ROC on LTO BiOp and Preliminary Effects Analysis Briefing

Director-level Briefing

May 6, 2019

Species and Critical Habitat

Sacramento River winter-run Chinook salmon and Critical Habitat

- Endangered

Central Valley spring-run Chinook salmon and Critical Habitat

- Threatened

California Central Valley steelhead and Critical Habitat

- Threatened

Southern DPS Green Sturgeon and Critical Habitat

- Threatened

Southern Resident Killer Whale

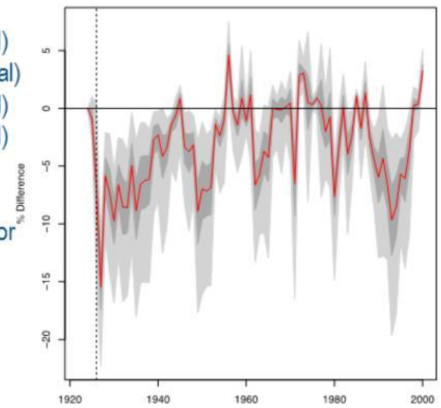
- Endangered

Integration and Synthesis: Winter-run

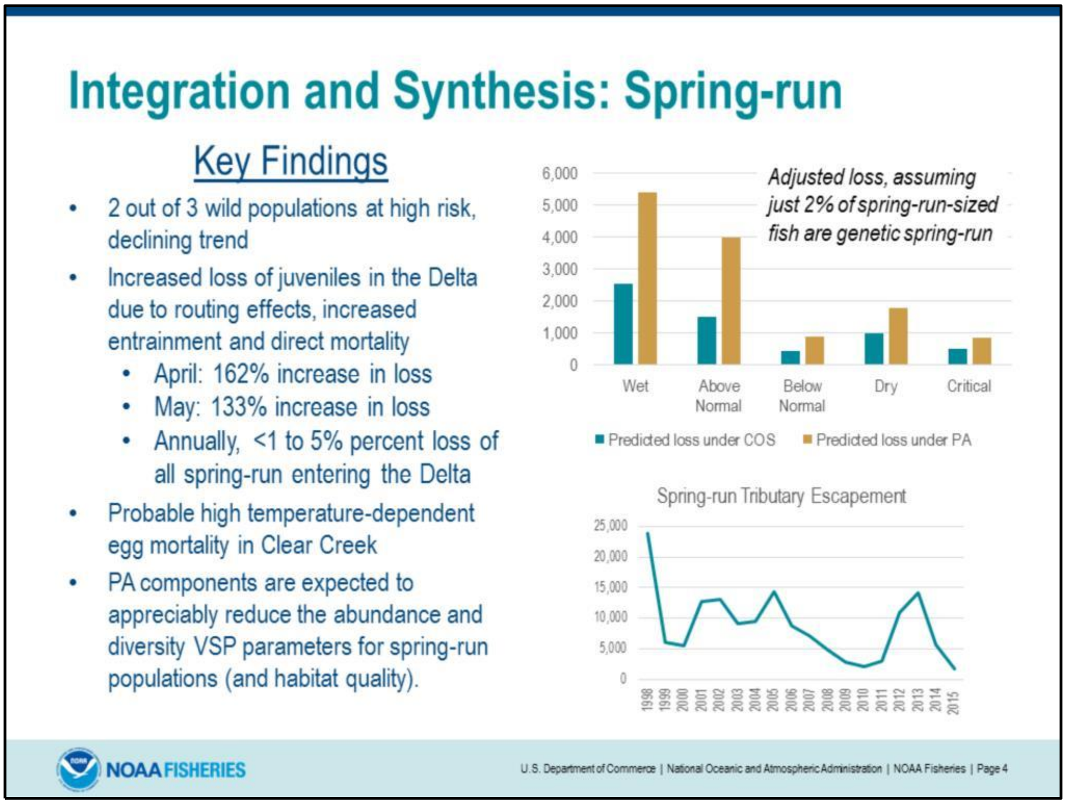
Key Findings

- One remaining population at high risk
- PA is expected to result in concerning levels of egg mortality:
  - **Tier 1:** 0-6% ~45-69% of years (historical:modeled)
  - **Tier 2:** 2-26% ~17-35% of years (modeled:historical)
  - **Tier 3:** 7-59% ~7-15% of years (modeled:historical)
  - **Tier 4:** 70-93% ~5-7% of years (historical:modeled)
- No commitment to stay within a Tier
- No commitment to build Shasta storage
- Increased chance of juvenile entrainment in to the Interior Delta at the DCC
- Estimated loss 6-36% higher at Delta pumping facilities
- LCM shows a 3% reduction in average abundance
- The PA is likely to reduce the abundance and diversity VSP parameters (and habitat quality)

Annual Percent difference in abundance
(PA – COS)/COS x 100%



Increased chance of juvenile entrainment in to the Interior Delta DCC may be open up to an 10 additional days Dec-Jan all years



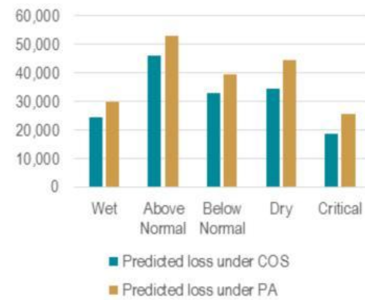
Modeled Old and Middle River flows (OMR flows) will be approximately 3,500 to 4,000 cfs more negative during April and May in wetter water year types with the elimination of the I:E ratio.
OMR flows are modeled to not be positive at any time (monthly average/ exceedance plots).

Clear Creek spawning and holding temperatures often exceeded management approach not current scientific standard.

Integration and Synthesis: Steelhead

Key Findings

- DPS at moderate risk of extinction
- Increased loss of juveniles in the Delta due to routing effects, increased entrainment and direct mortality
  - April: 165% increase in loss
  - May: 134% increase in loss
  - Annually, 5-32% percent loss of all steelhead entering the Delta
- Through-Delta survival 13-19% lower without barrier at head of Old River.
- OMR flows and steelhead density triggers are less protective of the Southern Sierra Diversity Group
- PA components are expected to appreciably reduce the abundance VSP parameter for steelhead populations of the Sacramento River and San Joaquin River basin



CCV steelhead

Month	Predicted loss under COS	Predicted loss under PA	PA-COS	% change
April	2,108	5,586	3,478	165
May	1,326	3,109	1,783	134

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Modeled Old and Middle River flows (OMR flows) will be approximately 3,500 to 4,000 cfs more negative during April and May in wetter water year types without spring protective measures.

OMR flows are modeled to not be positive at any time (monthly average/ exceedance plots).

Integration and Synthesis: Green Sturgeon

Key Findings

- Single population at moderate risk
- Green sturgeon presumably have access to suitable spawning and incubation areas on the Sacramento River under all conditions (e.g., droughts)
- Low and medium magnitude impacts from PA and only a small portion of the population are likely to experience mortality or substantial injury
- Overall, the PA is not expected to exert any additional selective pressures on green sturgeon and the diversity VSP parameter of the population is expected to remain unchanged

Integration and Synthesis: SRKW

Key Findings

- Species is at a high risk of extinction
- Recent information indicates that fecundity is low and that the population is expected to decline in the future.
- Chinook salmon are dominant components of available Chinook salmon prey.
- Under the PA, SRKWs will continue to be exposed to a decreasing abundance of CV Chinook salmon during sensitive time period (winter-spring)
- The PA is expected to diminish VSP parameters and increase extinction risk of ESA-listed units.
- The prospect for persistent and escalating risks of reduced survival and reproductive success continuing indefinitely in the future reduce the likelihood of survival and recovery of this species.

	median
Upstream survival compared to COS	0.9995
Delta Survival compared to COS	0.9985
Freshwater change (upstream X Delta)	0.9981
Ocean Adult Abundance (COS)	457345
Ocean Adult Abundance (PA)	456693
Change in median number of Adult Chinook in the Ocean COS to PA	-652
Percent abundance change in adult Chinook in the Ocean from COS to PA	-0.14%

Winter-run Chinook Effects: North of Delta

Location: Sacramento River between Keswick Reservoir and Clear Creek

Species/Life Stages most affected: Endangered winter-run egg incubation early fry

Response: Temperature dependent mortality (showing the widest range of 25 and 75 percentiles for 2 different models)

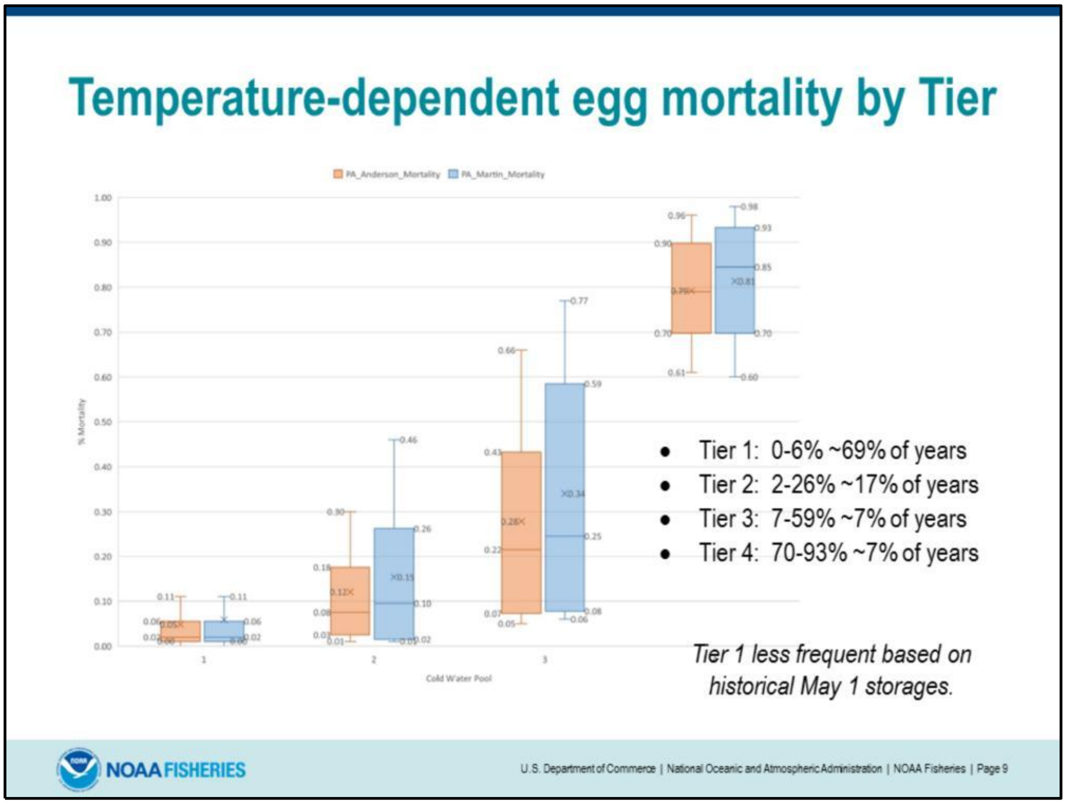
- **Tier 1:** 0-6%~45-69%of years (historical:modeled)
- **Tier 2:** 2-26%~17-35%of years (modeled:historical)
- **Tier 3:** 7-59%~7-15%of years (modeled:historical)
- **Tier 4:** 70-93%~5-7%of years (historical:modeled)

Severity of Response: High

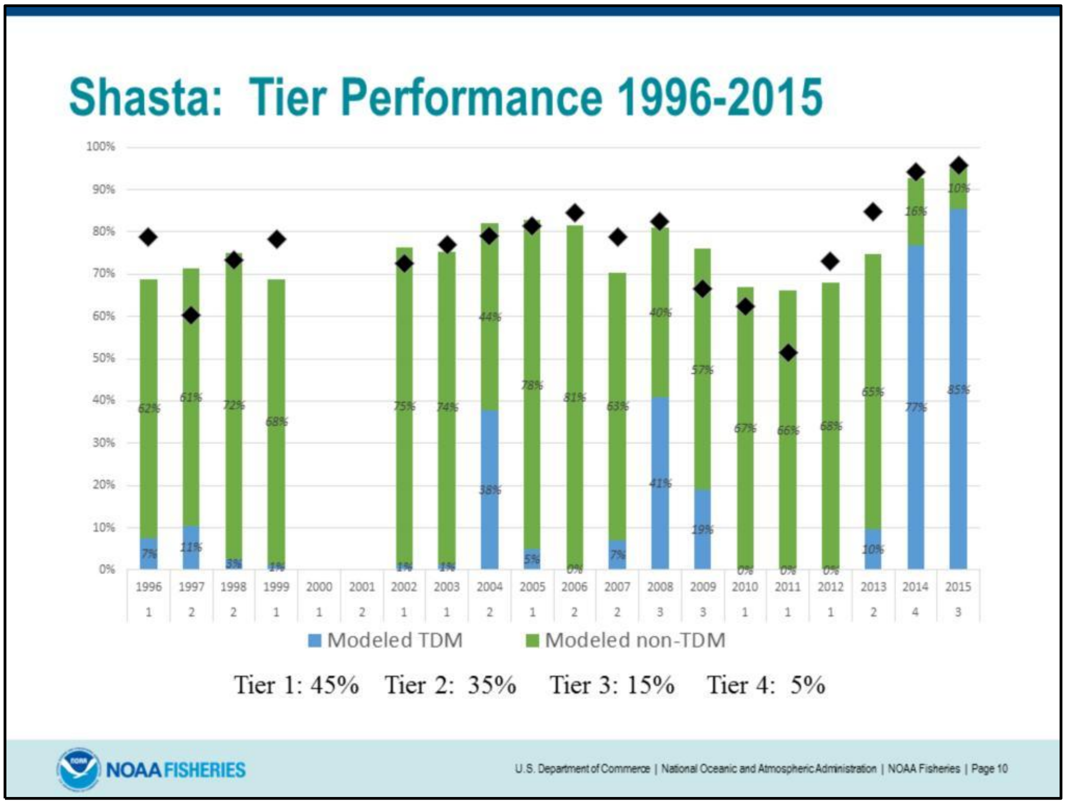
Weight of evidence: High-supported by multiple models and scientific publications

Talking points/areas of concern:

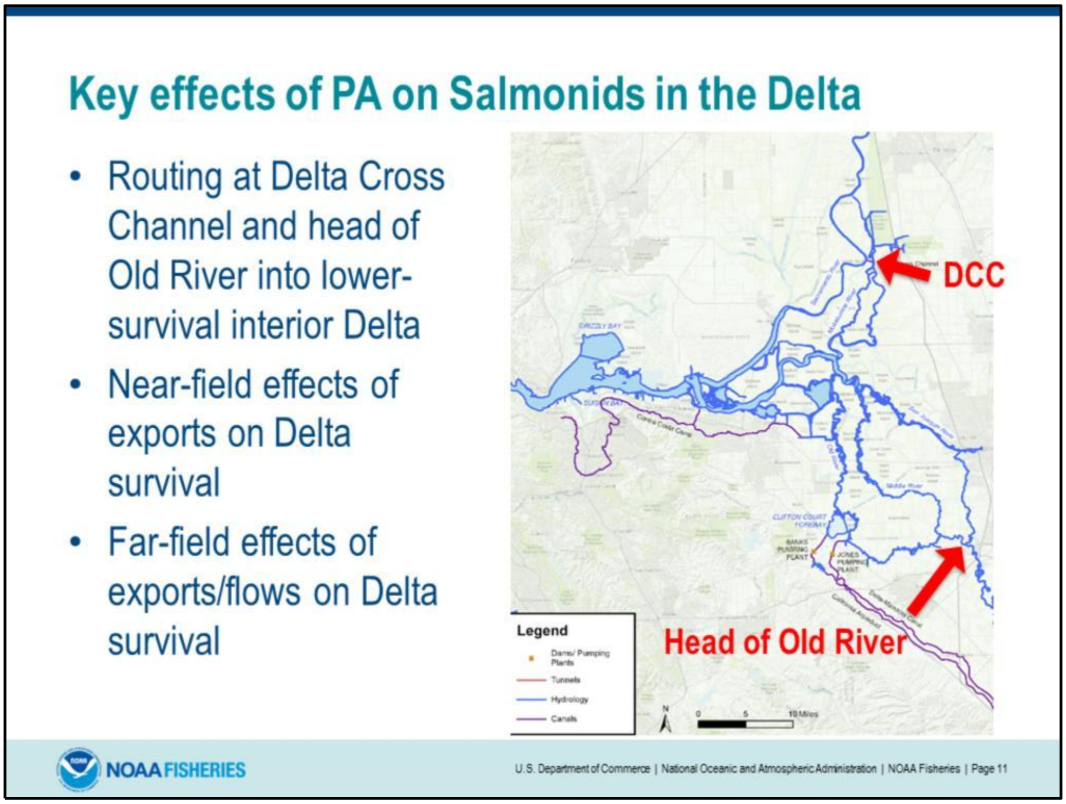
- No specific performance metrics.
- No clear strategy or commitment to build storage, especially in spring months.
- There is no commitment to stay within a given Tier for Shasta Cold Water Pool Management. Therefore, the modeled temperature dependent egg mortality in Reclamation's biological assessment levels are skewed low.
- The Anderson approach for hatch protection is novel and untested.
- The characterization of current operations, COS, and the PA in physical modeling.
- Lack of certainty in process to protect Shasta Reservoir storage and build its cold water pool, increases the risk to the species regarding upstream temperature management.



The data plotted in the figures I sent earlier were derived by Miles Daniels at the SWFSC, using the methods described by Reclamation in BA appendix d, modeling. Using the methods described by Reclamation, Miles was able to generate the same model results as what Reclamation has presented in the BA (although Reclamation presented them by WYT not Tier). The Anderson (Hatch) and Martin (Emerge) results are based on CalSim II modeling (82 year record), HEC5Q temperature modeling (same for both COS and PA), and an averaged spatio-temporal distribution of WR redds (2007 - 2014).

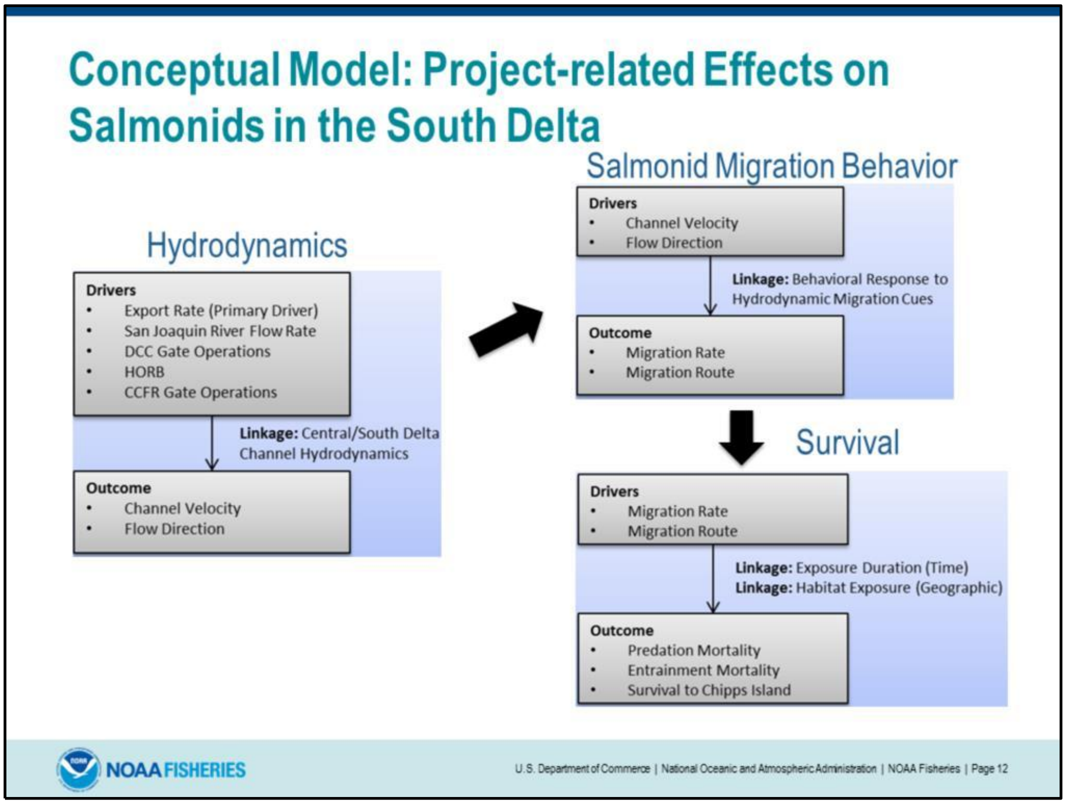


This is a look back at Tier performance since 1996



These are three key project-related mechanisms of effects to salmonids in both the COS and PA. Our analysis shows some increases in effects, to one or more salmonid species, for each of these mechanisms.

(Use the map to highlight two key routing junctions at DCC and HOR; also indicate area of near-field vs. far-field effects.)



This is the overarching conceptual model that the CAMT Salmonid Scoping Team used to develop its report on what we know and don't know about project-related effects on salmonids in the South Delta.

It's a lot easier to measure and model hydrodynamic changes than fish responses to those changes, the goal of the CAMT SST report was to review evidence and clarify mechanisms that could lead from hydrodynamic changes to biological responses in behavior or survival.

The report focused on "behavior" in terms of migration rate and route, and on survival.

Routing into the Interior Delta

Location: Delta Cross Channel Gates

Species/Life Stages most affected: *Sacramento River-origin fish:* Winter-run smolts but spring-run and steelhead also affected

Response: Mortality due to routing and altered hydrodymanics into the delta interior

- DCC may be open 10 additional days Dec-Jan in all years
- If the 10 additional days corresponds with a pulse of endangered winter-run then the magnitude of effect could be very high

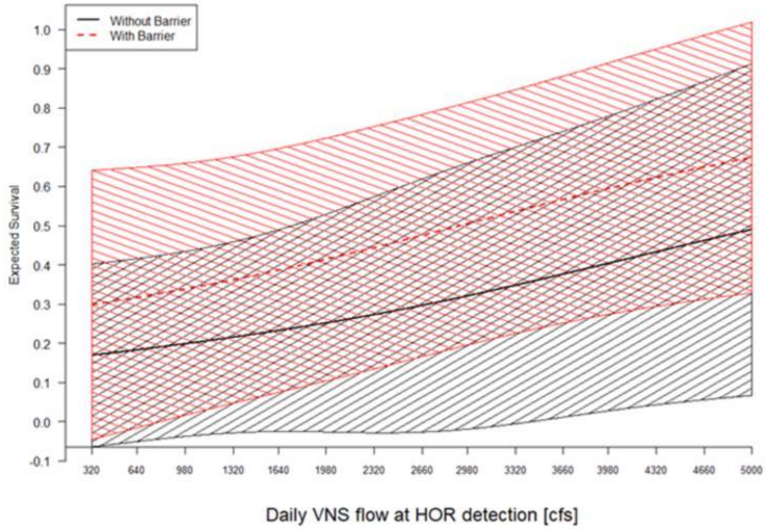
Location: Head of Old River

Species/Life Stages most affected: *San Joaquin River-origin fish: Steelhead and spring-run*

Response: Mortality due to routing and altered hydrodymanics into the delta interior

- Steelhead migration in San Joaquin River primarily in April and May
- Through-Delta survival for steelhead 13-19% lower without barrier at head of Old River *(Buchanan 2019).*
- Effects of routing into interior Delta exacerbated by increased PA exports in April and May.

Effects on Steelhead Survival Associated with Head of Old River Barrier (HORB)



Source: Buchanan 2019

Near-field Effects: Fish Loss at Export Facilities

Location: Sacramento River, SJ River, Delta

Species/Life Stages most affected: Spring-run, steelhead, winter-run,

Response: Mortality related to entrainment loss at the pumping facilities

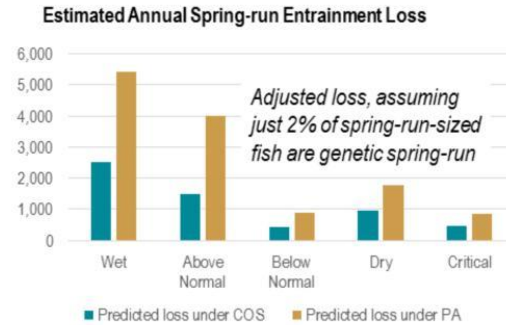
- Effects occur from October through May and most significant for spring-run and steelhead in April and May
- Spring-run
    - April: 162% increase
    - May: 133% increase
    - Annually, <1 to 5% of SR entering Delta
- Steelhead
    - April: 165% increase
    - May: 134% increase
    - Annually, 5 to 32% of SH in Delta

Severity of Response: High

Weight of evidence: High

Talking points/areas of concern:

- Higher export levels and more negative OMR flows even with real-time OMR restriction triggers
- Effects of exports exacerbated by potential for increased routing into interior Delta



Modeled monthly loss at export facilities

CV spring-run Chinook salmon*				
Month	Predicted loss under COS	Predicted loss under PA	PA-COS	% change
October	1	1	0	48
November	0	0	0	--
December	0	0	0	--
January	0	0	0	--
February	18	18	1	4
March	550	516	-34	-6
April	1,284	3,366	2,082	162
May	634	1,481	847	133
June	33	33	0	0
July	0	0	0	--
August	0	0	0	--
September	0	0	0	--

*2% of modeled loss of spring-run-sized Chinook

CCV steelhead				
Month	Predicted loss under COS	Predicted loss under PA	PA-COS	% change
October	175	260	85	48
November	52	60	9	17
December	167	147	-21	-12
January	5,558	5,927	369	7
February	6,696	6,992	296	4
March	7,197	6,731	-466	-6
April	2,108	5,586	3,478	165
May	1,326	3,109	1,783	134
June	975	982	7	1
July	37	36	0	-1
August	12	12	0	-1
September	17	17	0	2

These tables show results from the “Salvage Density model”, converted using the standard loss multipliers to loss. Because the model is based on historical salvage records which assign race based on the length-at-date criteria, the SR-sized numbers likely include a lot of non-genetic spring-run fish. Based on a DWR report in 2013, which found that 2% of SR-sized fish were genetic SR, we converted SR-sized fish to SR (rough estimate).

SR: The migration timing of SR overlaps with the increased period of exports in April and May, so we see effects to a significant proportion of the population.

Steelhead: As for SR, the most significant effects to steelhead occur in April and May. This is the period of migration of steelhead from the SJR basin. As Joe described as part of our I&S, we are concerned about the overall level of loss throughout the year, but the deepening of harm is most severe in the late spring.

CV spring-run population context of modeled loss

- Annual estimated Delta juvenile population range: ~100,000-2,500,000*

- Estimated annual loss from PA: 5,415
- Estimated annual loss from COS: 2,519

PA: Loss of <1 to 5 percent of spring-run in the Delta

COS: Loss of <1 to 3 percent of spring-run in the Delta

**Conceptual estimate based on recent (previous 5 yrs) potential demographic similarities:*

	Escapement	JPE
Winter-run	1,200-6,400	100,00-1,200,000
Spring-run	1,500-14,100	~100,000-2,500,000

CCV steelhead population context of modeled loss

- Estimated annual Delta juvenile population range- 94,000-658,000*

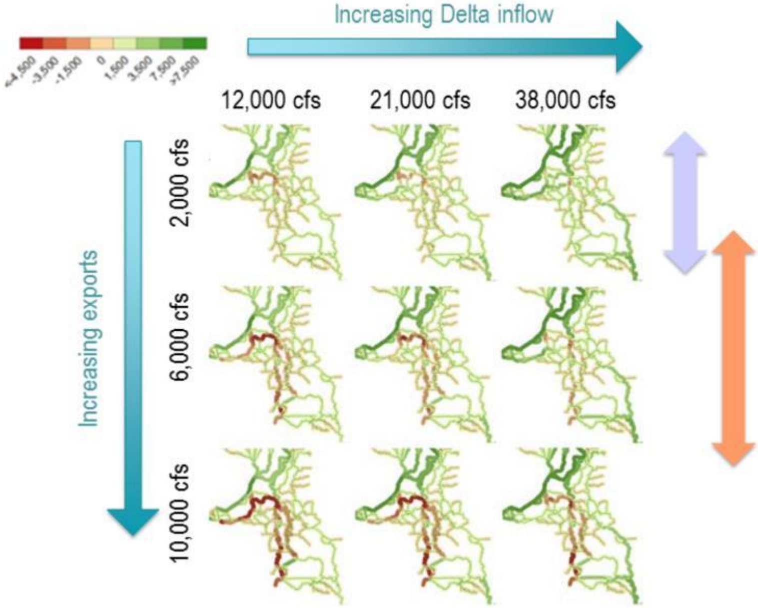
- Estimated annual loss from PA: 29,858
- Estimated annual loss from COS: 24,319

  PA: Loss of 5 to 32 percent of steelhead in the Delta
  COS: Loss of 4 to 26 percent of steelhead in the Delta

- **Take Home- Potential loss of substantial portions of a cohort in poor production years**

**Annual Delta juvenile population range 1997-2000:*
94,000-336,000 (Good et al. 2005)
413,069-658,453 (Nobriga and Cadrett 2001)

Far-field Effects: PA increases export footprint



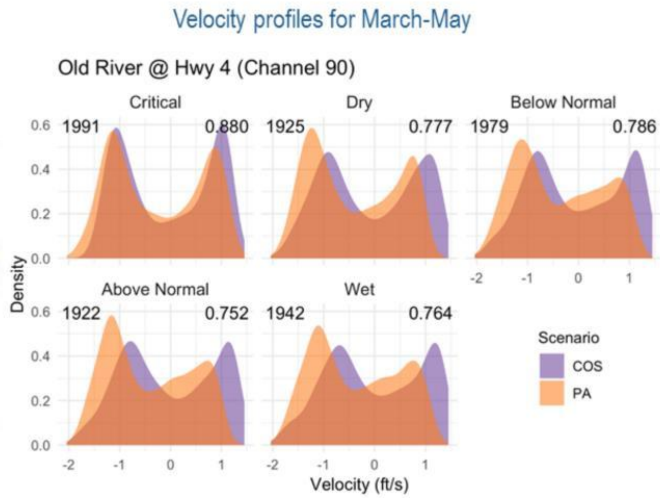
Source: Modified from Figure 3-2 of CAMT SST Report Volume I

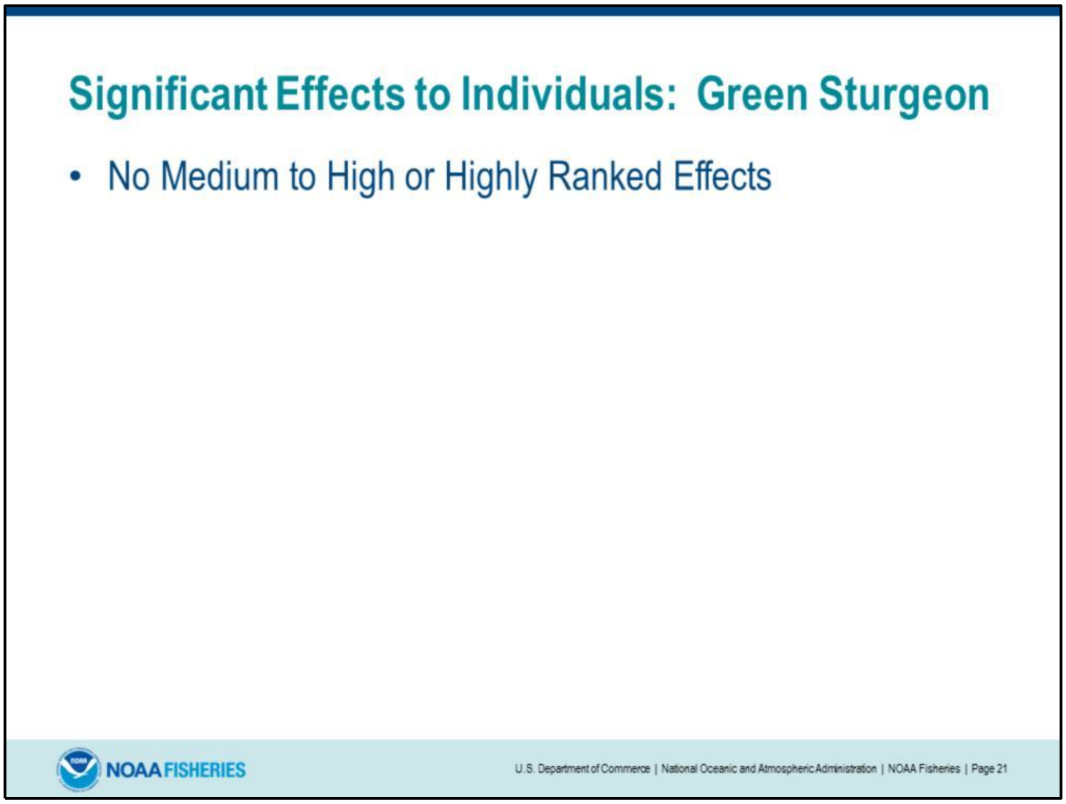
April & May exports:

COS: 1,500-3,500 cfs

PA: 2,300-7,800 cfs

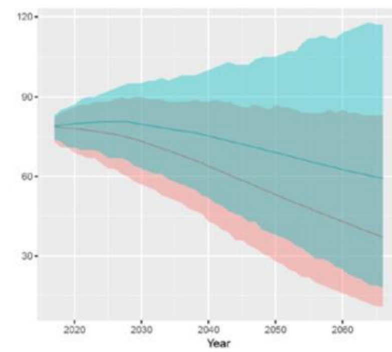
Far-field Effects: PA reduces net downstream flows in spring





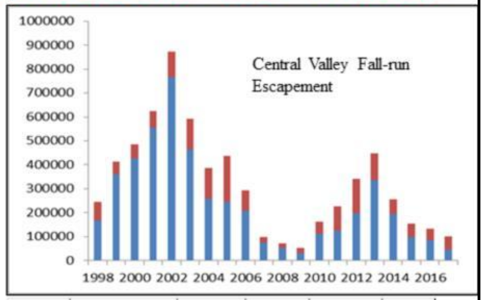
Routing and loss could be affected by PA, but not a high magnitude concern.

Southern Resident Killer Whales Population



Significant Effects: Southern Resident Killer Whales

- The productivity of CV Chinook salmon, especially the dominant fall-run population, is decreasing.
- There are few measures under the PA to minimize the impacts of operations on the non-ESA listed populations.
- Some of the potential benefits of proposed restoration activities that have been proposed are uncertain at this time and others may be in the Environmental Baseline (previously consulted on)
- Reductions and limitations in the abundance of Chinook available as prey as a result of the PA will increase over time.
- For ESA-listed Chinook salmon ESUs in the Central Valley, we conclude that population level effects for ESA-listed species and critical habitats overall under the PA are significant across multiple VSP parameters, including abundance.



Run	Yeartype (Sacramento "40-30-30" Index under ELT Q5 hydrology)	Predicted loss under COS	Predicted loss under PA	Difference in predicted loss (PA-COS)	% change
Fall-run	Wet	226,747	371,844	145,097	64
	Above Normal	94,948	187,099	92,151	97
	Below Normal	44,277	83,163	38,885	88
	Dry	101,357	197,171	95,813	95
	Critical	18,494	33,213	14,719	80
Late fall-run	Wet	1,339	1,309	-30	-2
	Above Normal	1,132	1,246	114	10
	Below Normal	94	109	15	16
	Dry	649	705	56	9
	Critical	161	178	17	11
Spring-run	Wet	125,972	270,759	144,788	115
	Above Normal	75,124	199,562	124,438	166
	Below Normal	20,859	43,781	22,922	110
	Dry	48,347	88,278	39,931	83
	Critical	23,917	42,325	18,408	77
Winter-run	Wet	48,450	54,035	5,585	12
	Above Normal	24,818	26,201	1,383	6
	Below Normal	21,509	25,499	3,991	19
	Dry	14,276	17,820	3,543	25
	Critical	3,890	5,283	1,392	36