Reintroduction of Salmon into their Historic Habitats (Two-Part Session)

A Concurrent Session at the 35th Annual Salmonid Restoration Conference held in Davis, CA from March 29 – April 1, 2017.

Session Overview

- Session Coordinators:
  - Curtis Knight, CalTrout
  - Rob Lusardi, Ph.D., CalTrout/UC Davis

Climate change, aging water infrastructure, successive years of drought, and increasing demand for water resources has precipitated strong declines in salmonids throughout California. Compounding this, longitudinal and lateral disconnections from historical spawning and rearing habitat has triggered a loss of salmonid life history diversity, making species less resilient to change. As a result, reintroductions of salmonids to historical habitat has occurred or is proposed as a recovery strategy. Dam removal, trap and haul above high head dams, reintroduction of captive bred animals, and improving lateral connectivity to historical floodplain habitat are proposed methods to improve salmonid life history diversity, abundance, population redundancy and, ultimately, resilience to change. We seek abstracts that examine the methods, science, and policy implications of salmonid reintroductions to historical habitat.

Presentations

Part 1 of Morning session

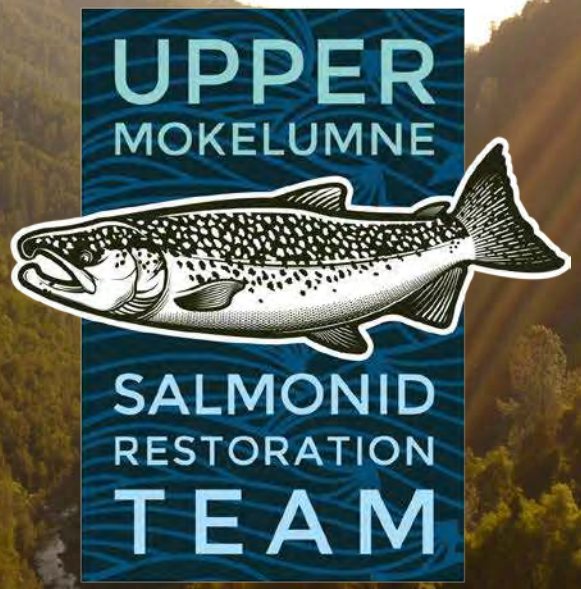
(Slide 4) A Collaborative Effort to Develop a Pilot Project and Assess the Feasibility of Reintroducing Chinook Salmon above Pardee Reservoir on the Mokelumne River, CA
Reuben Childress, Foothill Conservancy, and Michelle Workman, East Bay Municipal Utility District Fisheries and Wildlife Division

(Slide 33) A Plan for Reintroduction of Winter-run Chinook Salmon to Battle Creek
James Lecky, ICF

(Slide 58) Techno-Arrogance: Why Trap and Haul Fails to Recover Salmon & Watersheds
Matt Stoecker, Stoecker Ecological

Upper Mokelumne River

Salmonid Restoration Team



Salmonid Resoration Federation Conference
March, 2017

A collaborative effort to develop a pilot project and assess the feasibility of reintroducing Chinook salmon above Pardee Reservoir on the Mokelumne River

Reuben Childress – Foothill Conservancy
Michelle Workman – East Bay Municipal Utility District

Who is the SRT?
What are we doing?

Nongovernmental organizations:

- Foothill Conservancy*
- California Sportfishing Protection Alliance
- Trout Unlimited
- Delta Fly Fishers
- Amador Flyfishers
- Buena Vista Rancheria Mi-Wuk Indians
- Jackson Rancheria Band of Miwuk Indians

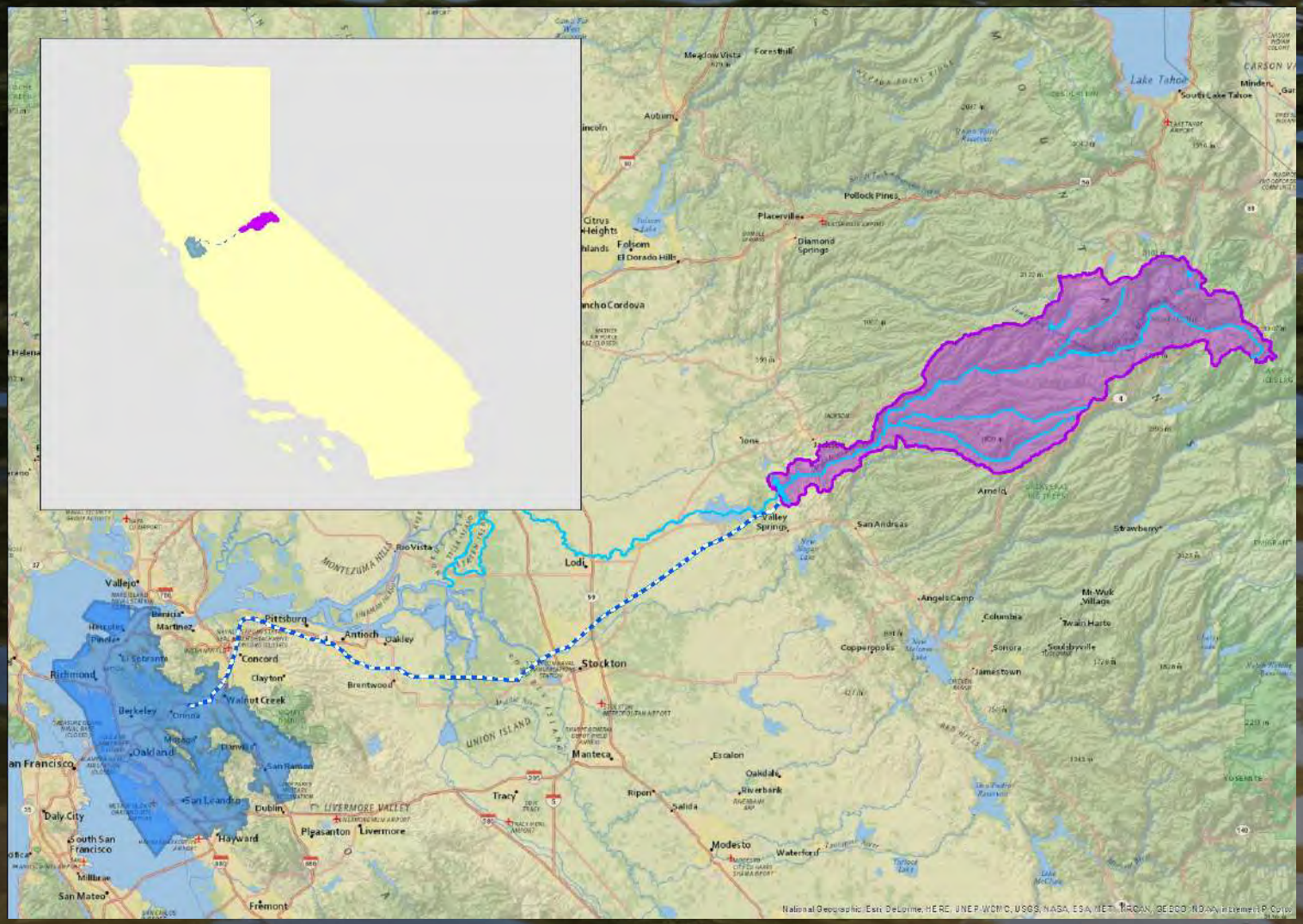
State and Federal agencies:

- US Forest Service
- Bureau of Land Management
- US Fish and Wildlife Service
- California Department of Fish and Wildlife
- National Marine Fisheries Service
- Central Valley Regional Water Board

Water agencies, utilities, and stakeholders:

- East Bay Municipal Utility District
- Amador and Calaveras Counties
- Pacific Gas and Electric
- Calaveras Public Utility District
- Calaveras County Water District
- Roaring Camp Mining Company

The Mokelumne River Watershed



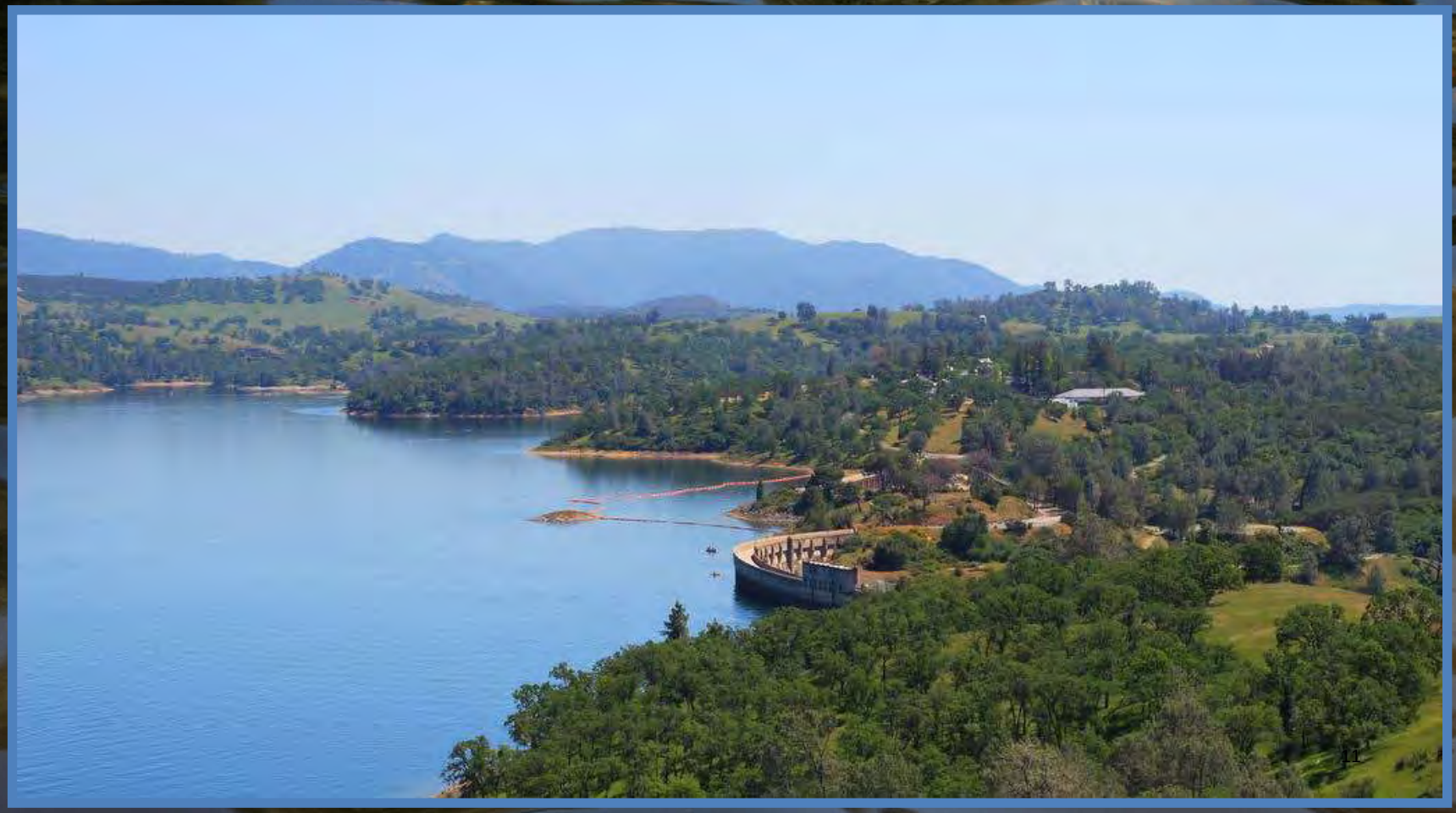
Background
Collaborative History

How did this process start?

Why on the Mokelumne?

Background
Collaborative History

How did we get stakeholders involved?



Background
Collaborative History

How does this project differ from others in the State?

- Volitional passage not currently an option
- Mokelumne is not a state priority for reintroduction

Background
Collaborative History

What is the value of working on a river that isn't a state priority?

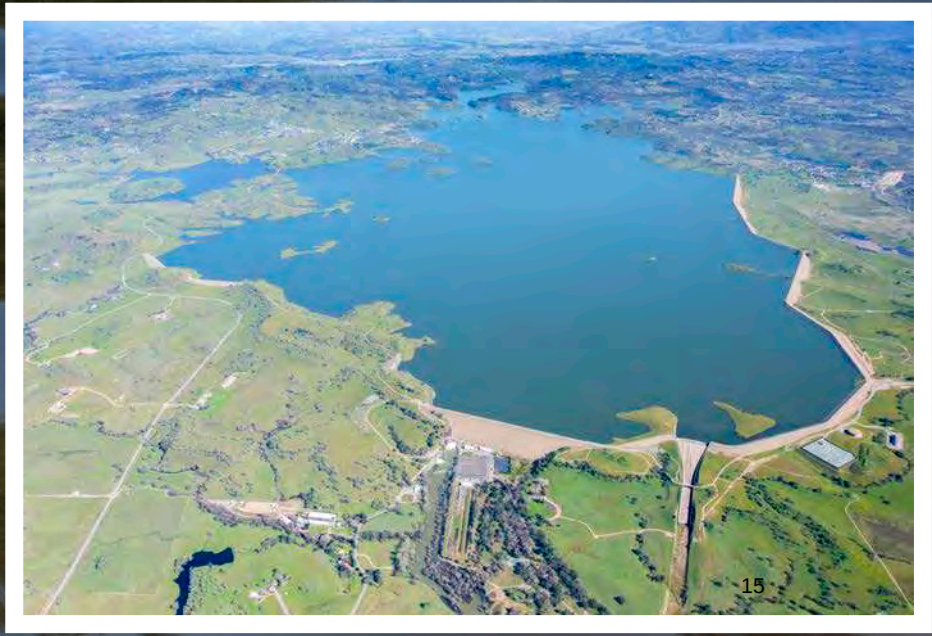
- Fish Hatcheries and Pathogens
- Catch 22
- Working toward same goals as prioritized projects

Background
Goals

- Short-term/long-term goals
  - Short-term: Pilot project
  - Long-term: Reintroduction of a sustainable population
- Guiding Documents:
  - Feasibility Assessment
  - HACCP
  - Pilot project
  - Impacts to other species and water uses
  - Habitat suitability

Downstream Dams

- Pardee provides drinking water to 1.4 million customers in the East Bay
- Camanche provides flood control and maintains fishery flows downstream



Pilot Project

Stepwise project aimed at gathering data to support restoration.

- Determine if logistics are feasible, followed by obtaining approval
- Develop short-term goals that can be implemented on a ~ 5 year time-step

The Process:

- Gather information/build consensus/develop guiding documents
- Pilot project development
  Get approvals

Pilot Project - Background

Stakeholder concerns:

- Reintroduction will require changes in flow requirements (at detriment of existing water rights holders)
- Reintroduction of listed species (steelhead) will place more regulatory controls on upper river stakeholders

Solutions:

- Create Pilot that does not require changes in flow
- Take steelhead off the table for the Pilot

Pilot Project – Short-Term Objectives

- Can we move fish upstream successfully?
- Will they spawn successfully?
- Will juveniles survive in the incubation/ rearing environment?

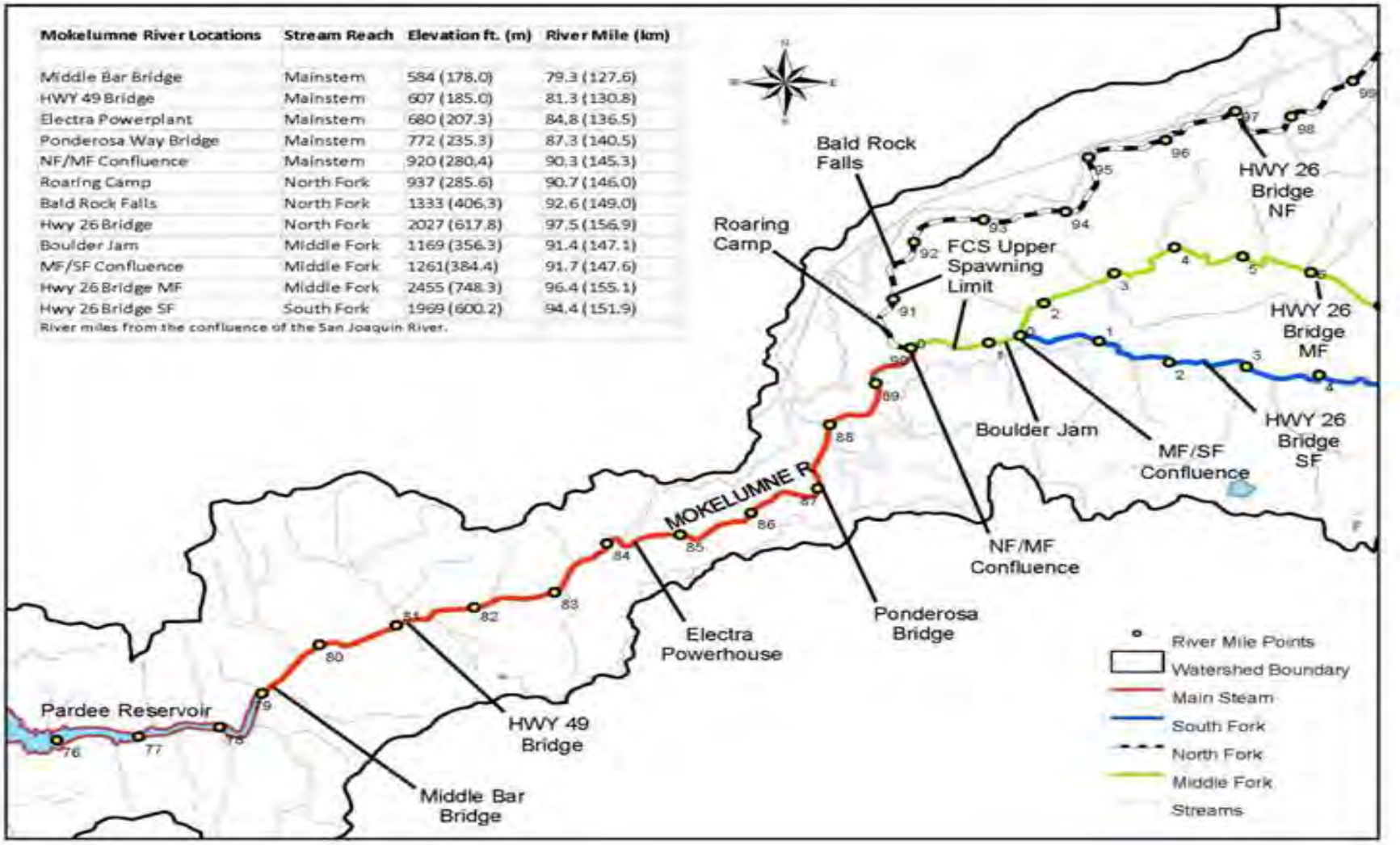
IF YES:

Then develop long-term objectives for population sustainability

Potential Area

Mokelumne River Locations	Stream Reach	Elevation ft. (m)	River Mile (km)
Middle Bar Bridge	Mainstem	584 (178.0)	79.3 (127.6)
HWY 49 Bridge	Mainstem	607 (185.0)	81.3 (130.8)
Electra Powerplant	Mainstem	680 (207.3)	84.8 (136.5)
Ponderosa Way Bridge	Mainstem	772 (235.3)	87.3 (140.5)
NF/MF Confluence	Mainstem	920 (280.4)	90.3 (145.3)
Roaring Camp	North Fork	937 (285.6)	90.7 (146.0)
Bald Rock Falls	North Fork	1333 (406.3)	92.6 (149.0)
Hwy 26 Bridge	North Fork	2027 (617.8)	97.5 (156.9)
Boulder Jam	Middle Fork	1169 (356.3)	91.4 (147.1)
MF/SF Confluence	Middle Fork	1261(384.4)	91.7 (147.6)
Hwy 26 Bridge MF	Middle Fork	2455 (748.3)	96.4 (155.1)
Hwy 26 Bridge SF	South Fork	1969 (600.2)	94.4 (151.9)

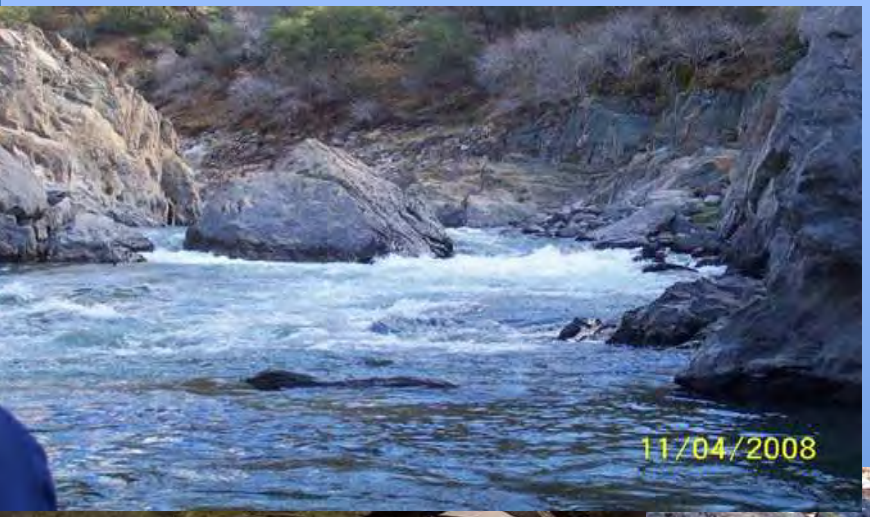
River miles from the confluence of the San Joaquin River.



Potential Barriers

No

Yes



Maybe

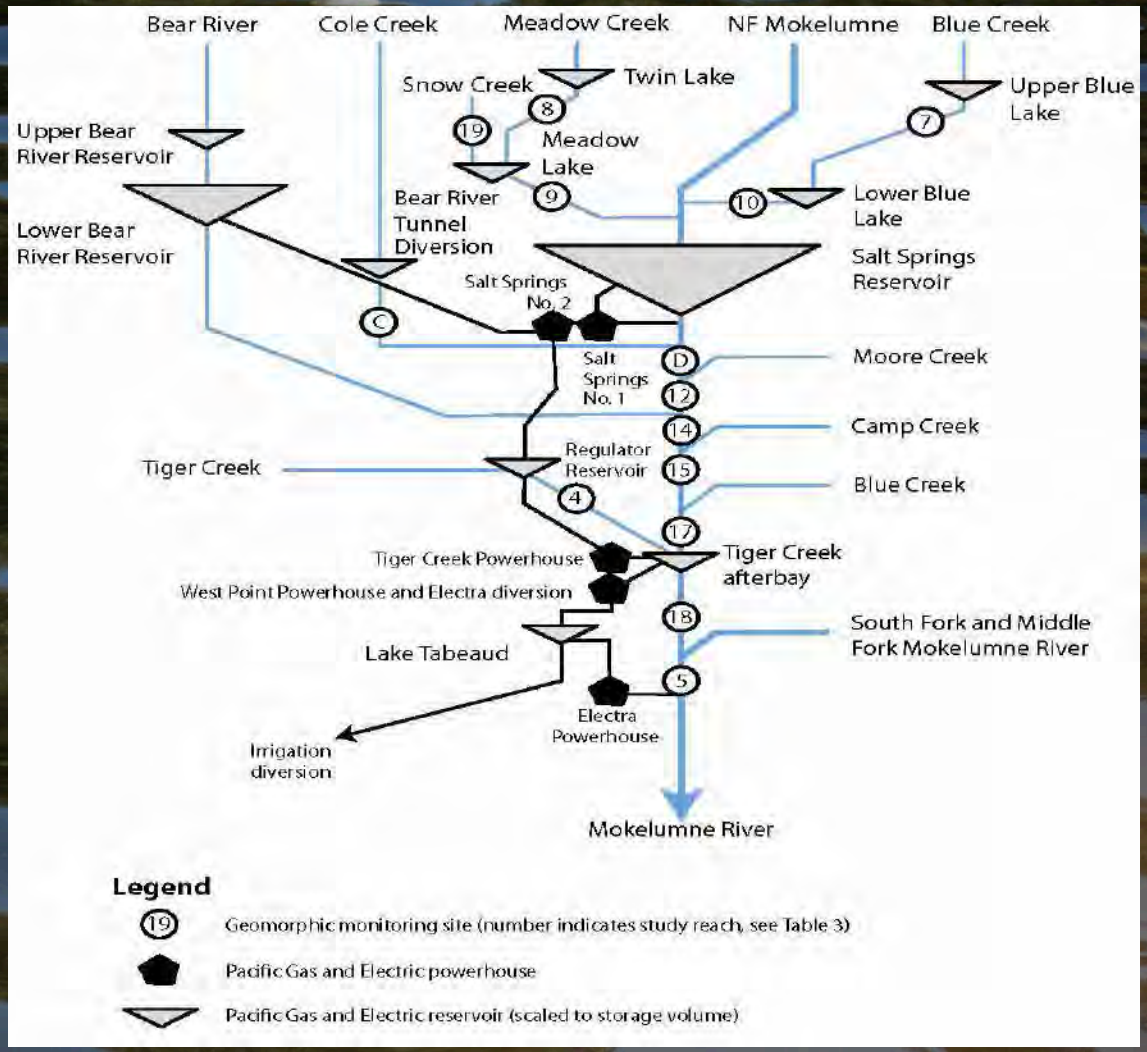
Pilot Project – Process

- Compile Information on:
  - Historic and Existing habitat, hydrology, species composition (Data Source: PG&E 2015)

Most Recent Sample	Station	Species	Fish/Mile	Pounds/Acre
2014	Upper	Rainbow Trout	402	4.6
2014	Upper	Brown Trout	10	0.5
2014	Upper	Sacramento Sucker	10	0.01
2014	Mid	Rainbow Trout	29	0.9
2014	Mid	Sacramento Pikeminnow/hardhead	512	3
2014	Mid	Sacramento Sucker	44	0.1
2014	Mid	speckled dace	15	<0.1
2014	Mid	Unid. Juve.	1449	0.3
2014	Lower	Rainbow Trout	40	1.4
2014	Lower	Brown Trout	30	0.2
2014	Lower	Sacramento Pikeminnow/hardhead	3863	10.3
2014	Lower	California Roach	70	0.1
2014	Lower	speckled dace	40	0.1
2014	Lower	Riffle sculpin	10	<0.1
2014	Lower	Unid. Juve.	1016	0.2

Pilot Project – Process

- Compile Information on:
  - Existing facilities and Operations: PG&E and EBMUD



Pilot Project – Process

- Habitat Assessment:
  - Is habitat suitable?
  - Will provide supporting documentation that we can open up approximately 11-12 miles of habitat?
  - What would be needed to improve it?

Pilot Project – Fish Source

- Mokelumne River Fish Hatchery
  - Work within their operational needs
  - 2 plans for implementation
    - Direct release of adult chinook
    - Artificial redd creation and ‘release’ of eggs for incubation in the reintroduction area

Pilot Project – Release Locations

- Adult Fish:
  - Middle Bar Bridge (RM 79)
  - Hwy 49 (RM 81)
- Egg Tubes:
  - Distributed throughout appropriate spawning habitat from RM 79 to RM 90

Pilot Project – Monitoring

- Adult Fish reintroductions
  - Gastric implanted acoustic tags
  - Spawning surveys

Pilot Project – Monitoring

- Natural Redds
  - Cap redds and collect juveniles

Pilot Project – Monitoring

- Egg Tubes
  - PVC tubes with drilled holes
  - Mesh screen liner
  - PVC caps
- Installation
  - 50 eyed eggs per tube
  - Buried 6-18 inches deep

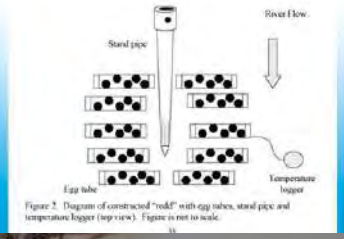
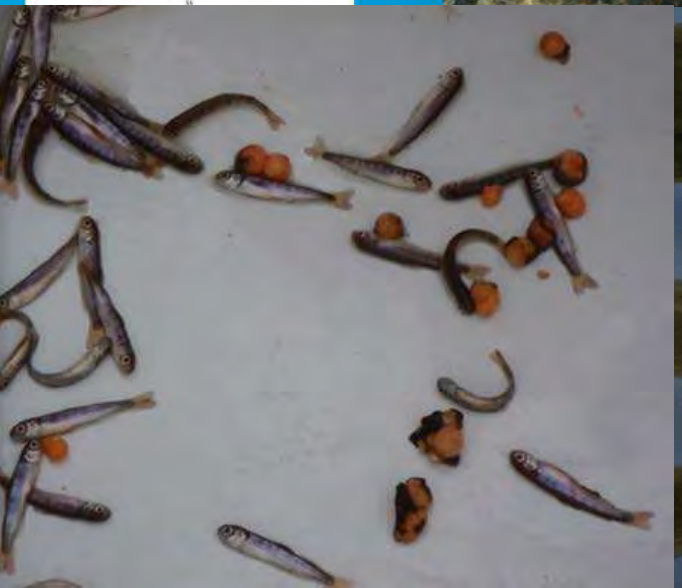


Figure 2. Diagram of constructed "redd" with egg tubes, stand pipe and temperature logger (top view). Figure is not to scale.



- Egg reintroductions
  - Egg tubes placed in good spawning gravel
  - Sac fry would be pulled, counted, then reared at the Mokelumne Hatchery for downstream release.

Issues to Address

- Pathology Investigations
  - Winter and summer
  - Wild Fish Survey – USFWS
- IHN – Infectious Haematopoietic Necrosis

Fish#	Time	Species	FL (cm)	Condition	Sex	Notes
1	10:37	Kok	30.5	Live	F	Prespawn
2	10:37	Kok	32	Live	M	Large Spln
3	11:00	Kok	30.5	Live	F	Prespawn
4	11:06	Kok	32	Live	M	
5	11:06	Kok	27.5	Live	F	Prespawn
6	11:06	Kok	32	Live	F	Prespawn
7	11:45	Kok	30.5	Live	F	Prespawn
		BRN	54	Live	M	
		BRN	53	Live	M	
		BRN	39	Live	F	Spawned
		BRN	39	Live	M	
		BRN	46	Live	M	

Species	Total Fish	Tissue	Assay	No. Samp	Pool Size	No. Pos	Pathogen
Brown Trout	17	Kidney	Bacteriology	17	1	0	
		Kidney	Virology	4	4	0	
		Kidney	*Rs*-DFAT	17	1	0	
		It/Kd	Histology	8	1	0	
Rainbow Trout	7	Kidney	Bacteriology	7	1	1	*Hafnia alvei*
		Kidney	Virology	2	4	0	
		Kidney	*Rs*-DFAT	7	1	0	
		It/Kd	Histology	4	1	0	
		Gill	Histology	1	1	1	Glochidia
		Liv/Spln	Histology	4	1	0	
		Head	Mc-PTD	5	1	2	*Myxobolus cerebralis*
Sacramento Pikeminnow	8	Kidney	Bacteriology	7	1	0	
		Kidney	Virology	2	4	0	
Sacramento Sucker	11	Kidney	Bacteriology	1	1	0	
		Kidney	Virology	2	5	0	

Next Steps

- Complete Pathology assessment with USFWS Fish Health Lab
- Release RFP and Complete Habitat Assessment on project reach
- Continue revising Pilot Plan based on results
- Continue to try to gain agency support

Questions?

Thank you!

www.foothillconservancy.org/salmon

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Reintroduction of Salmon into their Historic Habitats

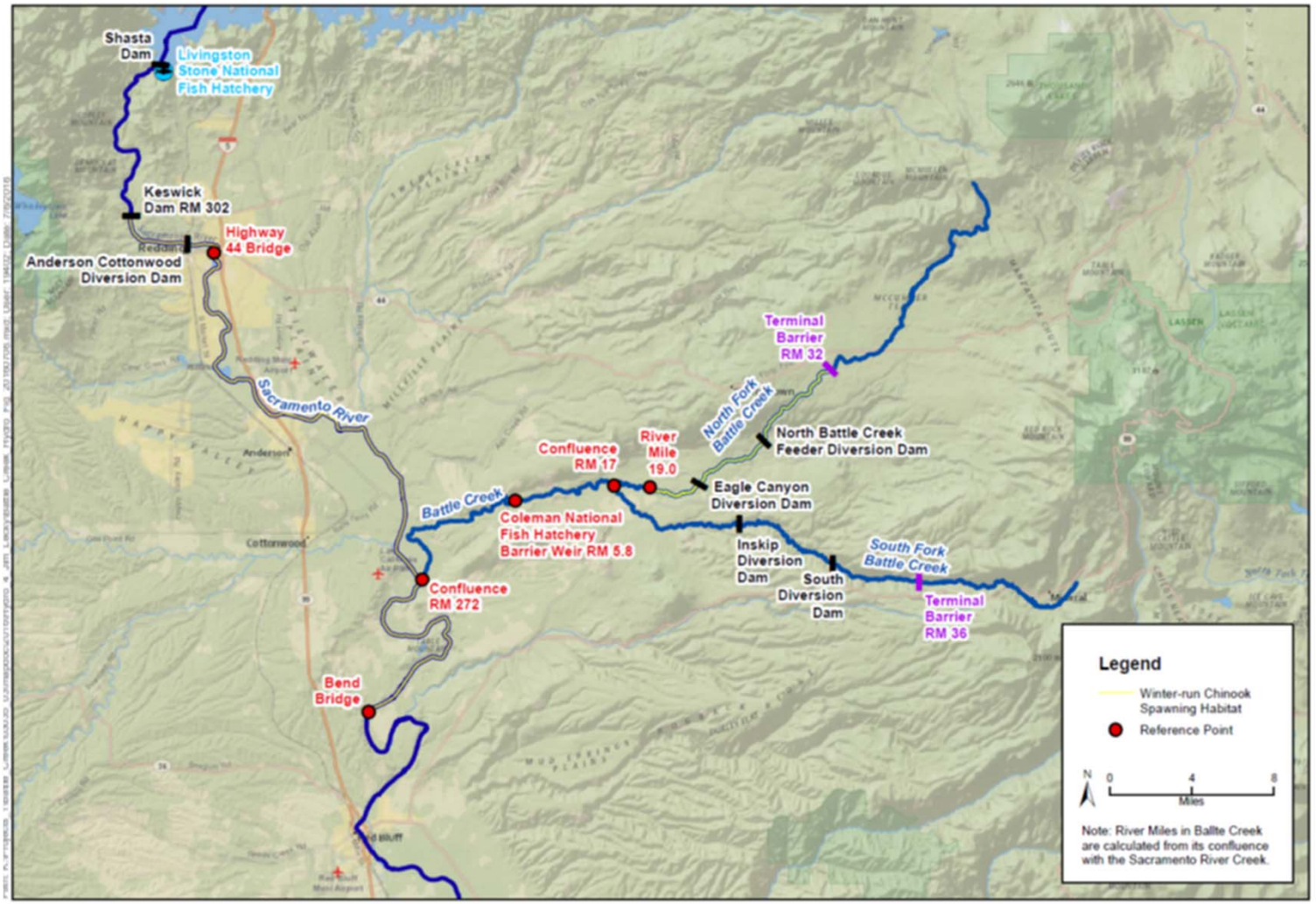
Battle Creek

04/2017

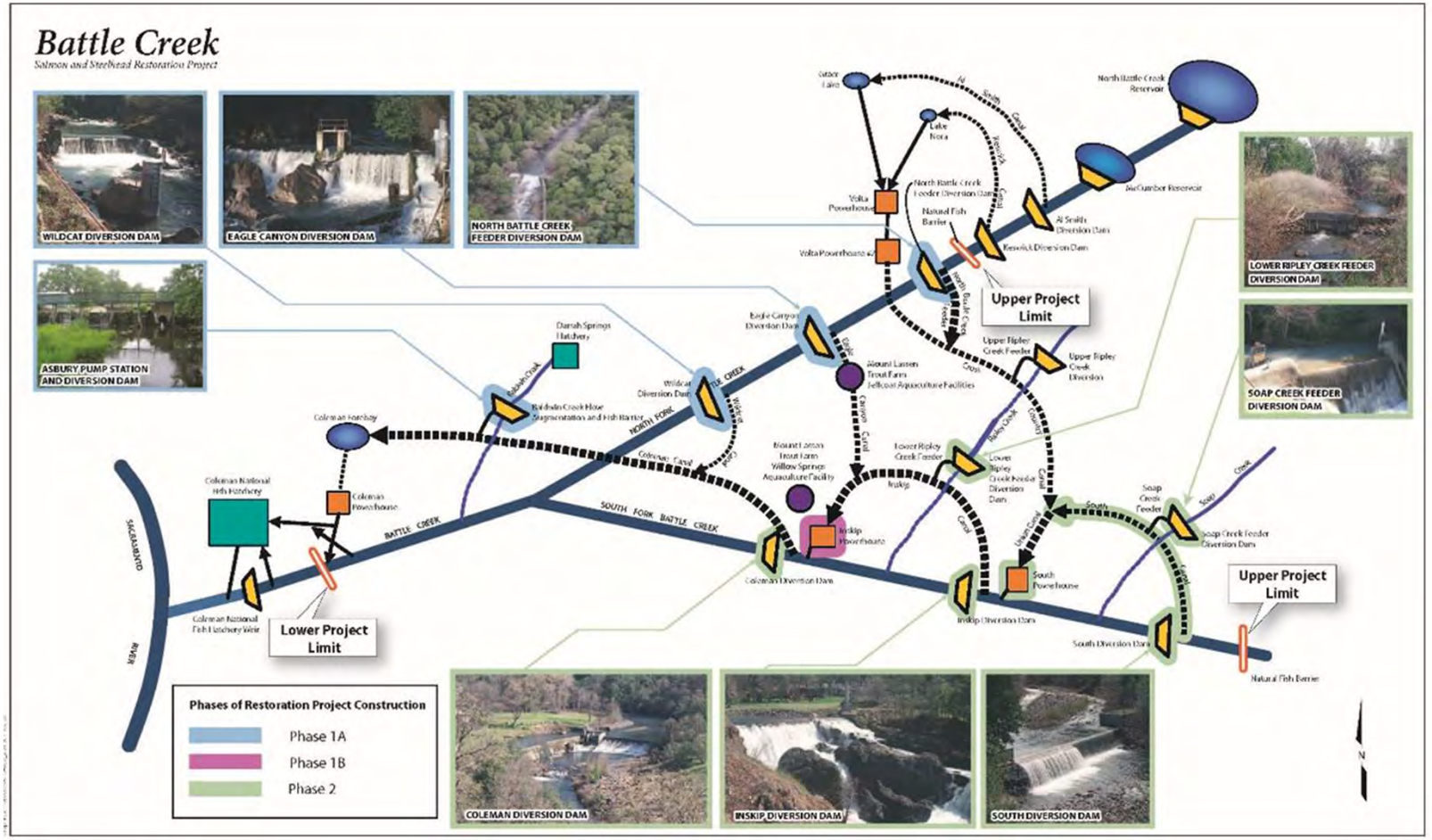
35th Annual Salmonid Restoration Federation Conference

(Marin Greenwood for)
Jim Lecky
Senior Consultant

Battle Creek



Battle Creek Salmon and Steelhead Restoration Project



Winter-run Chinook Reintroduction Plan

Key Assumptions

- The BCRP will be completed
- There is habitat to support a viable population of winter-run Chinook
- The CNFH AMP will be implemented
- Limiting factors outside Battle Creek are addressed

https://www.wildlife.ca.gov/Drought/Projects/Battle-Creek

Winter-run Chinook Reintroduction Plan

Vision

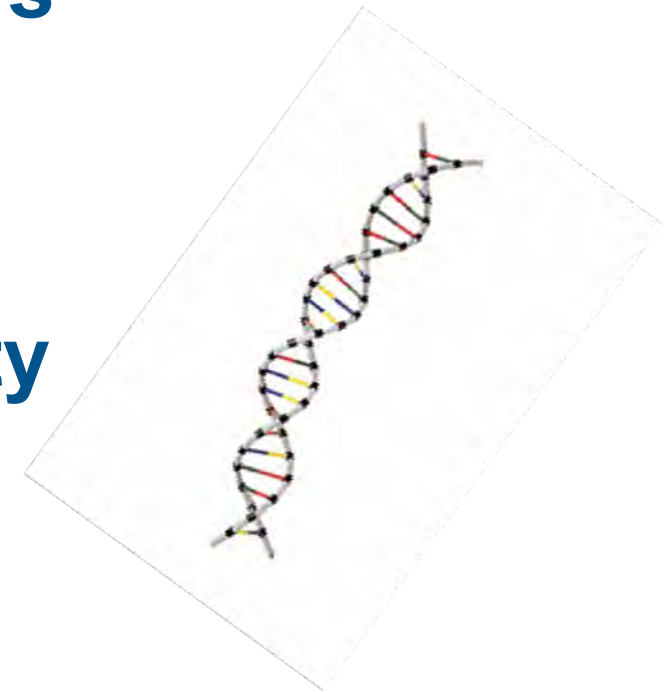
Establish a viable, self-sustaining and locally adapted population of winter-run Chinook salmon in Battle Creek that adds to the spatial diversity and abundance of the Sacramento River winter-run Chinook ESU.

What's the best strategy?

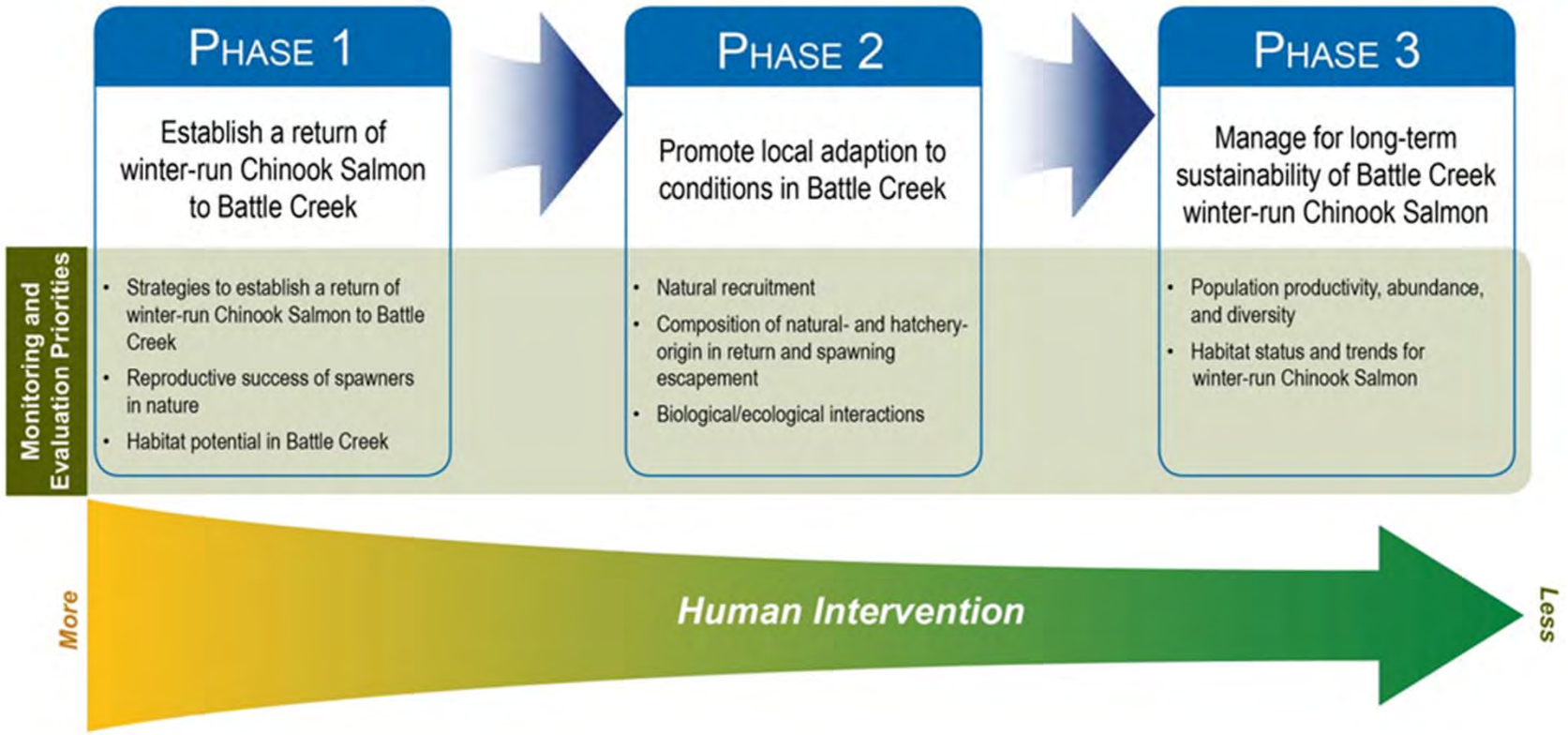
Numbers

vs.

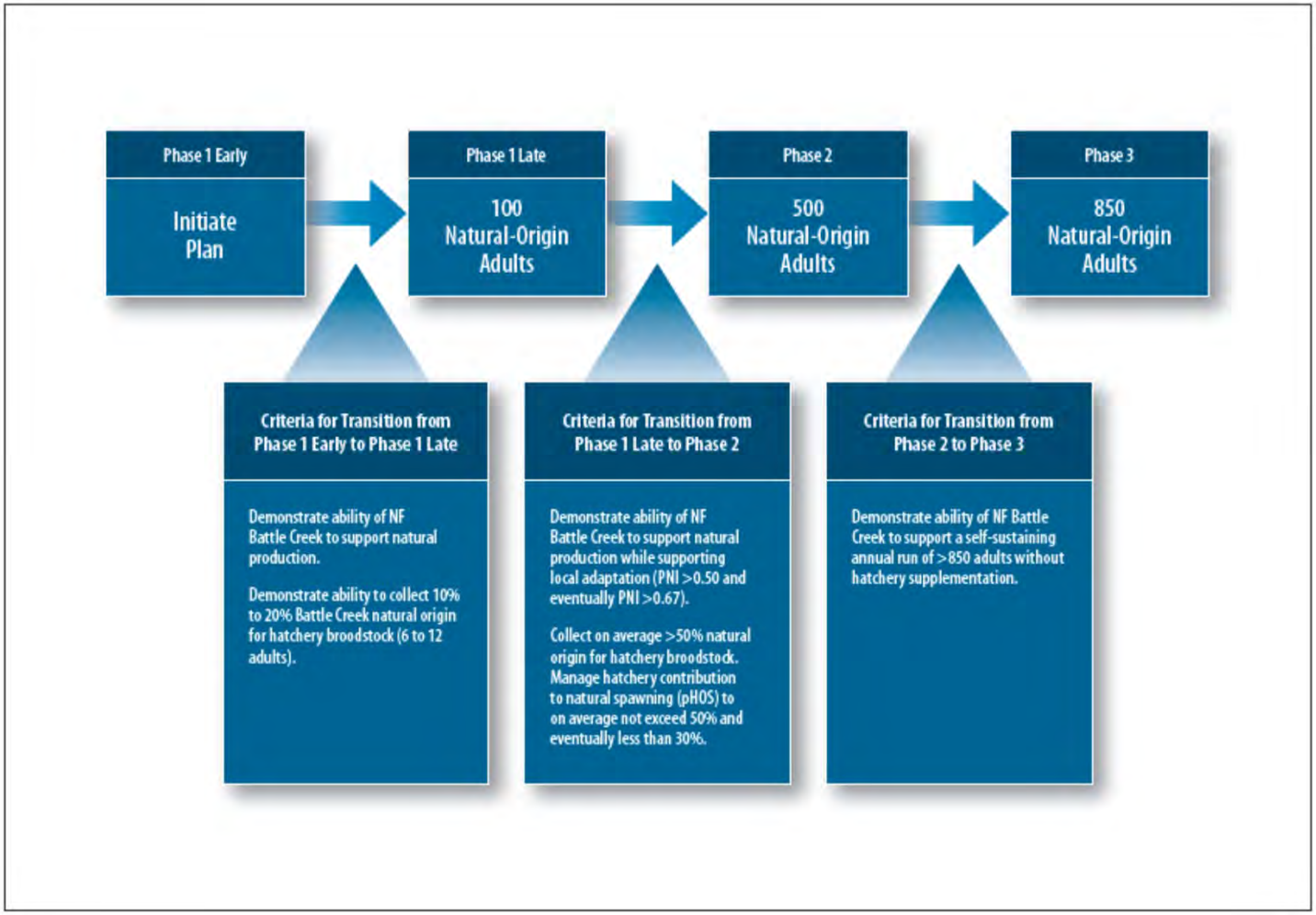
Diversity



Winter-run Chinook Reintroduction Plan



Winter-run Chinook Reintroduction Plan

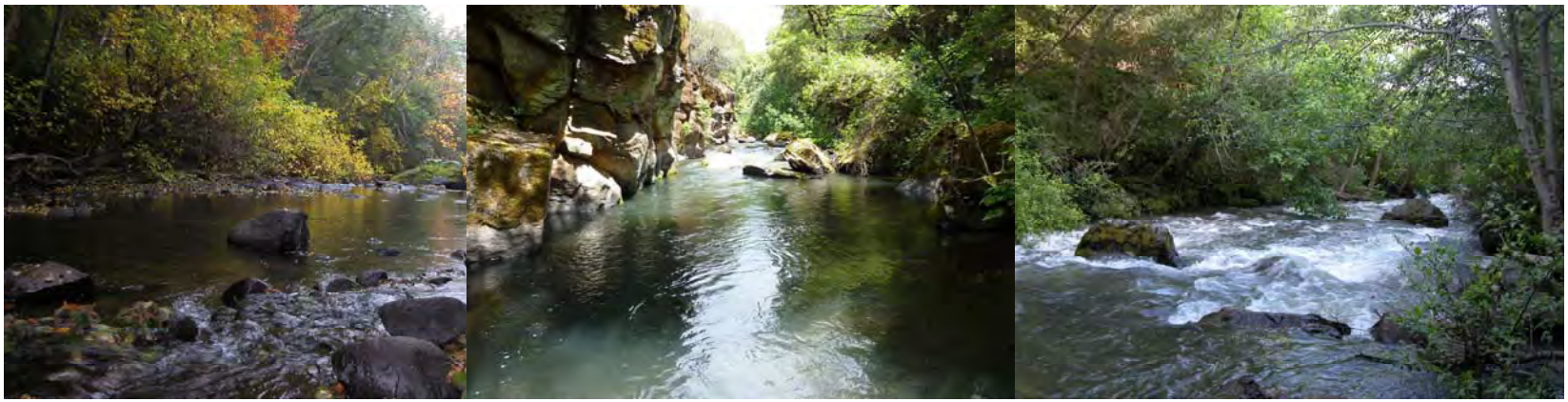


BY DAMON ARTHUR OF THE REDDING RECORD SEARCHLIGHT

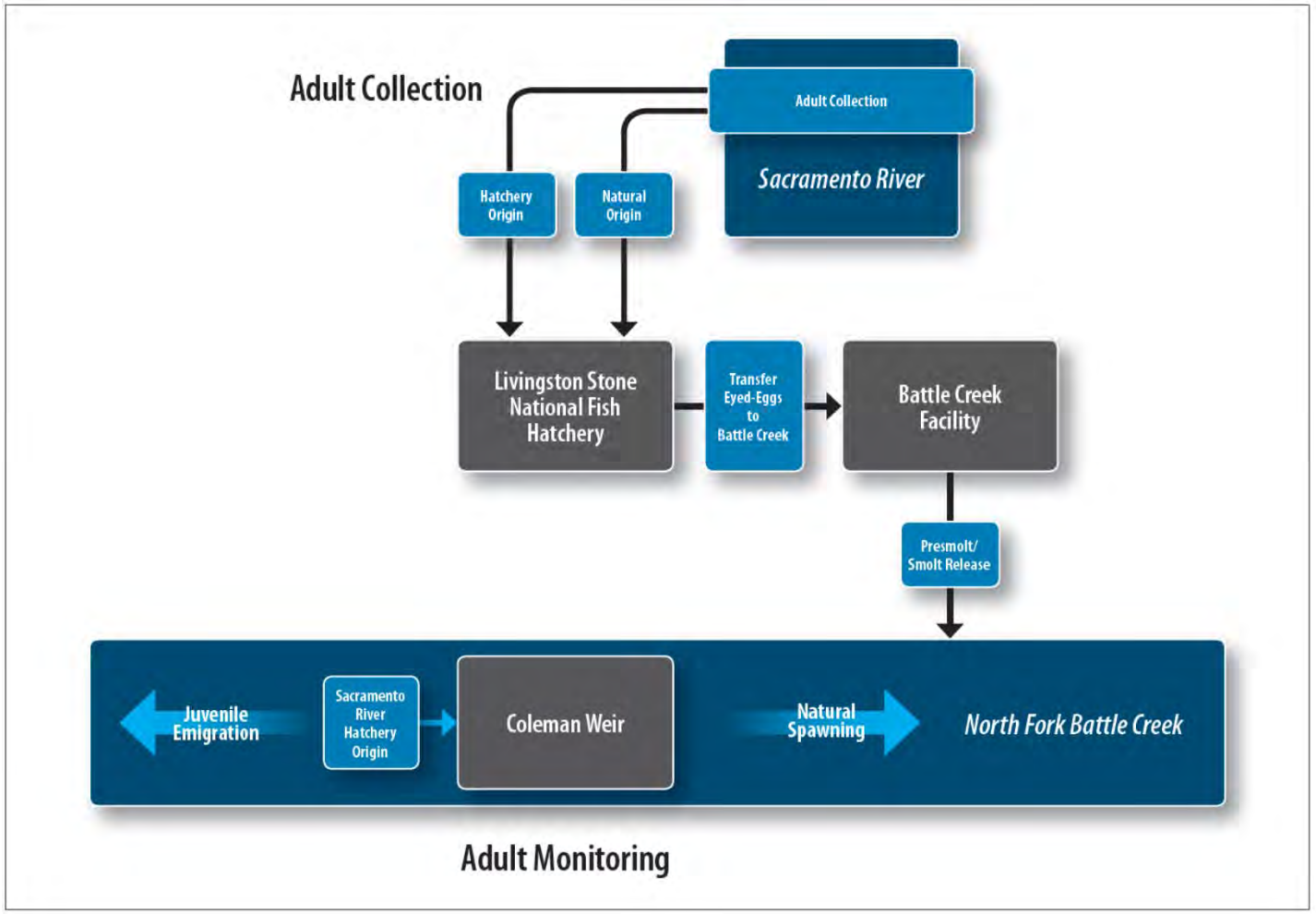
Phase 1

Goal

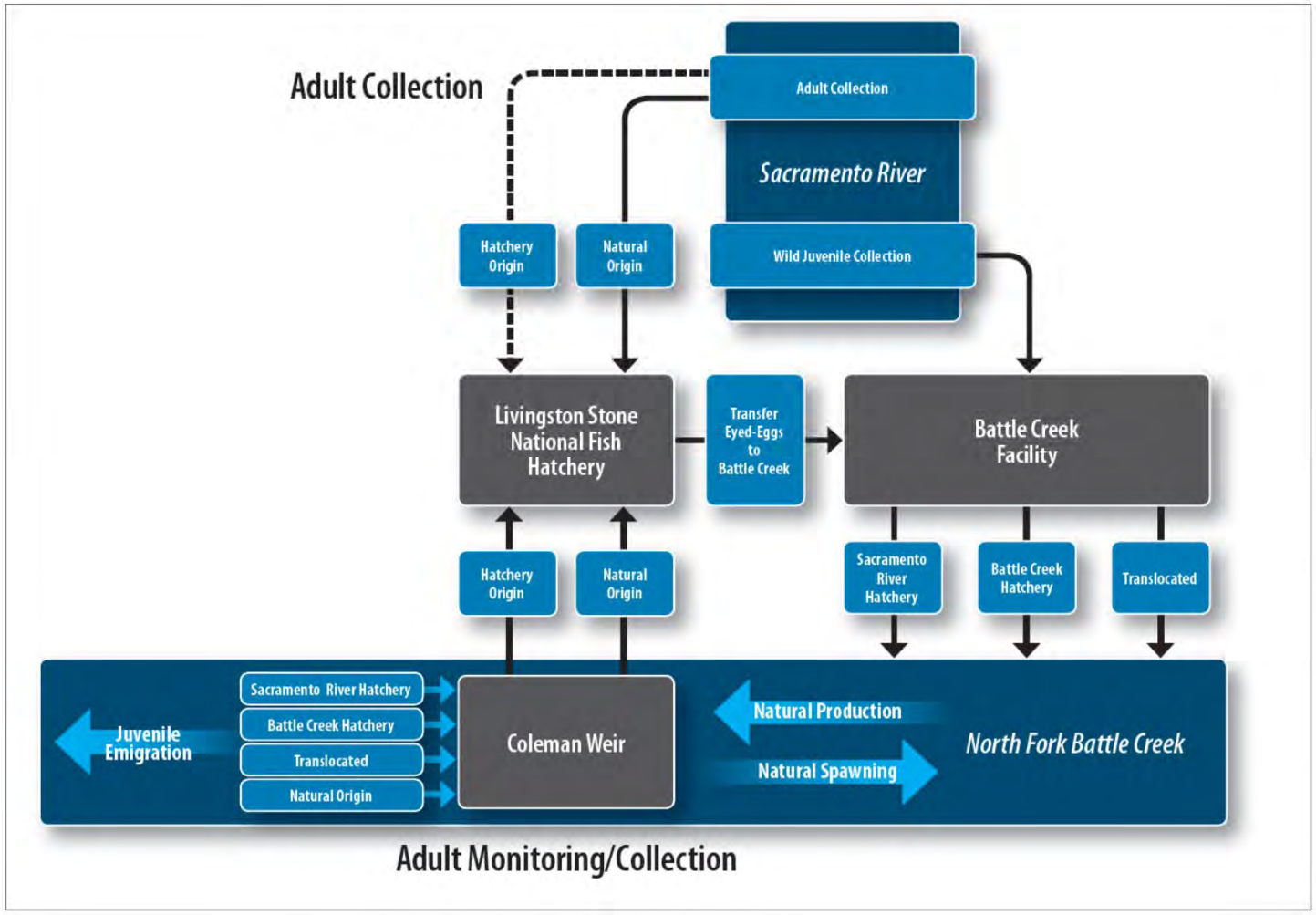
Establish a population of winter-run Chinook Salmon in Battle Creek that meets abundance objectives, retains the genetic diversity of the Sacramento River population, and includes a substantial proportion of natural-origin fish.



Phase 1 Early Actions



Phase 1 Late Actions



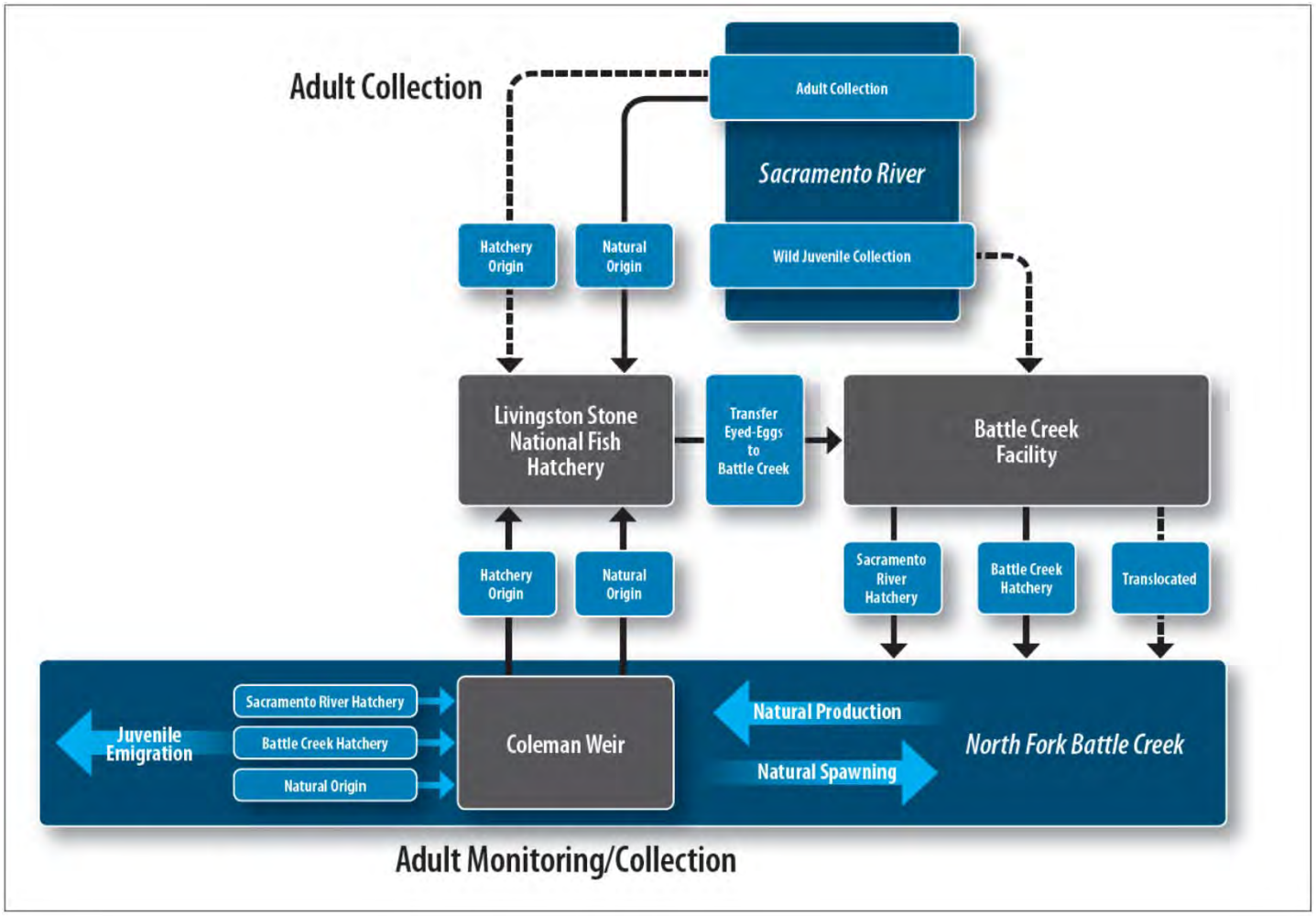
Phase 2

Goal

- *Establish a self-sustaining, locally adapted population of winter-run Chinook Salmon in Battle Creek by encouraging local adaptation of the Battle Creek population,*
- *Phasing out the contribution of artificial production, and*
- *Eliminating the genetic contribution from the Sacramento River population into the artificial production program.*



Phase 2 Actions

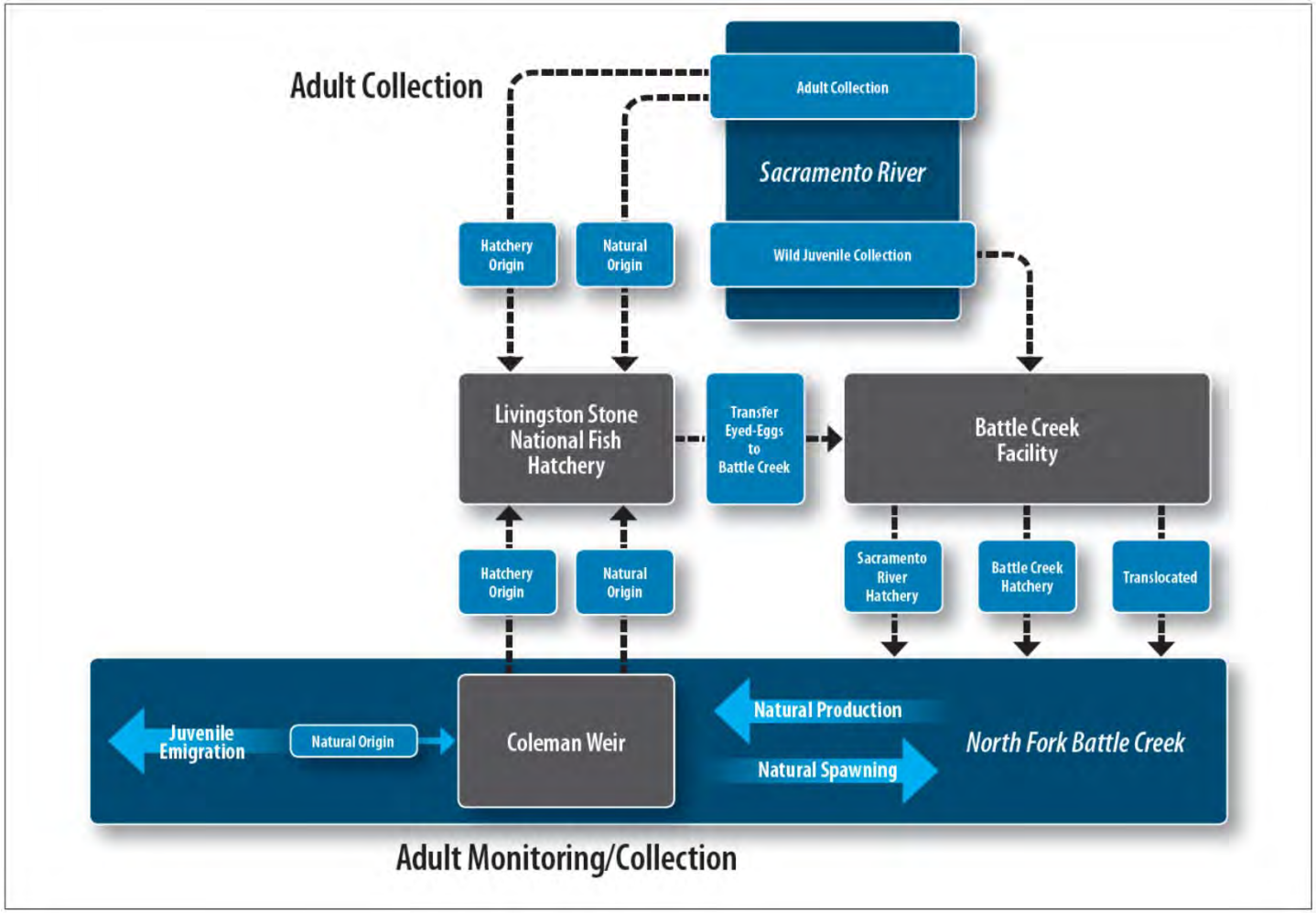


Phase 3

Goal

- *Monitor the viability of the Battle Creek population and respond to concerns set by ESA recovery needs.*

Phase 3 Actions



Program Evaluation And Adaptive Management

Integrated with and relies on other plans

- **BCRP AMP**
  - Surveys for Winter-Run will need to be accelerated due to accelerated establishment of return
- **LSNFH HGMP**
  - HGMP will have to be modified/expanded to address effects of the expanded hatchery program on natural production in Battle Creek and the Sacramento River
- **CNFH AMP**
  - Will have to be modified to address the need to select specific individuals based on origin
  - Mechanisms and rules for retaining or passing winter-run Chinook will need to be created

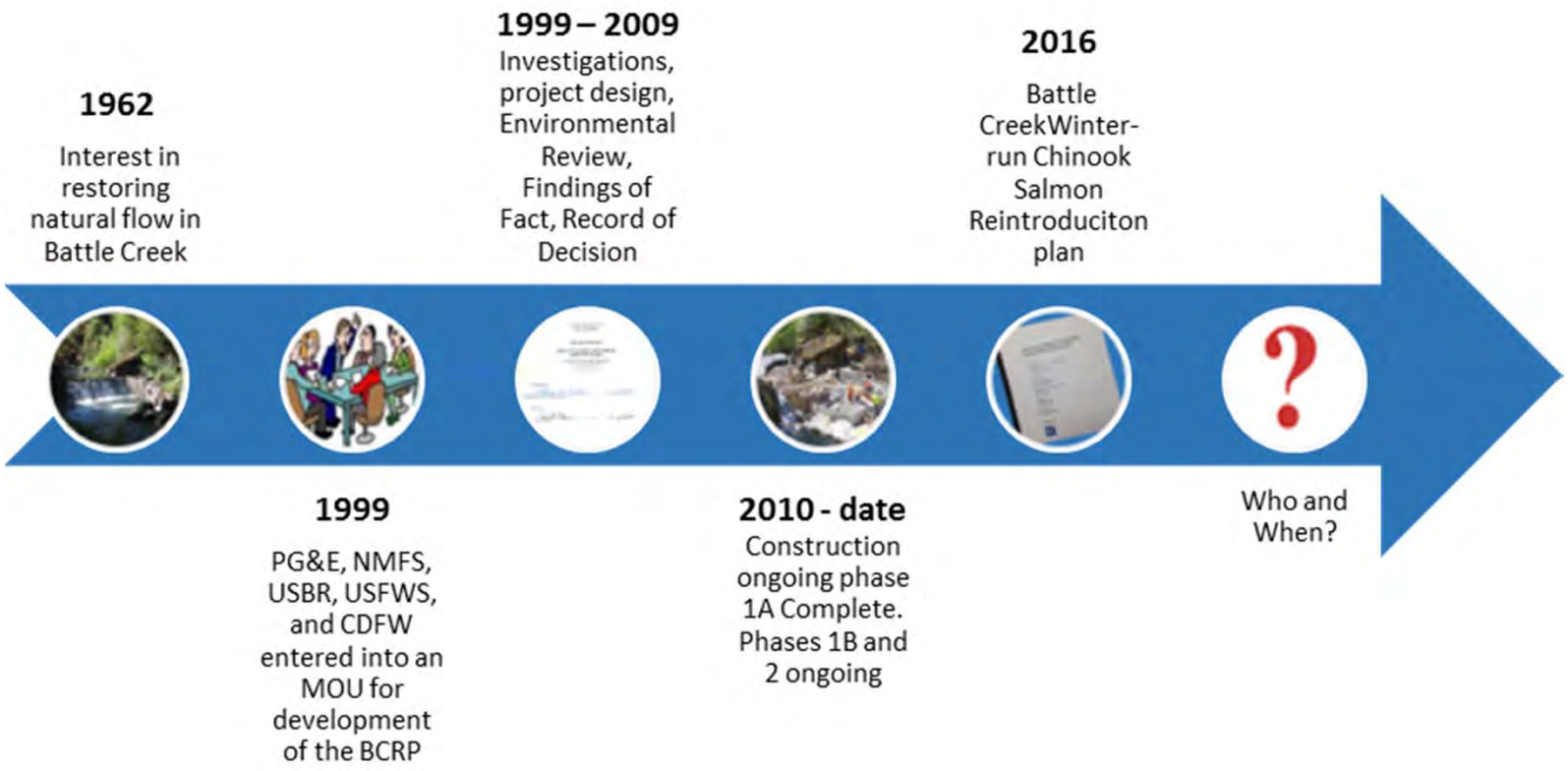
Facility Needs and Program Costs

- **Existing facilities**
  - Adult trap at Keswick
  - LSNFH
- **Essential new facilities**
  - Temporary juvenile holding tanks
  - 250 gallon transport Truck for juvenile transport to battle Creek
  - Fish culture facility on North Fork Battle Creek above CNFH near reliable source of cold water for rearing from eyed egg stage to release, and hold of Sacramento juveniles prior to release
  - Tagging/marking facilities
  - Temporary adult holding tanks, water supply, and chillers at CNFH
  - 2000 gallon transport truck for transport of adults to LSNFH
- **Possible additional facilities**
  - Development of alternative adult capture site e.g. at/near ACID
  - Expansion of NF culture facility to accept and spawn adults

Facility Needs and Program Costs*

Category	Item	One time cost	Annual cost
Planning and design	New facilities	$500,000	
Environmental Compliance	NEPA, CEQA, ESA, permitting	$500,000	
Modification of existing facilities and capital equipment	Tanks, plumbing, chillers, trucks	$240,000	
Construction	New facilities	$2,125,000	
Annual Operations	Staff, power, water, equipment		$650,000
Totals		$3,365,000	$650,000

* Facilities cost based on LSNFH costs which maybe low. Based on comparison to other facilities a reasonable planning range is $3-8 million.

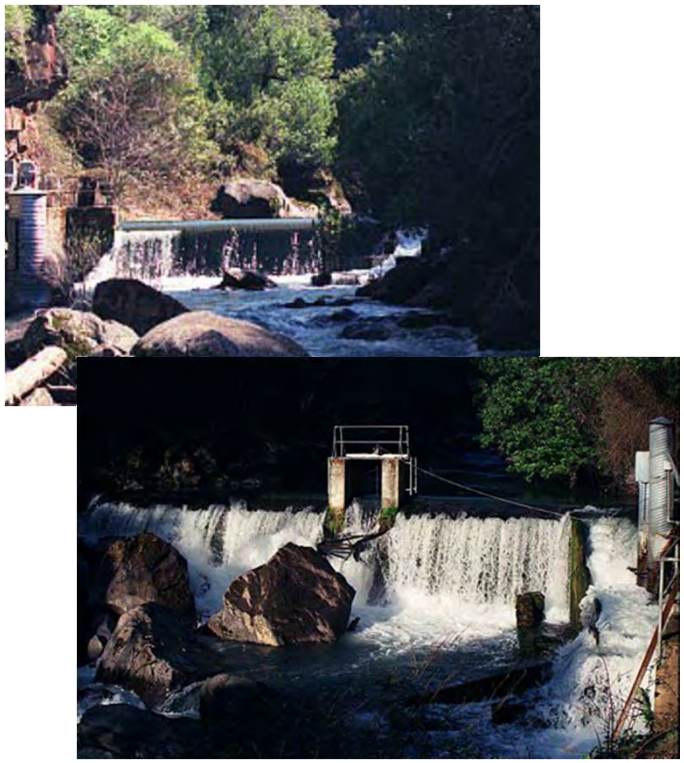


https://www.wildlife.ca.gov/Drought/Projects/Battle-Creek

https://www.wildlife.ca.gov/Drought/Projects/Battle-Creek

EXTRA SLIDES

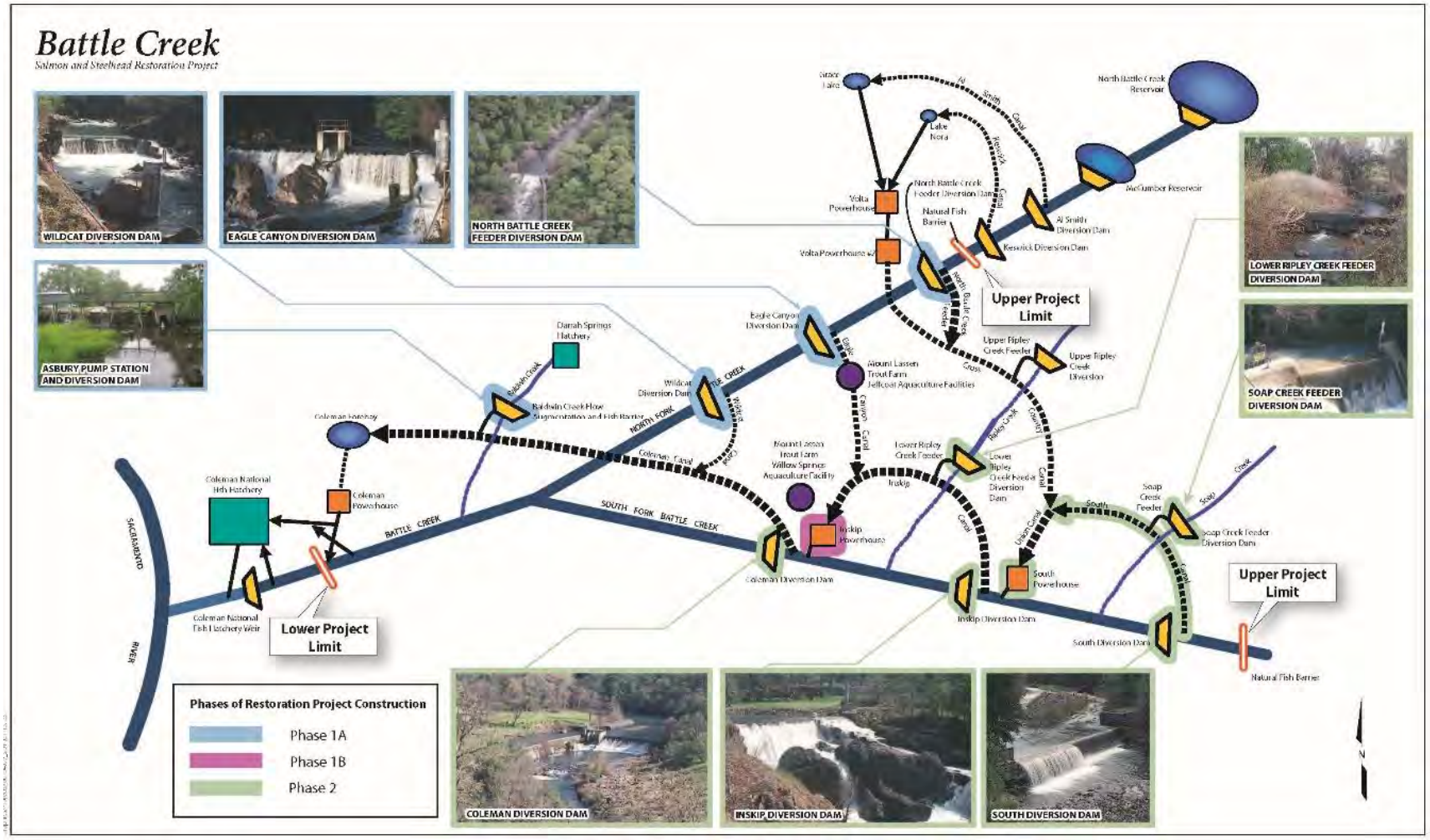
Battle Creek Salmon and Steelhead Restoration Project



Purpose and need

… restore approximately 42 miles of habitat in Battle Creek … while minimizing the loss of clean and renewable energy

Battle Creek Salmon and Steelhead Restoration Project



Estimated Capacity

Table 1. Estimated Number of Winter-Run Chinook Spawners That Could Be Supported in Battle Creek

Scenario Five-Dam Removal	Spawning Area (acres)	Spawning Area Distribution	Redds		Spawners	
			Low	High	Low	High
North Fork	1.41	66%	409	819	1,228	2,457
South Fork	0.71	34%	206	412	618	1236
Mainstem	0	0%	0	0	0	0
Total	**2.12**		**615**	**1,231**	**1,846**	**3,711**

Note: Estimated numbers are based on area of suitable spawning substrate accessible for winter-run Chinook upon completion of the Battle Creek Restoration Project (the Five Dam Removal Alternative). While Thomas R. Payne and Associates (2005) estimate that space will be available for winter-run Chinook spawners in the South Fork and mainstem of Battle Creek, temperatures in the South Fork may be challenging for egg incubation and juvenile survival. For this reason, the estimates in Table 1 for the South Fork and mainstem may be less relevant to this plan than the estimates for the North Fork.

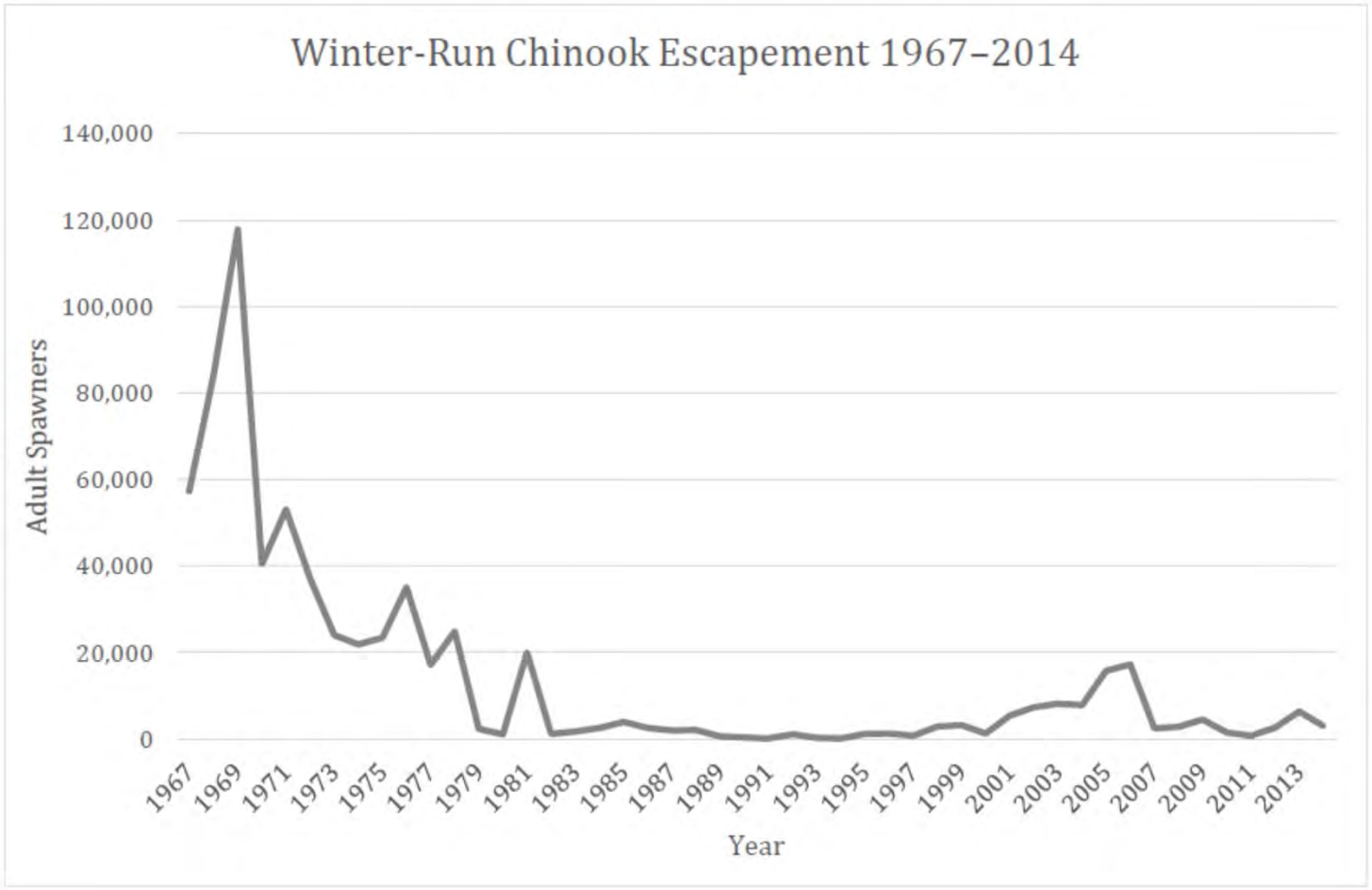
Assumptions:

Redd size: Low = 150 sq. ft./redd, High = 75 sq. ft./redd

3 fish/redd

Source: USBR 2005.

Status of Winter-run Chinook



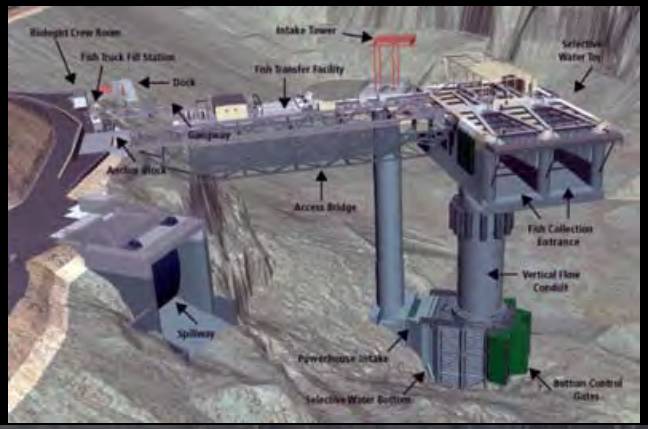
Techno-Arrogance:
Why Trap & Haul Fails to Recover Salmon & Watersheds

Matt Stoecker | Stoecker Ecological

Reintroduction --> Self-sustaining

We know these work!

Ongoing, artificial, human-dependent



These have not worked

“history of failure of trap-and-truck operations”

"techno-arrogance”

- California Department of Fish and Game 1996 Steelhead Restoration & Management Plan

Nearly 400 steelhead die in Applegate fish-trap failure

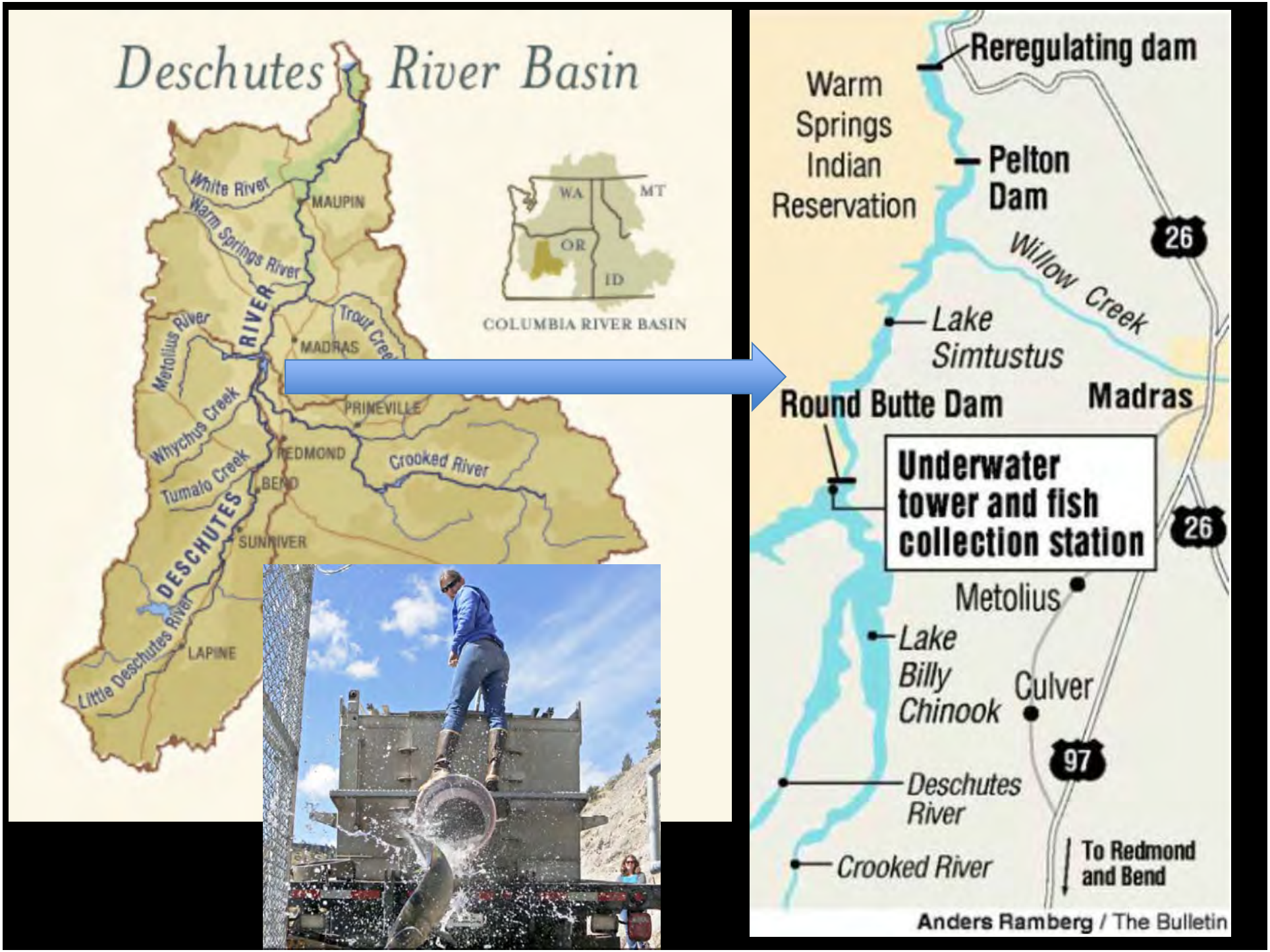
day
ed Apr 10, 2015 at 3:02 PM
ated Apr 10, 2015 at 4:59 PM

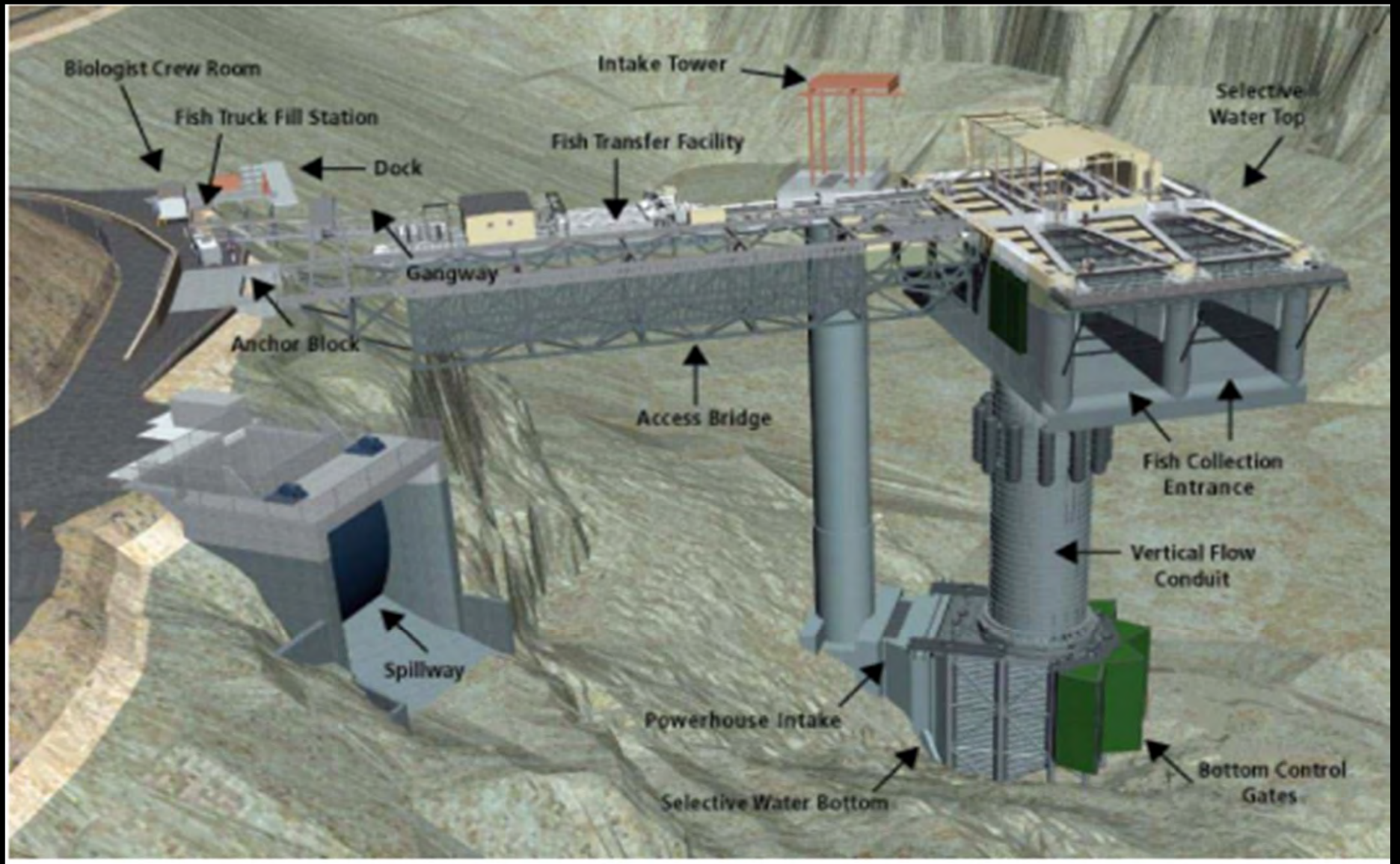
By Mark FreemanMail Tribune

APPLEGATE — A breakdown of a fish-loading facility at the base of Applegate Dam killed almost 400 Applegate River adult winter steelhead that were bound for Cole Rivers Hatchery.

Trap and Haul programs
"impose an artificial selective force
and generally reduce fitness."

- Oregon Department of Fish and Wildlife 2006

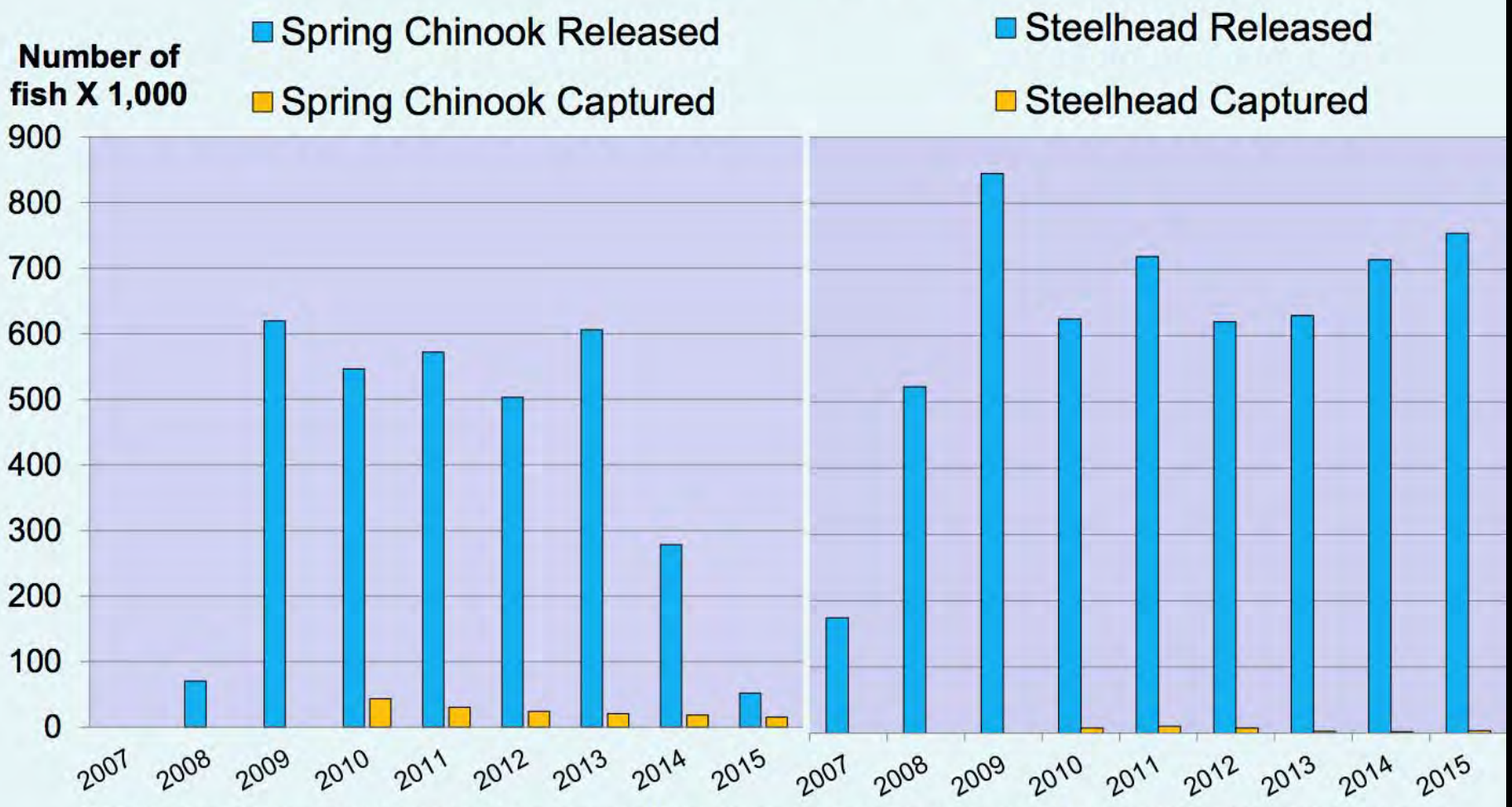

Deschutes River Basin
White River
Warm Springs River
MAUPIN
RIVER
Metolius River
Trout Creek
MADRAS
PRINEVILLE
Whychus Creek
Tumalo Creek
REDMOND
BEND
Crooked River
DESCHUTES
SUNRIVER
LAPINE
Little Deschutes River
WA
MT
OR
ID
COLUMBIA RIVER BASIN
Reregulating dam
Warm Springs Indian Reservation
Pelton Dam
26
Willow Creek
Lake Simtustus
Round Butte Dam
Madras
Underwater tower and fish collection station
26
Metolius
Lake Billy Chinook
Culver
97
Deschutes River
Crooked River
To Redmond and Bend
Anders Ramberg / The Bulletin



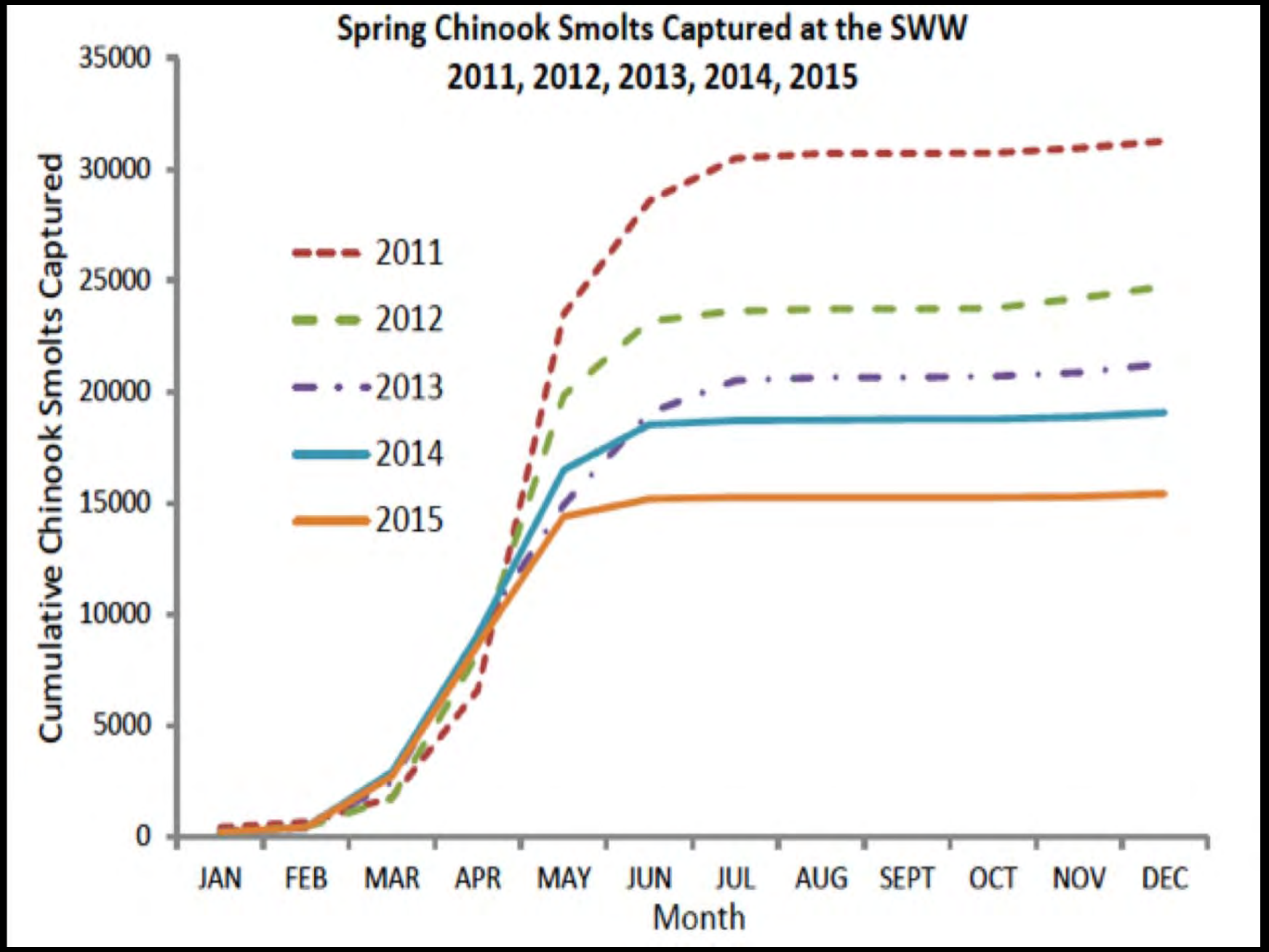
A computer-generated model shows the underwater tower and fish collection station at Round Butte Dam.

"State-of-the-art" fish collection + trap & truck (2009) $100M+ Tower

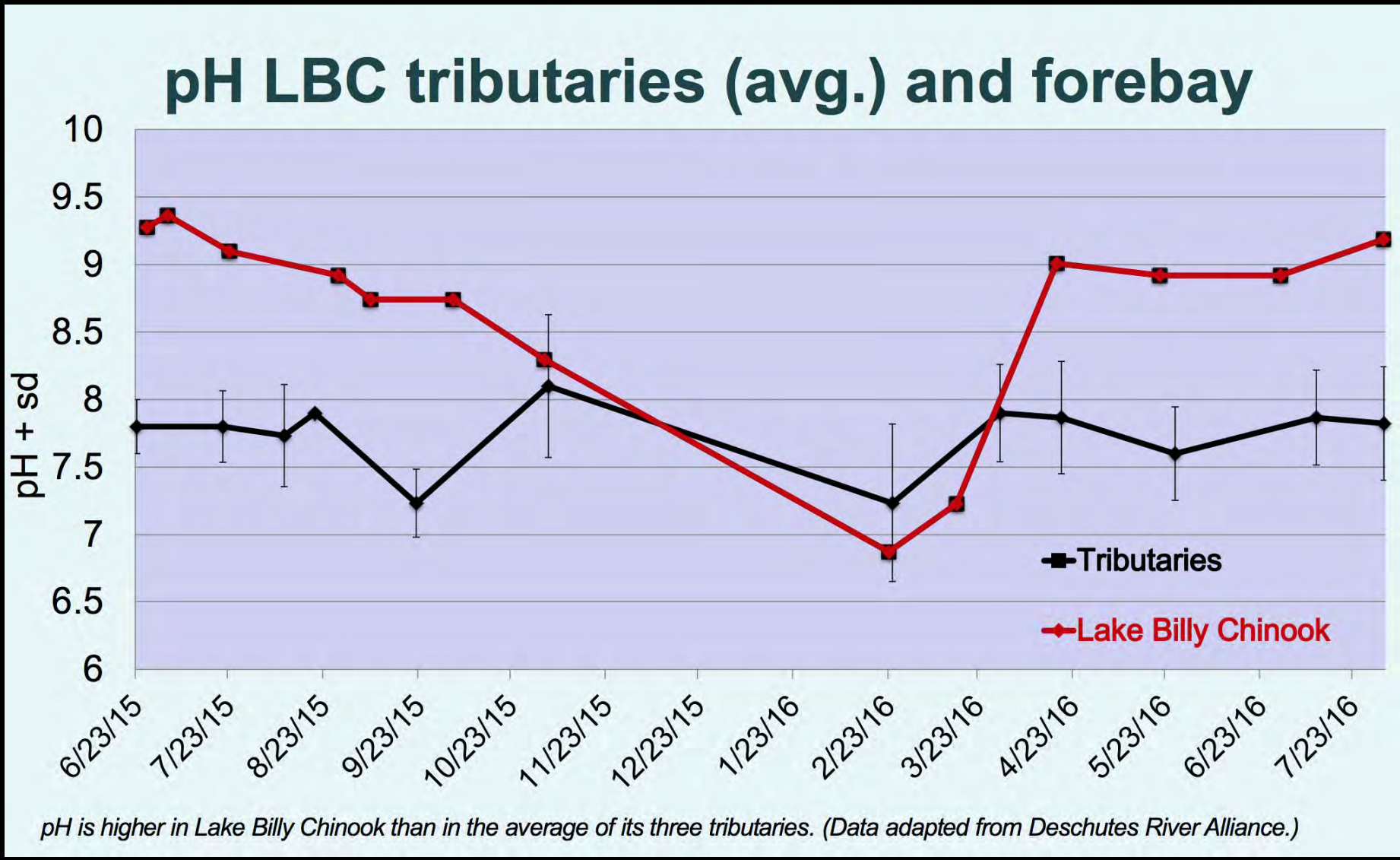
Tributary releases far exceed tower arrivals at Lake Billy Chinook



Graphs adapted from: 2007-2014 PGE Annual Fish Passage Reports to Federal Energy Regulatory Commission.



Source: PGE data to FERC June 2016. Chart DRA



pH is higher in Lake Billy Chinook than in the average of its three tributaries. (Data adapted from Deschutes River Alliance.)

ODEQ pH standard maximum = 8.5 | DRA cites 1000+ CWA violations

Deschutes Fish Die Off 2015

Sockeye (above) & Spring Chinook (right)

- Infections *columnaris & Ceratomyxa shasta*
- Thermal stress

Source: Deschutes River Alliance

Hatchery & Transplant Record of Failure

- "Despite the increased risks of methods such as transplanting adults and hatchery releases, we found no direct evidence that these approaches have established a demographically independent, self-sustaining natural population."

- Planning Pacific Salmon and Steelhead Reintroductions Aimed at Long-Term Viability and Recovery 2014 NOAA, ODFW, WDFW

"recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported"

- Endangered Species Consultation Handbook USFWS & NMFS

(CDFW management plans also uses "self-sustaining")

Delisting (the official goal of ESA "recovery") requires adequate "wild" & "self-sustaining" populations

"Species that require ongoing, intensive human intervention cannot generally be considered at low risk of extinction because of the ephemeral nature of human institutions."

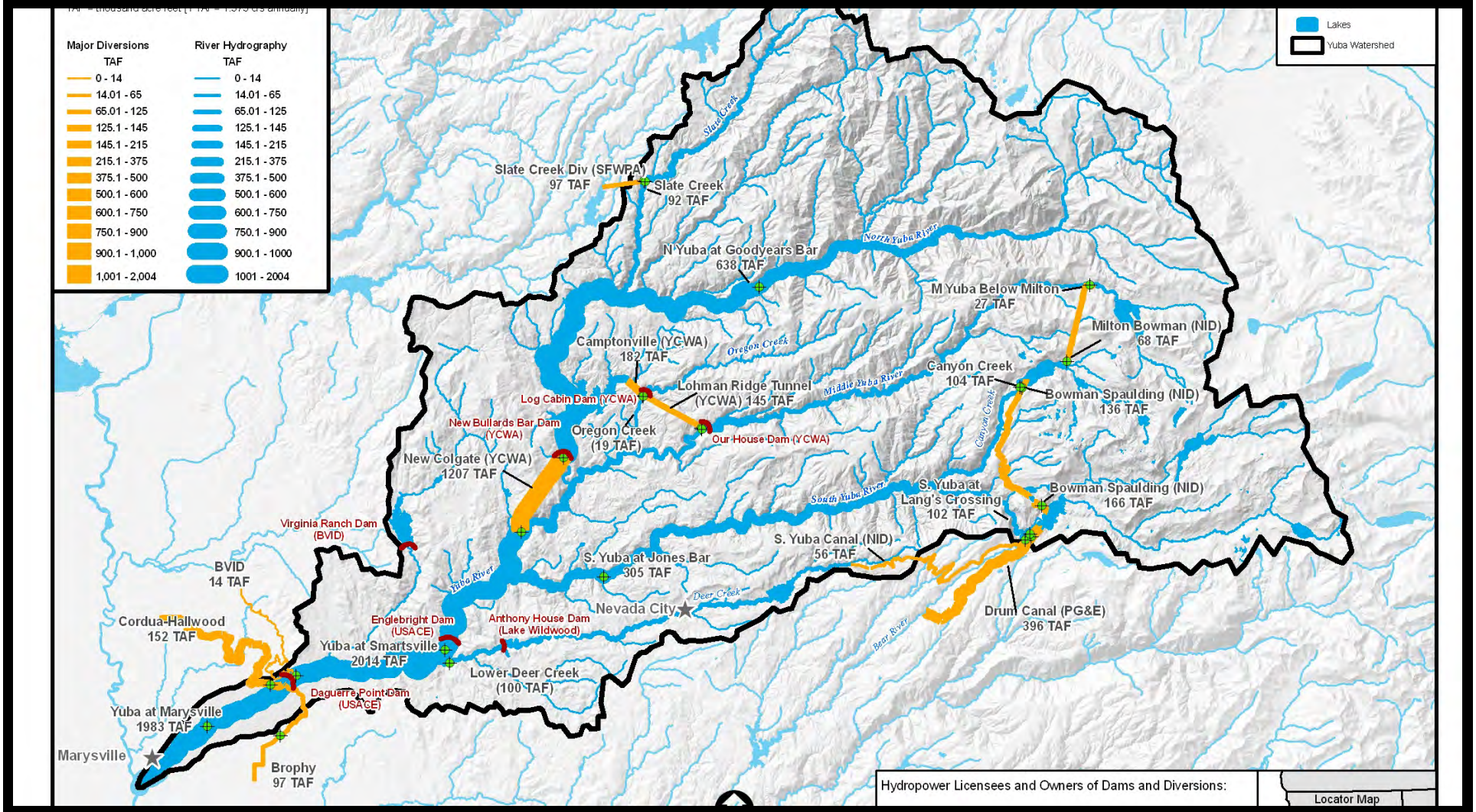
- Science Director, NMFS Fisheries Science Center 2004

"We agree that the intent of the ESA is to conserve *natural self-sustaining populations and functioning ecosystems*"

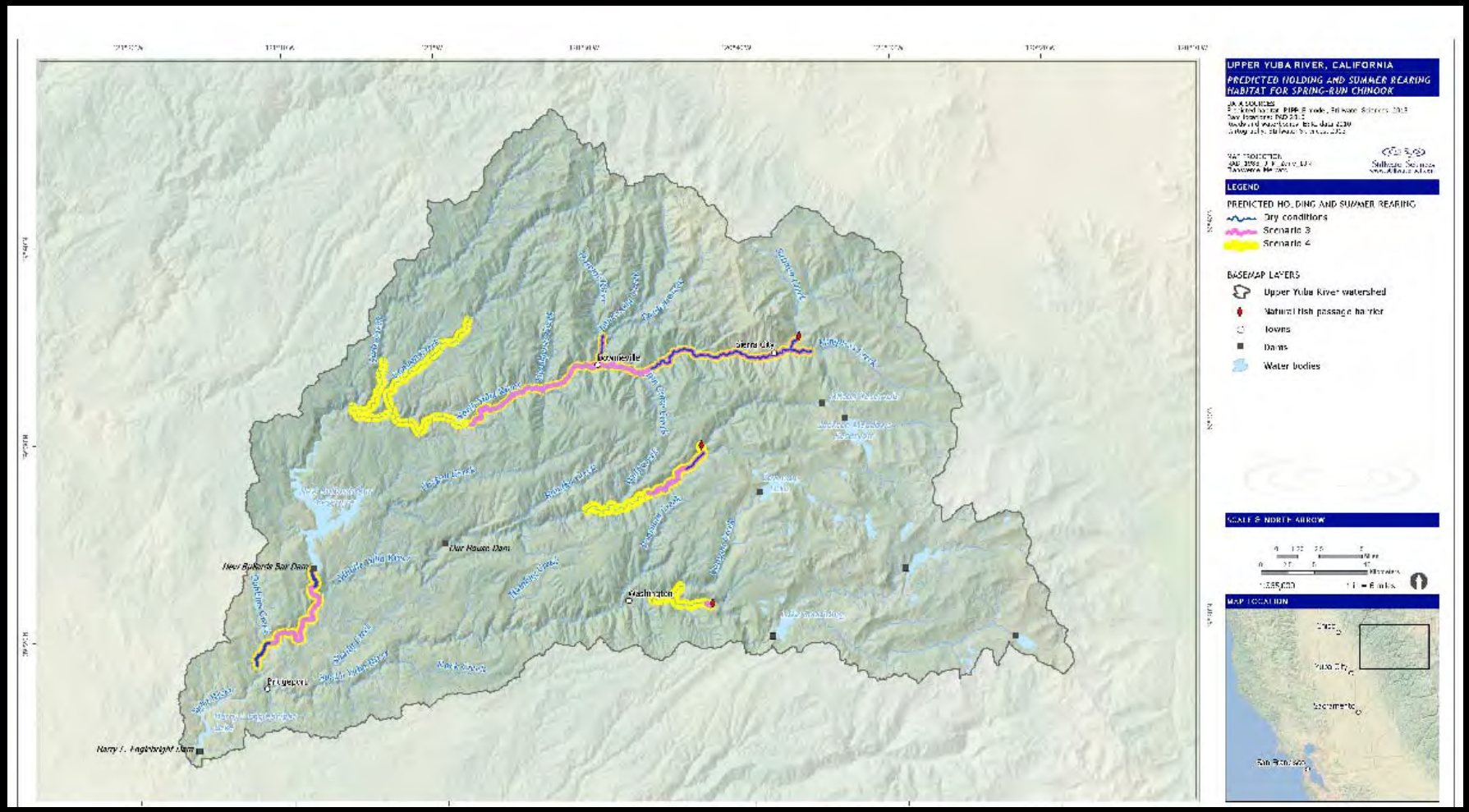
- National Marine Fisheries Service 2005

Trap & Haul Discourages Ecosystem Restoration

Yuba Salmon Partnership Initiative



Ignores flow needs & ecosystem restoration

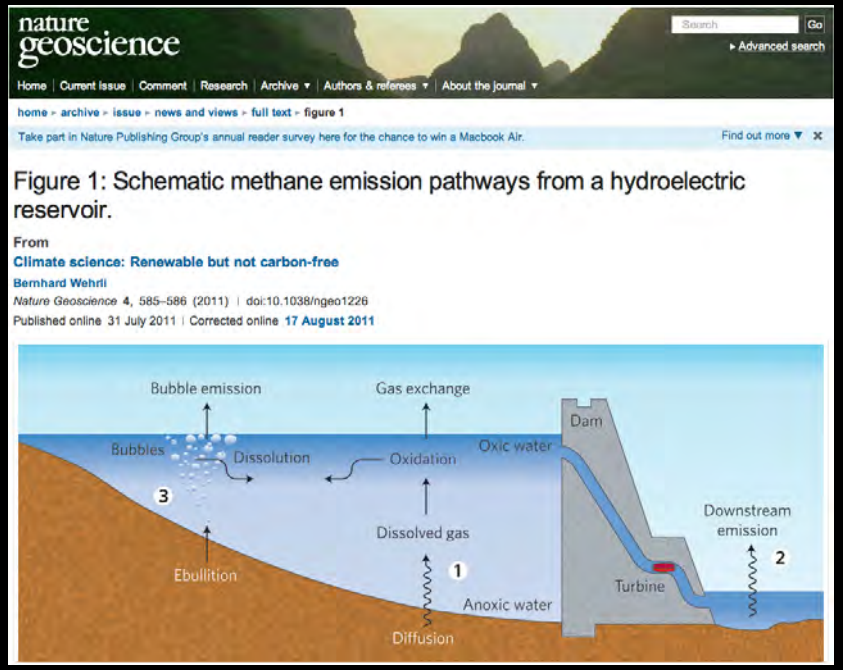


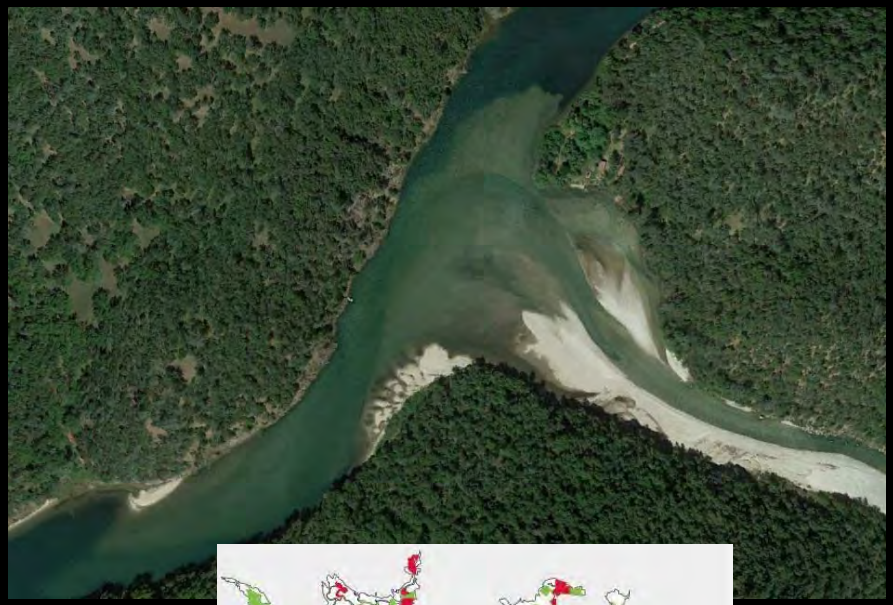
- Using inaccurate low temperature thresholds for salmon

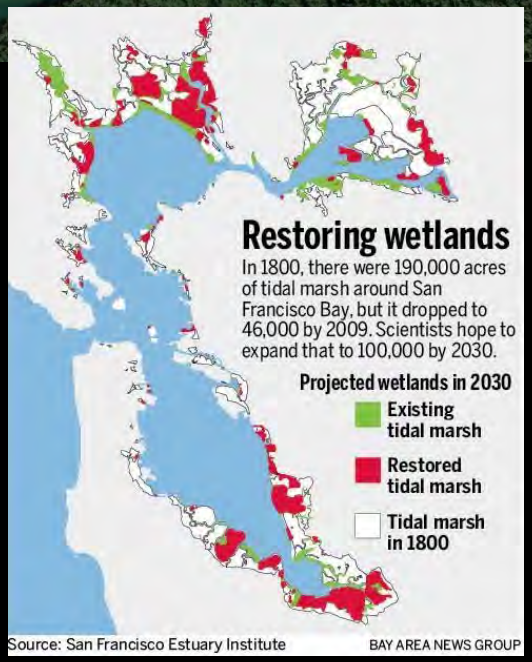
- Inaccurately describing habitat quantity & quality
  ("a few miles" vs. 87 mi + smaller tributaries)

Butte Creek Spring Chinook

Worsens Englebright Reservoir climate impacts, water quality, evaporation, sedimentation, downstream habitat







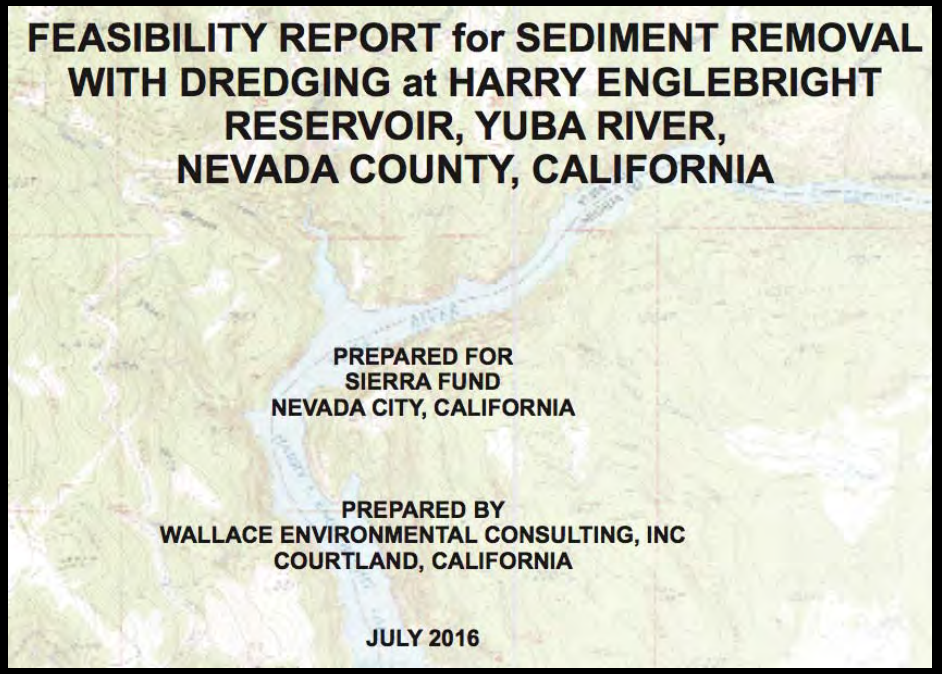
Sediment Alternatives Ignored / Overestimated

~ 29M cubic yards

- Mercury

- YSPI est. $3B (2015)

- Report est. $550M (2016)



-"Combinations of alternatives (dry sediment removal, stabilization) may prove … more desirable…cost effective. These alternative sediment management options deserve additional study"

- Additional $ Bay wetland projects, pollution clean up

- Misleads about flood risk and dam removal
- Ignores downstream flood protection opportunities

"Removing… Englebright Dam… warrants additional study."

- *Optimizing the dammed: Water supply losses and fish habitat gains from dam removal in California* 2014. Null et. Al. UC Davis

$3M Yuba River Ecosystem Restoration Feasibility Study now underway

"dam removal will provide substantial ecological benefits beyond salmonid recovery… can repair riverine ecosystem processes, such as natural flow regime, sediment and wood transport, and nutrient cycling, that create and maintain habitat for many plants and animals."

- Planning Pacific Salmon and Steelhead Reintroductions Aimed at Long-Term Viability and Recovery 2014 NOAA, ODFW, WDFW

Alternatives to Shasta Dam T&H Plans

Sacramento River:
- Restore Floodplain Rearing Habitat
- Mimic Natural Flows / Releases
- Minimize Adult Mortality / Straying

Battle Creek:
- Remove Dams / Expand Habitat
- Restore Habitat

Volitional Passage:
- Cow Creek & other tributaries


Sacramento Valley Current River Floodplain Ecosystem

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BECAUSE THE EARTH NEEDS A GOOD LAWYER

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"…the real danger with this philosophy is that it can divert attention, and forestall real, long-term solutions."

- California Department of Fish & Game 1996 Steelhead Restoration and Management Plan

Decision Time: Recovery or “Hatchery 2.0”