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**FISHERIES**

# ROC on LTO BiOp and Preliminary Effects Analysis Briefing

Director-level Briefing  
May 6, 2019

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## 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

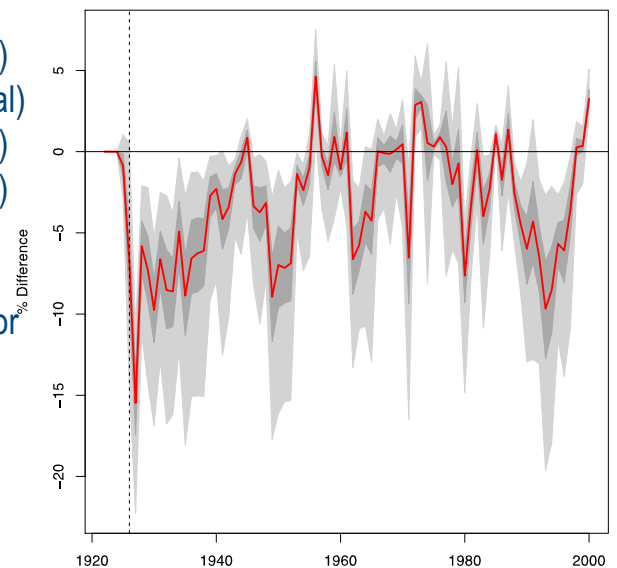


# Integration and Synthesis: Winter-run

## 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)

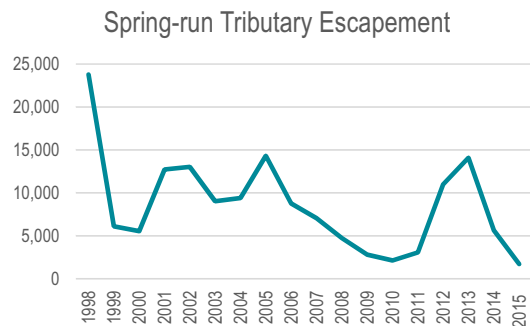
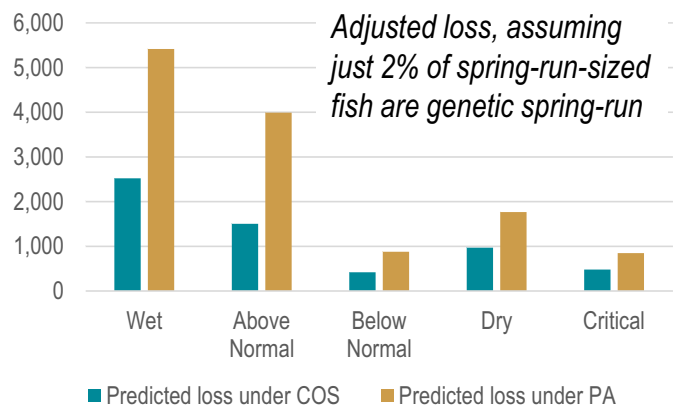
**Annual Percent difference in abundance  
(PA – COS)/COS x 100%**



# Integration and Synthesis: Spring-run

## Key Findings

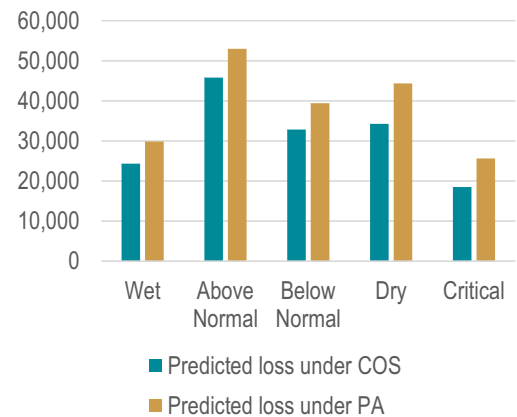
- 2 out of 3 wild populations at high risk, declining trend
- Increased loss of juveniles in the Delta due to routing effects, increased entrainment and direct mortality
  - April: 162% increase in loss
  - May: 133% increase in loss
  - Annually, <1 to 5% percent loss of all spring-run entering the Delta
- Probable high temperature-dependent egg mortality in Clear Creek
- PA components are expected to appreciably reduce the abundance and diversity VSP parameters for spring-run populations (and habitat quality).



# 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

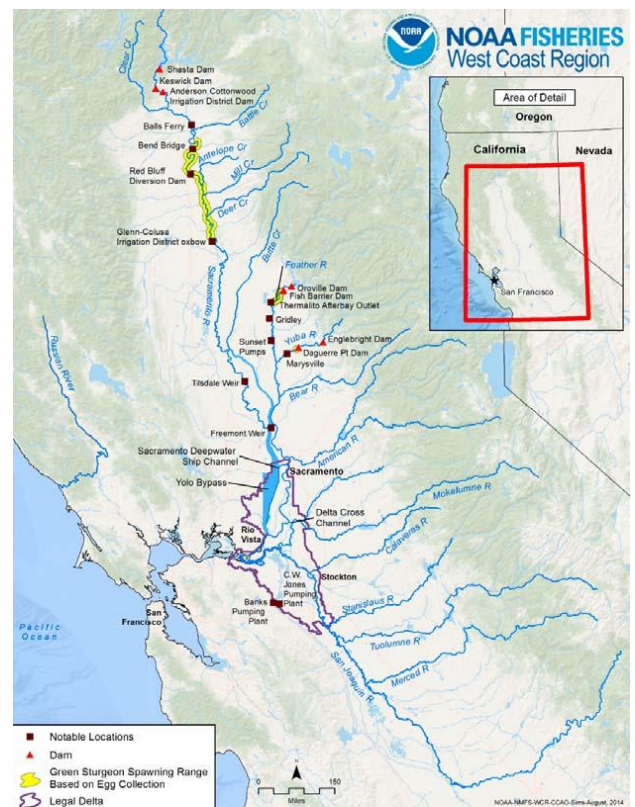


CCV steelhead				
Month	Predicted loss under COS	Predicted loss under PA	PA-COS	% change
April	2,108	5,586	3,478	165
May	1,326	3,109	1,783	134

# 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%



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## 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

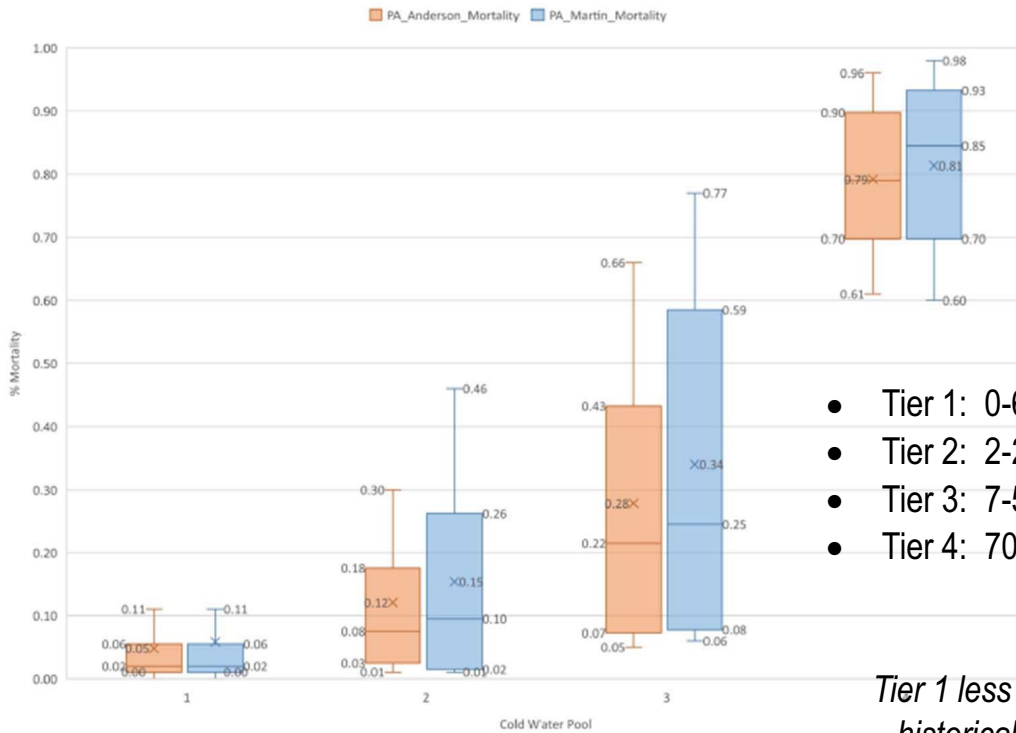
**Weight of evidence:** High-supported by multiple models and scientific publications

**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.



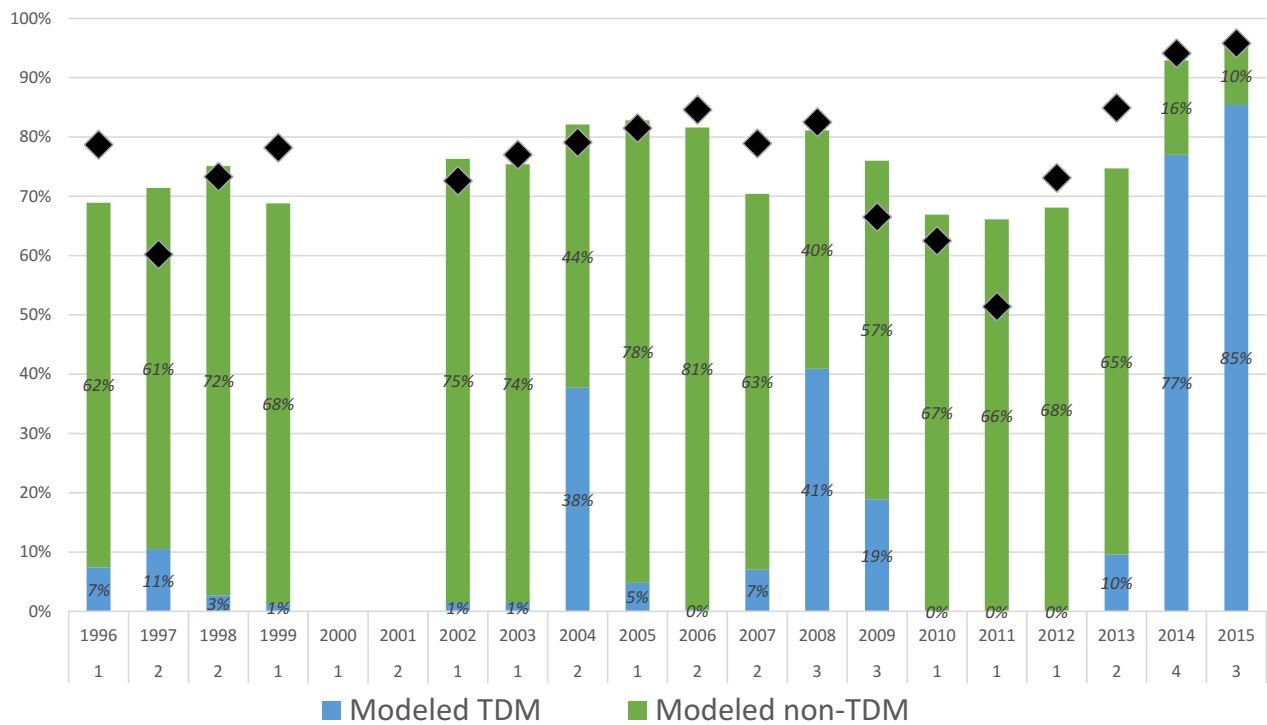
# Temperature-dependent egg mortality by Tier



- Tier 1: 0-6% ~69% of years
- Tier 2: 2-26% ~17% of years
- Tier 3: 7-59% ~7% of years
- Tier 4: 70-93% ~7% of years

*Tier 1 less frequent based on historical May 1 storages.*

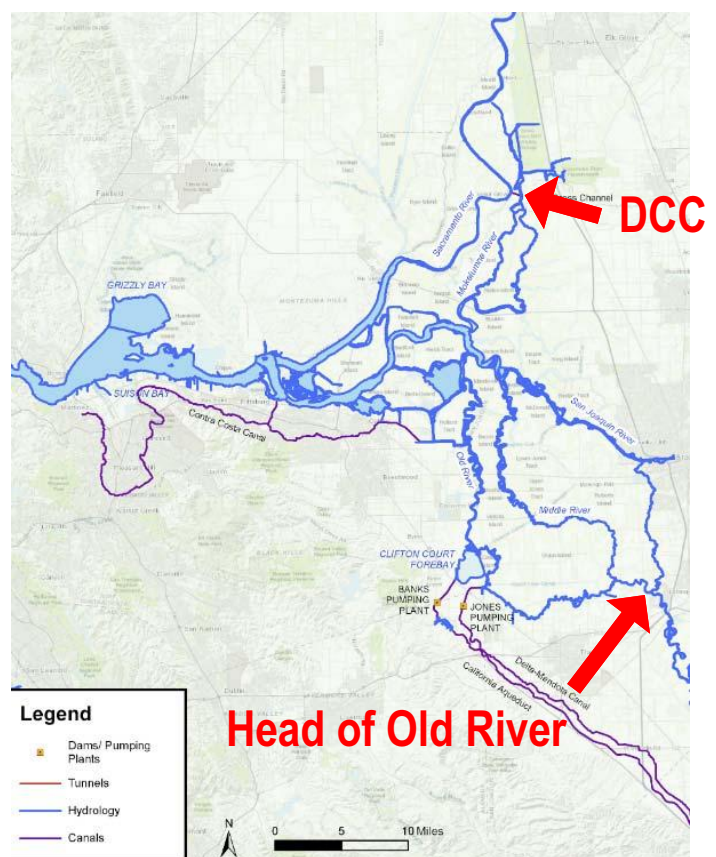
# Shasta: Tier Performance 1996-2015



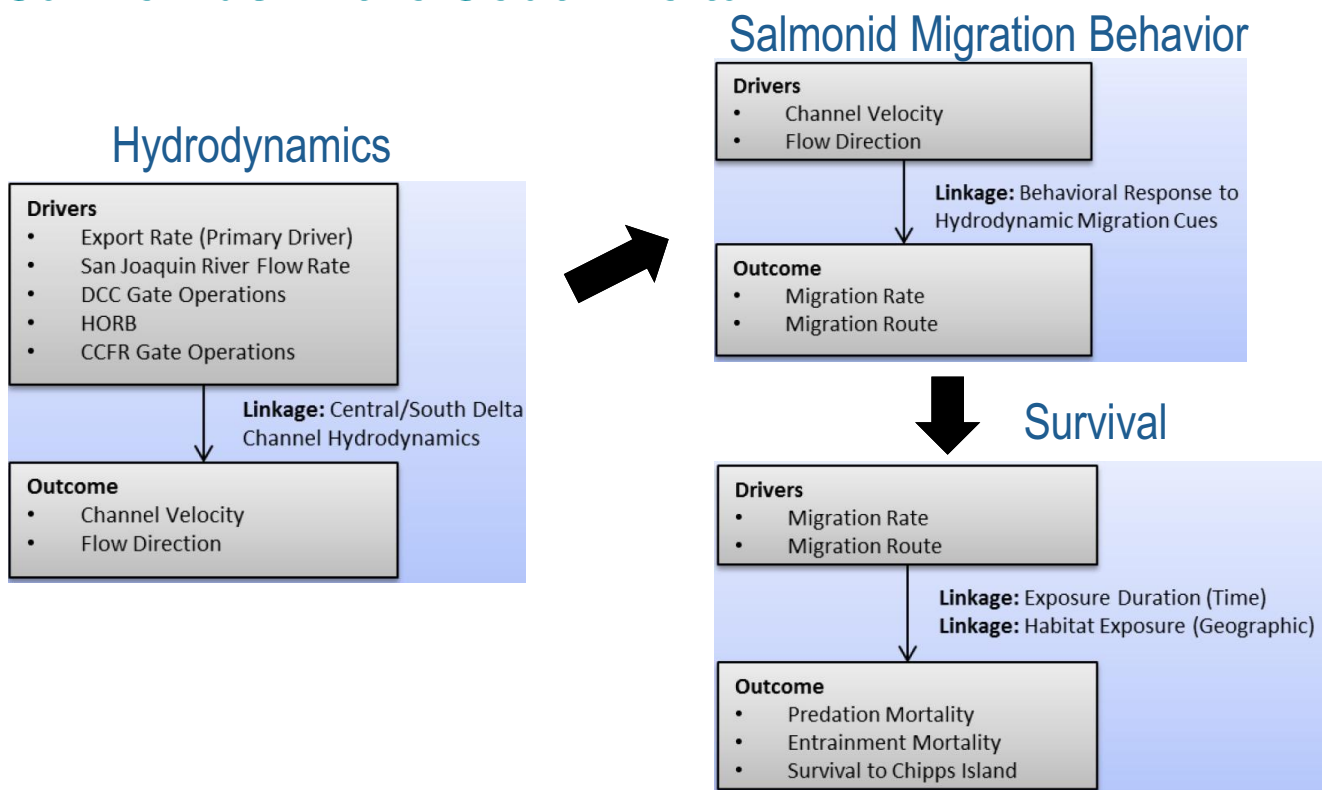
Tier 1: 45%    Tier 2: 35%    Tier 3: 15%    Tier 4: 5%

## Key effects of PA on Salmonids in the Delta

- Routing at Delta Cross Channel and head of Old River into lower-survival interior Delta
- Near-field effects of exports on Delta survival
- Far-field effects of exports/flows on Delta survival



# Conceptual Model: Project-related Effects on Salmonids in the South Delta



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## 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 hydrodynamics 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

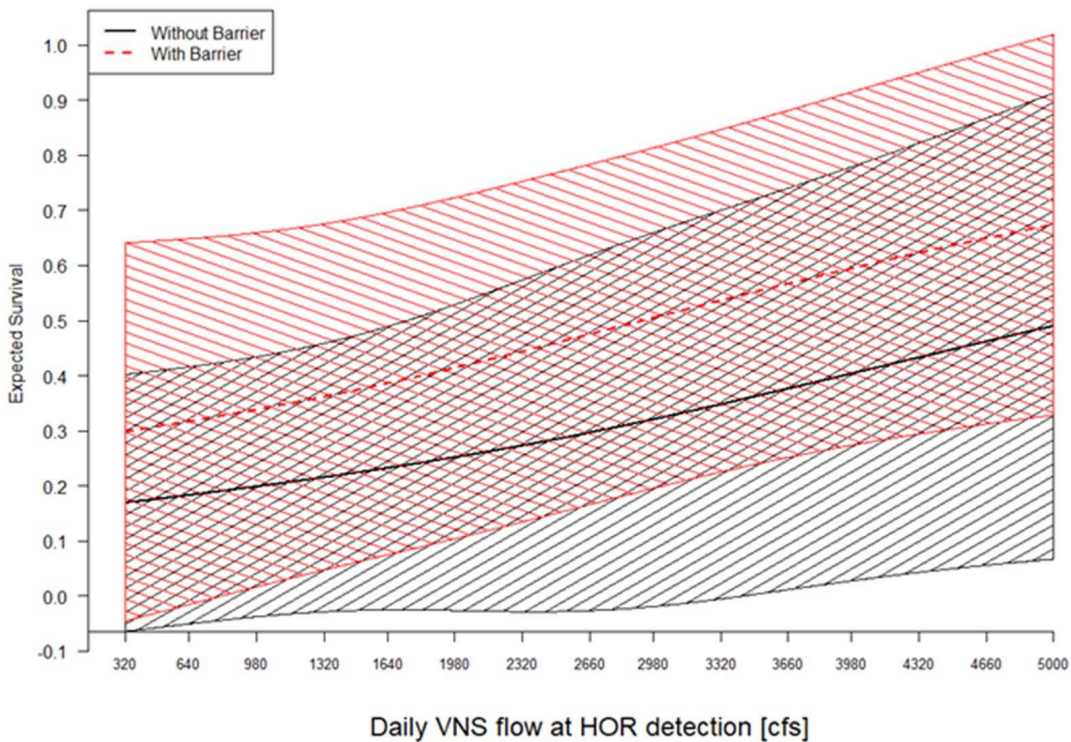
**Location:** Head of Old River

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

**Response:** Mortality due to routing and altered hydrodynamics 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

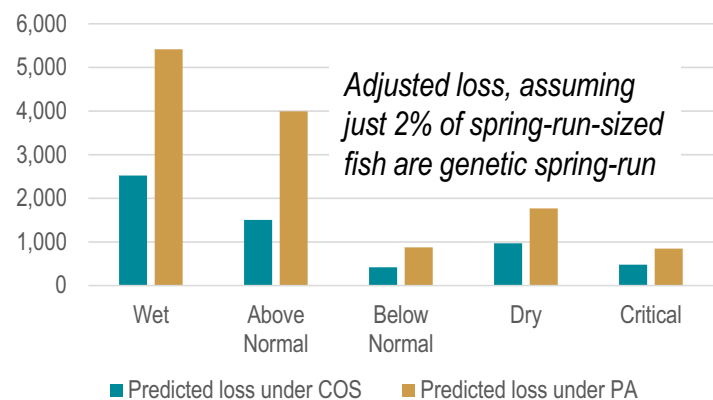
**Severity of Response:** High

**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

**Estimated Annual Spring-run Entrainment Loss**



## 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	--

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

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



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## 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



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## 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**

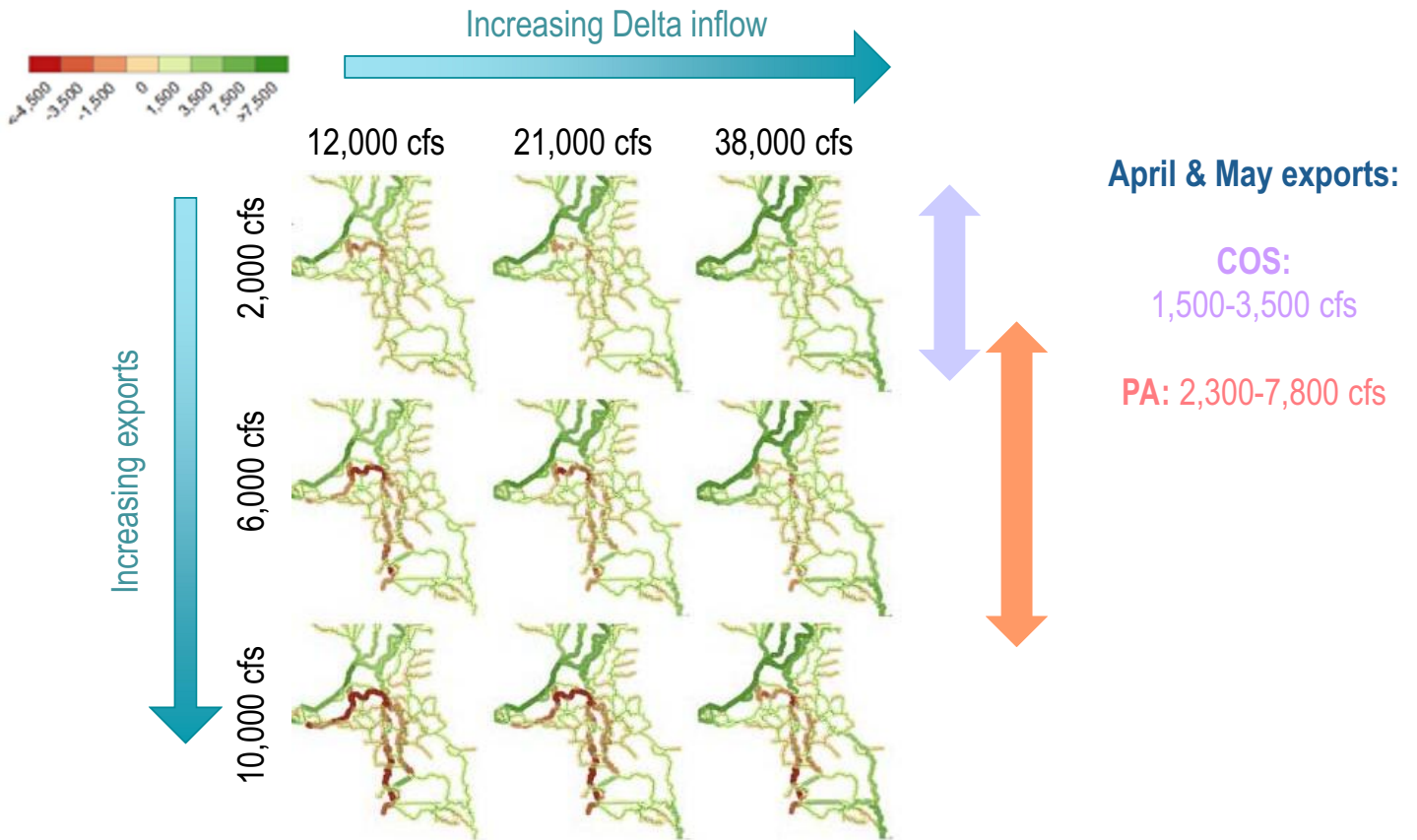
*\*Annual Delta juvenile population range 1997-2000:*

94,000-336,000 (Good et al. 2005)

413,069-658,453 (Nobriga and Cadrett 2001)



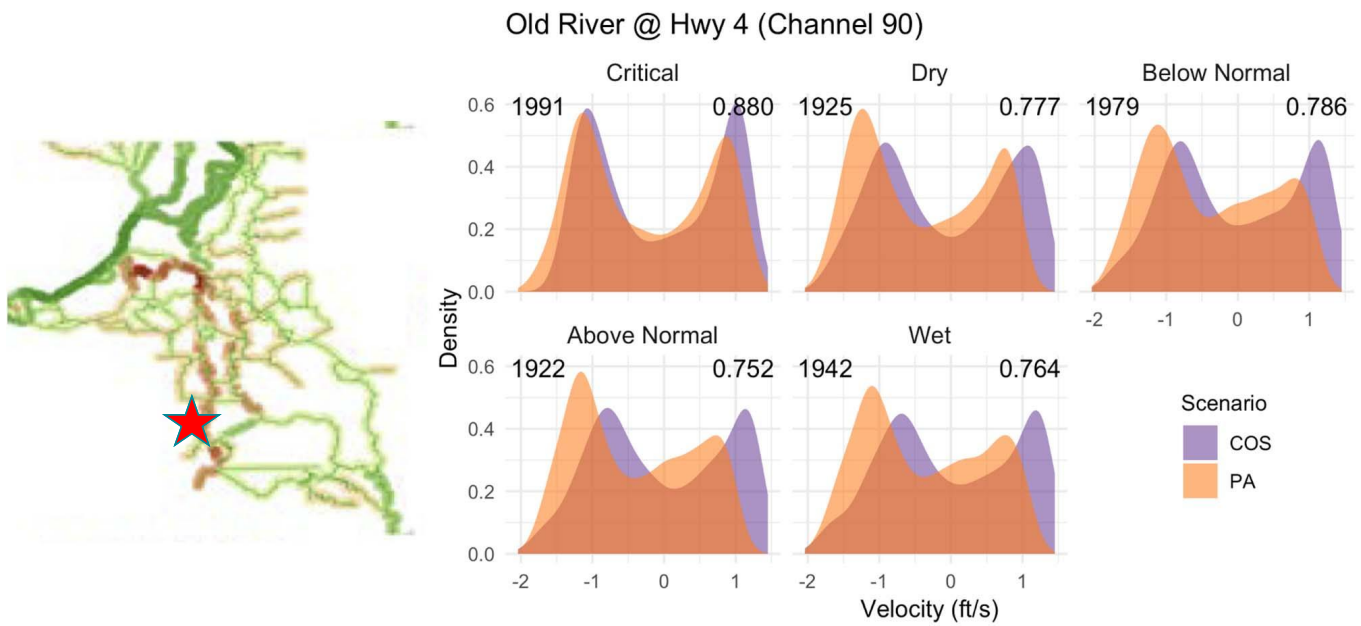
## Far-field Effects: PA increases export footprint



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

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

### Velocity profiles for March-May



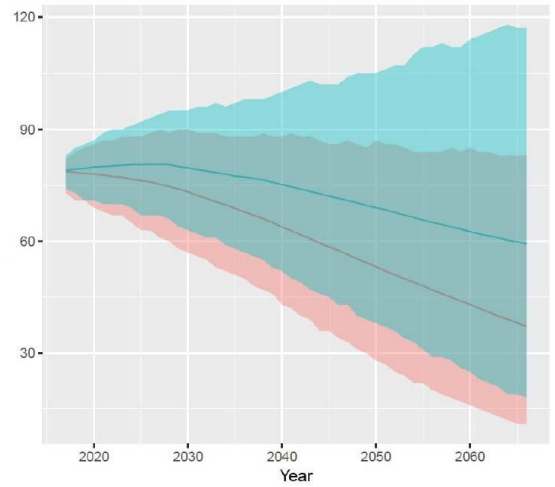
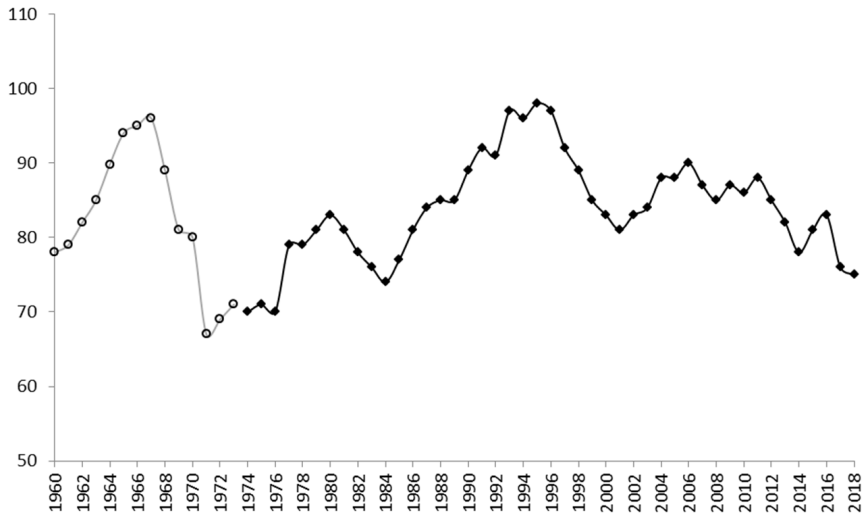
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## Significant Effects to Individuals: Green Sturgeon

- No Medium to High or Highly Ranked Effects

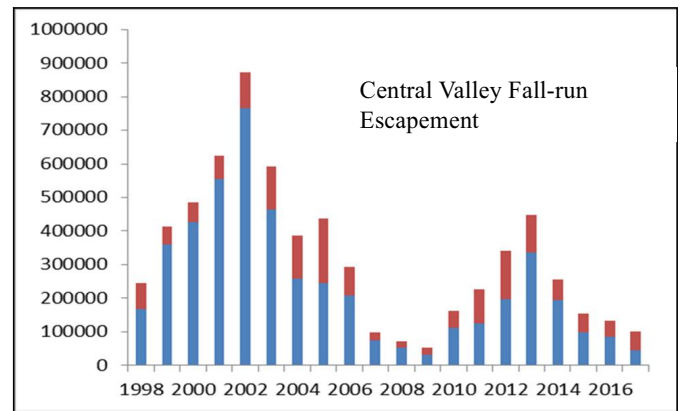


# Southern Resident Killer Whales Population



# 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