

BDCP

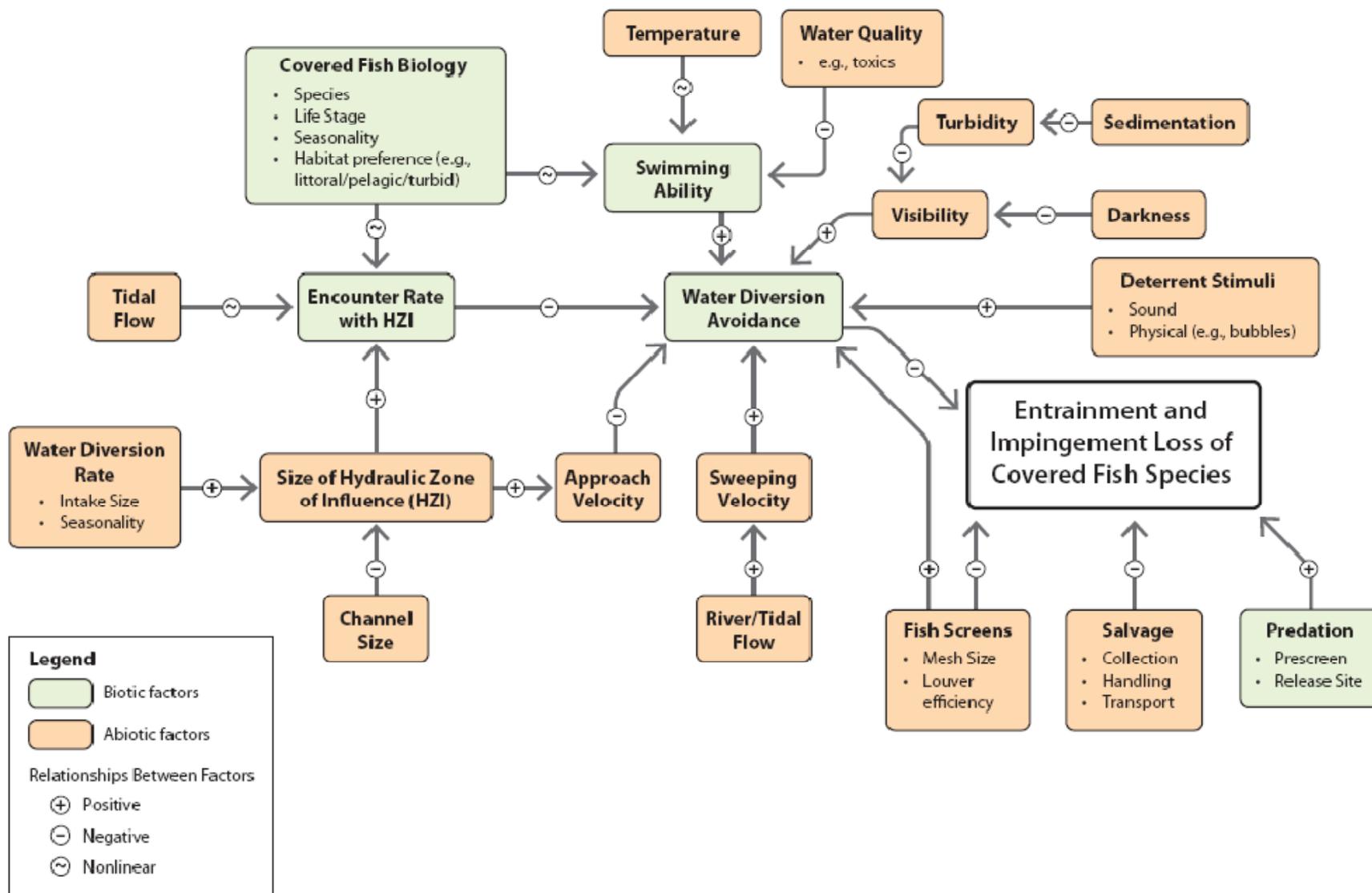
BAY DELTA CONSERVATION PLAN

BDCP Effects Analysis Review: Overview of Draft Appendix B, Entrainment

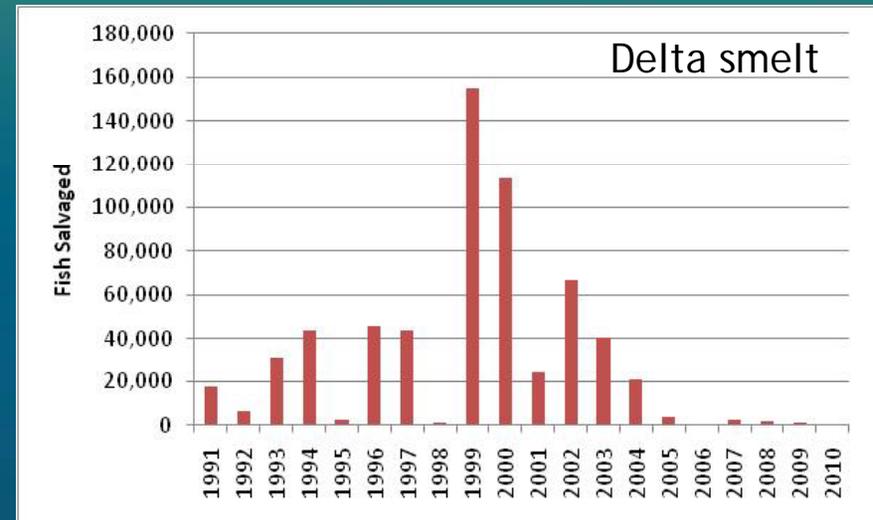
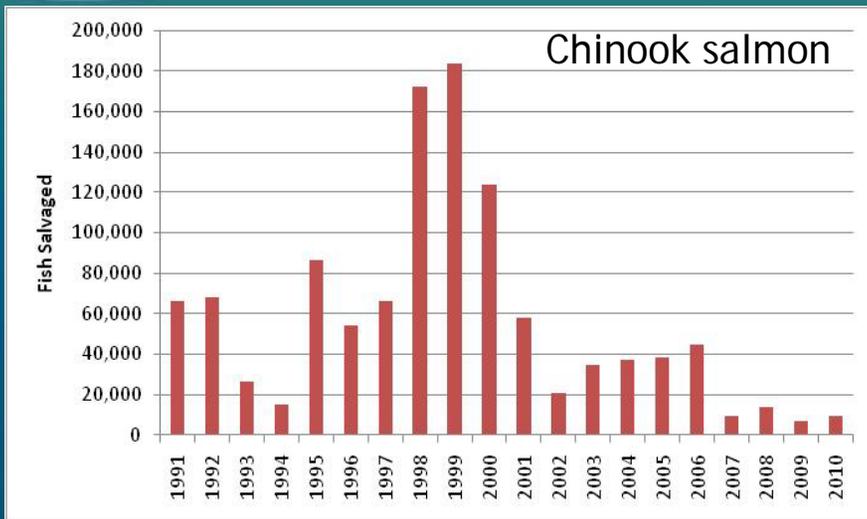
October 25, 2011

Marin Greenwood, ICF International

ENTRAINMENT CONCEPTUAL MODEL



- Substantial Historic Losses of Fish



- Some Evidence for Effects on Delta Smelt Population

- MacNally et al. 2010; Thomson et al. 2010; Maunder & Deriso 2011

BDCP EFFECTS ON ENTRAINMENT

- Reduction of South Delta Water Exports
 - Dual conveyance: North/South Delta exports
- Installation of Nonphysical Barriers at South Delta Export Facilities
- Reduction of Water Exports from North Bay Aqueduct Barker Slough Pumping Plant
- Removal/Screening of Agricultural Diversions from Restoration Areas

BDCP MODELING SCENARIOS

- Existing Biological Conditions (EBC1)
 - Similar to EBC2, without fall X2 requirement
- Existing Biological Conditions (EBC2)
 - Current
 - Early Long Term (2025): EBC2_ELT
 - Late Long Term (2060): EBC2_LLT
- Preliminary Proposal (BDCP)
 - Early Long Term (2025): PP_ELT
 - Late Long Term (2060): PP_LLT

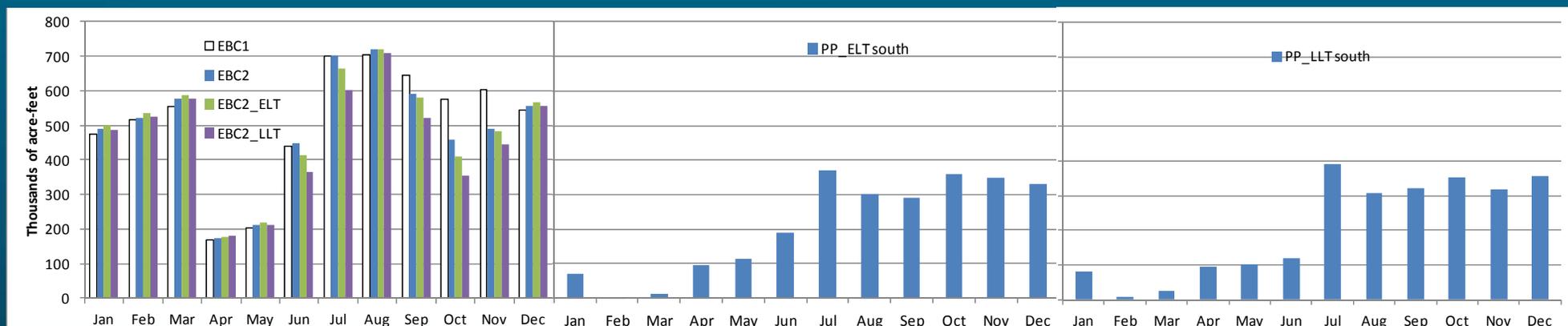
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Wet Years (32% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

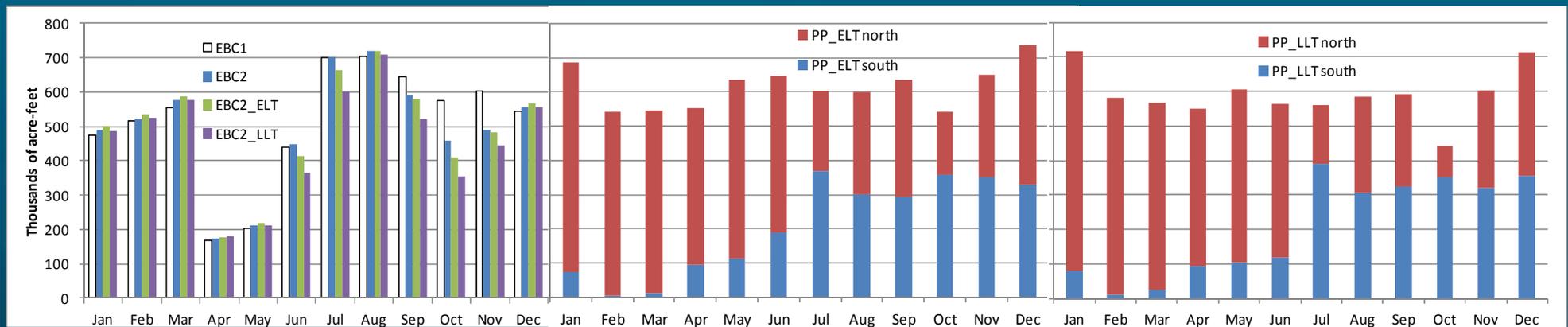
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Environmental Modeling Results
(CALSIM)

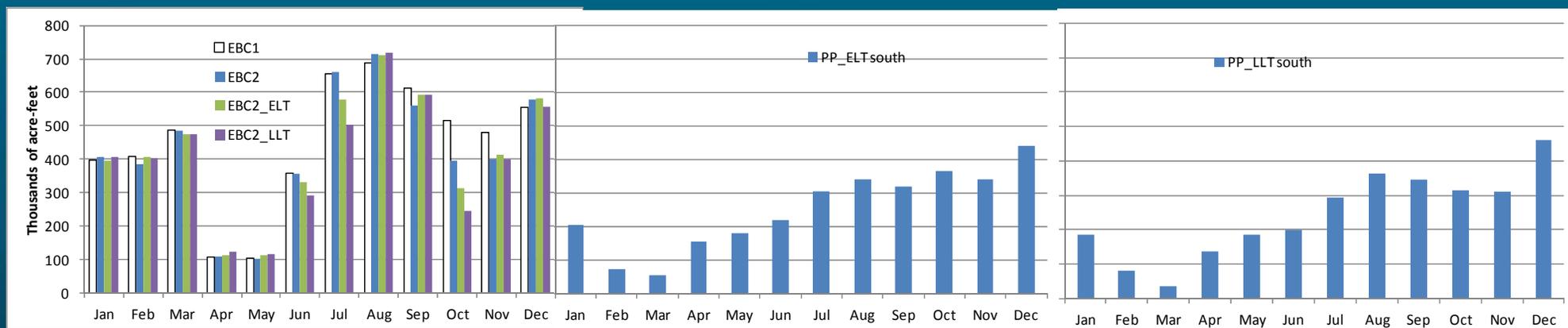
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Above Normal Years (15% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

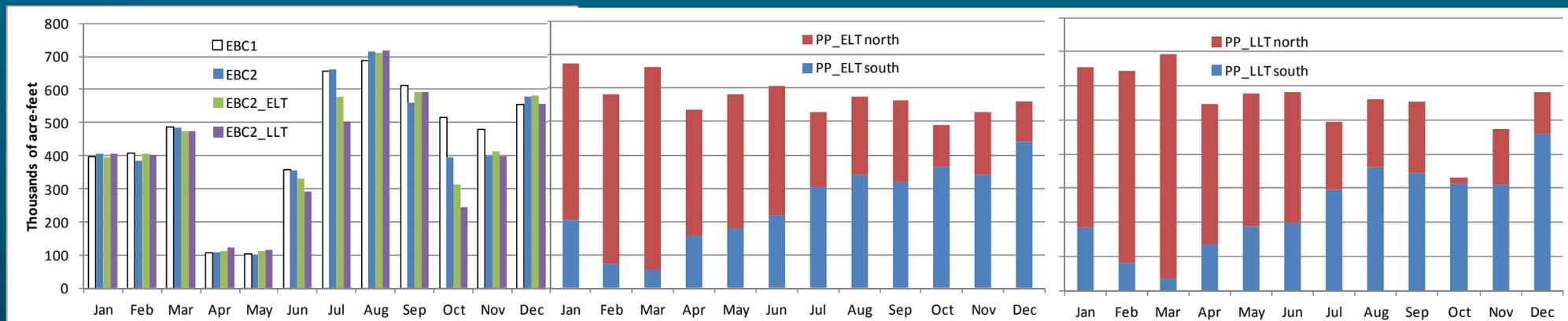
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Environmental Modeling Results
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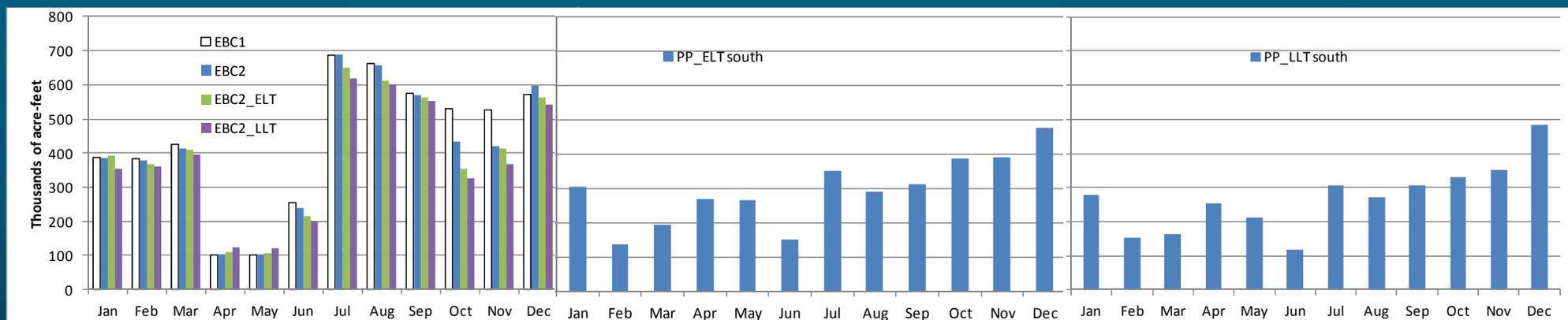
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Below Normal Years (17% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

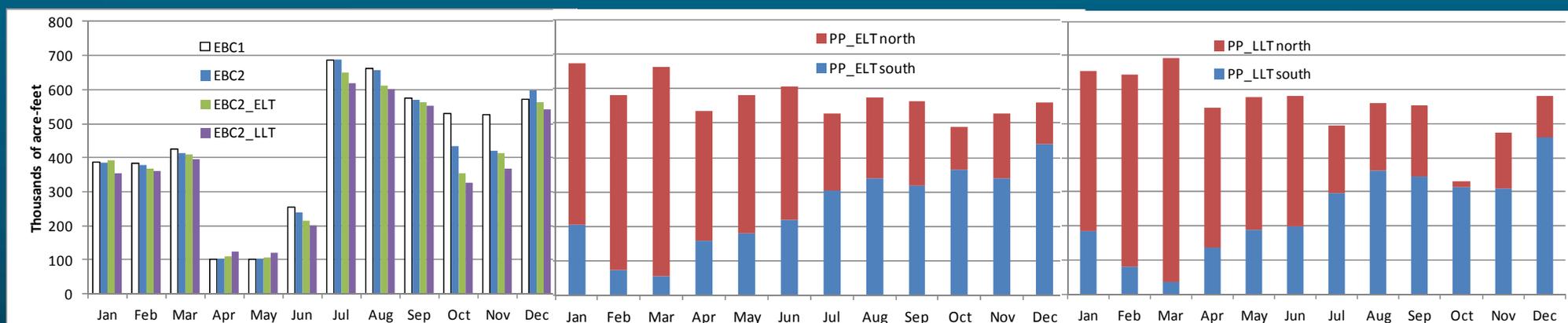
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Below Normal Years (17% of Years)

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Environmental Modeling Results
(CALSIM)

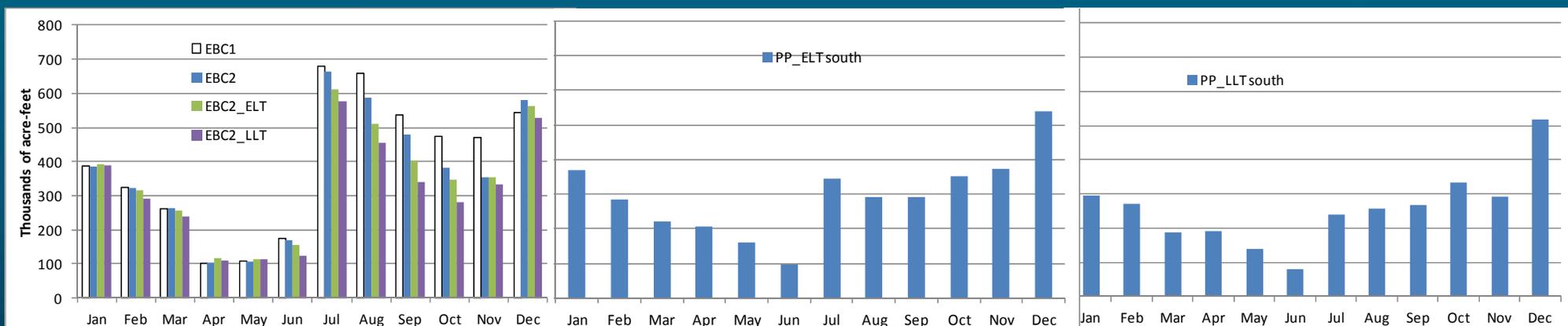
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Dry Years (22% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

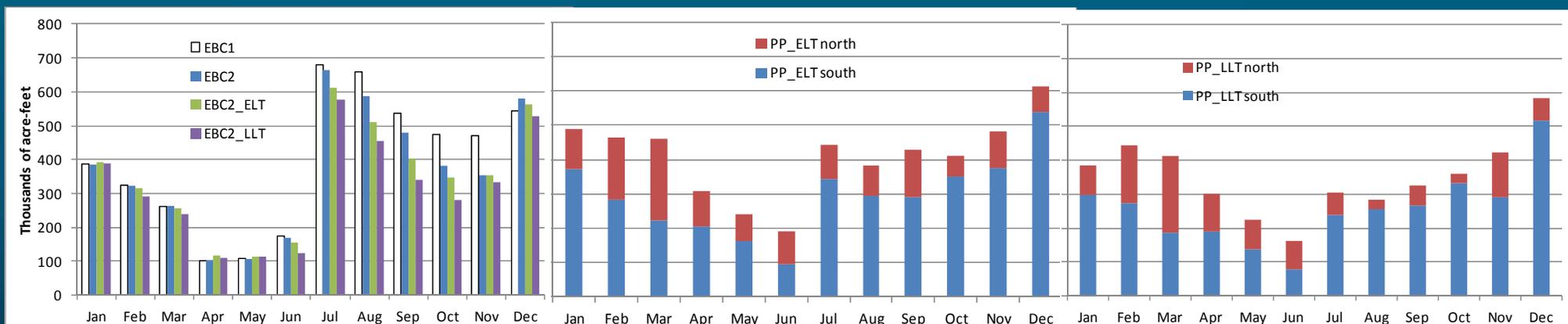
CHANGES IN SOUTH DELTA EXPORT PATTERNS

■ Dry Years (22% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

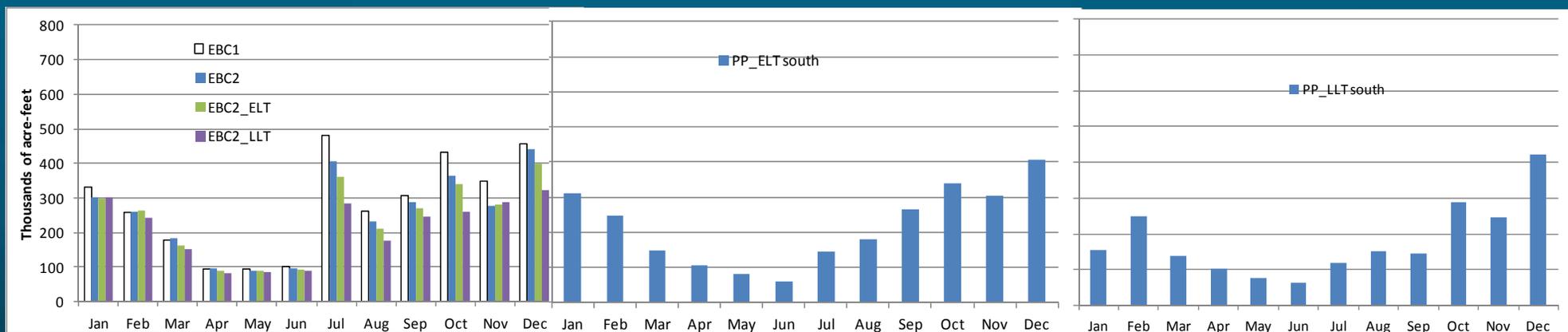
CHANGES IN SOUTH DELTA EXPORT PATTERNS

■ Critical Years (15% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

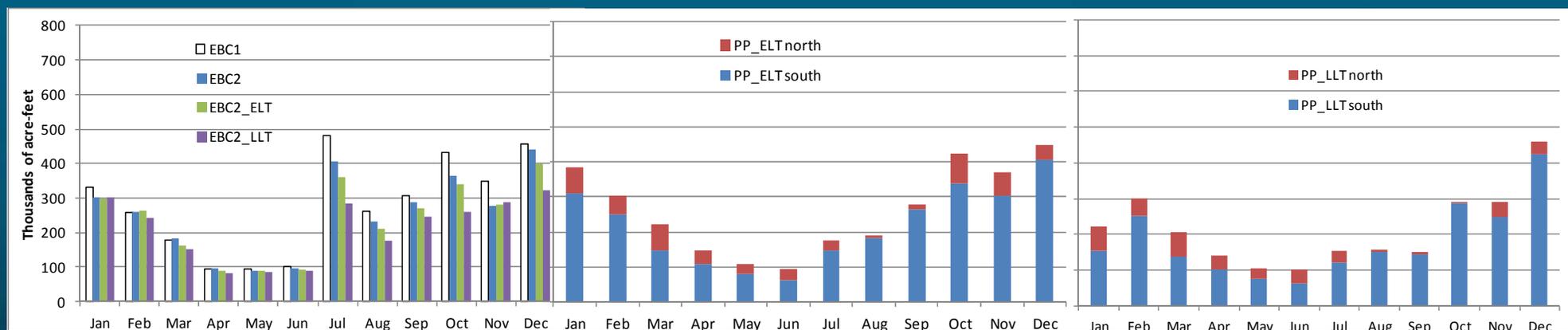
CHANGES IN SOUTH DELTA EXPORT PATTERNS

- Critical Years (15% of Years)

Existing Biological Conditions
(South Delta only)

BDCP Early Long Term
(Dual Conveyance)

BDCP Late Long Term
(Dual Conveyance)



Environmental Modeling Results
(CALSIM)

OVERVIEW OF METHODS

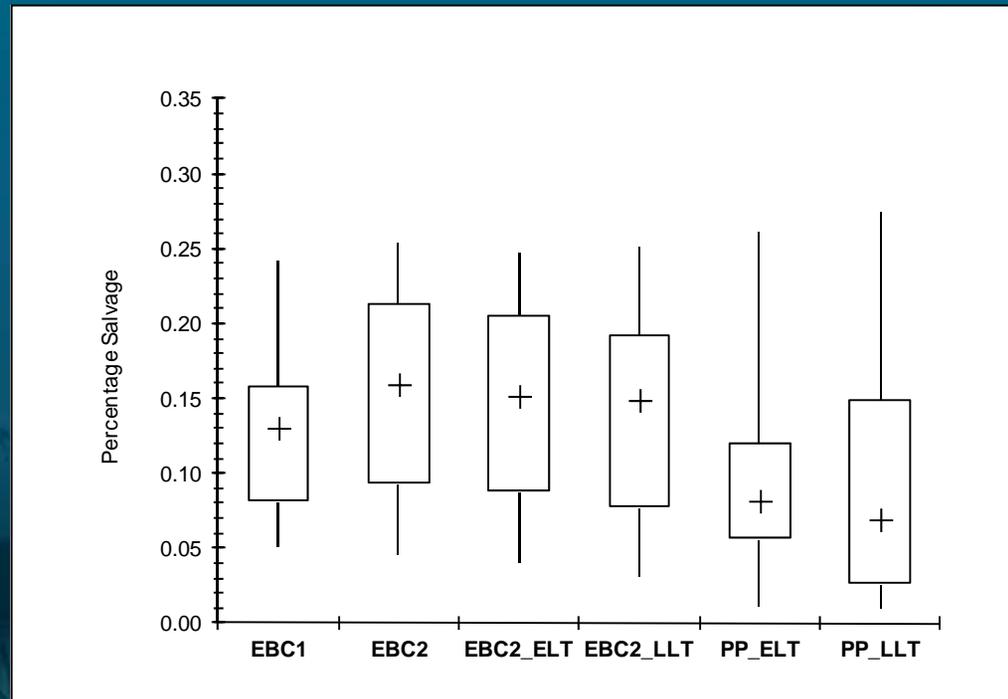
Table B-5. Methods Used to Analyze Entrainment Effects, by Entrainment Location, Species, and Life Stage

Entrainment Location or Species	Geographic Subregion or Life Stage	Salvage-Density Method	Old and Middle River Flow Proportional Entrainment Regressions	DSM2 Particle-Tracking Model (PTM)	Manly (2011) Salvage Estimation Equation	Delta Passage Model Proportional Salvage Estimates	Effectiveness of Nonphysical Barriers	North Delta Intakes Screening Effectiveness Analysis	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	
SWP North Bay Aqueduct Barker Slough Pumping Plant and Alternative Intake				X					
Agricultural diversions				X					X

- BDCP will substantially change the amount and pattern of water exports from SWP/CVP facilities, which is expected to reduce the number of fish of all species entrained relative to existing biological conditions

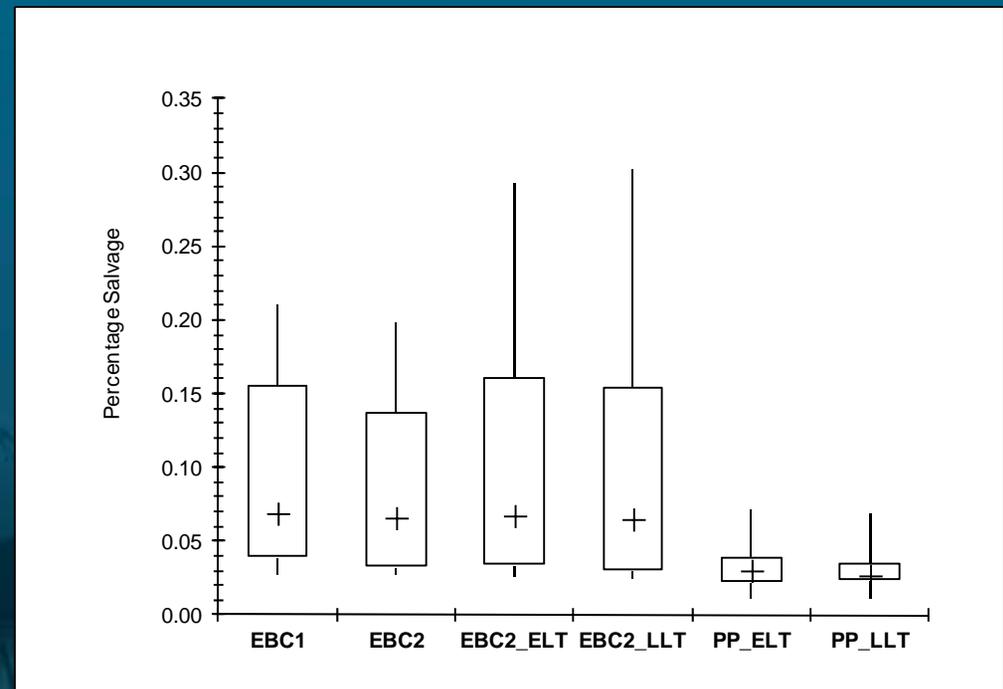
- Winter-Run Chinook Salmon Smolts
 - % of Smolts Salvaged (Delta Passage Model)

WY	EBC1	EBC2	EBC2_ELT	EBC2_LLT	PP_ELT	PP_LLT
1975 (W)	0.24	0.21	0.23	0.19	0.13	0.15
1976 (C)	0.24	0.22	0.20	0.18	0.12	0.15
1977 (C)	0.08	0.05	0.05	0.04	0.06	0.04
1978 (AN)	0.07	0.08	0.08	0.08	0.05	0.03
1979 (BN)	0.15	0.20	0.20	0.20	0.12	0.16
1980 (AN)	0.18	0.24	0.18	0.15	0.07	0.15
1981 (D)	0.12	0.21	0.22	0.21	0.12	0.14
1982 (W)	0.14	0.14	0.14	0.14	0.06	0.02
1983 (W)	0.11	0.22	0.24	0.24	0.01	0.01
1984 (W)	0.16	0.15	0.14	0.16	0.01	0.01
1985 (D)	0.24	0.25	0.25	0.25	0.26	0.27
1986 (W)	0.13	0.16	0.15	0.12	0.13	0.18
1987 (D)	0.15	0.16	0.17	0.16	0.09	0.10
1988 (C)	0.07	0.08	0.08	0.08	0.08	0.07
1989 (D)	0.08	0.10	0.09	0.07	0.08	0.05
1990 (C)	0.11	0.09	0.09	0.06	0.09	0.06
1991 (C)	0.05	0.04	0.04	0.03	0.04	0.03
Average	0.14	0.15	0.15	0.14	0.09	0.10



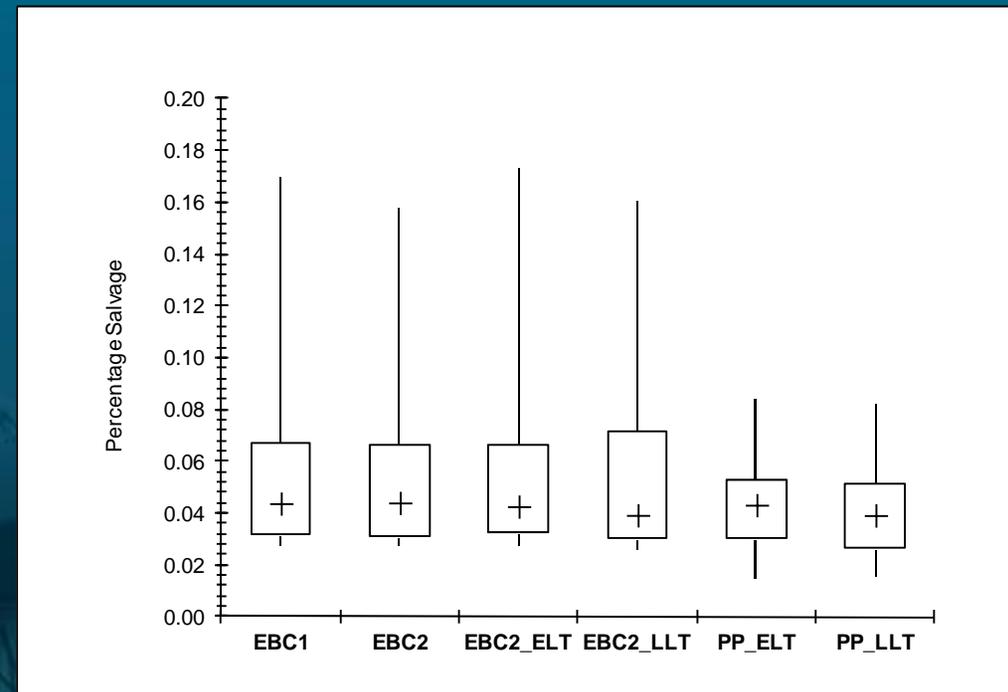
- Spring-Run Chinook Salmon Smolts
 - % of Smolts Salvaged (Delta Passage Model)

WY	EBC1	EBC2	EBC2_ELT	EBC2_LLT	PP_ELT	PP_LLT
1975 (W)	0.16	0.14	0.14	0.13	0.02	0.03
1976 (C)	0.07	0.07	0.08	0.06	0.07	0.06
1977 (C)	0.03	0.03	0.03	0.02	0.03	0.03
1978 (AN)	0.17	0.17	0.17	0.16	0.01	0.01
1979 (BN)	0.17	0.16	0.16	0.16	0.04	0.03
1980 (AN)	0.10	0.08	0.09	0.08	0.02	0.02
1981 (D)	0.07	0.06	0.05	0.06	0.04	0.06
1982 (W)	0.21	0.20	0.20	0.17	0.01	0.01
1983 (W)	0.05	0.07	0.06	0.08	0.01	0.01
1984 (W)	0.15	0.16	0.17	0.15	0.03	0.03
1985 (D)	0.07	0.07	0.07	0.06	0.07	0.07
1986 (W)	0.16	0.10	0.29	0.30	0.02	0.02
1987 (D)	0.04	0.06	0.06	0.04	0.05	0.05
1988 (C)	0.04	0.03	0.03	0.03	0.03	0.02
1989 (D)	0.03	0.03	0.03	0.03	0.03	0.02
1990 (C)	0.03	0.03	0.03	0.03	0.03	0.03
1991 (C)	0.03	0.03	0.03	0.03	0.03	0.03
Average	0.09	0.09	0.10	0.09	0.03	0.03



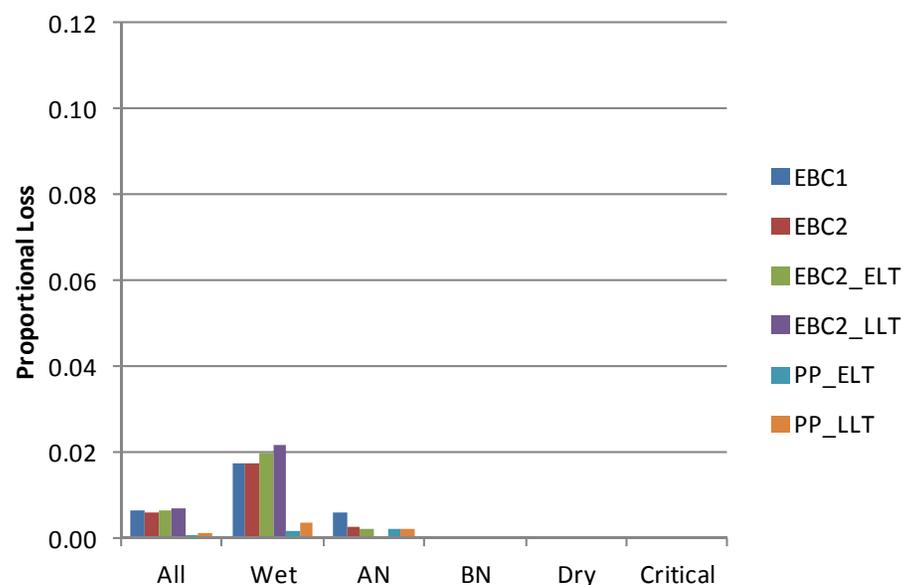
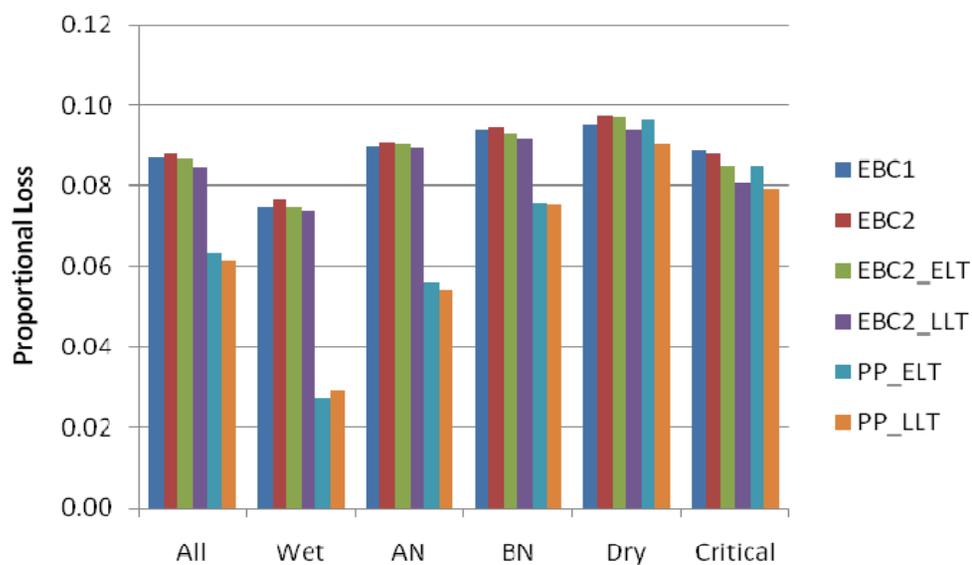
- Sac River Fall-Run Chinook Salmon Smolts
 - % of Smolts Salvaged (Delta Passage Model)

WY	EBC1	EBC2	EBC2_ELT	EBC2_LLT	PP_ELT	PP_LLT
1975 (W)	0.07	0.07	0.07	0.07	0.05	0.05
1976 (C)	0.04	0.05	0.04	0.04	0.04	0.04
1977 (C)	0.03	0.03	0.03	0.03	0.03	0.02
1978 (AN)	0.07	0.08	0.08	0.08	0.02	0.03
1979 (BN)	0.07	0.07	0.07	0.07	0.08	0.08
1980 (AN)	0.05	0.04	0.04	0.04	0.05	0.05
1981 (D)	0.04	0.04	0.04	0.04	0.05	0.05
1982 (W)	0.17	0.16	0.17	0.16	0.02	0.02
1983 (W)	0.07	0.10	0.10	0.11	0.01	0.01
1984 (W)	0.06	0.07	0.06	0.07	0.06	0.05
1985 (D)	0.04	0.04	0.04	0.04	0.06	0.04
1986 (W)	0.07	0.06	0.11	0.13	0.05	0.05
1987 (D)	0.03	0.03	0.03	0.03	0.05	0.05
1988 (C)	0.04	0.03	0.03	0.03	0.03	0.03
1989 (D)	0.03	0.03	0.03	0.03	0.03	0.02
1990 (C)	0.03	0.03	0.03	0.03	0.03	0.03
1991 (C)	0.03	0.03	0.03	0.03	0.04	0.04
Average	0.05	0.06	0.06	0.06	0.04	0.04



- Entrainment of delta smelt at the south Delta export facilities may generally decrease under BDCP relative to existing biological conditions, although instances of increased entrainment are also possible

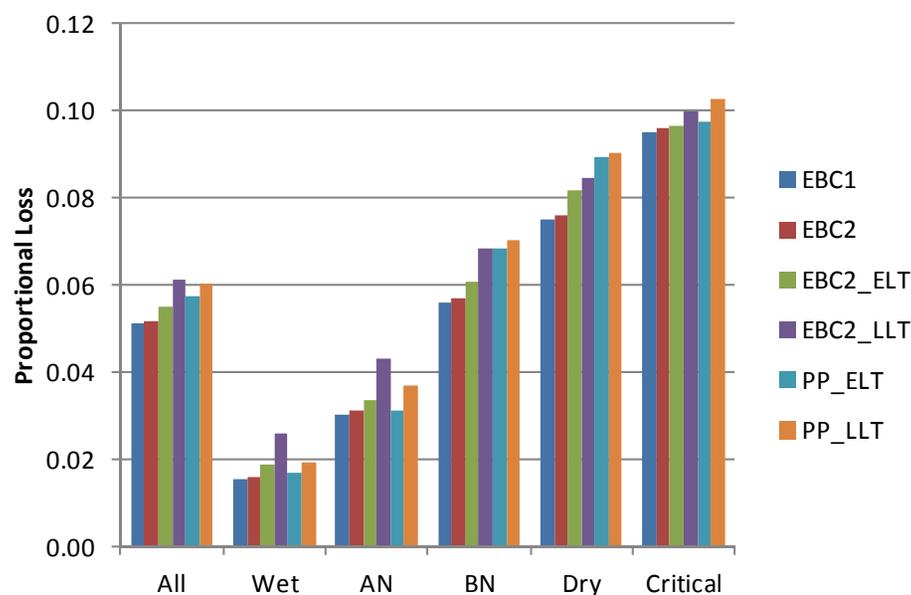
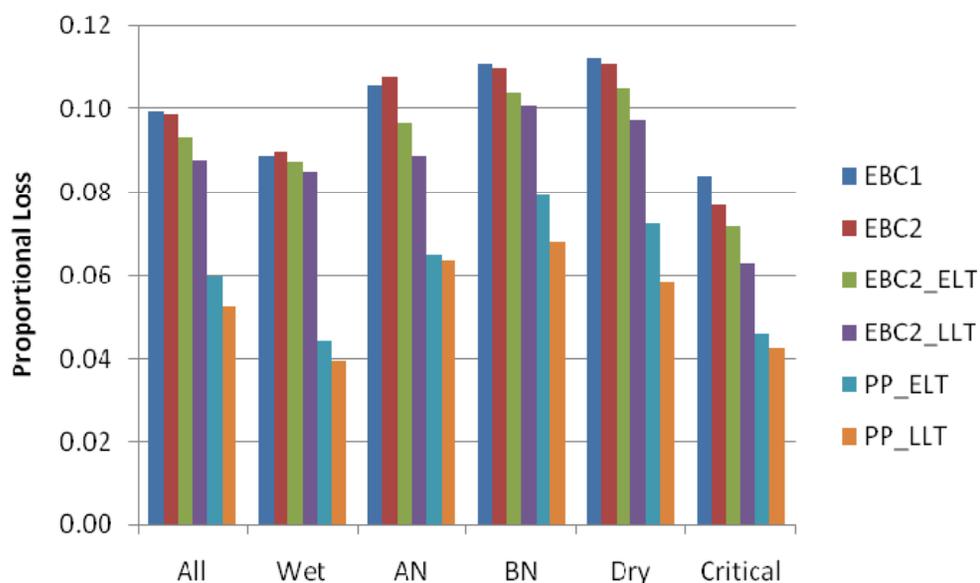
- Delta Smelt Adult
 - Proportion of population lost (OMR Regression)



“Based on Kimmerer” :
Old/Middle River flow only (December-April average)

“Adjusted Kimmerer”, “Based on Miller” :
Old/Middle River flow (December-March average) and Secchi depth (December-February average, estimated from Sac. Basin inflow - assumed to be at 2010 levels)

- Delta Smelt Larvae/Juveniles
 - Proportion of population lost (OMR Regressions)



“Based on Kimmerer” :
Old/Middle River flow only (May-July
average)

“Adjusted Kimmerer”, “Based on Miller” :
Old/Middle River flow and X2 (March-June
average), adjustment for Secchi depth
(assumed to remain at 2010 levels)

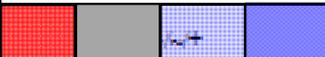
- Entrainment of Sacramento splittail at the south Delta export facilities may increase because improved reproduction from increased accessibility to floodplain habitat would increase population size
 - Yolo Bypass inundation effects increasing population size may 'outweigh' reductions in pumping
 - Need to develop measure of overall abundance

- Screening of the SWP/CVP north Delta intakes should prevent entrainment and impingement of all but the smallest life stages of covered fish species
 - Agency comments: More robust analysis needed for impingement effects
 - (Effects of reduced flow and increased predation not analyzed in this Appendix)

- Estimates of entrainment changes under BDCP are uncertain, but entrainment is readily monitored
 - Continuation of existing monitoring programs
 - Creation of new monitoring programs (e.g., entrainment and impingement at north Delta diversions)
 - Uncertainty about 'unseen' losses

SUMMARY OF RESULTS

Table B-254. Summary of Effects of BDCP on Entrainment of Covered F

		SWP/CVP South Delta Export Facilities by Water-Year Type					
Species	Life Stage	All	Wet	Above Normal	Below Normal	Dry	Cr
Steelhead	Egg/Alevin	Occur upstream of Plan Area					
	Fry	Occur upstream of Plan Area					
	Juvenile	---	----	---	---	-/0	-
	Adult	Large body size/strong swimming ability make entrainment					
Winter-run Chinook salmon	Egg/Alevin	Occur upstream of Plan Area					
	Fry	Occur upstream or otherwise included under analysis					
	Juvenile	---(-)/0/+	----	----/---	--	-/0	-
	Adult	Large body size/strong swimming ability make entrainment					
Spring-run Chinook salmon	Egg/Alevin	Occur upstream of Plan Area					
	Fry	Occur upstream or otherwise included under analysis					
	Juvenile	---(-)/0	---	0/+	+++/++++	++/+++/++++	-
	Adult	Large body size/strong swimming ability make entrainment					
Fall-late fall-run Chinook salmon	Egg/Alevin	Occur upstream of Plan Area					
	Fry	Occur upstream or otherwise included under analysis					
	Juvenile	--(-)/0/++	---	--(-)	--(-)/0/++	-(-)/++/+++	--(-)/
	Adult	Large body size/strong swimming ability make entrainment					
Delta smelt	Egg/Embryo	Adhere to substrates and therefore minimally subject to					
	Larva ¹	---(-)/0/+	----(-)/---(-)/0/+	--(-)/0/+++	--(-)/0/+++	----(-)/-(-)/0/+	---(-)/
	Juvenile	 0/+	----(-)/---(-)/0/+	--(-)/0/+++	--(-)/0/+++	----(-)/-(-)/0/+	---(-)/
	Adult		----(-)/---	---(-)/-	--(-)	-/0	-