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 2 of Morning session

(Slide 4) *continued …* Achieving Reintroduction through the Federal Power Act
Steve Edmondson, NMFS

(Slide 13) Salmon in the Sierra: Reintroduction into the North Yuba River
Chris Shutes, California Sportfishing Protection Alliance

(Slide 43) Two-Way Trap and Haul as a Conservation Strategy for Anadromous Salmonids
Robert Lusardi, Ph.D., California Trout and University of California Davis

Passage is Biologically Feasible

Output from Odenweller Model:

Brood Year:	Ocean Surv.:
1997	0.7760
1998	1.8623
1999	1.5817

Fishery User Input Values

Boundary Value | User Modifiable Value

Info **Reset Default Values**
Info **Model Output Totals**
Info **Model Results Interpretation**

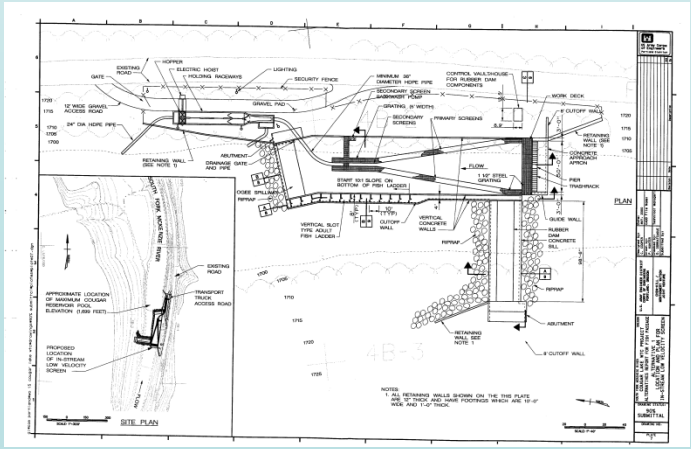
Info	Best Case	Expected	Worst Case
	Total Habitat Accessed		
	647476		
	Adult Return to Adult Passed Ratio		
	4.15	1.72	0.12

	Best Case	Expected	Worst Case
Total Adults Passed			
	192	192	192
Juvenile Release to Adult Passed Ratio			
	314.28	122.50	75.78

	Best Case	Expected	Worst Case
Total Juveniles Released			
	60341	23520	14550
Adult Return to Juvenile Release Ratio			
	0.01	0.01	0.00

Spawning Potential	System Total Best Case	System Total Expected	System Total Worst Case	West Branch Best Case	West Branch Expected	West Branch Worst Case	North Fork Best Case	North Fork Expected	North Fork Worst Case
Prespawn Mortality Survival Rate (%)				97%	95%	90%	97%	95%	90%
Redd Size (sf)	27	55	223						
Egg Production Per Female	5520	5365	5209						
In River Egg to Smolt Survival Rate, Stream (%)				13%	6%	5%	13%	6%	5%
In River Egg to Smolt Survival Rate, Ocean (%)				15%	9%	3%	15%	9%	3%
Juvenile Collection									
Low Tributary Flow - Screen									
Proportion of Juvenile Capture (%)				95%	95%	95%	95%	95%	95%
Screen Capture Efficiency (%)				95%	95%	95%	95%	95%	95%
High Tributary Flow - Gulper									
In Reservoir Mortality Survival Rate (%)				96%	91%	88%	96%	91%	88%
Gulper Capture Efficiency (%)				79%	50%	21%	79%	50%	21%
Juvenile Sorting and Tagging									
Sorting Efficiency (%)				99%	95%	90%	99%	95%	90%
% Juvenile Sized for PIT Tagging (%)	25%	50%	75%						
% Appropriate Juvenile PIT Tagged (%)	10%	20%	30%						
% Juvenile CWT Tagged (%)	50%	60%	70%						
Info Tagging Survival Rate (%)				99%	97%	95%	99%	97%	95%
Holding Survival Rate (%)				99%	97%	86%	99%	97%	86%
Downstream Juvenile Transport									
Emigration Period (days)		200							
Barge Survival Rate (%)				99%	95%	70%	99%	95%	70%
Truck Survival Rate (%)				99%	98%	88%	99%	98%	88%
Adult Immigration & Passage									
Immigration Period (days)		120							
Juvenile Release to Adult Capture, Stream (%)	1.32%	1.41%	0.16%						
Juvenile Release to Adult Capture, Ocean (%)	0.66%	0.23%	0.08%						
Adult Holding & Sorting Survival Rate (%)	99%	97%	95%						
Adult Trucking Survival Rate (%)	99%	96%	92%						
Marina Adult Release Efficiency (%)	75%	50%	25%						

Engineering Feasibility



Public interest determination

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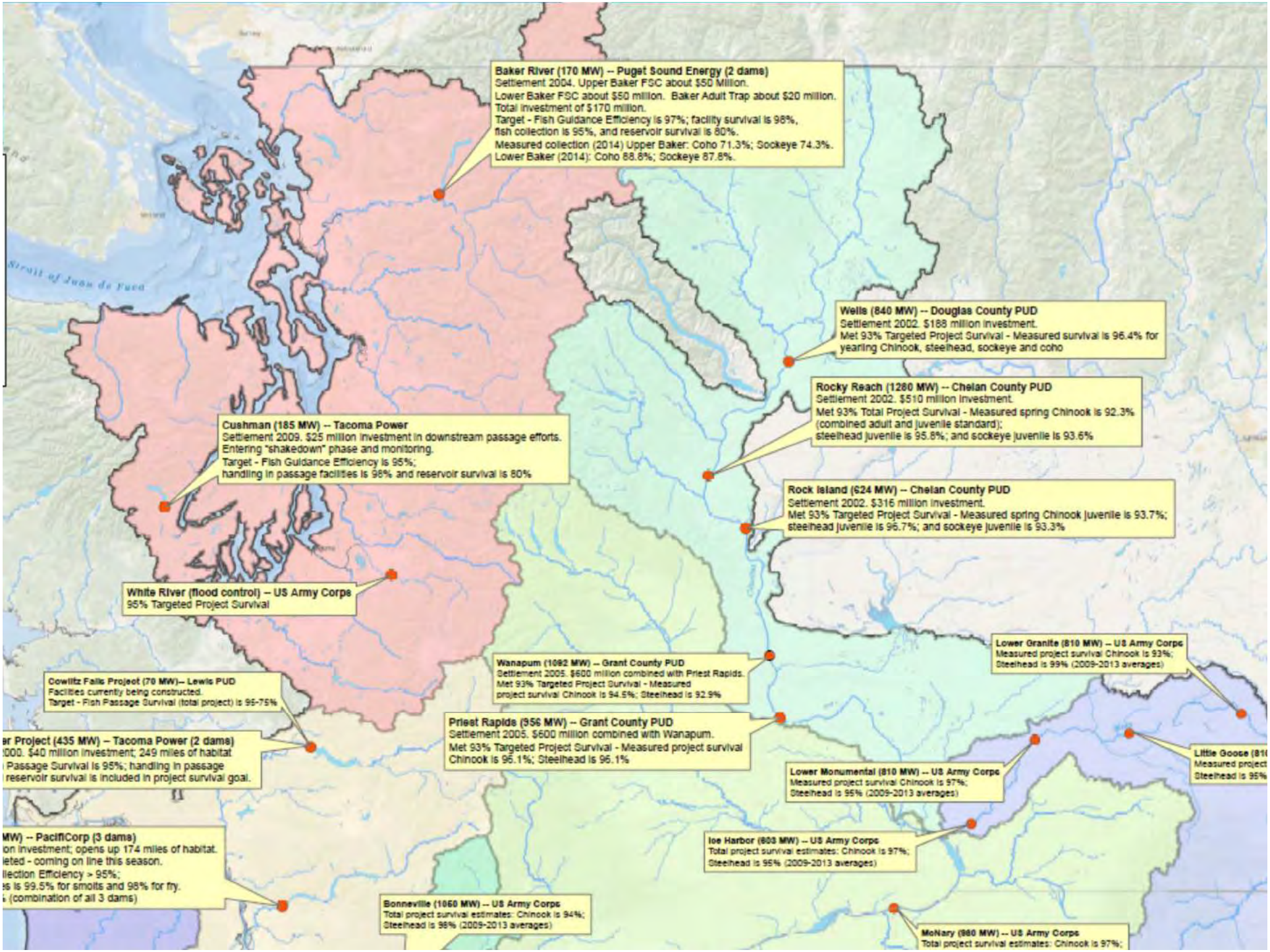
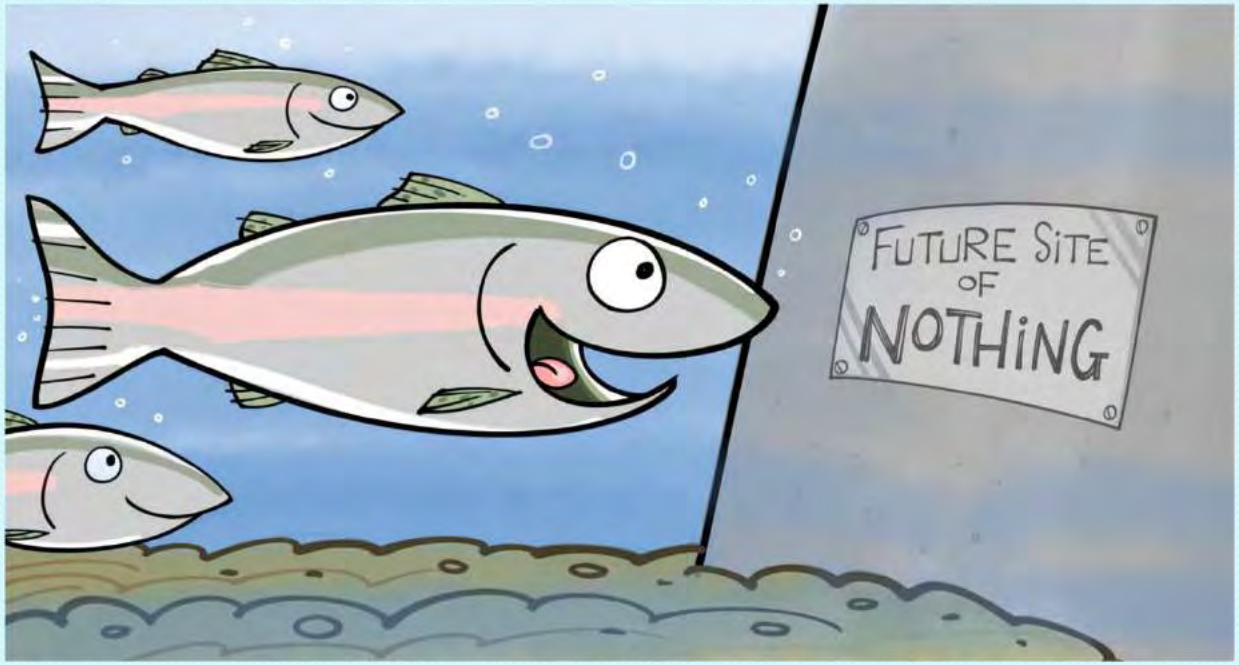
The Opportunity Is There

Hundreds of FERC licensed dams up for renewal…

NMFS-SWR
Habitat Conservation Division


Baker River (170 MW) -- Puget Sound Energy (2 dams)
Settlement 2004. Upper Baker FSC about $50 Million.
Lower Baker FSC about $50 million. Baker Adult Trap about $20 million.
Total investment of $170 million.
Target - Fish Guidance Efficiency is 97%; facility survival is 98%,
fish collection is 95%, and reservoir survival is 80%.
Measured collection (2014) Upper Baker: Coho 71.3%; Sockeye 74.3%.
Lower Baker (2014): Coho 88.6%; Sockeye 87.8%.
Strait of Juan de Fuca
Wells (840 MW) -- Douglas County PUD
Settlement 2002. $188 million investment.
Met 93% Targeted Project Survival - Measured survival is 96.4% for
yearling Chinook, steelhead, sockeye and coho
Rocky Reach (1280 MW) -- Chelan County PUD
Settlement 2002. $510 million investment.
Met 93% Total Project Survival - Measured spring Chinook is 92.3%
(combined adult and juvenile standard);
steelhead juvenile is 95.8%; and sockeye juvenile is 93.6%
Cushman (185 MW) -- Tacoma Power
Settlement 2009. $25 million investment in downstream passage efforts.
Entering "shakedown" phase and monitoring.
Target - Fish Guidance Efficiency is 95%;
handling in passage facilities is 98% and reservoir survival is 80%
Rock Island (624 MW) -- Chelan County PUD
Settlement 2002. $316 million investment.
Met 93% Targeted Project Survival - Measured spring Chinook juvenile is 93.7%;
steelhead juvenile is 95.7%; and sockeye juvenile is 93.3%
White River (flood control) -- US Army Corps
95% Targeted Project Survival
Lower Granite (810 MW) -- US Army Corps
Measured project survival Chinook is 93%;
Steelhead is 99% (2009-2013 averages)
Wanapum (1092 MW) -- Grant County PUD
Settlement 2005. $600 million combined with Priest Rapids.
Met 93% Targeted Project Survival - Measured
project survival Chinook is 94.5%; Steelhead is 92.9%
Cowlitz Falls Project (70 MW)-- Lewis PUD
Facilities currently being constructed.
Target - Fish Passage Survival (total project) is 95-75%
Priest Rapids (356 MW) -- Grant County PUD
Settlement 2005. $600 million combined with Wanapum.
Met 93% Targeted Project Survival - Measured project survival
Chinook is 96.1%; Steelhead is 96.1%
Lower Monumental (810 MW) -- US Army Corps
Measured project survival Chinook is 97%;
Steelhead is 95% (2009-2013 averages)
Ice Harbor (603 MW) -- US Army Corps
Total project survival estimates: Chinook is 97%;
Steelhead is 95% (2009-2013 averages)
Bonneville (1050 MW) -- US Army Corps
Total project survival estimates: Chinook is 94%;
Steelhead is 98% (2009-2013 averages)
McNary (980 MW) -- US Army Corps
Total project survival estimates: Chinook is 97%;

Questions?



Oregon and Washington projects with trap and haul

Project	Adult passage	Juvenile Passage
Baker (Puget Sound Energy) 312ft	yes	yes
Cle Elum (BOR) 165ft	yes	under design
Cougar (Corps) 452ft	yes	future addition
Cowlitz River (Tacoma Power) 606ft	yes	yes
Cushman (Tacoma Power) 235ft	yes	yes
Dexter Reservoir (Corps) 93ft	yes	passage via spill
Fall Creek (Corps) 180ft	yes	drain reservoir to river level for seasonal passage
Faraday/North Fork (Portland General Electric) 85ft	yes (hands free sorting for wild fish)	yes

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Habitat Conservation Division

Continued:

Foster (Corps) 126ft	yes	passage via spill
Howard Hanson (Corps) 235ft	yes	future addition
Hells Canyon (Idaho Power) 328ft	yes	relicensing incomplete
Lewis River (PacifiCorp) 313ft; 323ft; and 512ft	yes	yes - first of 3 FSC's is coming on line
Little Goose (Corps) 98ft	volitional	yes - capture/transport location
Lower Granite (Corps) 100ft	volitional	yes - capture/transport location
McNary (Corps) 183ft	volitional	yes - capture/transport location ***(used on "as needed" basis)
Minto (Corps)	yes	future addition
Mud Mountain Dam (Corps) 432ft	yes	passage through dam - no generation units
Pelton-Round Butte (Portland General Electric) 440ft; 204ft; and 88ft	yes	yes
Umatilla (Westland) 24ft		yes

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North Yuba Salmon Reintroduction in a Central Valley Context

Chris Shutes

California Sportfishing Protection Alliance

April 1, 2017

Preface:
What this presentation is not

- It is not a blow-by-blow description of the Yuba Salmon Partnership (YSP)
- It is not a point-by-point defense of the YSP program (trap and haul from Lower Yuba to North Yuba, and lower Yuba habitat actions)
- We've done that in several workshops, and don't have a lot more to add at this time.

Copies of my rationale in support of the project are available

- Hard copies here in the room
- http://calsport.org/news/we-need-to-get-salmon-upstream-of-central-valley-rim-dams/

We live with many unspoken assumptions

- Roads will allow us to attend conferences and we'll have a place to park
- Water will come out of the tap
- Sewage treatment will happen
- Food will be available as long as we can pay for it.

And so we have assumptions about CV spring-run salmon

- Populations exist in many locations
- Another is coming on the San Joaquin
- Hatcheries (love or hate ‘em) produce them.
- Regulations will protect them

The last 5 years show how tenuous Central Valley spring-run really are.

Lower Feather River
February 2017

Oroville Dam, February 9, 2017

Lower Feather River
March 2017

Riverbend Park, Oroville, March 6, 2017, Chico Enterprise-Record

Oroville hatchery February, 2017

February 10, 2017

Oroville hatchery February 2017

February 10, 2017

Butte Creek 2015

Threatened salmon die after utility temporarily shuts canal

By ELLEN KNICKMEYER | June 22, 2015 | 5:35 PM EDT

SAN FRANCISCO (AP) — More than one-tenth of the largest wild population of threatened salmon in the Central Valley died after repair work near a power plant led Pacific Gas & Electric Co. to cut off a cooling flow of water into a creek, wildlife and utility officials said Friday.

Butte Creek February 16, 2017: PG&E will not operate DeSabla Project

Pacific Gas and Electric Company	)	Project No. 803-087
	)	(DeSabla-Centerville)

NOTICE OF WITHDRAWAL
OF
APPLICATION FOR NEW LICENSE

Spring-run trends 2008-2015
Sacramento River tribs abv Feather

California Department of Fish and Wildlife - Fisheries Branch Anadromous Assessment - GrandTab

CHINOOK SALMON ESCAPEMENT - SPRING RUN

CENTRAL VALLEY: Sacramento and San Joaquin river systems

YEAR	Sacramento River Mainstem			Battle Ck 4/	Clear Ck	Cotton-wood Ck	Antelope Ck	Mill Ck	Thomes Ck	Deer Ck	Big Chico Ck	Butte Ck Snorkel	Butte Ck 5/ Carcass
	Upstr. RBDD 1/	Downstr. RBDD	TOTAL										
2008	0	52	52	105	200	0	3	381		140	0	3,935	11,046
[2009]	0	0	0	194	120	0	0	220		213	6	2,059	2,687
[2010]	0	0	0	172	21	15	17	482		262	2	1,160	1,991
[2011]	0	0	0	157	8	2	6	366		271	124	2,130	4,871
[2012]	0	0	0	799	68	1	1	768		734	0	8,615	16,317
[2013]	0	0	0	606	659	1	0	644		708	0	11,470	16,782
[2014]	0	0	0	429	95	2	7	679		830	0	3,616	5,083
[2015]	0	0	0	161	45	0	5	127		268	0	1,082	569

San Joaquin River Restoration

Text of Proposed HR 23 (Valadao)

January 30, 2017

San Joaquin River Restoration

SEC. 114. SAN JOAQUIN RIVER SETTLEMENT.

(a) CALIFORNIA STATE LAW SATISFIED BY WARM WATER FISHERY.—

(1) IN GENERAL.—Sections 5930 through 5948 of the California Fish and Game Code, and all applicable Federal laws, including the San Joaquin River Restoration Settlement Act (Public Law 111–11) and the Stipulation of Settlement (Natural Resources Defense Council, et al. v. Kirk Rodgers, et al., Eastern District of California, No. Civ. S–88–1658–LKK/GGH), shall be satisfied by the existence of a warm water fishery in the San Joaquin River below Friant Dam, but upstream of Gravelly Ford.

San Joaquin River Restoration

(b) REPEAL OF THE SAN JOAQUIN RIVER SETTLEMENT.—As of the date of enactment of this section, the Secretary of the Interior shall cease any action to implement the San Joaquin River Restoration Settlement Act

Central Valley spring-run need spatial diversity

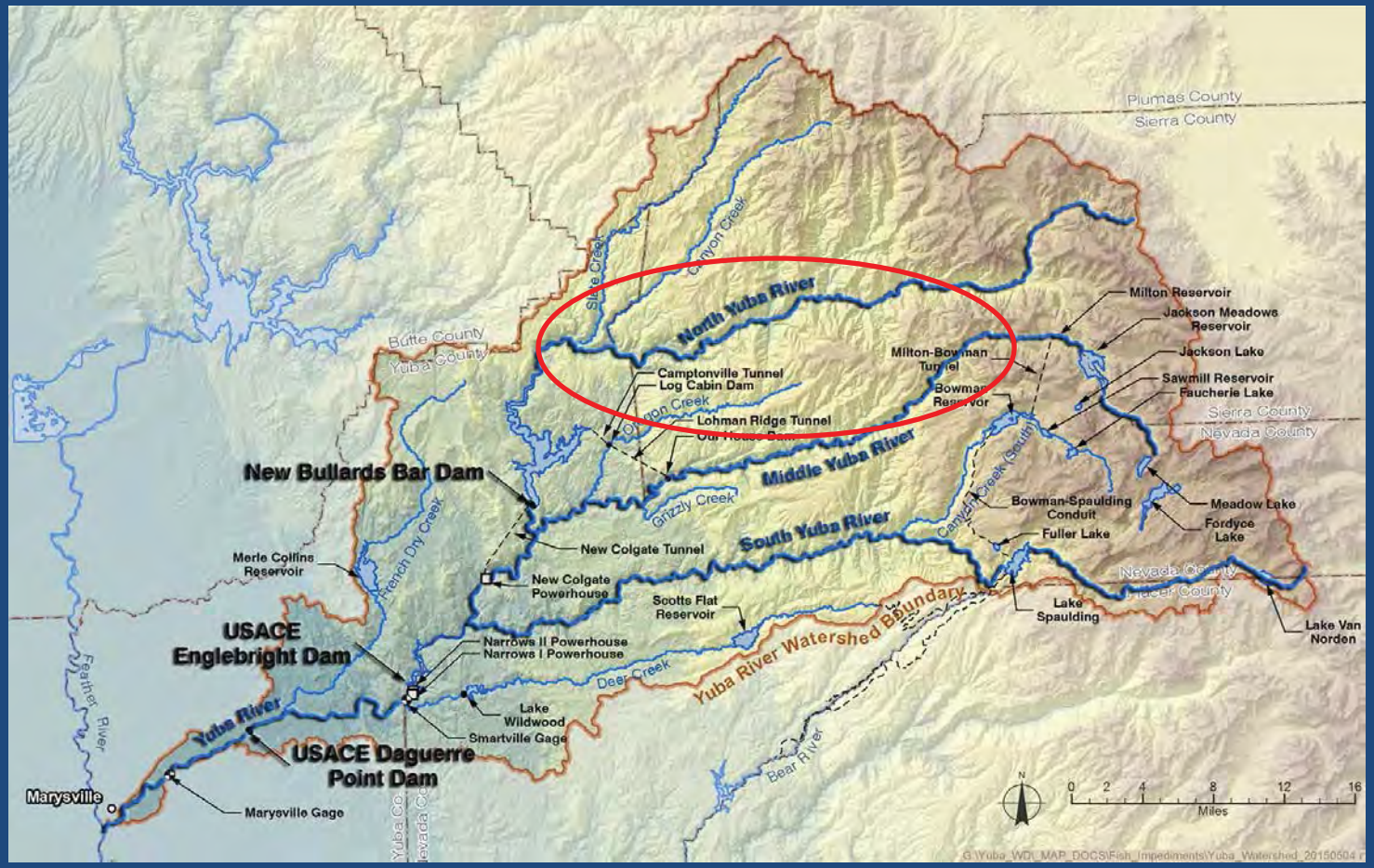
A variety of approaches to CV salmon reintroduction

- Tuolumne:
  - Regulatory proceeding in La Grange licensing
  - Habitat evaluation on the Tuolumne is about where study was on the Yuba in ~2003
- Mokelumne :
  - Very modest, voluntary low budget approach (fall-run)
- McCloud (winter-run):
  - Pilot program, step-wise, very deliberate
- Oroville and NF Feather hydro projects
  - Punted 10 years ago

Yuba Salmon Partnership

- Two components to plan:
- Trap and haul program from Lower Yuba to North Yuba River upstream of New Bullards Bar Reservoir
- Lower Yuba River habitat improvements

North Yuba Reintroduction



Yuba Salmon Partnership (YSP)

- Ongoing FERC proceeding but contested jurisdiction of FERC over dam owned by Army Corps
- Licensee willing to contribute but not to take all responsibility for reintroduction
- Two willing fisheries agencies
- NGO's willing to take heat, broaden outlook of licensee, offset potential for agency paralysis

From study to action

- 15 yrs. of study: reintroducing salmonids to upper Yuba watershed (Upper Yuba River Studies Program, Yuba Salmon Forum, NMFS studies, info. from Yuba-Bear/Drum-Spaulding and Yuba River Development relicensings)
- Is trap and haul better than no passage at all?
- Not everyone agrees with YSP answer, or that it's time to stop asking questions

Solve problems or fight?

- Some examples that CSPA has been part of:
  - San Joaquin River lawsuit
  - Amador vs El Dorado
  - CSPA vs. EBMUD
  - Foothill Conservancy v. EBMUD
- Most water fights aim to get to the point where it is possible to solve problems

All parties have to ask …
If we fight now, will we:

- Start from a better place in the future?
- Get a better outcome?
- Get a better process?

Is a fight worth the delay or the risk?

YSP decided to pull together to work out everything we can

- A plan
- Facilities
- Funding
- Performance
- An achievable timeline
- Governance
- Regulatory issues:
  - ESA
  - CESA
  - FERC license
  - State Board Water Quality Certification
  - A dozen-odd permits
- Potential impacts to others

YSP decided to leave some subjects to other processes

YSP doesn't have an agreement yet

- It is complicated
- It is expensive
- It is hard to work together
- Similar to a construction project, the last part of the process is the hardest and takes the most time.
- An extended process allows more time to get pieces into place

If we reach an agreement, it will take a long time to implement

- My best guess: about ten years to move the first fish
- It will still be hard
- We will try to structure a program that does not get in the way of success
- There will be trial and there will be error

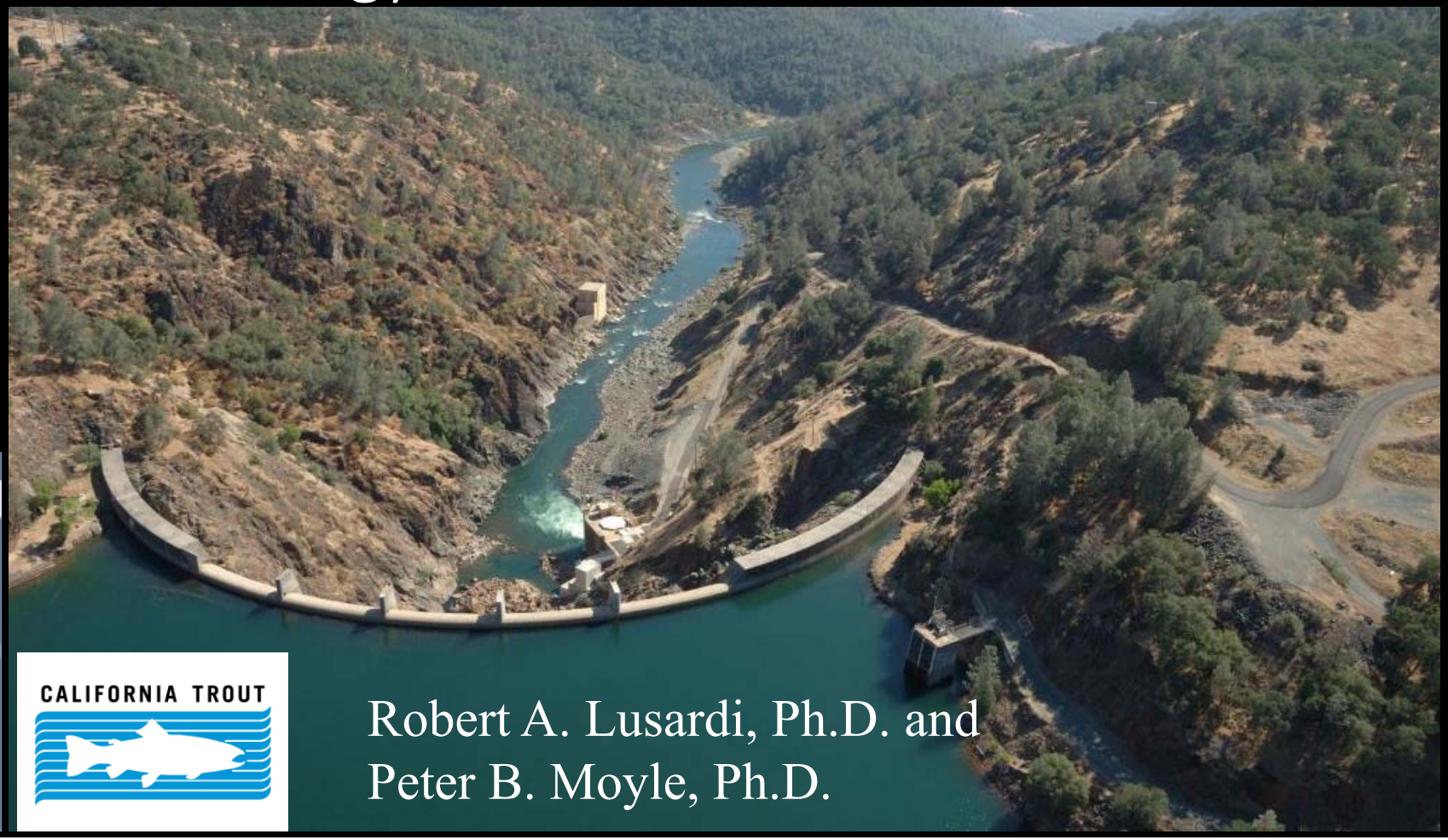
Why we may succeed

- No apparent better option
- The right organizations working together
- The right people
- Intelligent sequencing
- We may start soon enough to save the species
- Putting resources toward results and not towards perceived preconditions for results

This is not the only way to do this.

But it is important that a group think through and plan a complete reintroduction program.

Two-way trap and haul (TH2) as a conservation strategy for anadromous salmonids



Center for Watershed Sciences UCDAVIS

CALIFORNIA TROUT

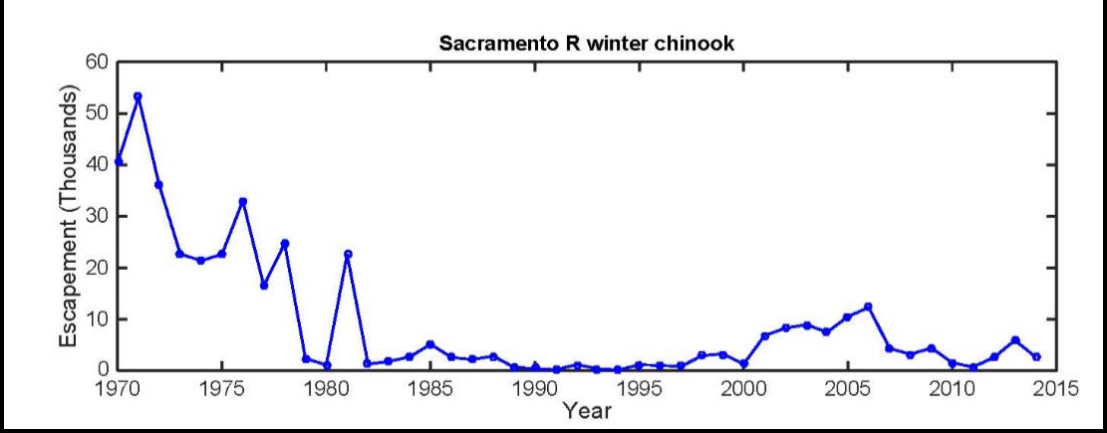
Robert A. Lusardi, Ph.D. and
Peter B. Moyle, Ph.D.

Central Valley Salmon and Steelhead

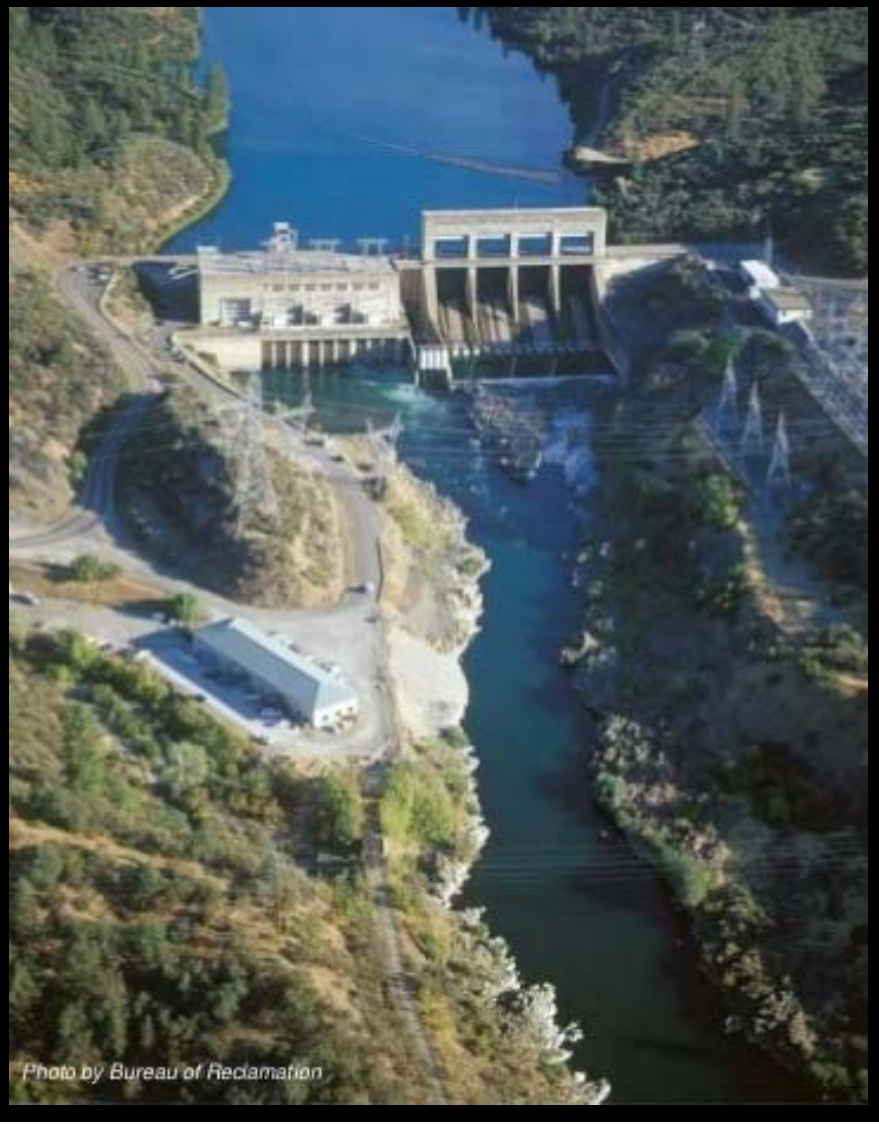
- Central Valley steelhead
- Spring-run Chinook
- Winter-run Chinook

Winter-run habitat

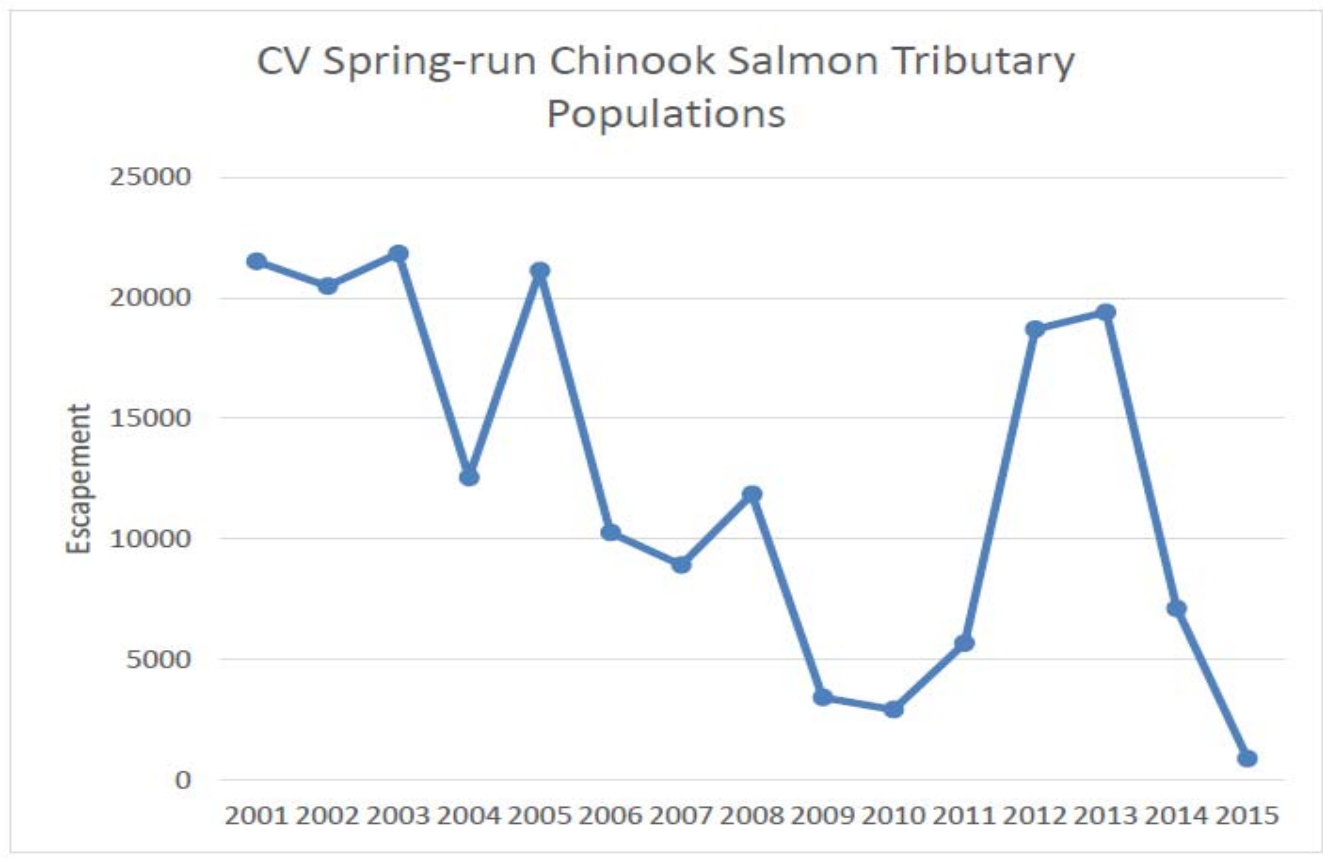
Winter-run habitat



NMFS 2016



Not much better for spring-run Chinook



NMFS 2016

Trap and haul: Columbia River fish barges

Two-way trap and haul (TH2)

Recovery Action? Two-way trap and haul (TH2)

- What TH2 programs currently exist?
- How effective are these programs?
- What does the science say?

Transportation Effects

- Reduce adult homing ability (Bond et al. 2017)
- Earlier ocean entry and reduced growth rates (Muir et al. 2006, Rechisky 2012)
- Impaired auditory function (Halvorsen et al. 2009)
- Adult failure to pass dams (Keefer et al. 2008)
- Adult pre-spawn mortality (Keefer et al. 2010)

Population Replacement

- Cohort Replacement Rate > 1.0?

- Willamette River Programs
  - Evans et al. (2016): 0.96-1.56
  - Sard et al. (2016): 0.31-0.41
  - O'malley et al. (2015): 1.07

- Willamette programs: juveniles pass volitionally

+

?

Images: USBR

Juvenile Outmigration Capture Efficiency

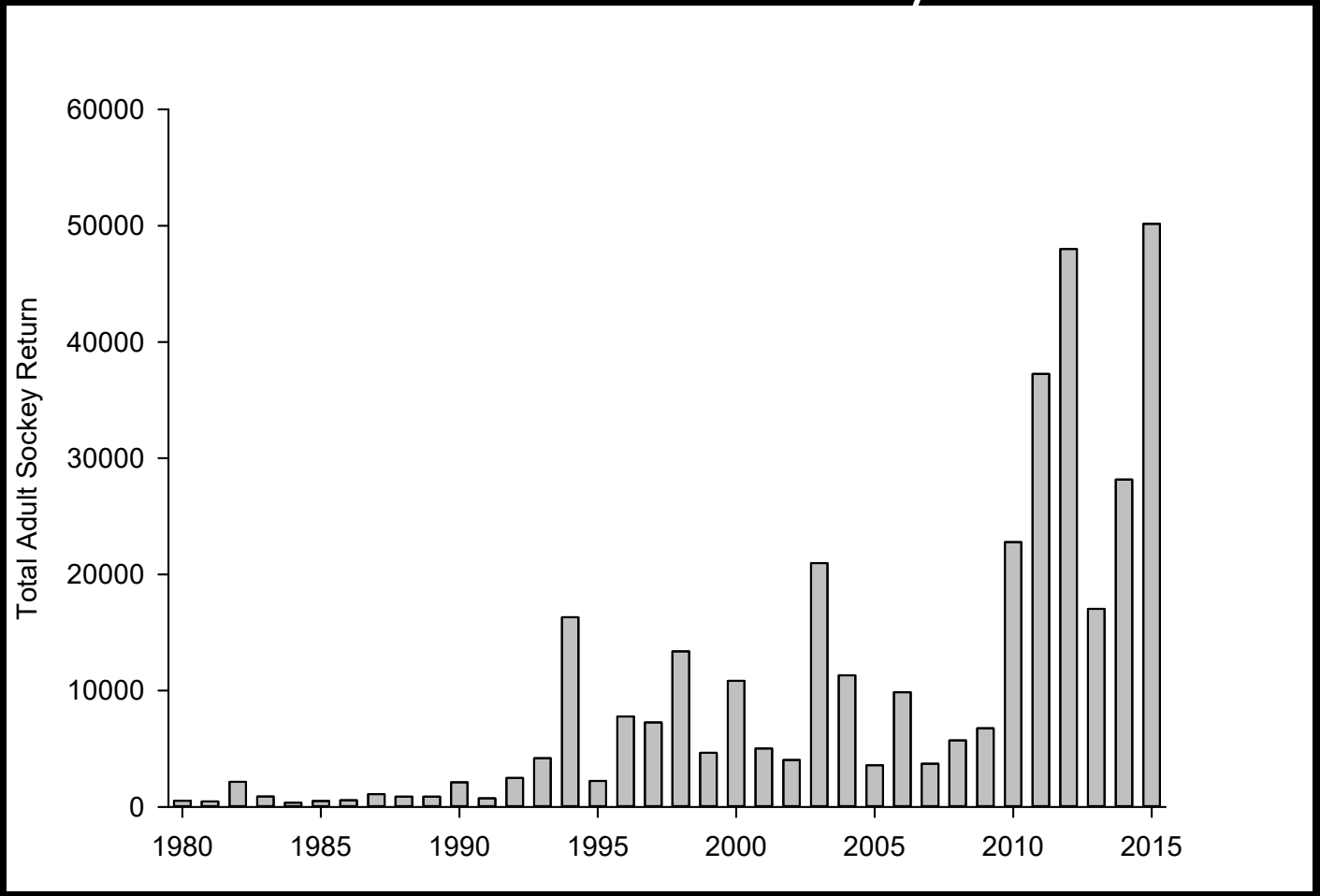
- Deschutes River TH2 Program (2010-2014):
  - 5.8 million hatchery fry and smolts released (SRC and SH)
  - 169,000 individuals successfully migrated through reservoir, captured, and released
  - Outmigration capture rates: 0.3-7.9% of total.
  - 102 and 337 adult SRC and SH returned as adults

Summary

- Uncertainties
  - Delayed mortality
  - Population replacement rate
  - Out-migrant capture efficiency
  - Role of hatchery supplementation?
- Most TH2 programs are new or in experimental phases
- Except.....

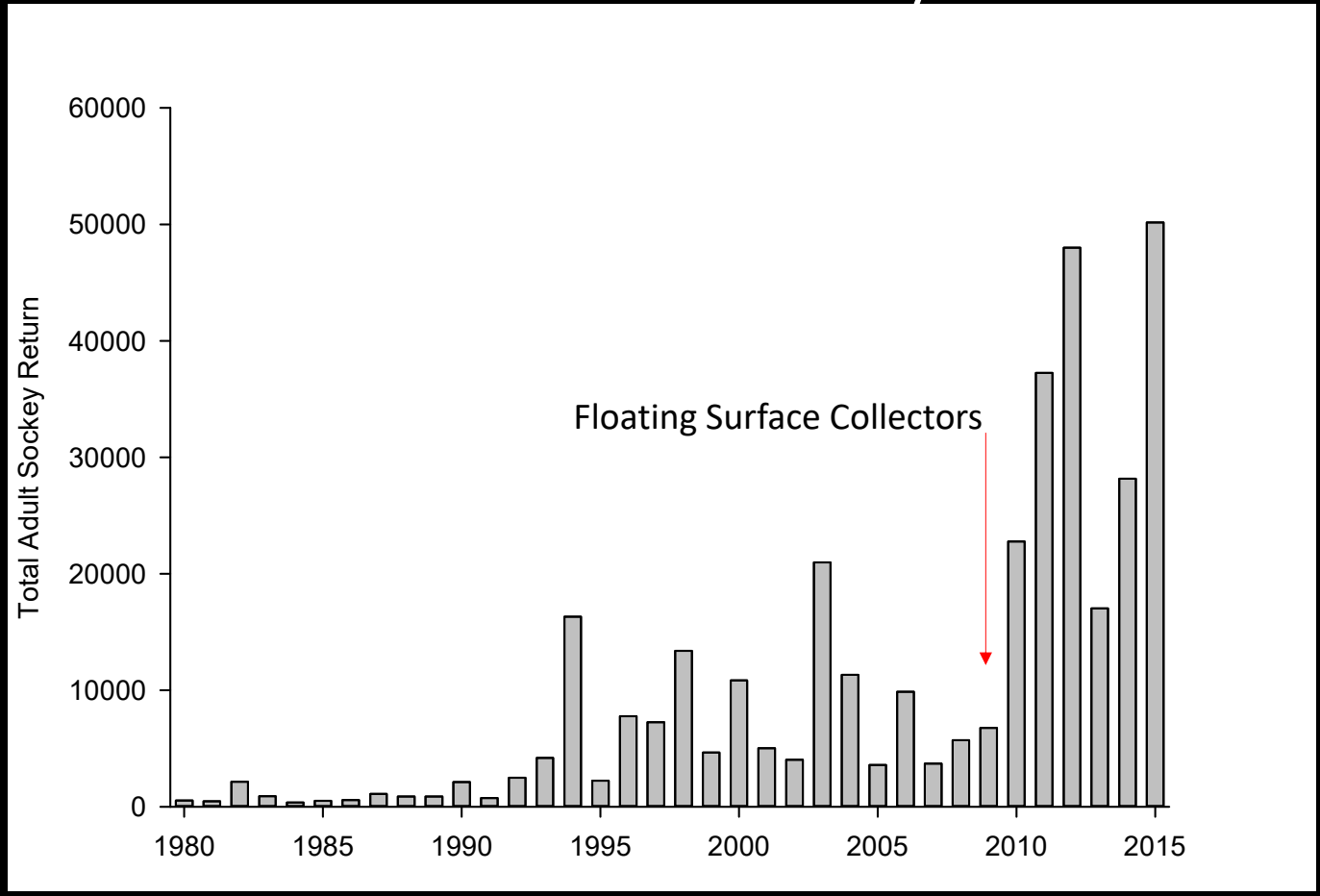
Baker River TH2

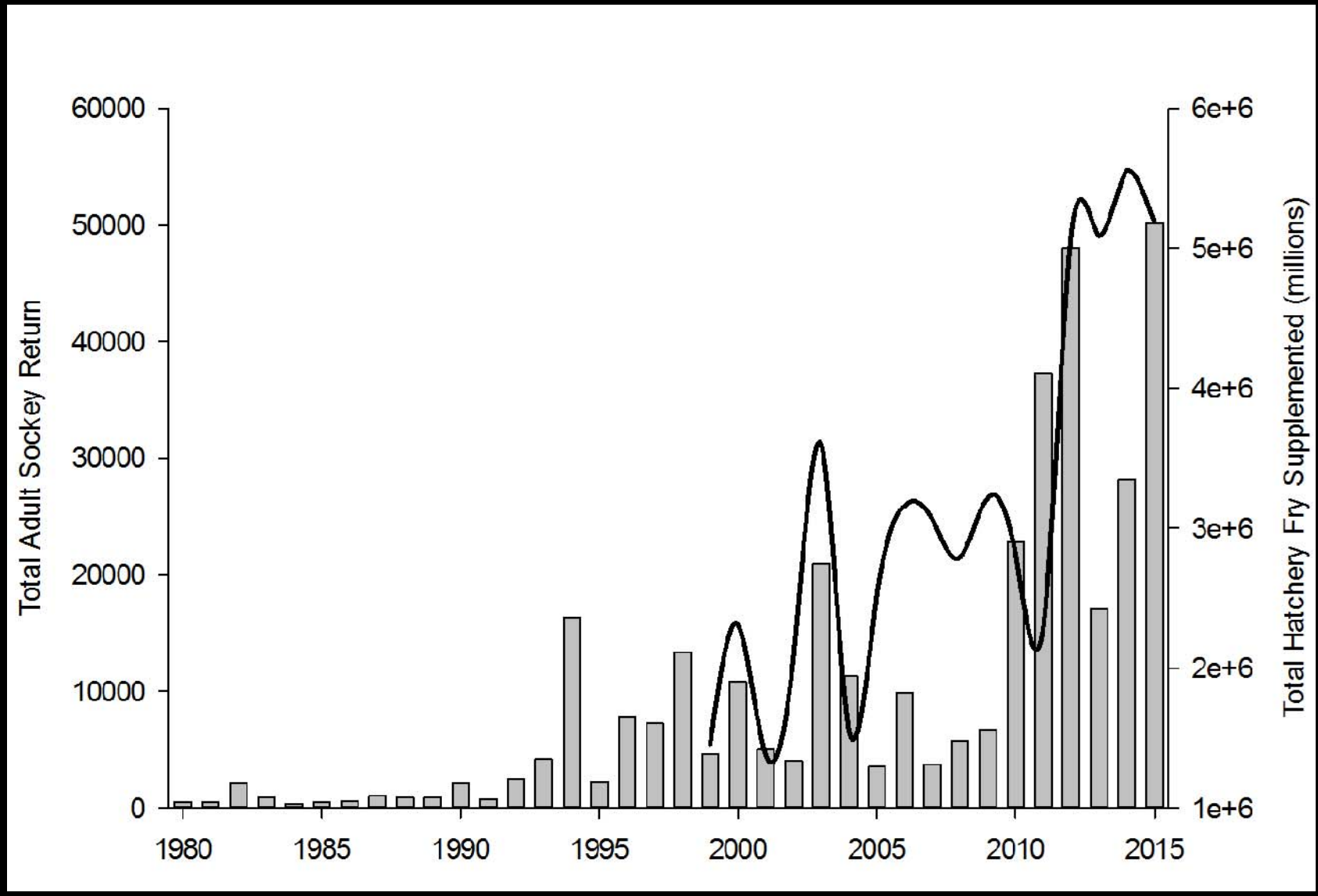
Baker River Adult Sockeye Returns

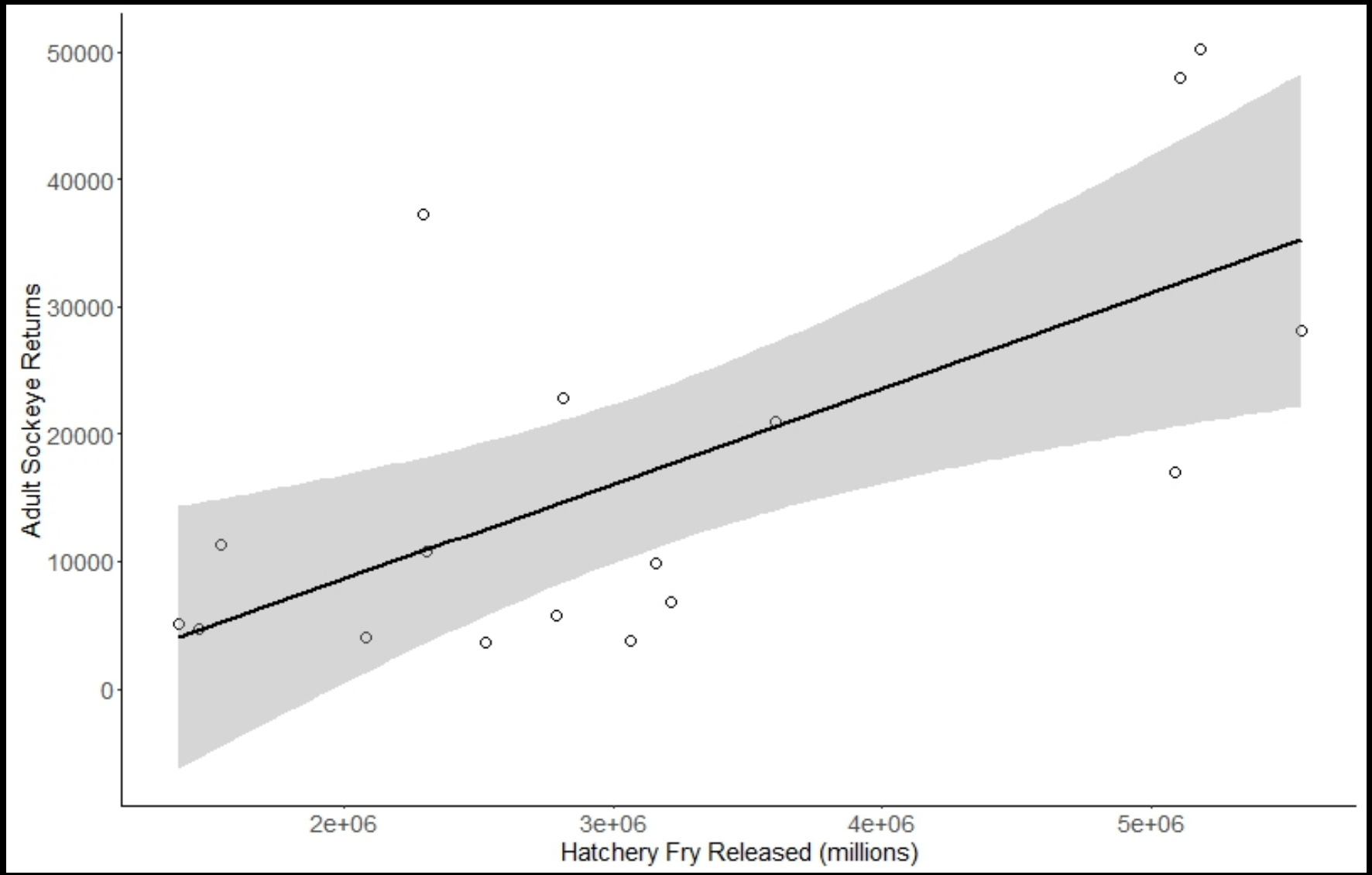


Floating Surface Collectors

Baker River Adult Sockeye Returns




Total Adult Sockey Return
60000
50000
40000
30000
20000
10000
0
1980
1985
1990
1995
2000
2005
2010
2015
Total Hatchery Fry Supplemented (millions)
6e+6
5e+6
4e+6
3e+6
2e+6
1e+6


50000
40000
30000
20000
10000
0
Adult Sockeye Returns
2e+06
3e+06
4e+06
5e+06
Hatchery Fry Released (millions)

CONCLUSIONS

- Uncertainty associated with TH2 programs: delayed mortality, population replacement, juvenile capture, role of hatcheries
- May be most appropriate for critically endangered species
- Move in parallel with long-term conservation strategies that consider the entire life cycle of the species
- Clearly define measurable and objective success criteria, approach experimentally and adaptively, be part of a comprehensive conservation strategy


SEE YOU UPSTREAM, LOSERS!
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