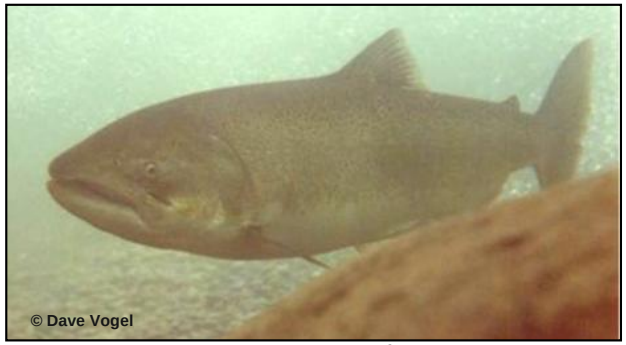
Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Native Anadromous Fish Restoration for Consideration in the Bay-Delta Water Quality Control Plan Update

Dave Vogel
Natural Resource Scientists, Inc.
November 14, 2012 – SWRCB Workshop

Insights into the
Problems, Progress, and Potential Solutions
for Sacramento River Basin Native Anadromous Fish Restoration



Spring-Run Chinook Salmon in Mill Creek, California (Photo by Dave Vogel)

April 2011

Prepared for:

Northern California Water Association
and
Sacramento Valley Water Users

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Technical Report Available at: Norcalwater.org

Also Submitted as a SWRCB Exhibit

Summary Points of Presentation

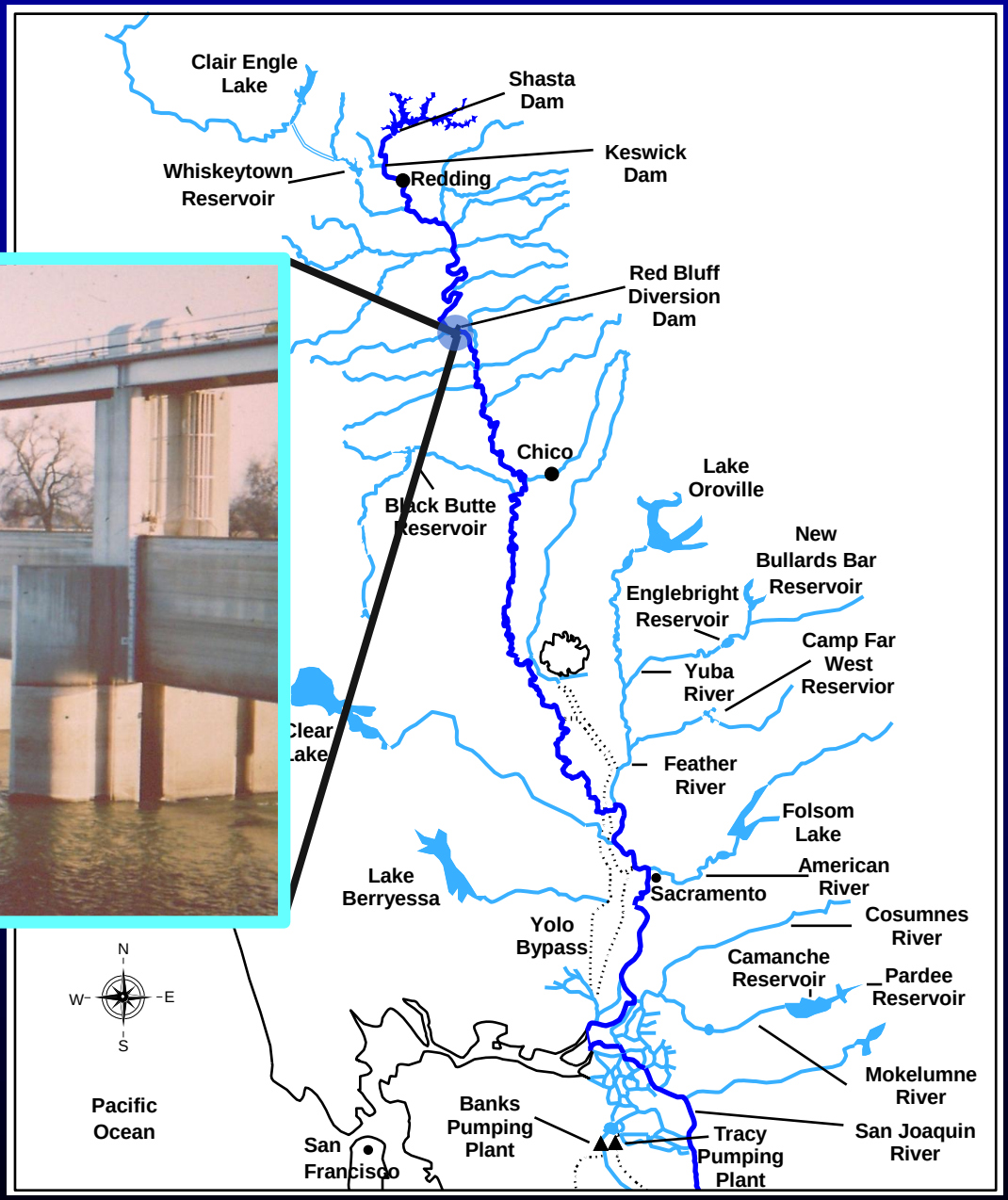
- Salmon Restoration Progress in Upstream Areas
- Need to Fix Predation Problems in the Delta to Fully Realize the Benefits of Upstream Actions
- Potential High Unimpaired Flow Criteria Impacts on Salmon
- Recommended Actions and Studies to Benefit Salmon

Progress – Red Bluff Diversion Dam

1987 - Dam Gates Out 6 months/yr

1993 - Dam Gates Out 8 months/yr

2012 - Dam Gates Out Year Round



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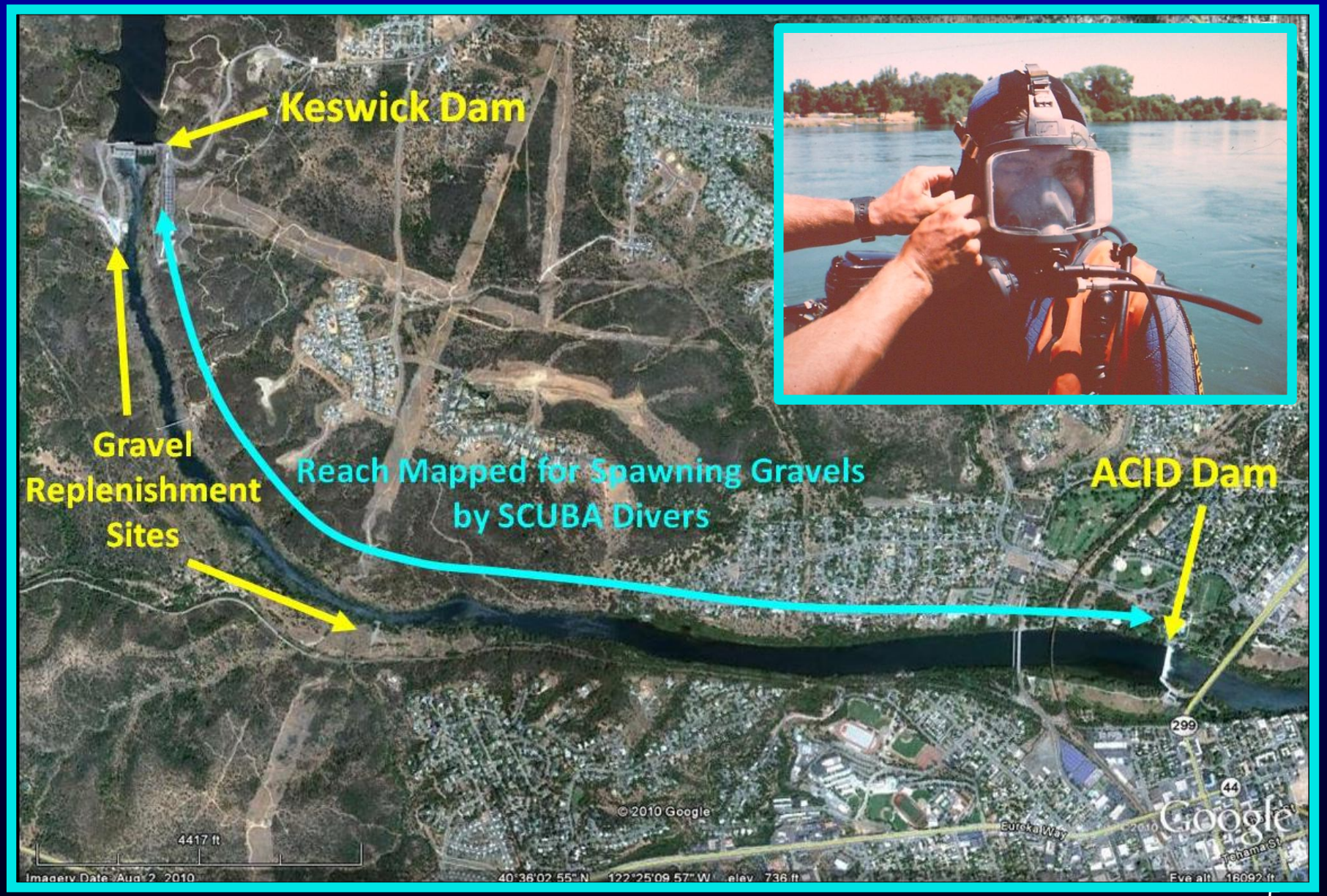
Progress – Salmon Spawning Habitats



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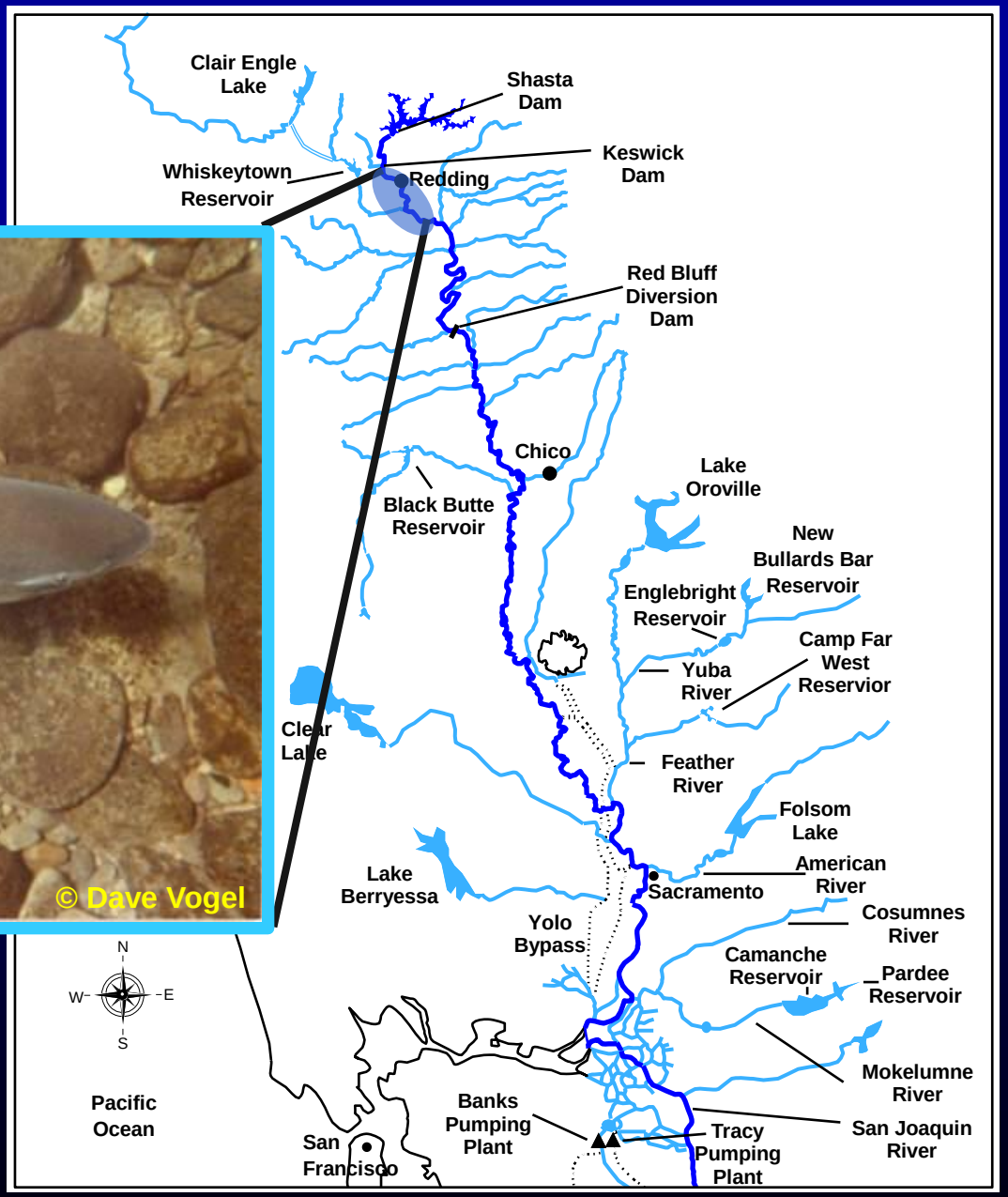
Progress – Salmon Spawning Habitats

Large-Scale Spawning Gravel Injections

Progress – Salmon Spawning Habitats

Female Chinook Salmon



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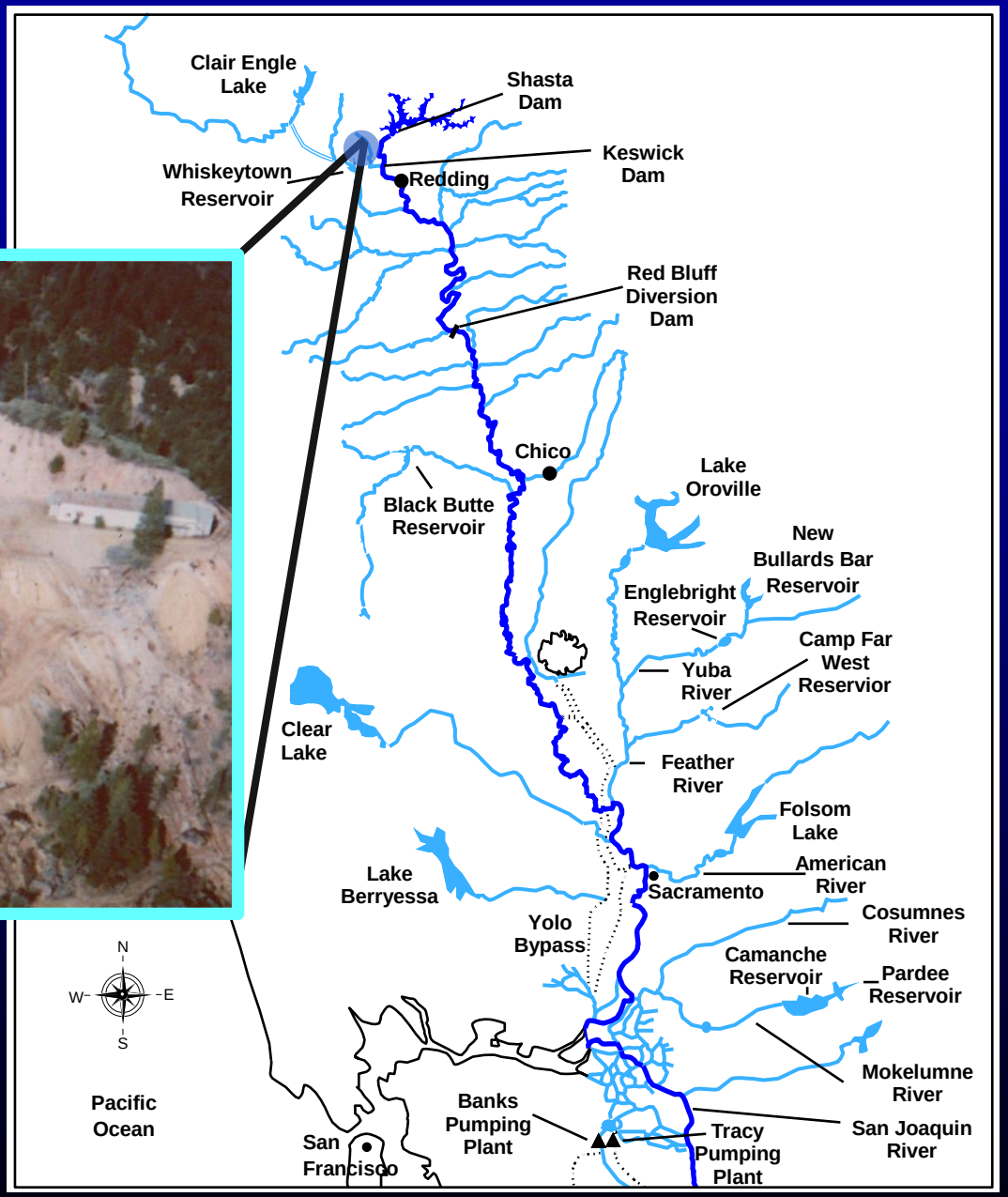
Progress – Pollution Control

Acid Mine Drainage from
Iron Mountain Mine



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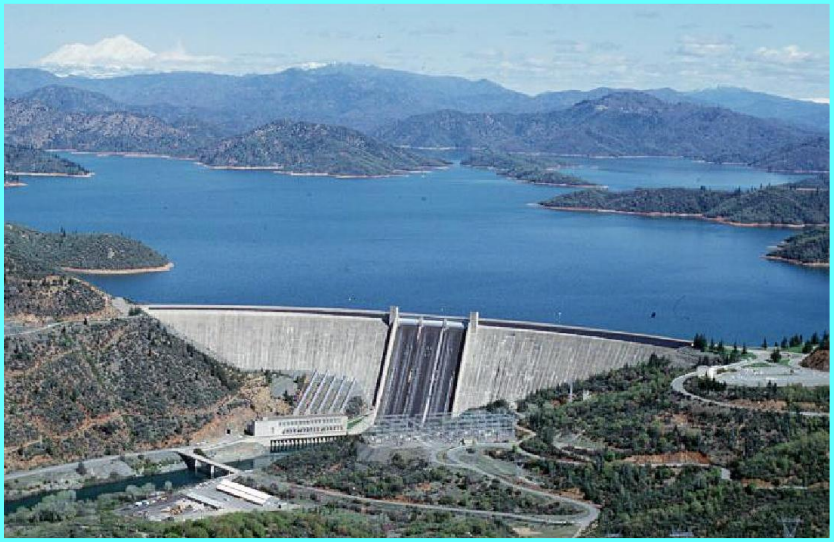
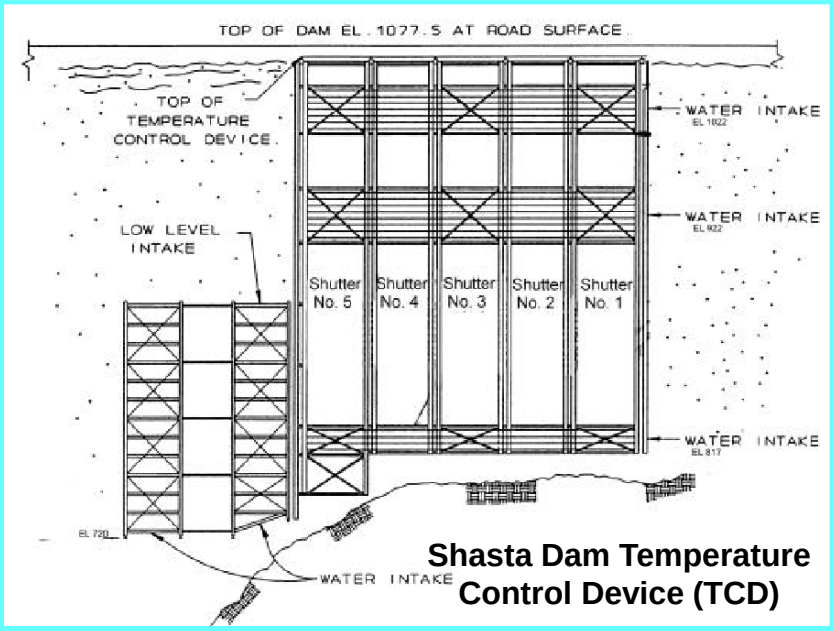
Progress – Water Temperatures



U.S. Bureau of Reclamation Photo and Schematic



Shasta Dam Temperature Control Device (TCD)

1987 - Spillway Bypass
1997 – Temperature Control Device

Clair Engle Lake
Shasta Dam
Keswick Dam
Whiskeytown Reservoir
Redding
Red Bluff Diversion Dam
Chico
Lake Oroville
Black Butte Reservoir
New Bullards Bar Reservoir
Englebright Reservoir
Camp Far West Reservior
Yuba River
Clear Lake
Feather River
Folsom Lake
American River
Sacramento
Lake Berryessa
Yolo Bypass
Cosumnes River
Camanche Reservoir
Pardee Reservoir
Mokelumne River
Banks Pumping Plant
Tracy Pumping Plant
San Joaquin River
San Francisco
Pacific Ocean
N
W
E
S

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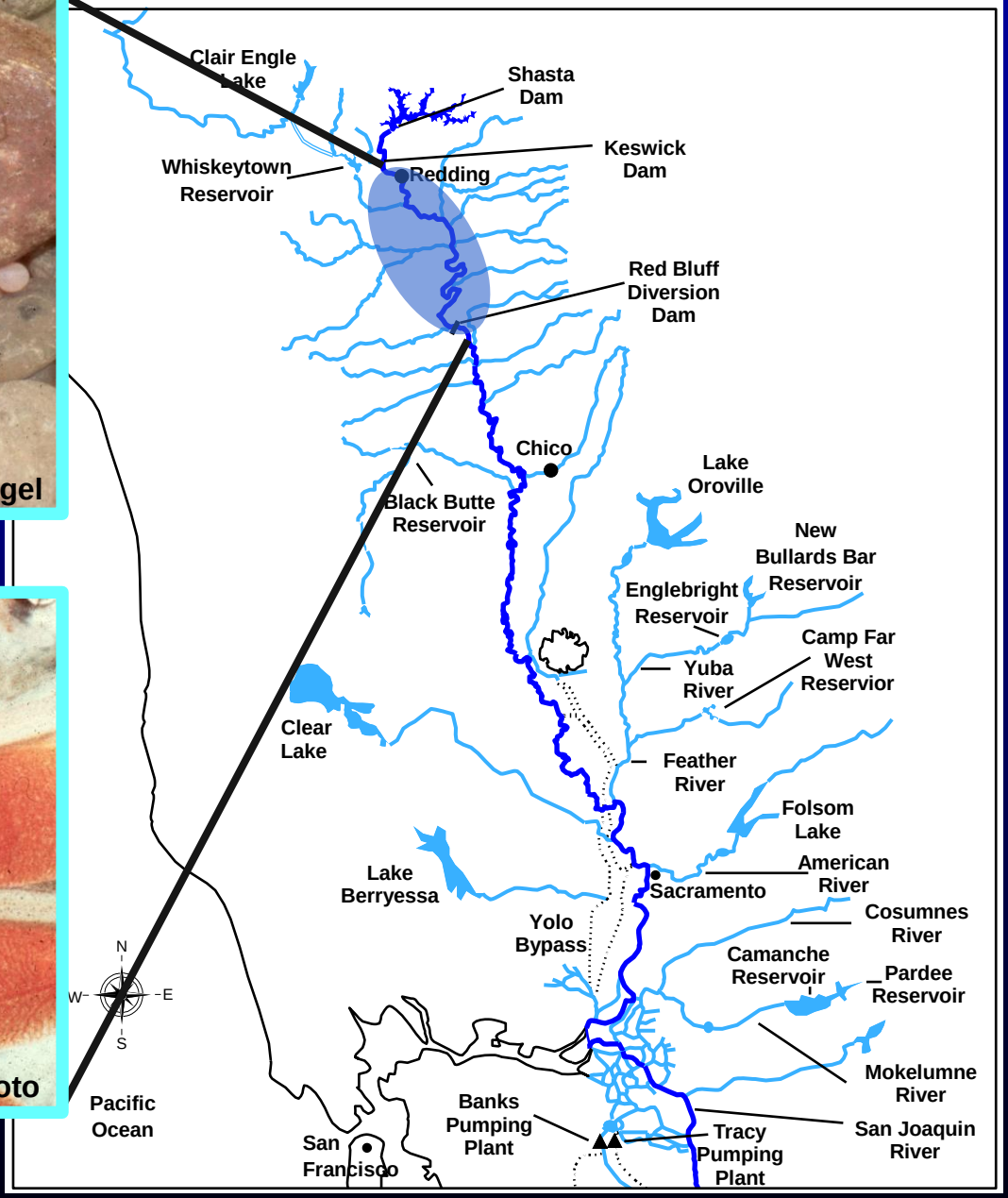
Progress – Water Temperatures

Salmon Eggs

Salmon Alevins



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Winter-Run Chinook 10-Point Action Plan

Developed in 1986 by
Dave Vogel (USFWS) and John Hayes (DFG)

1) Raise the Red Bluff Diversion Dam gates: Completed
2) Develop winter-run Chinook salmon propagation program: Completed
3) Restore spawning habitat in Redding area: Partially Completed
4) Control pikeminnow at Red Bluff Diversion Dam: Completed
5) Restrict in-river fishery: Completed
6) Develop water temperature control: Completed
7) Correct Iron Mountain Mine pollution problem: Completed
8) Fix problems at Anderson-Cottonwood Irrigation District dam: Completed
9) Correct stilling basin problem at Keswick Dam: Completed
10) Continue and expand studies on winter-run Chinook: Partially Completed

Progress – Tributary Restoration

Clear Creek

– Dam Removal, Flows, & Spawning Gravels

Battle Creek

– Large-Scale Watershed Restoration

Lower Feather River

– FERC Settlement Flows and Actions

Lower Yuba River

– Lower Yuba River Accord

Lower American River

– Water Forum Flows in NMFS 2009 BiOp

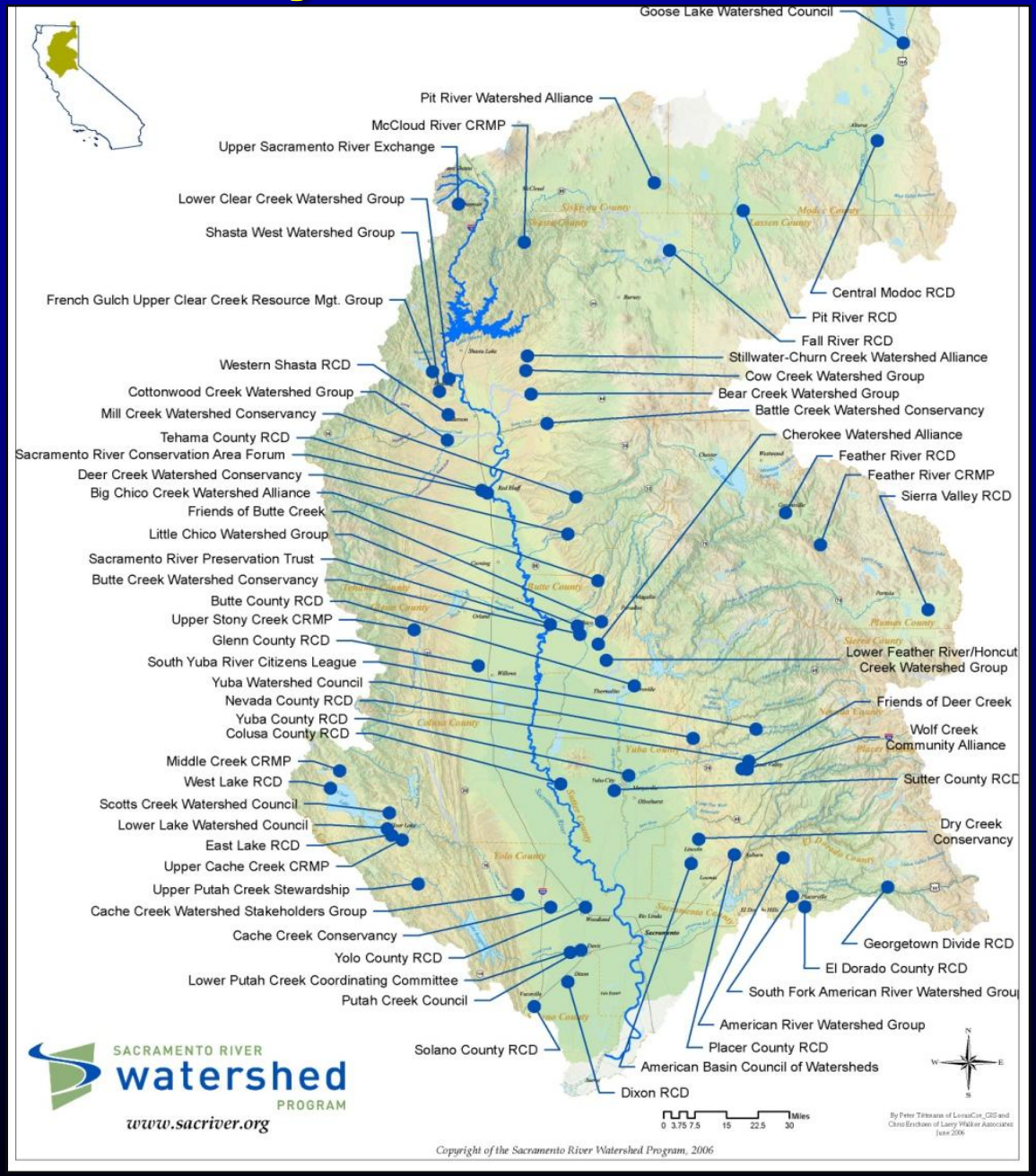
Numerous Smaller Tributaries

– Flows, Fish Screens, Habitat and Fish Passage Improvements

Progress – Tributary Restoration

Watershed Groups

Improved Watershed Conditions



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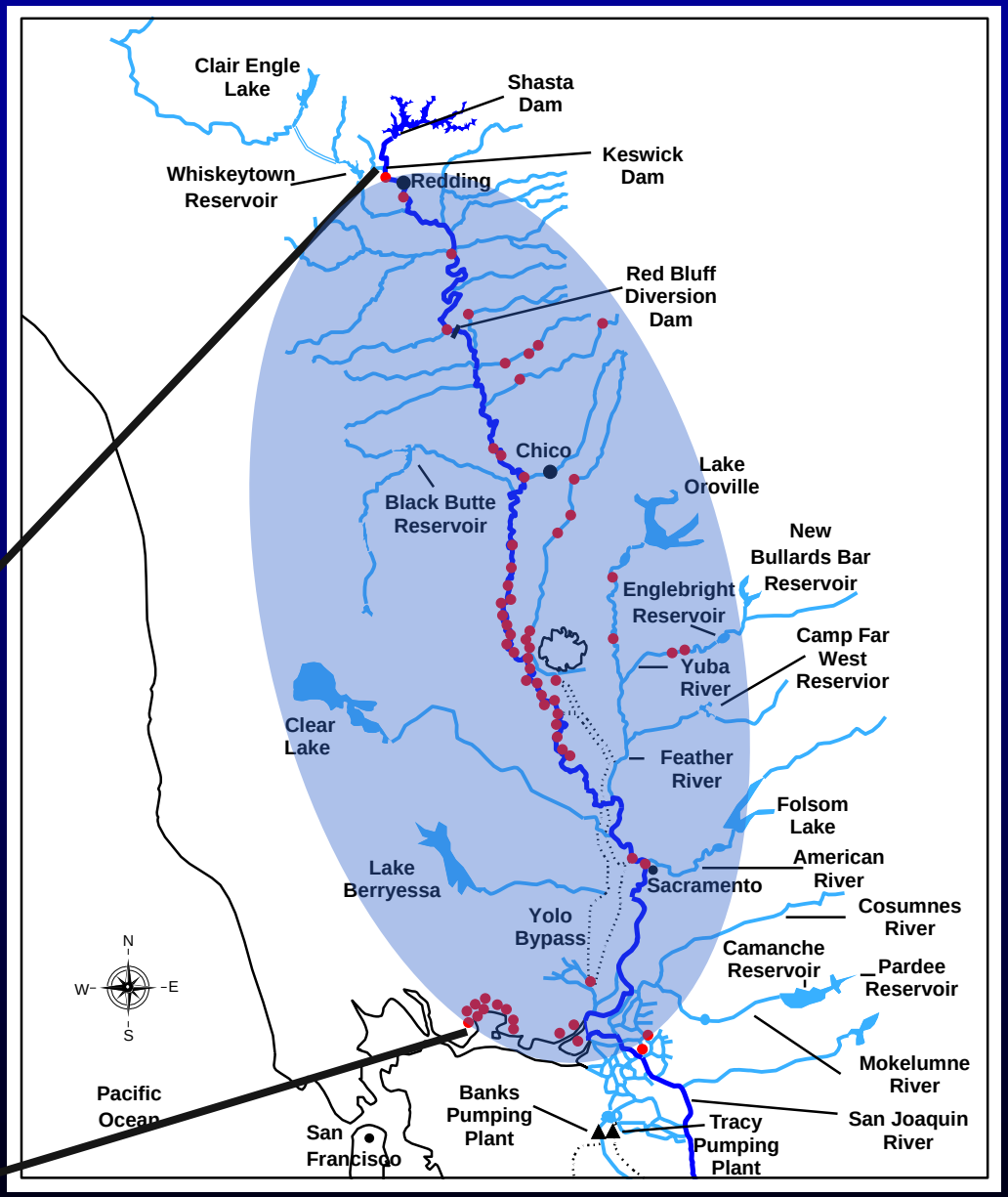
Progress – Fish Screens

Recent Fish Screen Projects through 2012

> $500 Million



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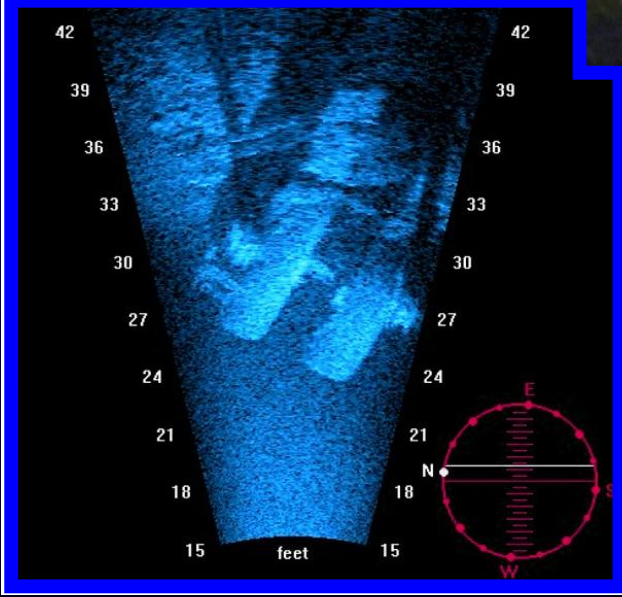
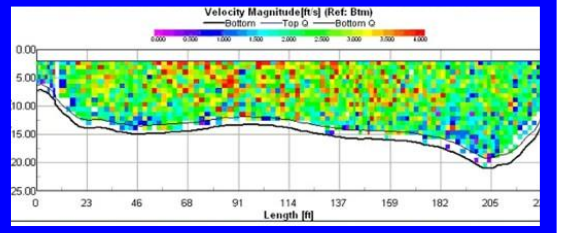
In-River Surveys of Unscreened Diversions





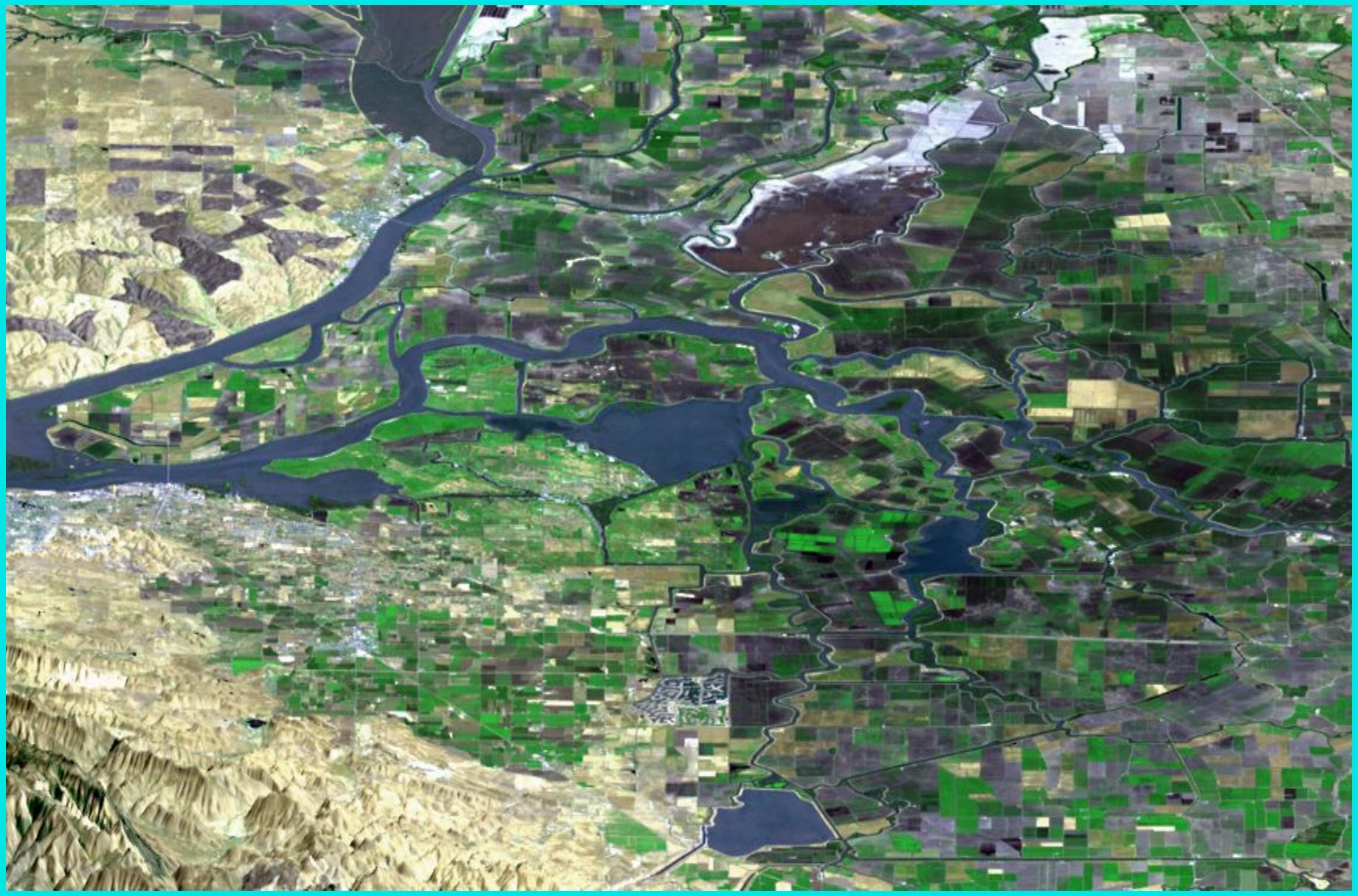
Unscreened Diversion Surveys

No Large Impacts on Salmonids Observed

Over $1,000,000,000 Has Been Spent on Anadromous Fish Restoration

Why Have the Fish Runs Not Recovered?

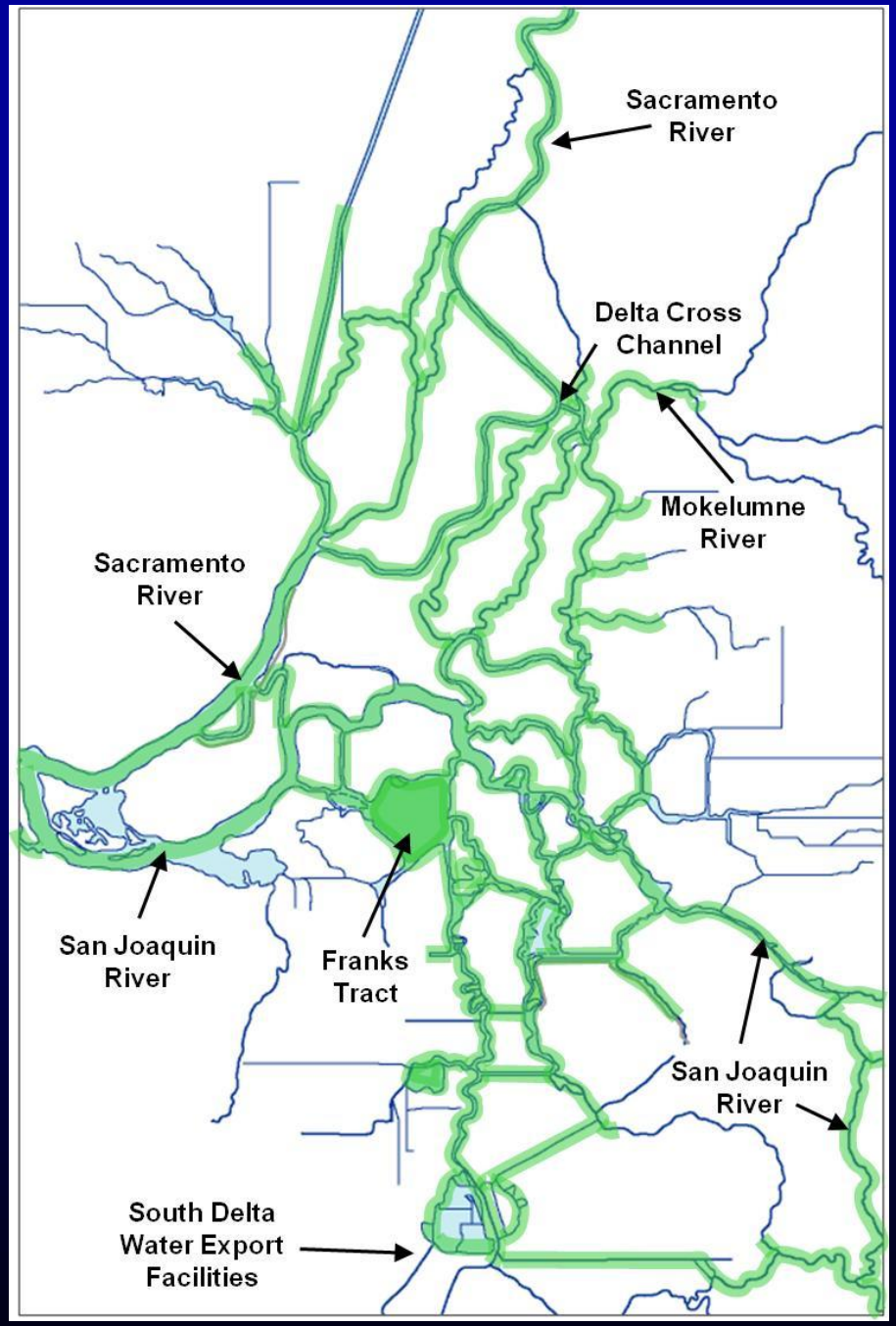
Sacramento – San Joaquin Delta



Predators on Salmonids

Pikeminnow **Striped Bass** **Largemouth Bass**

Salmon Telemetry Studies in the Delta (15 Years)



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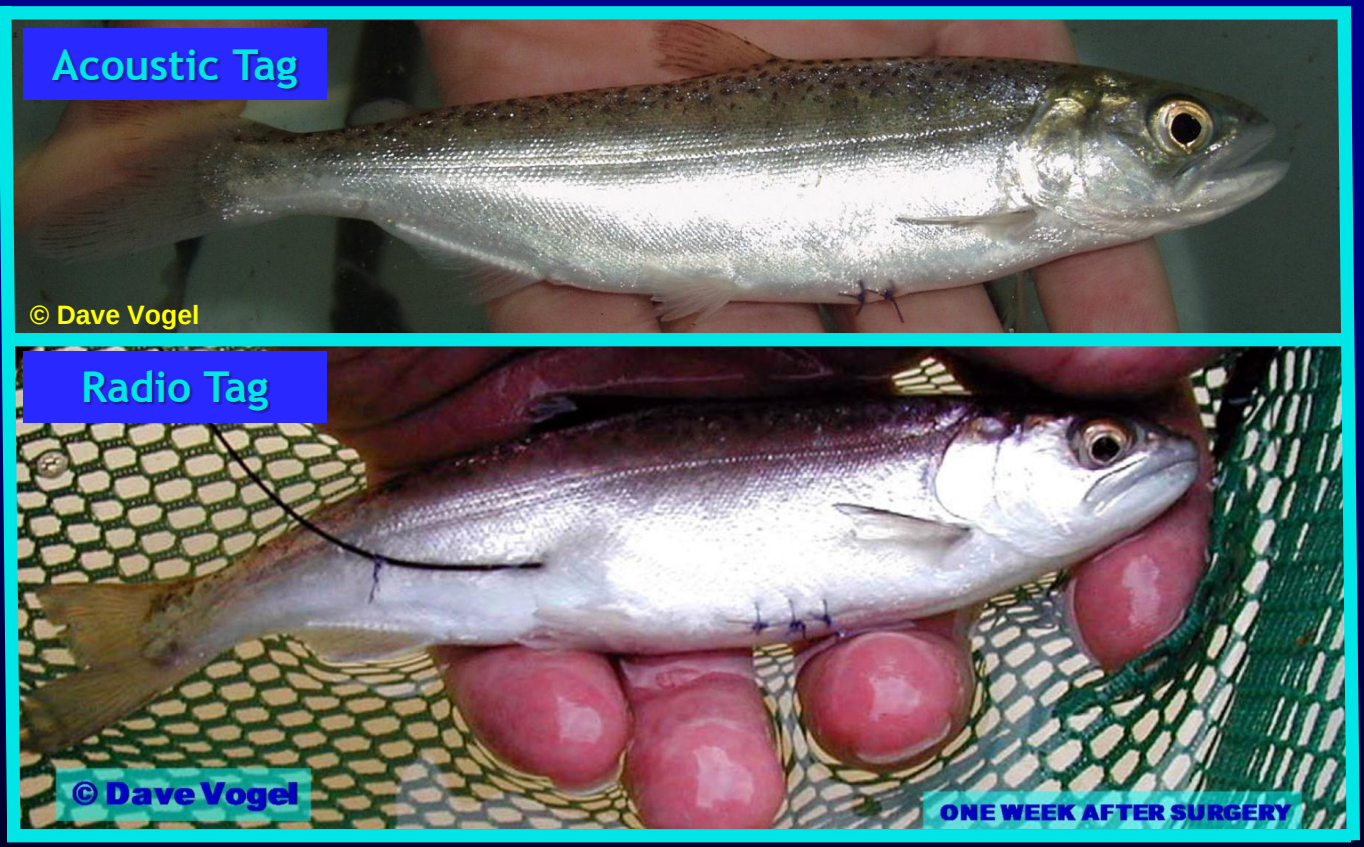
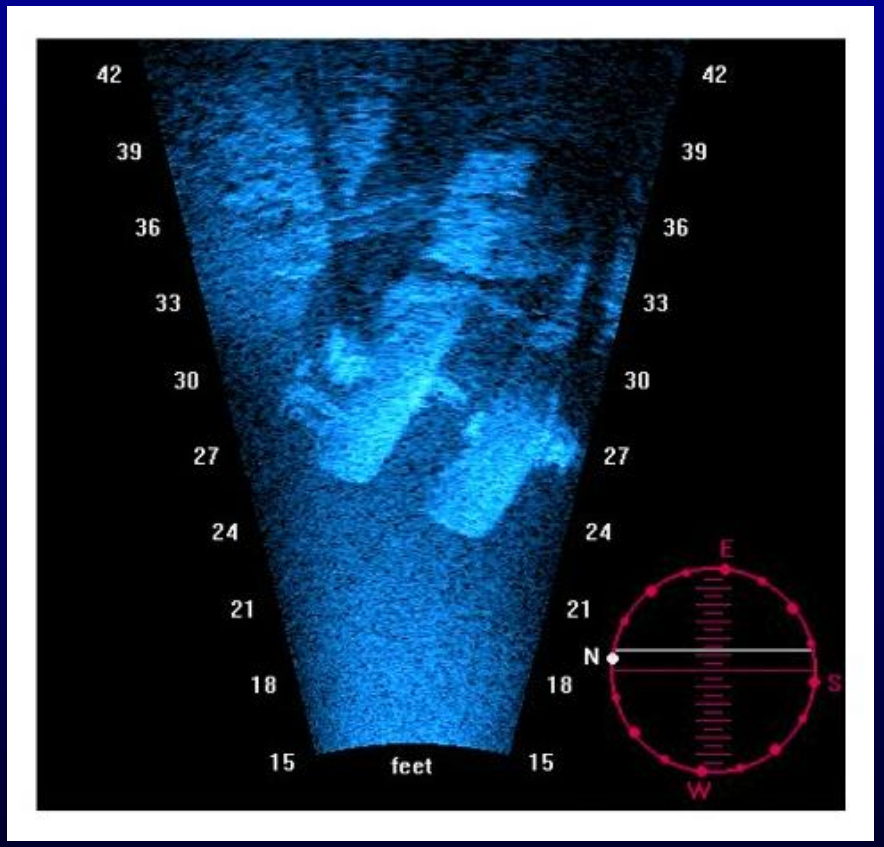
Juvenile Salmon Telemetry Studies in the Delta



Dual-Frequency Identification Sonar Surveys in the Delta

YouTube Footage: NRSIncorporated

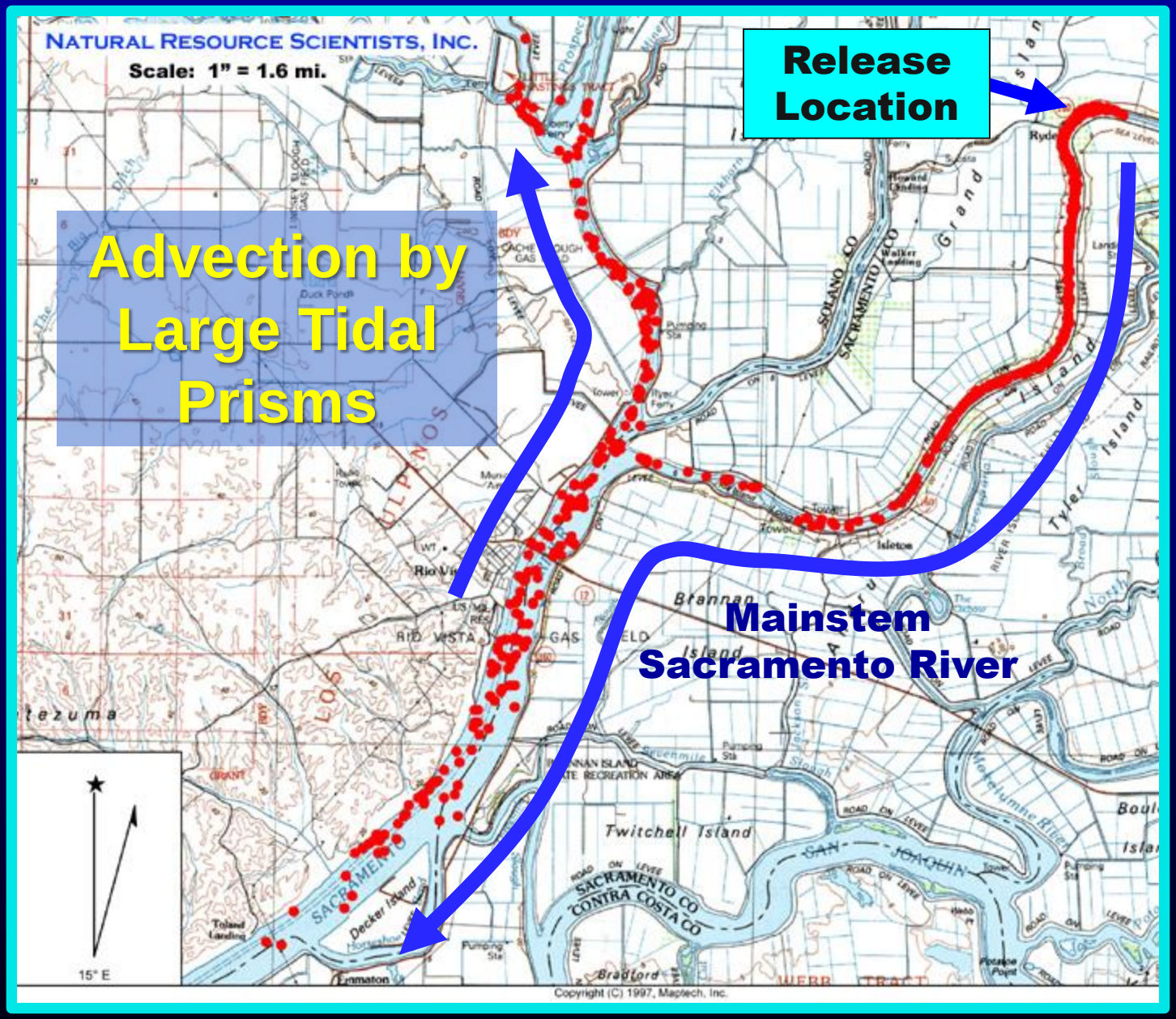
Sonar Camera



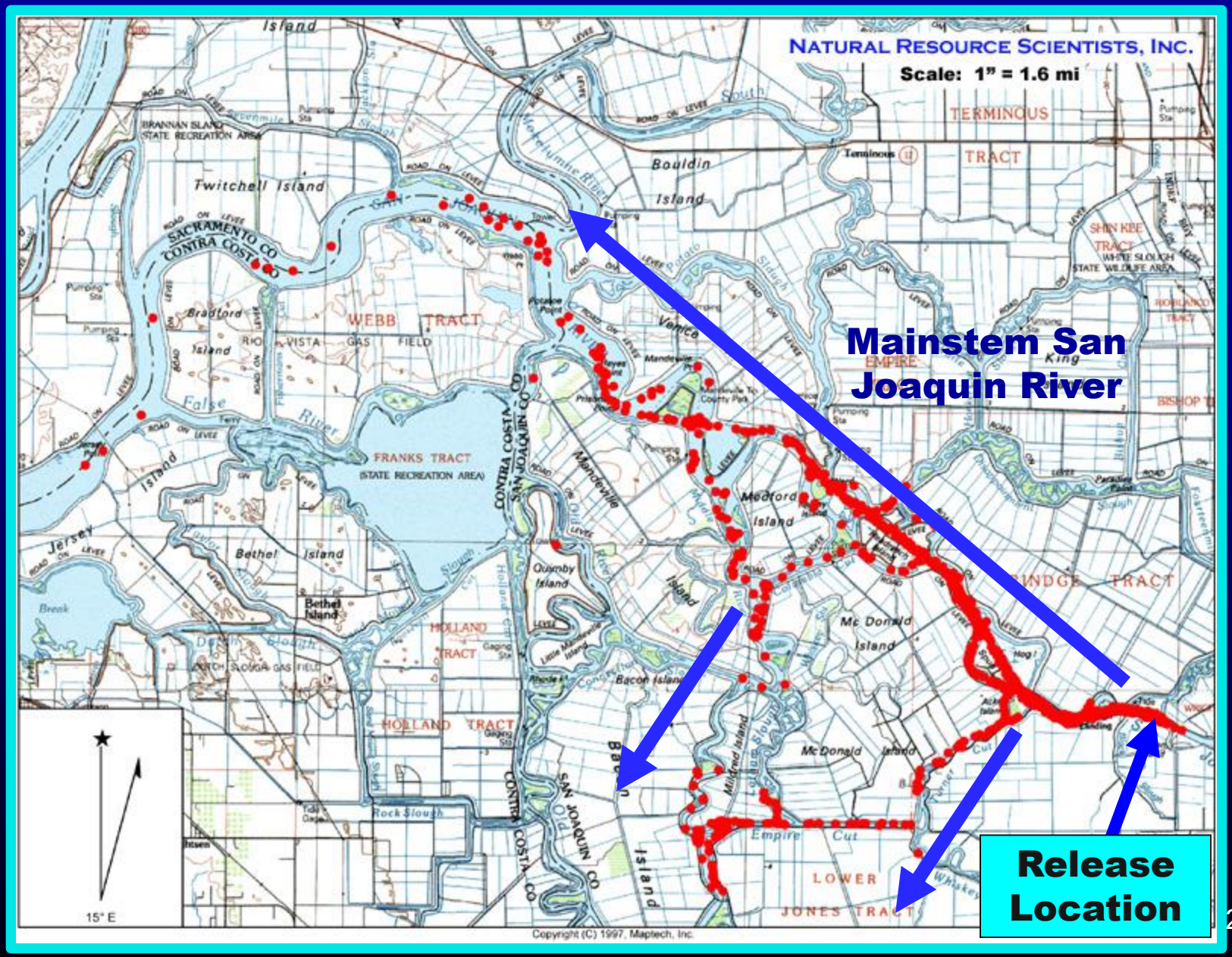
Sonar Image

Delta Cross Channel and Georgiana Slough Studies

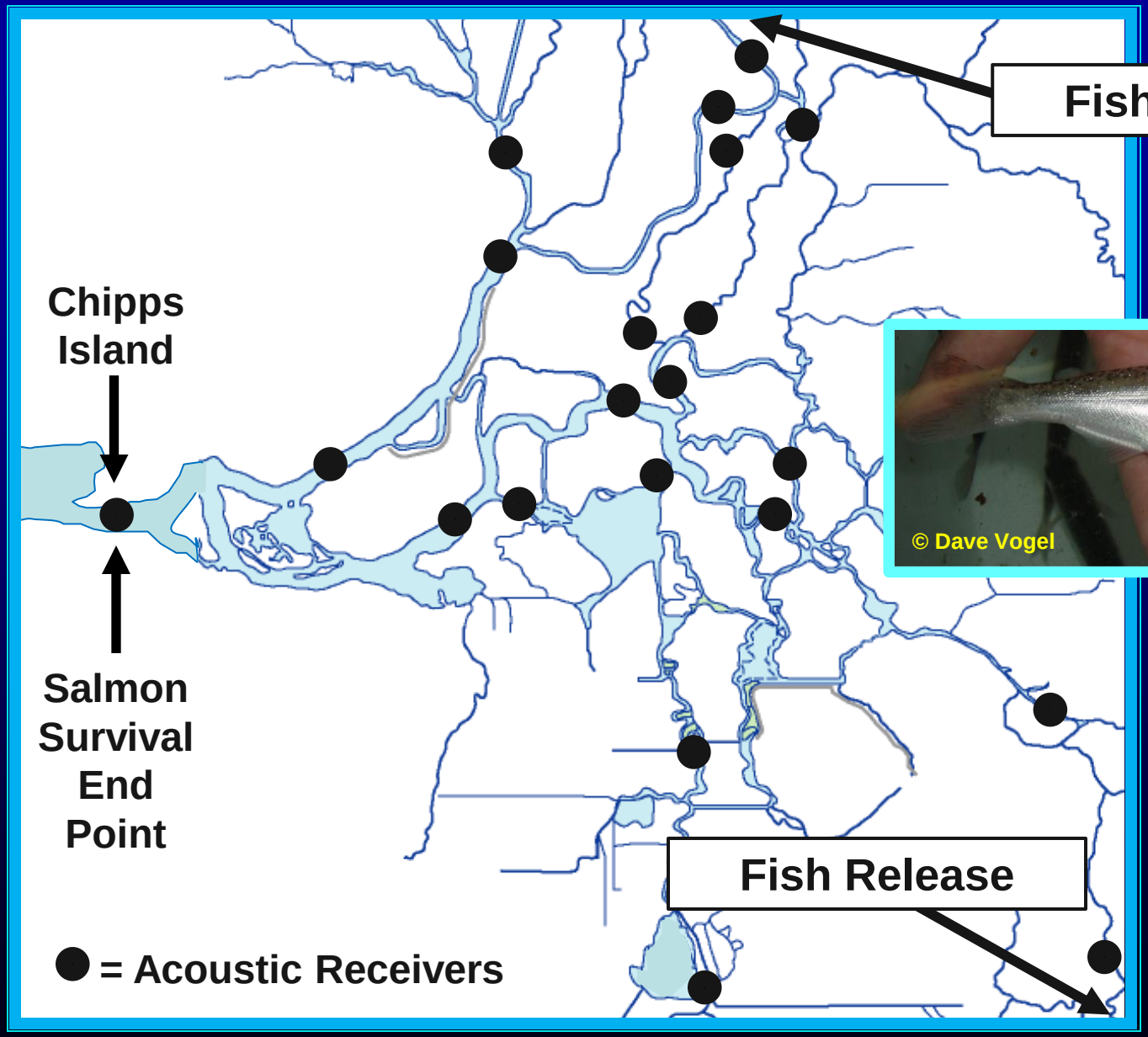
Telemetered Locations of Salmon Smolts



Telemetered Locations of Salmon Smolts

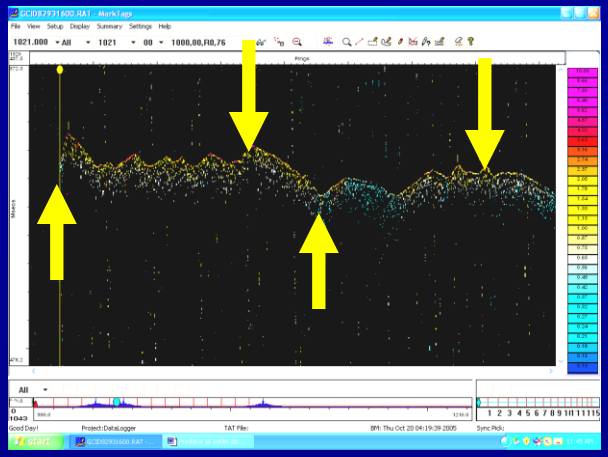


Hypothetical Acoustic Telemetry Array to Estimate Salmon Survival

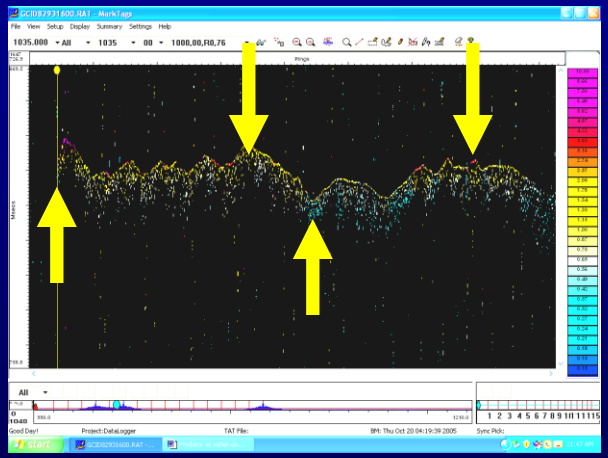


Miniaturized Acoustic Tag (Different Technology)

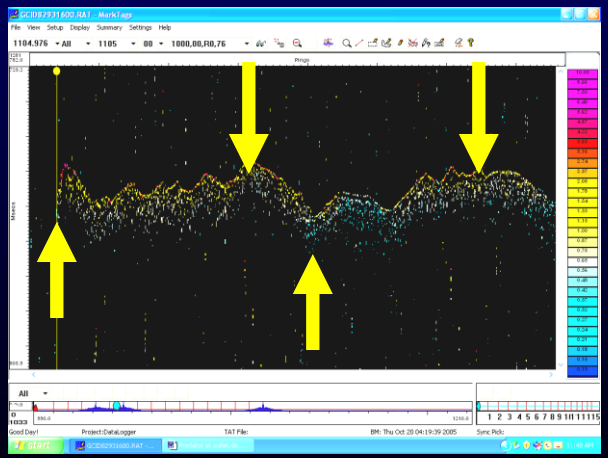
Acoustic-Tagged Salmon No. 1021



Acoustic-Tagged Salmon No. 1035



Acoustic-Tagged Salmon No. 1105



Acoustic Echograms

Juvenile Acoustic-Tagged Salmon Released at Different Times and Locations Arrived Downstream at the Same Second

Movement Patterns were Identical for all 3 Transmitters

<u>Conclusion:</u>
<u>3 Salmon Eaten by 1 Predator</u>

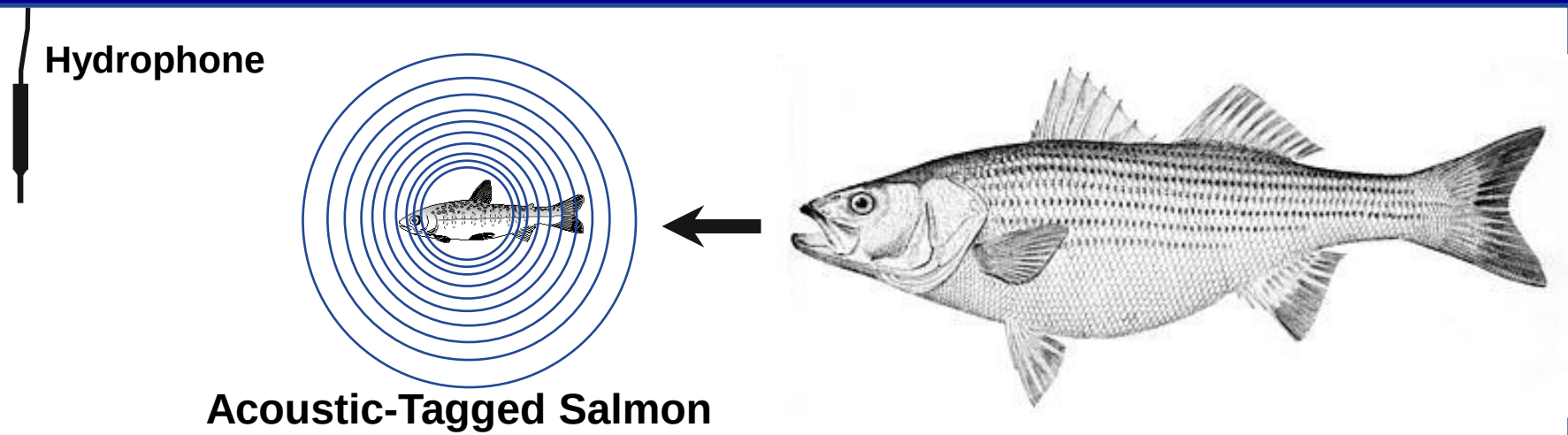
Ramifications of Striped Bass Predation on Acoustic-Tagged Salmon

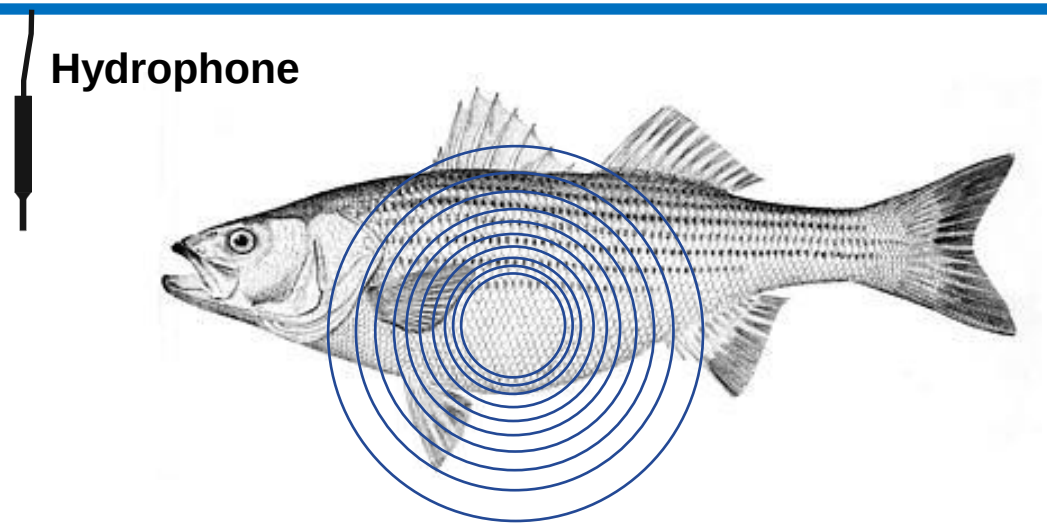
Re-analysis changed salmon survival estimates in a lower Sacramento River study from 100% survival to 100% mortality.

Statistical models failing to account for this predation problem would be in error.

Major Problem with Study Design

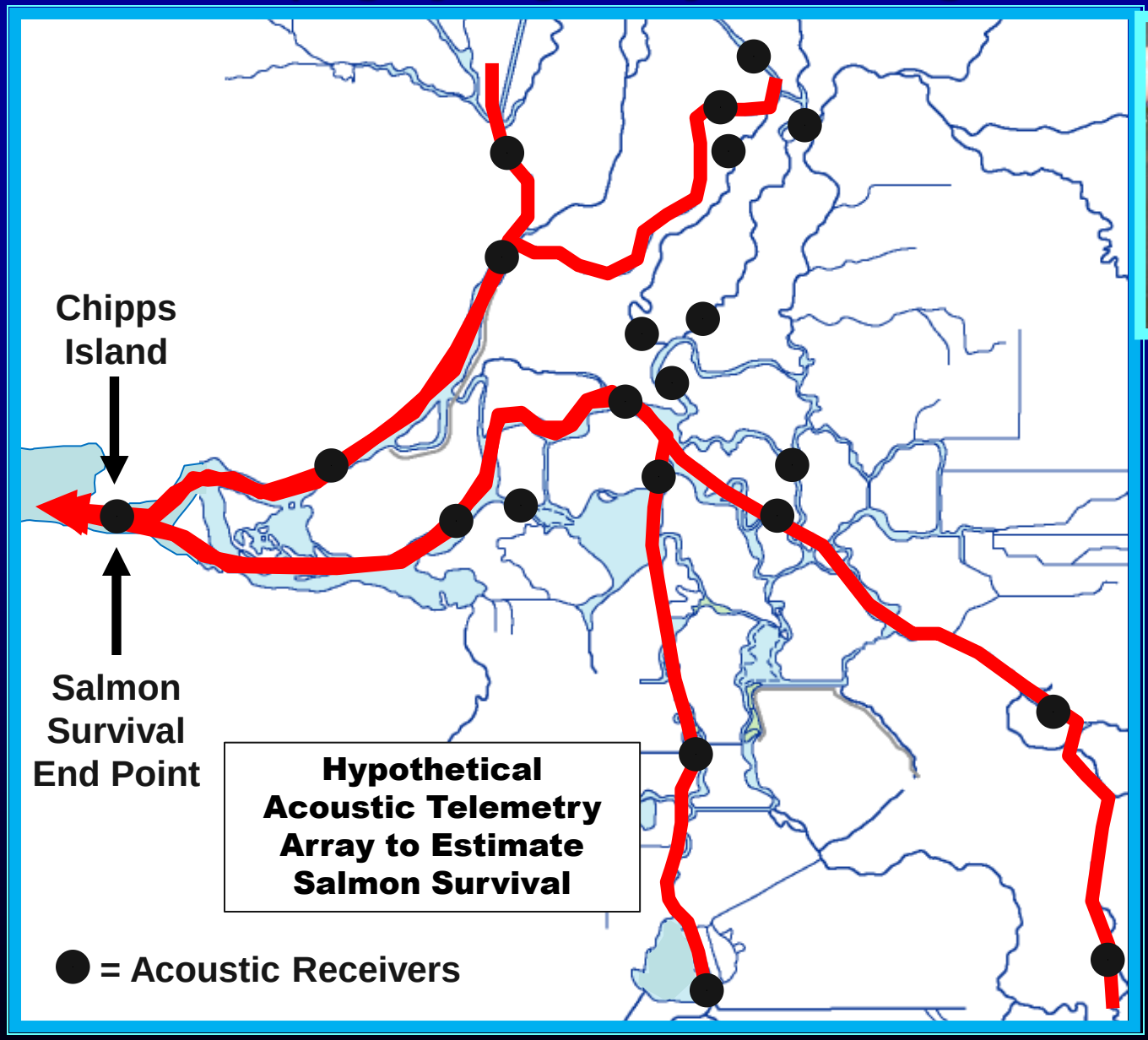
Striped Bass Predation on Acoustic-Tagged Salmon





Inability to Determine Live Salmon vs Dead Salmon Inside Striped Bass

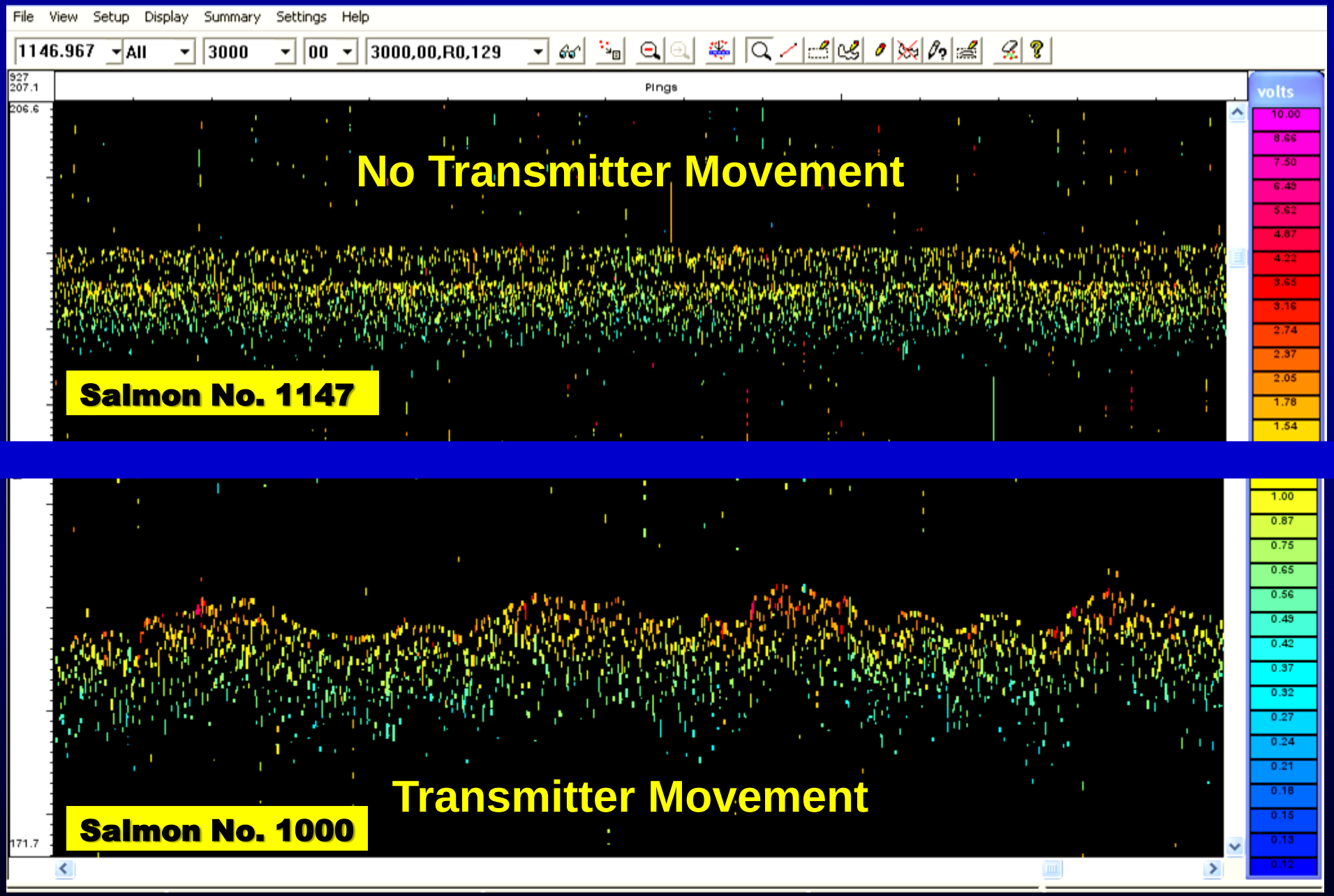
Striped Bass Movements in the Delta
(Highly Migratory over Long Distances!)



Acoustic-Tagged Striped Bass

Live Salmon or Dead Salmon Passing Receivers ?

Statistical models failing to account for this predation problem would be in error.

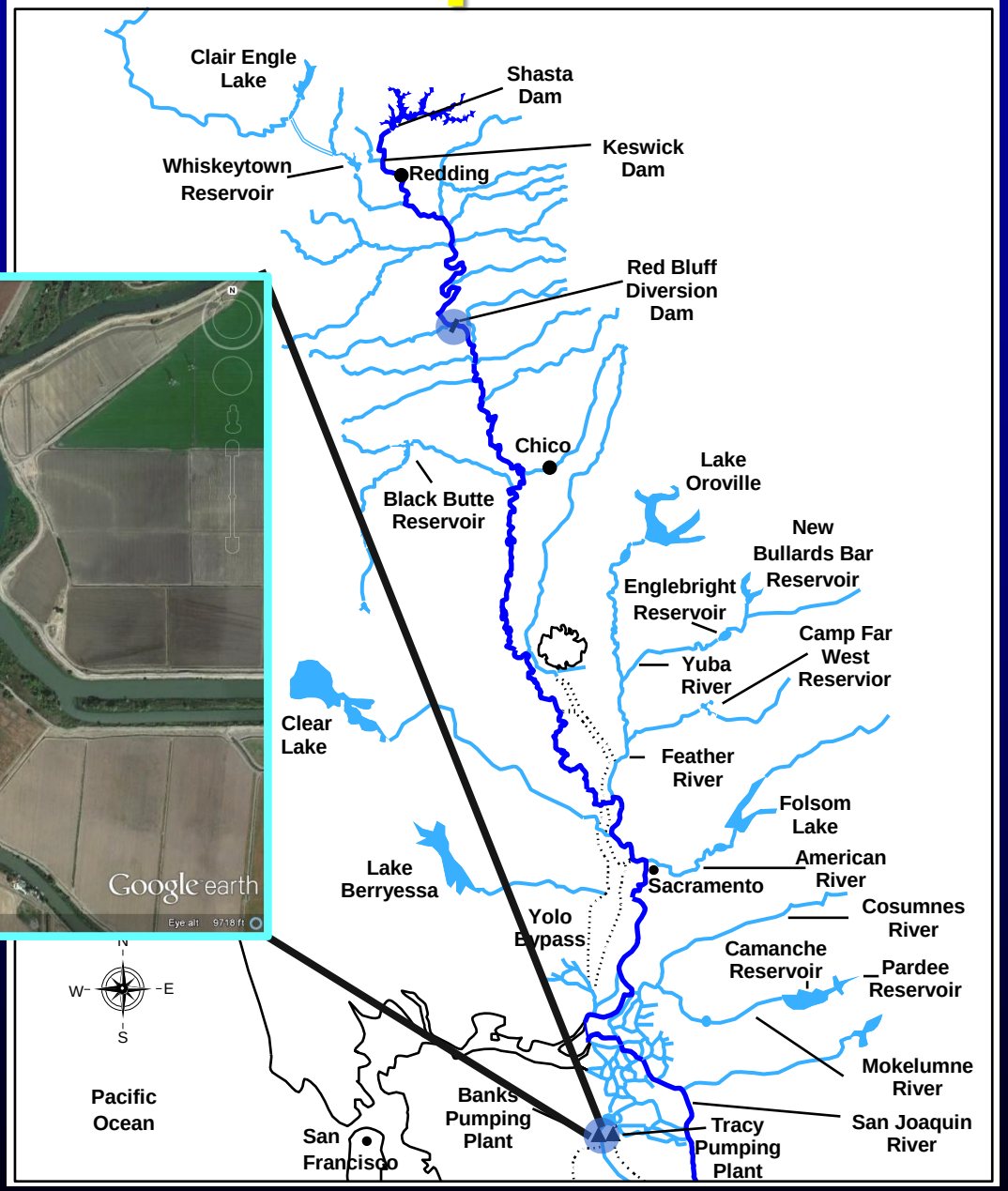


Acoustic Echograms

Extremely High Fish Mortality

Motionless Acoustic Transmitters (Dead Salmon)

Predation "Hot Spots"



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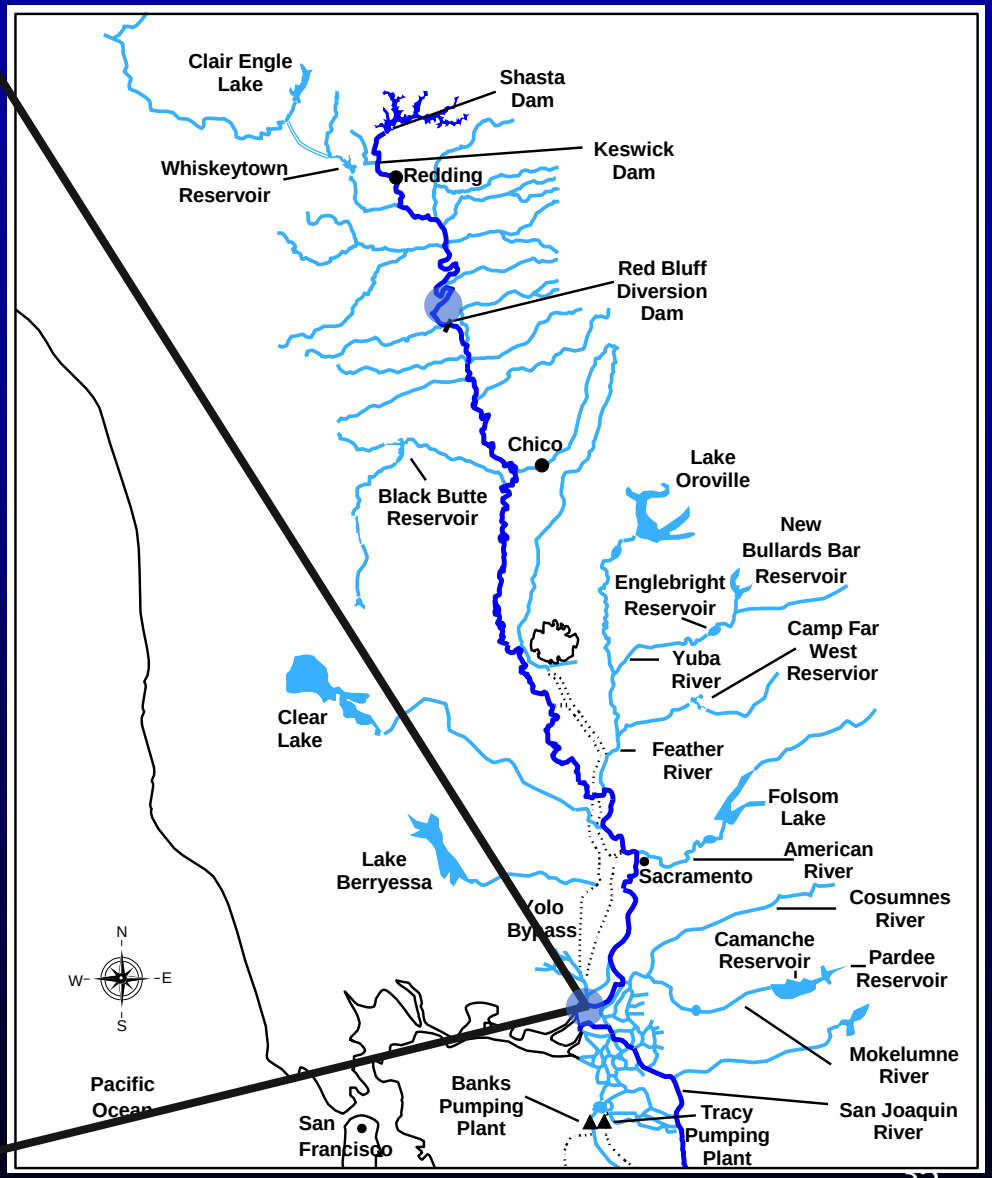
Predation "Hot Spots"

Before Flooding

After Flooding



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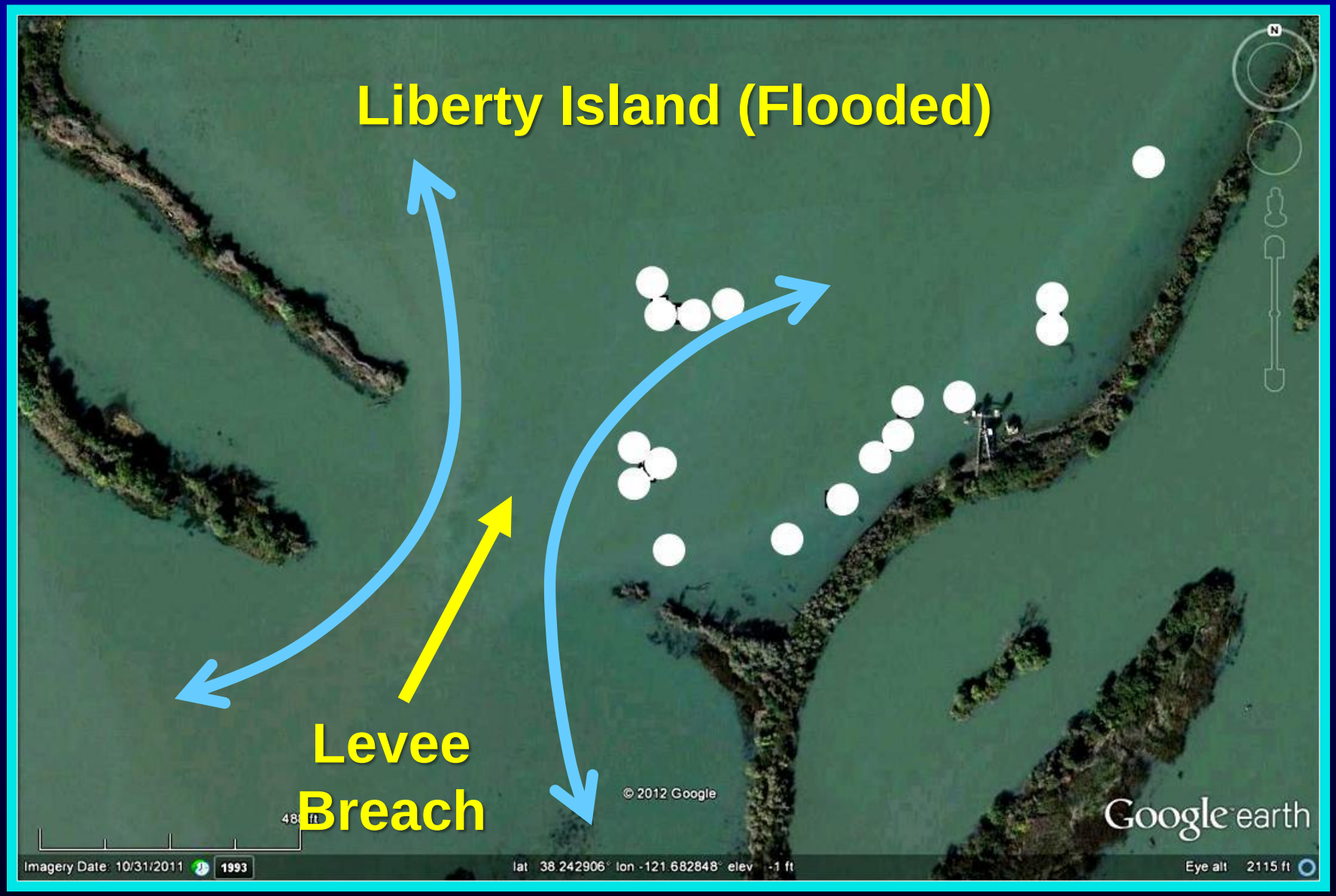
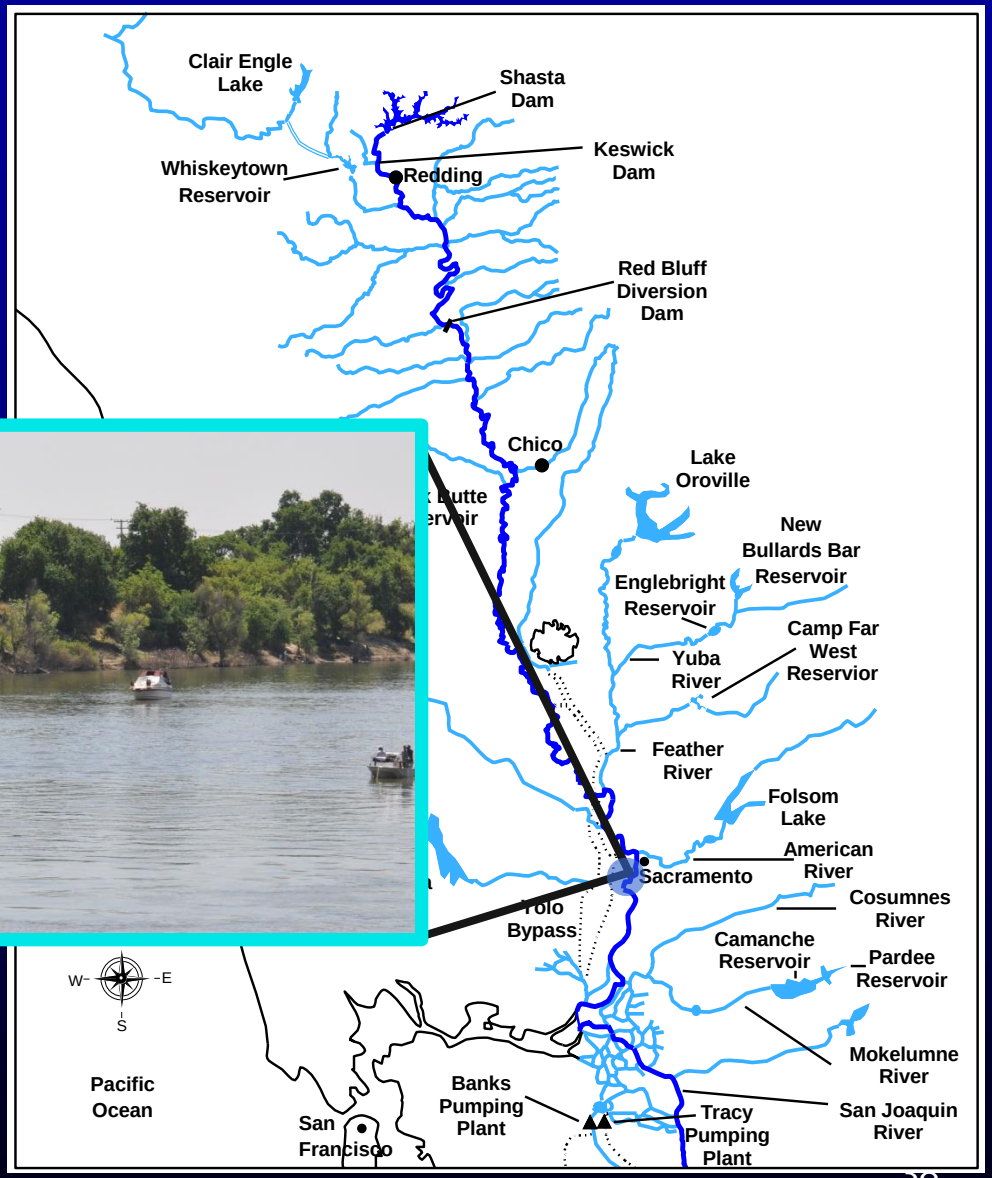
Acoustic-Tagged Adult Striped Bass

Acoustic-Tagged Adult Striped Bass



Predation "Hot Spots"

Striped Bass Anglers at the Freeport Pipeline



Summary: Predation in the Delta is not Uniform

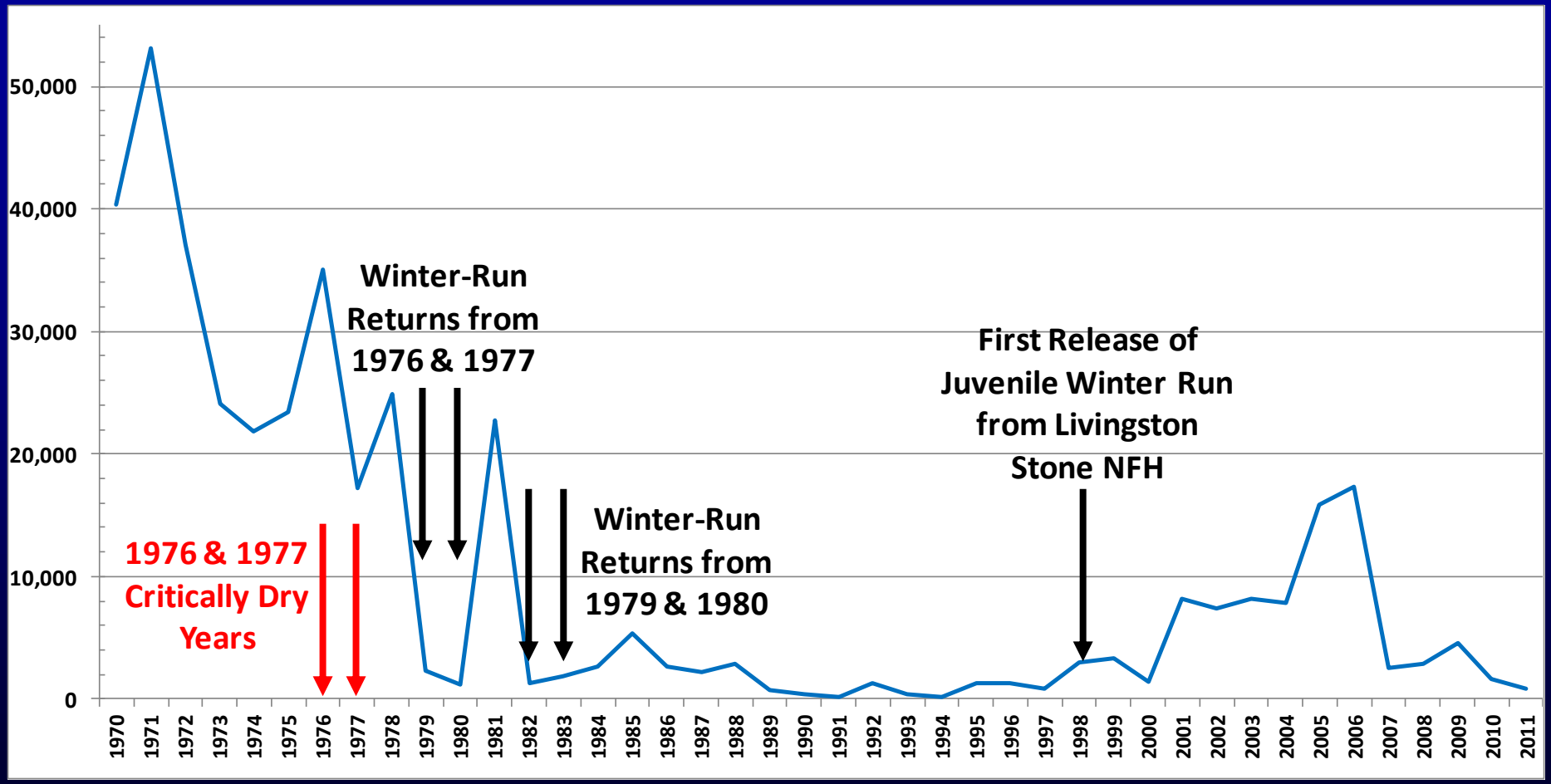
Flow Criteria

- 40% – 50% Unimpaired Flow

(MBK Report - Board Workshop #1)

Careful Analyses Needed to Avoid Adverse Impacts to Salmon

High Unimpaired Flow Criteria: Consequences of Loss of Cold-Water Storage



Severe Impacts to Winter-Run Chinook Resulting from Reduced Cold-Water Pool

Flow Criteria

- 40% – 50% Unimpaired Flow
- Standard-Setting Base Flows

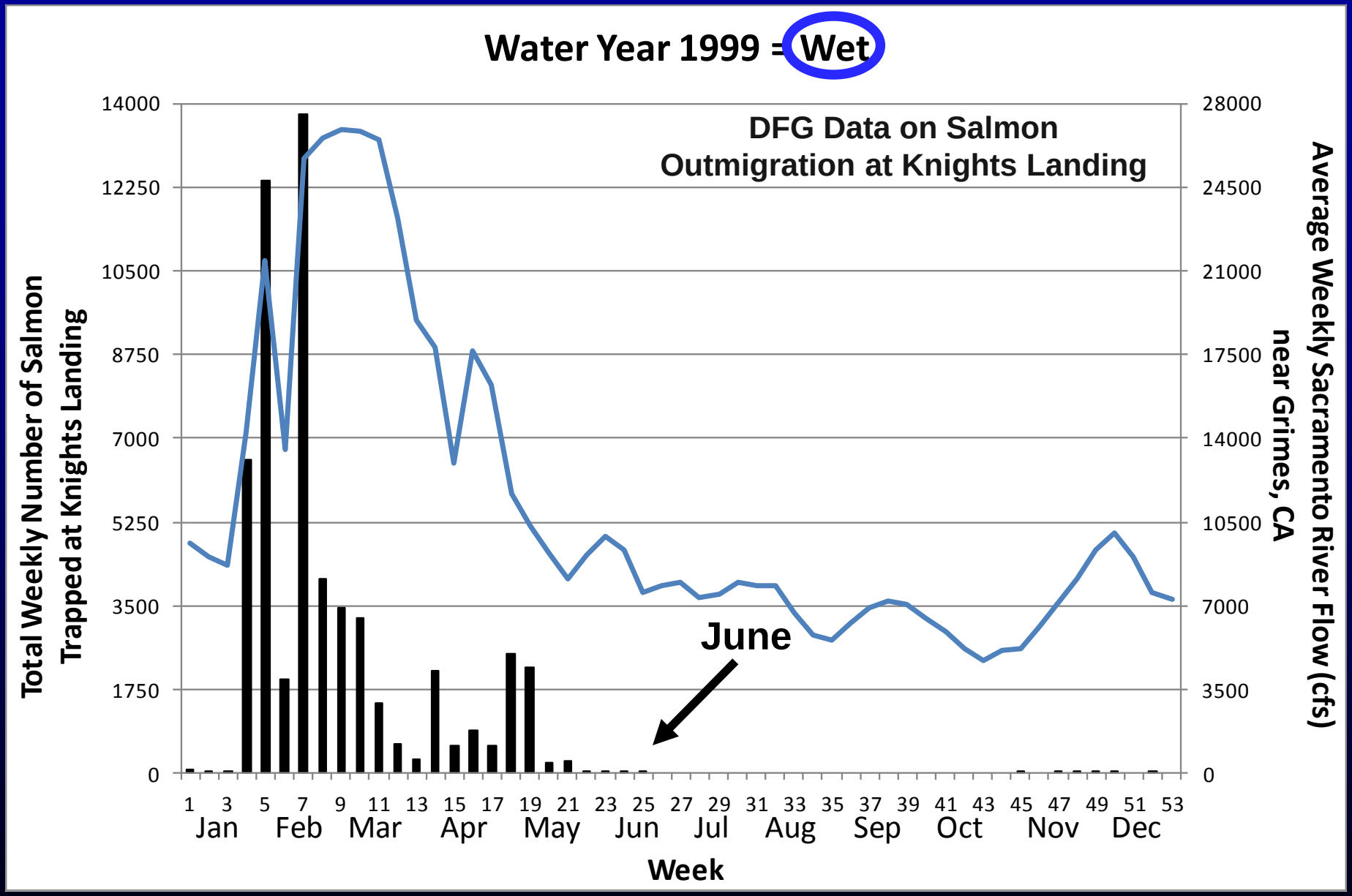
(NCWA Report - Board Workshop #1)

Instream flows developed by fishery agencies and project operators based on site-specific conditions.

Flow Criteria

- 40% – 50% Unimpaired Flow
- Standard-Setting Base Flows
- Pulse Flows with Natural Events

Juvenile Salmon Emigration Timing in Relation to Flows



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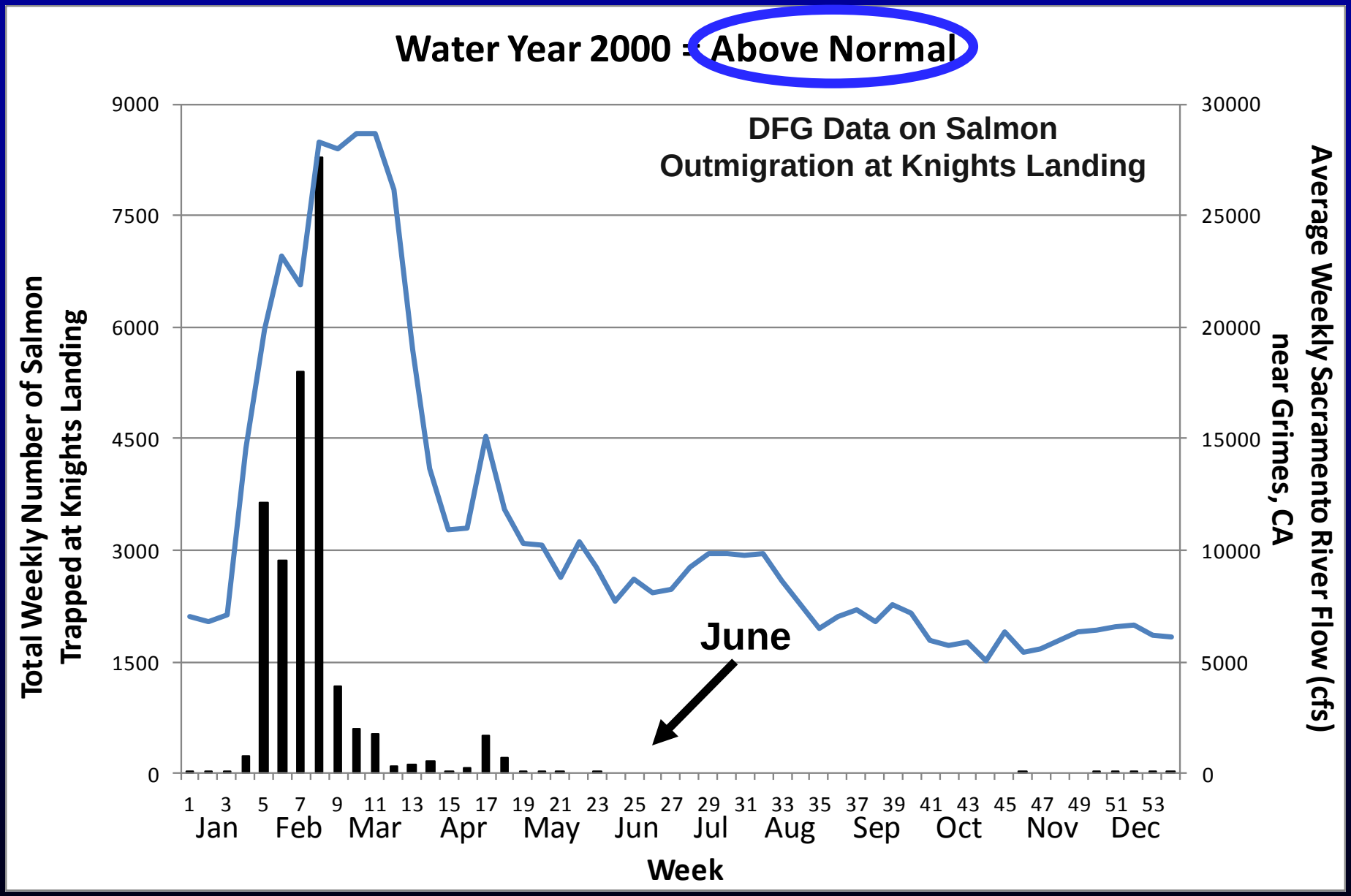
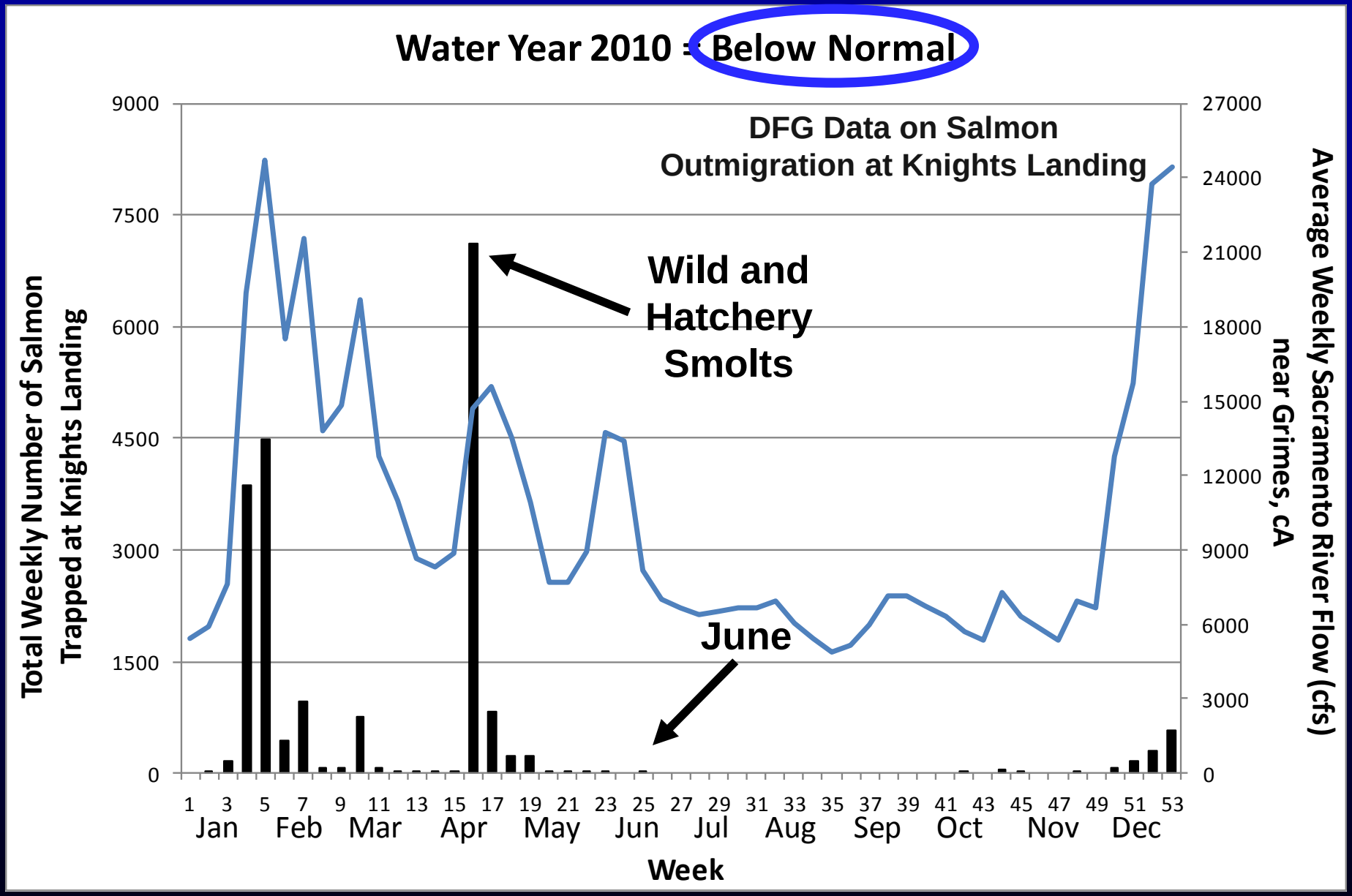
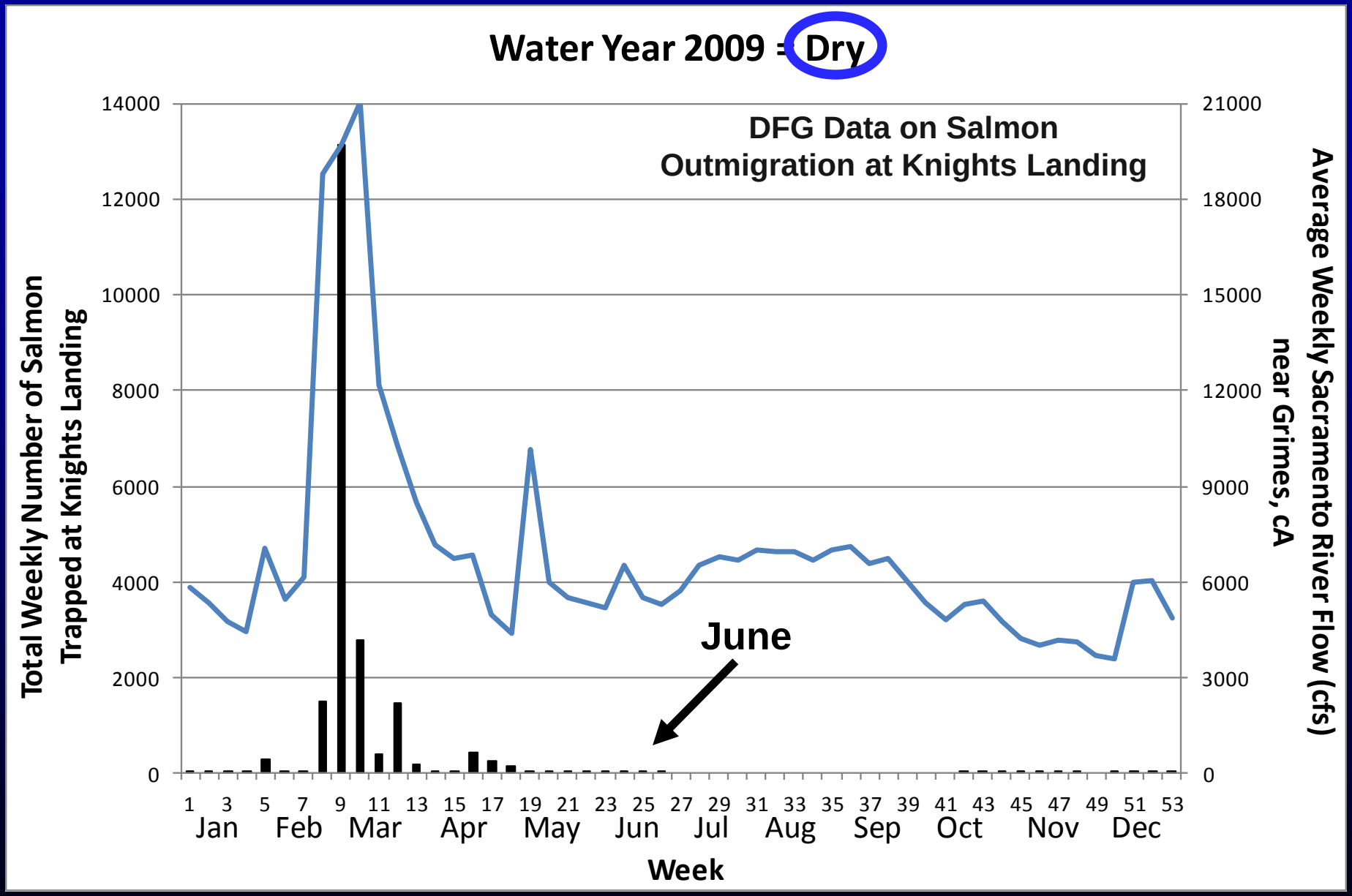


Juvenile Salmon Emigration Timing in Relation to Flows



Juvenile Salmon Emigration Timing in Relation to Flows



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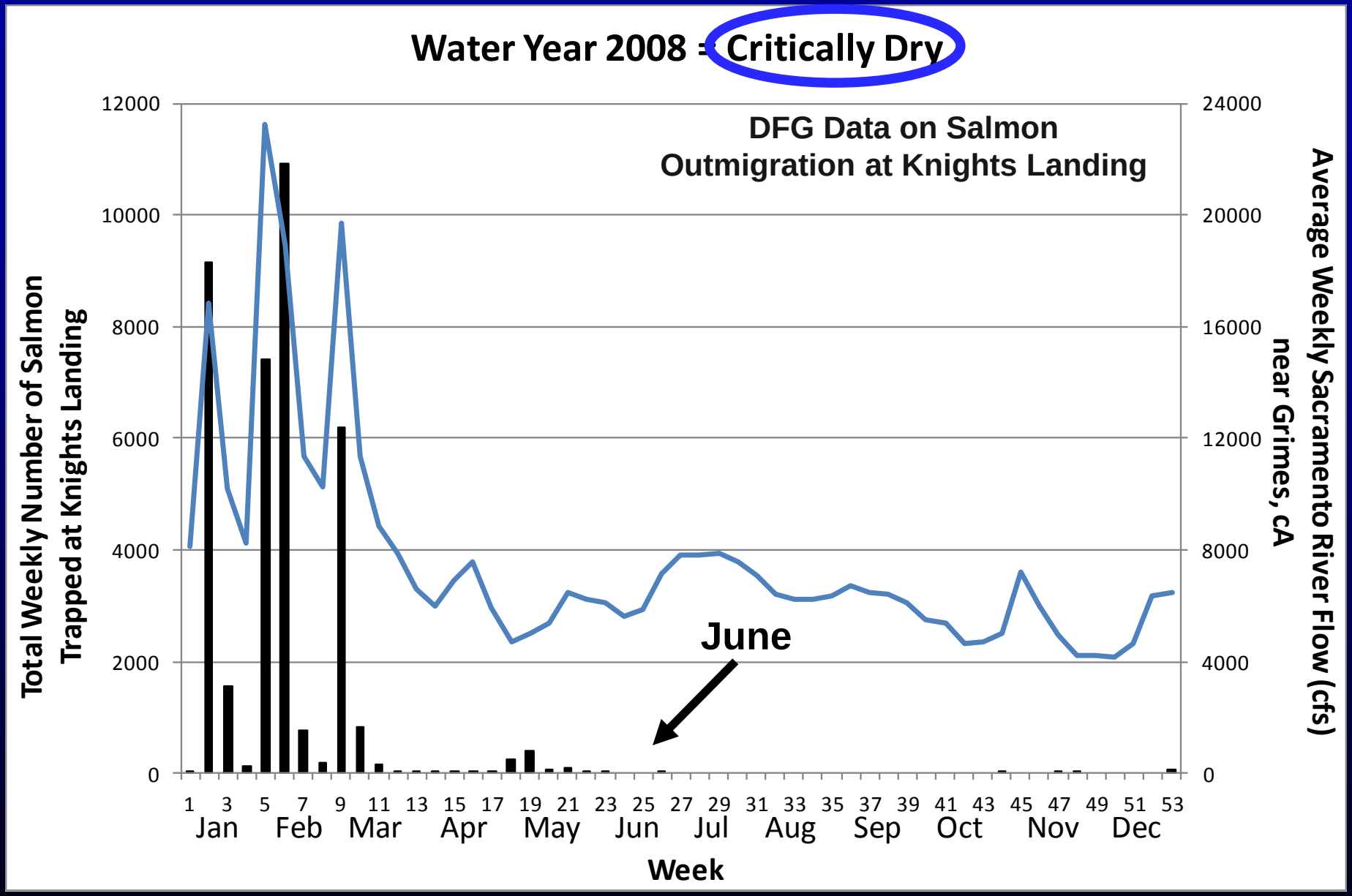
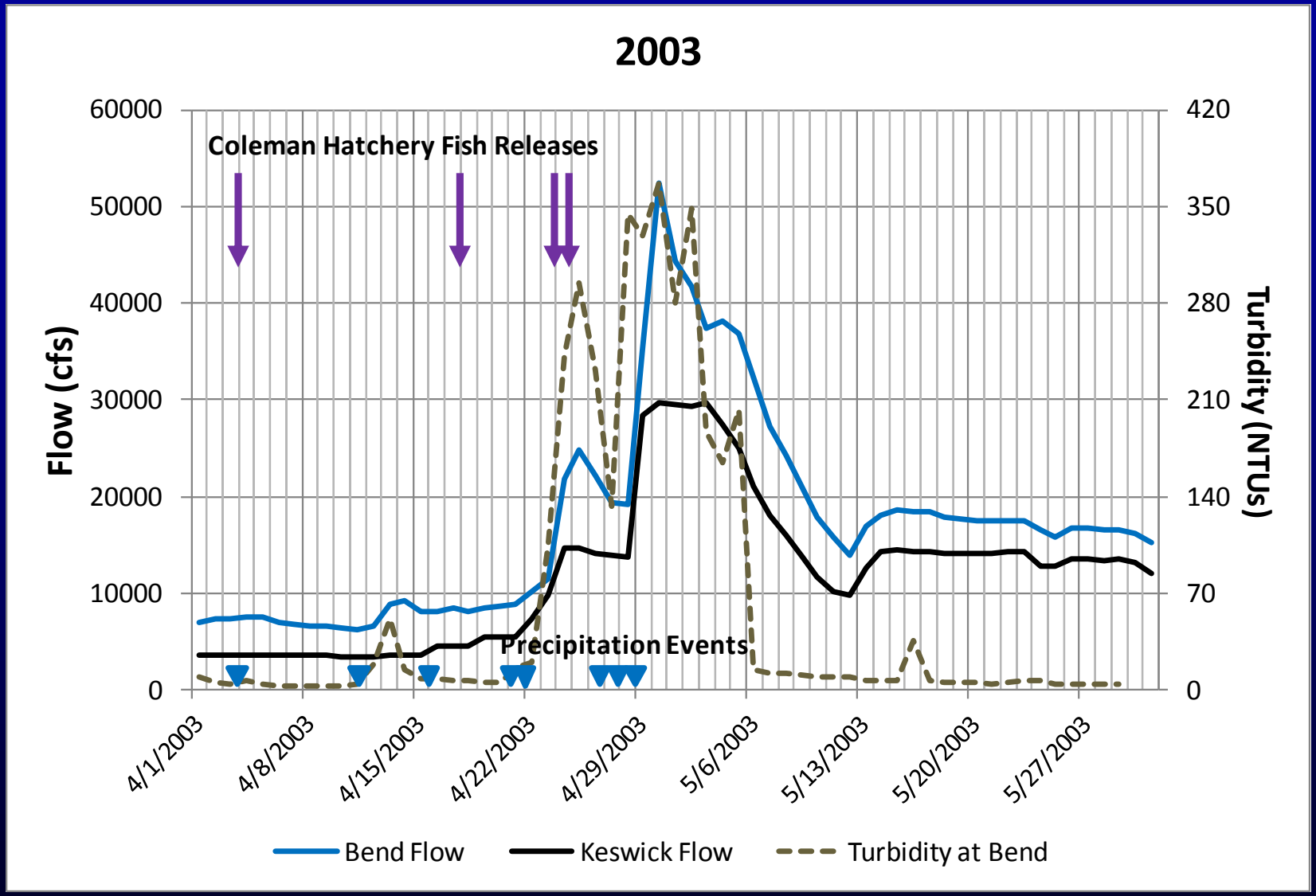
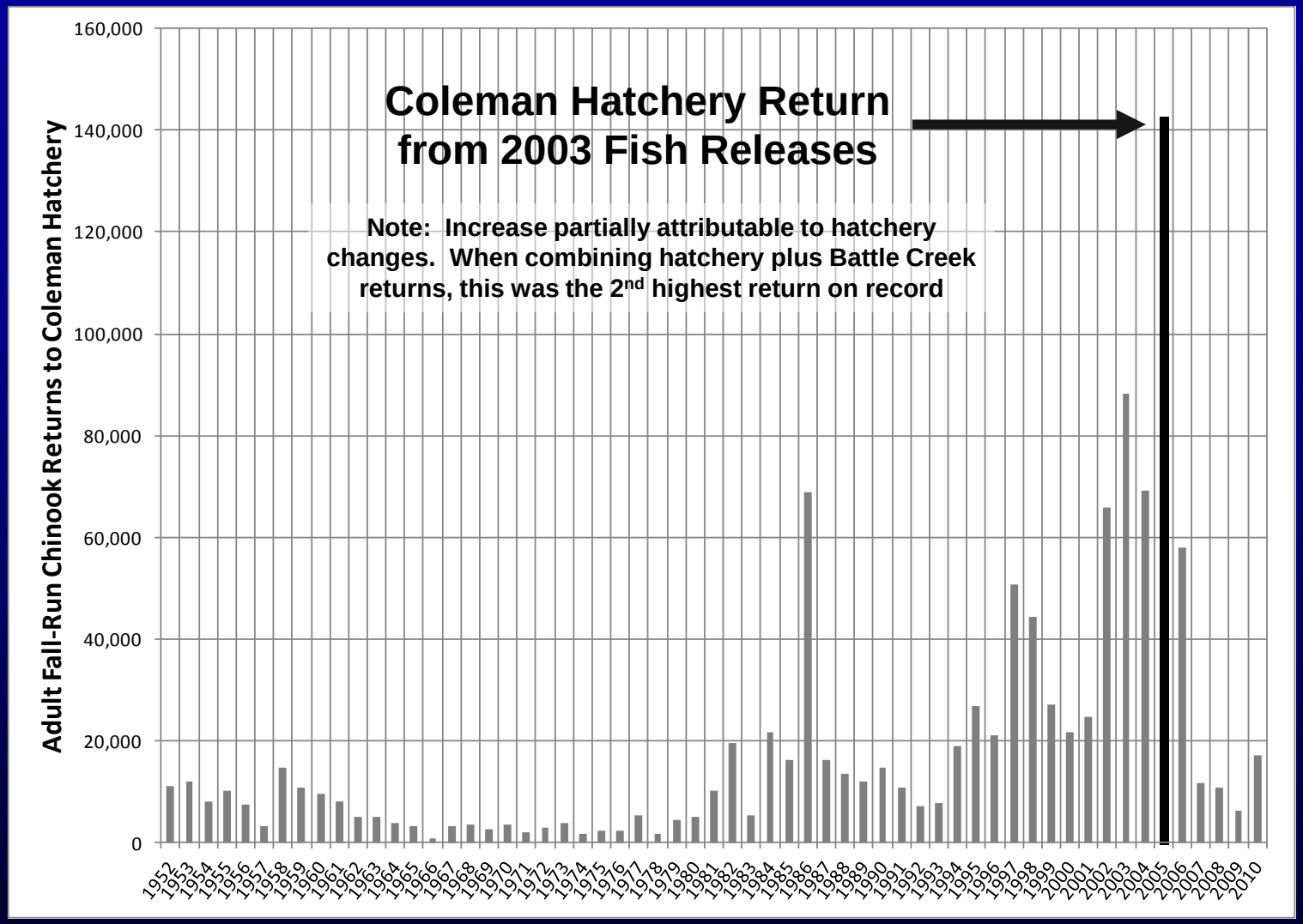


Pulse Flows with Natural Events



Salmon Released Prior to High Flow and Turbidity

Annual Coleman Hatchery Returns (1952 – 2010)

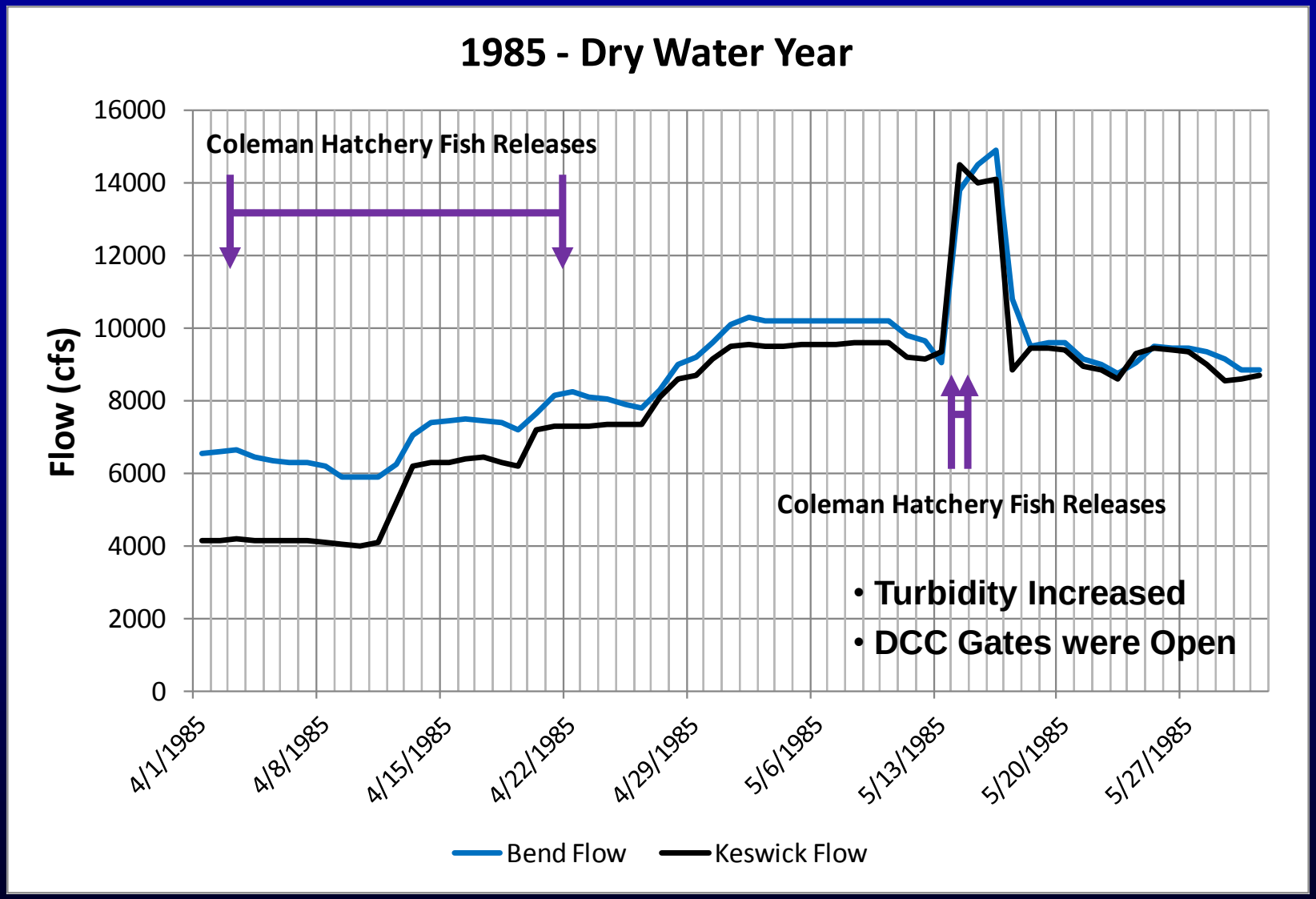


The progeny returning in 2005 from the 2003 flow events was the largest historical return to the hatchery.

Flow Criteria

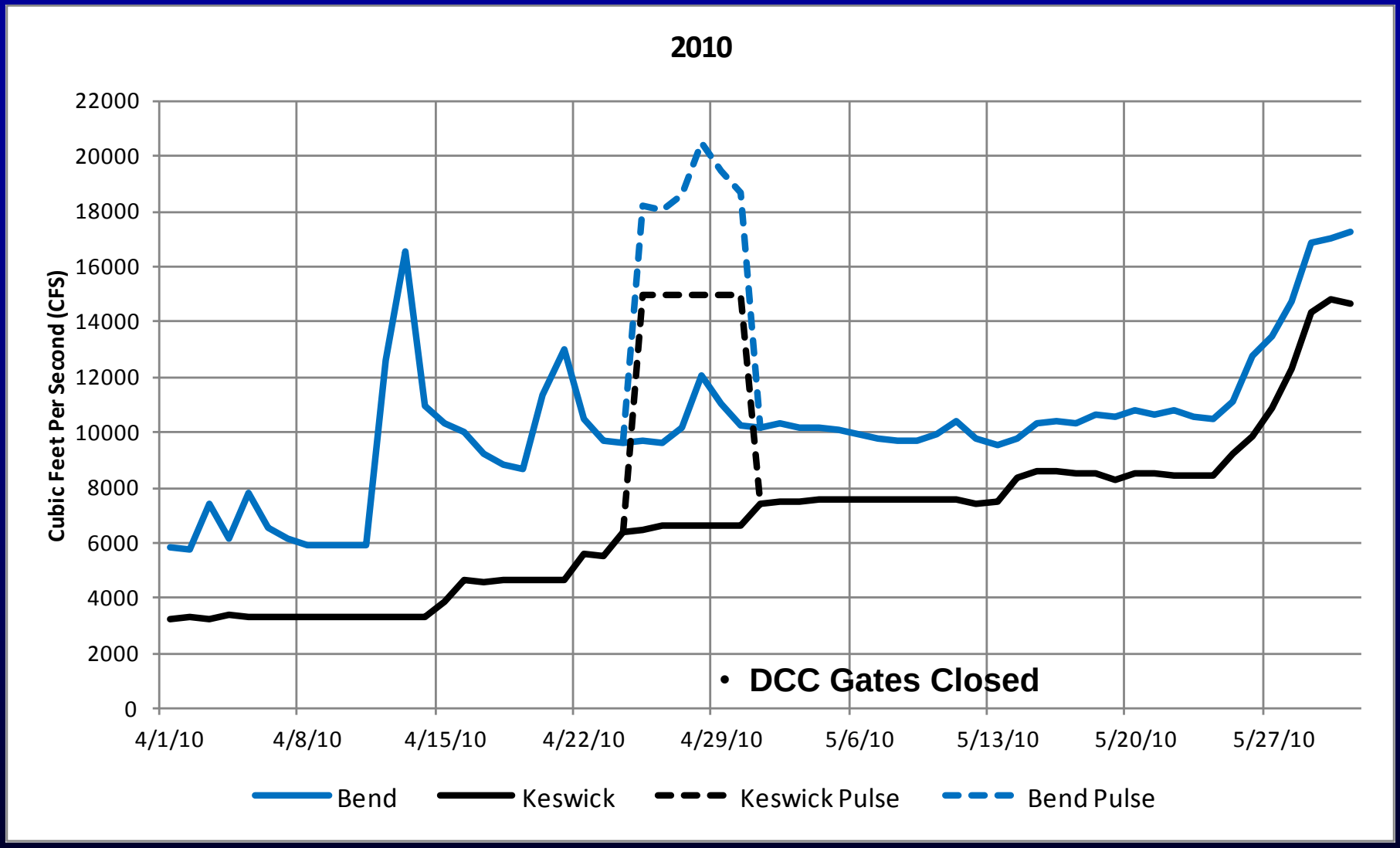
- 40% – 50% Unimpaired Flow
- Standard-Setting Base Flows
- Pulse Flows with Natural Events
- Pulse Flows without Natural Events

Pulse Flows without Natural Events



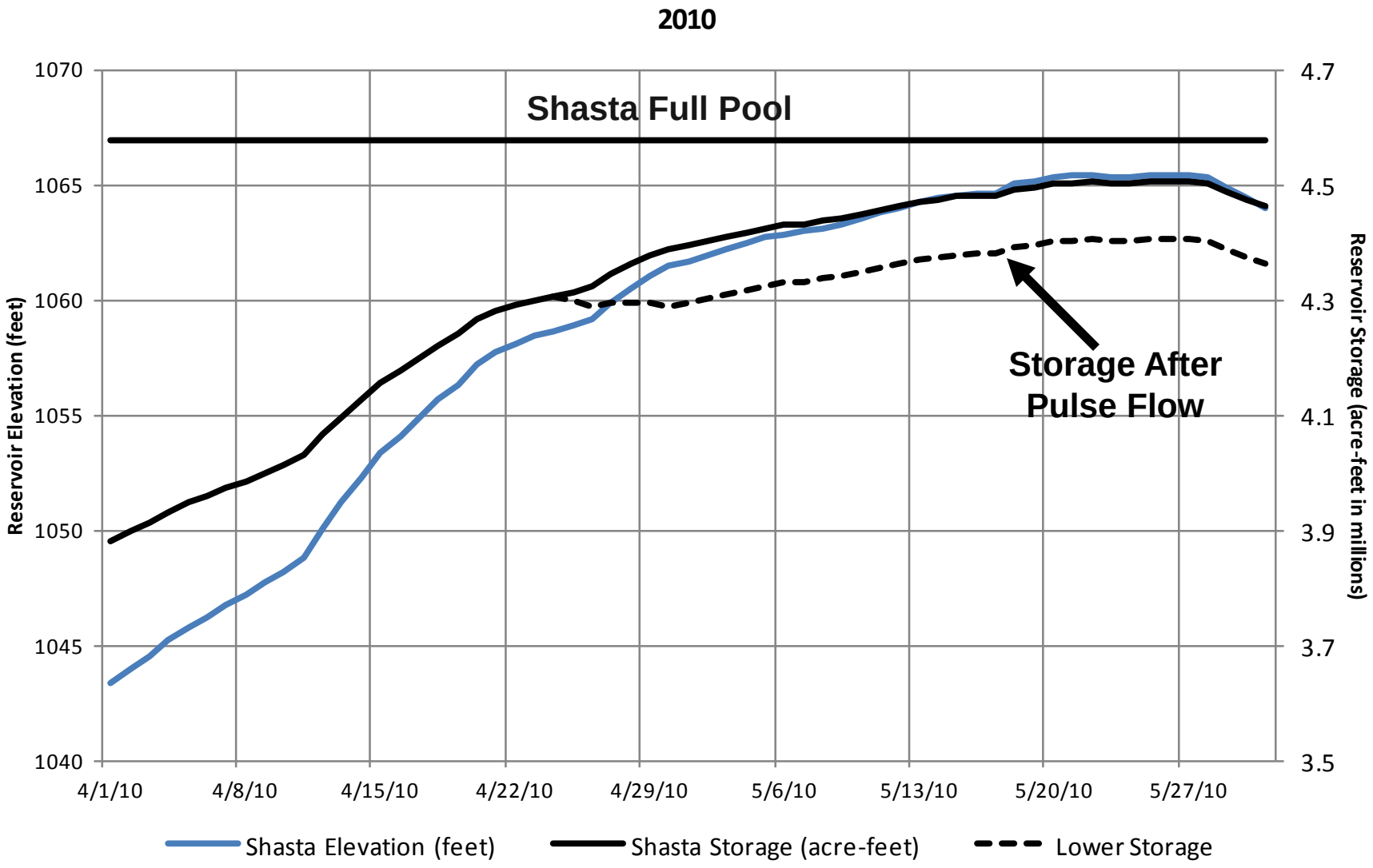
Salmon Released to Coincide with Artificial Pulse Flow

Hypothetical Pulse Flows



Modeling Studies Needed to Determine Effects

Hypothetical Pulse Flows



Water Supply Impacts from Short-Term Pulse Flows May be Minimal but Modeling Needed to Confirm Assumption

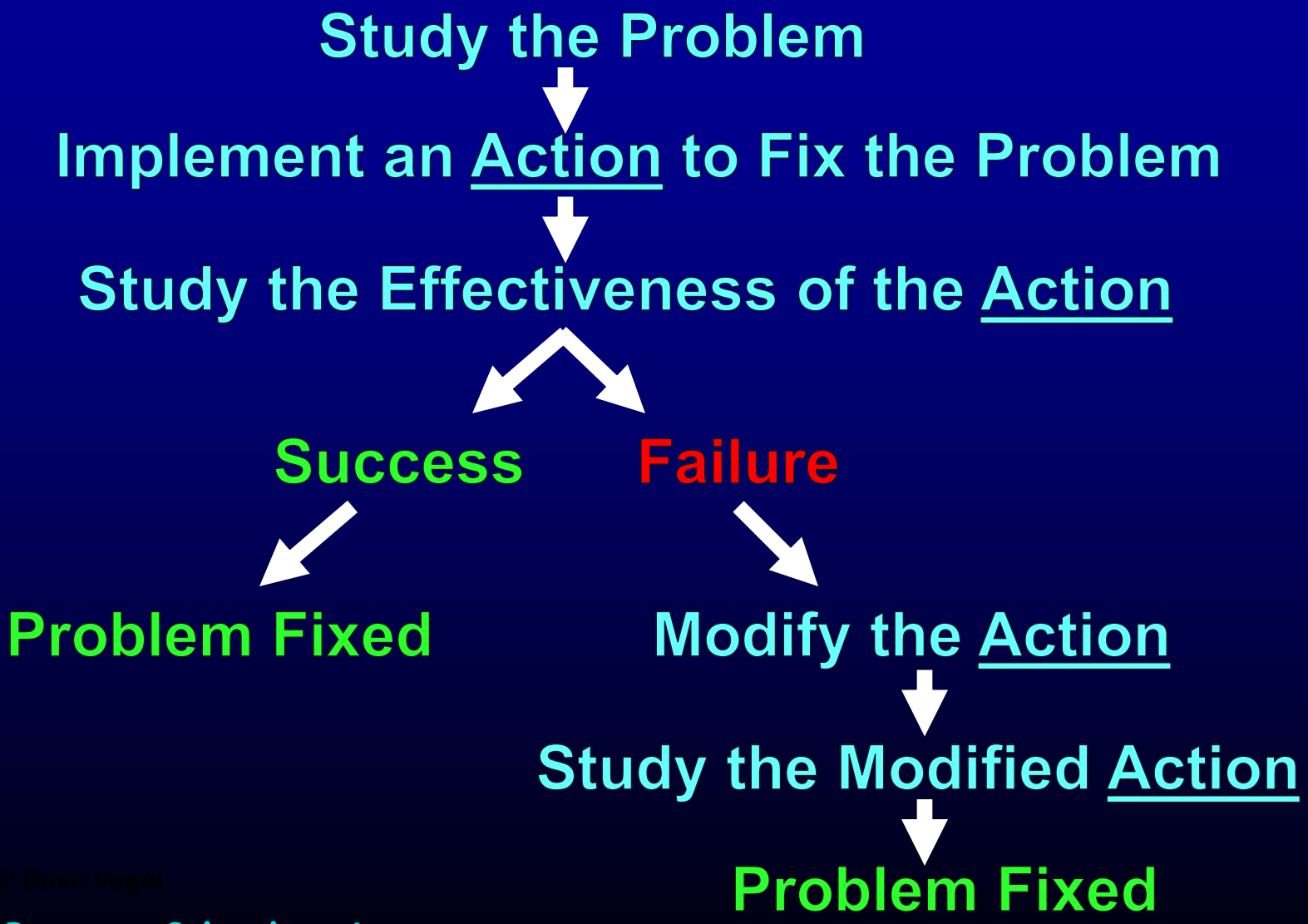
Opportunities – Actions and Studies

- **Modeling Studies of Changes to Thermal Regime and Water Supply from High Unimpaired Flows**
- **Evaluate Efficacy of Pulse Flows with and without Natural Events**
- **Fine-Tune Temperature Compliance and Management of Cold-Water Pool**
- **Add Expertise to Flow/Temperature Management**
- **Greatly Expand Spawning Gravel Injections**

Opportunities – Actions and Studies

- **Re-Create Shallow-Water Delta Rearing Habitats**
- **Fix Problems with Breached Levees**
- **Eliminate Predator "Hot Spots"**
- **Implement New Study Approaches for Shorter Reaches in the Delta to Determine Mortality Sites using Adaptive Management Instead of "Global" Studies**

Adaptive Management
(How It Should Be Implemented in the Delta)



Examples of Adaptive Management Projects
(Evaluate Pre- and Post-Project)

- Determine effectiveness of short-term pulse flows
- Feather out breached levees
- Turn off/reduce lights to reduce nocturnal predation
- Aggressive predator removal at TFF and CCFB
- Reposition Freeport pipeline
- Pilot acclimation chamber for export salvaged fish
- Isolate Georgiana Slough mortality
- Reduce/eliminate predator habitat at artificial structures
- Pilot shallow-water rearing habitats for juvenile salmon
- Locate and eliminate additional predation hot spots

Questions ?