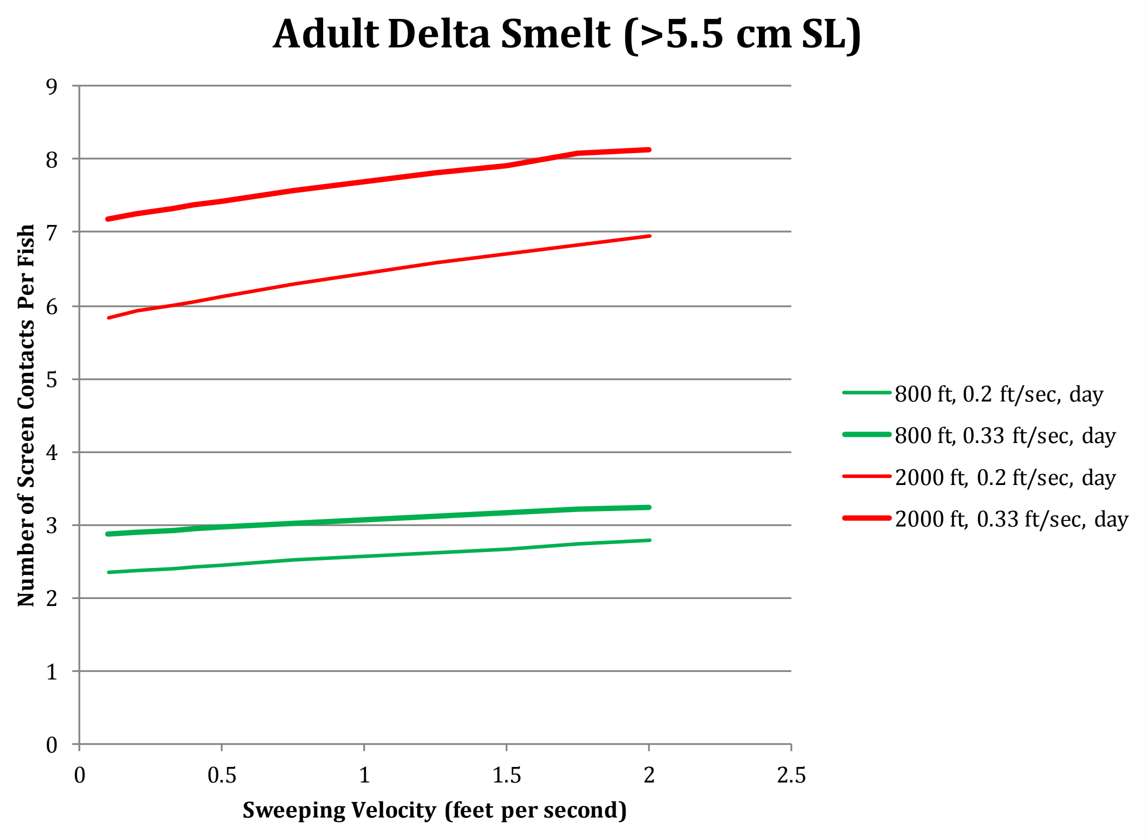
The proposed north Delta intakes would probably operate at approach velocities of 0.2 ft/sec when monitoring shows that delta smelt are present (or indeed at all times). Results of the screen interaction analysis based on equations from Swanson and coauthors (2005) illustrated the importance of screen length, approach and sweeping velocities, and the day/night factor. At approach velocities of 0.2 ft/sec, the percentage of juvenile and adult delta smelt occurring in the vicinity of the proposed north Delta diversion that may die within 48 hours of encountering them was estimated at less than 0.1% of those in the vicinity of the intakes for an 800-foot screen during the day with sweeping velocities at or below 0.4 ft/sec. As described in the methods section, note that ‘percentage mortality’ only refers to the delta smelt occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones occurring near the river margins where the on-bank intakes would be sited. Mortality increased to 0.8% with sweeping velocity of 2 ft/sec (Figure 5.B.6-46). At night, the same screen length and approach velocity was estimated to result in an order of magnitude more mortality over the same range of sweeping velocities. Increasing screen length from 800 feet to 2,000 feet gave a roughly proportional increase in mortality by a factor of 2.5. The importance of approach velocity was clear, as intakes operated to a criterion of 0.33 ft/sec were estimated to result in mortality rates that were 2–10 times greater than the mortality at an approach velocity of 0.22 ft/sec, for the same sweeping velocity. Thus potential mortality was estimated to be as high as 16% for a 2,000-foot screen operated to 0.33 ft/sec approach velocity at night. The results of the present analysis suggest that, assuming an approach velocity of 0.2 ft/sec when delta smelt are present and a sweeping velocity equal to or greater than this, 48-hour mortality at each screen may range from 0% to 8.4% depending on screen length (Figure 5.B.6-46). Fish encountering multiple screens during the same time period would face a progressively greater likelihood of dying from screen contact.

For adult delta smelt, the number of screen contacts during the day would be estimated to increase mostly with increasing screen length and approach velocity. Increased screen contacts related to sweeping velocity would be rather limited with sweeping velocity along an 800-foot screen, but greater along a 2,000-foot screen (Figure 5.B.6-47). Assuming an approach velocity of 0.2 ft/sec and an equivalent or greater sweeping velocity, adult delta smelt would be estimated to contact a fish screen between 2.4 and 7 times, which would result in varying levels of stress to the fish. As noted for mortality analyses, fish encountering multiple screens would have more total contacts and would experience greater levels of stress.



Note that this plot is only relevant to the delta smelt occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones encountering the intake screens at the river margins where the on-bank intakes would be sited.

Figure 5.B.6-46. Estimated 48-hour Mortality of Juvenile and Adult Delta Smelt Encountering an 800- or 2,000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 feet per second during the Day and Night



Note that this plot is only relevant to the delta smelt occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones encountering the intake screens at the river margins where the on-bank intakes would be sited.

Figure 5.B.6-47. Estimated Number of Screen Contacts per Fish for Adult Delta Smelt Encountering an 800- or 2,000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 Feet per Second during the Day and Night

5.B.6.2.3 Longfin Smelt

5.B.6.2.3.1 Occurrence near the Proposed North Delta Intakes

As with delta smelt, potential for entrainment or impingement of longfin smelt at the proposed north Delta intakes is driven by their geographic distribution in that region and their proximity to the shore. No longfin smelt have been collected during the fall midwater trawling near the proposed intakes (in contrast with much greater abundance downstream; Table 5.B.6-228) and very few longfin smelt have been collected during USFWS seine surveys at any location (Table 5.B.6-229 andTable 5.B.6-230). This suggests that the species is difficult to catch, occurs near channel margins far less frequently than delta smelt, or is generally not found at the main seining sites. Very low numbers of longfin smelt larvae were collected in the intake vicinity during the egg and larval survey, with density at downstream locations several orders of magnitude greater than at stations near the proposed intakes (Table 5.B.6-231). Together, these observations suggest that longfin smelt are largely well downstream of the intake area but that a small number may occur near the intakes at times. With sea level rise, the species' distribution may move further upstream in the future, increasing the proportion of the population that may encounter the intakes.

Table 5.B.6-228. Number of Longfin Smelt Collected and Catch per Trawl during the Fall Midwater Trawl Survey (September–December)

Year	Number of Samples		Total Caught		Proportion (Intake Area/Total)	Mean Catch Per Trawl	
	Intake Area	Downstream Area	Intake Area	Downstream Area		Intake Area	Downstream Area
1991	9	590	0	223	0.00	0.00	0.38
1992	21	685	0	74	0.00	0.00	0.11
1993	18	875	0	668	0.00	0.00	0.76
1994	24	805	0	1006	0.00	0.00	1.25
1995	21	713	0	2799	0.00	0.00	3.93
1996	22	719	0	1943	0.00	0.00	2.70
1997	18	626	0	604	0.00	0.00	0.96
1998	6	509	0	4958	0.00	0.00	9.74
1999	12	532	0	2644	0.00	0.00	4.97
2000	13	581	0	2472	0.00	0.00	4.25
2001	21	628	0	1122	0.00	0.00	1.79
2002	9	356	0	473	0.00	0.00	1.33
2003	12	359	0	322	0.00	0.00	0.90
2004	12	357	0	115	0.00	0.00	0.32
2005	12	359	0	46	0.00	0.00	0.13
2006	8	351	0	275	0.00	0.00	0.78
2007	12	360	0	9	0.00	0.00	0.03
2008	12	356	0	78	0.00	0.00	0.22
2009	12	382	0	49	0.00	0.00	0.13
2010	12	384	0	50	0.00	0.00	0.13
Source: California Department of Fish and Game Delta FTP site.							

Table 5.B.6-229. Number of Longfin Smelt (<60 mm Fork Length) Collected and Catch per Seine during USFWS Seine Sampling in the Plan Area (January–December)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	0	0	–	0.00	0.00
1977	118	190	0	0	–	0.00	0.00
1978	72	147	0	0	–	0.00	0.00
1979	95	363	0	0	–	0.00	0.00
1980	104	440	0	31	0.00	0.00	0.07
1981	93	308	0	0	–	0.00	0.00
1982	101	321	0	0	–	0.00	0.00
1983	66	267	0	0	–	0.00	0.00
1984	66	256	0	0	–	0.00	0.00
1985	59	230	0	0	–	0.00	0.00
1986	33	168	0	0	–	0.00	0.00
1987	44	172	0	0	–	0.00	0.00
1988	43	164	0	0	–	0.00	0.00
1989	49	202	0	0	–	0.00	0.00
1990	19	52	0	0	–	0.00	0.00
1991	44	152	0	0	–	0.00	0.00
1992	103	338	0	0	–	0.00	0.00
1993	149	413	0	9	0.00	0.00	0.02
1994	215	731	1	1	0.50	0.00	0.00
1995	497	645	0	7	0.00	0.00	0.01
1996	646	782	0	0	–	0.00	0.00
1997	444	693	0	0	–	0.00	0.00
1998	360	782	0	2	0.00	0.00	0.00
1999	323	854	0	0	–	0.00	0.00
2000	372	826	0	1	0.00	0.00	0.00
2001	364	924	0	0	–	0.00	0.00
2002	331	1070	1	3	0.25	0.00	0.00
2003	332	1014	0	1	0.00	0.00	0.00
2004	359	1015	0	0	–	0.00	0.00
2005	386	1006	0	3	0.00	0.00	0.00
2006	324	928	0	0	–	0.00	0.00
2007	360	994	0	1	0.00	0.00	0.00
2008	341	950	0	0	–	0.00	0.00
2009	358	970	0	0	–	0.00	0.00
2010	359	850	0	0	–	0.00	0.00
2011	347	852	0	0	–	0.00	0.00
Mean	222	561	0	2	0.08	0.00	0.00
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	0	0	0.00	0.00	0.00
Median	182	543	0	0	0.00	0.00	0.00
75th percentile	359	872	0	1	0.00	0.00	0.00
95th percentile	457	1014	0	8	0.39	0.00	0.01
Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.).							

Table 5.B.6-230. Number of Longfin Smelt (≥60 mm Fork Length) Collected and Catch per Seine during USFWS Seine Sampling in the Plan Area (January–December)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	0	0	–	0.00	0.00
1977	118	190	0	0	–	0.00	0.00
1978	72	147	0	0	–	0.00	0.00
1979	95	363	0	15	0.00	0.00	0.04
1980	104	440	0	1	0.00	0.00	0.00
1981	93	308	0	0	–	0.00	0.00
1982	101	321	0	1	0.00	0.00	0.00
1983	66	267	0	0	–	0.00	0.00
1984	66	256	0	0	–	0.00	0.00
1985	59	230	0	0	–	0.00	0.00
1986	33	168	0	0	–	0.00	0.00
1987	44	172	0	0	–	0.00	0.00
1988	43	164	0	0	–	0.00	0.00
1989	49	202	0	0	–	0.00	0.00
1990	19	52	0	0	–	0.00	0.00
1991	44	152	0	0	–	0.00	0.00
1992	103	338	0	0	–	0.00	0.00
1993	149	413	0	0	–	0.00	0.00
1994	215	731	1	0	1.00	0.00	0.00
1995	497	645	0	0	–	0.00	0.00
1996	646	782	0	8	0.00	0.00	0.01
1997	444	693	0	0	–	0.00	0.00
1998	360	782	1	0	1.00	0.00	0.00
1999	323	854	0	0	–	0.00	0.00
2000	372	826	0	0	–	0.00	0.00
2001	364	924	0	0	–	0.00	0.00
2002	331	1070	0	0	–	0.00	0.00
2003	332	1014	0	0	–	0.00	0.00
2004	359	1015	0	0	–	0.00	0.00
2005	386	1006	0	0	–	0.00	0.00
2006	324	928	0	0	–	0.00	0.00
2007	360	994	0	0	–	0.00	0.00
2008	341	950	0	0	–	0.00	0.00
2009	358	970	0	0	–	0.00	0.00
2010	359	850	0	0	–	0.00	0.00
2011	347	852	0	0	–	0.00	0.00
Mean	222	561	0	1	0.33	0.00	0.00
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	0	0	0.00	0.00	0.00
Median	182	543	0	0	0.00	0.00	0.00
75th percentile	359	872	0	0	0.75	0.00	0.00
95th percentile	457	1014	0	3	1.00	0.00	0.00

Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.).

Table 5.B.6-231. Number of Longfin Smelt Larvae Collected and Catch per Cubic Meter during the CDFW Striped Bass Egg and Larval Survey in the Plan Area (February–July)

Water Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Cubic Meter (Intake Area)	Catch per Cubic Meter (Downstream)
	Intake Area	Downstream					
1991	217	1371	38	2333	0.02	0.17	9.65
1992	355	2064	2	2497	0.00	0.01	10.18
1993	261	2160	3	2632	0.00	0.01	12.30
1994	312	2348	2	22233	0.00	0.01	97.17
Mean	286	1986	11	7424	0.00	0.05	32.32

Source: California Department of Fish and Game Delta FTP site.

5.B.6.2.3.2 Entrainment

Screening Effectiveness Analysis

As noted for delta smelt, potential entrainment of longfin smelt at the proposed north Delta diversions would occur at sizes of less than around 22-mm SL, based on a body fineness ratio of 10 (Section 5.B.5.9.2.1, *Screening Effectiveness Analysis*). As discussed above, longfin smelt have been found in the vicinity of the proposed diversions, although only a very small proportion of the population appears to occur there, much less than for delta smelt. The species rarely is distributed upstream of Rio Vista on the Sacramento River (Moyle 2002), although more longfin smelt may occur in this area under future climate conditions if sea level rise induces movement of the spawning population farther upstream than is currently typical. No longfin smelt were collected at the Freeport Regional Water Authority intake in 2012 (Kozlowski, pers. comm.). As noted above for delta smelt, monitoring of entrainment would inform the extent of longfin smelt larval entrainment.

Particle Tracking Modeling

As described above for delta smelt in Section 5.B.6.2.2.2, *Entrainment*, in the *Particle Tracking Modeling* subsection, the evaluated starting operations avoid upstream entrainment of particles from the modeled Sacramento River at Sutter Slough location (Figure 5.B.6-45), whereas particles released at the Sacramento River at Sacramento were entrained in proportion to flow diverted at the north Delta intakes. Therefore the effects of entrainment at the north Delta intakes would apply only to the very small proportion of longfin smelt larvae less than 22-mm standard length that may occur in the vicinity of the north Delta intakes (see *Screening Effectiveness Analysis* above).

5.B.6.2.3.3 Impingement and Screen Contact

No focused studies have been made of longfin smelt potential for impingement and screen contact. The species is related to delta smelt and may exhibit similar behavior in relation to fish screens. As described above for delta smelt, there is potential for screen contact and mortality for the relatively few individuals occurring sufficiently far upstream to encounter the intakes, with the interaction of approach/sweeping velocities and time of day being of particular importance. Longfin smelt live longer than delta smelt and so older individuals may have better swimming abilities because of larger size. Monitoring during Plan implementation would reduce the uncertainty surrounding the potential for longfin smelt impingement and mortality.

5.B.6.2.4 Sacramento Splittail (Larvae, Juvenile, and Adult)

5.B.6.2.4.1 Entrainment (Screening Effectiveness Analysis)

Juvenile splittail emigrating from spawning habitats in the Sacramento River and its tributaries upstream of the intakes potentially would be vulnerable to entrainment by the proposed north Delta diversions. These spawning areas include the important floodplain habitat of the Sutter Bypass but do not include the Yolo Bypass because splittail enter and exit the Yolo Bypass by way of Cache Slough (downstream of the proposed north Delta intakes). The Yolo Bypass has almost four times as much floodplain habitat as the Sutter Bypass. However, riverine habitat upstream of the north Delta diversions likely is especially important in dry years, when spawning is limited to channel margin habitat (Feyrer et al. 2005). Juvenile splittail emigrating from habitat along the Cosumnes and San Joaquin Rivers would have little to no entrainment risk at the intakes because flow from these habitats joins flow from the Sacramento River well downstream of the proposed intake locations.

Based on a fineness ratio of 10 (Section 5.B.5.9.2.1, *Screening Effectiveness Analysis*), splittail larvae and juveniles less than 22-mm SL would be vulnerable to entrainment by the north Delta diversions, whereas individuals greater than 22 mm are likely to be effectively excluded by the proposed screen mesh size of 1.75 mm. Three USFWS seine survey stations are the closest, upstream and downstream, to the proposed intake locations on the Sacramento River: Garcia Bend (RM49), Clarksburg (RM43), and Koket (RM24). In these samples, less than 0.1% of the splittail in the samples were equal to or less than 15 mm in length, and about 1% were less than 20 mm in length. However, very small fish/larvae are not measured, so the samples are not representative of the abundance of larval splittail that could be entrained at the north Delta intakes. No splittail larvae were identified in the CDFW striped bass egg and larval survey that included stations in the vicinity of the proposed north Delta intakes, although splittail larvae may have been part of unidentified cyprinids. The draft DRERIP conceptual model for splittail indicates that splittail larvae occur in floodplain and channel margin habitat, with juveniles 20–30 mm SL occurring in these habitats and the Delta. Monitoring at the 1.75-mm-screened Contra Costa Water District Middle River Intake in 2011 showed splittail occurrence in May (Raifsnider 2011). It is possible that appreciable numbers of small larvae could be entrained through the proposed north Delta intake screens. Four splittail, fork lengths 14.5-16.2 mm, were collected during entrainment monitoring at the Freeport Regional Water Authority intake in May 2012 (Kozlowski pers. comm.). As noted for the smelts, monitoring at the proposed north Delta diversions would allow assessment of the extent to which larval splittail are lost to entrainment.

5.B.6.2.4.2 Impingement and Screen Contact

Splittail are strong swimmers (Young and Cech 1996; Young et al. 1999; Danley et al. 2002). Juvenile splittail are potentially vulnerable to impingement on the surface of the intake fish screens. However, the use of a smooth screen surface (e.g., wedge-wire screen material) and low approach velocity maintained by routine screen cleaning are expected to minimize impingement of juvenile splittail on the screen surface. The smooth surface also would serve to reduce the risk of abrasion and scale loss for any fish that comes into contact with the screen surface. For juvenile splittail occurring in the vicinity of the proposed north Delta intakes, laboratory studies by Swanson and coauthors (2004a) suggested that the number of contacts with the fish screens may vary primarily as a result of light level (day/night) and sweeping velocity, with a minor effect of fish size during the day. Thus the number of contacts per fish was shown to vary from less than two (4 cm fish during the day along an 800-foot screen) to 40–50 contacts per fish at low sweeping velocity during the night (both sizes of fish) (Figure 5.B.6-48 and Figure 5.B.6-49). Because juvenile splittail tend to swim with the prevailing current and contact the screen more during the night (Swanson et al. 2004a), screen passage time and contact rate go down considerably with increased sweeping velocity. It is important to note the uncertainty in the significance of different screen contact rates for juvenile splittail, because no clear statistical link has been established between indicators of adverse effects (e.g., cortisol levels, mortality, and injury) and screen contacts (Danley et al. 2002). Nevertheless, from the present analysis it is possible to estimate that juvenile splittail encountering a fish screen during periods of operation at 0.2-ft/sec approach velocity (e.g., during periods of delta smelt presence) may contact the screen between 0 almost 50 times depending on screen length and sweeping velocity; operation at 0.33 ft/sec (e.g., during periods when delta smelt are absent) would result in somewhat lower contact rates.

Based on these considerations, the direct loss of juvenile splittail to impingement at the north Delta intakes may be low but the uncertainty will be addressed through monitoring.

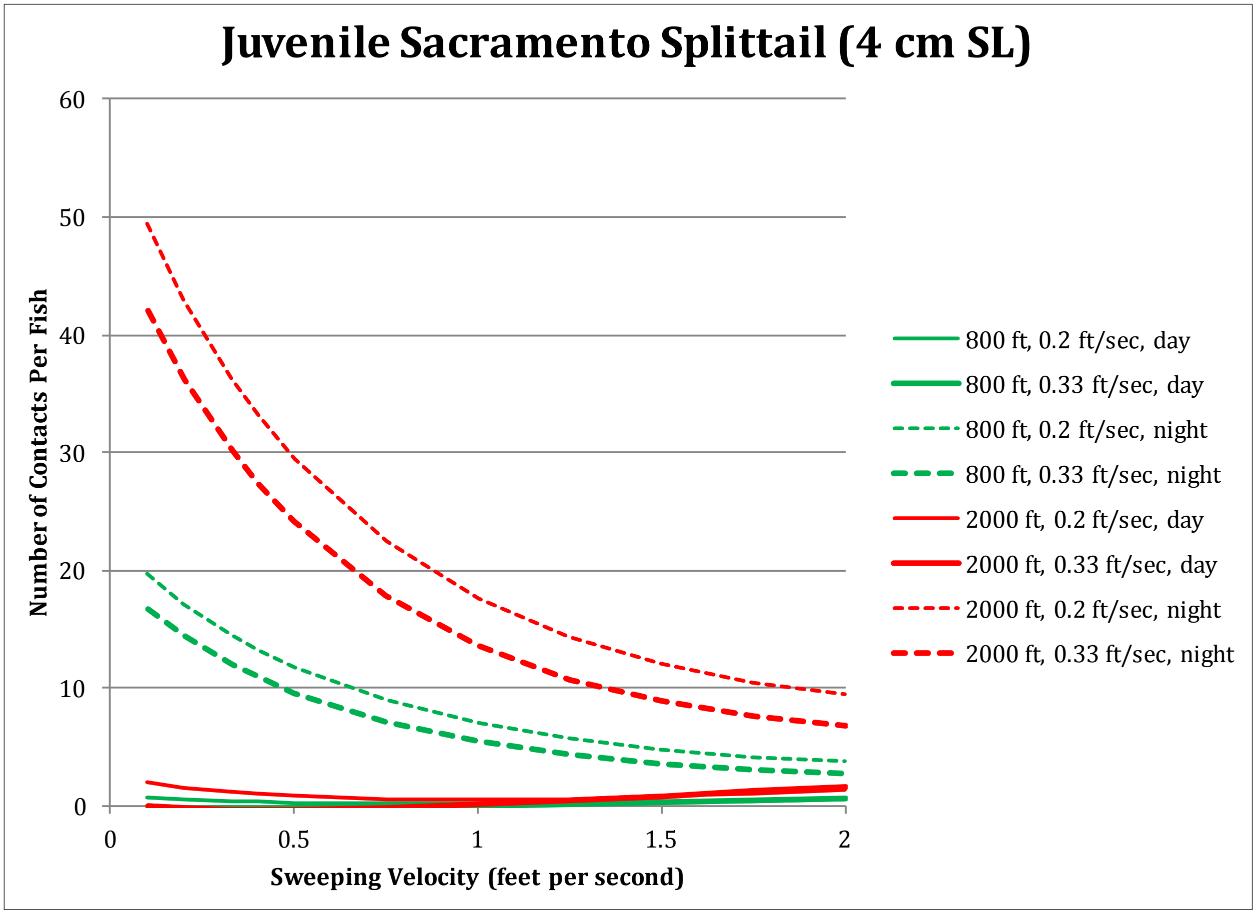


Figure 5.B.6-48. Estimated Number of Screen Contacts per Fish for Juvenile Sacramento Splittail (4 cm Standard Length) Encountering an 800- or 2,000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 feet per second during the Day and Night. Note that this plot is only relevant to the splittail occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones encountering the intake screens at the river margins where the on-bank intakes would be sited.

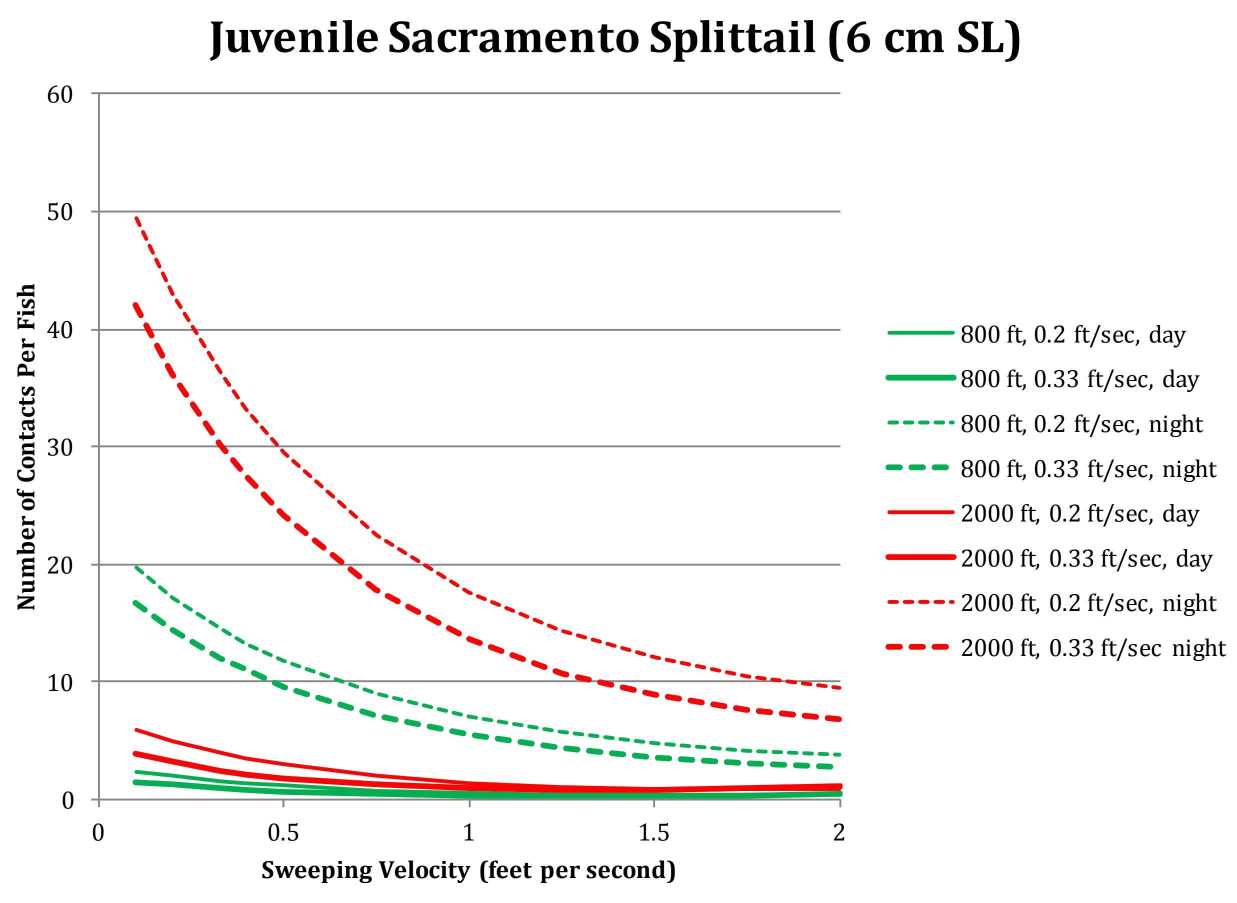


Figure 5.B.6-49. Estimated Number of Screen Contacts per Fish for Juvenile Sacramento Splittail (6 cm Standard Length) Encountering an 800- or 2,000-foot-long Fish Screen at Approach Velocities of 0.2 or 0.33 feet per second during the Day and Night. Note that this plot is only relevant to the splittail occurring in the reach of the Sacramento River where the intake occurs, and of those, only the ones encountering the intake screens at the river margins where the on-bank intakes would be sited.

5.B.6.2.5 White Sturgeon (Egg/Embryo, Larvae, and Juvenile)

5.B.6.2.5.1 Entrainment (Screening Effectiveness Analysis)

White sturgeon eggs and embryos can occur from the lower mainstem of the Sacramento River downstream to the north Delta (Israel et al. 2009), including in the vicinity of the north Delta diversion facilities. Israel and coauthors (2009) indicate an April–May occurrence of these life stages in this region, although eggs and embryos may occur as early as February. This February–May period overlaps periods of increased north Delta pumping. However, there are currently no quantitative modeling estimates of egg/embryo entrainment for these proposed facilities, and documentation of agricultural entrainment of sturgeon of any age in the north Delta is extremely limited. Because of the sticky nature of sturgeon eggs, which allows them to adhere to substrates within the first few hours of being laid (Parsley et al. 1989) and minimizes their drift, the north Delta diversions may entrain very few eggs; therefore, they would have a minimal effect on white sturgeon. The certainty of this effect is low because of the lack of sufficient data and an inability to model entrainment. Monitoring of entrainment samples would address the uncertainty regarding entrainment of early life stages of white sturgeon.

The entrainment risk of north Delta diversions to white sturgeon larvae may be greater than for egg/embryo stages because larvae occur within the water column. Based on a fineness ratio of 5 (Section 5.B.5.9.2.1, *Screening Effectiveness Analysis*), the 1.75-mm mesh size of the intake screens would prevent entrainment of white sturgeon larvae greater than around 10 mm long. Because larvae are around 11 mm long (Wang 1986, as cited by Moyle 2002: 108), the majority of larvae encountering the intakes may be excluded from entrainment by the mesh of the proposed north Delta diversions.

5.B.6.2.5.2 Impingement and Screen Contact

Juvenile white sturgeon are demersal and therefore probably have less potential to be near the off-bottom vertical fish screens of the proposed north Delta diversion facilities intakes than other non-sturgeon covered fish species. However, Hallock and Van Woert (1959) detected entrainment of three white sturgeon at an agricultural diversion and so it is possible that white sturgeon may have the potential to be impinged at the north Delta diversions. Studies of juvenile white sturgeon behavior in the vicinity of fish screens have not been undertaken; however studies of juvenile green sturgeon were carried out at the UC Davis Fish Treadmill facility by Swanson and coauthors (2004a). The results of these studies showed that green sturgeon tended to occur near the channel bottom and inner/outer screen surfaces, involuntary screen contacts influenced by two-vector flows were difficult to distinguish from contacts during active swimming, and the contact rates were higher than for other species tested. Contact rates were independent of flow velocity and time of day/light level, and screen contact did not result in injury or mortality, with uniformly high survival during testing. As noted for other species, the extent to which these laboratory observations, undertaken in relatively benign conditions, are reflective of conditions that may occur at the proposed north Delta diversion facility screens in unknown. Position in the water column and laboratory studies generally suggest that risk of adverse effects on juvenile white sturgeon from impingement at the proposed north Delta diversions is low but this is uncertain. As described above, white sturgeon larvae are large enough to be excluded from entrainment by the 1.75-mm mesh of the proposed north Delta intake screens. There may be a risk of impingement, but there are no studies from which to infer the potential effects of impingement on this species; the effects therefore are uncertain. As with other species, the extent to which white sturgeon may be impinged at the north Delta diversions would be monitored during implementation of the Plan.

5.B.6.2.6 Green Sturgeon (Juvenile)

5.B.6.2.6.1 Entrainment (Screening Effectiveness Analysis)

Green sturgeon eggs, embryos, and larvae occur farther upstream in the Sacramento River than the proposed location of the north Delta diversions (Israel and Klimley 2008). As a result, it is concluded with high certainty that the egg and embryo life stages of green sturgeon would not be entrained by the north Delta diversion facilities.

Juvenile green sturgeon that may occur in the vicinity of the north Delta diversion facilities are greater than 30 mm in length. Consequently, juvenile green sturgeon would not be expected to be entrained through the screens at the north Delta intake facilities because only green sturgeon of 10 mm or less have the potential to be entrained, based on an estimated sturgeon fineness ratio of 5 (Section 5.B.5.9.2.1).

5.B.6.2.6.2 Impingement and Screen Contact

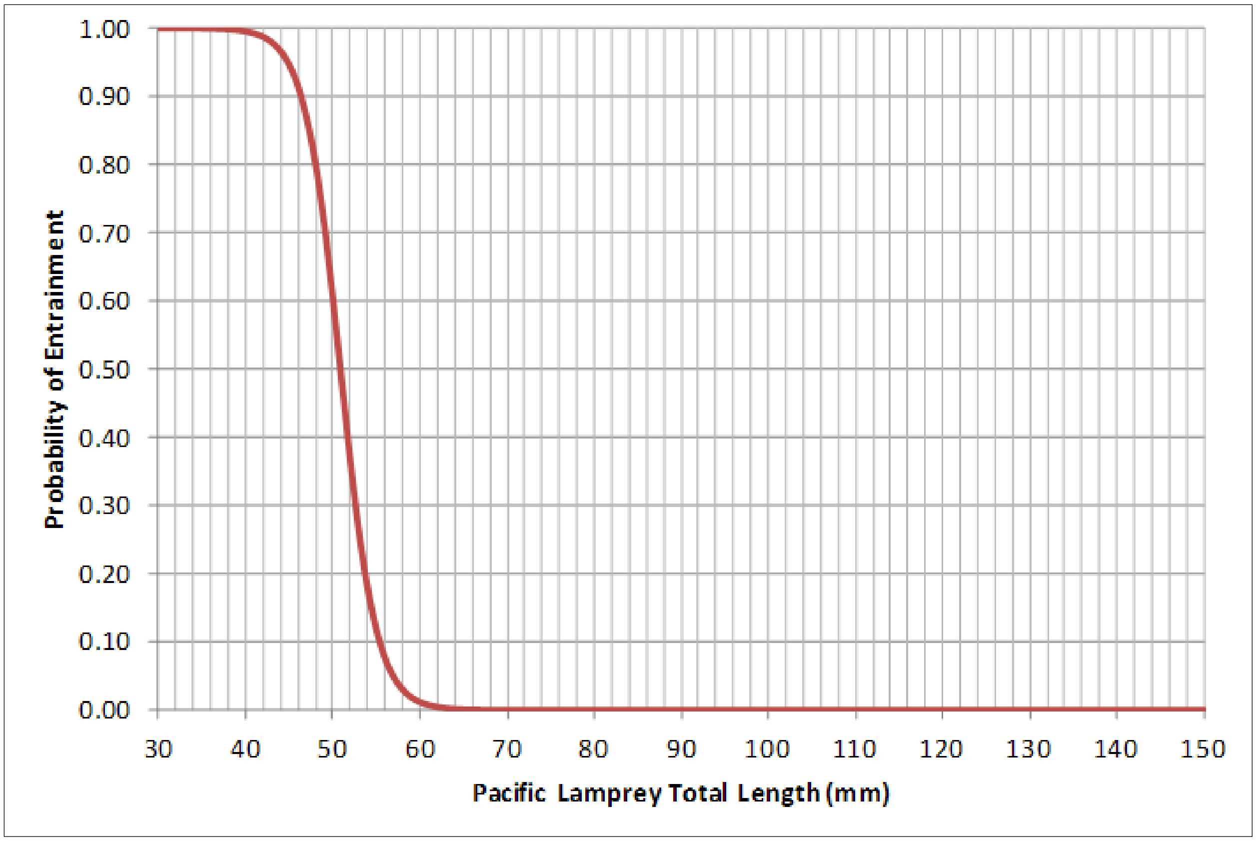
As is the case for white sturgeon, green sturgeon are demersal (i.e., tend to occupy the bottom of the channel), and therefore less likely to occur near vertical, on-bank fish screens that are off the river bottom. As noted for white sturgeon, water-column position and laboratory studies (Swanson et al. 2004a) suggest that there would be little to no adverse effect on juvenile green sturgeon from impingement at the north Delta intake facilities, but this is uncertain. Uncertainty would be addressed by monitoring during Plan implementation.

5.B.6.2.7 Pacific Lamprey and River Lamprey (Ammocoetes, Macropthalmia, and Adults)

5.B.6.2.7.1 Entrainment (Screening Effectiveness Analysis)

Lamprey may spend 3 to 7 years after birth upstream of the Plan Area as ammocoetes before outmigrating to the ocean at larger sizes (Moyle 2002). However, ammocoetes are also present within the Plan Area, and are 35 to 195 mm in length (average length = 127 mm) when they reach the approximate location of the north Delta intake structures (1976–2010 USFWS Sacramento trawl unpublished data; note that mesh size of the trawls may not retain smaller individuals). Monitoring initiated at the Freeport Regional Water Authority intake upstream of the proposed north Delta intakes found 19 lamprey ammocoetes in January 2012; of these, two individuals were 40 and 46 mm long and the remainder ranged from 21 to 31 mm (Kozlowski pers. comm.).

The recent laboratory study of Rose and Mesa (2012) found that the probability of entrainment of Pacific lamprey ammocoetes varied based on fish length and screen type/aperture size. Vertical bar screens similar to those proposed for the north Delta intakes were effective at greatly reducing the entrainment probability of ammocoetes greater than 40–50 mm total length, with the probability of entrainment being reduced to almost zero at 60 mm total length(Figure 5.B.6-50). In general, the results of Rose and Mesa (2012) and monitoring at the Freeport intake suggest that lamprey ammocoetes less than 50–60 mm in total length may be susceptible to entrainment at the north Delta intakes. Monitoring of entrainment would provide more information on the actual sizes of lamprey entrained.



Sources: Rose and Mesa 2012; Mesa pers. comm.

Figure 5.B.6-50. Probability of Entrainment of Pacific Lamprey Ammocoetes by Total Length of Fish, In Relation to a 1.75-mm Vertical Bar Screen

5.B.6.2.7.2 Impingement and Screen Contact

Lamprey ammocoetes, macropthalmia, and adults are vulnerable to impingement on the fish screen surface. Rose and Mesa's (2012) study examined injury rates of Pacific lamprey ammocoetes exposed for 60 minutes to an approach velocity of 0.4 ft/sec toward several different screen types. They found that ammocoetes of all sizes (28–153-mm total length) contacted the screens and became impinged. However, injury rate (typically minor abrasions) was low (less than 10%) and did not differ from control fish that were not exposed to screens, while smaller fish (<50-mm total length) tended to be injured more commonly. For the BDCP, the combined use of a smooth screen surface (i.e., wedge-wire screen material) and low approach velocity maintained by routine (e.g., continuous) screen cleaning is intended to minimize impingement of lamprey on the screen surface. Additionally, Rose and Mesa (2012: 603) noted that their "tests probably represent a worst-case scenario for lamprey ammocoetes that encounter fish screens because we tested vertical screens positioned perpendicular to the flow without a bypass route or a sweeping velocity"; the BDCP's screens would have sweeping velocity criteria to reduce negative effects. As seen by Rose and Mesa (2012), the smooth surface also would serve to reduce the risk of abrasion for fish that come into contact with the screen surface. It is uncertain whether or not lamprey macropthalmia may attempt to attach to the screens for holding during migration through the North Delta subregion. In laboratory tests, Ostrand (2007) found that Pacific lamprey macropthalmia frequently contacted test screens and often attached themselves to the screens or the sides of the test chamber. No macropthalmia died following screen contact, either immediately or after 24 hours. Ostrand

(2007:8) noted that adhesion to screens for extended periods could place lamprey at risk from injury (e.g., from screen cleaning apparatus) or predation. Approach velocity criteria that are adopted will aim to be protective of delta smelt larvae, which have weak swimming ability, and therefore may also be somewhat protective of weak-swimming lamprey, although Rose and Mesa (2012) noted that entrainment rates of Pacific lamprey ammocoetes were greater than those of delta smelt. As with winter-run Chinook salmon, the most common occurrence of downstream migrating lamprey in the Delta is during or just after the first pulse flow (1976–2010 USFWS Sacramento trawl unpublished data) which, according to BDCP operating criteria, is when operations of the north Delta diversion would be minimized for winter-run protection.

It is considered that the direct loss of lamprey to impingement at the proposed north Delta intakes is likely to be low, but is uncertain. An impingement monitoring program will address the uncertainties.

5.B.6.3 SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake (Cache Slough and North Delta Subregions)

5.B.6.3.1 Delta Smelt (Larvae)

5.B.6.3.1.1 Particle Tracking Modeling

The 30-day PTM results for delta smelt larval entrainment by the North Bay Aqueduct Barker Slough Pumping Plant showed that entrainment ranged from zero under all scenarios in several hydroperiods to 10% under EBC2 and EBC2_ELT in June 1978 (Table 5.B.6-232). In general a small percentage of particles was entrained, with averages of 1.7–1.8% for EBC scenarios and 0.7–0.9% for ESO scenarios. ESO scenarios gave lower entrainment in more than three quarters of the ESO-vs.-EBC comparisons that were made, with higher entrainment under ESO scenarios in less than 8% of comparisons. On average ESO scenarios gave 0.8–1.1% lower entrainment than EBC scenarios, a relative change of 47–61% (Table 5.B.6-233). The 60-day PTM results generally have patterns similar to the 30-day PTM results, although, of course, the overall percentage of particles entrained was greater because of the longer particle tracking duration: average entrainment was 1.9% for EBC scenarios and 0.9–1.4% for ESO scenarios (Table 5.B.6-234), which meant ESO entrainment was on average 0.5–1% lower than EBC entrainment, or 25–53% lower in relative terms (Table 5.B.6-235).

It should be noted that the existing modeling results do not account for the establishment of a dual diversion system for the NBA, with combined operations of a new intake on the Sacramento River (operated in conjunction with proposed BDCP north Delta facilities) and the existing intake at Barker Slough, which would allow entrainment of delta smelt larvae to be limited by removing most of the export pumping from the Barker Slough facility to the new Sacramento River facility at times when entrainment risk is greatest. Therefore the difference between EBC and ESO scenarios probably would be greater than modeled here.

Table 5.B.6-232. Percentage of Particles Representing Delta Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
2008 Dist/Dec 1923	4,500	1.7	1.6	1.6	1.7	0.4	0.4
2008 Dist/Jun 1940	6,166	1.7	1.7	1.7	1.7	1.0	1.3
2008 Dist/Jun 1934	7,100	1.6	1.7	1.6	1.6	0.6	0.9
2008 Dist/Apr 1929	8,019	1.7	1.7	1.7	1.6	0.6	0.6
2008 Dist/May 1966	9,759	1.7	1.7	1.6	1.6	0.8	0.8
2001 Dist/May 1966	9,759	0.4	0.4	0.4	0.4	0.2	0.2
2007 Dist/Feb 1948	11,145	9.6	7.9	7.7	7.3	0.2	0.2
2009 Dist/Feb 1948	11,145	7.6	6.3	6.1	5.8	0.2	0.1
1997 Dist/Feb 1948	11,145	1.3	1.1	1.1	1.0	0.0	0.0
2004 Dist/Feb 1948	11,145	0.1	0.1	0.1	0.1	0.0	0.0
2007 Dist/Jun 1978	12,346	9.6	10.0	10.0	9.5	5.7	7.3
2009 Dist/June 1978	12,346	7.6	7.9	8.0	7.6	4.5	5.8
1997 Dist/June 1978	12,346	1.3	1.4	1.4	1.3	0.8	1.0
2004 Dist/June 1978	12,346	0.1	0.1	0.1	0.1	0.0	0.1
2002 Dist/June 1978	12,346	1.1	1.2	1.2	1.1	0.7	0.9
1997 Dist/Apr 1970	13,369	1.3	1.4	1.3	1.3	0.7	1.0
2004 Dist/Apr 1970	13,369	0.1	0.1	0.1	0.1	0.0	0.1
2002 Dist/Apr 1970	13,369	1.1	1.1	1.1	1.1	0.6	0.9
2002 Dist/Mar 1961	13,725	1.1	1.1	1.1	1.1	0.5	0.6
2000 Dist/May 1937	20,349	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/May 1935	20,628	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/Feb 2003	21,852	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/Mar 2001	22,272	0.4	0.4	0.4	0.4	0.1	0.2
2000 Dist/June 1993	22,451	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/Mar 1942	23,456	0.4	0.4	0.4	0.4	0.2	0.3
2010 Dist/Jan 1966	24,810	8.6	8.5	8.5	8.3	3.3	4.7
2010 Dist/Apr 1986	27,195	8.2	8.5	8.5	8.4	4.3	5.9
2005 Dist/Apr 1986	27,195	0.3	0.3	0.3	0.3	0.2	0.2
2005 Dist/May 1963	30,035	0.3	0.3	0.3	0.3	0.2	0.2
1999 Dist/Mar 1993	34,327	0.0	0.0	0.0	0.0	0.0	0.0
1999 Dist/Dec 2002	35,239	0.0	0.0	0.0	0.0	0.0	0.0
1999 Dist/June 1952	37,199	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Jan 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Feb 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
1998 Dist/Feb 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		1.9	1.8	1.8	1.7	0.7	0.9

Table 5.B.6-233. Difference between Scenarios in Percentage of Particles Representing Delta Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2008 Dist/Dec 1923	4,500	-1.29 (-76%)	-1.30 (-77%)	-1.20 (-75%)	-1.21 (-76%)	-1.20 (-75%)	-1.31 (-77%)
2008 Dist/Jun 1940	6,166	-0.67 (-40%)	-0.36 (-22%)	-0.70 (-41%)	-0.39 (-23%)	-0.66 (-40%)	-0.38 (-22%)
2008 Dist/Jun 1934	7,100	-1.06 (-64%)	-0.70 (-43%)	-1.07 (-65%)	-0.71 (-43%)	-1.06 (-64%)	-0.68 (-42%)
2008 Dist/Apr 1929	8,019	-1.02 (-61%)	-1.10 (-66%)	-1.01 (-61%)	-1.10 (-66%)	-1.00 (-61%)	-1.03 (-65%)
2008 Dist/May 1966	9,759	-0.86 (-52%)	-0.88 (-53%)	-0.87 (-52%)	-0.89 (-53%)	-0.82 (-51%)	-0.82 (-52%)
2001 Dist/May 1966	9,759	-0.21 (-52%)	-0.21 (-51%)	-0.22 (-52%)	-0.21 (-51%)	-0.20 (-50%)	-0.20 (-50%)
2007 Dist/Feb 1948	11,145	-9.40 (-98%)	-9.42 (-98%)	-7.74 (-97%)	-7.76 (-98%)	-7.55 (-97%)	-7.08 (-97%)
2009 Dist/Feb 1948	11,145	-7.46 (-98%)	-7.48 (-98%)	-6.14 (-97%)	-6.16 (-98%)	-5.99 (-97%)	-5.62 (-97%)
1997 Dist/Feb 1948	11,145	-1.30 (-98%)	-1.31 (-98%)	-1.07 (-97%)	-1.08 (-98%)	-1.05 (-97%)	-0.98 (-97%)
2004 Dist/Feb 1948	11,145	-0.07 (-98%)	-0.07 (-98%)	-0.05 (-97%)	-0.05 (-98%)	-0.05 (-97%)	-0.05 (-97%)
2007 Dist/Jun 1978	12,346	-3.90 (-41%)	-2.25 (-24%)	-4.34 (-43%)	-2.69 (-27%)	-4.37 (-44%)	-2.22 (-23%)
2009 Dist/June 1978	12,346	-3.10 (-41%)	-1.78 (-23%)	-3.45 (-43%)	-2.13 (-27%)	-3.47 (-44%)	-1.76 (-23%)
1997 Dist/June 1978	12,346	-0.54 (-41%)	-0.30 (-22%)	-0.60 (-43%)	-0.36 (-26%)	-0.60 (-43%)	-0.29 (-22%)
2004 Dist/June 1978	12,346	-0.03 (-39%)	-0.01 (-8%)	-0.03 (-42%)	-0.01 (-12%)	-0.03 (-42%)	-0.01 (-8%)
2002 Dist/June 1978	12,346	-0.45 (-41%)	-0.24 (-21%)	-0.50 (-43%)	-0.29 (-25%)	-0.50 (-43%)	-0.23 (-21%)
1997 Dist/Apr 1970	13,369	-0.67 (-51%)	-0.30 (-23%)	-0.71 (-52%)	-0.34 (-25%)	-0.69 (-51%)	-0.30 (-23%)
2004 Dist/Apr 1970	13,369	-0.03 (-46%)	0.00 (-3%)	-0.03 (-48%)	0.00 (-6%)	-0.03 (-47%)	0.00 (-4%)
2002 Dist/Apr 1970	13,369	-0.56 (-50%)	-0.24 (-22%)	-0.59 (-52%)	-0.27 (-24%)	-0.57 (-51%)	-0.24 (-22%)
2002 Dist/Mar 1961	13,725	-0.61 (-55%)	-0.48 (-44%)	-0.60 (-55%)	-0.47 (-43%)	-0.59 (-55%)	-0.47 (-43%)
2000 Dist/May 1937	20,349	-0.16 (-45%)	-0.10 (-28%)	-0.17 (-46%)	-0.11 (-30%)	-0.17 (-46%)	-0.11 (-29%)
2000 Dist/May 1935	20,628	-0.19 (-53%)	-0.09 (-25%)	-0.19 (-54%)	-0.09 (-26%)	-0.20 (-54%)	-0.09 (-25%)
2000 Dist/Feb 2003	21,852	-0.19 (-51%)	-0.10 (-26%)	-0.18 (-49%)	-0.08 (-24%)	-0.18 (-49%)	-0.09 (-24%)
2000 Dist/Mar 2001	22,272	-0.22 (-62%)	-0.18 (-51%)	-0.21 (-60%)	-0.17 (-49%)	-0.21 (-60%)	-0.17 (-49%)
2000 Dist/June 1993	22,451	-0.17 (-45%)	-0.09 (-25%)	-0.16 (-45%)	-0.09 (-24%)	-0.17 (-46%)	-0.08 (-23%)
2000 Dist/Mar 1942	23,456	-0.15 (-41%)	-0.10 (-28%)	-0.14 (-40%)	-0.10 (-27%)	-0.14 (-39%)	-0.09 (-26%)
2010 Dist/Jan 1966	24,810	-5.29 (-61%)	-3.89 (-45%)	-5.16 (-61%)	-3.76 (-44%)	-5.13 (-61%)	-3.58 (-43%)
2010 Dist/Apr 1986	27,195	-3.89 (-47%)	-2.33 (-28%)	-4.15 (-49%)	-2.59 (-31%)	-4.14 (-49%)	-2.51 (-30%)
2005 Dist/Apr 1986	27,195	-0.15 (-47%)	-0.09 (-28%)	-0.16 (-49%)	-0.10 (-31%)	-0.16 (-49%)	-0.10 (-30%)

Starting Distribution/ Modeled Hydroperiod	**Modeled Delta Outflow (cfs)**	**EBC1 vs. ESO_ELT**	**EBC1 vs. ESO_LLT**	**EBC2 vs. ESO_ELT**	**EBC2 vs. ESO_LLT**	**EBC2_ELT vs. ESO_ELT**	**EBC2_LLT vs. ESO_LLT**
2005 Dist/May 1963	30,035	-0.14 (-43%)	-0.10 (-30%)	-0.14 (-43%)	-0.10 (-30%)	-0.15 (-45%)	-0.10 (-31%)
1999 Dist/Mar 1993	34,327	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1999 Dist/Dec 2002	35,239	0.00 (0%)	0.01 (0%)	0.00 (0%)	0.01 (0%)	0.00 (0%)	0.01 (0%)
1999 Dist/June 1952	37,199	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Apr 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Jan 1971	47,872	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Apr 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Feb 1945	52,920	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1998 Dist/Feb 1940	64,008	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Average	0	-1.15 (-62%)	-0.93 (-50%)	-1.09 (-61%)	-0.88 (-49%)	-1.08 (-61%)	-0.81 (-47%)
Note: Negative values indicate lower entrainment under ESO scenarios.							

Table 5.B.6-234. Percentage of Particles Representing Delta Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM Simulation

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
2008 Dist/Dec 1923	4,500	1.8	1.7	1.7	1.8	0.6	1.0
2008 Dist/Jun 1940	6,166	1.7	1.7	1.7	1.7	1.2	1.7
2008 Dist/Jun 1934	7,100	1.6	1.7	1.6	1.6	0.6	0.9
2008 Dist/Apr 1929	8,019	1.7	1.7	1.7	1.6	0.7	0.7
2008 Dist/May 1966	9,759	1.7	1.7	1.7	1.6	0.9	1.4
2001 Dist/May 1966	9,759	0.4	0.4	0.4	0.4	0.2	0.4
2007 Dist/Feb 1948	11,145	10.2	9.3	9.3	9.3	1.5	4.1
2009 Dist/Feb 1948	11,145	8.1	7.3	7.4	7.3	1.2	3.2
1997 Dist/Feb 1948	11,145	1.4	1.3	1.3	1.3	0.2	0.6
2004 Dist/Feb 1948	11,145	0.1	0.1	0.1	0.1	0.0	0.0
2007 Dist/Jun 1978	12,346	9.7	10.2	10.3	9.7	6.8	9.1
2009 Dist/June 1978	12,346	7.7	8.1	8.1	7.7	5.4	7.3
1997 Dist/June 1978	12,346	1.4	1.4	1.4	1.4	0.9	1.3
2004 Dist/June 1978	12,346	0.1	0.1	0.1	0.1	0.0	0.1
2002 Dist/June 1978	12,346	1.1	1.2	1.2	1.1	0.8	1.1
1997 Dist/Apr 1970	13,369	1.4	1.4	1.4	1.4	0.8	1.3
2004 Dist/Apr 1970	13,369	0.1	0.1	0.1	0.1	0.0	0.1
2002 Dist/Apr 1970	13,369	1.1	1.2	1.1	1.1	0.7	1.1
2002 Dist/Mar 1961	13,725	1.1	1.1	1.1	1.1	0.5	0.7
2000 Dist/May 1937	20,349	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/May 1935	20,628	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/Feb 2003	21,852	0.4	0.4	0.4	0.4	0.2	0.3
2000 Dist/Mar 2001	22,272	0.4	0.4	0.4	0.4	0.2	0.2
2000 Dist/June 1993	22,451	0.4	0.4	0.4	0.4	0.2	0.4
2000 Dist/Mar 1942	23,456	0.4	0.4	0.4	0.4	0.3	0.3
2010 Dist/Jan 1966	24,810	8.8	8.7	8.6	8.5	3.9	6.7
2010 Dist/Apr 1986	27,195	8.3	8.6	8.6	8.5	5.2	7.6
2005 Dist/Apr 1986	27,195	0.3	0.3	0.3	0.3	0.2	0.3
2005 Dist/May 1963	30,035	0.3	0.3	0.3	0.3	0.2	0.3
1999 Dist/Mar 1993	34,327	0.0	0.0	0.0	0.0	0.0	0.0
1999 Dist/Dec 2002	35,239	0.0	0.0	0.0	0.0	0.0	0.0
1999 Dist/June 1952	37,199	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1996	45,853	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/May 1941	47,347	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Jan 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1927	52,656	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Feb 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
1998 Dist/Feb 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		1.9	1.9	1.9	1.9	0.9	1.4

Table 5.B.6-235. Difference between Scenarios in Percentage of Particles Representing Delta Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2008 Dist/Dec 1923	4,500	-1.20 (-68%)	-0.79 (-44%)	-1.08 (-65%)	-0.66 (-40%)	-1.09 (-66%)	-0.81 (-45%)
2008 Dist/Jun 1940	6,166	-0.51 (-30%)	-0.04 (-2%)	-0.54 (-31%)	-0.06 (-4%)	-0.50 (-29%)	-0.04 (-2%)
2008 Dist/Jun 1934	7,100	-1.06 (-64%)	-0.70 (-42%)	-1.07 (-65%)	-0.71 (-43%)	-1.06 (-64%)	-0.68 (-42%)
2008 Dist/Apr 1929	8,019	-1.01 (-60%)	-0.99 (-59%)	-1.01 (-60%)	-0.99 (-59%)	-0.99 (-59%)	-0.91 (-57%)
2008 Dist/May 1966	9,759	-0.77 (-45%)	-0.34 (-20%)	-0.78 (-45%)	-0.35 (-20%)	-0.75 (-44%)	-0.28 (-17%)
2001 Dist/May 1966	9,759	-0.19 (-45%)	-0.06 (-13%)	-0.19 (-45%)	-0.06 (-14%)	-0.19 (-44%)	-0.04 (-10%)
2007 Dist/Feb 1948	11,145	-8.73 (-85%)	-6.16 (-60%)	-7.75 (-84%)	-5.19 (-56%)	-7.77 (-84%)	-5.18 (-56%)
2009 Dist/Feb 1948	11,145	-6.93 (-85%)	-4.89 (-60%)	-6.15 (-84%)	-4.11 (-56%)	-6.16 (-84%)	-4.11 (-56%)
1997 Dist/Feb 1948	11,145	-1.21 (-85%)	-0.85 (-60%)	-1.07 (-84%)	-0.72 (-56%)	-1.08 (-84%)	-0.72 (-56%)
2004 Dist/Feb 1948	11,145	-0.06 (-84%)	-0.04 (-59%)	-0.05 (-82%)	-0.04 (-54%)	-0.05 (-82%)	-0.04 (-54%)
2007 Dist/Jun 1978	12,346	-2.94 (-30%)	-0.61 (-6%)	-3.36 (-33%)	-1.03 (-10%)	-3.46 (-34%)	-0.61 (-6%)
2009 Dist/June 1978	12,346	-2.33 (-30%)	-0.47 (-6%)	-2.66 (-33%)	-0.80 (-10%)	-2.74 (-34%)	-0.47 (-6%)
1997 Dist/June 1978	12,346	-0.41 (-30%)	-0.05 (-4%)	-0.46 (-33%)	-0.11 (-8%)	-0.48 (-34%)	-0.05 (-4%)
2004 Dist/June 1978	12,346	-0.02 (-29%)	0.02 (32%)	-0.02 (-32%)	0.02 (26%)	-0.02 (-32%)	0.02 (32%)
2002 Dist/June 1978	12,346	-0.34 (-30%)	-0.02 (-2%)	-0.39 (-33%)	-0.07 (-6%)	-0.40 (-33%)	-0.02 (-2%)
1997 Dist/Apr 1970	13,369	-0.57 (-42%)	-0.06 (-4%)	-0.61 (-44%)	-0.10 (-7%)	-0.58 (-42%)	-0.06 (-4%)
2004 Dist/Apr 1970	13,369	-0.03 (-38%)	0.03 (43%)	-0.03 (-39%)	0.03 (39%)	-0.03 (-38%)	0.03 (43%)
2002 Dist/Apr 1970	13,369	-0.47 (-42%)	-0.03 (-2%)	-0.51 (-43%)	-0.06 (-5%)	-0.48 (-42%)	-0.02 (-2%)
2002 Dist/Mar 1961	13,725	-0.56 (-51%)	-0.40 (-36%)	-0.57 (-51%)	-0.41 (-37%)	-0.56 (-51%)	-0.40 (-36%)
2000 Dist/May 1937	20,349	-0.13 (-35%)	-0.03 (-7%)	-0.14 (-37%)	-0.04 (-10%)	-0.14 (-37%)	-0.04 (-10%)
2000 Dist/May 1935	20,628	-0.16 (-45%)	-0.02 (-6%)	-0.17 (-46%)	-0.02 (-7%)	-0.17 (-46%)	-0.02 (-6%)
2000 Dist/Feb 2003	21,852	-0.17 (-44%)	-0.04 (-11%)	-0.15 (-42%)	-0.03 (-8%)	-0.15 (-42%)	-0.03 (-9%)
2000 Dist/Mar 2001	22,272	-0.20 (-54%)	-0.18 (-49%)	-0.19 (-52%)	-0.17 (-47%)	-0.19 (-52%)	-0.17 (-47%)
2000 Dist/June 1993	22,451	-0.14 (-37%)	-0.02 (-5%)	-0.14 (-37%)	-0.02 (-5%)	-0.15 (-39%)	-0.02 (-6%)
2000 Dist/Mar 1942	23,456	-0.11 (-29%)	-0.04 (-11%)	-0.10 (-28%)	-0.03 (-10%)	-0.10 (-28%)	-0.03 (-8%)
2010 Dist/Jan 1966	24,810	-4.88 (-55%)	-2.08 (-24%)	-4.73 (-55%)	-1.94 (-22%)	-4.69 (-54%)	-1.82 (-21%)
2010 Dist/Apr 1986	27,195	-3.20 (-38%)	-0.73 (-9%)	-3.43 (-40%)	-0.96 (-11%)	-3.43 (-40%)	-0.91 (-11%)
2005 Dist/Apr 1986	27,195	-0.13 (-38%)	-0.03 (-9%)	-0.13 (-40%)	-0.04 (-11%)	-0.13 (-40%)	-0.04 (-11%)

Starting Distribution/ Modeled Hydroperiod	**Modeled Delta Outflow (cfs)**	**EBC1 vs. ESO_ELT**	**EBC1 vs. ESO_LLT**	**EBC2 vs. ESO_ELT**	**EBC2 vs. ESO_LLT**	**EBC2_ELT vs. ESO_ELT**	**EBC2_LLT vs. ESO_LLT**
2005 Dist/May 1963	30,035	-0.11 (-33%)	-0.02 (-7%)	-0.11 (-33%)	-0.02 (-7%)	-0.12 (-34%)	-0.03 (-8%)
1999 Dist/Mar 1993	34,327	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1999 Dist/Dec 2002	35,239	0.00 (0%)	0.01 (0%)	0.00 (0%)	0.01 (0%)	0.00 (0%)	0.01 (0%)
1999 Dist/June 1952	37,199	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Apr 1996	45,853	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/May 1941	47,347	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Jan 1971	47,872	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Apr 1927	52,656	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1996 Dist/Feb 1945	52,920	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
1998 Dist/Feb 1940	64,008	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Average		-1.01 (-53%)	-0.52 (-27%)	-0.99 (-53%)	-0.49 (-26%)	-0.99 (-53%)	-0.46 (-25%)
Note: Negative values indicate lower entrainment under ESO scenarios.							

5.B.6.3.2 Longfin Smelt (Larvae)

5.B.6.3.2.1 Particle Tracking Modeling

Based on the DSM2 PTM results using the wetter starting distribution, on average a very low percentage of particles (0.1%) of particles representing longfin smelt larvae was entrained at the North Bay Aqueduct Barker Slough Pumping Plant after 30 days for the EBC and ESO scenarios (Table 5.B.6-236). Of the 28 hydroperiods modeled in the analysis, ESO scenarios had lower entrainment than EBC scenarios in just more than 20% of comparisons and higher entrainment than ESO scenarios in nearly 40% of comparisons, depending on the scenarios that were compared, with the remainder having no difference because of no entrainment (Table 5.B.6-237). On average, entrainment differences between ESO and EBC scenarios ranged from 0.01% (19% in relative terms) less under ESO_LLT compared with EBC2, to 0.04% more (63% in relative terms) more under ESO_ELT compared with EBC2_ELT. Under the drier starting distribution for the 30-day runs, around 30% of comparisons resulted in higher entrainment under the EBC scenarios than the ESO scenarios, with the opposite being true in two thirds of comparisons (Table 5.B.6-238 and Table 5.B.6-239). On average, entrainment differences between ESO and EBC scenarios ranged from 0.02% (16% in relative terms) less under ESO_LLT compared to EBC2, to 0.08% (64% in relative terms) more under ESO_ELT compared to EBC2_ELT.

The 60-day PTM results for the wetter distribution had a similar proportion of runs with no entrainment under any scenario to the 30-day runs (around 40% of runs). Entrainment averaged 0.1–0.2% for all scenarios (Table 5.B.6-240). Patterns were similar to the 30-day runs, with average entrainment differences between ESO and EBC scenarios ranging from 0.01% (11% in relative terms) less under ESO_LLT compared to EBC2, to 0.08% (81% in relative terms) more under ESO_ELT compared to EBC2_ELT (Table 5.B.6-241). For the drier distribution, entrainment was less under ESO scenarios than under EBC scenarios in about 30% of comparisons, and the opposite was true in the remaining ~70% of comparisons (Table 5.B.6-242 and Table 5.B.6-243). The levels of entrainment were higher because the period of particle exposure to potential entrainment was longer, but the relative differences between scenarios generally were similar to the patterns shown for the wetter 60-day distribution.

Sensitivity analyses of the 30-day PTM runs that adapted the drier starting distribution to shift 2–15% of the particles to the south Delta gave virtually the same patterns of results as the original 30-day starting distribution runs (Table 5.B.6-244 through Table 5.B.6-249).

As described above for delta smelt, the existing modeling results do not account for the establishment of a dual diversion system for the NBA, which would allow entrainment of longfin smelt larvae to be limited by removing most of the export pumping from the Barker Slough facility to the new Sacramento River facility at times when entrainment risk is greatest.

Table 5.B.6-236. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.0	0.0	0.1	0.1	0.0
June 1940	6,166	0.0	0.1	0.0	0.1	0.3	0.2
June 1934	7,100	0.1	0.0	0.0	0.0	0.1	0.1
April 1929	8,019	0.0	0.0	0.0	0.0	0.0	0.0
May 1966	9,759	0.0	0.0	0.0	0.0	0.0	0.0
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.0	0.1	0.1	0.1	0.2	0.1
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	0.0	0.0	0.0	0.0	0.0	0.0
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	0.3	0.1	0.2	0.2	0.2	0.1
March 2001	22,272	0.0	0.0	0.0	0.0	0.0	0.0
June 1993	22,451	0.0	0.0	0.0	0.0	0.0	0.0
March 1942	23,456	0.2	0.1	0.1	0.1	0.2	0.1
January 1966	24,810	0.3	0.2	0.2	0.0	0.2	0.1
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.0	0.1	0.1	0.1	0.2	0.1
March 1993	34,327	0.1	0.1	0.0	0.0	0.2	0.0
December 2002	35,239	0.2	0.4	0.3	0.2	0.4	0.2
June 1952	37,199	0.0	0.0	0.0	0.0	0.3	0.2
April 1996	45,853	0.0	0.1	0.1	0.1	0.1	0.0
May 1941	47,347	0.0	0.1	0.1	0.1	0.2	0.1
January 1971	47,872	0.3	0.2	0.2	0.2	0.1	0.1
April 1927	52,656	0.1	0.1	0.1	0.1	0.1	0.0
February 1945	52,920	0.4	0.2	0.2	0.1	0.1	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.1	0.1

Table 5.B.6-237. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.02 (29%)	-0.07 (-85%)	0.10 (Inf.)	0.01 (Inf.)	0.10 (Inf.)	-0.09 (-88%)
June 1940	6,166	0.29 (715%)	0.12 (293%)	0.28 (504%)	0.11 (192%)	0.29 (608%)	0.10 (152%)
June 1934	7,100	0.06 (94%)	0.02 (37%)	0.08 (173%)	0.04 (94%)	0.08 (210%)	0.06 (195%)
April 1929	8,019	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1966	9,759	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1948	11,145	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
June 1978	12,346	0.19 (435%)	0.10 (231%)	0.11 (92%)	0.02 (19%)	0.12 (103%)	0.08 (132%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	-0.11 (-41%)	-0.16 (-59%)	0.02 (15%)	-0.03 (-21%)	0.01 (7%)	-0.06 (-36%)
March 2001	22,272	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
June 1993	22,451	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1942	23,456	-0.04 (-20%)	-0.11 (-51%)	0.05 (38%)	-0.02 (-16%)	0.04 (30%)	0.06 (110%)
January 1966	24,810	-0.13 (-44%)	-0.23 (-80%)	-0.05 (-25%)	-0.16 (-73%)	0.00 (-1%)	0.01 (20%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.20 (552%)	0.08 (216%)	0.17 (279%)	0.05 (84%)	0.16 (211%)	0.04 (45%)
March 1993	34,327	0.12 (200%)	-0.01 (-22%)	0.12 (200%)	-0.01 (-22%)	0.15 (500%)	0.04 (600%)
December 2002	35,239	0.15 (66%)	-0.05 (-24%)	-0.01 (-3%)	-0.21 (-56%)	0.03 (10%)	-0.07 (-30%)
June 1952	37,199	0.23 (1335%)	0.16 (895%)	0.23 (1297%)	0.16 (868%)	0.23 (865%)	0.14 (458%)
April 1996	45,853	0.06 (237%)	0.02 (73%)	0.02 (39%)	-0.02 (-29%)	0.02 (26%)	-0.04 (-48%)
May 1941	47,347	0.15 (369%)	0.09 (225%)	0.10 (108%)	0.04 (44%)	0.11 (131%)	0.04 (46%)
January 1971	47,872	-0.19 (-70%)	-0.21 (-78%)	-0.12 (-60%)	-0.15 (-71%)	-0.15 (-64%)	-0.09 (-60%)
April 1927	52,656	0.04 (58%)	-0.03 (-40%)	0.00 (-2%)	-0.07 (-63%)	0.00 (0%)	-0.10 (-70%)
February 1945	52,920	-0.27 (-73%)	-0.32 (-89%)	-0.07 (-40%)	-0.12 (-75%)	-0.06 (-38%)	-0.06 (-59%)
February 1940	64,008	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Average		0.03 (36%)	-0.02 (-29%)	0.04 (55%)	-0.01 (-19%)	0.04 (63%)	0.00 (4%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-238. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.0	0.0	0.1	0.1	0.0
June 1940	6,166	0.1	0.1	0.1	0.1	0.4	0.2
June 1934	7,100	0.1	0.1	0.1	0.0	0.2	0.1
April 1929	8,019	0.1	0.1	0.1	0.0	0.2	0.0
May 1966	9,759	0.1	0.1	0.0	0.0	0.2	0.0
February 1948	11,145	0.1	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.1	0.3	0.2	0.1	0.3	0.2
April 1970	13,369	0.1	0.2	0.2	0.1	0.3	0.2
March 1961	13,725	0.1	0.1	0.1	0.1	0.2	0.1
May 1937	20,349	0.1	0.1	0.1	0.1	0.3	0.2
May 1935	20,628	0.1	0.1	0.2	0.1	0.2	0.1
February 2003	21,852	0.3	0.1	0.2	0.2	0.2	0.1
March 2001	22,272	0.1	0.0	0.0	0.0	0.1	0.0
June 1993	22,451	0.2	0.2	0.2	0.1	0.4	0.2
March 1942	23,456	0.2	0.1	0.1	0.1	0.2	0.1
January 1966	24,810	0.3	0.2	0.2	0.0	0.2	0.1
April 1986	27,195	0.0	0.1	0.1	0.1	0.1	0.1
May 1963	30,035	0.0	0.1	0.1	0.1	0.2	0.1
March 1993	34,327	0.1	0.1	0.0	0.0	0.2	0.0
December 2002	35,239	0.3	0.4	0.4	0.3	0.4	0.2
June 1952	37,199	0.0	0.0	0.0	0.1	0.2	0.2
April 1996	45,853	0.0	0.1	0.1	0.1	0.1	0.0
May 1941	47,347	0.0	0.1	0.1	0.1	0.2	0.2
January 1971	47,872	0.3	0.2	0.2	0.2	0.1	0.1
April 1927	52,656	0.1	0.1	0.1	0.2	0.1	0.0
February 1945	52,920	0.4	0.2	0.2	0.1	0.1	0.1
February 1940	64,008	0.3	0.1	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.2	0.1

Table 5.B.6-239. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.02 (22%)	-0.08 (-85%)	0.12 (Inf.)	0.01 (Inf.)	0.12 (Inf.)	-0.10 (-87%)
June 1940	6,166	0.29 (280%)	0.13 (125%)	0.26 (199%)	0.10 (78%)	0.26 (208%)	0.09 (63%)
June 1934	7,100	0.06 (61%)	0.01 (10%)	0.07 (88%)	0.02 (28%)	0.08 (110%)	0.06 (173%)
April 1929	8,019	0.17 (213%)	-0.06 (-74%)	0.18 (279%)	-0.05 (-69%)	0.16 (174%)	0.02 (Inf.)
May 1966	9,759	0.16 (191%)	-0.04 (-50%)	0.18 (280%)	-0.02 (-34%)	0.23 (1192%)	0.04 (Inf.)
February 1948	11,145	-0.13 (-94%)	-0.14 (-100%)	0.01 (Inf.)	0.00 (0%)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	0.20 (224%)	0.12 (130%)	0.04 (16%)	-0.04 (-18%)	0.05 (19%)	0.07 (52%)
April 1970	13,369	0.15 (120%)	0.07 (55%)	0.06 (28%)	-0.02 (-10%)	0.10 (64%)	0.07 (63%)
March 1961	13,725	0.07 (44%)	-0.07 (-46%)	0.14 (201%)	0.01 (12%)	0.15 (215%)	0.01 (18%)
May 1937	20,349	0.22 (344%)	0.09 (140%)	0.16 (127%)	0.03 (23%)	0.17 (144%)	0.02 (15%)
May 1935	20,628	0.12 (133%)	0.00 (3%)	0.08 (66%)	-0.03 (-26%)	0.05 (33%)	0.01 (7%)
February 2003	21,852	-0.14 (-47%)	-0.17 (-56%)	0.01 (6%)	-0.02 (-13%)	-0.01 (-5%)	-0.08 (-37%)
March 2001	22,272	-0.02 (-14%)	-0.08 (-63%)	0.07 (219%)	0.01 (36%)	0.08 (396%)	0.02 (119%)
June 1993	22,451	0.15 (77%)	-0.02 (-11%)	0.17 (95%)	0.00 (-2%)	0.16 (81%)	0.08 (85%)
March 1942	23,456	-0.06 (-25%)	-0.11 (-52%)	0.04 (33%)	-0.02 (-15%)	0.03 (19%)	0.04 (72%)
January 1966	24,810	-0.15 (-46%)	-0.24 (-76%)	-0.04 (-20%)	-0.14 (-64%)	-0.01 (-3%)	0.03 (56%)
April 1986	27,195	0.12 (509%)	0.09 (384%)	0.02 (17%)	-0.01 (-7%)	0.03 (27%)	0.01 (14%)
May 1963	30,035	0.19 (432%)	0.08 (179%)	0.15 (197%)	0.04 (56%)	0.14 (157%)	0.04 (42%)
March 1993	34,327	0.11 (200%)	-0.01 (-22%)	0.11 (200%)	-0.01 (-22%)	0.14 (500%)	0.04 (600%)
December 2002	35,239	0.18 (69%)	-0.01 (-2%)	-0.02 (-4%)	-0.20 (-44%)	0.01 (1%)	-0.03 (-10%)
June 1952	37,199	0.22 (718%)	0.16 (520%)	0.21 (554%)	0.15 (396%)	0.21 (495%)	0.14 (276%)
April 1996	45,853	0.05 (254%)	0.02 (107%)	0.02 (46%)	-0.01 (-15%)	0.01 (11%)	-0.03 (-41%)
May 1941	47,347	0.16 (389%)	0.13 (300%)	0.10 (89%)	0.06 (55%)	0.10 (92%)	0.06 (52%)
January 1971	47,872	-0.19 (-67%)	-0.21 (-75%)	-0.13 (-58%)	-0.15 (-68%)	-0.14 (-59%)	-0.09 (-56%)
April 1927	52,656	0.07 (97%)	-0.03 (-43%)	0.01 (10%)	-0.08 (-68%)	0.03 (23%)	-0.12 (-75%)
February 1945	52,920	-0.31 (-75%)	-0.36 (-87%)	-0.07 (-41%)	-0.12 (-70%)	-0.08 (-44%)	-0.05 (-49%)
February 1940	64,008	-0.25 (-87%)	-0.27 (-93%)	-0.02 (-40%)	-0.04 (-65%)	-0.01 (-20%)	0.02 (Inf.)
Average		0.05 (39%)	-0.04 (-27%)	0.07 (59%)	-0.02 (-16%)	0.08 (64%)	0.01 (16%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-240. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.2	0.1	0.3	0.2	0.1
June 1940	6,166	0.1	0.0	0.1	0.1	0.5	0.3
June 1934	7,100	0.0	0.1	0.0	0.0	0.1	0.1
April 1929	8,019	0.0	0.0	0.0	0.0	0.0	0.0
May 1966	9,759	0.0	0.0	0.0	0.0	0.0	0.0
February 1948	11,145	0.0	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.1	0.1	0.1	0.1	0.4	0.3
April 1970	13,369	0.0	0.0	0.0	0.0	0.0	0.0
March 1961	13,725	0.0	0.0	0.0	0.0	0.0	0.0
May 1937	20,349	0.0	0.0	0.0	0.0	0.0	0.0
May 1935	20,628	0.0	0.0	0.0	0.0	0.0	0.0
February 2003	21,852	0.2	0.4	0.2	0.3	0.3	0.2
March 2001	22,272	0.0	0.0	0.0	0.0	0.0	0.0
June 1993	22,451	0.0	0.0	0.0	0.0	0.0	0.0
March 1942	23,456	0.2	0.3	0.2	0.1	0.3	0.2
January 1966	24,810	0.4	0.5	0.3	0.2	0.3	0.1
April 1986	27,195	0.0	0.0	0.0	0.0	0.0	0.0
May 1963	30,035	0.1	0.1	0.1	0.1	0.4	0.2
March 1993	34,327	0.1	0.1	0.1	0.0	0.3	0.1
December 2002	35,239	0.5	0.3	0.4	0.4	0.5	0.3
June 1952	37,199	0.0	0.0	0.0	0.0	0.3	0.3
April 1996	45,853	0.1	0.0	0.1	0.1	0.2	0.1
May 1941	47,347	0.1	0.1	0.1	0.1	0.4	0.2
January 1971	47,872	0.3	0.4	0.3	0.3	0.2	0.1
April 1927	52,656	0.1	0.1	0.1	0.2	0.2	0.1
February 1945	52,920	0.4	0.5	0.2	0.2	0.2	0.1
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.2	0.1

Table 5.B.6-241. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.15 (149%)	-0.02 (-21%)	0.01 (4%)	-0.16 (-67%)	0.16 (204%)	-0.18 (-71%)
June 1940	6,166	0.39 (556%)	0.24 (337%)	0.41 (891%)	0.26 (560%)	0.40 (716%)	0.23 (279%)
June 1934	7,100	0.08 (173%)	0.04 (94%)	0.06 (94%)	0.02 (37%)	0.08 (210%)	0.06 (195%)
April 1929	8,019	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1966	9,759	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 1948	11,145	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
June 1978	12,346	0.29 (211%)	0.12 (91%)	0.36 (632%)	0.20 (349%)	0.29 (221%)	0.17 (207%)
April 1970	13,369	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1961	13,725	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1937	20,349	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1935	20,628	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
February 2003	21,852	0.05 (22%)	-0.05 (-21%)	-0.11 (-28%)	-0.21 (-53%)	0.04 (18%)	-0.07 (-28%)
March 2001	22,272	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
June 1993	22,451	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
March 1942	23,456	0.13 (72%)	0.01 (5%)	0.04 (13%)	-0.08 (-31%)	0.10 (47%)	0.08 (68%)
January 1966	24,810	-0.15 (-37%)	-0.30 (-74%)	-0.21 (-45%)	-0.36 (-78%)	-0.08 (-23%)	-0.11 (-51%)
April 1986	27,195	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
May 1963	30,035	0.30 (441%)	0.16 (238%)	0.32 (603%)	0.18 (339%)	0.28 (309%)	0.13 (143%)
March 1993	34,327	0.22 (250%)	0.01 (12%)	0.23 (314%)	0.02 (32%)	0.25 (469%)	0.07 (224%)
December 2002	35,239	0.00 (0%)	-0.19 (-41%)	0.13 (38%)	-0.06 (-18%)	0.05 (12%)	-0.10 (-26%)
June 1952	37,199	0.31 (1703%)	0.25 (1401%)	0.31 (1571%)	0.25 (1291%)	0.30 (1061%)	0.23 (579%)
April 1996	45,853	0.08 (117%)	0.02 (34%)	0.13 (551%)	0.07 (302%)	0.07 (84%)	0.00 (4%)
May 1941	47,347	0.27 (253%)	0.13 (121%)	0.32 (531%)	0.18 (296%)	0.28 (268%)	0.12 (93%)
January 1971	47,872	-0.14 (-44%)	-0.21 (-68%)	-0.22 (-55%)	-0.29 (-75%)	-0.16 (-47%)	-0.16 (-62%)
April 1927	52,656	0.07 (50%)	-0.04 (-32%)	0.08 (73%)	-0.02 (-21%)	0.06 (45%)	-0.09 (-49%)
February 1945	52,920	-0.16 (-43%)	-0.25 (-67%)	-0.25 (-54%)	-0.34 (-74%)	-0.03 (-12%)	-0.13 (-51%)
February 1940	64,008	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Average		0.07 (67%)	0.00 (-3%)	0.06 (52%)	-0.01 (-11%)	0.08 (81%)	0.01 (10%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-242. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.3	0.1	0.3	0.3	0.1
June 1940	6,166	0.2	0.1	0.2	0.2	0.6	0.4
June 1934	7,100	0.1	0.1	0.1	0.0	0.2	0.1
April 1929	8,019	0.1	0.1	0.1	0.0	0.3	0.0
May 1966	9,759	0.1	0.1	0.1	0.0	0.4	0.2
February 1948	11,145	0.0	0.3	0.1	0.0	0.2	0.0
June 1978	12,346	0.3	0.1	0.3	0.2	0.5	0.4
April 1970	13,369	0.2	0.2	0.2	0.2	0.4	0.4
March 1961	13,725	0.2	0.2	0.1	0.1	0.3	0.1
May 1937	20,349	0.2	0.1	0.1	0.2	0.4	0.3
May 1935	20,628	0.2	0.1	0.2	0.1	0.3	0.2
February 2003	21,852	0.2	0.4	0.3	0.3	0.3	0.2
March 2001	22,272	0.1	0.2	0.1	0.0	0.2	0.1
June 1993	22,451	0.2	0.2	0.2	0.2	0.5	0.3
March 1942	23,456	0.2	0.3	0.2	0.1	0.3	0.2
January 1966	24,810	0.4	0.5	0.3	0.2	0.3	0.1
April 1986	27,195	0.1	0.1	0.2	0.1	0.3	0.2
May 1963	30,035	0.1	0.1	0.1	0.1	0.4	0.3
March 1993	34,327	0.1	0.1	0.0	0.0	0.3	0.1
December 2002	35,239	0.5	0.4	0.5	0.4	0.6	0.4
June 1952	37,199	0.0	0.0	0.0	0.1	0.3	0.3
April 1996	45,853	0.1	0.0	0.1	0.1	0.1	0.1
May 1941	47,347	0.1	0.1	0.1	0.1	0.4	0.3
January 1971	47,872	0.3	0.4	0.3	0.3	0.2	0.1
April 1927	52,656	0.1	0.1	0.1	0.2	0.2	0.1
February 1945	52,920	0.4	0.5	0.3	0.3	0.2	0.1
February 1940	64,008	0.2	0.3	0.1	0.1	0.1	0.0
Average		0.2	0.2	0.2	0.1	0.3	0.2

Table 5.B.6-243. between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 60-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.17 (163%)	-0.01 (-8%)	0.02 (7%)	-0.16 (-63%)	0.18 (178%)	-0.23 (-71%)
June 1940	6,166	0.41 (239%)	0.24 (140%)	0.47 (395%)	0.30 (250%)	0.43 (284%)	0.24 (141%)
June 1934	7,100	0.07 (88%)	0.02 (28%)	0.06 (61%)	0.01 (10%)	0.08 (110%)	0.06 (173%)
April 1929	8,019	0.18 (215%)	-0.04 (-48%)	0.15 (148%)	-0.06 (-59%)	0.15 (139%)	0.03 (211%)
May 1966	9,759	0.26 (222%)	0.03 (29%)	0.24 (176%)	0.01 (11%)	0.26 (226%)	0.13 (578%)
February 1948	11,145	0.13 (295%)	0.00 (2%)	-0.14 (-44%)	-0.26 (-86%)	0.11 (171%)	0.01 (35%)
June 1978	12,346	0.26 (89%)	0.07 (26%)	0.42 (360%)	0.24 (206%)	0.25 (85%)	0.19 (115%)
April 1970	13,369	0.20 (81%)	0.15 (63%)	0.24 (127%)	0.20 (104%)	0.22 (102%)	0.23 (139%)
March 1961	13,725	0.11 (75%)	-0.04 (-24%)	0.08 (46%)	-0.07 (-37%)	0.12 (85%)	0.01 (13%)
May 1937	20,349	0.28 (183%)	0.16 (104%)	0.34 (356%)	0.22 (228%)	0.30 (211%)	0.15 (93%)
May 1935	20,628	0.16 (99%)	0.01 (9%)	0.21 (180%)	0.06 (53%)	0.14 (76%)	0.05 (40%)
February 2003	21,852	0.04 (17%)	-0.03 (-13%)	-0.13 (-32%)	-0.20 (-49%)	0.01 (5%)	-0.08 (-27%)
March 2001	22,272	0.07 (57%)	-0.07 (-58%)	0.00 (0%)	-0.14 (-73%)	0.11 (130%)	0.02 (79%)
June 1993	22,451	0.29 (139%)	0.10 (49%)	0.28 (132%)	0.09 (45%)	0.25 (106%)	0.14 (79%)
March 1942	23,456	0.11 (67%)	0.02 (11%)	0.02 (7%)	-0.08 (-29%)	0.08 (38%)	0.07 (63%)
January 1966	24,810	-0.13 (-33%)	-0.26 (-66%)	-0.22 (-46%)	-0.35 (-72%)	-0.08 (-23%)	-0.07 (-36%)
April 1986	27,195	0.15 (110%)	0.09 (63%)	0.23 (378%)	0.16 (272%)	0.12 (77%)	0.07 (49%)
May 1963	30,035	0.30 (357%)	0.17 (202%)	0.33 (553%)	0.20 (332%)	0.28 (257%)	0.15 (134%)
March 1993	34,327	0.20 (250%)	0.02 (21%)	0.21 (314%)	0.03 (43%)	0.23 (469%)	0.07 (250%)
December 2002	35,239	0.03 (5%)	-0.17 (-32%)	0.19 (53%)	0.00 (-1%)	0.05 (10%)	-0.04 (-11%)
June 1952	37,199	0.28 (730%)	0.26 (674%)	0.28 (783%)	0.26 (724%)	0.27 (569%)	0.23 (378%)
April 1996	45,853	0.08 (123%)	0.03 (45%)	0.12 (568%)	0.07 (336%)	0.06 (65%)	0.00 (3%)
May 1941	47,347	0.28 (235%)	0.16 (132%)	0.34 (545%)	0.22 (348%)	0.28 (217%)	0.13 (92%)
January 1971	47,872	-0.14 (-43%)	-0.21 (-65%)	-0.21 (-53%)	-0.28 (-71%)	-0.14 (-44%)	-0.15 (-57%)
April 1927	52,656	0.08 (56%)	-0.05 (-36%)	0.11 (100%)	-0.02 (-17%)	0.09 (64%)	-0.10 (-52%)
February 1945	52,920	-0.16 (-44%)	-0.22 (-60%)	-0.30 (-59%)	-0.35 (-71%)	-0.05 (-20%)	-0.11 (-42%)
February 1940	64,008	-0.07 (-44%)	-0.12 (-77%)	-0.23 (-72%)	-0.28 (-89%)	-0.02 (-19%)	-0.02 (-29%)
Average		0.13 (76%)	0.01 (7%)	0.12 (59%)	-0.01 (-3%)	0.14 (81%)	0.04 (31%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

1 **Table 5.B.6-244. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM**
2 **Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta**

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.0	0.0	0.1	0.1	0.0
June 1940	6,166	0.1	0.1	0.1	0.1	0.4	0.2
June 1934	7,100	0.1	0.1	0.1	0.0	0.1	0.1
April 1929	8,019	0.1	0.1	0.1	0.0	0.2	0.0
May 1966	9,759	0.1	0.1	0.0	0.0	0.2	0.0
February 1948	11,145	0.1	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.1	0.2	0.2	0.1	0.3	0.2
April 1970	13,369	0.1	0.2	0.2	0.1	0.3	0.2
March 1961	13,725	0.1	0.1	0.1	0.1	0.2	0.1
May 1937	20,349	0.1	0.1	0.1	0.1	0.3	0.1
May 1935	20,628	0.1	0.1	0.1	0.1	0.2	0.1
February 2003	21,852	0.3	0.1	0.2	0.2	0.2	0.1
March 2001	22,272	0.1	0.0	0.0	0.0	0.1	0.0
June 1993	22,451	0.2	0.2	0.2	0.1	0.3	0.2
March 1942	23,456	0.2	0.1	0.1	0.1	0.2	0.1
January 1966	24,810	0.3	0.2	0.2	0.0	0.2	0.1
April 1986	27,195	0.0	0.1	0.1	0.1	0.1	0.1
May 1963	30,035	0.0	0.1	0.1	0.1	0.2	0.1
March 1993	34,327	0.1	0.1	0.0	0.0	0.2	0.0
December 2002	35,239	0.2	0.4	0.4	0.3	0.4	0.2
June 1952	37,199	0.0	0.0	0.0	0.0	0.2	0.2
April 1996	45,853	0.0	0.1	0.1	0.1	0.1	0.0
May 1941	47,347	0.0	0.1	0.1	0.1	0.2	0.2
January 1971	47,872	0.3	0.2	0.2	0.2	0.1	0.1
April 1927	52,656	0.1	0.1	0.1	0.2	0.1	0.0
February 1945	52,920	0.4	0.2	0.2	0.1	0.1	0.1
February 1940	64,008	0.3	0.1	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.2	0.1

3

Table 5.B.6-245. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.02 (22%)	-0.08 (-85%)	0.12 (Inf.)	0.01 (Inf.)	0.12 (Inf.)	-0.10 (-87%)
June 1940	6,166	0.28 (280%)	0.12 (125%)	0.25 (199%)	0.10 (78%)	0.26 (208%)	0.09 (63%)
June 1934	7,100	0.06 (61%)	0.01 (10%)	0.07 (88%)	0.02 (28%)	0.08 (110%)	0.06 (173%)
April 1929	8,019	0.16 (213%)	-0.06 (-74%)	0.18 (279%)	-0.04 (-69%)	0.15 (174%)	0.02 (Inf.)
May 1966	9,759	0.16 (191%)	-0.04 (-50%)	0.18 (280%)	-0.02 (-34%)	0.22 (1192%)	0.04 (Inf.)
February 1948	11,145	-0.13 (-94%)	-0.13 (-100%)	0.01 (Inf.)	0.00 (0%)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	0.20 (224%)	0.11 (130%)	0.04 (16%)	-0.04 (-18%)	0.05 (19%)	0.07 (52%)
April 1970	13,369	0.14 (120%)	0.06 (55%)	0.06 (28%)	-0.02 (-10%)	0.10 (64%)	0.07 (63%)
March 1961	13,725	0.06 (44%)	-0.07 (-46%)	0.14 (201%)	0.01 (12%)	0.14 (215%)	0.01 (18%)
May 1937	20,349	0.21 (344%)	0.09 (140%)	0.16 (127%)	0.03 (23%)	0.16 (144%)	0.02 (15%)
May 1935	20,628	0.11 (133%)	0.00 (3%)	0.08 (66%)	-0.03 (-26%)	0.05 (33%)	0.01 (7%)
February 2003	21,852	-0.14 (-47%)	-0.16 (-56%)	0.01 (6%)	-0.02 (-13%)	-0.01 (-5%)	-0.07 (-37%)
March 2001	22,272	-0.02 (-14%)	-0.07 (-63%)	0.07 (219%)	0.01 (36%)	0.08 (396%)	0.02 (119%)
June 1993	22,451	0.15 (77%)	-0.02 (-11%)	0.17 (95%)	0.00 (-3%)	0.15 (81%)	0.08 (85%)
March 1942	23,456	-0.05 (-25%)	-0.11 (-52%)	0.04 (33%)	-0.02 (-15%)	0.03 (19%)	0.04 (72%)
January 1966	24,810	-0.14 (-46%)	-0.23 (-76%)	-0.04 (-20%)	-0.13 (-64%)	-0.01 (-3%)	0.03 (56%)
April 1986	27,195	0.12 (509%)	0.09 (384%)	0.02 (17%)	-0.01 (-7%)	0.03 (27%)	0.01 (14%)
May 1963	30,035	0.18 (432%)	0.08 (179%)	0.15 (197%)	0.04 (56%)	0.14 (157%)	0.03 (42%)
March 1993	34,327	0.11 (200%)	-0.01 (-22%)	0.11 (200%)	-0.01 (-22%)	0.13 (500%)	0.04 (600%)
December 2002	35,239	0.17 (69%)	-0.01 (-2%)	-0.02 (-4%)	-0.19 (-44%)	0.01 (1%)	-0.03 (-10%)
June 1952	37,199	0.21 (718%)	0.15 (520%)	0.21 (554%)	0.15 (396%)	0.20 (495%)	0.14 (276%)
April 1996	45,853	0.05 (254%)	0.02 (107%)	0.02 (46%)	-0.01 (-15%)	0.01 (11%)	-0.03 (-41%)
May 1941	47,347	0.16 (389%)	0.12 (300%)	0.09 (89%)	0.06 (55%)	0.10 (92%)	0.06 (52%)
January 1971	47,872	-0.18 (-67%)	-0.20 (-75%)	-0.12 (-58%)	-0.15 (-68%)	-0.13 (-59%)	-0.09 (-56%)
April 1927	52,656	0.07 (97%)	-0.03 (-43%)	0.01 (10%)	-0.08 (-68%)	0.02 (23%)	-0.11 (-75%)
February 1945	52,920	-0.30 (-75%)	-0.35 (-87%)	-0.07 (-41%)	-0.12 (-70%)	-0.08 (-44%)	-0.05 (-49%)
February 1940	64,008	-0.25 (-87%)	-0.26 (-93%)	-0.02 (-40%)	-0.04 (-65%)	-0.01 (-20%)	0.02 (Inf.)
Average		0.05 (39%)	-0.04 (-27%)	0.07 (59%)	-0.02 (-16%)	0.07 (64%)	0.01 (16%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-246. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.0	0.0	0.1	0.1	0.0
June 1940	6,166	0.1	0.1	0.1	0.1	0.3	0.2
June 1934	7,100	0.1	0.1	0.1	0.0	0.1	0.1
April 1929	8,019	0.1	0.1	0.1	0.0	0.2	0.0
May 1966	9,759	0.1	0.1	0.0	0.0	0.2	0.0
February 1948	11,145	0.1	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.1	0.2	0.2	0.1	0.3	0.2
April 1970	13,369	0.1	0.2	0.1	0.1	0.2	0.2
March 1961	13,725	0.1	0.1	0.1	0.1	0.2	0.1
May 1937	20,349	0.1	0.1	0.1	0.1	0.3	0.1
May 1935	20,628	0.1	0.1	0.1	0.1	0.2	0.1
February 2003	21,852	0.3	0.1	0.1	0.2	0.1	0.1
March 2001	22,272	0.1	0.0	0.0	0.0	0.1	0.0
June 1993	22,451	0.2	0.2	0.2	0.1	0.3	0.2
March 1942	23,456	0.2	0.1	0.1	0.1	0.1	0.1
January 1966	24,810	0.3	0.2	0.2	0.0	0.2	0.1
April 1986	27,195	0.0	0.1	0.1	0.1	0.1	0.1
May 1963	30,035	0.0	0.1	0.1	0.1	0.2	0.1
March 1993	34,327	0.0	0.0	0.0	0.0	0.1	0.0
December 2002	35,239	0.2	0.4	0.4	0.2	0.4	0.2
June 1952	37,199	0.0	0.0	0.0	0.0	0.2	0.2
April 1996	45,853	0.0	0.0	0.1	0.1	0.1	0.0
May 1941	47,347	0.0	0.1	0.1	0.1	0.2	0.2
January 1971	47,872	0.3	0.2	0.2	0.1	0.1	0.1
April 1927	52,656	0.1	0.1	0.1	0.1	0.1	0.0
February 1945	52,920	0.4	0.2	0.2	0.1	0.1	0.0
February 1940	64,008	0.3	0.1	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.2	0.1

Table 5.B.6-247. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.02 (22%)	-0.07 (-85%)	0.11 (Inf.)	0.01 (Inf.)	0.11 (Inf.)	-0.09 (-87%)
June 1940	6,166	0.26 (280%)	0.11 (125%)	0.23 (199%)	0.09 (78%)	0.23 (208%)	0.08 (63%)
June 1934	7,100	0.05 (61%)	0.01 (10%)	0.06 (88%)	0.02 (28%)	0.07 (110%)	0.06 (173%)
April 1929	8,019	0.15 (213%)	-0.05 (-74%)	0.16 (279%)	-0.04 (-69%)	0.14 (174%)	0.02 (Inf.)
May 1966	9,759	0.14 (191%)	-0.04 (-50%)	0.16 (280%)	-0.02 (-34%)	0.20 (1192%)	0.04 (Inf.)
February 1948	11,145	-0.12 (-94%)	-0.12 (-100%)	0.01 (Inf.)	0.00 (0%)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	0.18 (224%)	0.10 (130%)	0.04 (16%)	-0.04 (-18%)	0.04 (19%)	0.06 (52%)
April 1970	13,369	0.13 (120%)	0.06 (55%)	0.05 (28%)	-0.02 (-10%)	0.09 (64%)	0.06 (63%)
March 1961	13,725	0.06 (44%)	-0.06 (-46%)	0.13 (201%)	0.01 (12%)	0.13 (215%)	0.01 (18%)
May 1937	20,349	0.20 (344%)	0.08 (140%)	0.14 (127%)	0.03 (23%)	0.15 (144%)	0.02 (15%)
May 1935	20,628	0.10 (133%)	0.00 (3%)	0.07 (66%)	-0.03 (-26%)	0.05 (33%)	0.01 (7%)
February 2003	21,852	-0.12 (-47%)	-0.15 (-56%)	0.01 (6%)	-0.02 (-13%)	-0.01 (-5%)	-0.07 (-37%)
March 2001	22,272	-0.02 (-14%)	-0.07 (-63%)	0.06 (219%)	0.01 (36%)	0.07 (396%)	0.02 (119%)
June 1993	22,451	0.14 (77%)	-0.02 (-11%)	0.15 (95%)	0.00 (-3%)	0.14 (81%)	0.07 (85%)
March 1942	23,456	-0.05 (-25%)	-0.10 (-52%)	0.04 (33%)	-0.02 (-15%)	0.02 (19%)	0.04 (72%)
January 1966	24,810	-0.13 (-46%)	-0.22 (-76%)	-0.04 (-20%)	-0.12 (-64%)	0.00 (-3%)	0.02 (56%)
April 1986	27,195	0.11 (509%)	0.08 (384%)	0.02 (17%)	-0.01 (-7%)	0.03 (27%)	0.01 (14%)
May 1963	30,035	0.17 (432%)	0.07 (179%)	0.14 (197%)	0.04 (56%)	0.13 (157%)	0.03 (42%)
March 1993	34,327	0.10 (200%)	-0.01 (-22%)	0.10 (200%)	-0.01 (-22%)	0.12 (500%)	0.03 (600%)
December 2002	35,239	0.16 (69%)	-0.01 (-2%)	-0.01 (-4%)	-0.18 (-44%)	0.00 (1%)	-0.02 (-10%)
June 1952	37,199	0.20 (718%)	0.14 (520%)	0.19 (554%)	0.14 (396%)	0.19 (495%)	0.12 (276%)
April 1996	45,853	0.05 (254%)	0.02 (107%)	0.02 (46%)	-0.01 (-15%)	0.01 (11%)	-0.03 (-41%)
May 1941	47,347	0.15 (389%)	0.11 (300%)	0.09 (89%)	0.05 (55%)	0.09 (92%)	0.05 (52%)
January 1971	47,872	-0.17 (-67%)	-0.19 (-75%)	-0.11 (-58%)	-0.14 (-68%)	-0.12 (-59%)	-0.08 (-56%)
April 1927	52,656	0.06 (97%)	-0.03 (-43%)	0.01 (10%)	-0.08 (-68%)	0.02 (23%)	-0.10 (-75%)
February 1945	52,920	-0.28 (-75%)	-0.32 (-87%)	-0.06 (-41%)	-0.11 (-70%)	-0.07 (-44%)	-0.04 (-49%)
February 1940	64,008	-0.23 (-87%)	-0.24 (-93%)	-0.02 (-40%)	-0.04 (-65%)	-0.01 (-20%)	0.02 (Inf.)
Average		0.05 (39%)	-0.03 (-27%)	0.06 (59%)	-0.02 (-16%)	0.07 (64%)	0.01 (16%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-248. Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.1	0.0	0.0	0.1	0.1	0.0
June 1940	6,166	0.1	0.1	0.1	0.1	0.3	0.2
June 1934	7,100	0.1	0.1	0.1	0.0	0.1	0.1
April 1929	8,019	0.1	0.1	0.1	0.0	0.2	0.0
May 1966	9,759	0.1	0.1	0.0	0.0	0.2	0.0
February 1948	11,145	0.1	0.0	0.0	0.0	0.0	0.0
June 1978	12,346	0.1	0.2	0.2	0.1	0.2	0.2
April 1970	13,369	0.1	0.2	0.1	0.1	0.2	0.2
March 1961	13,725	0.1	0.1	0.1	0.1	0.2	0.1
May 1937	20,349	0.1	0.1	0.1	0.1	0.2	0.1
May 1935	20,628	0.1	0.1	0.1	0.1	0.2	0.1
February 2003	21,852	0.2	0.1	0.1	0.2	0.1	0.1
March 2001	22,272	0.1	0.0	0.0	0.0	0.1	0.0
June 1993	22,451	0.2	0.2	0.2	0.1	0.3	0.1
March 1942	23,456	0.2	0.1	0.1	0.1	0.1	0.1
January 1966	24,810	0.3	0.2	0.1	0.0	0.1	0.1
April 1986	27,195	0.0	0.1	0.1	0.1	0.1	0.1
May 1963	30,035	0.0	0.1	0.1	0.1	0.2	0.1
March 1993	34,327	0.0	0.0	0.0	0.0	0.1	0.0
December 2002	35,239	0.2	0.4	0.4	0.2	0.4	0.2
June 1952	37,199	0.0	0.0	0.0	0.0	0.2	0.2
April 1996	45,853	0.0	0.0	0.1	0.1	0.1	0.0
May 1941	47,347	0.0	0.1	0.1	0.1	0.2	0.1
January 1971	47,872	0.2	0.2	0.2	0.1	0.1	0.1
April 1927	52,656	0.1	0.1	0.1	0.1	0.1	0.0
February 1945	52,920	0.3	0.1	0.2	0.1	0.1	0.0
February 1940	64,008	0.2	0.1	0.0	0.0	0.0	0.0
Average		0.1	0.1	0.1	0.1	0.2	0.1

Table 5.B.6-249. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	0.02 (22%)	-0.07 (-85%)	0.10 (Inf.)	0.01 (Inf.)	0.10 (Inf.)	-0.08 (-87%)
June 1940	6,166	0.24 (280%)	0.11 (125%)	0.22 (199%)	0.08 (78%)	0.22 (208%)	0.08 (63%)
June 1934	7,100	0.05 (61%)	0.01 (10%)	0.06 (88%)	0.02 (28%)	0.07 (110%)	0.05 (173%)
April 1929	8,019	0.14 (213%)	-0.05 (-74%)	0.15 (279%)	-0.04 (-69%)	0.13 (174%)	0.02 (Inf.)
May 1966	9,759	0.14 (191%)	-0.04 (-50%)	0.15 (280%)	-0.02 (-34%)	0.19 (1192%)	0.04 (Inf.)
February 1948	11,145	-0.11 (-94%)	-0.12 (-100%)	0.01 (Inf.)	0.00 (0%)	0.01 (Inf.)	0.00 (0%)
June 1978	12,346	0.17 (224%)	0.10 (130%)	0.03 (16%)	-0.04 (-18%)	0.04 (19%)	0.06 (52%)
April 1970	13,369	0.12 (120%)	0.06 (55%)	0.05 (28%)	-0.02 (-10%)	0.09 (64%)	0.06 (63%)
March 1961	13,725	0.06 (44%)	-0.06 (-46%)	0.12 (201%)	0.01 (12%)	0.12 (215%)	0.01 (18%)
May 1937	20,349	0.19 (344%)	0.08 (140%)	0.13 (127%)	0.02 (23%)	0.14 (144%)	0.02 (15%)
May 1935	20,628	0.10 (133%)	0.00 (3%)	0.07 (66%)	-0.03 (-26%)	0.04 (33%)	0.01 (7%)
February 2003	21,852	-0.12 (-47%)	-0.14 (-56%)	0.01 (6%)	-0.02 (-13%)	-0.01 (-5%)	-0.06 (-37%)
March 2001	22,272	-0.01 (-14%)	-0.06 (-63%)	0.06 (219%)	0.01 (36%)	0.07 (396%)	0.02 (119%)
June 1993	22,451	0.13 (77%)	-0.02 (-11%)	0.14 (95%)	0.00 (-3%)	0.13 (81%)	0.07 (85%)
March 1942	23,456	-0.05 (-25%)	-0.10 (-52%)	0.03 (33%)	-0.02 (-15%)	0.02 (19%)	0.04 (72%)
January 1966	24,810	-0.12 (-46%)	-0.20 (-76%)	-0.03 (-20%)	-0.11 (-64%)	0.00 (-3%)	0.02 (56%)
April 1986	27,195	0.10 (509%)	0.08 (384%)	0.02 (17%)	-0.01 (-7%)	0.03 (27%)	0.01 (14%)
May 1963	30,035	0.16 (432%)	0.07 (179%)	0.13 (197%)	0.04 (56%)	0.12 (157%)	0.03 (42%)
March 1993	34,327	0.09 (200%)	-0.01 (-22%)	0.09 (200%)	-0.01 (-22%)	0.12 (500%)	0.03 (600%)
December 2002	35,239	0.15 (69%)	-0.01 (-2%)	-0.01 (-4%)	-0.17 (-44%)	0.00 (1%)	-0.02 (-10%)
June 1952	37,199	0.18 (718%)	0.13 (520%)	0.18 (554%)	0.13 (396%)	0.18 (495%)	0.12 (276%)
April 1996	45,853	0.05 (254%)	0.02 (107%)	0.02 (46%)	-0.01 (-15%)	0.01 (11%)	-0.03 (-41%)
May 1941	47,347	0.14 (389%)	0.11 (300%)	0.08 (89%)	0.05 (55%)	0.08 (92%)	0.05 (52%)
January 1971	47,872	-0.16 (-67%)	-0.18 (-75%)	-0.11 (-58%)	-0.13 (-68%)	-0.12 (-59%)	-0.08 (-56%)
April 1927	52,656	0.06 (97%)	-0.03 (-43%)	0.01 (10%)	-0.07 (-68%)	0.02 (23%)	-0.10 (-75%)
February 1945	52,920	-0.26 (-75%)	-0.31 (-87%)	-0.06 (-41%)	-0.10 (-70%)	-0.07 (-44%)	-0.04 (-49%)
February 1940	64,008	-0.21 (-87%)	-0.23 (-93%)	-0.02 (-40%)	-0.03 (-65%)	-0.01 (-20%)	0.02 (Inf.)
Average		0.05 (39%)	-0.03 (-27%)	0.06 (59%)	-0.02 (-16%)	0.06 (64%)	0.01 (16%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

5.B.6.4 Agricultural Diversions (Cache Slough, North Delta, West Delta, East Delta, South Delta, and Suisun Marsh Subregions)

5.B.6.4.1 Delta Smelt (Larvae)

In addition to the analysis using PTM (see below), an analysis of delta smelt entrainment at agricultural diversions is presented in the section entitled All Covered Species (below).

5.B.6.4.1.1 Particle Tracking Modeling

The 30-day PTM results for delta smelt larval entrainment by agricultural diversions showed that average entrainment was fairly similar between scenarios at 2.6–2.7% for EBC scenarios and 2.8–2.9% for ESO scenarios (Table 5.B.6-250). ESO scenarios gave lower entrainment in just under 40% of the ESO-vs.-EBC comparisons that were made, with higher entrainment under ESO scenarios in most of the remaining comparisons. On average ESO scenarios gave 0.13–0.22% greater entrainment than EBC scenarios, a relative change of 5–8% (Table 5.B.6-251). The 60-day PTM results generally have patterns similar to the 30-day PTM results, with the overall percentage of particles entrained being greater because of the longer particle tracking duration: average entrainment was 4–4.1% for EBC scenarios and 3.7–3.9% for ESO scenarios (Table 5.B.6-252), which meant ESO entrainment was on average 0.13–0.41% lower than EBC entrainment, or 3–11% lower in relative terms (Table 5.B.6-253).

The BDCP has the potential to reduce entrainment related to agricultural diversions through conversion of cultivated lands into tidal habitat and implementation of *CM21 Nonproject Diversions*, which aims to reduce entrainment through removal, consolidation, relocation, reconfiguration, and screening at nonproject diversions (primarily agricultural diversions). The BDCP will restore 25,000 acres of tidal habitat in the Plan Area in the early long-term and 55,000 acres plus up to an additional 10,000 acres in the late long-term. There are more than 2,600 agricultural diversions in the Plan Area (California Department of Fish and Game Passage Assessment Database 2010). Information regarding the sizes and types of these diversions is spotty and inconsistent. Information regarding their operation is largely nonexistent. For the purposes of this analysis, it was assumed that all of these diversions are of similar size and operate in a similar manner, recognizing *a priori* that this assumption is an oversimplification. Based on a hypothetical restoration scenario, it was estimated that approximately 109 diversions will be removed by the early long-term and about 236 would be removed by the late long-term (Table 5.B.6-254). This corresponds to 4.2% and 12.4% of the total number of diversions, which would result in reduced entrainment of covered fish species, including delta smelt.

Table 5.B.6-250. Percentage of Particles Representing Delta Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
2008 Dist/Dec 1923	4,500	0.4	0.5	0.5	0.4	0.5	0.4
2008 Dist/Jun 1940	6,166	8.6	8.5	8.2	7.2	8.9	8.3
2008 Dist/Jun 1934	7,100	9.9	9.8	9.7	9.0	10.6	10.2
2008 Dist/Apr 1929	8,019	3.0	2.9	2.9	2.7	2.6	2.4
2008 Dist/May 1966	9,759	5.9	5.8	5.3	5.1	5.0	5.0
2001 Dist/May 1966	9,759	4.1	4.1	3.8	3.9	3.7	4.0
2007 Dist/Feb 1948	11,145	0.5	0.4	0.4	0.4	0.5	0.5
2009 Dist/Feb 1948	11,145	0.6	0.5	0.5	0.5	0.6	0.6
1997 Dist/Feb 1948	11,145	0.2	0.2	0.2	0.2	0.2	0.2
2004 Dist/Feb 1948	11,145	0.4	0.3	0.3	0.2	0.3	0.3
2007 Dist/Jun 1978	12,346	14.1	13.9	14.5	13.8	13.4	11.7
2009 Dist/June 1978	12,346	12.0	11.9	12.6	12.0	12.2	10.8
1997 Dist/June 1978	12,346	3.4	3.5	4.3	4.1	3.4	3.5
2004 Dist/June 1978	12,346	2.9	3.0	4.3	4.2	3.2	3.8
2002 Dist/June 1978	12,346	5.0	5.1	6.0	5.8	7.3	6.9
1997 Dist/Apr 1970	13,369	1.8	1.7	1.7	1.7	1.4	1.4
2004 Dist/Apr 1970	13,369	1.4	1.3	1.3	1.3	1.3	1.3
2002 Dist/Apr 1970	13,369	2.6	2.5	2.4	2.4	2.6	2.5
2002 Dist/Mar 1961	13,725	0.2	0.2	0.2	0.1	0.2	0.2
2000 Dist/May 1937	20,349	4.1	3.7	3.9	3.6	4.3	3.8
2000 Dist/May 1935	20,628	4.5	4.5	4.7	4.3	5.6	4.7
2000 Dist/Feb 2003	21,852	0.2	0.2	0.2	0.2	0.2	0.4
2000 Dist/Mar 2001	22,272	0.4	0.3	0.3	0.3	0.4	0.4
2000 Dist/June 1993	22,451	5.0	4.8	4.9	5.2	10.6	9.9
2000 Dist/Mar 1942	23,456	0.4	0.4	0.4	0.4	0.8	0.7
2010 Dist/Jan 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
2010 Dist/Apr 1986	27,195	4.2	4.1	4.0	3.8	2.8	2.7
2005 Dist/Apr 1986	27,195	0.6	0.6	0.6	0.5	0.5	0.5
2005 Dist/May 1963	30,035	1.8	1.8	1.7	1.6	1.8	1.7
1999 Dist/Mar 1993	34,327	1.0	0.9	0.7	0.8	0.8	0.7
1999 Dist/Dec 2002	35,239	0.1	0.0	0.0	0.0	0.0	0.0
1999 Dist/June 1952	37,199	2.6	2.6	2.8	3.9	2.5	5.0
1996 Dist/Apr 1996	45,853	0.1	0.1	0.1	0.1	0.2	0.1
1996 Dist/May 1941	47,347	0.1	0.1	0.1	0.1	0.1	0.2
1996 Dist/Jan 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1927	52,656	0.0	0.0	0.0	0.0	0.1	0.0
1996 Dist/Feb 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
1998 Dist/Feb 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		2.7	2.6	2.7	2.6	2.9	2.8

Table 5.B.6-251. Difference between Scenarios in Percentage of Particles Representing Delta Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2008 Dist/Dec 1923	4,500	0.07 (17%)	0.02 (6%)	-0.05 (-9%)	-0.09 (-17%)	0.01 (3%)	-0.01 (-3%)
2008 Dist/Jun 1940	6,166	0.31 (4%)	-0.24 (-3%)	0.38 (5%)	-0.17 (-2%)	0.64 (8%)	1.09 (15%)
2008 Dist/Jun 1934	7,100	0.76 (8%)	0.38 (4%)	0.86 (9%)	0.48 (5%)	0.95 (10%)	1.20 (13%)
2008 Dist/Apr 1929	8,019	-0.39 (-13%)	-0.54 (-18%)	-0.30 (-10%)	-0.45 (-16%)	-0.38 (-13%)	-0.32 (-12%)
2008 Dist/May 1966	9,759	-0.95 (-16%)	-0.90 (-15%)	-0.82 (-14%)	-0.76 (-13%)	-0.33 (-6%)	-0.11 (-2%)
2001 Dist/May 1966	9,759	-0.47 (-11%)	-0.16 (-4%)	-0.41 (-10%)	-0.11 (-3%)	-0.10 (-3%)	0.10 (3%)
2007 Dist/Feb 1948	11,145	0.04 (7%)	0.02 (5%)	0.10 (25%)	0.09 (22%)	0.13 (34%)	0.09 (21%)
2009 Dist/Feb 1948	11,145	0.00 (0%)	-0.01 (-1%)	0.08 (15%)	0.07 (14%)	0.11 (23%)	0.09 (19%)
1997 Dist/Feb 1948	11,145	-0.02 (-10%)	-0.02 (-6%)	0.00 (1%)	0.01 (4%)	0.04 (20%)	0.06 (33%)
2004 Dist/Feb 1948	11,145	-0.08 (-21%)	-0.05 (-12%)	-0.03 (-8%)	0.01 (2%)	0.05 (17%)	0.12 (51%)
2007 Dist/Jun 1978	12,346	-0.73 (-5%)	-2.40 (-17%)	-0.52 (-4%)	-2.18 (-16%)	-1.19 (-8%)	-2.14 (-15%)
2009 Dist/June 1978	12,346	0.19 (2%)	-1.25 (-10%)	0.36 (3%)	-1.09 (-9%)	-0.34 (-3%)	-1.19 (-10%)
1997 Dist/June 1978	12,346	-0.01 (0%)	0.10 (3%)	-0.02 (-1%)	0.09 (3%)	-0.87 (-20%)	-0.57 (-14%)
2004 Dist/June 1978	12,346	0.25 (8%)	0.88 (30%)	0.17 (6%)	0.80 (27%)	-1.15 (-27%)	-0.41 (-10%)
2002 Dist/June 1978	12,346	2.24 (44%)	1.89 (37%)	2.22 (44%)	1.86 (37%)	1.24 (21%)	1.08 (18%)
1997 Dist/Apr 1970	13,369	-0.40 (-22%)	-0.42 (-23%)	-0.31 (-18%)	-0.33 (-20%)	-0.30 (-18%)	-0.30 (-18%)
2004 Dist/Apr 1970	13,369	-0.16 (-11%)	-0.14 (-10%)	0.00 (0%)	0.02 (1%)	0.00 (0%)	-0.02 (-2%)
2002 Dist/Apr 1970	13,369	-0.03 (-1%)	-0.15 (-6%)	0.10 (4%)	-0.03 (-1%)	0.16 (7%)	0.03 (1%)
2002 Dist/Mar 1961	13,725	-0.04 (-20%)	-0.06 (-25%)	0.02 (15%)	0.01 (8%)	0.01 (6%)	0.02 (12%)
2000 Dist/May 1937	20,349	0.17 (4%)	-0.29 (-7%)	0.51 (14%)	0.05 (1%)	0.37 (9%)	0.18 (5%)
2000 Dist/May 1935	20,628	1.12 (25%)	0.23 (5%)	1.10 (24%)	0.21 (5%)	0.95 (20%)	0.49 (12%)
2000 Dist/Feb 2003	21,852	0.01 (4%)	0.18 (78%)	0.04 (18%)	0.21 (100%)	0.03 (16%)	0.21 (106%)
2000 Dist/Mar 2001	22,272	0.00 (1%)	0.00 (-1%)	0.06 (21%)	0.06 (18%)	0.04 (12%)	0.04 (11%)
2000 Dist/June 1993	22,451	5.64 (113%)	4.93 (99%)	5.80 (120%)	5.09 (106%)	5.72 (117%)	4.71 (91%)
2000 Dist/Mar 1942	23,456	0.35 (83%)	0.30 (72%)	0.37 (91%)	0.32 (78%)	0.41 (111%)	0.34 (89%)
2010 Dist/Jan 1966	24,810	0.00 (-47%)	0.00 (-38%)	0.00 (374%)	0.00 (461%)	0.00 (532%)	0.00 (-5%)
2010 Dist/Apr 1986	27,195	-1.43 (-34%)	-1.52 (-36%)	-1.30 (-32%)	-1.40 (-34%)	-1.19 (-30%)	-1.14 (-30%)
2005 Dist/Apr 1986	27,195	-0.10 (-17%)	-0.09 (-16%)	-0.10 (-16%)	-0.09 (-15%)	-0.05 (-10%)	-0.03 (-6%)

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2005 Dist/May 1963	30,035	0.03 (1%)	-0.09 (-5%)	0.04 (2%)	-0.07 (-4%)	0.15 (9%)	0.16 (10%)
1999 Dist/Mar 1993	34,327	-0.23 (-23%)	-0.29 (-28%)	-0.14 (-15%)	-0.19 (-21%)	0.07 (10%)	-0.03 (-4%)
1999 Dist/Dec 2002	35,239	-0.07 (-63%)	-0.09 (-74%)	0.01 (15%)	-0.01 (-19%)	0.00 (-8%)	-0.01 (-17%)
1999 Dist/June 1952	37,199	-0.16 (-6%)	2.38 (90%)	-0.09 (-3%)	2.45 (95%)	-0.35 (-12%)	1.15 (30%)
1996 Dist/Apr 1996	45,853	0.04 (31%)	0.01 (11%)	0.02 (18%)	0.00 (0%)	0.04 (32%)	0.03 (34%)
1996 Dist/May 1941	47,347	0.00 (3%)	0.06 (62%)	-0.01 (-5%)	0.06 (49%)	0.02 (21%)	0.06 (51%)
1996 Dist/Jan 1971	47,872	0.00 (-77%)	0.00 (-58%)	0.00 (-57%)	0.00 (-23%)	0.00 (-33%)	0.00 (-58%)
1996 Dist/Apr 1927	52,656	0.01 (29%)	0.01 (16%)	0.01 (31%)	0.01 (17%)	0.00 (6%)	0.01 (20%)
1996 Dist/Feb 1945	52,920	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (-67%)
1998 Dist/Feb 1940	64,008	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Average	0	0.16 (6%)	0.07 (3%)	0.22 (8%)	0.13 (5%)	0.13 (5%)	0.13 (5%)
Note: Negative values indicate lower entrainment under ESO scenarios.							

Table 5.B.6-252. Percentage of Particles Representing Delta Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
2008 Dist/Dec 1923	4,500	0.5	0.6	0.6	0.5	0.6	0.5
2008 Dist/Jun 1940	6,166	11.2	11.0	11.0	9.2	11.8	11.1
2008 Dist/Jun 1934	7,100	15.3	15.1	15.1	14.6	16.8	16.9
2008 Dist/Apr 1929	8,019	5.5	5.5	5.7	5.4	5.6	5.6
2008 Dist/May 1966	9,759	9.6	9.5	8.7	8.9	8.2	9.1
2001 Dist/May 1966	9,759	7.2	7.2	6.7	7.3	6.8	8.0
2007 Dist/Feb 1948	11,145	0.7	0.5	0.5	0.5	0.6	0.6
2009 Dist/Feb 1948	11,145	0.8	0.6	0.5	0.6	0.7	0.6
1997 Dist/Feb 1948	11,145	0.3	0.2	0.2	0.2	0.2	0.2
2004 Dist/Feb 1948	11,145	0.4	0.4	0.3	0.2	0.3	0.4
2007 Dist/Jun 1978	12,346	18.5	18.5	19.8	18.6	16.9	14.7
2009 Dist/June 1978	12,346	15.6	15.6	16.9	15.9	15.3	13.5
1997 Dist/June 1978	12,346	4.2	4.3	5.8	5.3	4.3	4.6
2004 Dist/June 1978	12,346	3.3	3.5	5.9	5.4	4.0	5.2
2002 Dist/June 1978	12,346	5.8	5.9	7.6	7.2	8.6	8.6
1997 Dist/Apr 1970	13,369	2.3	2.2	2.2	2.2	2.0	2.1
2004 Dist/Apr 1970	13,369	1.7	1.6	1.5	1.7	1.8	2.0
2002 Dist/Apr 1970	13,369	3.7	3.6	3.5	3.6	4.6	4.5
2002 Dist/Mar 1961	13,725	1.4	1.3	1.4	1.5	1.3	1.3
2000 Dist/May 1937	20,349	5.1	4.6	5.0	4.6	5.4	5.2
2000 Dist/May 1935	20,628	7.1	7.1	7.5	7.0	8.8	10.4
2000 Dist/Feb 2003	21,852	0.3	0.2	0.2	0.2	0.3	0.5
2000 Dist/Mar 2001	22,272	0.9	0.8	0.8	0.8	0.8	0.8
2000 Dist/June 1993	22,451	5.7	5.5	5.5	6.0	12.1	11.7
2000 Dist/Mar 1942	23,456	0.6	0.5	0.5	0.5	1.2	1.3
2010 Dist/Jan 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
2010 Dist/Apr 1986	27,195	6.7	6.6	6.6	6.5	4.9	4.8
2005 Dist/Apr 1986	27,195	0.8	0.8	0.7	0.7	0.6	0.7
2005 Dist/May 1963	30,035	2.9	2.8	2.8	2.6	3.2	3.2
1999 Dist/Mar 1993	34,327	1.3	1.2	0.9	0.9	1.2	1.0
1999 Dist/Dec 2002	35,239	0.1	0.0	0.0	0.0	0.0	0.0
1999 Dist/June 1952	37,199	2.8	2.7	3.0	4.8	2.9	5.9
1996 Dist/Apr 1996	45,853	0.1	0.1	0.1	0.1	0.2	0.1
1996 Dist/May 1941	47,347	0.1	0.1	0.1	0.1	0.1	0.2
1996 Dist/Jan 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
1996 Dist/Apr 1927	52,656	0.1	0.1	0.1	0.1	0.1	0.1
1996 Dist/Feb 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
1998 Dist/Feb 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.7	3.7	3.9	3.8	4.0	4.1

Table 5.B.6-253. Difference between Scenarios in Percentage of Particles Representing Delta Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2008 Dist/Dec 1923	4,500	0.08 (16%)	0.02 (5%)	-0.01 (-2%)	-0.07 (-12%)	0.01 (1%)	-0.02 (-4%)
2008 Dist/Jun 1940	6,166	0.61 (5%)	-0.07 (-1%)	0.78 (7%)	0.10 (1%)	0.79 (7%)	1.93 (21%)
2008 Dist/Jun 1934	7,100	1.50 (10%)	1.59 (10%)	1.70 (11%)	1.79 (12%)	1.71 (11%)	2.24 (15%)
2008 Dist/Apr 1929	8,019	0.11 (2%)	0.13 (2%)	0.12 (2%)	0.14 (3%)	-0.07 (-1%)	0.17 (3%)
2008 Dist/May 1966	9,759	-1.37 (-14%)	-0.52 (-5%)	-1.23 (-13%)	-0.39 (-4%)	-0.46 (-5%)	0.13 (1%)
2001 Dist/May 1966	9,759	-0.45 (-6%)	0.77 (11%)	-0.43 (-6%)	0.80 (11%)	0.07 (1%)	0.71 (10%)
2007 Dist/Feb 1948	11,145	-0.07 (-11%)	-0.09 (-14%)	0.10 (19%)	0.08 (15%)	0.13 (27%)	0.09 (18%)
2009 Dist/Feb 1948	11,145	-0.10 (-13%)	-0.11 (-14%)	0.07 (12%)	0.06 (11%)	0.11 (19%)	0.09 (17%)
1997 Dist/Feb 1948	11,145	-0.05 (-17%)	-0.04 (-13%)	0.00 (0%)	0.01 (4%)	0.03 (16%)	0.06 (32%)
2004 Dist/Feb 1948	11,145	-0.10 (-23%)	-0.06 (-13%)	-0.03 (-10%)	0.01 (2%)	0.03 (12%)	0.12 (51%)
2007 Dist/Jun 1978	12,346	-1.61 (-9%)	-3.80 (-20%)	-1.55 (-8%)	-3.74 (-20%)	-2.84 (-14%)	-3.84 (-21%)
2009 Dist/June 1978	12,346	-0.35 (-2%)	-2.13 (-14%)	-0.32 (-2%)	-2.10 (-13%)	-1.62 (-10%)	-2.40 (-15%)
1997 Dist/June 1978	12,346	0.10 (2%)	0.44 (11%)	0.02 (0%)	0.36 (8%)	-1.48 (-26%)	-0.69 (-13%)
2004 Dist/June 1978	12,346	0.73 (22%)	1.94 (60%)	0.54 (16%)	1.75 (51%)	-1.88 (-32%)	-0.19 (-4%)
2002 Dist/June 1978	12,346	2.74 (47%)	2.74 (47%)	2.64 (44%)	2.64 (44%)	0.94 (12%)	1.40 (19%)
1997 Dist/Apr 1970	13,369	-0.31 (-14%)	-0.21 (-9%)	-0.22 (-10%)	-0.12 (-5%)	-0.19 (-9%)	-0.14 (-6%)
2004 Dist/Apr 1970	13,369	0.04 (3%)	0.25 (14%)	0.22 (14%)	0.43 (27%)	0.26 (17%)	0.31 (18%)
2002 Dist/Apr 1970	13,369	0.90 (24%)	0.79 (21%)	1.06 (29%)	0.94 (26%)	1.14 (32%)	0.96 (27%)
2002 Dist/Mar 1961	13,725	-0.11 (-8%)	-0.12 (-8%)	-0.01 (-1%)	-0.02 (-2%)	-0.08 (-5%)	-0.16 (-11%)
2000 Dist/May 1937	20,349	0.35 (7%)	0.17 (3%)	0.82 (18%)	0.63 (14%)	0.45 (9%)	0.63 (14%)
2000 Dist/May 1935	20,628	1.74 (25%)	3.39 (48%)	1.74 (25%)	3.39 (48%)	1.26 (17%)	3.46 (49%)
2000 Dist/Feb 2003	21,852	0.05 (18%)	0.27 (104%)	0.08 (35%)	0.31 (134%)	0.07 (30%)	0.31 (134%)
2000 Dist/Mar 2001	22,272	-0.11 (-13%)	-0.08 (-9%)	0.00 (0%)	0.03 (4%)	-0.02 (-2%)	-0.02 (-2%)
2000 Dist/June 1993	22,451	6.38 (112%)	5.98 (105%)	6.59 (120%)	6.18 (112%)	6.55 (118%)	5.68 (95%)
2000 Dist/Mar 1942	23,456	0.65 (116%)	0.76 (136%)	0.69 (135%)	0.80 (156%)	0.73 (153%)	0.82 (165%)
2010 Dist/Jan 1966	24,810	0.00 (-2%)	-0.01 (-21%)	0.01 (55%)	0.00 (24%)	0.00 (-8%)	0.00 (27%)
2010 Dist/Apr 1986	27,195	-1.78 (-26%)	-1.93 (-29%)	-1.65 (-25%)	-1.80 (-27%)	-1.64 (-25%)	-1.76 (-27%)
2005 Dist/Apr 1986	27,195	-0.12 (-16%)	-0.10 (-13%)	-0.12 (-16%)	-0.09 (-12%)	-0.07 (-10%)	-0.08 (-11%)

Starting Distribution/ Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
2005 Dist/May 1963	30,035	0.37 (13%)	0.35 (12%)	0.44 (16%)	0.41 (15%)	0.43 (15%)	0.59 (22%)
1999 Dist/Mar 1993	34,327	-0.04 (-4%)	-0.25 (-20%)	0.01 (1%)	-0.20 (-17%)	0.34 (39%)	0.07 (7%)
1999 Dist/Dec 2002	35,239	-0.07 (-63%)	-0.09 (-74%)	0.00 (11%)	-0.01 (-22%)	0.00 (-8%)	-0.01 (-17%)
1999 Dist/June 1952	37,199	0.16 (6%)	3.09 (111%)	0.22 (8%)	3.15 (116%)	-0.09 (-3%)	1.06 (22%)
1996 Dist/Apr 1996	45,853	0.06 (51%)	0.02 (18%)	0.05 (37%)	0.01 (7%)	0.06 (52%)	0.04 (41%)
1996 Dist/May 1941	47,347	0.00 (-2%)	0.07 (59%)	-0.01 (-11%)	0.06 (45%)	0.02 (17%)	0.06 (51%)
1996 Dist/Jan 1971	47,872	0.00 (-68%)	0.00 (-32%)	0.00 (-61%)	0.00 (-17%)	0.00 (-50%)	0.00 (-31%)
1996 Dist/Apr 1927	52,656	0.06 (110%)	0.04 (77%)	0.06 (111%)	0.04 (77%)	0.04 (66%)	0.03 (55%)
1996 Dist/Feb 1945	52,920	0.00 (4035%)	0.00 (4361%)	0.00 (-60%)	0.00 (-56%)	0.00 (1967%)	0.00 (-35%)
1998 Dist/Feb 1940	64,008	0.01 (100%)	-0.01 (-100%)	0.01 (0%)	0.00 (0%)	0.01 (0%)	-0.01 (-100%)
Average		0.26 (7%)	0.35 (9%)	0.33 (9%)	0.41 (11%)	0.13 (3%)	0.31 (8%)
Note: Negative values indicate lower entrainment under ESO scenarios.							

Table 5.B.6-254. Hypothetical Nonproject Diversions to Be Removed through Habitat Restoration Actions

		Number Removed	
Region	**Existing Total**	**ELT**	**LLT**
North	610	25	52
East	493	5	5
Central	733	23	23
South	364	0	64
Suisun	423	56	182
Total diversions	2623	109	326
Percent of diversions removed		4.2	12.4

5.B.6.4.2 Longfin Smelt (Larvae)

In addition to the analysis using PTM (see below), an analysis of longfin smelt entrainment at agricultural diversions is presented in the section entitled All Covered Species.

5.B.6.4.2.1 Particle Tracking Modeling

Under the 30-day PTM runs with a wetter starting distribution of particles, entrainment of particles representing longfin smelt larvae at Delta agricultural diversions averaged 3.7–3.9% for EBC scenarios and 1.4–1.9% for ESO scenarios (Table 5.B.6-255), or 1.9–2.5% (49–64% in relative terms) less entrainment under ESO scenarios (Table 5.B.6-256). Entrainment in agricultural diversions was lower under ESO scenarios compared to EBC scenarios in the great majority (90%) of comparisons. Very similar patterns were observed for the drier distribution of 30-day PTM runs (Table 5.B.6-257 and Table 5.B.6-258). For the 60-day PTM runs under both the wetter and drier starting distributions, virtually all comparisons between scenarios resulted in lower entrainment under ESO scenarios compared to EBC scenarios (Table 5.B.6-259 through Table 5.B.6-262). The sensitivity analyses of the drier distribution under the 30-day PTM, which placed 2–15% of particles into the south Delta, gave results very similar to the original 30-day PTM drier distribution (Table 5.B.6-263 through Table 5.B.6-268).

As described above for delta smelt, there is additional potential for any losses of longfin smelt to be further lowered under the BDCP relative to existing conditions by the removal of agricultural diversions during restoration of tidal areas and by *CM21 Nonproject Diversions*, discussed further below.

Table 5.B.6-255. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.4	0.5	0.4	0.4	0.3	0.2
June 1940	6,166	10.8	11.0	10.5	9.9	7.8	5.5
June 1934	7,100	9.8	9.7	9.4	9.6	5.6	4.2
April 1929	8,019	6.1	5.9	5.7	5.5	2.1	1.6
May 1966	9,759	8.5	8.4	8.2	8.3	4.5	3.6
February 1948	11,145	0.2	0.2	0.1	0.2	0.3	0.1
June 1978	12,346	9.3	9.2	9.6	9.4	6.6	4.7
April 1970	13,369	6.7	6.5	6.5	6.2	2.3	1.7
March 1961	13,725	0.2	0.1	0.1	0.1	0.1	0.1
May 1937	20,349	8.1	7.9	8.2	8.1	3.7	2.3
May 1935	20,628	5.5	5.5	5.3	5.1	1.9	1.2
February 2003	21,852	0.1	0.1	0.1	0.1	0.1	0.0
March 2001	22,272	0.3	0.3	0.3	0.3	0.2	0.1
June 1993	22,451	7.9	7.9	7.8	8.1	4.5	3.1
March 1942	23,456	0.3	0.3	0.3	0.3	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	4.2	4.1	3.9	3.7	1.0	0.7
May 1963	30,035	4.6	4.4	4.3	4.1	1.4	1.0
March 1993	34,327	3.8	3.5	3.3	3.1	1.5	1.0
December 2002	35,239	0.1	0.0	0.0	0.0	0.0	0.0
June 1952	37,199	8.3	8.3	8.3	8.5	4.3	3.4
April 1996	45,853	4.6	4.6	4.3	3.9	1.4	1.0
May 1941	47,347	3.9	3.8	3.7	3.5	1.2	1.0
January 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
April 1927	52,656	1.4	1.3	1.2	1.0	0.6	0.4
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.9	3.8	3.8	3.7	1.9	1.4

Table 5.B.6-256. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Wetter StartingDistribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.07 (-17%)	-0.23 (-57%)	-0.17 (-33%)	-0.33 (-66%)	-0.11 (-25%)	-0.25 (-59%)
June 1940	6,166	-3.08 (-28%)	-5.35 (-49%)	-3.22 (-29%)	-5.49 (-50%)	-2.68 (-26%)	-4.36 (-44%)
June 1934	7,100	-4.27 (-44%)	-5.64 (-57%)	-4.19 (-43%)	-5.56 (-57%)	-3.89 (-41%)	-5.41 (-56%)
April 1929	8,019	-4.08 (-66%)	-4.53 (-74%)	-3.85 (-65%)	-4.31 (-73%)	-3.65 (-64%)	-3.90 (-71%)
May 1966	9,759	-3.96 (-47%)	-4.85 (-57%)	-3.95 (-47%)	-4.84 (-57%)	-3.72 (-45%)	-4.68 (-56%)
February 1948	11,145	0.04 (15%)	-0.11 (-44%)	0.10 (58%)	-0.04 (-23%)	0.16 (132%)	-0.04 (-22%)
June 1978	12,346	-2.70 (-29%)	-4.62 (-50%)	-2.61 (-28%)	-4.53 (-49%)	-2.99 (-31%)	-4.65 (-50%)
April 1970	13,369	-4.37 (-66%)	-4.99 (-75%)	-4.18 (-64%)	-4.79 (-74%)	-4.17 (-64%)	-4.48 (-73%)
March 1961	13,725	-0.08 (-44%)	-0.08 (-49%)	-0.02 (-16%)	-0.03 (-24%)	-0.03 (-25%)	-0.04 (-32%)
May 1937	20,349	-4.36 (-54%)	-5.74 (-71%)	-4.22 (-53%)	-5.60 (-71%)	-4.45 (-54%)	-5.80 (-71%)
May 1935	20,628	-3.54 (-65%)	-4.23 (-77%)	-3.57 (-65%)	-4.27 (-78%)	-3.39 (-64%)	-3.85 (-76%)
February 2003	21,852	0.00 (2%)	-0.08 (-72%)	-0.01 (-4%)	-0.09 (-74%)	-0.02 (-12%)	-0.08 (-72%)
March 2001	22,272	-0.07 (-22%)	-0.21 (-66%)	-0.06 (-18%)	-0.19 (-65%)	-0.09 (-26%)	-0.17 (-61%)
June 1993	22,451	-3.41 (-43%)	-4.79 (-60%)	-3.38 (-43%)	-4.76 (-60%)	-3.30 (-42%)	-4.95 (-61%)
March 1942	23,456	-0.13 (-42%)	-0.21 (-70%)	-0.14 (-45%)	-0.23 (-72%)	-0.12 (-40%)	-0.19 (-69%)
January 1966	24,810	0.00 (0%)	0.00 (0%)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)
April 1986	27,195	-3.22 (-77%)	-3.48 (-83%)	-3.09 (-76%)	-3.35 (-82%)	-2.93 (-75%)	-2.94 (-80%)
May 1963	30,035	-3.15 (-69%)	-3.53 (-78%)	-3.04 (-68%)	-3.42 (-77%)	-2.89 (-67%)	-3.06 (-75%)
March 1993	34,327	-2.22 (-59%)	-2.76 (-73%)	-2.01 (-57%)	-2.54 (-72%)	-1.76 (-53%)	-2.09 (-68%)
December 2002	35,239	-0.11 (-89%)	-0.09 (-71%)	-0.04 (-73%)	-0.01 (-28%)	-0.01 (-48%)	-0.01 (-27%)
June 1952	37,199	-4.00 (-48%)	-4.96 (-60%)	-4.01 (-48%)	-4.98 (-60%)	-4.02 (-48%)	-5.13 (-60%)
April 1996	45,853	-3.15 (-69%)	-3.54 (-78%)	-3.14 (-69%)	-3.54 (-78%)	-2.93 (-67%)	-2.91 (-74%)
May 1941	47,347	-2.75 (-71%)	-2.95 (-76%)	-2.65 (-70%)	-2.84 (-75%)	-2.53 (-69%)	-2.52 (-72%)
January 1971	47,872	-0.01 (-56%)	-0.01 (-41%)	-0.01 (-61%)	-0.01 (-48%)	-0.01 (-65%)	0.00 (-20%)
April 1927	52,656	-0.84 (-60%)	-0.99 (-71%)	-0.76 (-58%)	-0.91 (-69%)	-0.65 (-54%)	-0.61 (-60%)
February 1945	52,920	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1940	64,008	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (0%)	0.00 (-100%)
Average		-1.98 (-51%)	-2.52 (-65%)	-1.93 (-50%)	-2.47 (-64%)	-1.86 (-49%)	-2.30 (-63%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-257. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.4	0.5	0.4	0.4	0.3	0.2
June 1940	6,166	10.8	10.9	10.4	9.7	8.1	6.0
June 1934	7,100	9.9	9.7	9.4	9.5	5.9	4.6
April 1929	8,019	5.8	5.6	5.5	5.2	2.1	1.7
May 1966	9,759	8.3	8.3	8.0	8.0	4.6	3.8
February 1948	11,145	0.3	0.2	0.1	0.2	0.3	0.2
June 1978	12,346	9.1	9.0	9.5	9.3	6.7	5.1
April 1970	13,369	6.3	6.1	6.1	5.9	2.3	1.8
March 1961	13,725	0.2	0.1	0.1	0.1	0.1	0.1
May 1937	20,349	7.6	7.5	7.6	7.7	3.7	2.5
May 1935	20,628	5.1	5.1	5.0	4.8	1.9	1.3
February 2003	21,852	0.1	0.1	0.1	0.1	0.1	0.0
March 2001	22,272	0.3	0.3	0.3	0.3	0.2	0.1
June 1993	22,451	7.6	7.5	7.5	7.9	4.5	3.2
March 1942	23,456	0.3	0.3	0.3	0.3	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	3.9	3.8	3.6	3.4	0.9	0.7
May 1963	30,035	4.2	4.1	4.0	3.8	1.4	1.1
March 1993	34,327	3.6	3.4	3.1	2.9	1.5	1.0
December 2002	35,239	0.1	0.1	0.0	0.0	0.0	0.0
June 1952	37,199	7.7	7.8	7.8	8.0	4.1	3.3
April 1996	45,853	4.2	4.2	4.0	3.6	1.3	1.0
May 1941	47,347	3.6	3.5	3.4	3.2	1.1	0.9
January 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
April 1927	52,656	1.3	1.2	1.1	1.0	0.5	0.4
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.7	3.7	3.6	3.5	1.9	1.4

Table 5.B.6-258. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier StartingDistribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.06 (-15%)	-0.17 (-43%)	-0.15 (-30%)	-0.26 (-53%)	-0.10 (-22%)	-0.19 (-44%)
June 1940	6,166	-2.78 (-26%)	-4.89 (-45%)	-2.84 (-26%)	-4.94 (-45%)	-2.35 (-23%)	-3.72 (-38%)
June 1934	7,100	-4.01 (-41%)	-5.32 (-54%)	-3.84 (-40%)	-5.14 (-53%)	-3.56 (-38%)	-4.98 (-52%)
April 1929	8,019	-3.66 (-63%)	-4.08 (-70%)	-3.49 (-62%)	-3.91 (-69%)	-3.33 (-61%)	-3.52 (-67%)
May 1966	9,759	-3.72 (-45%)	-4.47 (-54%)	-3.68 (-45%)	-4.43 (-54%)	-3.46 (-43%)	-4.21 (-52%)
February 1948	11,145	0.02 (8%)	-0.07 (-26%)	0.09 (48%)	0.00 (1%)	0.15 (112%)	0.01 (3%)
June 1978	12,346	-2.39 (-26%)	-4.07 (-45%)	-2.25 (-25%)	-3.94 (-44%)	-2.76 (-29%)	-4.21 (-45%)
April 1970	13,369	-3.98 (-63%)	-4.51 (-71%)	-3.78 (-62%)	-4.31 (-70%)	-3.77 (-62%)	-4.06 (-69%)
March 1961	13,725	-0.08 (-43%)	-0.09 (-43%)	-0.01 (-10%)	-0.01 (-11%)	-0.02 (-14%)	-0.01 (-5%)
May 1937	20,349	-3.95 (-52%)	-5.17 (-68%)	-3.81 (-51%)	-5.03 (-67%)	-3.96 (-52%)	-5.25 (-68%)
May 1935	20,628	-3.20 (-63%)	-3.86 (-75%)	-3.22 (-63%)	-3.88 (-76%)	-3.06 (-62%)	-3.53 (-74%)
February 2003	21,852	-0.02 (-17%)	-0.09 (-65%)	-0.03 (-20%)	-0.09 (-66%)	-0.04 (-24%)	-0.10 (-68%)
March 2001	22,272	-0.08 (-26%)	-0.19 (-60%)	-0.07 (-22%)	-0.18 (-58%)	-0.08 (-26%)	-0.15 (-54%)
June 1993	22,451	-3.11 (-41%)	-4.42 (-58%)	-3.06 (-41%)	-4.38 (-58%)	-3.02 (-40%)	-4.70 (-60%)
March 1942	23,456	-0.13 (-45%)	-0.19 (-65%)	-0.15 (-48%)	-0.20 (-67%)	-0.12 (-43%)	-0.17 (-63%)
January 1966	24,810	0.00 (211%)	0.00 (33%)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)
April 1986	27,195	-2.95 (-76%)	-3.17 (-82%)	-2.83 (-75%)	-3.05 (-81%)	-2.68 (-74%)	-2.67 (-79%)
May 1963	30,035	-2.85 (-68%)	-3.16 (-75%)	-2.76 (-67%)	-3.06 (-74%)	-2.63 (-66%)	-2.75 (-72%)
March 1993	34,327	-2.11 (-59%)	-2.60 (-72%)	-1.93 (-57%)	-2.42 (-71%)	-1.64 (-53%)	-1.94 (-66%)
December 2002	35,239	-0.10 (-83%)	-0.09 (-75%)	-0.03 (-57%)	-0.02 (-38%)	-0.01 (-30%)	-0.02 (-36%)
June 1952	37,199	-3.68 (-48%)	-4.41 (-57%)	-3.72 (-48%)	-4.45 (-57%)	-3.73 (-48%)	-4.67 (-58%)
April 1996	45,853	-2.91 (-69%)	-3.23 (-77%)	-2.89 (-69%)	-3.22 (-77%)	-2.70 (-67%)	-2.65 (-73%)
May 1941	47,347	-2.51 (-69%)	-2.68 (-74%)	-2.39 (-68%)	-2.56 (-73%)	-2.32 (-68%)	-2.28 (-71%)
January 1971	47,872	-0.01 (-67%)	-0.01 (-36%)	-0.01 (-67%)	-0.01 (-35%)	-0.01 (-66%)	0.00 (-6%)
April 1927	52,656	-0.76 (-59%)	-0.90 (-70%)	-0.69 (-57%)	-0.82 (-68%)	-0.60 (-53%)	-0.57 (-59%)
February 1945	52,920	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1940	64,008	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (0%)	0.00 (-100%)
Average		-1.82 (-49%)	-2.29 (-61%)	-1.76 (-48%)	-2.23 (-61%)	-1.70 (-47%)	-2.09 (-59%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-259. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation, Wetter Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.5	0.5	0.5	0.5	0.4	0.2
June 1940	6,166	14.0	14.0	13.7	12.7	9.1	6.7
June 1934	7,100	13.2	13.3	13.1	13.2	7.5	6.1
April 1929	8,019	7.4	7.6	7.5	7.3	3.2	2.6
May 1966	9,759	10.6	10.7	10.3	10.4	5.6	4.8
February 1948	11,145	0.2	0.3	0.2	0.2	0.3	0.1
June 1978	12,346	11.9	11.9	12.7	12.2	7.5	5.6
April 1970	13,369	7.2	7.3	7.2	7.0	2.8	2.1
March 1961	13,725	3.5	3.6	3.5	3.6	0.8	0.7
May 1937	20,349	9.5	9.8	9.7	9.6	4.4	2.9
May 1935	20,628	7.6	7.7	7.5	7.4	2.5	1.6
February 2003	21,852	0.2	0.3	0.3	0.2	0.1	0.1
March 2001	22,272	3.8	3.8	3.8	3.8	0.8	0.5
June 1993	22,451	10.2	10.4	10.3	10.5	5.2	3.8
March 1942	23,456	0.5	0.5	0.5	0.4	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	5.5	5.6	5.5	5.4	1.3	1.0
May 1963	30,035	6.9	7.1	6.9	6.7	2.0	1.4
March 1993	34,327	5.3	5.4	5.1	5.0	1.7	1.1
December 2002	35,239	0.0	0.1	0.0	0.1	0.0	0.0
June 1952	37,199	11.0	11.1	11.0	11.2	4.8	3.8
April 1996	45,853	5.5	5.5	5.4	5.1	1.5	1.1
May 1941	47,347	7.0	7.0	6.9	6.7	1.7	1.5
January 1971	47,872	0.1	0.1	0.1	0.1	0.0	0.0
April 1927	52,656	4.2	4.4	4.3	4.1	0.8	0.6
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		5.4	5.5	5.4	5.3	2.4	1.8

Table 5.B.6-260. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation, Wetter StartingDistribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.12 (-23%)	-0.30 (-58%)	-0.05 (-11%)	-0.23 (-52%)	-0.10 (-20%)	-0.27 (-55%)
June 1940	6,166	-4.95 (-35%)	-7.36 (-52%)	-4.90 (-35%)	-7.31 (-52%)	-4.60 (-34%)	-5.99 (-47%)
June 1934	7,100	-5.69 (-43%)	-7.10 (-54%)	-5.74 (-43%)	-7.15 (-54%)	-5.61 (-43%)	-7.07 (-54%)
April 1929	8,019	-4.19 (-57%)	-4.83 (-65%)	-4.36 (-58%)	-5.00 (-66%)	-4.26 (-57%)	-4.71 (-65%)
May 1966	9,759	-5.06 (-48%)	-5.88 (-55%)	-5.09 (-48%)	-5.92 (-55%)	-4.69 (-46%)	-5.64 (-54%)
February 1948	11,145	0.08 (35%)	-0.08 (-36%)	-0.03 (-10%)	-0.19 (-58%)	0.14 (83%)	-0.07 (-32%)
June 1978	12,346	-4.36 (-37%)	-6.35 (-53%)	-4.33 (-36%)	-6.32 (-53%)	-5.11 (-40%)	-6.67 (-55%)
April 1970	13,369	-4.36 (-61%)	-5.07 (-71%)	-4.52 (-62%)	-5.24 (-71%)	-4.35 (-61%)	-4.88 (-70%)
March 1961	13,725	-2.77 (-78%)	-2.85 (-81%)	-2.88 (-79%)	-2.96 (-81%)	-2.77 (-78%)	-2.94 (-81%)
May 1937	20,349	-5.13 (-54%)	-6.63 (-70%)	-5.44 (-55%)	-6.94 (-71%)	-5.36 (-55%)	-6.70 (-70%)
May 1935	20,628	-5.10 (-67%)	-6.02 (-79%)	-5.12 (-67%)	-6.04 (-79%)	-4.93 (-66%)	-5.82 (-78%)
February 2003	21,852	-0.08 (-35%)	-0.17 (-74%)	-0.11 (-42%)	-0.20 (-77%)	-0.12 (-44%)	-0.17 (-74%)
March 2001	22,272	-3.02 (-80%)	-3.28 (-87%)	-3.05 (-80%)	-3.31 (-87%)	-3.01 (-80%)	-3.32 (-87%)
June 1993	22,451	-4.99 (-49%)	-6.39 (-62%)	-5.12 (-49%)	-6.52 (-63%)	-5.01 (-49%)	-6.69 (-64%)
March 1942	23,456	-0.32 (-64%)	-0.39 (-79%)	-0.33 (-65%)	-0.40 (-79%)	-0.29 (-62%)	-0.32 (-75%)
January 1966	24,810	0.00 (53%)	0.00 (-64%)	-0.01 (-58%)	-0.02 (-90%)	0.00 (-37%)	0.00 (-69%)
April 1986	27,195	-4.21 (-77%)	-4.51 (-82%)	-4.31 (-77%)	-4.61 (-83%)	-4.26 (-77%)	-4.45 (-82%)
May 1963	30,035	-4.91 (-71%)	-5.48 (-79%)	-5.09 (-72%)	-5.66 (-80%)	-4.91 (-71%)	-5.28 (-79%)
March 1993	34,327	-3.60 (-68%)	-4.11 (-78%)	-3.71 (-69%)	-4.23 (-79%)	-3.48 (-68%)	-3.90 (-77%)
December 2002	35,239	-0.04 (-73%)	-0.01 (-28%)	-0.11 (-89%)	-0.09 (-71%)	-0.01 (-48%)	-0.02 (-31%)
June 1952	37,199	-6.17 (-56%)	-7.17 (-65%)	-6.25 (-56%)	-7.25 (-65%)	-6.14 (-56%)	-7.40 (-66%)
April 1996	45,853	-4.02 (-73%)	-4.44 (-80%)	-4.04 (-73%)	-4.45 (-81%)	-3.87 (-72%)	-4.04 (-79%)
May 1941	47,347	-5.30 (-76%)	-5.53 (-79%)	-5.36 (-76%)	-5.59 (-79%)	-5.20 (-76%)	-5.27 (-78%)
January 1971	47,872	-0.04 (-73%)	-0.05 (-81%)	-0.05 (-77%)	-0.06 (-84%)	-0.06 (-78%)	-0.06 (-84%)
April 1927	52,656	-3.43 (-81%)	-3.60 (-85%)	-3.59 (-82%)	-3.76 (-86%)	-3.49 (-82%)	-3.50 (-85%)
February 1945	52,920	-0.03 (-89%)	-0.03 (-88%)	-0.03 (-87%)	-0.03 (-86%)	-0.04 (-91%)	-0.03 (-89%)
February 1940	64,008	0.00 (62%)	0.00 (-75%)	0.00 (-24%)	0.00 (-88%)	0.00 (160%)	0.00 (-75%)
Average		-3.03 (-56%)	-3.62 (-67%)	-3.10 (-57%)	-3.68 (-67%)	-3.02 (-56%)	-3.53 (-66%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-261. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation, Drier Starting Distribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.5	0.5	0.5	0.5	0.4	0.3
June 1940	6,166	14.1	14.1	13.8	12.5	9.7	7.4
June 1934	7,100	13.5	13.6	13.4	13.4	8.3	7.0
April 1929	8,019	7.2	7.3	7.3	7.0	3.5	2.9
May 1966	9,759	10.5	10.6	10.1	10.2	5.9	5.3
February 1948	11,145	0.2	0.3	0.2	0.2	0.3	0.2
June 1978	12,346	11.6	11.6	12.6	12.1	7.8	6.2
April 1970	13,369	6.8	7.0	6.8	6.7	2.9	2.3
March 1961	13,725	3.4	3.5	3.3	3.5	0.9	0.8
May 1937	20,349	9.0	9.3	9.1	9.1	4.4	3.1
May 1935	20,628	7.1	7.1	7.0	7.0	2.5	1.6
February 2003	21,852	0.2	0.3	0.3	0.2	0.1	0.1
March 2001	22,272	3.5	3.6	3.5	3.6	0.7	0.5
June 1993	22,451	9.8	9.9	9.8	10.3	5.3	4.0
March 1942	23,456	0.5	0.5	0.4	0.4	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	5.0	5.2	5.1	5.0	1.2	1.0
May 1963	30,035	6.4	6.6	6.4	6.3	1.9	1.5
March 1993	34,327	5.0	5.1	4.8	4.7	1.6	1.1
December 2002	35,239	0.1	0.1	0.0	0.1	0.0	0.0
June 1952	37,199	10.3	10.3	10.2	10.6	4.6	3.8
April 1996	45,853	5.1	5.1	5.0	4.7	1.4	1.0
May 1941	47,347	6.4	6.5	6.4	6.2	1.6	1.5
January 1971	47,872	0.1	0.1	0.1	0.1	0.0	0.0
April 1927	52,656	3.9	4.0	4.0	3.8	0.7	0.6
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		5.2	5.3	5.2	5.1	2.4	1.9

Table 5.B.6-262. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 60-Day DSM2-PTM Simulation, Drier StartingDistribution

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.09 (-18%)	-0.23 (-44%)	-0.04 (-8%)	-0.17 (-37%)	-0.10 (-19%)	-0.20 (-41%)
June 1940	6,166	-4.42 (-31%)	-6.75 (-48%)	-4.44 (-31%)	-6.76 (-48%)	-4.08 (-30%)	-5.09 (-41%)
June 1934	7,100	-5.21 (-39%)	-6.51 (-48%)	-5.36 (-39%)	-6.65 (-49%)	-5.15 (-38%)	-6.43 (-48%)
April 1929	8,019	-3.71 (-52%)	-4.29 (-60%)	-3.84 (-53%)	-4.43 (-61%)	-3.85 (-53%)	-4.17 (-59%)
May 1966	9,759	-4.63 (-44%)	-5.21 (-50%)	-4.74 (-45%)	-5.31 (-50%)	-4.29 (-42%)	-4.93 (-48%)
February 1948	11,145	0.06 (29%)	-0.03 (-15%)	-0.05 (-14%)	-0.14 (-43%)	0.12 (71%)	-0.02 (-9%)
June 1978	12,346	-3.78 (-33%)	-5.44 (-47%)	-3.78 (-33%)	-5.44 (-47%)	-4.81 (-38%)	-5.93 (-49%)
April 1970	13,369	-3.95 (-58%)	-4.52 (-66%)	-4.11 (-59%)	-4.69 (-67%)	-3.95 (-58%)	-4.41 (-66%)
March 1961	13,725	-2.53 (-74%)	-2.62 (-77%)	-2.63 (-75%)	-2.72 (-77%)	-2.44 (-73%)	-2.67 (-77%)
May 1937	20,349	-4.63 (-51%)	-5.91 (-66%)	-4.92 (-53%)	-6.20 (-67%)	-4.76 (-52%)	-6.04 (-66%)
May 1935	20,628	-4.59 (-64%)	-5.48 (-77%)	-4.61 (-65%)	-5.50 (-77%)	-4.44 (-64%)	-5.32 (-76%)
February 2003	21,852	-0.09 (-40%)	-0.16 (-68%)	-0.12 (-46%)	-0.19 (-72%)	-0.13 (-47%)	-0.17 (-70%)
March 2001	22,272	-2.78 (-79%)	-2.98 (-85%)	-2.81 (-79%)	-3.01 (-85%)	-2.76 (-79%)	-3.01 (-85%)
June 1993	22,451	-4.44 (-45%)	-5.72 (-59%)	-4.61 (-46%)	-5.90 (-59%)	-4.51 (-46%)	-6.27 (-61%)
March 1942	23,456	-0.31 (-65%)	-0.36 (-75%)	-0.31 (-66%)	-0.36 (-76%)	-0.28 (-63%)	-0.30 (-72%)
January 1966	24,810	0.00 (76%)	0.00 (-65%)	-0.01 (-55%)	-0.02 (-91%)	-0.01 (-34%)	-0.01 (-76%)
April 1986	27,195	-3.83 (-76%)	-4.07 (-81%)	-3.94 (-76%)	-4.18 (-81%)	-3.90 (-76%)	-4.03 (-81%)
May 1963	30,035	-4.46 (-70%)	-4.92 (-77%)	-4.63 (-70%)	-5.09 (-77%)	-4.48 (-70%)	-4.77 (-76%)
March 1993	34,327	-3.40 (-68%)	-3.87 (-77%)	-3.48 (-69%)	-3.95 (-78%)	-3.23 (-67%)	-3.59 (-76%)
December 2002	35,239	-0.03 (-57%)	-0.02 (-38%)	-0.10 (-83%)	-0.09 (-75%)	-0.01 (-30%)	-0.02 (-40%)
June 1952	37,199	-5.68 (-55%)	-6.43 (-63%)	-5.71 (-55%)	-6.47 (-63%)	-5.64 (-55%)	-6.74 (-64%)
April 1996	45,853	-3.69 (-73%)	-4.04 (-79%)	-3.72 (-73%)	-4.07 (-80%)	-3.57 (-72%)	-3.68 (-78%)
May 1941	47,347	-4.80 (-75%)	-4.93 (-77%)	-4.88 (-75%)	-5.01 (-77%)	-4.75 (-74%)	-4.74 (-76%)
January 1971	47,872	-0.04 (-68%)	-0.04 (-76%)	-0.05 (-74%)	-0.06 (-80%)	-0.05 (-74%)	-0.05 (-79%)
April 1927	52,656	-3.14 (-81%)	-3.30 (-85%)	-3.29 (-82%)	-3.45 (-86%)	-3.22 (-81%)	-3.22 (-85%)
February 1945	52,920	-0.03 (-89%)	-0.03 (-89%)	-0.02 (-87%)	-0.02 (-87%)	-0.04 (-91%)	-0.03 (-89%)
February 1940	64,008	0.00 (112%)	0.00 (-75%)	0.00 (-11%)	0.00 (-89%)	0.00 (240%)	0.00 (-83%)
Average		-2.75 (-53%)	-3.25 (-63%)	-2.82 (-54%)	-3.33 (-63%)	-2.75 (-53%)	-3.18 (-62%)
Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.							

Table 5.B.6-263. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.4	0.5	0.4	0.4	0.4	0.2
June 1940	6,166	10.8	10.8	10.3	9.6	8.1	6.0
June 1934	7,100	9.9	9.7	9.4	9.5	5.9	4.6
April 1929	8,019	5.7	5.5	5.4	5.1	2.1	1.7
May 1966	9,759	8.1	8.1	7.9	7.9	4.5	3.8
February 1948	11,145	0.3	0.2	0.1	0.2	0.3	0.2
June 1978	12,346	9.0	8.9	9.4	9.2	6.6	5.0
April 1970	13,369	6.2	6.0	6.0	5.7	2.3	1.8
March 1961	13,725	0.2	0.1	0.1	0.1	0.1	0.1
May 1937	20,349	7.4	7.3	7.5	7.5	3.6	2.4
May 1935	20,628	5.0	5.0	4.9	4.7	1.9	1.3
February 2003	21,852	0.1	0.1	0.1	0.1	0.1	0.1
March 2001	22,272	0.3	0.3	0.3	0.3	0.2	0.1
June 1993	22,451	7.5	7.5	7.4	7.8	4.4	3.2
March 1942	23,456	0.3	0.3	0.3	0.3	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	3.8	3.7	3.5	3.3	0.9	0.7
May 1963	30,035	4.1	4.0	3.9	3.7	1.4	1.1
March 1993	34,327	3.5	3.3	3.1	2.9	1.5	1.0
December 2002	35,239	0.1	0.1	0.0	0.1	0.0	0.0
June 1952	37,199	7.6	7.6	7.6	7.9	4.0	3.3
April 1996	45,853	4.1	4.1	3.9	3.5	1.3	1.0
May 1941	47,347	3.5	3.4	3.3	3.1	1.1	0.9
January 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
April 1927	52,656	1.3	1.2	1.1	0.9	0.5	0.4
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.7	3.6	3.6	3.5	1.9	1.4

Table 5.B.6-264. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 2% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.05 (-13%)	-0.17 (-41%)	-0.14 (-28%)	-0.25 (-51%)	-0.09 (-20%)	-0.18 (-43%)
June 1940	6,166	-2.71 (-25%)	-4.74 (-44%)	-2.77 (-26%)	-4.81 (-44%)	-2.26 (-22%)	-3.57 (-37%)
June 1934	7,100	-3.96 (-40%)	-5.26 (-53%)	-3.77 (-39%)	-5.07 (-52%)	-3.48 (-37%)	-4.87 (-51%)
April 1929	8,019	-3.56 (-63%)	-3.97 (-70%)	-3.39 (-62%)	-3.80 (-69%)	-3.24 (-60%)	-3.42 (-67%)
May 1966	9,759	-3.59 (-44%)	-4.31 (-53%)	-3.55 (-44%)	-4.27 (-53%)	-3.34 (-42%)	-4.07 (-52%)
February 1948	11,145	0.02 (7%)	-0.07 (-26%)	0.09 (47%)	0.00 (1%)	0.14 (106%)	0.01 (3%)
June 1978	12,346	-2.34 (-26%)	-3.97 (-44%)	-2.22 (-25%)	-3.84 (-43%)	-2.72 (-29%)	-4.14 (-45%)
April 1970	13,369	-3.86 (-63%)	-4.38 (-71%)	-3.68 (-61%)	-4.19 (-70%)	-3.66 (-61%)	-3.95 (-69%)
March 1961	13,725	-0.08 (-41%)	-0.08 (-42%)	-0.01 (-10%)	-0.01 (-12%)	-0.02 (-15%)	-0.01 (-5%)
May 1937	20,349	-3.83 (-52%)	-5.02 (-67%)	-3.70 (-51%)	-4.89 (-67%)	-3.84 (-52%)	-5.10 (-68%)
May 1935	20,628	-3.11 (-62%)	-3.75 (-75%)	-3.14 (-62%)	-3.78 (-75%)	-2.98 (-61%)	-3.43 (-73%)
February 2003	21,852	-0.02 (-14%)	-0.08 (-60%)	-0.02 (-17%)	-0.09 (-61%)	-0.03 (-21%)	-0.09 (-63%)
March 2001	22,272	-0.08 (-25%)	-0.19 (-57%)	-0.06 (-21%)	-0.17 (-54%)	-0.08 (-25%)	-0.14 (-50%)
June 1993	22,451	-3.10 (-41%)	-4.35 (-58%)	-3.04 (-41%)	-4.29 (-58%)	-3.00 (-40%)	-4.61 (-59%)
March 1942	23,456	-0.13 (-45%)	-0.19 (-65%)	-0.15 (-48%)	-0.21 (-67%)	-0.13 (-44%)	-0.18 (-64%)
January 1966	24,810	0.00 (99%)	0.00 (-17%)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)
April 1986	27,195	-2.86 (-76%)	-3.08 (-81%)	-2.75 (-75%)	-2.96 (-81%)	-2.61 (-74%)	-2.59 (-79%)
May 1963	30,035	-2.77 (-67%)	-3.07 (-74%)	-2.67 (-66%)	-2.97 (-74%)	-2.56 (-65%)	-2.68 (-72%)
March 1993	34,327	-2.04 (-58%)	-2.52 (-72%)	-1.86 (-56%)	-2.35 (-70%)	-1.58 (-52%)	-1.87 (-65%)
December 2002	35,239	-0.10 (-82%)	-0.09 (-73%)	-0.03 (-55%)	-0.02 (-33%)	-0.01 (-29%)	-0.02 (-33%)
June 1952	37,199	-3.62 (-48%)	-4.30 (-57%)	-3.65 (-48%)	-4.33 (-57%)	-3.67 (-48%)	-4.60 (-58%)
April 1996	45,853	-2.82 (-69%)	-3.14 (-76%)	-2.81 (-68%)	-3.13 (-76%)	-2.62 (-67%)	-2.57 (-73%)
May 1941	47,347	-2.44 (-69%)	-2.60 (-74%)	-2.33 (-68%)	-2.49 (-73%)	-2.25 (-67%)	-2.21 (-70%)
January 1971	47,872	-0.01 (-61%)	-0.01 (-32%)	-0.01 (-61%)	-0.01 (-32%)	-0.01 (-60%)	0.00 (0%)
April 1927	52,656	-0.74 (-59%)	-0.87 (-69%)	-0.66 (-56%)	-0.80 (-67%)	-0.59 (-53%)	-0.55 (-59%)
February 1945	52,920	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1940	64,008	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (-100%)	0.00 (0%)	0.00 (-100%)
Average		-1.77 (-48%)	-2.23 (-61%)	-1.72 (-47%)	-2.17 (-60%)	-1.65 (-46%)	-2.03 (-58%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-265. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.4	0.5	0.4	0.4	0.4	0.3
June 1940	6,166	11.0	11.0	10.5	9.7	8.5	6.6
June 1934	7,100	10.4	10.1	9.7	9.7	6.4	5.1
April 1929	8,019	5.4	5.3	5.1	4.9	2.1	1.7
May 1966	9,759	7.8	7.8	7.6	7.7	4.6	4.0
February 1948	11,145	0.3	0.2	0.2	0.2	0.3	0.2
June 1978	12,346	8.8	8.7	9.2	9.1	6.5	5.1
April 1970	13,369	5.8	5.7	5.6	5.4	2.3	1.8
March 1961	13,725	0.2	0.1	0.2	0.1	0.1	0.1
May 1937	20,349	7.0	6.8	7.0	7.0	3.5	2.4
May 1935	20,628	4.8	4.8	4.6	4.5	1.9	1.3
February 2003	21,852	0.2	0.2	0.2	0.2	0.2	0.1
March 2001	22,272	0.4	0.3	0.4	0.3	0.3	0.2
June 1993	22,451	7.6	7.4	7.4	7.8	4.3	3.3
March 1942	23,456	0.3	0.3	0.3	0.3	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	3.5	3.4	3.3	3.1	0.9	0.7
May 1963	30,035	3.9	3.8	3.7	3.6	1.4	1.1
March 1993	34,327	3.3	3.2	2.9	2.7	1.5	1.0
December 2002	35,239	0.1	0.1	0.0	0.1	0.0	0.0
June 1952	37,199	7.3	7.3	7.4	7.8	3.8	3.3
April 1996	45,853	3.9	3.9	3.7	3.3	1.3	1.0
May 1941	47,347	3.3	3.2	3.1	2.9	1.1	0.9
January 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
April 1927	52,656	1.2	1.1	1.1	0.9	0.5	0.4
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.6	3.5	3.5	3.4	1.9	1.5

Table 5.B.6-266. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 10% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.04 (-9%)	-0.15 (-35%)	-0.13 (-25%)	-0.24 (-47%)	-0.05 (-12%)	-0.17 (-38%)
June 1940	6,166	-2.50 (-23%)	-4.33 (-39%)	-2.58 (-23%)	-4.41 (-40%)	-2.00 (-19%)	-3.07 (-32%)
June 1934	7,100	-3.95 (-38%)	-5.29 (-51%)	-3.67 (-36%)	-5.01 (-50%)	-3.29 (-34%)	-4.66 (-48%)
April 1929	8,019	-3.32 (-61%)	-3.69 (-68%)	-3.14 (-60%)	-3.52 (-67%)	-3.00 (-59%)	-3.12 (-64%)
May 1966	9,759	-3.18 (-41%)	-3.81 (-49%)	-3.14 (-40%)	-3.77 (-48%)	-2.96 (-39%)	-3.66 (-48%)
February 1948	11,145	0.00 (1%)	-0.07 (-26%)	0.08 (40%)	0.00 (2%)	0.13 (85%)	0.01 (5%)
June 1978	12,346	-2.28 (-26%)	-3.70 (-42%)	-2.20 (-25%)	-3.63 (-42%)	-2.73 (-30%)	-4.04 (-44%)
April 1970	13,369	-3.55 (-61%)	-4.06 (-69%)	-3.38 (-60%)	-3.89 (-69%)	-3.35 (-59%)	-3.65 (-67%)
March 1961	13,725	-0.07 (-35%)	-0.07 (-37%)	-0.01 (-10%)	-0.02 (-13%)	-0.03 (-17%)	0.00 (-1%)
May 1937	20,349	-3.52 (-50%)	-4.63 (-66%)	-3.39 (-50%)	-4.49 (-66%)	-3.54 (-51%)	-4.69 (-67%)
May 1935	20,628	-2.88 (-60%)	-3.48 (-73%)	-2.90 (-61%)	-3.50 (-73%)	-2.74 (-59%)	-3.17 (-71%)
February 2003	21,852	-0.01 (-4%)	-0.07 (-41%)	-0.01 (-8%)	-0.07 (-44%)	-0.01 (-7%)	-0.07 (-43%)
March 2001	22,272	-0.08 (-23%)	-0.16 (-45%)	-0.05 (-15%)	-0.13 (-40%)	-0.08 (-22%)	-0.11 (-35%)
June 1993	22,451	-3.26 (-43%)	-4.25 (-56%)	-3.14 (-42%)	-4.13 (-56%)	-3.10 (-42%)	-4.48 (-58%)
March 1942	23,456	-0.16 (-47%)	-0.22 (-65%)	-0.17 (-49%)	-0.23 (-66%)	-0.15 (-46%)	-0.22 (-65%)
January 1966	24,810	0.00 (-20%)	0.00 (-67%)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)
April 1986	27,195	-2.64 (-75%)	-2.84 (-81%)	-2.54 (-74%)	-2.74 (-80%)	-2.41 (-73%)	-2.39 (-78%)
May 1963	30,035	-2.56 (-65%)	-2.83 (-72%)	-2.44 (-64%)	-2.71 (-71%)	-2.36 (-63%)	-2.48 (-69%)
March 1993	34,327	-1.81 (-55%)	-2.29 (-69%)	-1.65 (-52%)	-2.12 (-67%)	-1.39 (-48%)	-1.68 (-62%)
December 2002	35,239	-0.10 (-77%)	-0.08 (-66%)	-0.02 (-42%)	-0.01 (-14%)	-0.01 (-27%)	-0.01 (-23%)
June 1952	37,199	-3.53 (-48%)	-4.04 (-55%)	-3.54 (-48%)	-4.05 (-55%)	-3.60 (-49%)	-4.53 (-58%)
April 1996	45,853	-2.57 (-66%)	-2.88 (-75%)	-2.56 (-66%)	-2.88 (-75%)	-2.38 (-65%)	-2.36 (-71%)
May 1941	47,347	-2.26 (-68%)	-2.39 (-72%)	-2.15 (-67%)	-2.29 (-71%)	-2.08 (-66%)	-2.03 (-69%)
January 1971	47,872	-0.01 (-38%)	0.00 (-16%)	-0.01 (-43%)	-0.01 (-23%)	-0.01 (-37%)	0.01 (42%)
April 1927	52,656	-0.68 (-57%)	-0.80 (-67%)	-0.61 (-54%)	-0.73 (-65%)	-0.56 (-52%)	-0.51 (-56%)
February 1945	52,920	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1940	64,008	0.00 (-100%)	0.00 (-100%)	-0.01 (-100%)	-0.01 (-100%)	0.00 (0%)	0.00 (-100%)
Average		-1.66 (-46%)	-2.08 (-58%)	-1.61 (-46%)	-2.02 (-57%)	-1.54 (-45%)	-1.89 (-56%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

Table 5.B.6-267. Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1	EBC2	EBC2_ELT	EBC2_LLT	ESO_ELT	ESO_LLT
December 1923	4,500	0.4	0.5	0.4	0.5	0.4	0.3
June 1940	6,166	11.1	11.2	10.5	9.8	8.7	7.0
June 1934	7,100	10.7	10.3	9.9	9.9	6.7	5.3
April 1929	8,019	5.3	5.1	5.0	4.7	2.1	1.8
May 1966	9,759	7.6	7.6	7.4	7.5	4.7	4.1
February 1948	11,145	0.3	0.2	0.2	0.2	0.3	0.2
June 1978	12,346	8.7	8.6	9.2	9.1	6.4	5.1
April 1970	13,369	5.6	5.5	5.4	5.2	2.3	1.8
March 1961	13,725	0.2	0.1	0.2	0.1	0.1	0.1
May 1937	20,349	6.7	6.5	6.7	6.7	3.4	2.3
May 1935	20,628	4.6	4.7	4.5	4.3	1.9	1.3
February 2003	21,852	0.2	0.2	0.2	0.2	0.2	0.1
March 2001	22,272	0.4	0.3	0.4	0.3	0.3	0.2
June 1993	22,451	7.6	7.4	7.4	7.8	4.2	3.4
March 1942	23,456	0.4	0.4	0.4	0.4	0.2	0.1
January 1966	24,810	0.0	0.0	0.0	0.0	0.0	0.0
April 1986	27,195	3.4	3.3	3.1	2.9	0.9	0.7
May 1963	30,035	3.8	3.7	3.6	3.5	1.4	1.1
March 1993	34,327	3.2	3.0	2.8	2.6	1.5	1.1
December 2002	35,239	0.1	0.1	0.0	0.1	0.0	0.0
June 1952	37,199	7.2	7.1	7.2	7.8	3.7	3.3
April 1996	45,853	3.7	3.7	3.5	3.2	1.3	1.0
May 1941	47,347	3.2	3.1	3.0	2.8	1.0	0.9
January 1971	47,872	0.0	0.0	0.0	0.0	0.0	0.0
April 1927	52,656	1.2	1.1	1.1	0.9	0.5	0.4
February 1945	52,920	0.0	0.0	0.0	0.0	0.0	0.0
February 1940	64,008	0.0	0.0	0.0	0.0	0.0	0.0
Average		3.5	3.5	3.4	3.4	1.9	1.5

Table 5.B.6-268. Difference between Scenarios in Percentage of Particles Representing Longfin Smelt Larvae Entrained by Delta Agricultural Diversions for 30-Day DSM2-PTM Simulation, Drier Starting Distribution, Assuming 15% of Particles Start in the South Delta

Modeled Hydroperiod	Modeled Delta Outflow (cfs)	EBC1 vs. ESO_ELT	EBC1 vs. ESO_LLT	EBC2 vs. ESO_ELT	EBC2 vs. ESO_LLT	EBC2_ELT vs. ESO_ELT	EBC2_LLT vs. ESO_LLT
December 1923	4,500	-0.03 (-6%)	-0.14 (-32%)	-0.13 (-23%)	-0.24 (-44%)	-0.03 (-7%)	-0.16 (-35%)
June 1940	6,166	-2.37 (-21%)	-4.07 (-37%)	-2.47 (-22%)	-4.17 (-37%)	-1.84 (-17%)	-2.76 (-28%)
June 1934	7,100	-3.94 (-37%)	-5.32 (-50%)	-3.60 (-35%)	-4.98 (-48%)	-3.17 (-32%)	-4.53 (-46%)
April 1929	8,019	-3.16 (-60%)	-3.52 (-67%)	-2.99 (-59%)	-3.35 (-66%)	-2.86 (-57%)	-2.94 (-63%)
May 1966	9,759	-2.92 (-38%)	-3.49 (-46%)	-2.88 (-38%)	-3.45 (-46%)	-2.72 (-37%)	-3.41 (-45%)
February 1948	11,145	0.00 (-2%)	-0.08 (-26%)	0.08 (36%)	0.00 (2%)	0.12 (74%)	0.01 (6%)
June 1978	12,346	-2.23 (-26%)	-3.53 (-41%)	-2.19 (-25%)	-3.49 (-41%)	-2.74 (-30%)	-3.97 (-44%)
April 1970	13,369	-3.36 (-60%)	-3.85 (-68%)	-3.20 (-58%)	-3.70 (-67%)	-3.15 (-58%)	-3.46 (-66%)
March 1961	13,725	-0.06 (-30%)	-0.06 (-33%)	-0.01 (-10%)	-0.02 (-13%)	-0.03 (-19%)	0.00 (1%)
May 1937	20,349	-3.33 (-50%)	-4.38 (-66%)	-3.19 (-49%)	-4.24 (-65%)	-3.35 (-50%)	-4.44 (-66%)
May 1935	20,628	-2.74 (-59%)	-3.30 (-71%)	-2.76 (-59%)	-3.33 (-71%)	-2.59 (-58%)	-3.01 (-69%)
February 2003	21,852	0.00 (0%)	-0.06 (-33%)	-0.01 (-4%)	-0.06 (-35%)	0.00 (0%)	-0.06 (-33%)
March 2001	22,272	-0.08 (-21%)	-0.15 (-39%)	-0.04 (-12%)	-0.11 (-32%)	-0.08 (-21%)	-0.09 (-27%)
June 1993	22,451	-3.36 (-44%)	-4.19 (-55%)	-3.20 (-43%)	-4.03 (-54%)	-3.16 (-43%)	-4.40 (-57%)
March 1942	23,456	-0.17 (-48%)	-0.23 (-65%)	-0.18 (-49%)	-0.24 (-66%)	-0.17 (-48%)	-0.25 (-66%)
January 1966	24,810	0.00 (-44%)	0.00 (-77%)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)	0.00 (Inf.)
April 1986	27,195	-2.50 (-75%)	-2.68 (-80%)	-2.41 (-74%)	-2.59 (-79%)	-2.28 (-73%)	-2.26 (-77%)
May 1963	30,035	-2.42 (-64%)	-2.68 (-71%)	-2.29 (-63%)	-2.55 (-70%)	-2.24 (-62%)	-2.36 (-68%)
March 1993	34,327	-1.67 (-52%)	-2.14 (-67%)	-1.51 (-50%)	-1.98 (-65%)	-1.27 (-45%)	-1.56 (-60%)
December 2002	35,239	-0.10 (-74%)	-0.08 (-62%)	-0.02 (-34%)	0.00 (-3%)	-0.01 (-26%)	-0.01 (-18%)
June 1952	37,199	-3.47 (-49%)	-3.88 (-54%)	-3.47 (-49%)	-3.87 (-54%)	-3.56 (-49%)	-4.49 (-58%)
April 1996	45,853	-2.41 (-65%)	-2.72 (-73%)	-2.41 (-65%)	-2.72 (-73%)	-2.23 (-63%)	-2.23 (-69%)
May 1941	47,347	-2.14 (-68%)	-2.26 (-71%)	-2.04 (-67%)	-2.16 (-71%)	-1.98 (-66%)	-1.92 (-68%)
January 1971	47,872	-0.01 (-27%)	0.00 (-9%)	-0.01 (-35%)	-0.01 (-19%)	-0.01 (-26%)	0.01 (65%)
April 1927	52,656	-0.64 (-55%)	-0.75 (-65%)	-0.57 (-52%)	-0.68 (-63%)	-0.54 (-51%)	-0.48 (-54%)
February 1945	52,920	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)	0.00 (Inf.)	0.00 (0%)
February 1940	64,008	0.00 (-100%)	0.00 (-100%)	-0.01 (-100%)	-0.01 (-100%)	0.00 (0%)	0.00 (-100%)
Average		-1.60 (-45%)	-1.98 (-56%)	-1.54 (-44%)	-1.93 (-55%)	-1.48 (-43%)	-1.81 (-54%)

Note: Negative values indicate lower entrainment under ESO Scenarios; Inf. indicates that percentage change is infinity because denominator (EBC scenario) is zero.

5.B.6.4.3 All Covered Fish Species

5.B.6.4.3.1 Delta Regional Ecosystem Restoration Implementation Plan Analysis of Nonproject Diversions

As described above in Section 5.B.6.4.1.1, *Particle Tracking Modeling* (results for larval delta smelt), it is estimated that 4.2% of agricultural diversions in the Delta could be removed by habitat restoration within ROAs in the ELT and 12.4% in the LLT. Assuming all agricultural diversions in the Delta have a similar rate of water intake, approximately 4.2–12.4% less entrainment may occur for each covered species. It is not well known to what extent covered fish species are entrained in agricultural diversions but the available evidence suggests that it is not great (Cook and Buffaloe 1998; Nobriga et al. 2004). Therefore the 4.2–12.4% reduction in entrainment may be a reduction from an already small number. Removal of agricultural diversions (and other types of diversions such as for waterfowl rearing areas) in association with habitat restoration is one element included in *CM21 Nonproject Diversions*. The other elements include various remediation measures and are outlined in Chapter 3, Section 3.4, *Conservation Measures;* they include removal, consolidation, and relocation of diversions; screening of diversions (e.g., with positive barriers or behavioral devices as appropriate); and alteration of daily and seasonal timing of operations. The 2009 DRERIP evaluation of the then-proposed BDCP conservation measure of modification (e.g., screening) or elimination of nonproject diversions concluded that the potential positive outcomes from this measure would be increased food availability and reduced entrainment mortality. The analysis concluded that the measure generally would be, from a fish population–level perspective, of the lowest magnitude (score = 1) and have the lowest certainty (score = 1) of achieving the outcomes (Table 5.B.6-269) for all of the covered fish species (except Pacific and river lamprey, which were not analyzed but for which the results are assumed to be applicable). The only species/life stages for which this measure had a greater score than 1 were delta smelt larvae and juveniles (magnitude and certainty both equal to 2). The 2009 DRERIP evaluation focused on a then-proposed measure that was similar to the current CM21, wherein there would be selection of priority larger intakes for attention—the previous measure proposed >50 cfs and the current measure proposes >100 cfs, at least for initial work—and the 2009 evaluation therefore remains very applicable to the currently proposed measure. The DRERIP evaluation suggested that in general the population-level effect attributable to addressing nonproject diversions, including agricultural diversions, would be minimal. However, as Vogel (2011) notes, the benefits to covered species associated with removing water diversion structures may be manifested more in terms of reduction in predator holding/ambush habitat (as opposed to entrainment loss), a topic treated in Appendix 5.F, *Biological Stressors on Covered Fish*.

Table 5.B.6-269. Summary of 2009 DRERIP Evaluation of Positive Outcomes That Could Result from Modifying or Eliminating Nonproject Diversions in the Delta to Reduce the Entrainment of Covered Fish Species

Covered Species	Positive Outcomes Description	Magnitude*	Certainty*
Chinook salmon	Increased food availability	1	1
Chinook salmon—fry and juvenile	Reduced entrainment mortality by nonproject diversions	1	1
Delta smelt	Increased food availability	1	1
Delta smelt—larval and juvenile	Reduced entrainment mortality by nonproject diversions	2	2
Green sturgeon	Increased food availability	1	1
Green sturgeon—juvenile	Reduced entrainment mortality by nonproject diversions	1	1
Longfin smelt	Increased food availability	1	1
Longfin smelt—larval and juvenile	Reduced entrainment mortality by nonproject diversions	1	1
Splittail	Increased food availability	1	1
Splittail—juvenile	Reduced entrainment mortality by nonproject diversions	1	1
Steelhead	Increased food availability	1	1
Steelhead—fry and juvenile	Reduced entrainment mortality by nonproject diversions	1	1
White sturgeon	Increased food availability	1	1
White sturgeon—juvenile	Reduced entrainment mortality by nonproject diversions	1	1

Source: Cavallo et al. 2009.
*Note: *Magnitude* assesses the size or level of the outcome, either positive or negative, in terms of population or habitat effects on a given species. *Certainty* describes the likelihood that a given restoration action will achieve a certain outcome. Both are ranked on a scale from 1 (lowest) to 4 (highest).

5.B.6.5 Potential Entrainment Differences Between Evaluated Starting Operations (ESO), High-Outflow Scenario (HOS), and Low-Outflow Scenario (LOS)

In general, most covered fish species occur within the Plan Area during winter-spring and, therefore, there would be little difference in south Delta entrainment between ESO and LOS scenarios based on the similarity of south Delta export pumping for these scenarios. Lower south Delta export pumping during the spring under the HOS would result in lower entrainment of species occurring during this period.

5.B.6.5.1 Late Fall-Run Chinook Salmon (Juvenile—SWP/CVP South Delta Export Facilities: Salvage-Density Method)

The average annual entrainment index of juvenile late fall-run Chinook salmon at the SWP/CVP south Delta export facilities estimated with the salvage-density method was around 1,900 fish for EBC2 scenarios; 1,250 fish for HOS scenarios; and 1,200–1,300 fish for LOS scenarios (Table 5.B.6-270). The ESO scenarios had similar entrainment indices to the HOS and LOS scenarios (see Table 5.B.6-80), so that average entrainment indices for the ESO, HOS, and LOS scenarios were all around 33% less than EBC scenarios.

Table 5.B.6-270. Estimated Mean Monthly Entrainment Index (Number of Fish Lost with 95% Confidence Interval [CI], Based on Normalized Salvage Data) of Juvenile Late Fall–Run Chinook Salmon for Existing Biological Conditions (EBC2_ELT and EBC2_LLT), High-Outflow (HOS_ELT and HOS_LLT), and Low-Outflow (LOS_ELT and LOS_LLT) Scenarios at the SWP and CVP Salvage Facilities for All Water Years

	EBC2_ELT			EBC2_LLT			HOS_ELT			HOS_LLT			LOS_ELT			LOS_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	10	±	2	8	±	1	4	±	1	4	±	1	5	±	1	5	±	1
November	17	±	3	17	±	3	9	±	2	9	±	2	16	±	3	15	±	3
December	82	±	7	80	±	7	60	±	5	59	±	5	61	±	5	61	±	5
January	619	±	128	610	±	126	314	±	70	326	±	71	329	±	73	297	±	64
February	161	±	33	150	±	31	74	±	16	66	±	15	74	±	16	73	±	16
March	1	±	0	1	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	0	±	0	0	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	4	±	1	4	±	1	2	±	0	2	±	0	2	±	1	2	±	0
September	3	±	1	3	±	1	1	±	0	1	±	0	2	±	0	2	±	0
Annual Average	899	±	158	875	±	153	463	±	80	466	±	81	490	±	84	457	±	76
(b) CVP																		
October	1	±	0	1	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	12	±	2	11	±	1	6	±	1	5	±	1	9	±	1	8	±	1
December	719	±	148	653	±	139	624	±	130	590	±	125	630	±	132	556	±	122
January	149	±	30	143	±	29	91	±	20	87	±	20	76	±	17	95	±	21
February	12	±	2	12	±	3	6	±	2	7	±	2	6	±	1	6	±	1
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	77	±	18	78	±	18	43	±	11	36	±	10	61	±	14	57	±	13
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	82	±	19	74	±	17	36	±	9	24	±	7	48	±	11	39	±	9
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	1,052	±	212	974	±	200	807	±	165	750	±	155	829	±	169	762	±	158

5.B.6.5.2 Delta Smelt (SWP/CVP South Delta Export Facilities: Proportional Entrainment Loss Regressions)

Estimates of average annual larval/juvenile delta smelt loss during March–June were similar for ESO and LOS scenarios (Figure 5.B.6-51) and, therefore, estimates of total delta smelt population loss for these scenarios were little different (Figure 5.B.6-52) because OMR flows in December–March (the adult entrainment period) do not appreciably differ between these scenarios. Average annual larval/juvenile proportional entrainment loss under HOS scenarios was 0.11–0.12 across all water years, or 0.02 less than ESO and LOS scenarios. The relative differences between HOS and ESO/LOS scenarios were greatest in wetter water years (Figure 5.B.6-51 and Figure 5.B.6-52). Total population proportional entrainment averaged across all water years was 0.17–0.18 under HOS_ELT and HOS_LLT scenarios compared with 0.19–0.20 under LOS_ELT, LOS_LLT, ESO_ELT, and ESO_LLT scenarios, and 0.21–0.22 for EBC2_ELT and EBC2_LLT scenarios (Figure 5.B.6-22). This represented around 20% lower average entrainment loss under HOS_ELT and HOS_LLT scenarios than under EBC2_ELT and EBC2_LLT scenarios, reflecting lower X2 (higher outflow) under HOS scenarios.

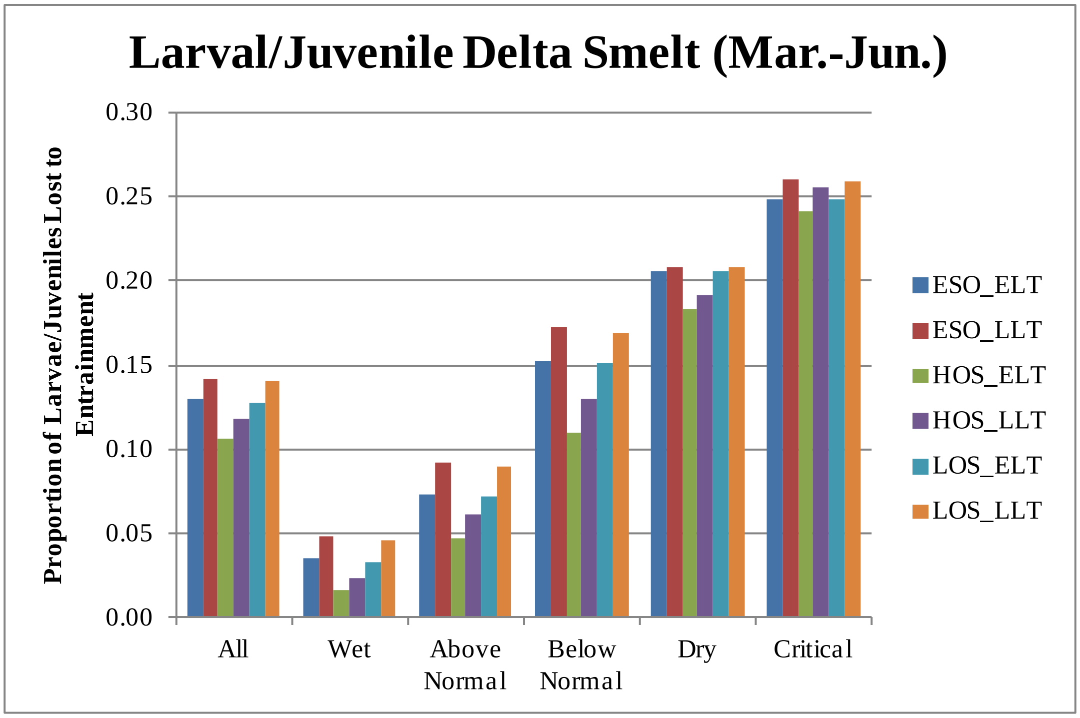


Figure 5.B.6-51. Average Annual Estimated Proportion of the Larval/Juvenile Delta Smelt Population Lost to Entrainment at the SWP/CVP South Delta Export Facilities by Water-Year Type and All Years Combined for the ESO, HOS, and LOS Scenarios, Based on the Proportional Entrainment Regression

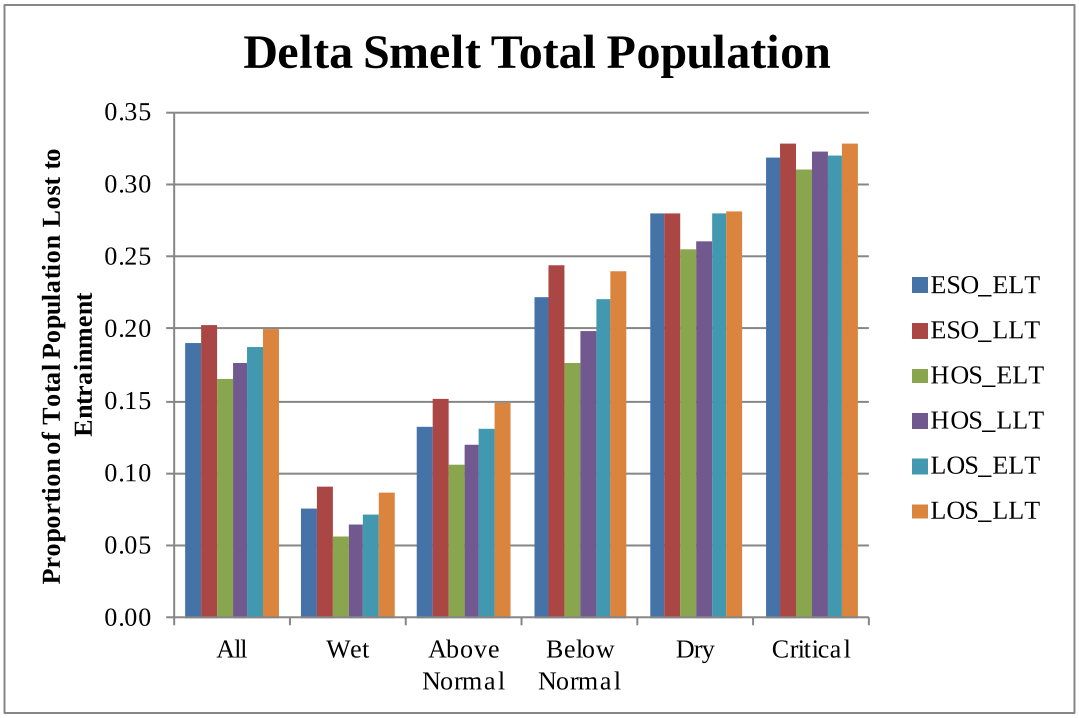


Figure 5.B.6-52. Average Annual Estimated Proportion of the Total Delta Smelt Population Lost to Entrainment at the SWP/CVP South Delta Export Facilities by Water-Year Type and All Years Combined for the Study Scenarios, Based on the Proportional Entrainment Regressions for Larvae/Juveniles and Adults

5.B.6.5.3 White Sturgeon (Juvenile—SWP/CVP South Delta Export Facilities: Salvage-Density Method)

The average annual entrainment index of juvenile white sturgeon at the SWP/CVP south Delta export facilities estimated with the salvage-density method for wet and above-normal years was around 240–260 fish for EBC2 scenarios; 100 fish for HOS scenarios; and 140 fish for LOS scenarios (Table 5.B.6-271). ESO scenarios had similar entrainment to HOS scenarios at just more than 100 fish per year (see Table 5.B.6-201). Thus, in wet and above normal years, average entrainment indices under ESO and HOS scenarios were around 60% less than EBC2 scenarios, whereas LOS scenarios were around 40% less than EBC2 scenarios. For below-normal, dry, and critical years, average entrainment indices were 33–35 fish for EBC2 scenarios; 22–24 fish for HOS scenarios; and 26–28 fish for LOS scenarios (Table 5.B.6-272); ESO scenarios had average entrainment indices of 25–26 fish (see Table 5.B.6-203). Therefore, average entrainment indices under LOS, ESO, and HOS scenarios were around 20%, 25%, and 30% less than average entrainment indices under EBC2 scenarios.

Table 5.B.6-271. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification) for Existing Biological Conditions (EBC2_ELT and EBC2_LLT), High-Outflow (HOS_ELT and HOS_LLT), and Low-Outflow (LOS_ELT and LOS_LLT) Scenarios

	EBC2_ELT			**EBC2_LLT**			**HOS_ELT**			**HOS_LLT**			**LOS_ELT**			**LOS_LLT**		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	14	±	4	11	±	3	5	±	1	4	±	1	6	±	1	6	±	1
November	24	±	5	23	±	5	10	±	3	9	±	3	18	±	4	17	±	3
December	17	±	2	17	±	3	11	±	2	12	±	2	11	±	2	11	±	2
January	19	±	6	18	±	5	8	±	3	8	±	3	9	±	3	7	±	2
February	23	±	6	22	±	6	7	±	2	6	±	2	7	±	2	7	±	2
March	7	±	1	7	±	1	1	±	0	1	±	0	1	±	0	2	±	0
April	1	±	0	1	±	0	0	±	0	0	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	5	±	1	4	±	1	1	±	0	1	±	0	2	±	0	2	±	0
July	8	±	1	8	±	1	5	±	1	4	±	1	6	±	1	6	±	1
August	12	±	2	12	±	2	4	±	1	4	±	1	5	±	1	5	±	1
September	11	±	2	10	±	2	0	±	0	0	±	0	6	±	1	6	±	2
Annual Average	141	±	16	133	±	15	54	±	7	50	±	6	71	±	8	70	±	8
(b) CVP																		
October	31	±	5	27	±	5	11	±	2	9	±	2	13	±	2	14	±	2
November	24	±	4	23	±	4	9	±	2	9	±	2	15	±	3	16	±	3
December	7	±	2	7	±	2	6	±	1	6	±	1	6	±	1	5	±	1
January	4	±	1	4	±	1	2	±	1	2	±	1	2	±	0	3	±	1
February	3	±	1	3	±	1	1	±	0	1	±	0	1	±	0	1	±	0
March	7	±	2	7	±	2	1	±	1	1	±	1	1	±	0	1	±	1
April	3	±	1	3	±	1	1	±	0	1	±	0	2	±	0	2	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	5	±	1	4	±	1	2	±	0	1	±	0	2	±	0	2	±	0
July	10	±	2	8	±	1	8	±	1	8	±	1	9	±	2	9	±	1
August	8	±	1	8	±	1	6	±	1	6	±	1	5	±	1	6	±	1
September	15	±	3	14	±	3	0	±	0	1	±	1	10	±	2	9	±	2
Annual Average	118	±	15	109	±	14	48	±	7	45	±	7	67	±	67	66	±	9

Table 5.B.6-272. Estimated Juvenile White Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification) for Existing Biological Conditions (EBC2_ELT and EBC2_LLT), High-Outflow (HOS_ELT and HOS_LLT), and Low-Outflow (LOS_ELT and LOS_LLT) Scenarios

	EBC2_ELT			EBC2_LLT			HOS_ELT			HOS_LLT			LOS_ELT			LOS_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	2	±	0	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0
November	2	±	0	2	±	0	1	±	0	2	±	0	3	±	0	3	±	0
December	6	±	1	5	±	1	4	±	1	4	±	1	5	±	1	5	±	1
January	1	±	0	1	±	0	0	±	0	1	±	0	0	±	0	0	±	0
February	2	±	0	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0
March	1	±	0	1	±	0	0	±	0	0	±	0	1	±	0	1	±	0
April	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0	1	±	0
May	2	±	0	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	4	±	1	4	±	1	3	±	1	3	±	1	3	±	1	3	±	1
September	2	±	1	2	±	1	1	±	0	1	±	0	1	±	0	1	±	0
Annual Average	23	±	3	22	±	2	14	±	2	14	±	2	18	±	2	17	±	2
(b) CVP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	3	±	1	3	±	1	2	±	0	2	±	0	2	±	0	2	±	0
March	2	±	1	2	±	1	1	±	0	1	±	0	2	±	1	2	±	1
April	2	±	0	2	±	0	1	±	0	1	±	0	2	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	3	±	1	3	±	1	3	±	1	2	±	1	3	±	1	2	±	1
August	2	±	1	2	±	0	2	±	1	2	±	1	1	±	0	1	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	12	±	2	12	±	2	9	±	1	8	±	1	10	±	2	9	±	1

5.B.6.5.4 Green Sturgeon (Juvenile—SWP/CVP South Delta Export Facilities: Salvage-Density Method)

The average annual entrainment index of juvenile green sturgeon at the SWP/CVP south Delta export facilities estimated with the salvage-density method for wet and above-normal years was around 105–110 fish for EBC2 scenarios; 40 fish for HOS scenarios; and 55 fish for LOS scenarios (Table 5.B.6-273). ESO scenarios had similar entrainment to HOS and LOS scenarios at around 45–50 fish per year (see Table 5.B.6-209). Thus, in wet and above normal years, average entrainment indices under HOS scenarios were more than 60% less than EBC2 scenarios, whereas ESO and LOS scenarios were around 50–55% less than EBC2 scenarios. For below-normal, dry, and critical years, average entrainment indices were 41–46 fish for EBC2 scenarios; 25–27 fish for HOS scenarios; and 31–33 fish for LOS scenarios (Table 5.B.6-274); ESO scenarios had average entrainment indices of 27–28 fish (see Table 5.B.6-211). Therefore, average entrainment indices under LOS, ESO, and HOS scenarios were around 25%, 37%, and 40% less than average entrainment indices under EBC2 scenarios.

Table 5.B.6-273. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Wet and Above-Normal Years (Sacramento Valley Water Year–Type Classification) for Existing Biological Conditions (EBC2_ELT and EBC2_LLT), High-Outflow (HOS_ELT and HOS_LLT), and Low-Outflow (LOS_ELT and LOS_LLT) Scenarios

	EBC2_ELT			EBC2_LLT			HOS_ELT			HOS_LLT			LOS_ELT			LOS_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	2	±	1	2	±	1	1	±	0	1	±	0	1	±	0	1	±	0
November	3	±	1	3	±	1	1	±	1	1	±	0	2	±	1	2	±	1
December	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
January	2	±	0	2	±	0	1	±	0	1	±	0	1	±	0	1	±	0
February	28	±	8	26	±	8	8	±	3	7	±	3	8	±	3	9	±	3
March	2	±	1	2	±	1	0	±	0	0	±	0	0	±	0	0	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	1	±	0	1	±	0	0	±	0	0	±	0	1	±	0	1	±	0
July	2	±	0	2	±	0	1	±	0	1	±	0	2	±	0	2	±	0
August	20	±	6	20	±	6	7	±	3	6	±	2	9	±	3	8	±	3
September	10	±	1	9	±	1	0	±	0	0	±	0	5	±	1	6	±	1
Annual Average	70	±	9	67	±	9	20	±	4	18	±	3	29	±	5	29	±	4
(b) CVP																		
October	4	±	1	4	±	1	2	±	0	1	±	0	2	±	0	2	±	0
November	3	±	1	3	±	1	1	±	0	1	±	0	2	±	1	2	±	1
December	6	±	2	5	±	2	5	±	1	5	±	1	5	±	1	4	±	1
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	3	±	1	2	±	1	1	±	0	1	±	0	1	±	0	1	±	0
June	3	±	1	3	±	1	1	±	0	1	±	0	2	±	0	1	±	0
July	11	±	3	9	±	3	9	±	3	8	±	3	10	±	3	10	±	3
August	3	±	1	3	±	1	2	±	1	3	±	1	2	±	1	2	±	1
September	7	±	1	6	±	1	0	±	0	0	±	0	4	±	1	4	±	1
Annual Average	41	±	6	37	±	5	22	±	4	20	±	4	28	±	28	26	±	4

Table 5.B.6-274. Estimated Juvenile Green Sturgeon Entrainment Index (Number of Fish as Expanded Salvage ± 95% Confidence Intervals [CI]) at the SWP and CVP Salvage Facilities during Below-Normal, Dry, and Critical Years (Sacramento Valley Water Year–Type Classification) for Existing Biological Conditions (EBC2_ELT and EBC2_LLT), High-Outflow (HOS_ELT and HOS_LLT), and Low-Outflow (LOS_ELT and LOS_LLT) Scenarios

	EBC2_ELT			EBC2_LLT			HOS_ELT			HOS_LLT			LOS_ELT			LOS_LLT		
Month	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**	**Avg**	**±**	**95% CI**
(a) SWP																		
October	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
November	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
December	10	±	2	10	±	2	8	±	2	8	±	1	9	±	2	9	±	2
January	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	2	±	0	2	±	0	1	±	0	1	±	0	2	±	0	2	±	0
April	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	13	±	2	12	±	2	9	±	2	9	±	2	11	±	2	11	±	2
(b) CVP																		
October	10	±	2	9	±	2	4	±	1	3	±	1	5	±	1	4	±	1
November	14	±	4	13	±	4	8	±	3	6	±	2	11	±	3	10	±	3
December	5	±	1	4	±	1	4	±	1	4	±	1	4	±	1	4	±	1
January	2	±	0	2	±	0	2	±	0	1	±	0	2	±	0	2	±	0
February	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
March	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
April	1	±	0	1	±	0	1	±	0	0	±	0	1	±	0	1	±	0
May	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
June	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
July	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
August	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
September	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0	0	±	0
Annual Average	33	±	7	29	±	6	18	±	4	15	±	3	22	±	5	20	±	4

5.B.7 Summary and Conclusions for Effects on Entrainment

Table 5.B.7-1 summarizes the results of the numerous analyses of the effects of the BDCP on entrainment in the Plan Area by species and life stage. General conclusions related to this table are presented in the conclusion statements following the table. Within the table, effects are summarized for each of the major sources of entrainment. Effects of the SWP/CVP south Delta export facilities generally are separated by each of five water-year types when possible (wet, above-normal, below-normal, dry, and critical). Estimated effects of entrainment at most of the other sources are not differentiated by water-year type. For analyses based on limited water years (e.g., analyses using DSM2 modeled flows), summaries were calculated only for all water years. The color coding in the table is based on consideration of the percentage change betweenEBC2_ELT and ESO_ELT and between EBC2_LLT and ESO_LLT, with estimated percentage values shown in text. Table 5.B.7-1 focuses on the ESO_ELT vs. EBC2_ELT and ESO_LLT vs. EBC2_LLT comparisons to account for climate change effects and to provide a concise summary. As with all such analyses, caution should be applied when interpreting absolute differences (e.g., numbers of fish) and more emphasis should be put on relative differences between scenarios.

Table 5.B.7-1. Summary of Effects of the BDCP on Entrainment of Covered Fish Species

Species	Life Stage	Method (Document Section for Detailed Results)/Metric	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)												SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake		Agricultural Diversions	
			All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results	Method (Document Section for Detailed Results)/Metric	Results
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT						
Steelhead	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream of Plan Area																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.1.1)/ Number of fish (% change)	-4,810 (-52%)	-4,506 (-51%)	-4,443 (-68%)	-4,271 (-68%)	-7,752 (-58%)	-7,389 (-55%)	-4,674 (-39%)	-3,683 (-33%)	-1,517 (-21%)	-1,591 (-23%)	-917 (-16%)	-858 (-16%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Winter-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.2.1)/ Number of fish (% change)	-3,773 (-54%)	-3,524 (-52%)	-8,670 (-72%)	-8,237 (-70%)	-4,396 (-65%)	-4,043 (-60%)	-3,230 (-44%)	-2,241 (-33%)	-793 (-22%)	-809 (-23%)	-170 (-14%)	-205 (-18%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Smolts only	DPM (5.B.6.1.2.2)/ % of smolts (% change)	-0.033 (-62%)	-0.031 (-63%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Spring-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.3.1)/ Number of fish (% change)	-14,788 (-38%)	-15,755 (-40%)	-57,967 (-63%)	-58,340 (-63%)	-8,520 (-31%)	-10,644 (-36%)	-1,669 (-25%)	-1,579 (-22%)	74 (0%)	-1,960 (-11%)	-1,916 (-17%)	-1,316 (-13%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
	Smolts only	DPM (5.B.6.1.3.2)/ % of smolts (% change)	-0.012 (-55%)	-0.012 (-58%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Fall-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																		
	Fry	Occur upstream or otherwise included under analysis of juveniles																		
	Juvenile	Salvage-density method, normalized (5.B.6.1.4.1)/ Number of fish (% change)	-23,707 (-42%)	-24,016 (-44%)	-85,155 (-64%)	-80,786 (-63%)	-14,279 (-42%)	-13,962 (-42%)	-3,951 (-29%)	-3,864 (-28%)	-760 (-4%)	-3,538 (-17%)	-11,208 (-29%)	-7,626 (-21%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (both qualitative scores = 1 out of 4)
	Smolts only (Sacramento River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.008 (-45%)	-0.008 (-47%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given															
	Smolts only (San Joaquin River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.108 (-22%)	-0.104 (-22%)											Unlikely to encounter these intakes		Unlikely to encounter these intakes			
	Smolts only (Mokelumne River)	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.017 (-13%)*	-0.007 (-6%)*											Unlikely to encounter these intakes		Unlikely to encounter these intakes			
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Species	Life Stage	Method (Document Section for Detailed Results)/Metric	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years): All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		SWP/CVP North Delta Intakes: Method (Document Section for Detailed Results)	SWP/CVP North Delta Intakes: Results	SWP NBA Barker Slough Pumping Plant and Alternative Intake: Method (Document Section for Detailed Results)/Metric	SWP NBA Barker Slough Pumping Plant and Alternative Intake: Results		Agricultural Diversions: Method (Document Section for Detailed Results)/Metric	Agricultural Diversions: Results	
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT								
Late fall-run Chinook salmon	Egg/ Alevin	Occur upstream of Plan Area																				
	Fry	Occur upstream or otherwise included under analysis of juveniles																				
	Juvenile	Salvage-density method, normalized (5.B.6.1.4.1)/ Number of fish (% change)	-643 (-33%)	-627 (-34%)	-2,895 (-47%)	-2,714 (-46%)	-223 (-39%)	-245 (-44%)	-26 (-45%)	-18 (-34%)	-30 (-23%)	-29 (-24%)	-25 (-16%)	-38 (-25%)	i) screening effectiveness analysis, ii) screen passage time (5.B.6.2.1)	i) Nearly 100% screened; ii) screen passage time lower with higher sweeping velocity, shorter screen, and smaller fish	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (both qualitative scores = 1 out of 4)	
	Smolts only	DPM (5.B.6.1.4.2)/ % of smolts (% change)	-0.052 (-63%)	-0.046 (-64%)	Only 16 years available from DSM2 simulation, therefore only all-water year summary is given																	
	Adult	Large body size/strong swimming ability make entrainment very unlikely																				
Delta smelt	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																				
	Larva	Proportional entrainment regression (5.B.6.1.5.1)/ Proportion of population (% change)	-0.004 (-3%)	-0.005 (-3%)	-0.011 (-23%)	-0.016 (-24%)	-0.017 (-19%)	-0.018 (-16%)	0.001 (1%)	0.003 (1%)	0.006 (3%)	0.004 (2%)	0.003 (1%)	0.011 (4%)	i) screening effectiveness analysis, ii) PTM (5.B.6.2.2.2)	i) 100% screened at >~22 mm, ii) entrainment occurs in proportion to flow diverted, but the great majority of larvae would be downstream of the intake and not susceptible to entrainment	PTM (5.B.6.3.1) /Percent of particles (% change)	**ESO_ELT vs. EBC2_ELT** 30 days: -1.08 (-61%); 60 days: -0.99 (-53%)	**ESO_LLT vs. EBC2_LLT** 30 days: -0.81 (-47%); 60 days: -0.46 (-25%)	PTM (5.B.6.4.1) /Percent of particles (% change)	**ESO_ELT vs. EBC2_ELT** 30 days: -0.13 (-5%); 60 days: -0.13 (-3%)	**ESO_LLT vs. EBC2_LLT** 30 days: -0.13 (-5%); 60 days: -0.31 (-8%)
	Juvenile																			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Second lowest magnitude of positive population-level effect and certainty (both qualitative scores = 2 out of 4)	
	Adult	Proportional entrainment regression (5.B.6.1.5.2)/ Proportion of population (% change)	-0.016 (-21%)	-0.015 (-20%)	-0.029 (-42%)	-0.027 (-39%)	-0.021 (-26%)	-0.020 (-25%)	-0.011 (-14%)	-0.008 (-10%)	-0.008 (-9%)	-0.008 (-10%)	-0.002 (-2%)	-0.001 (-2%)	Impingement and screen contact (5.B.6.2.2.3)	Potential for screen contact-related mortality increases with increasing approach and sweeping velocity, by night, and with longer screens	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude smelt >15 mm based on north Delta intakes analysis			NA		
Longfin smelt	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																				
	Larva	PTM (5.B.6.1.6.1) / Percent of particles (% change) Wetter starting distribution	30 days: -0.20 (-22%); 60 days: -0.16 (-11%)	30 days: -0.43 (-49%); 60 days: -0.45 (-31%)	Relatively few months run in DSM2, so results are presented as averages over all years										i) screening effectiveness analysis, ii) PTM (5.B.6.2.3.2)	i) 100% screened at >~22 mm, ii) entrainment occurs in proportion to flow diverted but the great majority of larvae would be downstream of the intake and not susceptible to entrainment	PTM (5.B.6.3.2) /Percent of particles (% change) Wetter starting distribution	**ESO_ELT vs. EBC2_ELT** 30 days: 0.04 (63%); 60 days: 0.08 (81%)	**ESO_LLT vs. EBC2_LLT** 30 days: 0.00 (4%); 60 days: 0.01 (10%)	PTM (5.B.6.4.2) /Percent of particles (% change) Wetter starting distribution	**ESO_ELT vs. EBC2_ELT** 30 days: -1.86 (-49%); 60 days: -3.02 (-56%)	**ESO_LLT vs. EBC2_LLT** 30 days: -2.30 (-63%); 60 days: -3.53 (-66%)
		Drier starting distribution	30 days: -0.27 (-25%); 60 days: -0.32 (-17%)	30 days: -0.48 (-46%); 60 days: -0.50 (-28%)													Drier starting distribution	30 days: 0.08 (64%); 60 days: 0.14 (81%)	30 days: 0.01 (16%); 60 days: 0.04 (31%)	Drier starting distribution	30 days: -1.70 (-47%); 60 days: -2.75 (-53%)	30 days: -2.09 (-59%); 60 days: -3.18 (-62%)
	Juvenile	Salvage-density method (5.B.6.1.6.2)/ Number of fish (% change)	-108,770 (-37%)	-122,883 (-42%)	-37,987 (-56%)	-39,655 (-57%)	-1,062 (-22%)	-1,343 (-28%)	-484 (-16%)	-779 (-24%)	-38,267 (-7%)	-123,418 (-21%)	-173,992 (-32%)	-125,616 (-25%)	Impingement and screen contact	Possibly similar to delta smelt (see above)	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)	

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Species	Life Stage	Method (Document Section for Detailed Results)/Metric	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)												SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake		Agricultural Diversions	
			All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results	Method (Document Section for Detailed Results)/Metric	Results
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT						
	Adult	Salvage-density method (5.B.6.1.6.3)/ Number of fish (% change)	-1,924 (-52%)	-1,849 (-52%)	-78 (-58%)	-71 (-53%)	-302 (-43%)	-342 (-50%)	-907 (-45%)	-650 (-35%)	-336 (-28%)	-299 (-26%)	-3,991 (-18%)	-5,847 (-26%)	(5.B.6.2.3.3)		of 1.75-m mesh and therefore exclude smelt >15 mm based on north Delta intakes analysis		NA	
Sacramento splittail	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																		
	Larva	NA	NA		NA		NA		NA		NA		NA		Screening effectiveness analysis (5.B.6.2.4.1)	100% screened at >~22 mm	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude splittail >10 mm based on north Delta intakes analysis		NA	
	Juvenile	Per capita–based salvage-density method (5.B.6.1.7.1)/ Number of fish (% change)	-180,131 (-37%)	-168,940 (-38%)	-928,107 (-49%)	-774,445 (-46%)	-42,648 (-35%)	-43,187 (-38%)	-1,202 (-13%)	-2,166 (-22%)	-306 (-18%)	-401 (-26%)	-456 (-39%)	-369 (-34%)	Impingement and screen contact (5.B.6.2.4.2)	Number of screen contacts increases at night, with lower sweeping velocity, with lower approach velocity, and with larger fish size (during the day)			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
		Yolo Bypass inundation-based salvage density method (5.B.6.1.7.1)/ Number of fish (% change)[1]	1,901,912 (485%)	1,424,440 (385%)	5,589,647 (461%)	4,161,915 (363%)	853,965 (1,962%)	699,135 (1,881%)	22,475 (667%)	12,338 (413%)	3,540 (133%)	4 (70%)	-4 (0%)	3 (0%)						
	Adult	Salvage density method (5.B.6.1.7.2)/ Number of fish (% change)	-1,916 (-54%)	-1,765 (-52%)	-2,986 (-72%)	-2,857 (-70%)	-3,258 (-68%)	-3,024 (-63%)	-1,344 (-40%)	-1,011 (-32%)	-616 (-26%)	-625 (-27%)	-494 (-15%)	-512 (-16%)	NA				NA	
White sturgeon	Egg/ Embryo	Adhere to substrates and therefore minimally subject to entrainment																		
	Larva	Uncertain as to what extent entrainment occurs because most of the larval population is upstream of the south Delta export facilities													Screening effectiveness analysis (5.B.6.2.5.1)	100% screened at >10 mm	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4); Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude sturgeon >10 mm based on north Delta intakes analysis		NA	
	Juvenile	Salvage-density method (5.B.6.1.8.1) / Number of fish [2] (% change) Sacramento Valley WY classification	NA		-150 (-58%)	-139 (-58%)	-150 (-58%)	-139 (-58%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	-9 (-26%)	Impingement and screen contact (5.B.6.2.6.2)	Possibly similar to green sturgeon (see below)			DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
		San Joaquin Valley WY classification			-161 (-55%)	-148 (-54%)	-161 (-55%)	-148 (-54%)	-9 (-26%)	-8 (-25%)	-9 (-26%)	-8 (-25%)	-9 (-26%)	-8 (-25%)						
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Green sturgeon	Egg/ Embryo	Occur upstream of Plan Area																		
	Larva	Occur upstream of Plan Area																		
	Juvenile	Salvage-density method (5.B.6.1.9.1) / Number of fish [2] (% change) Sacramento Valley WY classification	NA		-62 (-56%)	-59 (-57%)	-62 (-56%)	-59 (-57%)	-17 (-37%)	-15 (-37%)	-17 (-37%)	-15 (-37%)	-17 (-37%)	-15 (-37%)	i) Screening effectiveness analysis (5.B.6.2.6.1), ii) impingement and screen contact (5.B.6.2.6.2)	i) 100% screened, ii) water column position and lab studies suggest little potential for adverse effects, but uncertain	Not explicitly analyzed, but would be expected to be 100% screened based on typical fish size and mesh size at Barker Slough Pumping Plant and Alternative Intake		DRERIP 2009 evaluation of Nonproject Diversions (5.B.6.4.3.1)	Lowest magnitude of positive population-level effect and certainty (qualitative scores = 1 out of 4)
		San Joaquin Valley WY classification			-68 (-54%)	-65 (-56%)	-68 (-54%)	-65 (-56%)	-16 (-41%)	-15 (-41%)	-16 (-41%)	-15 (-41%)	-16 (-41%)	-15 (-41%)						
	Adult	Large body size/strong swimming ability make entrainment very unlikely																		
Pacific lamprey and river lamprey	Egg/ Embryo	Occur upstream of Plan Area																		
	Ammocoete	Generally buried in the substrate upstream of the Plan Area but may be subject to entrainment if washed out of natal streams into the Plan Area (before burying into Plan Area substrates)													Screening effectiveness analysis (5.B.6.2.7.1)	Susceptible to entrainment at less than 50–60-mm total length	No explicit analysis but Barker Slough Pumping Plant is screened for fish >25 mm (Section 5.B.3.4), although lamprey would be longer than this because of body shape; Alternative Intake presumably would have screens of 1.75-m mesh and therefore exclude lamprey >50–60-mm total		Not explicitly analyzed, but presumably some minor benefit as suggested for other species from DRERIP evaluation (see above)	
	Macro-pthalmia	Salvage-density method (5.B.6.1.10.1)/Number of	-1,504 (-45%)	-1,356 (-41%)	NA										Impingement and screen	Possibly little potential for adverse				

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

Species	Life Stage	Method (Document Section for Detailed Results)/Metric	SWP/CVP South Delta Export Facilities by Water-Year Type (% of Years)												SWP/CVP North Delta Intakes		SWP NBA Barker Slough Pumping Plant and Alternative Intake		Agricultural Diversions	
			All		Wet (31%)		Above Normal (15%)		Below Normal (17%)		Dry (22%)		Critical (15%)		Method (Document Section for Detailed Results)	Results	Method (Document Section for Detailed Results)/Metric	Results	Method (Document Section for Detailed Results)/Metric	Results
			ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT	ESO_ELT vs. EBC2_ELT	ESO_LLT vs. EBC2_LLT						
	Adult	fish[3] (% change)	🟦	🟦											contact (5.B.6.2.7.2)	effect, but uncertain	length based on north Delta intakes analysis			

Note: Quantitative results are presented as mean or median (for skewed data, indicated with an asterisk *) difference between ESO_ELT and EBC2_ELT and between ESO_LLT and EBC2_LLT. See Table 5.B.0-1 for a description of these modeled scenarios. Negative values indicate lower entrainment under under ESO scenarios relative to EBC2 scenarios. Percentage difference between scenarios is color-coded as shown below.

75% or more	50 to 75%	25 to 50%	5 to 25%	-5 to 5%	-5 to -25%	-25 to -50%	-50 to -75%	-75% or more

CVP = Central Valley Project.
DPM = Delta Passage Model
NBA = North Bay Aqueduct.
NA = Not Analyzed.
PTM = Particle Tracking Model.
SWP = State Water Project.

[1] Anomalously greater salvage estimates under ESO scenarios relative to EBC scenarios because of estimated increase in overall population size caused by enhanced Yolo Bypass inundation under *CM2 Yolo Bypass Fisheries Enhancement.*

[2] Analysis was divided into wetter (wet and above-normal) and drier (below-normal, dry, and critical) water years. Results are shown for each water-year type separately, but were calculated together. Upper row and lower rows show results for Sacramento and San Joaquin Valley water-year types, respectively.

[3] Analysis included Pacific lamprey and river lamprey combined because taxa are not identified to species.

The BDCP would substantially change the amount and pattern of water exports from the south Delta SWP/CVP facilities, which generally would be expected to lower the number of fish of all species entrained relative to existing biological conditions.

Across the five water-year types, exports from the south Delta were modeled to change from 100% of total exports under the existing biological conditions to an average of 55–56% under the evaluated starting operations. The proportion of total exports from the south Delta facilities under the BDCP was lowest in wet water years (36–37%) and highest in critical water years (80–81%). In general, the BDCP evaluated starting operations had similar or greater average total exports compared to baseline during most months of most water-year types, reflecting the use of the north and south Delta intakes; however, in some months total exports were lower than under baseline conditions (e.g., August–November in wet and above-normal years). Average exports from the south Delta facilities generally were appreciably lower under the evaluated starting operations than baseline conditions and the differences decreased as the water-year type became drier. The smallest average differences in south Delta exports between evaluated starting operations scenarios and baseline scenarios generally were in April and May. With evaluated starting operations, total exports from combined north and south Delta intakes would be greater in future conditions without the BDCP to the existing biological conditions in wet, above-normal, and below-normal water years. Under dry and critical water years, total exports would be quite similar between the evaluated starting operations and existing biological conditions. Nonetheless, overall the evaluated starting operations will substantially reduce exports from the south Delta export facilities in most months relative to the existing biological conditions. Entrainment in the south Delta is expected to be reduced most in wetter years because there would be fewer restrictions from bypass flows and a greater percentage of flow will be diverted from the north Delta in wetter years than in drier years.

Entrainment of salmonids at the south Delta export facilities is projected to be lower under evaluated starting operations relative to existing biological conditions, with differences between water-year types.

Consistent with the general pattern of decreased south Delta exports under the evaluated starting operations reducing entrainment relative to existing biological conditions, entrainment of juvenile salmonids at the south Delta export facilities also generally would be lower under evaluated starting operations compared to existing biological conditions, with differences according to species and water-year type.

Based on the salvage-density method, juvenile steelhead entrainment would decrease substantially overall across all water years averaged together (greater than 50% decrease in both ELT and LLT), with decreases occurring mostly in wet (around 70%), above-normal (around 55–60%), and below-normal years (around 33–40%); average annual entrainment of juvenile steelhead in dry and critical years was estimated to be around 16–23% lower under the evaluated starting operations than under existing biological conditions (Table 5.B.7-1).

The relative change in juvenile winter-run Chinook salmon entrainment under the evaluated starting operations compared to existing biological conditions was very similar to that for juvenile steelhead, with overall average decreases across all water years of just over 50% based on the salvage-density method (Table 5.B.7-1). As with steelhead, this reduction was attributable to appreciable decreases in entrainment in wet, above-normal, and below-normal years and lower reductions in dry and critical years. The DPM suggests that the average percentage of winter-run Chinook salmon smolts salvaged under the evaluated starting operations (ESO_ELT/ESO_LLT) would be around 61–62% (0.02% of all individuals) less than under projected future conditions without the BDCP (EBC2_ELT/EBC2_LLT).

Average annual entrainment loss of juvenile spring-run Chinook salmon was estimated to be around 40% lower under the evaluated starting operations than under existing biological conditions across all water years (Table 5.B.7-1). The salvage-density results suggested that substantially lower entrainment in wet years under the evaluated starting operations (over 60% lower, but involving relatively large numbers of fish) contrasted with similar or modestly lower entrainment (0–17%) under the evaluated starting operations in dry and critical years, albeit with lower numbers of fish estimated to be entrained in these water-year types. The estimates of the percentage of spring-run Chinook salmon juveniles entrained at the south Delta export facilities from the salvage-density method was up to 5% for the evaluated starting operations and over 10% for existing biological conditions (e.g., Table 5.B.6-53), but these percentages are probably an overestimate because the length-based classification method may classify fall-run Chinook salmon as spring-run and assumed a fixed number of individuals entering the Delta each year. The relative change between scenarios is the more appropriate measure to focus on as it removes the uncertainty of run size and number of fish entrained and essentially illustrates pumping differences between scenarios weighted by species relative abundance. Results from the DPM showed that the average percentage of smolts entrained under the evaluated starting operations was 53-56% less (or 0.007% of modeled smolts) than under existing biological conditions, when comparing within the early- and late-long term periods.

The general similarity in emigration timing of juvenile fall-run Chinook salmon to spring-run Chinook salmon resulted in similar salvage-density method results: overall reduced average annual entrainment losses (around 40% across all years) under the evaluated starting operations compared to existing biological conditions that was driven largely by substantial decreases in entrainment in wet and above-normal years when more export pumping shifts to the north Delta intakes (Table 5.B.7-1). In below-normal and critical years, average annual entrainment loss was estimated to be 21–29% lower under the evaluated starting operations compared to existing biological conditions, whereas average entrainment loss was similar or slightly lower (4–17%) under the evaluated starting operations in dry years. The results for late fall–run Chinook salmon suggested lower average annual entrainment loss under the evaluated starting operations by around 33% across all water years relative to existing biological conditions, a pattern that reflected lower average entrainment loss under the evaluated starting operations of 34–47% in wet, above-normal, and below-normal years, and 16–25% lower entrainment loss under the evaluated starting operations in dry and critical years (Table 5.B.7-1). The results of the DPM for fall-run Chinook salmon suggested around 43–45% lower salvage (0.005% of smolts) under the evaluated starting operations than under existing biological conditions for fish from the Sacramento River watershed and 22% lower salvage (0.10% of smolts) under evaluated starting operations for fish from the San Joaquin watershed. Data for the Mokelumne River fall-run Chinook salmon smolts were highly skewed and examination of median estimates suggested that salvage under the evaluated starting operations (ESO_ELT/ESO_LLT) would be 6–13% less (0.01–0.02% of smolts) than under future biological conditions without the BDCP (EBC2_ELT/EBC2_LLT). The average percentage of late fall–run Chinook salmon smolts estimated to be salvaged using the DPM was 62–64% lower (0.03% of smolts) than under existing biological conditions in the early- and late-long term.

As noted for delta smelt (below), existing south Delta exports are managed in real-time according to triggers laid out in the USFWS (2008) and NMFS (2009) BiOps, in this case to minimize salmonid entrainment per the NMFS (2009) BiOp. Such operational changes are difficult to simulate with

CALSIM modeling. Nevertheless, the modeling here provides a sense of the potential differences in entrainment between the evaluated starting operations and existing biological conditions.

Entrainment loss of delta smelt at the south Delta export facilities was projected to be lower under evaluated starting operations relative to existing biological conditions, with appreciably lower loss of adults (December–March) and little difference in loss of larvae and juveniles (March–June); real-time management would be implemented and makes forecasting of changes challenging.

In general, entrainment of delta smelt was lower under the evaluated starting operations relative to existing biological conditions, reflecting the reduced south Delta exports. Therefore the evaluated starting operations generally would maintain or reduce the low entrainment from south Delta pumping regulations assumed under the existing biological conditions. For adults (December–March), considerably lower entrainment was modeled to occur under the evaluated starting operations in wet water years (Table 5.B.7-1), when the north Delta export facilities would provide a larger proportion of total exports. Differences between the evaluated starting operations and existing biological conditions were smaller in drier years, when north Delta bypass flows would require greater use of the south Delta export facilities. The relative differences in proportional entrainment loss between scenarios were greatest in wet years, in which ESO scenarios averaged losses of around 0.03 (i.e., 3% of the adult population); these losses were around 40% lower than the average losses under EBC scenarios (0.07, i.e., 7% of the adult population). In other water years, average annual entrainment loss under the evaluated starting operations ranged from 25–26% lower in above-normal years to 2% lower in critical years.

Larval and juvenile delta smelt proportional entrainment loss was similar between the evaluated starting operations and existing biological conditions averaged over all years (Table 5.B.7-1). Differences in average annual entrainment loss for future scenarios ranged from around 0.01–0.02 (16–24%) lower entrainment under ESO_ELT/ESO_LLT compared to EBC2_ELT/EBC2_LLT in wet and above-normal years, to similar (1–4% more) entrainment under the ESO scenarios in below-normal, dry, and critical years. The combination of adult and larval/juvenile proportional entrainment into estimates for total entrainment suggested that average annual entrainment loss under the evaluated starting operations in the early and late long-term would be less than or similar to existing biological conditions, reflecting lower entrainment in wet and above-normal years, and similar entrainment in below-normal, dry, and critical years (Table 5.B.6-138).

It is emphasized that modeling of entrainment of delta smelt, and indeed other species, has uncertainty because of real-time management decisions that could occur and alter export rates from those modeled here. Implementation of the BDCP would include a real-time operations management group, similar to (or a continuation of) the current Delta Smelt Working Group, which would meet weekly to examine hydrodynamic data and species distribution in order to recommend appropriate levels of export pumping that would minimize entrainment loss. Such decisions cannot be modeled accurately; accordingly, the results of the entrainment analyses should be viewed with some caution. Nevertheless, the existing modeling does suggest that there generally would be lower south Delta entrainment of delta smelt with implementation of the BDCP.

Entrainment loss of longfin smelt at the south Delta export facilities was projected to be lower under evaluated starting operations relative to existing biological conditions, with differences by water-year type.

Overall, entrainment loss of longfin smelt at the south Delta export facilities was estimated to be lower under the evaluated starting operations relative to existing biological conditions. There were decreases in average annual entrainment loss from the salvage-density method under the evaluated starting operations relative to existing biological conditions of around 40% for juveniles and around 50% for adults (Table 5.B.7-1). For adults, entrainment reductions under the evaluated starting operations were greatest in wet years (53–58%) and appreciable in above and below-normal years (35–50%); there was less reduction in dry and critical years (18–28%). For juveniles, reductions in average annual entrainment loss under the evaluated starting operations were again greatest in wet years (56–57%), and ranged from 7% to 32% in the remaining water-year types. Consistent with these changes, entrainment of larval longfin smelt as assessed by particle tracking modeling also was estimated to be lower under the evaluated starting operations, on average by around 20–60%.

Entrainment of Sacramento splittail at the south Delta export facilities was projected to increase because improved reproduction from increased accessibility to floodplain habitat would increase population size; losses on a per-capita basis were estimated to be lower because of lower pumping under the BDCP.

The two different modeling techniques for entrainment (represented by salvage) of Sacramento splittail gave opposite results because of their differing assumptions. The per capita salvage-density method estimated substantially less average annual salvage (nearly 40% less across all water-year types) under the evaluated starting operations compared to existing biological conditions because of reduced pumping in the south Delta (Table 5.B.7-1). This method essentially weights difference in pumping between scenarios by fixed monthly patterns of relative abundance. In contrast, the Yolo Bypass days of inundation method estimated that there would be substantial increases (severalfold to an order of magnitude or more) in the number of Sacramento splittail entrained in most water-year types; this would occur because of increased accessibility to floodplain habitat for spawning and early rearing, leading to substantially more juvenile splittail occupying the Plan Area. However, the general decrease in export pumping from the south Delta during the main May–July entrainment period for juvenile splittail will have the potential to result in a lower overall proportion of the splittail population being entrained. Increased abundance of juvenile and larval splittail due to increased floodplain habitat could result in an associated increase in entrainment, although the overall proportion of the population subject to entrainment may be lower than previously because of lower pumping during the months of greater abundance.

Entrainment of white sturgeon and green sturgeon at the south Delta export facilities was projected to decrease because of reduced export pumping.

Under the assumption that reduced export pumping in the south Delta is directly proportional to entrainment of juvenile white and green sturgeon (i.e., the salvage-density method), entrainment of these two species should decrease under the evaluated starting operations relative to existing biological conditions. The decrease was estimated to be greater in wet and above-normal years (50–60%) than in below-normal, dry, and critical years (25–40%), reflecting south Delta operations (Table 5.B.7-1).

Entrainment of pacific lamprey and river lamprey at the south Delta export facilities was projected to decrease because of reduced export pumping.

As with white and green sturgeon, reductions in south Delta export pumping would be expected to decrease entrainment of Pacific and river lamprey macropthalmia and adults under the evaluated starting operations relative to existing biological conditions. The estimated level of reduction (41–45% averaged across all water years) is based on the salvage-density method, i.e., on the assumption that proportional changes in flow lead to similar proportional changes in entrainment (Table 5.B.7-1).

Nonphysical barriers have the potential to reduce entrainment of some covered fish species at the SWP/CVP south Delta export facilities, but there is uncertainty about whether this would translate into increased survival because of other localized factors.

Nonphysical barriers at the entrances to Clifton Court Forebay (CCF) and the Delta-Mendota Canal (DMC) have the best potential to reduce entrainment of juvenile Chinook salmon and steelhead and juvenile and adult delta smelt, longfin smelt, and Sacramento splittail. There is little potential to reduce entrainment of white and green sturgeon or Pacific and river lamprey because these species are not as sensitive to the acoustic deterrence of the nonphysical barriers. The effectiveness of nonphysical barriers will depend on the water velocity characteristics in the vicinity of the barrier and on the extent to which predatory fish occur along the barrier. There is also uncertainty as to whether preventing entrainment into CCF and the DMC will enhance survival given the prevailing hydrodynamics in the area, i.e., if net reverse flows are present that may not allow fish to move away from the area and make them more susceptible to entrainment. Such uncertainties necessitate study to assess the effectiveness of nonphysical barriers at these locations.

Screening of the SWP/CVP north Delta intakes will prevent entrainment of all but the smallest life stages of covered fish species; potential negative effects associated with screen contact, impingement, and passage time will require monitoring.

Screening of the proposed north Delta intakes will prevent entrainment through the screens of most life stages of covered fish species, with larval delta smelt, longfin smelt, Sacramento splittail, and smaller lamprey ammocoetes that may encounter the intakes having the greatest potential for entrainment. There is potential for larger fish to have detrimental interactions with the screens. Final specifications have not been established fully for the screens but laboratory studies show that salmonid screen passage time would be expected to be facilitated by greater sweeping velocity. The proportion of Sacramento River-origin salmonids that may pass close enough to the intakes is uncertain but may be appreciable given the likely siting near the outside of river bends to minimize sedimentation and maintain sweeping velocity. Existing survey data suggest that most delta smelt and longfin smelt would be well downstream of the intakes, but those that do occur in the intake vicinity and near the shoreline may contact the screens and could suffer injury and potentially mortality. Approach velocity will be limited to 0.2 feet/second (ft/sec) when delta smelt are present. Laboratory studies have shown that the probability of mortality is greater with higher sweeping velocity and at night. Screen contact rate for Sacramento splittail decreases with increased sweeping velocity, so it is apparent that there are potentially different effects on different species from the north Delta intakes. Monitoring would be used to determine the actual impingement and related negative screen interactions for covered fish species at the proposed north Delta intakes.

Implementation of a dual conveyance for the SWP North Bay Aqueduct should reduce entrainment of delta smelt and longfin smelt larvae.

Construction of an alternative intake on the Sacramento River for the NBA will provide flexibility in operations and facilitate reduced pumping from the Barker Slough Pumping Plant in the Cache Slough subregion, a particularly important portion of the delta smelt range. This should reduce entrainment of delta smelt larvae because delta smelt are not commonly found in the vicinity of the alternative intake. It was estimated that under the evaluated starting operations, entrainment of longfin smelt larvae at the Barker Slough Pumping Plant may be similar or slightly greater under the evaluated starting operations relative to existing biological conditions; however, the percentage of entrained particles was very low and would become even lower with the implementation of a dual conveyance.

Decommissioning of agricultural diversions in the BDCP restoration opportunity areas will reduce entrainment of covered species to a small degree.

The level of entrainment of covered fish species at agricultural diversions in the Plan Area is largely unknown, but it is likely some entrainment is occurring. Whatever entrainment is occurring would be reduced by decommissioning agricultural diversions in the ROAs and implementing *CM21 Nonproject Diversions*, which will reduce entrainment through removal, consolidation, relocation, reconfiguration, and screening at nonproject diversions. Particle-tracking modeling of larval smelt entrainment suggested that changes in water operations under *CM1 Water Facilities and Operation* may result in lower entrainment of longfin smelt larvae under the evaluated starting operations compared with the existing biological conditions and similar or slightly higher entrainment of delta smelt larvae under the evaluated starting operations relative to existing biological conditions (Table 5.B.7-1). Changes in larval smelt entrainment are uncertain because particle tracking is not necessarily an accurate representation of smelt larval behavior in relation to agricultural intakes, nor does it account for the changes in diversions from tidal restoration or CM21. Greater benefits to smelt and other covered species associated with removing water diversion structures may occur from the reduction of predator holding habitat (see Appendix 5.F, *Biological Stressors on Covered Fish*) than from reductions in entrainment.

Estimates of entrainment changes under the BDCP are uncertain, but entrainment is readily monitored.

The relationship between pumping levels and entrainment is not fully understood; however, decreases in pumping generally should lead to decreased entrainment. An example of uncertainty is whether relationships between pumping and entrainment are linear or nonlinear. However, fish entrainment (and impingement) is readily monitored and the BDCP includes such monitoring. It is expected that monitoring will improve understanding and, through adaptive management, lead to refinements in BDCP implementation where appropriate. Particular emphasis will be placed on the following monitoring actions.

- Continuing salvage and entrainment monitoring at the SWP/CVP south Delta export facilities.
- Entrainment and impingement monitoring at the new SWP/CVP north Delta intakes.
- Entrainment and impingement monitoring at the SWP NBA Barker Slough Pumping Plant and Alternative Intake on the Sacramento River.

Continuing entrainment monitoring into the future will be of particular importance, given the likely changes in species distribution caused by large-scale habitat changes and/or climate change. For example, species such as longfin smelt may spawn farther upstream as sea level rises.

Winter-spring south Delta entrainment would be similar between low-outflow (LOS) and evaluated starting operations (ESO) scenarios, whereas the high-outflow scenario (HOS) would have lower entrainment

Most BDCP covered fish species that occur within the Plan Area are susceptible to entrainment during winter and spring (roughly December–June). For these species, there would be little difference in entrainment at the south Delta export facilities between ESO and LOS scenarios because pumping is similar for these two scenarios in winter and spring. In contrast, the HOS has lower south Delta export pumping and greater outflow during spring in particular. This has the potential to result in less entrainment compared with the ESO/LOS scenarios, as shown for delta smelt larvae/juveniles. Relatively few species are susceptible to entrainment during summer/fall because of their phenology, but for those that are—the sturgeons are the best examples—entrainment under the HOS would be similar to or less than the ESO, with both of these scenarios generally having somewhat lower entrainment than the LOS because of inclusion of the USFWS (2008) BiOp Fall X2 RPA under the HOS and ESO scenarios. As noted elsewhere in this appendix, modeling of entrainment has some uncertainty because of real-time management decisions that could occur and alter export rates from those modeled here.

5.B.8 References Cited

5.B.8.1 Literature Cited

Anderson, J. 2003. Delta Island Consumptive Use (DICU) values used for the South Delta Improvements Program (SDIP) simulations. Department of Water Resources, Delta Modeling Section. July 30.

Baxter, R., R. Breuer, L. Brown, L. Conrad, F. Feyrer, S. Fong, K. Gehrts, L. Grimaldo, B. Herbold, P. Hrodey, A. Mueller-Solger, T. Sommer, and K. Souza. 2010. *Pelagic organism decline work plan and synthesis of results*. <http://www.science.calwater.ca.gov/pod/pod_index.html>.

Bay Delta Conservation Plan Integration Team. 2009. Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass. Draft Technical Memorandum. April.

Beamish, F.W.H. 1978. Swimming capacity. *Fish Physiology*, Vol. VII:101–187.

Blake, A., and M.J. Horn. 2006. *Acoustic tracking of juvenile Chinook salmon movement in the vicinity of Delta Cross Channel, Sacramento River, California—2001 study results*. Draft. U.S. Department of the Interior, U.S. Geological Survey.

Bowen, M. D., and R. Bark. 2010. 2010 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). Draft Technical Memorandum 86-68290-10-07. US Department of the Interior, Bureau of Reclamation, Technical Service Center, Denver, CO.

Bowen, M. D., L. Hanna, R. Bark, V. Maisonneuve, and S. Hiebert. 2008. Non-Physical Barrier Evaluation, Physical Configuration I. U.S. Department of the Interior, Bureau of Reclamation. Technical Memorandum. Technical Service Center. Denver, CO.

Bowen, M. D., S. Hiebert, C. Hueth, and V. Maisonneuve. 2009. 2009 Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA). Draft Technical Memorandum 86-68290-11. US Department of the Interior, Bureau of Reclamation, Technical Service Center, Denver, CO.

Brown, R., S. Greene, P. Coulston, and S. Barrow. 1996. An evaluation of the effectiveness of fish salvage operations at the intake to the California Aqueduct, 1979–1993. Pages 497–518 *in* J. T. Hollibaugh, editor. *San Francisco Bay the ecosystem. Further investigations into the natural history of San Francisco Bay and Delta with reference to the influence of man*. San Francisco, CA: Pacific Division of the American Association for the Advancement of Science.

Burau, J. 2011. Smelt/Turbidity Experiment. Presentation to the 2011 Independent Review Panel on the Implementation of Reasonable and Prudent Alternative Action Affecting the Operations Criteria and Plan for State/Federal Water Operations, November 8, 2011.

Burau, J., A. Blake, and R. Perry. 2007. Sacramento/San Joaquin River Delta regional salmon outmigration study plan: developing understanding for management and restoration. Available: <http://www.science.calwater.ca.gov/pdf/workshops/workshop_outmigration_reg_study_plan_011608.pdf>. Accessed: March 27, 2012.

Bureau of Reclamation, see *U.S. Department of the Interior, Bureau of Reclamation*

CALFED Bay Delta Program. 2000. *Programmatic record of decision*. August. Sacramento, CA.

California Department of Fish and Game. Unpublished salvage data from Delta FTP site. Available: <ftp://ftp.delta.dfg.ca.gov/>

California Department of Fish and Game. 2000. Fish Screening Criteria. Available: <http://www.dfg.ca.gov/fish/Resources/Projects/Engin/Engin_ScreenCriteria.asp>. Accessed: March 24, 2012.

California Department of Fish and Game. 2009. State water project effects on longfin smelt. Effects analysis. Report of Fish and Game Commission. February.

California Department of Fish and Game. 2010. California Fish Passage Assessment Database. Available: <http://www.calfish.org/Programs/CalFishPrograms/FishPassageAssessment/tabid/83/Default.aspx>. Accessed: 2010.

California Department of Fish and Game. 2010. *GrandTab Database 2010.03.09*. Fisheries Branch. Stockton, CA.

California Department of Fish and Game. Delta FTP site. Available: <ftp://ftp.delta.dfg.ca.gov/>

California Department of Water Resources. 2009. *California Water Plan Update 2009*. Volume 4. Hyrdology—California River Indices. Available: <http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v4c12a01_cwp2009.pdf>. Accessed: March 27, 2012.

California Department of Water Resources. 2010. Fact sheet, Sacramento River Flood Control Project weirs and flood relief structures. Flood Operations Branch. December.

California Department of Water Resources, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2012. *Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan.* Prepared by ICF International. Sacramento, CA. February.

California Department of Water Resources and Bureau of Reclamation. 1994. Effects of the Central Valley Project and State Water Project on delta smelt and Sacramento splittail. Biological assessment. Prepared for U.S. Fish and Wildlife Service, Ecological Services, Sacramento, CA Field Office.

California Department of Water Resources and California Department of Fish and Game. 1986. Agreement between the Department of Water Resources and the Department of Fish and Game to offset direct fish losses in relation to the Harvey O. Banks Pumping Plant. Available: <http://www.water.ca.gov/environmentalservices/fourpumps.cfm>. Accessed July 20, 2011.

Castillo, G., J. Morinaka, J. Lindberg, R. Fujimura, B. Baskerville-Bridges, J. Hobbs, G. Tigan, L. Ellison. 2012. Pre-screen Loss and Fish Facility Efficiency for Delta Smelt at the South Delta's State Water Project, California. San Francisco Estuary and Watershed Science 10 (4).

Cavallo, B., D. Zezulak, J. Smith, J. Kindopp, S. Witalis, A. Willy, J. Israel, and L. Wise. 2009. OSCM (Other Stressors Conservation Measure) 21: Non-Project Diversions. Scientific Worksheets. Delta Regional Ecosystem Restoration Implementation Plan.

Clark, K. W., M. D. Bowen, R. B. Mayfield, K. P. Zehfuss, J. D. Taplin, and C. H. Hanson. 2009. Quantification of Pre-Screen Loss of Juvenile Steelhead in Clifton Court Forebay. California Department of Water Resources, Sacramento, CA.

Cook, L., and L. D. Buffaloe. 1998. Delta Agricultural Diversion Evaluation Summary Report, 1993–1995. Interagency Ecological Program Technical Report 61. June.

Danley, M. L., S. D. Mayr, P. S. Young, and J. J. Cech, Jr. 2002. Swimming performance and physiological stress responses of splittail exposed to a fish screen. North American Journal of Fisheries Management 22:1241–1249.

Davis, G. E., J. Foster, C. E. Warren, and P. Doudoroff. 1963. The Influence of Oxygen Concentration on the Swimming Performance of Juvenile Pacific Salmon at Various Temperatures. *Transactions of the American Fisheries Society* 92:111–124.

Del Rosario, R. B., Y. J. Redler, K. Newman, P. L. Brandes, T. Sommer, K. Reece, and R. Vincik. In press. Migration patterns of juvenile winter-run size Chinook salmon (*Oncorhynchus tshawytscha*) through the Sacramento – San Joaquin Delta. San Francisco Estuary and Watershed Science.

Deriso, R. B. 2010. Corrected declaration of Dr. Richard B. Deriso in support of Metropolitan Water District's joinder in motion for temporary restraining order. Submitted to Federal District Court. Judge O. W. Wanger.

ESA. 2009. Notice of preparation. Environmental impact report for the North Bay Aqueduct Alternative Intake Project. California Department of Water Resources. November. (ESA 209081.) Sacramento, CA. Available: <http://www.water.ca.gov/engineering/docs/DWR%20NBA%20AIP%20NOP%2011-24-09.pdf>. Accessed: July 2012.

Feyrer, F., T. R. Sommer, and R. D. Baxter. 2005. Spatial-temporal distribution and habitat associations of age-0 splittail in the lower San Francisco Estuary watershed. *Copeia* 2005:159–168.

Feyrer, F., T. Sommer, and W. Harrell. 2006. Managing floodplain inundation for native fish: production dynamics of age-0 splittail (*Pogonichthys macrolepidotus*) in California's Yolo Bypass. *Hydrobiologia* 573:213–226.

Fish, M.A. 2010. A White Sturgeon Year-Class Index for the San Francisco Estuary and Its Relation to Delta Outflow. *Interagency Ecological Program Newsletter* 23(2):80–84.

Gingras, M. 1997. Mark/recapture experiments at Clifton Court forebay to estimate pre-screening loss to entrained juvenile fishes: 1976-1993. Interagency Ecological Program Technical Report No. 55. November 1997.

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.

Hallock, R. J. and W. F. Van Woert. 1959. A survey of anadromous fish losses in irrigation diversions from the Sacramento and San Joaquin rivers. *California Fish and Game* 45:227–293.

Harvey, B. 2011. Length-at-Date Criteria to Classify Juvenile Chinook Salmon in the California Central Valley: Development and Implementation History. *Interagency Ecological Program Newsletter* 24(3):26–36.

Herren, J. R., and S. S. Kawasaki. 2001. Inventory of water diversions in four geographic areas in California's Central Valley. *Fish Bulletin* 179(2):343–355.

ICF International. 2010. *Monitoring plan to evaluate the biological efficacy of the Freeport Regional Water Authority's new water intake fish screen*. April. (ICF Project #00454.07.) Sacramento, CA. Prepared for Freeport Regional Water Authority and Sacramento County Water Agency, Sacramento, CA.

ICF International. 2011. *Addendum to the Monitoring Plan to Evaluate the Biological Efficacy of the Freeport Water Authority's New Water Intake Fish Screen*. October. (ICF Projecy #61107.06) Sacramento, CA. Prepared for Freeport Regional Water Authority and Sacramento County Water Agency, Sacramento, CA.

ICF International. Unpublished fish monitoring data at the Freeport Regional Water Authority Water Intake, 2012. (ICF Project #00454.07.) Sacramento, CA.

Israel, J. A. and A. P. Klimley. 2008. Life history conceptual model for North American green sturgeon (*Acipenser medirostris*). Final report. California Department of Fish and Game Delta Regional Ecosystem Restoration and Implementation Program.

Israel, J. A., A. M. Drauch, M. Gingras, and M. Donnellan. 2009. Life history conceptual model for white sturgeon (*Acipenser transmontanus*). California Department of Fish and Game Delta Regional Ecosystem Restoration and Implementation Program. Final.

Jahn, A. 2011. An Alternative Technique to Quantify the Incidental Take of Listed Anadromous Fishes at the Federal and State Water Export Facilities in the San Francisco Bay-Delta Estuary. July. Prepared for National Marine Fisheries Service, Central Valley Office. Kier Associates, Arcata, CA. Available: <http://deltacouncil.ca.gov/sites/default/files/documents/files/Kier%20Assoc_OIA%20TO%203062_Incidental%20take%20at%20the%20Delta%20pumps_final.pdf>. Accessed: March 27, 2012.

Kano, R. M. 1990. Occurrence and Abundance of Predator Fish in Clifton Court Forebay, California. IEP Technical Report 24. May. Interagency Ecological Program for the Sacramento-San Joaquin Estuary.

Kimmerer, W. J. 2008. Losses of Sacramento River Chinook salmon and delta smelt to entrainment in water diversions in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 6(2).

Kimmerer, W. J. 2011. Modeling delta smelt losses at the south Delta export facilities. *San Francisco Estuary and Watershed Science* 9(1).

Langford, T. E. 1983. Electricity generation and the ecology of natural waters. Liverpool, UK: Liverpool University Press.

Lovell, J. M., M. M. Findlay, R. M. Moate, J. R. Nedwell, and M. A. Pegg. 2005. The inner ear morphology and hearing abilities of the paddlefish (*Polyodon spathula*) and the lake sturgeon (*Acipenser fulvescens*). November. *Comparative Biochemistry and Physiology—Part A: Molecular & Integrative Physiology* 142(3):286–296.

Mac Nally, R., J.R. Thomson, W.J. Kimmerer, F. Feyrer, K.B. Newman, A. Sih, W. A. Bennett, L. Brown, E. Fleishman, S. D. Culberson, and G. Castillo. 2010. Analysis of pelagic species decline in the upper San Francisco Estuary using multivariate autoregressive modeling (MAR). *Ecological Applications* 20:1417–1430.

Maes, J., A. W. Turnpenny, D. R. Lambert, J. R. Nedwell, A. Parmentier, and F. Ollevier. 2004. Field evaluation of a sound system to reduce estuarine fish intake rates at a power plant cooling water inlet. *Journal of Fish Biology* 64(4):938–946.

Manly, B.F.J. 2011. Report on planning and forecasting turbidity and salvage predictions for the Metropolitan Water District of Southern California Task Order 1 of Agreement 119889. Incomplete draft. Western EcoSystems Technology, Inc., Cheyenne, WY.

Margraf, F. J., D. M. Chase, and K. Strawn. 1985. Intake Screens for Sampling Fish Populations: The Size-Selectivity Problem. *North American Journal of Fisheries Management* 5:210–213.

Maunder, M. N., and R. B. Deriso. 2011. A state-space multistage life cycle model to evaluate population impacts in the presence of density dependence: illustrated with application to delta smelt (*Hypomesus transpacificus*). *Canadian Journal of Fisheries and Aquatic Sciences* 68:1285–1306.

McEwan, D. 2001. Central Valley Steelhead, pp. 1–43, in Contributions to the biology of Central Valley salmonids, edited by R. L. Brown. California Department of Fish and Game.

Miller, W. J. 2011. Revisiting assumptions that underlie estimates of proportional entrainment of delta smelt by state and federal water diversions from the Sacramento–San Joaquin Delta. *San Francisco Estuary and Watershed Science* 9(1).

Miller, W. J., B. F. J. Manly, D. D. Murphy, D. Fullerton, and R. R. Ramey. 2012. An Investigation of Factors Affecting the Decline of Delta Smelt (*Hypomesus transpacificus*) in the Sacramento-San Joaquin Estuary. *Reviews in Fisheries Science* 20(1):1–19.

Miranda, J., R. Padilla, J. Morinaka, J. DuBois, and M. Horn. 2010. Release site predation study. California Department of Water Resources, Sacramento, CA.

Morinaka, J. 2010. *Can Delta Smelt Survive the CHTR Phase of the Fish Salvage Facilities?* Interagency Ecological Program Conference. May. Available: <http://www.water.ca.gov/iep/docs/052510smelt.pdf>. Accessed: February 5, 2012.

Moyle, P. B. 2002. Inland Fishes of California, revised and expanded ed. Berkeley: University of California Press.

Moyle, P. B., and J. A. Israel. 2005. Untested assumptions: Effectiveness of screening diversions for conservation of fish populations. *Fisheries* 30(5):20–29.

Moyle, P. B., R. D. Baxter, T. Sommer, T. C. Foin, and S. A. Matern. 2004. Biology and Population Dynamics of Sacramento splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: A Review. *San Francisco Estuary and Watershed Science* 2(1):1–47. Available: <http://repositories.cdlib.org/jmie/sfews/vol2/iss2/art3>. Accessed: December 15, 2011.

National Marine Fisheries Service. 1997. Fish screening criteria for anadromous salmonids. January. National Marine Fisheries Service, Southwest Region. Available: <http://swr.nmfs.noaa.gov/hcd/fishscrn.pdf>.

National Marine Fisheries Service. 2009. Biological opinion and conference opinion on the long-term operations of the Central Valley Project and State Water Project. National Marine Fisheries Service Southwest Region. June 4.

Nedwell, J. R., B. Edwards, A.W.H. Turnpenny, and J. Gordon. 2004. Fish and Marine Mammal Audiograms: A summary of available information. Subacoustech Report Reference: 534R0214, September 2004, To: Chevron Texaco Ltd., TotalFinaElf Exploration UK Plc, DSTL, DTI and Shell U.K. Exploration and Production Ltd.

Newman, K. B. 2008a. Sample design-based methodology for estimating delta smelt abundance. *San Francisco Estuary and Watershed Science* 6(3).

Newman, K. B. 2008b. An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon studies. Prepared for CALFED Science Program. March.

Newman, K. B., and P. L. Brandes. 2009. Hierarchical Modeling of Juvenile Chinook Salmon Survival as a Function of Sacramento–San Joaquin Delta Water Exports. *North American Journal of Fisheries Management* 30:157–169.

Newman, K. B., and P. L. Brandes. 2010. Hierarchical Modeling of Juvenile Chinook Salmon Survival as a Function of Sacramento–San Joaquin Delta Water Exports. *North American Journal of Fisheries Management* 30:157–169.

Nobriga, M. and B. Herbold. 2009. The Little Fish in California's Water Supply: a Literature Review and Life-History Conceptual Model for delta smelt (*Hypomesus transpacificus*) for the Delta Regional Ecosystem Restoration and Implementation Plan (DRERIP). Sacramento-San Joaquin Delta, Regional Ecosystem Restoration Implementation Plan. California Department of Fish and Game and U.S. Environmental Protection Agency.

Nobriga, M. L., T. R. Sommer, F. Feyrer, and K. Fleming. 2008. Long-Term Trends in Summertime Habitat Suitability for Delta Smelt (Hypomesus transpacificus). *San Francisco Estuary and Watershed Science* 6(1).

Nobriga, M. L., Z. Matica, and Z. P. Hymanson. 2004. Evaluating entrainment vulnerability to agricultural irrigation diversions: A comparison among open-water fishes. *American Fisheries Society Symposium* 39:281–295.

Ostrand, K. G. 2007. Validation of existing screening criteria for lamprey macrophthalmia. U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, Longview, WA.

Pandey, G.R., and N. Smith. 2010. Two Dimensional Hydraulic Modeling Studies of DHCCP Intakes. Technical memorandum. Final report. December. California Department of Water Resources.

Parsley, M. J., S. D. Duke, T. J. Underwood, and L. G. Beckman. 1989. Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam—Appendix C. Pp. 101–166 in Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam, edited by A. Nigro. Bonneville Power Administration, Portland, OR.

Raifsnider, C. 2011. Fish Monitoring Report for the Middle River Intake—November 16–30, 2011. Lafayette, CA: Tenera Environmental.

Richardson, J., and D. A. Dixon. 2004. Modeling the hydraulic zone of influence of Connecticut Yankee Nuclear Power Plant's cooling water intake. *American Fisheries Society Monograph* 9.

Rose, B. P., and M. G. Mesa. 2012. Effectiveness of Common Fish Screen Materials to Protect Lamprey Ammocoetes. *North American Journal of Fisheries Management* 32(3):597–603.

Saha, S. 2008. Delta Volume Calculation. Sacramento, CA: California Department of Water Resources, Bay-Delta Office.

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the Upper San Francisco Estuary. Fisheries 32(6), 270–277.

Sommer, T., R. Baxter, and B. Herbold. 1997. Resilience of splittail in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society 126:961–976.

Sprengel, G., and H. Luchtenberg. 1991. Infection by endoparasites reduces maximum swimming speed of European smelt *Osmerus eperlanus* and European eel *Anguilla anguilla*. *Diseases of Aquatic Organisms.* 11:31–35.

Swanson, C., P. S. Young, and J. J. Cech, Jr. 1998. Swimming performance of delta smelt: maximum performance, and behavioral and kinematic limittations of swimming at submaximal velocities. *Journal of Experimental Biology* 201:333–345.

Swanson, C., P. S. Young, and J. J. Cech, Jr. 2005. Close Encounters with a Fish Screen: Integrating Physiological and Behavioral Results to Protect Endangered Species in Exploited Ecosystems. *Transactions of the American Fisheries Society* 134(5):1111–1123.

Swanson, C., P. S. Young, J. J. Cech Jr., M. L. Kavvas, and G. A. Aasen. 2004a. Fish treadmill-developed fish screen criteria for native Sacramento-San Joaquin watershed fishes. Final Report prepared for the Anadromous Fish Screen Program Cooperative Agreement No. 114201J075.

Swanson. C., P. S. Young, and J. J. Cech, Jr. 2004b. Swimming in two-vector flows: Performance and behavior of juvenile Chinook salmon near a simulated screened water diversion. Transactions of the American Fisheries Society 133:265–278.

Sweetnam, D. A. 1999. Status of delta smelt in the Sacramento-San Joaquin estuary. California Fish and Game 85: 22–27.

Thomson, J. R., W. J. Kimmerer, L. R. Brown, K. B. Newman, R. MacNally, W. A. Bennett, F. Feyrer, and E. Fleishman. 2010. Bayesian change point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. *Ecological Applications* 20(5):1431–1448.

Turnpenny, A. W. H. 1981. An Analysis of Mesh Sizes Required for Screening Fishes at Water Intakes. *Estuaries* 4(4):363–368.

U.S. Department of the Interior, Bureau of Reclamation and Western Area Power Administration. 2009. Delta-Mendota Canal/California Aqueduct Intertie Environmental Impact Statement. Final. November. Central Valley Project, California. (DOE/EIS-0398.) Available: <http://www.usbr.gov/mp/intertie/index.html>.

U.S. Fish and Wildlife Service. 1976–2010. Sacramento trawl unpublished data. Provided to Rick Wilder (SAIC) by Jonathan Speegle (USFWS).

U.S. Fish and Wildlife Service. 2008. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Sacramento, CA. Fish and Wildlife Service, Region 8. December.

Vogel, D. 2011. Insights into the problems, progress, and potential solutions for Sacramento River basin native anadromous fish restoration. Prepared for Northern California Water Association and Sacramento Valley Water Users. April. Natural Resource Scientists, Inc., Red Bluff, CA.

Wang, J. C. S. 1986. Fishes of the Sacramento-San Joaquin Estuary and adjacent waters, California:a guide to the early life histories. Technical Report 9. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, Sacramento, CA.

Wang, J. C. S. 1991. Early life stages and early life history of the delta smelt, *Hypomesus transpacificus*, in the Sacramento-San Joaquin Estuary, with comparison of early life stages of the longfin smelt, *Spirinchus thaleichthys*. Technical Report 28. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary, Sacramento, CA.

Young, P. S. and Cech, J. J., Jr. 1996. Environmental tolerances and requirements of splittail. *Transactions of the American Fisheries Society* 125, 664–678.

Young, P. S., C. Swanson, and J. J. Cech. 2010. Close Encounters with a Fish Screen III: Behavior, Performance, Physiological Stress Responses, and Recovery of Adult Delta Smelt Exposed to Two-Vector Flows near a Fish Screen. *Transactions of the American Fisheries Society* 139(3):713–726.

Young, P. S., J. J. Cech, S. Griffin, P. Raquel, and D. Odenweller. 1997. Calculations of Required Screen Mesh Size and Vertical Bar Interval Based on Delta Smelt Morphometrics. *Interagency Ecological Program Newsletter* 10(1):19–20.

Young, P.S., T. Reid, and J.J. Cech, Jr. 1999. Comparative swimming performance of native (delta smelt and splittail) and introduced (inland silverside and wakasagi) delta fish. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary Newsletter, Winter 1999.

5.B.8.2 Personal Communications

Baxter, Randy. Fish Biologist. California Department of Fish and Game. 2011. August 9. Fall midwater trawl survey data provided to Patrick Crain, Fisheries Biologist, ICF International, Sacramento, CA.

Greene, Sheila. Scientist. California Department of Water Resources. June 2010—email of excel files containing salvage and entrainment loss data to Rick Wilder, Senior Fisheries Biologist, SAIC, Sacramento, CA.

Kozlowski, Jeff. Fish biologist. ICF International. Sacramento, CA. October 5, 2012—Freeport Regional Water Project entrainment monitoring data provided to Marin Greenwood, aquatic ecologist, ICF International, Sacramento, CA.

Llaban, Angela. Environmental scientist. California Department of Water Resources, Division of Environmental Services, West Sacramento, CA. February 8, 2012— email containing wild winter-run Chinook salmon incidental take estimates to Marin Greenwood, Aquatic Ecologist, ICF International, Sacramento, CA

Mesa, Matthew. Research fishery biologist. U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, WA. June 26, 2012—email containing logistic equations estimating probability of Pacific lamprey entrainment to Marin Greenwood, Aquatic Ecologist, ICF International, Sacramento, CA

Sommer, Ted. Senior environmental Scientist. California Department of Water Resources, West Sacramento, CA. June 28 and June 29, 2010—telephone communications about splittail spawning timing and conditions with Sophie Unger, Owner, Waterwise Consulting.

Speegle, Jonathan. Fish Biologist (Data Manager). U.S. Fish and Wildlife Service, Stockton Field Office, CA. November 11, 2011—excel data files containing USFWS Delta Juvenile Fish Monitoring Program data submitted to Marin Greenwood, Aquatic Ecologist, ICF International, Sacramento, CA, via ICF's file transfer service.

Turnpenny, Andrew. Director. Turnpenny Horsfield Associates Ltd. Southampton, UK. July 20, 2011—email to Marin Greenwood, Aquatic Ecologist, ICF International, Sacramento, CA.