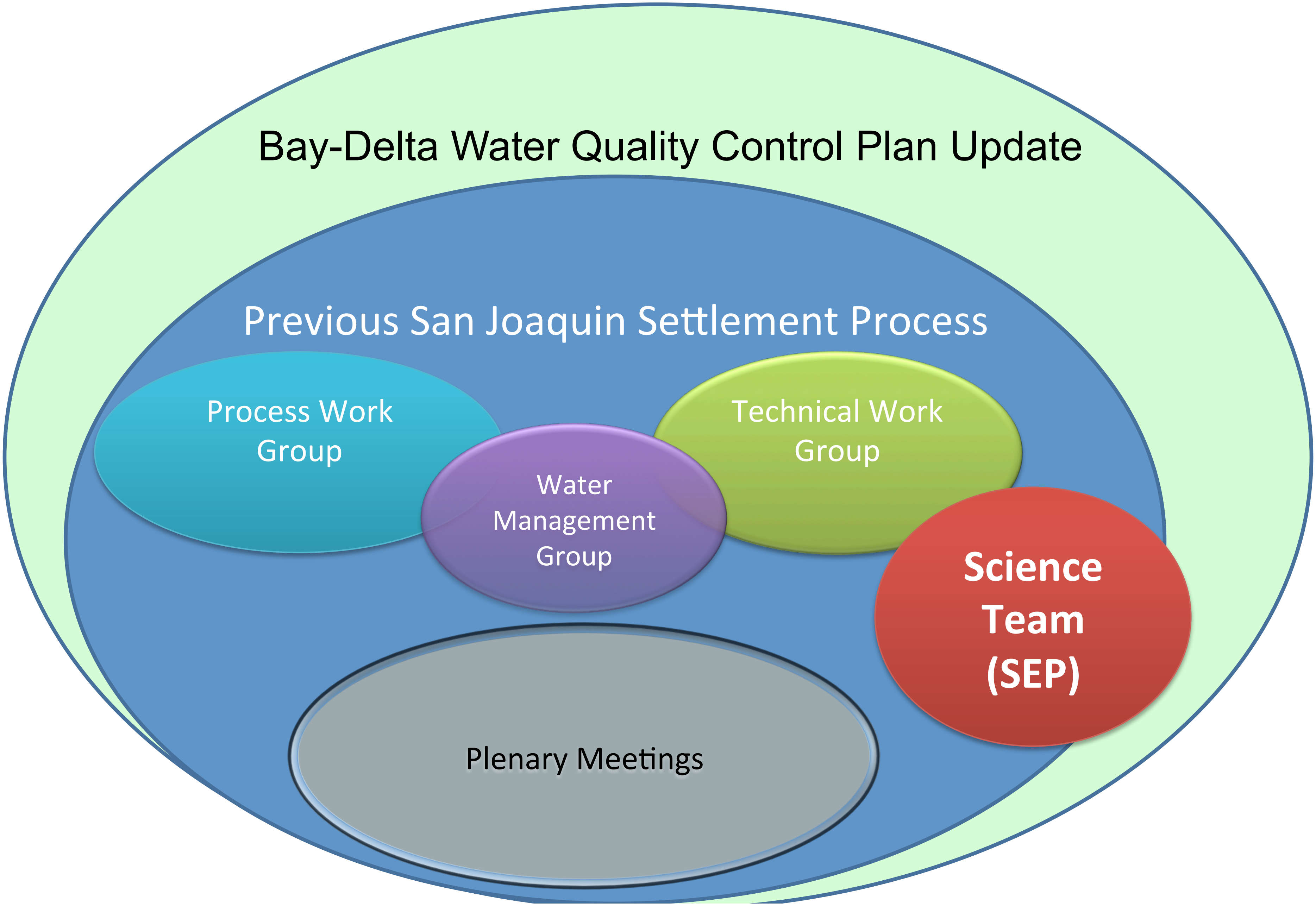
“Conservation Planning Foundation for Restoring Chinook Salmon (*Oncorhynchus tshawytscha*) and *O. mykiss* in the Stanislaus River”

A Structured Approach for Conservation and Recovery Planning

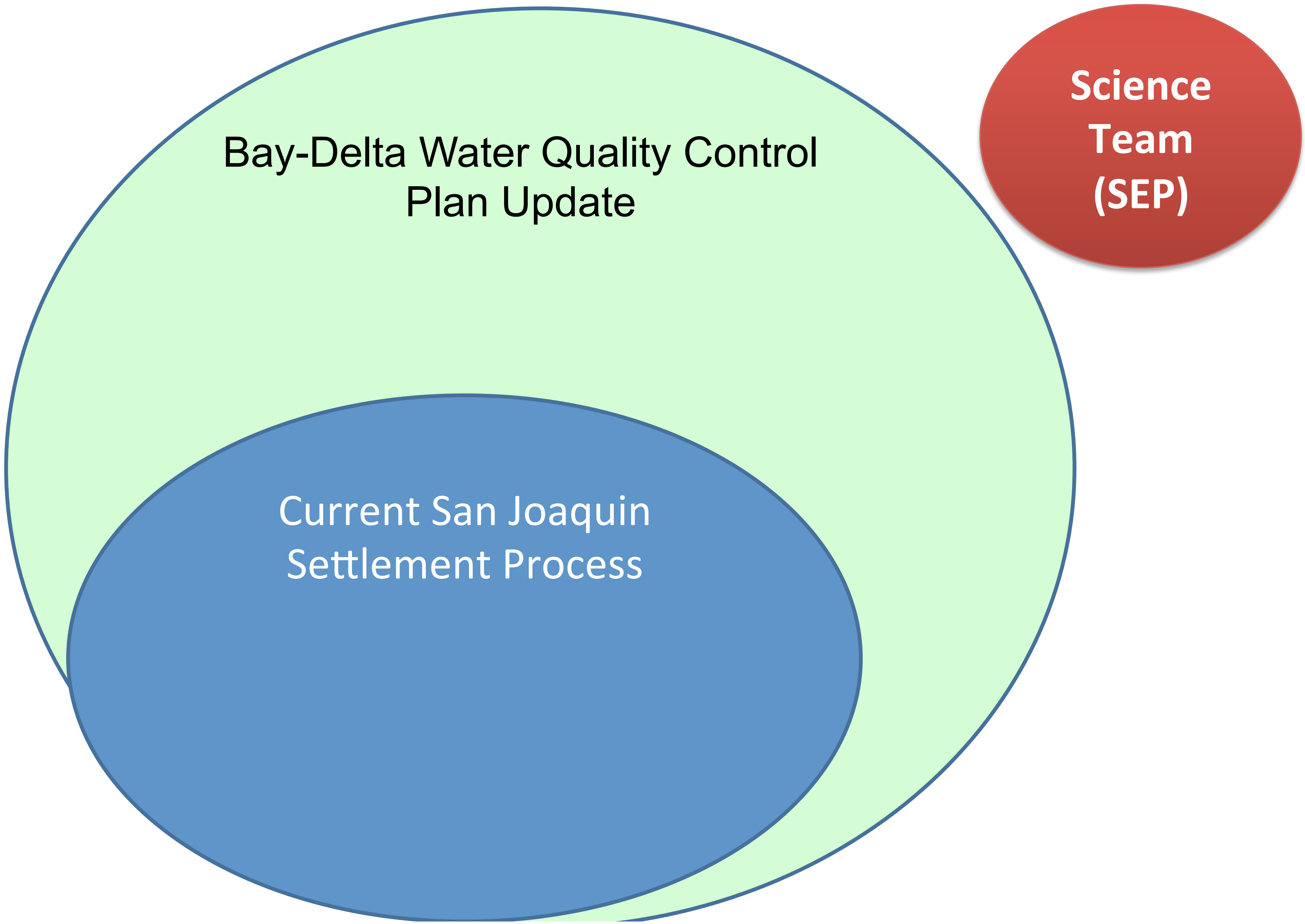
Outline

- **Stanislaus River Scientific Evaluation Process (SEP)**
- Approach to Defining Desired Outcomes
- Scope
- Biological Objectives
- Environmental Objectives
- Stressors

Where did the SEP originate?



SEPs Evolution



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And others….

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- **Approach to Defining Desired Outcomes**
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Current Challenges

Desired Outcomes for Salmon recovery (valley-wide goals) have been established

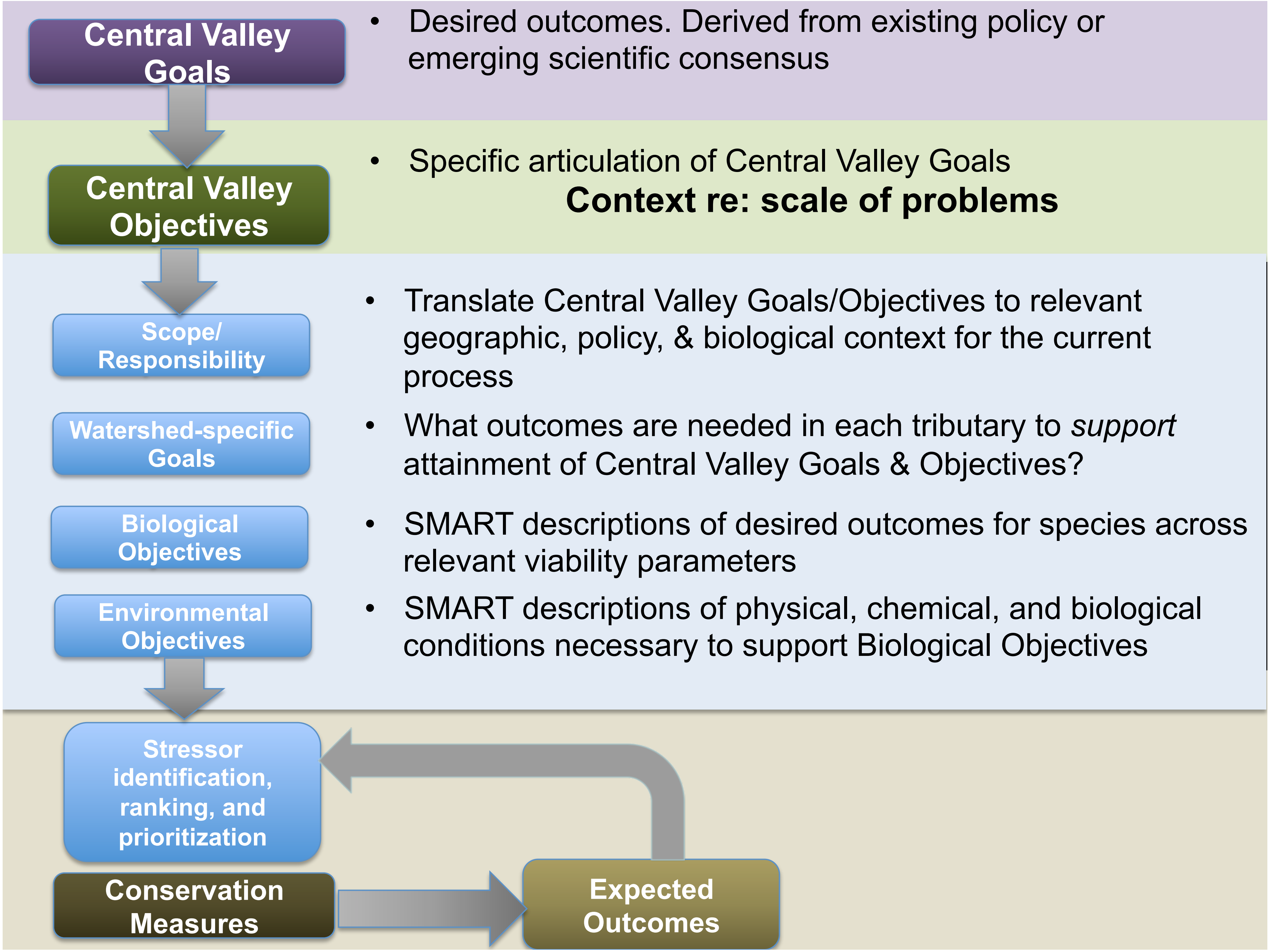
- CVPIA/AFRP
- Water Quality Control Plan
- ESA
- Fish and Game Code, etc.

But they often lack the articulation (i.e., **specific measurable achievable relevant and timebound biological or environmental "objectives")** to make them implementable

Flow applied as a proxy for environmental conditions

- Provides less flexibility to maximize beneficial uses
- Does not address non-flow measures

In the absence of S.M.A.R.T. objectives, **difficult to design, prioritize, or measure success of recovery actions**


Central Valley Goals
• Desired outcomes. Derived from existing policy or emerging scientific consensus
Central Valley Objectives
• Specific articulation of Central Valley Goals
Context re: scale of problems
Scope/ Responsibility
• Translate Central Valley Goals/Objectives to relevant geographic, policy, & biological context for the current process
Watershed-specific Goals
• What outcomes are needed in each tributary to *support* attainment of Central Valley Goals & Objectives?
Biological Objectives
• SMART descriptions of desired outcomes for species across relevant viability parameters
Environmental Objectives
• SMART descriptions of physical, chemical, and biological conditions necessary to support Biological Objectives
Stressor identification, ranking, and prioritization
Conservation Measures
Expected Outcomes

Process Products Include

S.M.A.R.T. biological and environmental objectives

- **Describe desired conditions for species and habitats**
- *Biological objectives* - describe and set bars for healthy populations through time as they progress towards, achieve, and maintain target population levels
- *Environmental objectives* - describe and set bars for the habitat conditions in the system (including timing and spatial extent) necessary to achieve and support biological objectives

Prioritized description of stressors

- Relate current conditions to biological and environmental objectives in a way that:
  - Informs sequencing of implementation actions
  - Calibrates anticipated outcomes by scope of impact

Process Products Do Not Include

Conservation Actions

- SEP Biological and Environmental Objectives are agnostic about the approach taken to achieve them
  - Allows for a wide variety of potential solutions
- Different combinations of flow and non-flow actions may achieve the same desired conditions
  - In those cases, other factors (policy, economics, practicality) will determine which combinations are preferred
- Flow levels may be “solved for”
  - Given assumptions about other habitat conditions, what level of flow is needed to produce desired outcomes
- Need for passage determined as part of a comprehensive assessment of stress

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Scope

Policy

Set objectives for the Stanislaus that harmonize desired outcomes of numerous policies, including:

- CVPIA, AFRP
- Water Quality Control Plan
- ESA
- Fish and Game Code, etc.

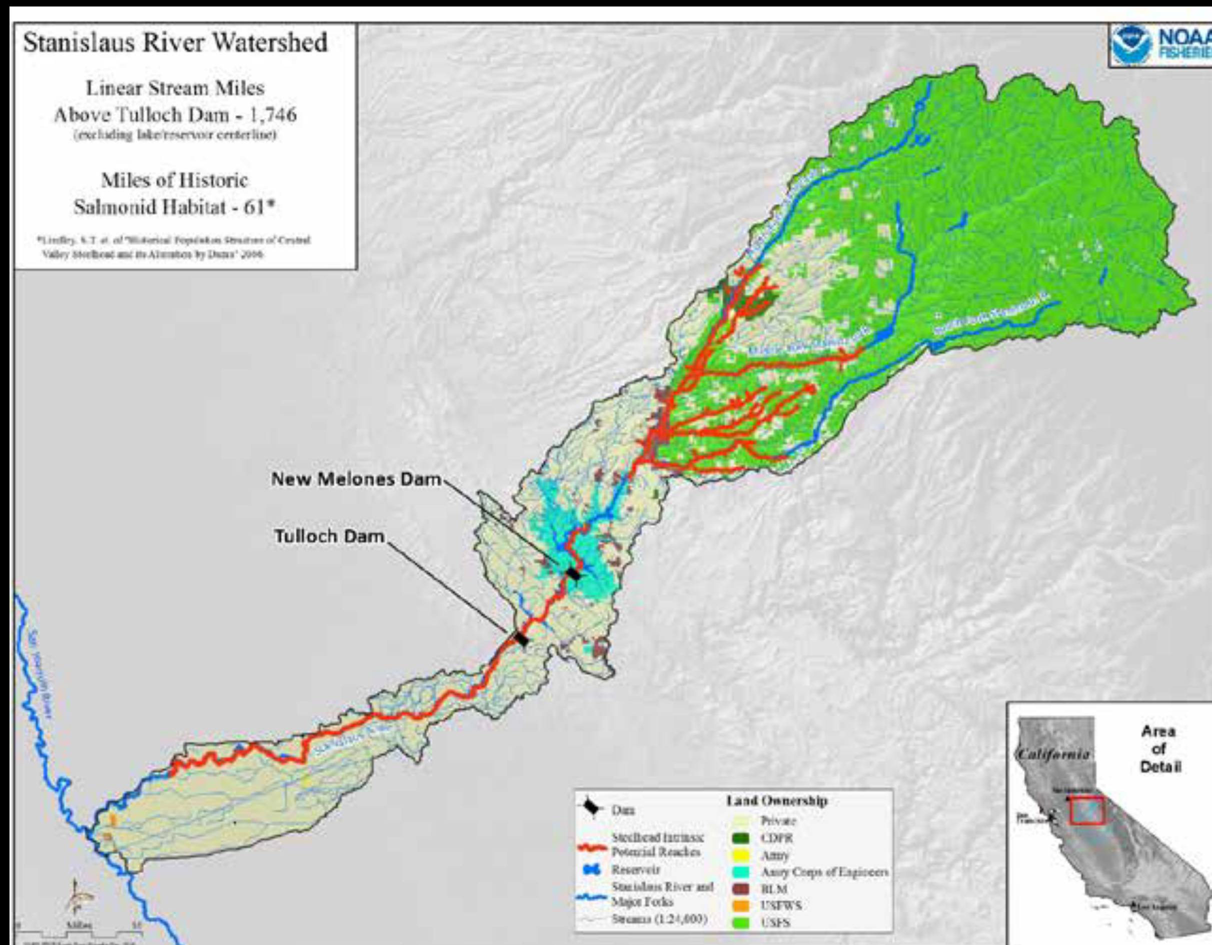
Scope

Geographic

Set objectives for the Stanislaus that:

- Can be attained by actions in that watershed
- Are independent of outcome elsewhere in the anadromous life history
- Serve Central Valley Goals and High Level Desired Outcomes

** Does not explicitly address southern Delta nor larger estuary*



Stanislaus River Watershed

Scope

Biological

Three salmonid populations

- Fall run Chinook salmon
- Spring run Chinook salmon
- *Oncorhynchus mykiss*

* *Stanislaus document does not cover desired outcomes for other species or ecosystem functions or necessary conditions to support them, in the Stan or beyond*

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- Environmental Objectives
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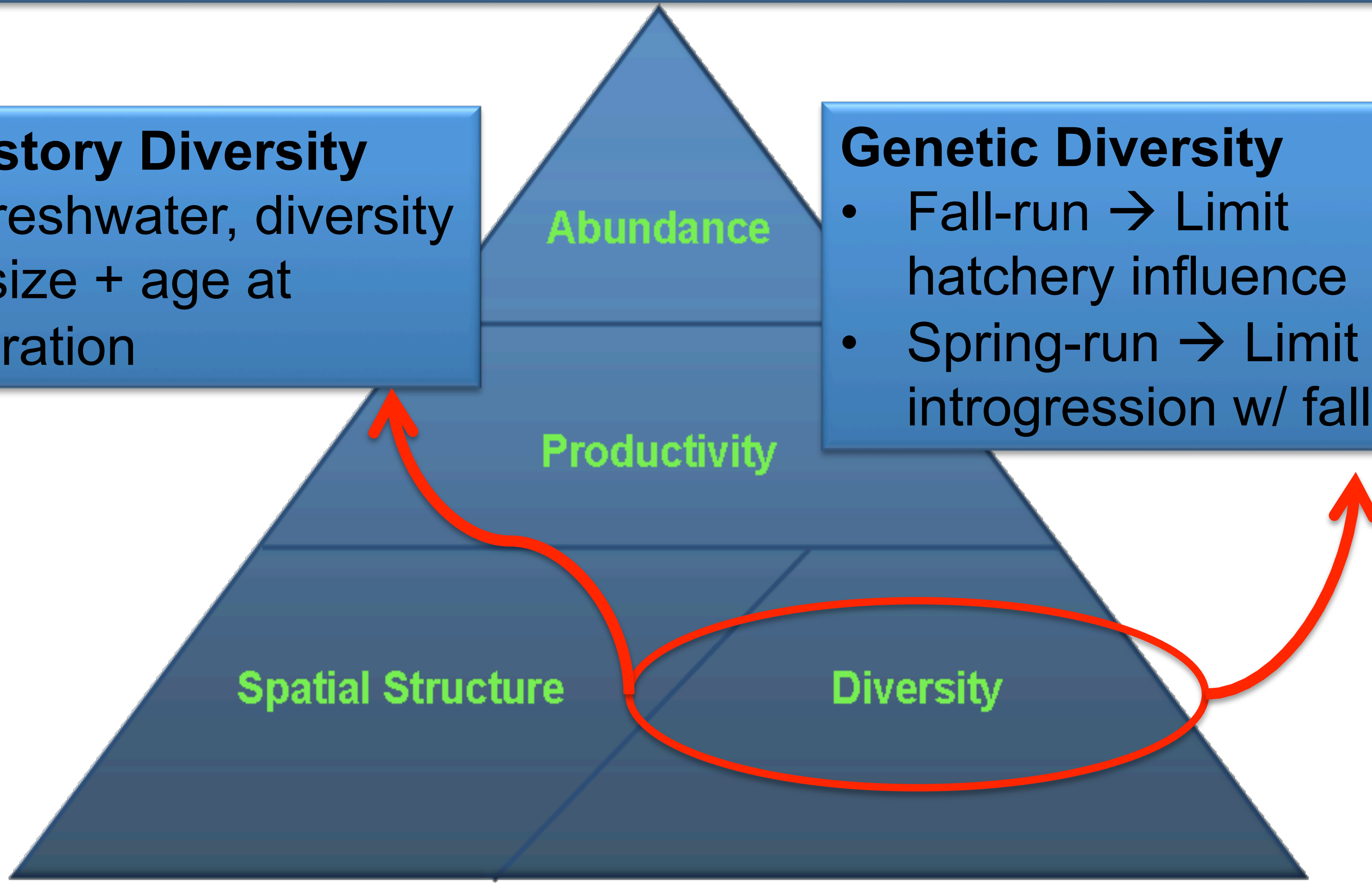
Biological Goals and Objectives
Salmonid Population Viability Attributes

Life History Diversity

- In freshwater, diversity → size + age at migration

Genetic Diversity

- Fall-run → Limit hatchery influence
- Spring-run → Limit introgression w/ fall-run



Goal: Support the fullest expression of fall run Chinook salmon life history diversity in order to increase population stability, resilience, and productivity.

Objective #1: (Life History – Timing of Migration)

By year 12, in every year, migration of fall run Chinook salmon spawned in the Stanislaus River will be detected in every week*

	Caswell RST		Mossdale** Trawl	
Size	**Start**	**End**	**Start**	**End**
Fry (<55mm)	Last week of January	2nd week of April	***	***
Parr (55mm>x<75mm)	1st week of February	Last week of May	2nd week of February	1st week of June
Smolt (>75mm)	3rd week of February	1st week of June	Last week of February	2nd week of June

* Until mean daily temperature at Mossdale ≥ 25ºC.

** Tributary contribution can be assigned (e.g. by otolith analyses)

*** Mossdale Trawl does not reliably detect fish <55mm.

Goal: Support the fullest expression of fall run Chinook salmon life history diversity in order to increase population stability, resilience, and productivity.

Objective #2: (Life History -- Size at Migration)

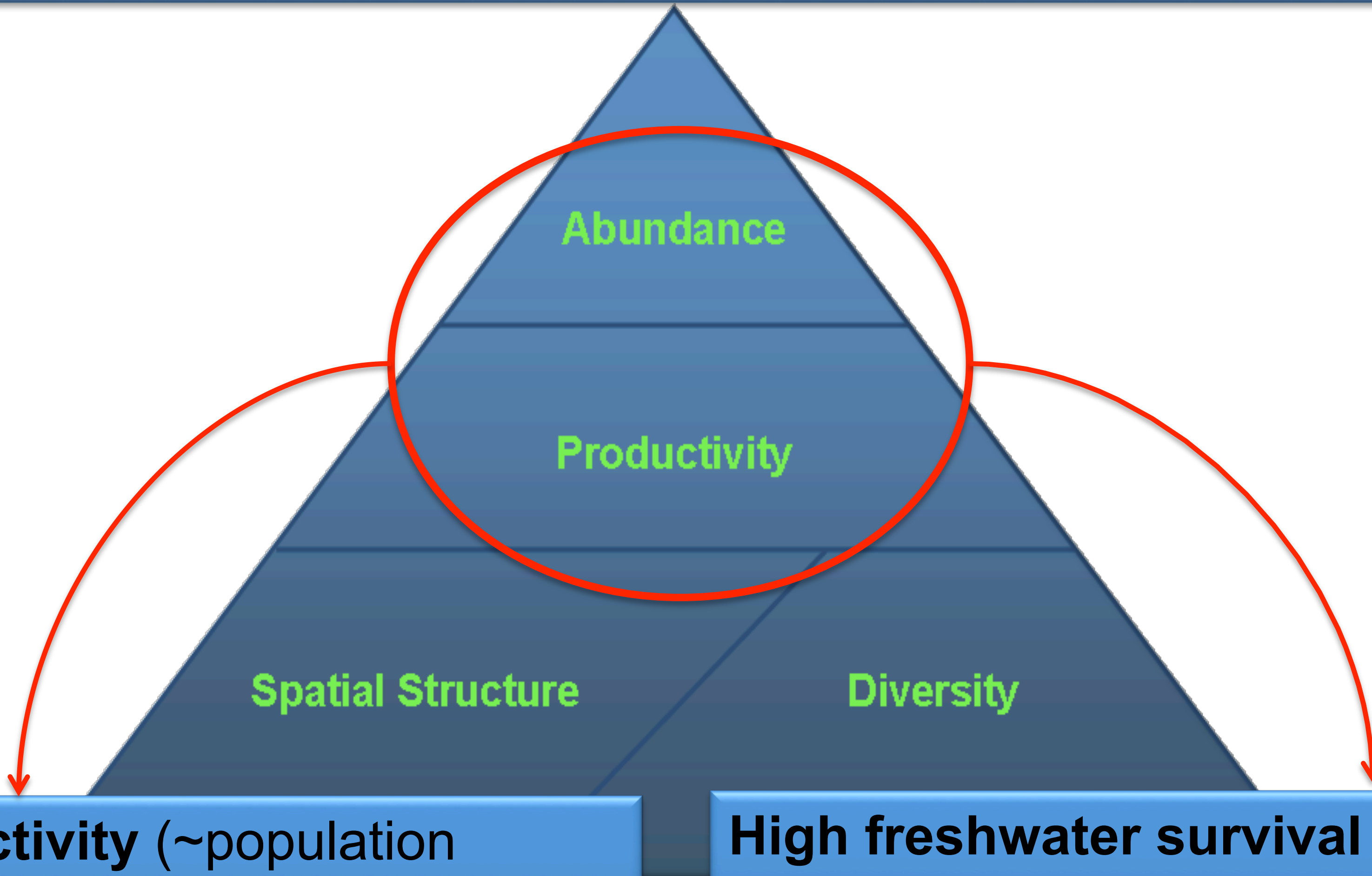
By year 12, generate annual emigrant size-class distribution as measured at Caswell RST* as follows:

Size Class	Wetter Years	Drier Years
Fry (<55mm)	20% min	20% min
Parr (55>x<75mm)	20% min	30% min
Smolt* (>75mm)	10% min	20% min

Initial estimates of size class distribution & relative success based on work by Rachel Johnson, Anna Sturrock, & others *in preparation*

* Includes only juveniles that migrate before daily mean temperatures >25^{o}C at Mossdale

Biological Objectives
Salmonid Population Viability Attributes



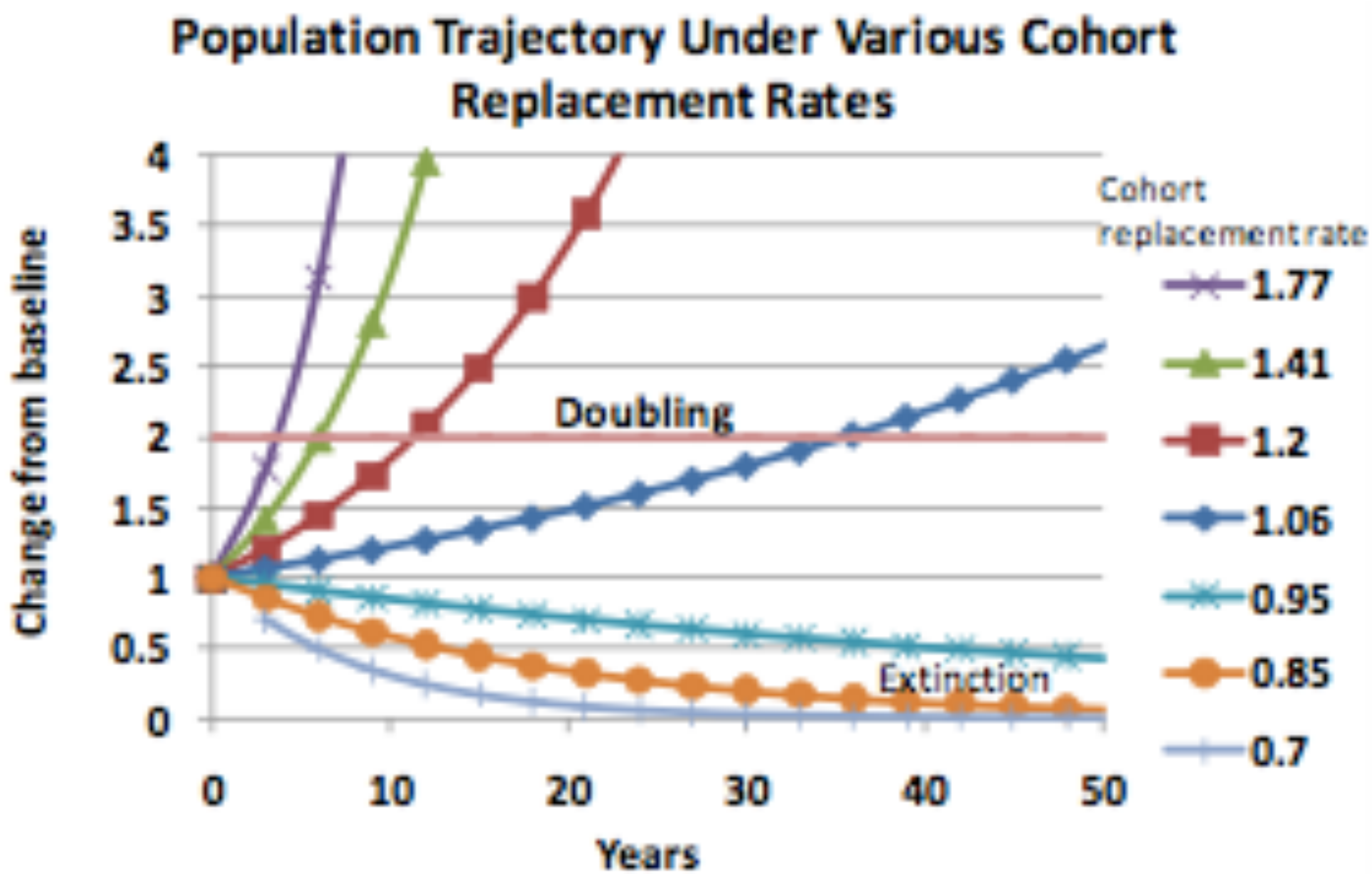
Productivity (~population growth rate)

- Tightly linked to abundance, but **not** identical

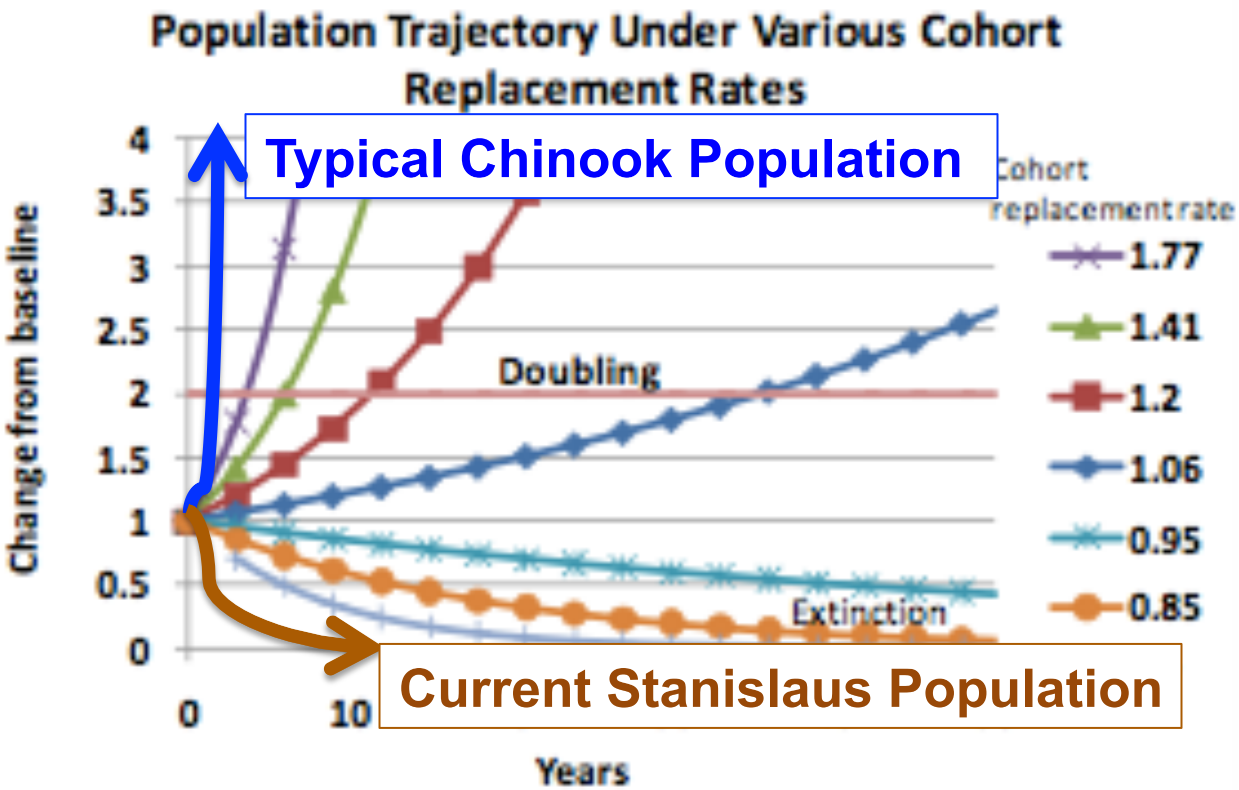
High freshwater survival rates typify salmonids → essential to their high intrinsic population growth rate

Productivity Goals

Desirable Population Growth Rate -- Often determined as a function of **abundance** target and time window to attain abundance target



Productivity Goals



- Typical population growth rates for Chinook salmon are **much** higher than those suggested by the "time-to-attain-doubling" approach
- Current Cohort Replacement Rate's are **much** lower than 1, suggesting short time to extirpation

Productivity Goals

Objective #3: Freshwater Survival Rates:

Goal A) Rebuild

- Support population growth rate of 2x within three generations

- *<u>Objective 3a</u> -- 2.12 % total freshwater survival rate w/i 10 years*

Goal B) Resilient

- Population can rebound from low recruitment to attain abundance/ production targets in 1 generation

- *<u>Objective 3b</u> -- 4.20% total freshwater survival rate w/i 15 years*

Goal C) Healthy

- Support species typical juvenile survival and population growth rates

- *<u>Objective 3c</u> -- 10% total freshwater survival rate w/i 24 years*

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- Stressors

Environmental Objectives

- Intended to represent environmental conditions needed to support Chinook salmon and *O. mykiss* populations
- Define the physical and chemical conditions needed to attain the biological objectives
- Provide life-stage specific guidance that should be used in the development and prioritization of conservation measures

Environmental Objectives

Environmental objectives have been developed for:

- Adult upstream migration
- Adult holding
- Spawning
- Egg incubation
- Juvenile rearing and migration

Environmental Objectives

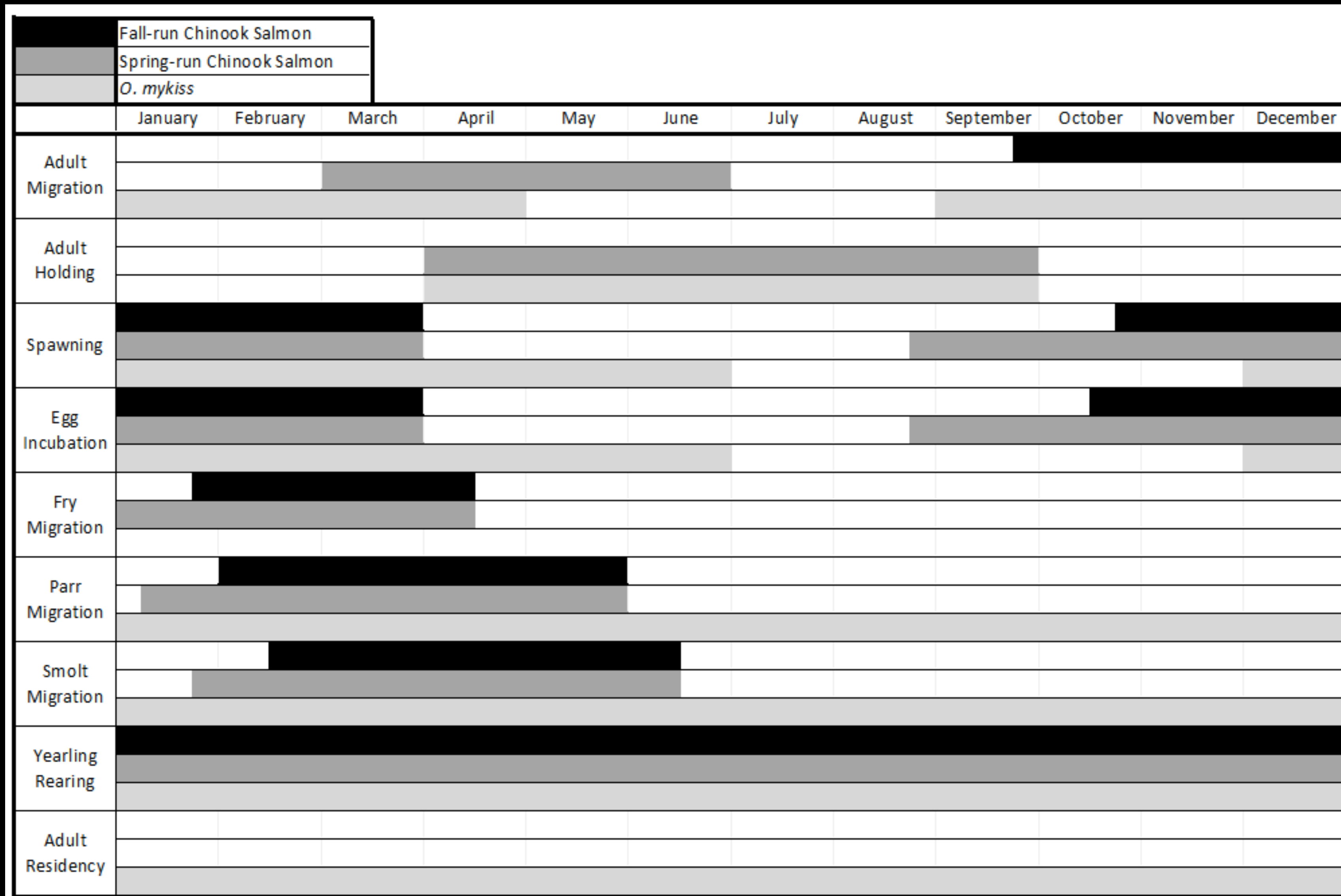

Figure 7 Timeline for Chinook Salmon and O. mykiss Migration and Rearing Periods in the San Joaquin River Basin

Environmental Objectives

Table 2B - Spatial Distribution

Spatial Application of Environmental Objectives

Life Stage	Habitat Type	Species	Reach						
			Upstream of Goodwin	Goodwin (59) to Knights Ferry (55)	Kights Ferry to Oakdale (41)	Oakdale to Riverbank (33)	Riverbank to Rippon ()	Rippon To Caswell ()	Caswell to Confluence
Egg and Emergence	In channel	Fall Run	x	x	x	x			
		Spring Run	x	x	x	x			
		Steelhead	x	x	x	x			
Juvenile Rearing	Short Innundation	Fall Run	x	x	x	x			
		Spring Run	x	x	x	x			
		Steelhead	x	x	x	x			
	Long Innundation	Fall Run					x	x	x
		Spring Run					x	x	x
		Steelhead	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Juvenile Migration	In channel	Fall Run	x	x	x	x	x	x	x
		Spring Run	x	x	x	x	x	x	x
		Steelhead	x	x	x	x	x	x	x
Adult Migration	In channel	Fall Run	x	x	x	x	x	x	x
		Spring Run	x	x	x	x	x	x	x
		Steelhead	x	x	x	x	x	x	x
Adult Holding	In channel	Fall Run	x	x					
		Spring Run	x	x					
		Steelhead	x	x					
Adult Spawning	Upstream (In channel)	Fall Run	x	x					
		Spring Run	x	x					
		Steelhead	x	x					
	Downstream (in channel)	Fall Run			x	x			
		Spring Run			x	x			
		Steelhead			x	x			

Environmental Objectives

Three categories of conditions:

Optimal

- Contribute to health & growth of individuals & the population
- Support the attainment of biological objectives

Sub-optimal

- Associated with some degree of impact at the population level
- May or may not support attainment of biological objectives

Detrimental

- Associated with a significant level of harm at the population level
- Do not support and are a detriment to the attainment of one or multiple biological objectives

Environmental Objectives

Define habitat in specific, measureable terms

ex: Not all rearing habitat is (or needs) to be “optimal”; so total acreage needs to reflect habitat quality

Physical Rearing Habitat Objectives (Including Metrics for Cover, Substrate, Depth, and Velocity) for Juvenile Chinook Salmon and *O. mykiss*

Habitat Type	Parameter	Condition	Range (Metric)
Floodplain – Short Inundation	Substrate	Optimal	> 5% fines to support vegetation recruitment
	Cover	Optimal	Average HSI score of ≥ 0.5 for all cover types Or: HSI for individual cover types: Woody debris ≥ 0.9 Cobble boulder ≥ 0.5 Overhanging vegetation ≥ 0.8 Root wad ≥ 1
	Depth	Optimal	0.15 m to 1.22 m (0.5 ft to 4 ft) Averaged spatially
		Sub-optimal	1.23 m to 2.13 m (4 ft to 7 ft) Averaged spatially
	Velocity	Optimal	0 m/s to 0.9 m/s (0 ft/s to 3 ft/s)
		Sub-optimal	> 0.9 m/s (> 3 ft/s)
Floodplain – Long Inundation	Substrate	Optimal	> 5% fines to support vegetation recruitment
	Cover	Optimal	Average HSI score of ≥ 0.5 for all cover types
	Depth	Optimal	0.15 m to 1.22 m (0.5 ft to 4 ft) Averaged spatially
		Sub-optimal	1.23 m to 2.13 m (4 ft to 7 ft) Averaged spatially
	Velocity	Optimal	0 m/s to 0.9 m/s (0 ft/s to 3 ft/s) s
		Sub-optimal	> 0.9 m/s (> 3 ft/s)
Channel	Substrate	Optimal	See spawning habitat requirements
	Cover	Optimal	Average HSI score of ≥ 0.5 for all cover types Or: HSI for individual cover types: Woody debris ≥ 0.9 Cobble boulder ≥ 0.5 Overhanging vegetation ≥ 0.8 Root wad ≥ 1
	Flow variability	Optimal	Summer flow variability that mimics the natural hydrograph; intended to contribute to the expression of anadromy

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Stressors

What environmental conditions limit attainment of objectives?

- Stressors were summarized at two scales:
  - **Coarse scale stressors** designed to guide where conservation efforts are focused
    - e.g., “Lack of suitable rearing habitat”
    - e.g., “Lack of suitable migratory cues”
    - e.g., “Negative sub-lethal effects during adult migration”
  - **Fine scale stressors** designed to guide the development of specific actions, associated monitoring, and adaptive management
    - e.g., “Lack of suitable rearing habitat *as a function of temperature*”
    - More directly linked to objectives

Stressors

General Process

- Identify key stressors identify their relative impact and relationship to one another
- Prioritize stressors and identify approaches to stressor reduction

Process Components

- Stressor prioritization by life history stage
- Prioritization of stressors relative to:
  1) current population, and
  2) target population
- Scoring 1-4 points in two categories
  - *Magnitude*
  - *Certainty*

Stressors

Magnitude

Magnitude assesses the size or level of the impact. It can be assigned using consideration of population or habitat effects; higher scores require consideration of the scale of impact.

Stressors

Certainty

Certainty describes the scientific basis for scoring the scale and magnitude of a particular stressor. Certainty considers both the predictability and understanding of linkages.

Stressors

Prioritization

- Magnitude and Certainty scores are combined to prioritize three different types of stressor response:
  - ***Action*** – To alleviate the stress and advance objectives
  - ***Research*** – To inform actions and the relative need for them
  - ***Monitoring*** – To track the level of stress

Magnitude

No Action → Priority Action

Certainty: Research ↔ Monitoring

Priority	1	2	3	4
1	Lowest Priority Research	Low Priority Research	Med Priority Research	High Priority Research
2	Lowest Priority Research	Med Priority Research	High Priority Research	Highest Priority Research
3	High Priority Monitoring	Medium Priority Action	Med – Hi Priority Action + Monitoring	High Priority Action + ARM
4	Baseline Monitoring	Med – Hi Priority Action + Monitoring	High Priority Action	Highest Priority Action

Stressors - Results

- Stressor prioritization scores were summarized at two scales:
  - **Coarse scale stressors** (e.g., "lack of suitable rearing habitat")
    - Designed to guide where conservation efforts are focused
  - **Fine scale stressors** (e.g., "lack of suitable rearing habitat *as a function of temperature"*)
    - More directly linked to objectives
    - Designed to guide the development of specific actions, associated monitoring, and adaptive management

Stressors – Results Ranked for Each Species

Coarse scale – Spring Run

Priority 1 (Highest)

Actions and Associated Monitoring:

Adult Spawning
- Interactions with hatchery fish and other runs

Egg Incubation
- Inadequate incubation conditions

Juvenile Rearing/Migration
- Lack of suitable rearing habitat
- Lack of suitable migratory conditions

Priority 2 (High)

Actions and Associated Monitoring:

Adult Holding
- Lack of suitable habitat

Actions and Adaptive Management:

Juvenile Rearing/Migration
- Lack of suitable migratory cues

Research:

Adult Holding
- Loss of fecundity

Adult Spawning
- Compression of the spawning window

Adult Migration
- Negative sub-lethal effects (indirect; e.g., reduced fecundity or mortality via disease)

Juvenile Rearing/Migration
- Compression of the rearing and migration window

Priority 3 (Medium)

Actions and Adaptive Management:

Adult Spawning
- Inadequate availability of high-quality habitat

Research:

None

Priority 4 (Low)

Actions and Adaptive Management:

None

Research:

Adult Migration
- Significant delay and/or failure to reach natal stream (direct effects)

Priority 5 (Lowest)

Actions and Adaptive Management:

None

Research:

None

Monitoring Baseline:

Juvenile Rearing/Migration
- Lack of suitable over-summering habitat

Priority 1 (Highest)

Actions and Associated Monitoring:

Adult Spawning
- Interactions with hatchery fish and other runs

Egg Incubation
- Inadequate incubation conditions

Juvenile Rearing/Migration
- Lack of suitable rearing habitat
- Lack of suitable migratory conditions

Priority 2 (High)

Actions and Associated Monitoring:

Adult Holding
- Lack of suitable habitat

Actions and Adaptive Management:

Juvenile Rearing/Migration
- Lack of suitable migratory cues

Research:

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Adult Spawning
- Inadequate availability of high-quality habitat

Research:

None

Priority 4 (Low)

Actions and Adaptive Management:

None

Research:

Adult Migration
- Significant delay and/or failure to reach natal stream (direct effects)

Priority 5 (Lowest)

Actions and Adaptive Management:

None

Research:

None

Monitoring Baseline:

Juvenile Rearing/Migration
- Lack of suitable over-summering habitat

Example:
Spring run Chinook Stressors

Highest Priority Actions to Address
- *Interactions with hatchery fish*
- *Inadequate incubation conditions*
- *Lack of suitable rearing habitat*
- *Lack of suitable migratory conditions*

High Priority Actions to Address
- Lack of suitable holding habitat
- Lack of juvenile migratory cues

High Priority Research needs
- *Loss of fecundity*
- *Compression of spawning window*
- *Negative sub-lethal effects on adult migrants*
- *Compression of rearing & migration window*

Stressors Inform Actions

Ex: Distribution of rearing habitat needs through space & time

BRINGING TOGETHER

BIOLOGICAL OBJECTIVES

- Productivity
- Life history diversity

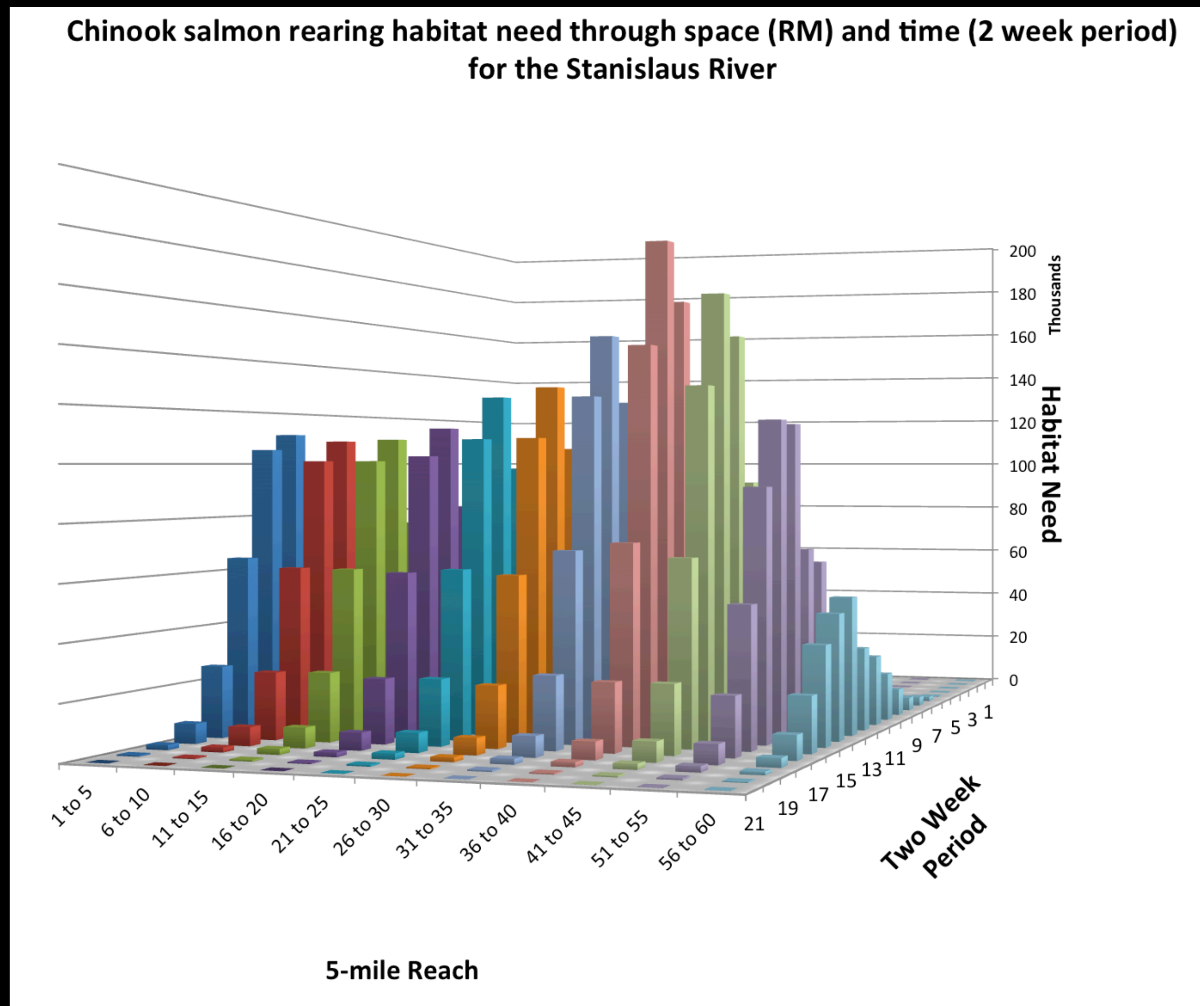
ENVIRONMENTAL OBJECTIVES

- Rearing Habitat Description
- Total Acreage Needed (ESHE Model)

STRESSOR

- Rearing Habitat Deficit
- Inadequate Distribution

ACTION →



Next Steps: Expand Geography

Expand SEP process to:

- Tuolumne River (> ~85% complete)
- Merced River (> ~85% complete)
- Lower San Joaquin River (> ~50% complete)


Thank You