

# Stanislaus, Tuolumne, and Merced Working Group Meeting

*Revised Draft Initial Biological Goals  
Productivity, Stock Recruitment, and  
Spatial Structure*



Division of Water Rights, December 7, 2022

# Welcoming Remarks

- Staff introductions
- This meeting is being recorded
- The presentation slides and the recording will be available by contacting [STM-WorkingGroup@waterboards.ca.gov](mailto:STM-WorkingGroup@waterboards.ca.gov)
- For more information visit the Lower San Joaquin River Flows Implementation Activities webpage: [bit.ly/baydelta\\_LSJ](http://bit.ly/baydelta_LSJ)
- Need assistance or have questions
  - Facilitating today is Ellen Blair (ICF International consultant)
  - Zoom chat, raise hand, or
  - Email [STM-WorkingGroup@waterboards.ca.gov](mailto:STM-WorkingGroup@waterboards.ca.gov)

# Welcoming Remarks – Background

- 2018 Bay-Delta Plan & Lower San Joaquin River Flows
  - Requires the development of Biological Goals
- Biological Goals
  - Used to inform: adaptive methods, the San Joaquin River Monitoring and Evaluation Program, evaluation of the effectiveness of the program of implementation, and future changes to the Bay-Delta Plan
  - Will not be used to assess compliance with the Bay-Delta Plan
- Stanislaus, Tuolumne, and Merced (STM) Working Group
  - STM provides recommendations on biological goals, staff takes input and revises draft goals for Board consideration, Board workshop and public comment on draft goals, Board consideration of approval of goals with any changes directed by Board

# Welcoming Remarks – Background Cont.

- 2019 Draft Biological Goals
  - STM Working Group Coordinator
  - Public comment and recommendations
- 2022 Revised Draft Biological Goals
  - Initial membership of STM Working Group
  - Public comment and recommendations
- STM Working Group Meetings to seek additional comment and recommendations
  - November 21, 2022
  - December 7, 2022 (today's meeting)

# Agenda

- Review Recommendations from November 21, 2022
- Meeting Objectives, Format, and Ground Rules
- Meeting Attendees
- Viable Salmonid Population Parameters
- Productivity Goals
- 🥪 Break (Lunch Period)
- Spatial Structure Goal
- Stock Recruitment
- General Comments
- Closing Remarks

Goal Component	Summary of Recommendations - November 21, 2022, Meeting
Abundance	
Trend	<ul style="list-style-type: none"> <li>• Support for/disagreement with including a positive trend</li> </ul>
Metric	<ul style="list-style-type: none"> <li>• Support for juvenile production (abundance) as metric</li> <li>• Support for/disagreement with using escapement or ocean production as metric</li> </ul>
Value	<ul style="list-style-type: none"> <li>• Support for a higher value</li> <li>• Disagreement with having a numeric goal, support only a trend</li> </ul>
Hatchery	<ul style="list-style-type: none"> <li>• Hatchery spawners should be excluded from assessment toward meeting goals</li> </ul>
Timeline	<ul style="list-style-type: none"> <li>• Trend should be evaluated no earlier than 15 years after implementation</li> <li>• Define measurable and substantial for the progress assessment</li> <li>• Support for/disagreement with timeframe (too much/not enough time)</li> </ul>

Goal Component	Summary of Recommendations - November 21, 2022, Meeting
Genetic Diversity	
pHOS	<ul style="list-style-type: none"> <li>• Support for pHOS of 10% or less</li> <li>• Support for hatchery management improvements, e.g., including marking or exclusion weirs, as necessary to contribute to achieving the goal</li> </ul>
Life History Diversity	
Emigration Timing & Juvenile Size Classes	<ul style="list-style-type: none"> <li>• Support for/disagreement with standardized or tributary-specific size classification methods</li> <li>• Support for developing tributary-specific timing ranges</li> <li>• Support for using goals to maximize size-class range of outmigration timing</li> <li>• Concern with using emigration timing or juvenile size-class range alone as a primary performance measures</li> </ul>
Other	<ul style="list-style-type: none"> <li>• Consider adult diversity goal of spawner age</li> </ul>

# Meeting Objectives

- Seek recommendations on Biological Goals pursuant to Bay-Delta Plan requirements
- Overall Role of STM Working Group membership
  - Assist with the implementation, monitoring and effectiveness assessment
  - Work as a watershed group and forum to coordinate implementation activities
- STM members role specific to draft revised Biological Goals
  - Focus on technical topics including but not limited to metrics, data availability, achievability, and adequacy
  - Recommendations for biological goals that represent viable salmonid populations
  - Opportunity for additional policy and technical input during Board consideration process on issues where STM members have different viewpoints

# Format & Ground Rules

- Staff will review the components of each goal
- Facilitator will solicit recommendations from STM members
- Questions can be asked verbally or using the Q&A feature
- Non-STM Members will have a chance to provide input
- Keep comments on point and concise
  - Keep comments succinct and specific to the Biological Goals
  - Avoid repeating recommendations provided in written comments
  - Respect staff and fellow attendees, even if their ideas differ from yours

# Meeting Attendees

- California Department of Fish & Wildlife
- Central Sierra Environmental Resource Center
- Department of the Interior, US Bureau of Reclamation
- Merced Irrigation District
- Merced River Conservation Committee
- Modesto Irrigation District
- National Marine Fisheries Service
- Oakdale and South San Joaquin Irrigation Districts
- San Francisco Baykeeper
- San Francisco Public Utilities Commission
- South San Joaquin Irrigation District
- Stanford University
- State Water Board
- Stockton East Water District
- The Nature Conservancy
- Tuolumne Utilities District
- Turlock Irrigation District
- US Fish & Wildlife Service
- Unaffiliated – William Martin
- Unaffiliated – Richard Morat
- Valley Water

# Bay-Delta Plan Requirements for Biological Goals

- “Biological goals will be used to inform the adaptive methods, evaluate the effectiveness of this program of implementation, the SJRMEP, and future changes to the Bay-Delta Plan.”
- “Biological goals will specifically be developed for LSJR salmonids...”
- “Reasonable contributions to these biological goals may include meeting temperature targets and other measures of quality and quantity of spawning, rearing, and migration habitat, fry production, and juvenile outmigrant survival to the confluence of each tributary to the LSJR.”

# Viable Salmonid Population (VSP) Parameters

*“...Indicators of viability include population abundance, spatial extent, distribution, structure, genetic and life history diversity, and productivity.”*

- Quantitative criteria to track fall-run Chinook salmon
- Required by Bay-Delta Plan
- Based on McElhaney et al. 2000
- Independent Science Advisory Panel (ISAP) recommendation
- Parameters
  - Abundance
  - Productivity as Measured by Population Growth Rate
  - Genetic and Life history Diversity
  - Population Spatial Extent, Distribution, and Structure

# Today's Discussion of Biological Goals

Productivity: Full Life-Cycle (Cohort Replacement Rate, CRR) and Juvenile (Percent Survival)

Spatial Extent, Distribution, and Structure

Stock Recruitment: Preliminary Analysis

# Full Life-Cycle Productivity Goals – Metric

- Returning spawners should outnumber their parents
- ISAP recommended
- Michel (2019) outmigration survival is the primary driver of adult cohort size
- Pre-Fishing =

$$\frac{\text{Ocean Production}}{(\text{Escapement} - 2 \text{ yrs})}$$

- Post-Fishing =

$$\frac{\text{Natural(Spawners)}}{(\text{Escapement} - 3 \text{ yrs})}$$

Productivity Metric	Goal	Progress Assessment
Cohort Replacement Rate (CRR) Trend	Positive generational trend until a CRR > 1 is met, measured as a 5-year geometric mean	Until numeric productivity goals are met (year 15)
Pre-Fishing CRR	Pre-Fishing CRR > 1 and > post-fishing CRR until abundance goals met and then sustained, measured as a 5-year geometric mean	Year 6, measurable progress Year 9, substantial progress
Post-Fishing CRR	Post-Fishing CRR > 1 until abundance goals met and then sustained CRR > 1, measured as a 5-year geometric mean	Year 15, achieve the goal

# Post-Fishing CRR Calculation

		Column Identifier									
		A	B	C	D	E	F	G	H	I	J
		Year	Hatchery Spawners (CFM)	Natural Spawners (CFM)	pHOS (CFM)	Total Escapement (CFM)	Post-Fishing CRR	Ocean Production (ChinookProd)	Adjusted Ocean Production	Pre-Fishing CRR	Age-2 Adult to Age-3 Spawner Survival
Row Identifier	1	2009				595		1222	611		
	2	2010	543	543	0.5	1086		1669	284		0.89
	3	2011	882	181	0.83	1063		6688	1137	1.91	0.64
	4	2012	3325	681	0.83	4006	1.14	4274	1465	1.35	0.60
	5	2013	1870	975	0.66	2845	0.90	4572	1616	1.52	0.67
	6	2014	1981	1083	0.65	3064	1.02	8984	1976	0.49	0.67
	7	2015	4786	1350	0.78	6136	0.34	13607	3402	1.20	0.68
	8	2016	6894	2298	0.75	9192	0.81	10520	210	0.07	0.68
	9	2017	3429	70	0.98	3499	0.02	4074	1019	0.17	0.33
	10	2018	1783	594	0.75	2377	0.10	3395	1562	0.17	0.58
	11	2019	812	692	0.54	1504	0.08	1198			0.44
Example Calculations>							C4/E1		G1*(1-D2)	H3/E1	C2/H1

# Adjusted Ocean Production Calculation

		Column Identifier									
		A	B	C	D	E	F	G	H	I	J
		Year	Hatchery Spawners (CFM)	Natural Spawners (CFM)	pHOS (CFM)	Total Escapement (CFM)	Post-Fishing CRR	Ocean Production (ChinookProd)	Adjusted Ocean Production	Pre-Fishing CRR	Age-2 Adult to Age-3 Spawner Survival
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Example Calculations>							C4/E1		G1*(1-D2)	H3/E1	C2/H1

# Pre-Fishing CRR Calculation

		Column Identifier									
		A	B	C	D	E	F	G	H	I	J
		Year	Hatchery Spawners (CFM)	Natural Spawners (CFM)	pHOS (CFM)	Total Escapement (CFM)	Post-Fishing CRR	Ocean Production (ChinookProd)	Adjusted Ocean Production	Pre-Fishing CRR	Age-2 Adult to Age-3 Spawner Survival
Row Identifier	1	2009				595		1222	611		
	2	2010	543	543	0.5	1066		1669	284		0.89
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Example Calculations>							C4/E1		G1*(1-D2)	H3/E1	C2/H1

# Age-2 Adult to Age-3 Spawner Survival Calculation

		Column Identifier									
		A	B	C	D	E	F	G	H	I	J
		Year	Hatchery Spawners (CFM)	Natural Spawners (CFM)	pHOS (CFM)	Total Escapement (CFM)	Post-Fishing CRR	Ocean Production (ChinookProd)	Adjusted Ocean Production	Pre-Fishing CRR	Age-2 Adult to Age-3 Spawner Survival
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Example Calculations>							C4/E1		G1*(1-D2)	H3/E1	C2/H1

# Full Life-Cycle Productivity Goals – Metric Please Provide Recommendations

Metric?

Productivity Metric	Goal	Progress Assessment
CRR Trend	Positive generational trend until a CRR > 1 is met, measured as a 5-year geometric mean	Until numeric productivity goals are met (year 15)
Pre-Fishing CRR	Pre-Fishing CRR > 1 and >post-fishing CRR until abundance goals met and then sustained, measured as a 5-year geometric mean	Year 6, measurable progress Year 9, substantial progress
Post-Fishing CRR	Post-Fishing CRR > 1 until abundance goals met and then sustained CRR > 1, measured as a 5-year geometric mean	Year 15, achieve the goal

# Full Life-Cycle Productivity Goals – Trend Please Provide Recommendations

Increasing Trend?

Productivity Metric	Goal	Progress Assessment
CRR Trend	Positive generational trend until a CRR > 1 is met, measured as a 5-year geometric mean	Until numeric productivity goals are met (year 15)
Pre-Fishing CRR	Pre-Fishing CRR > 1 and >post-fishing CRR until abundance goals met and then sustained, measured as a 5-year geometric mean	Year 6, measurable progress Year 9, substantial progress
Post-Fishing CRR	Post-Fishing CRR > 1 until abundance goals met and then sustained CRR > 1, measured as a 5-year geometric mean	Year 15, achieve the goal

# Full Life-Cycle Productivity Goals – Value Please Provide Recommendations

## Current CRR

(Geometric Mean)

### Pre-Fishing

- Stanislaus – 0.42
- Tuolumne – 0.96
- Merced – 1.23

### Post-Fishing

- Stanislaus – 0.29
- Tuolumne – 0.53
- Merced – 0.44

CFM and ChinookProd data (2009-2019)

Productivity Metric	Goal	Progress Assessment
CRR Trend	Positive generational trend until a CRR > 1 is met, measured as a 5-year geometric mean	Until numeric productivity goals are met (year 15)
Pre-Fishing CRR	Pre-Fishing CRR > 1 and >post-fishing CRR until abundance goals met and then sustained, measured as a 5-year geometric mean	Year 6, measurable progress
Post-Fishing CRR	Post-Fishing CRR > 1 until abundance goals met and then sustained CRR > 1, measured as a 5-year geometric mean	Year 9, substantial progress Year 15, achieve the goal

# Pre-Fishing CRR Value Calculation Option

## Please Provide Recommendations

Merced River

Age-2 to Age-3 Survival = 41%

Pre-Fishing CRR = Post-Fishing CRR  $\div$  41% = 1  $\div$  41% = 2.44

Tuolumne River and Stanislaus River

Age-2 to Age-3 Survival = 60%

Pre-Fishing CRR = Post-Fishing CRR  $\div$  60% = 1  $\div$  60% = 1.67

# Full Life-Cycle Productivity Goals – Timeline

## Please Provide Recommendations

- Pre-Fishing CRR should be sensitive to improvements in the watershed
- Full life-cycle goal requires progress toward meeting juvenile productivity goals
- CRR goals to be met prior to abundance goal

Productivity Metric	Goal	Progress Assessment
CRR Trend	Positive generational trend until a CRR > 1 is met, measured as a 5-year geometric mean	Until numeric productivity goals are met (year 15)
Pre-Fishing CRR	Pre-Fishing CRR > 1 and >post-fishing CRR until abundance goals met and then sustained, measured as a 5-year geometric mean	Year 6, measurable progress Year 9, substantial progress
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# Juvenile Productivity Goals – Metric Please Provide Recommendations

- ISAP recommended
- Direct measure of actions in the watershed
- Alternatives?
  - Tributary confluence survival
  - Egg to fry survival
  - Fry to tributary exit survival
  - Mainstem LSJR to Mossdale survival
  - Tributary confluence to Delta exit survival

Productivity Metric	Goal	Progress Assessment
Juvenile Productivity Trend	Positive trend in juvenile survival until abundance goal is met, measured as a 5-year geometric mean	Until numeric abundance goals are met (year 15)
LSJR tributary (egg) to Mossdale survival (SJRS)  LSJR at Mossdale to Chipps Island (Through-Delta) Survival (SJDS)	SJRS 5.5–20% as a 5-year geometric mean  SJDS 20–50% as a 5-year geometric mean	Year 6, measurable progress Year 9, substantial progress Year 15, achieve the goal

# Juvenile Productivity Goals – Metric Please Provide Recommendations

- Juvenile productivity goals are a measure of the amount and quality of habitat that juveniles are provided
- Juvenile survival rates may fluctuate as populations approach carrying capacity, e.g., a large number of spawners will produce the same number of juvenile outmigrants as a lower spawner number, but at a lower juvenile survival rate
- Option for juvenile productivity goals to be met though meeting juvenile percent survival goals or tributaries producing enough juveniles to attain doubling goals

River	Salmon Protection Objective Doubling Requirement	Number of Juveniles Past Chipps to Double (5.4% Delta to Age-2 Survival*)	Number of Juveniles Needed from Tributaries at Indicated Through Delta Survival (Millions)		
			20%	50%	10%
Tuolumne	38,000	702,000	3.5	1.4	7.0
Stanislaus	22,000	403,000	2.0	0.8	4.0
Merced	18,000	333,000	1.7	0.7	3.3

\*Derived from Michel (2010) adjusted for natural juvenile survival vs. hatchery smolt survival (SEP)

# Juvenile Productivity Goals – Trend Please Provide Recommendations

Increasing Trend?

Productivity Metric	Goal	Progress Assessment
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LSJR at Mossdale to Chipps Island (Through-Delta) Survival (SJDS)	SJDS 20–50% as a 5-year geometric mean	Year 9, substantial progress Year 15, achieve the goal

# Juvenile Productivity Goals – Value Please Provide Recommendations

- Ranges to allow for changing environmental conditions
- Overall Juvenile fresh water (FW) survival >1.1%
- Quinn (2005): Average FW survival 10%
- Expected to meet the full-life cycle productivity goals
- Current survival estimates
  - Tuolumne: 0.003-12% 2006-2018
  - Stanislaus: 0.08-21% 1997-2017
  - Merced: No recent RST

Productivity Metric	Goal	Progress Assessment
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# Juvenile Productivity Goals – Timeline

## Please Provide Recommendations

- Expect juvenile productivity to display improvements in short timeframes
- Assess an adequate range of years of survival rates to capture full expression of a viable population

Productivity Metric	Goal	Progress Assessment
Juvenile Productivity Trend	Positive trend in juvenile survival until abundance goal is met, measured as a 5-year geometric mean	Until numeric abundance goals are met (year 15)
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 **BREAK FOR LUNCH!**

# Spatial Structure

## Please Provide Recommendations

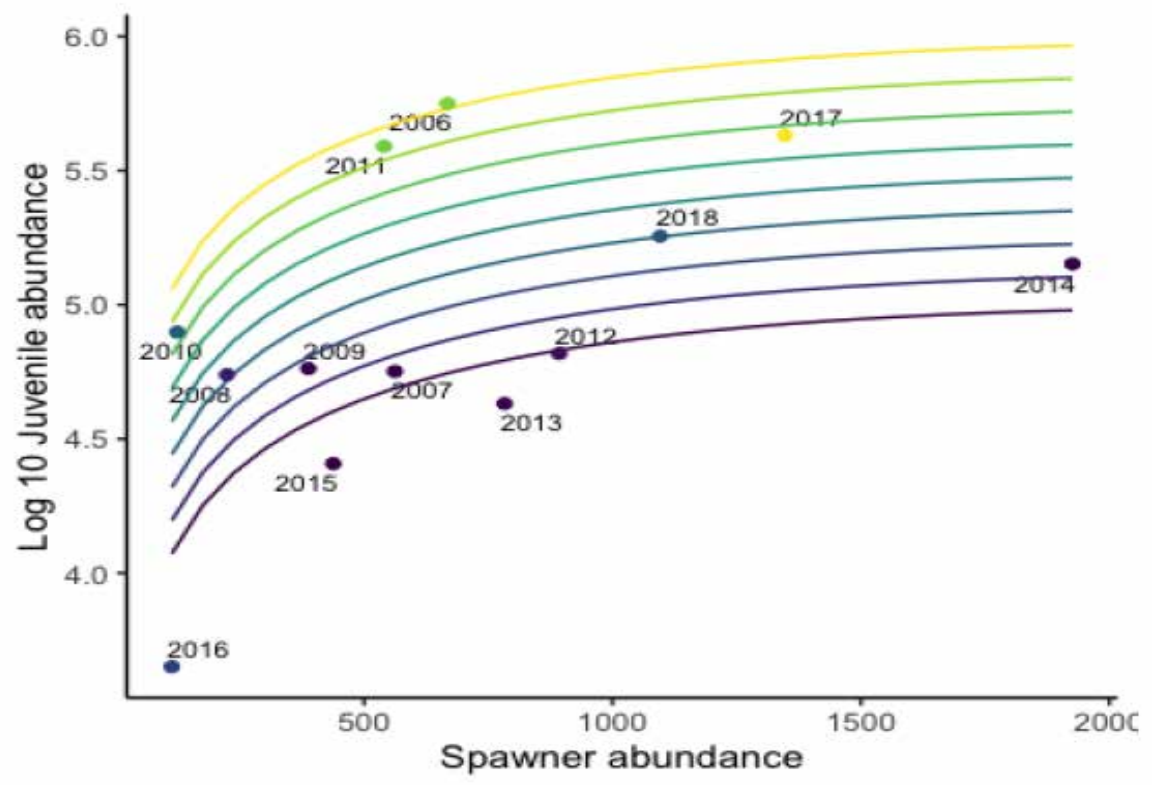
- Initial goal is to achieve abundance, productivity, and diversity goals on each of the tributaries
  - Restoring and sustaining geographic distribution of populations or individuals in a population reduces chance of catastrophic loss, facilitates recolonization, and buffers population from future environmental change
  - Decreases extinction risk
- ISAP recommendation

# Stock Recruitment (SR) Models

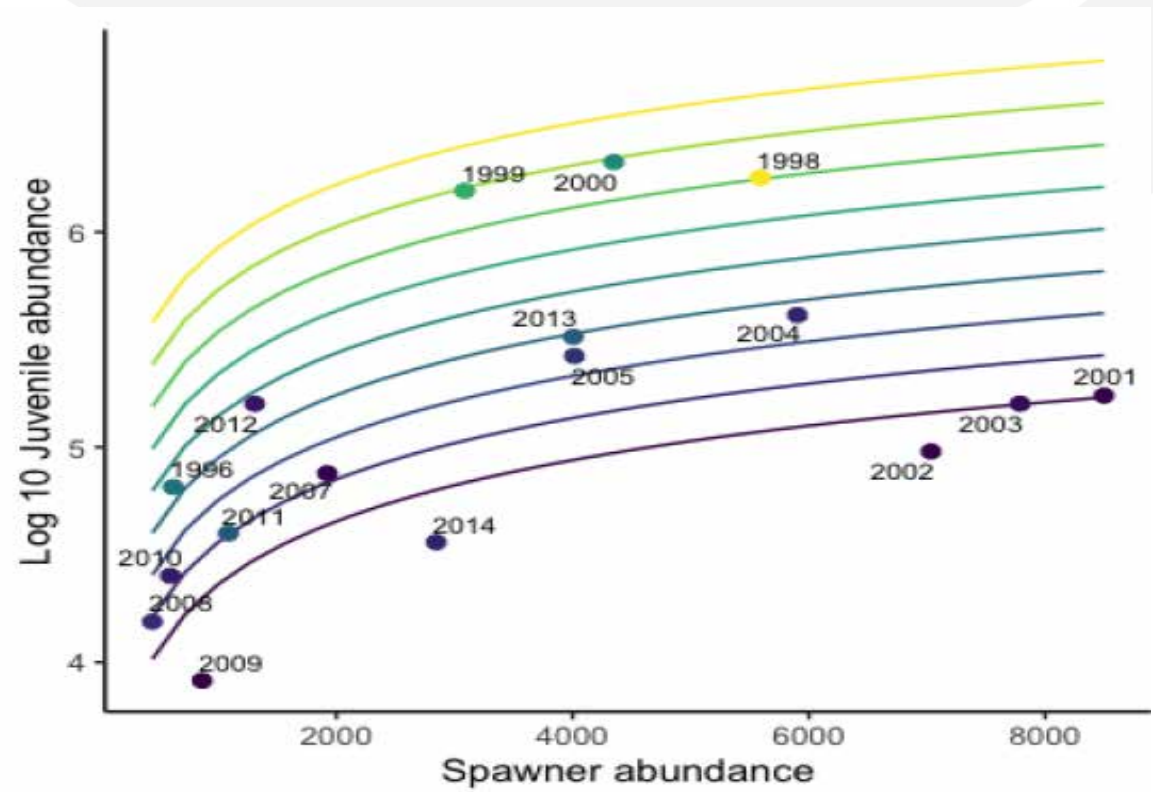
- ISAP recommended the use of SR models to track the status and trends of salmon populations
- Useful to evaluate management action effects or develop biological goals
- Staff examined the relationship between adult spawners and juvenile recruits for the Stanislaus and Tuolumne Rivers
  - Models evaluated density dependence, flow variability, flow magnitude, and temperature
  - Density-independent model
  - Density-dependent models: Beverton-Holt and Ricker

# Stock Recruitment Model Results

Tuolumne - Ricker



Stanislaus - Beverton-Holt



# Stock Recruitment – Future Applications

- Stock recruitment models are useful tools for analyzing and summarizing conditions observed, density-dependence influences, and potential environmental influences on salmon populations
- Stock recruitment models are statistical models, so estimates are unreliable when attempting to make predictions outside the ranges of data that are used to develop the model
- Current datasets are not mature enough to develop biological goals
- Continue to develop models as Bay-Delta Plan is implemented
- Staff will be able to refine the preliminary models as better and more monitoring data becomes available

# Process To-Date and Next Steps

- 2018 December Bay-Delta Plan Update
- 2019 September Draft Biological Goals
- 2022 June Revised Draft Biological Goals
- 2022 August Revised Draft Biological Goals Technical Workshop
- 2022 STM Working Group Meetings to seek recommendations
  - November 21, 2022
  - December 7, 2022 (today's meeting)
- 2023 Updated Draft Biological Goals Report for public comment
  - Board Technical Workshop and opportunity for additional written comments
  - Board Meeting consideration of approval

# General Comments

# Closing Remarks

- Thank you all for attending. Your recommendations from these meetings will be considered along with your written comments.