Delta Smelt Enclosures:

First Deployment Findings & Work in Progress

AUGUST 20TH, 2019

MELINDA BAERWALD

Interdisciplinary Collaborative Team

DWR

Brian Schreier

Ted Sommer

Nicole Kwan

Catarina Pien

Mallory Bedwell

Brittany Davis

Environmental Water Quality & Estuarine Studies Branch

USGS

Oliver Patton

Fred Feyrer

Jesse Kathan

Ethan Enos

CDFW

Daphne Gille

Jim Hobbs & UCD lab

USFWS

Evan Carson

USBR

Andrew Schultz

MWD

Shawn Acuna

UC Davis

Tien-Chieh Hung & staff

Nann Fangue & lab

Dennis Cocherell

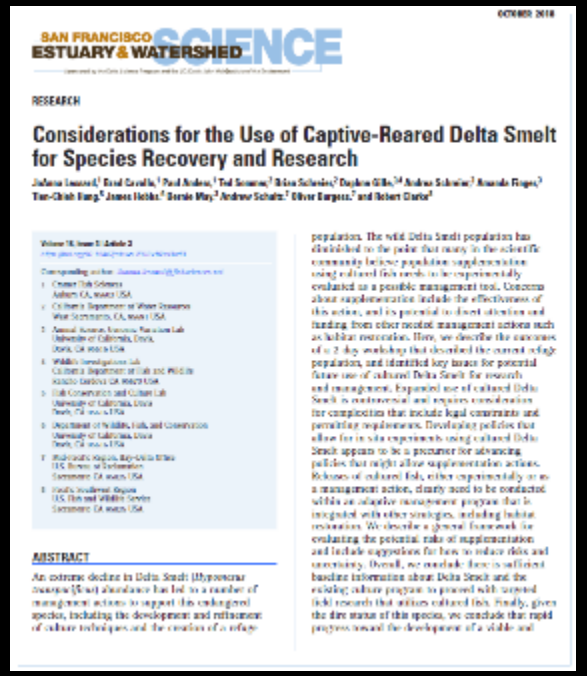
Richard Connon & lab

Swee Teh & lab

Mandi Finger, Andrea Schreier & lab

May 2017 Delta Smelt Reinforcement Workshop

- Participants from CDWR, UC Davis, CDFW, USBR Cramer Fish Sciences, USFWS, and AFS Cal-Neva
- "How can cultured Delta Smelt be more broadly used to support species recovery?"
- Day 1: invited speakers and presentations
- Day 2: discussion, identify knowledge gaps


SAN FRANCISCO ESTUARY & WATERSHED SCIENCE

RESEARCH

Considerations for the Use of Captive-Reared Delta Smelt for Species Recovery and Research

ABSTRACT

Knowledge Gap: Response of Delta Smelt to Enclosures

- **Design Delta Smelt cages for future field studies, evaluation of management actions, and possible soft release using cultured fish**
- Other Identified Knowledge Gaps
  - Create Hatchery and Genetic Management Plan
  - Understand hatchery domestication effects
  - Develop hatching frames for egg release
  - Identify optimal physical tagging method
  - Pathogen screening of cultured and wild Delta Smelt
  - Outreach and environmental education

Experimental Questions

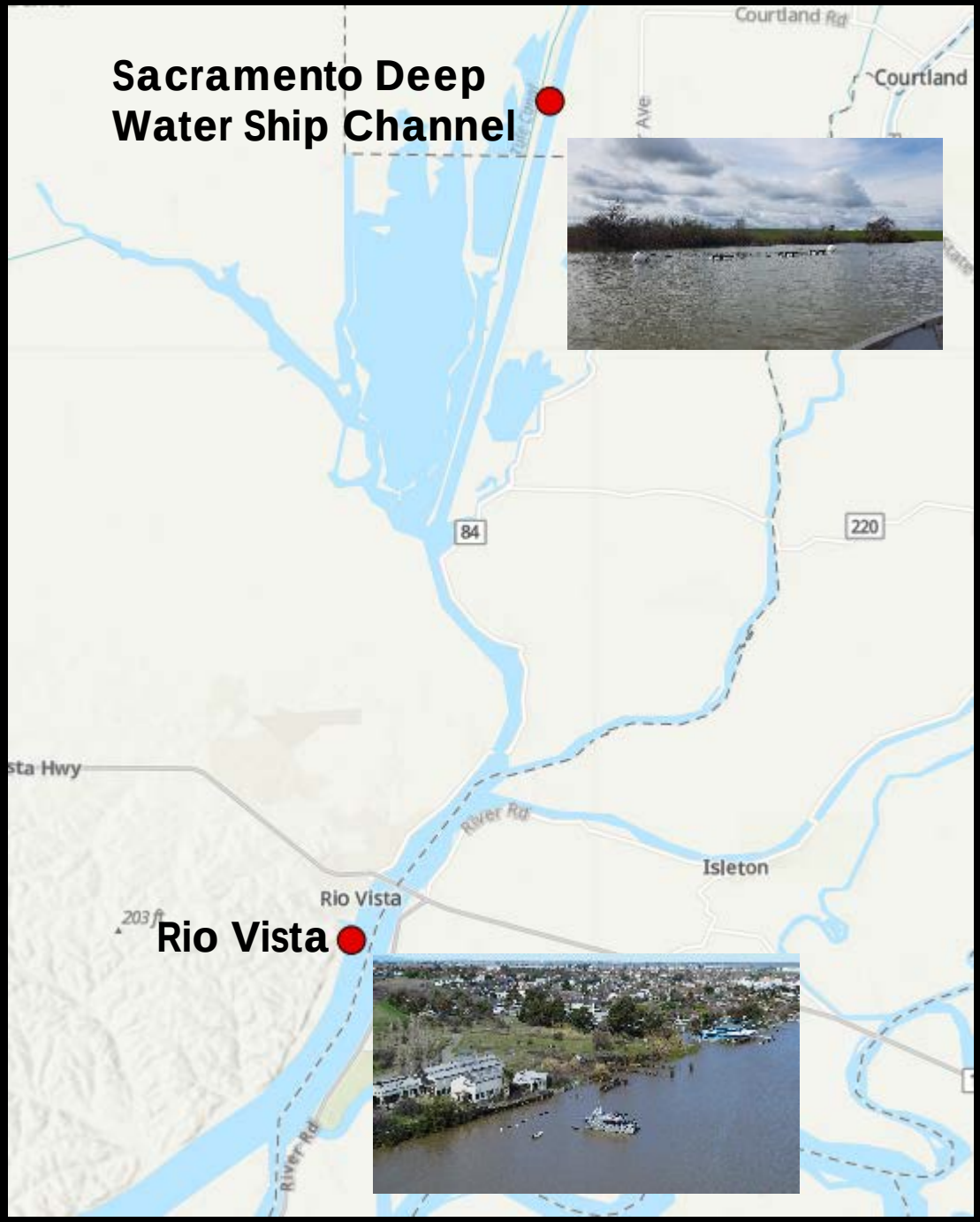
- Can cultured Delta Smelt survive under field conditions?
- Does survival or growth differ among cage prototypes?
- Differential survival with location?
- Critical information about cages: durability, biofouling, fish escape, prey entry
- To maximize benefits of study, other parallel studies
  - eDNA (Genomic Variation Lab at UC Davis & DWR)
  - Pathogen screening (R. Connon Lab at UC Davis)

Design & Laboratory Testing of Delta Smelt Cages

- Laboratory testing (materials, mesh porosity size, food availability, spatial usage, behavior)
- Designed 3 prototypes; each with 3’ diameter & 4’ tall
- Leads: Dennis Cocherell & Nann Fangue (UC Davis)

Field Testing

- 2 sites; 4 week deployment/site

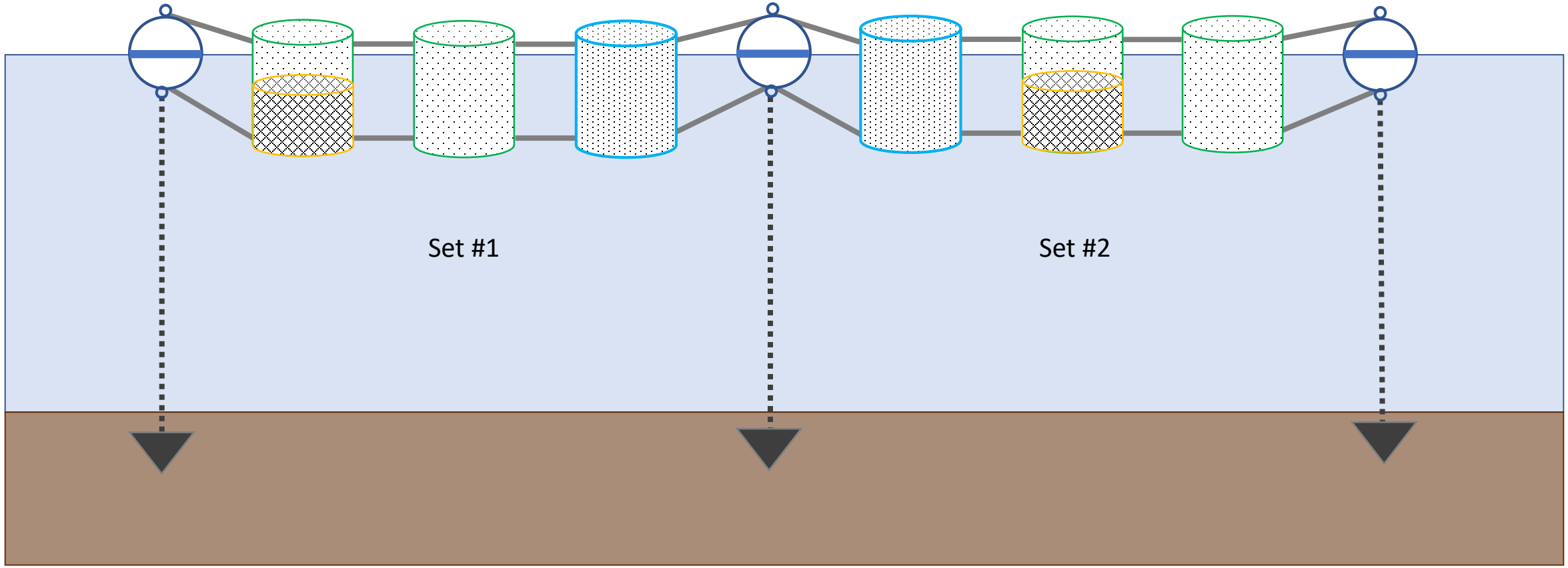


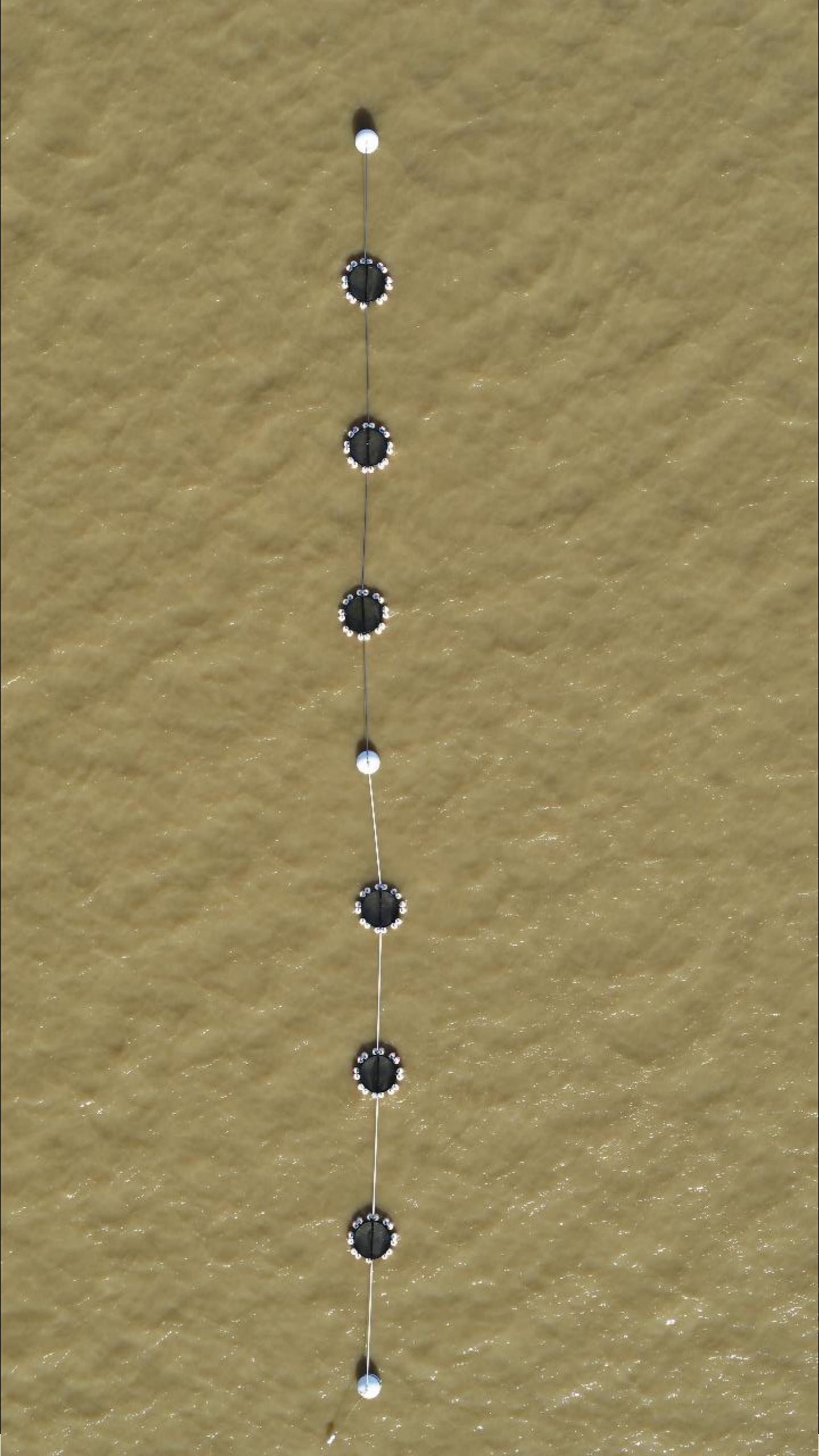
n = 64 fish per cage, mixed families

Army Base/upstream

Rio Vista Deployment

A	B	C	D	E	F
Perforated steel with 5/32" HOLES ON 3/16" Centers (41% openness) + wrap	Perforated steel with 5/32" HOLES ON 3/16" Centers (63% openness)	Perforated steel with 1/8" HOLES ON 3/16" Centers (41% openness)	Perforated steel with 1/8" HOLES ON 3/16" Centers (41% openness)	Perforated steel with 5/32" HOLES ON 3/16" Centers (41% openness) + wrap	Perforated steel with 5/32" HOLES ON 3/16" Centers (63% openness)

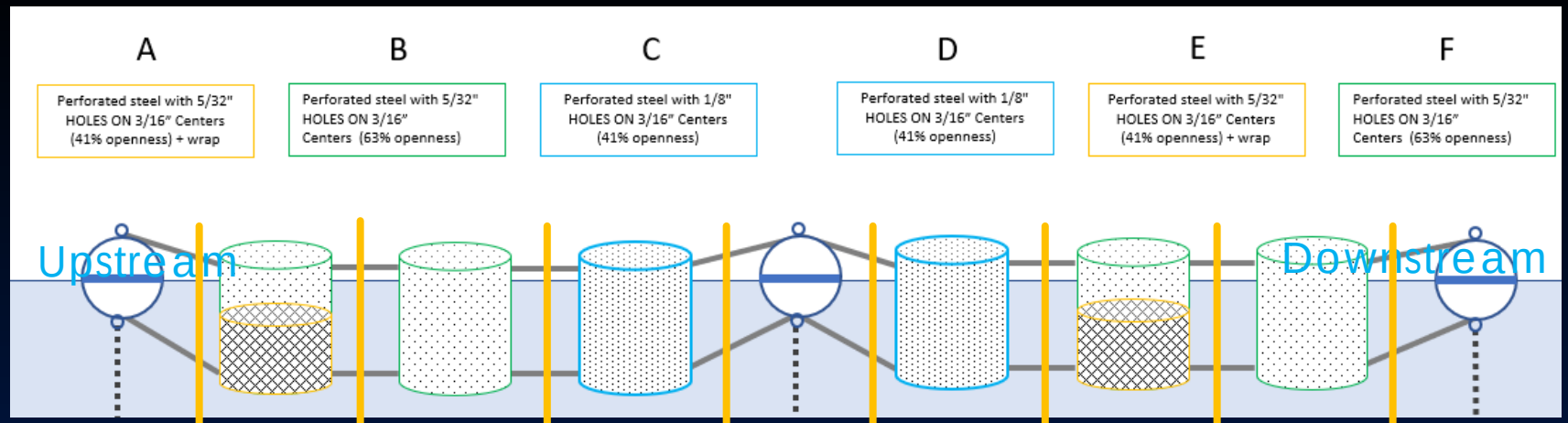




First Deployment Timeline & Some Observations

- No apparent impingement
- No debris or biofouling at Rio Vista & limited biofouling at DWSC
- Cages and fish held up well!

Very High Cage Survival

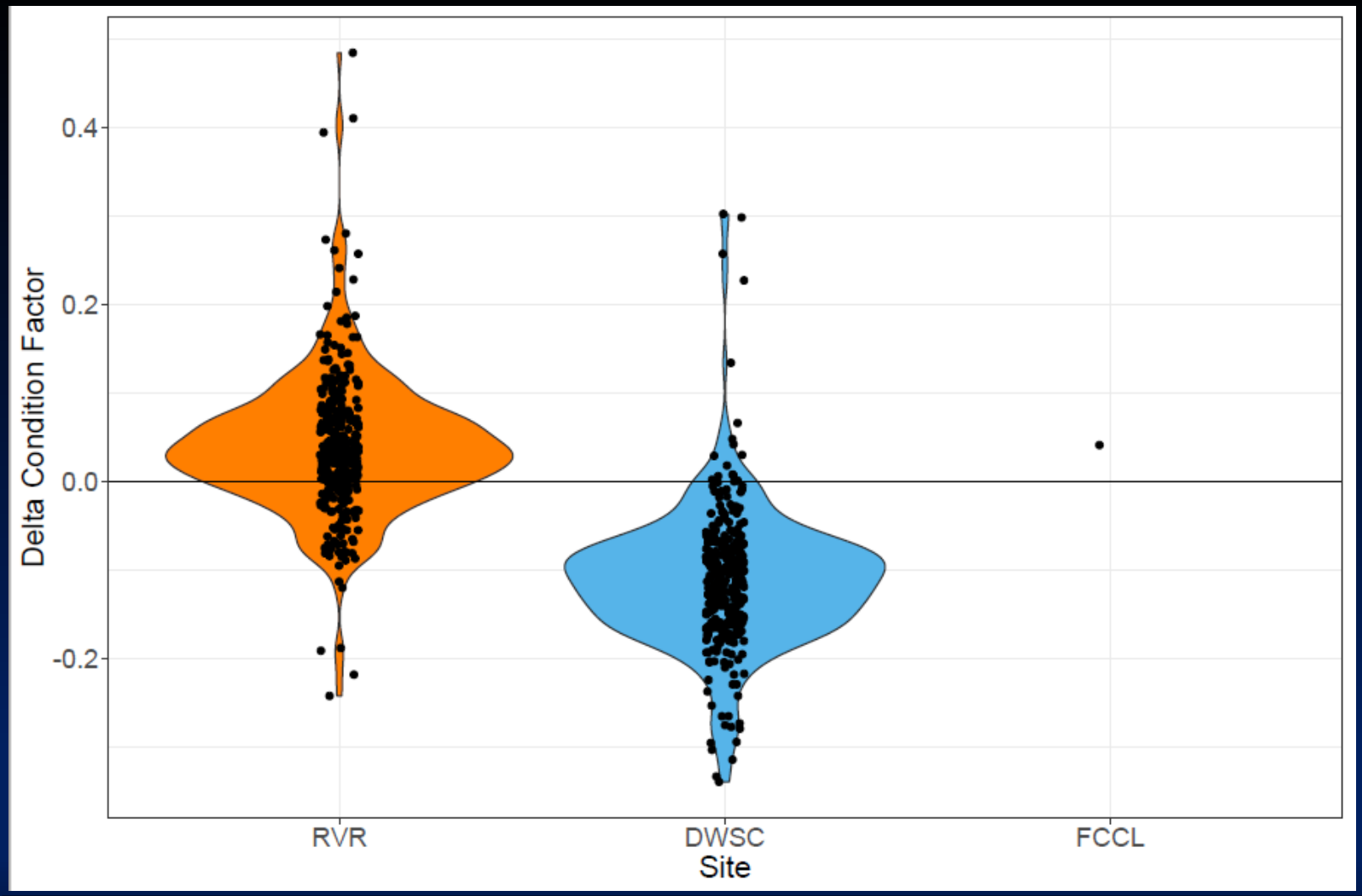


	A	B	C	D	E	F
Rio Vista % Survival	95	100	100	98	97	88
DWSC % Survival	98	100	97	100	100	97

~98% survival across cage types and sites

Condition Factor (Fish Health)

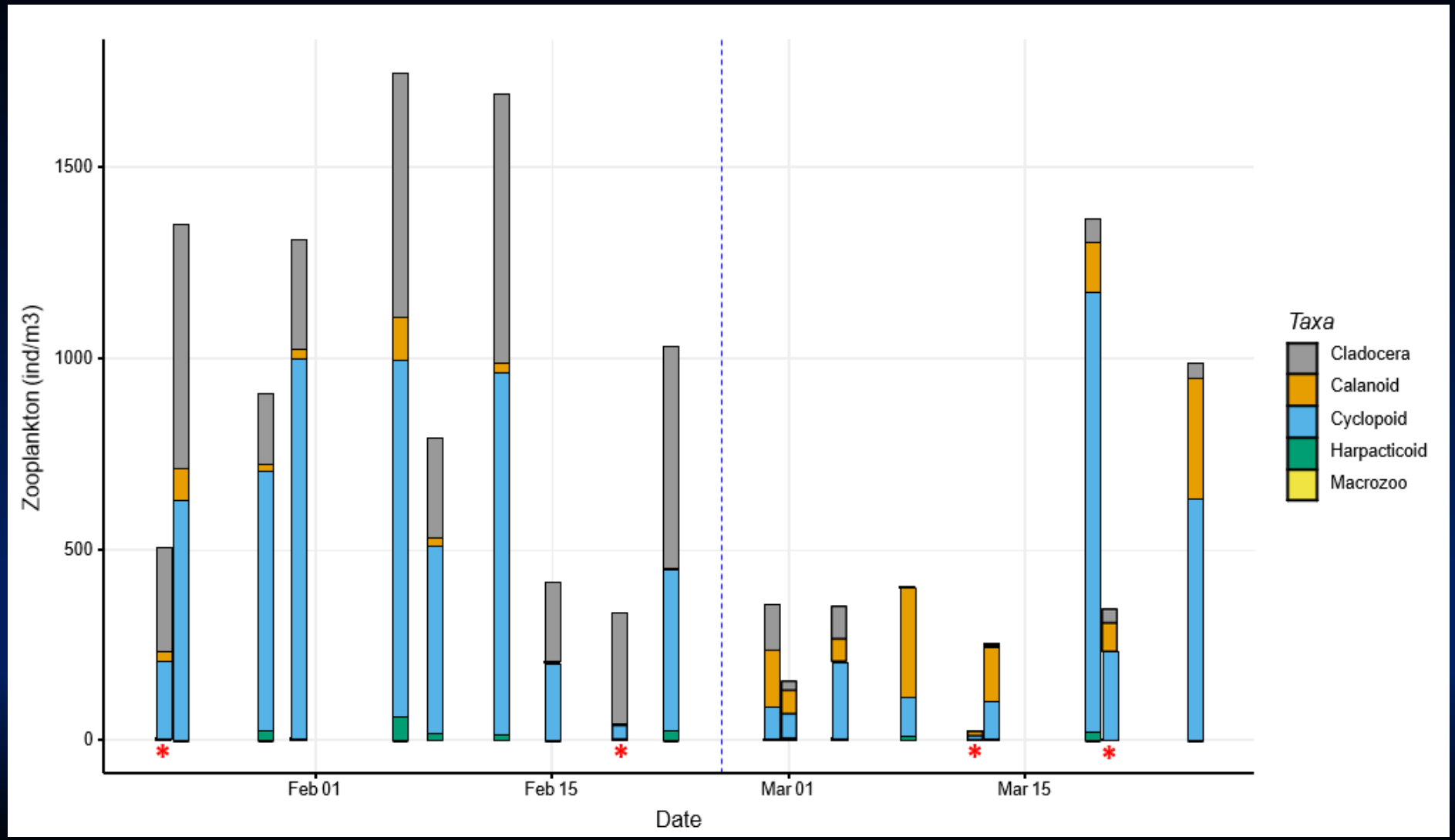
Condition Factor Change
(from start to end of study)



Similar weight:length ratios = no decline in general fish health

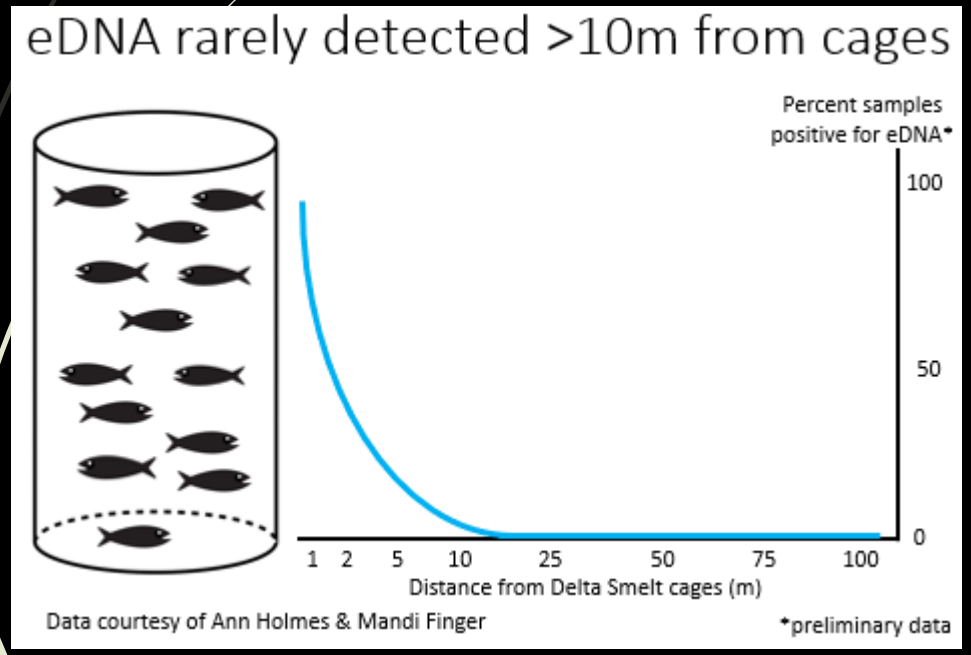
Zooplankton abundance near cages

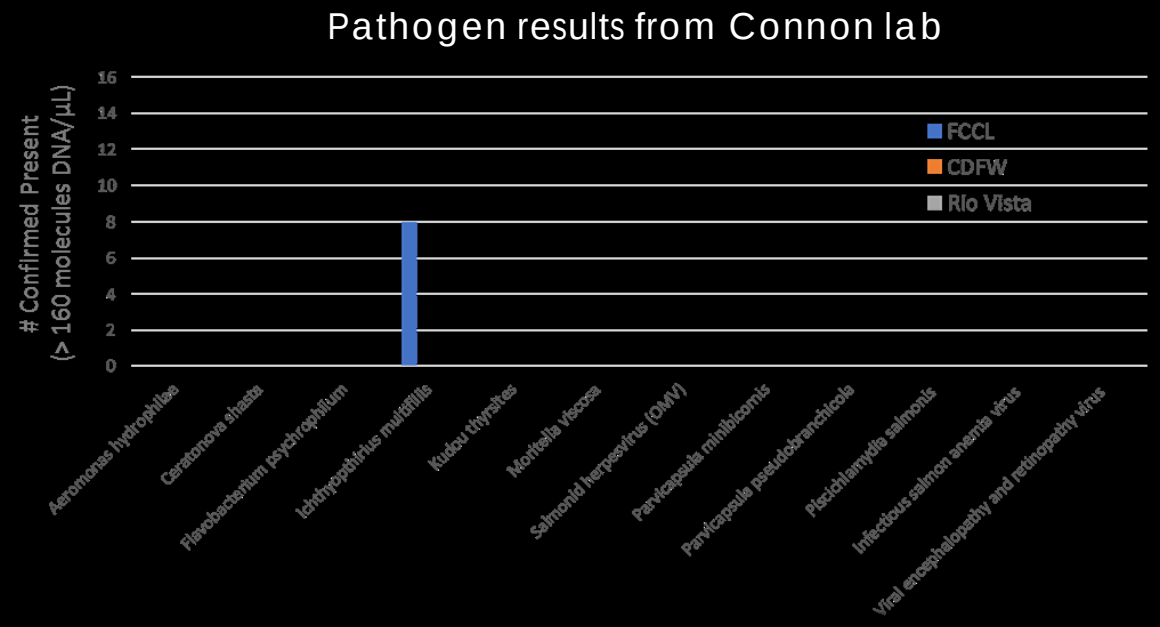
Rio Vista DWSC



Wrapping Up First Round of Deployments

- Results from additional studies: eDNA & disease
- Gut content analysis forthcoming
- Manuscript preparation

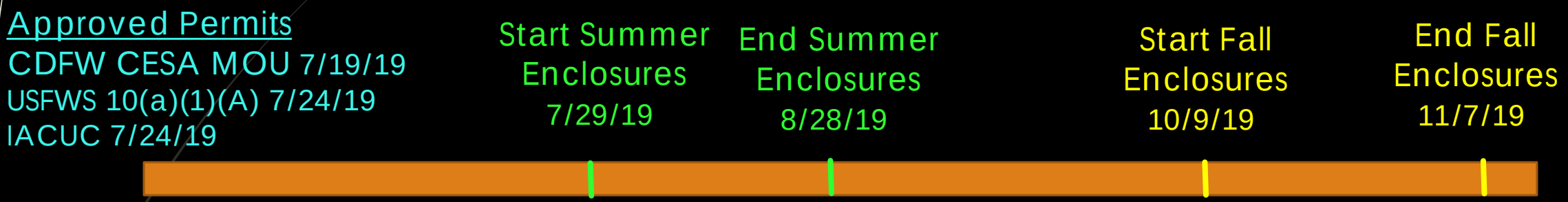




Current Deployments Underway

- Primary Goal
  - Test enclosures in different seasons & locations to provide information about the potential limits of their utility
- Secondary Goal
  - Evaluate potential effects of water management actions on Delta Smelt in enclosures
    - Suisun Marsh Salinity Control Gate Action
    - North Delta Food Web Action
    - Fall X2 Action

Study General Timeline



Summer

Yolo Bypass (retrieved 8/19) & Rio Vista (retrieved 8/28)

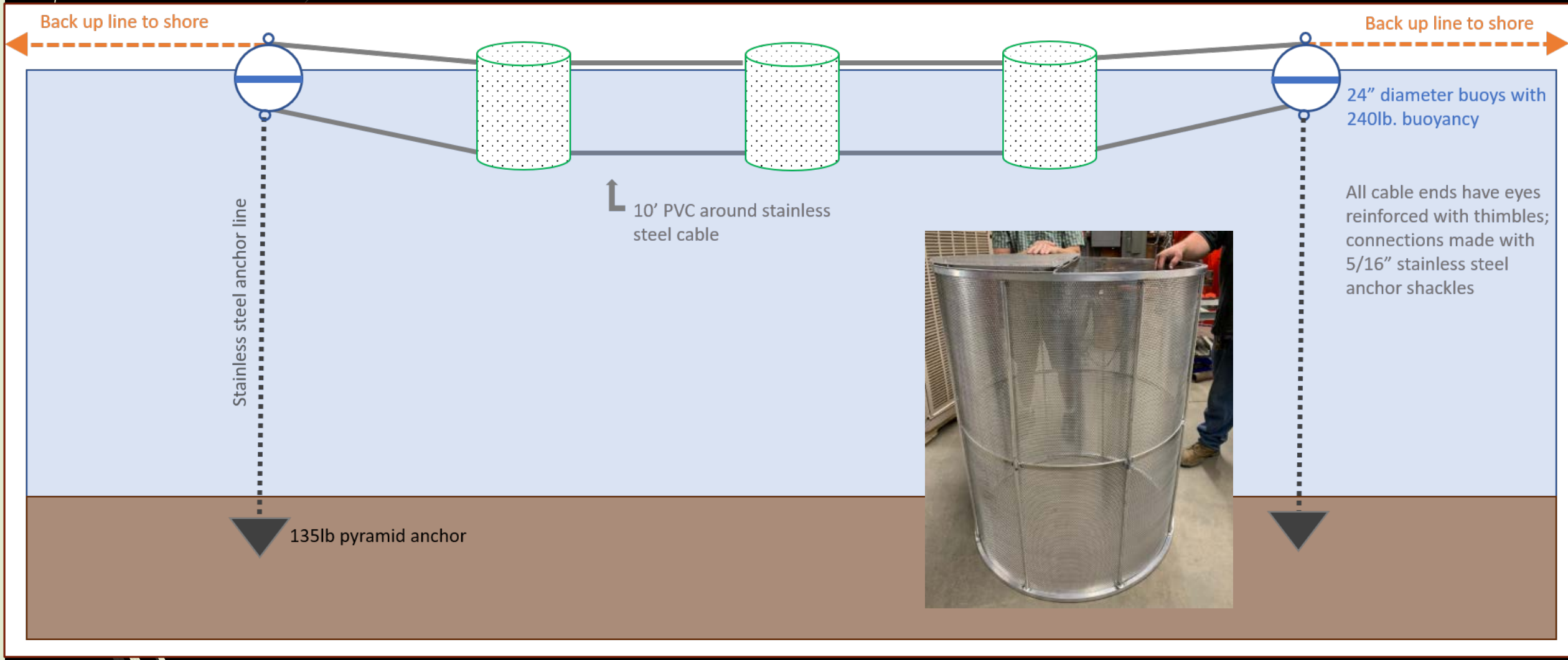
Fall

Rio Vista & Suisun: 10/9 deployment & 11/6 retrieval

Yolo: 10/10 deployment & 11/7 retrieval

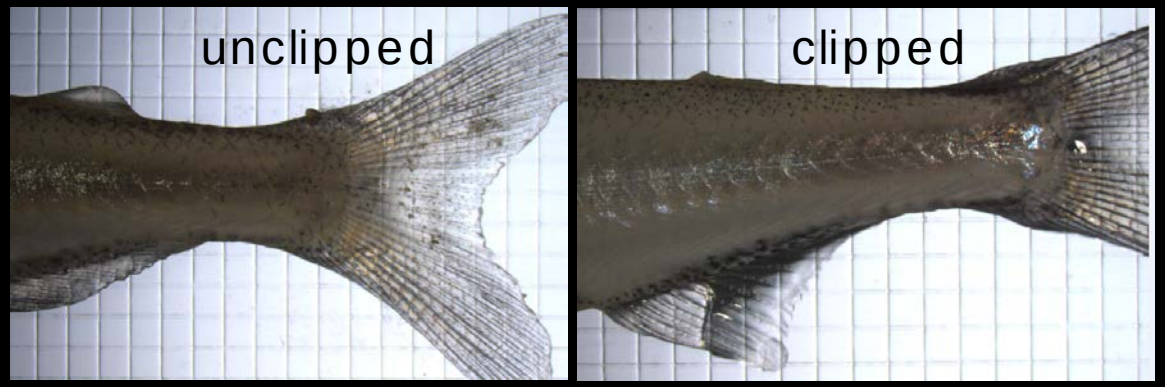
Cage Configuration

- 3 identical cages per site



Preparation & Preconditioning at FCCL

- Converted from dry feed to Artemia
- Adipose clipped to mark since too small for VIA tag
- Temperature acclimation to 18.5 C to increase survival in higher temps of Delta

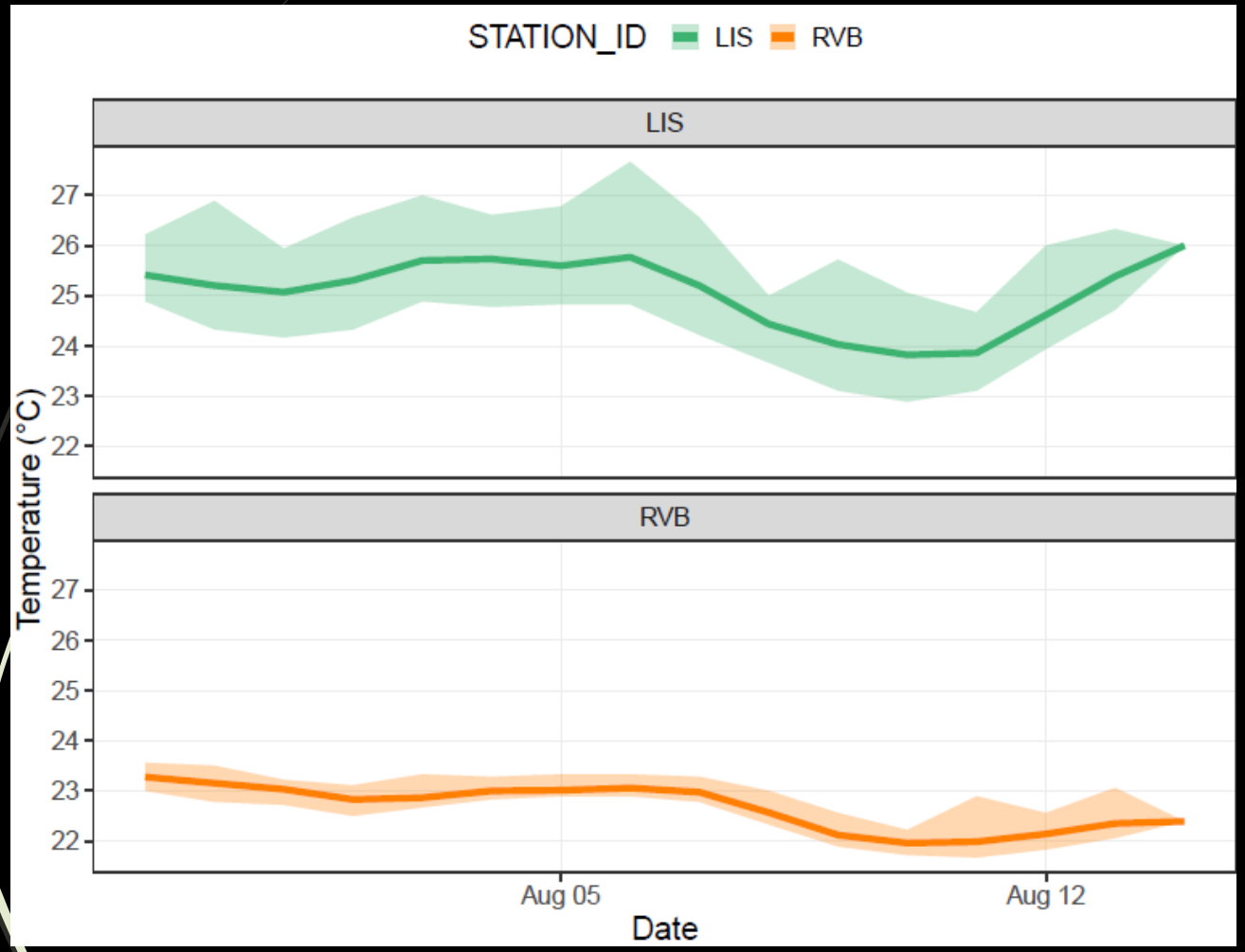


Cage Monitoring Activities

- Signs of cage damage
- Delta Smelt mortality
- Biofouling/cage scrubbing
- Environmental monitoring
  - Nearby continuous monitoring stations (15-min intervals)
    - Weekly checks with handheld YSI
  - Velocity
    - Handheld Hach FH950 & continuous monitoring stations
  - Weekly Zooplankton tows (50 um mesh)
  - Contaminants (Teh lab; October)

Post-mortem fish data collection & analysis will occur similarly to last deployments

Preliminary: Good Survival Despite Temperatures Repeatedly Nearing Reported Thermal Tolerance

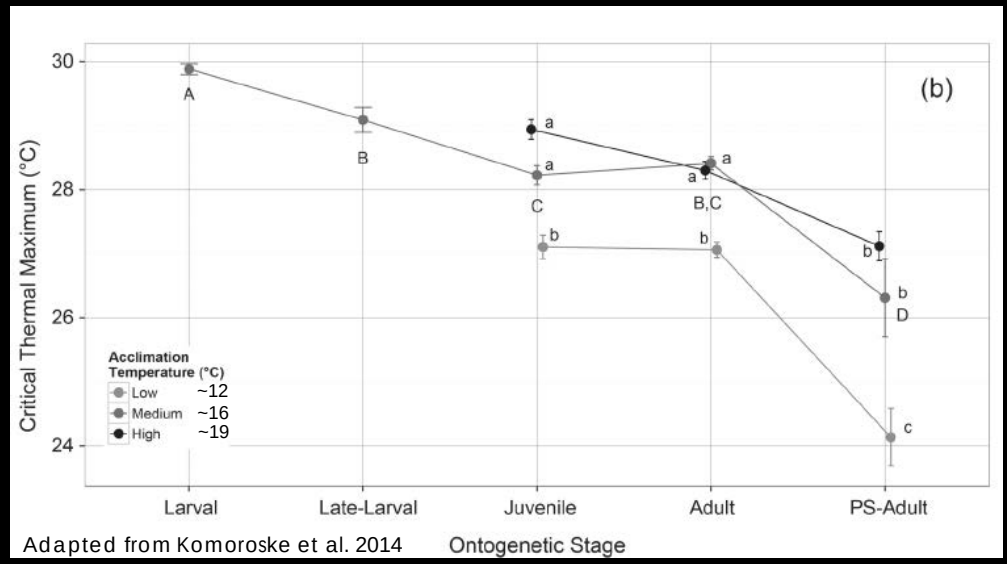


<u>Confirmed Mortalities as of 8/16/19</u>

Yolo Bypass: 3 out of 60

- 6 other morts likely on cage bottom

Rio Vista: 2 out of 180

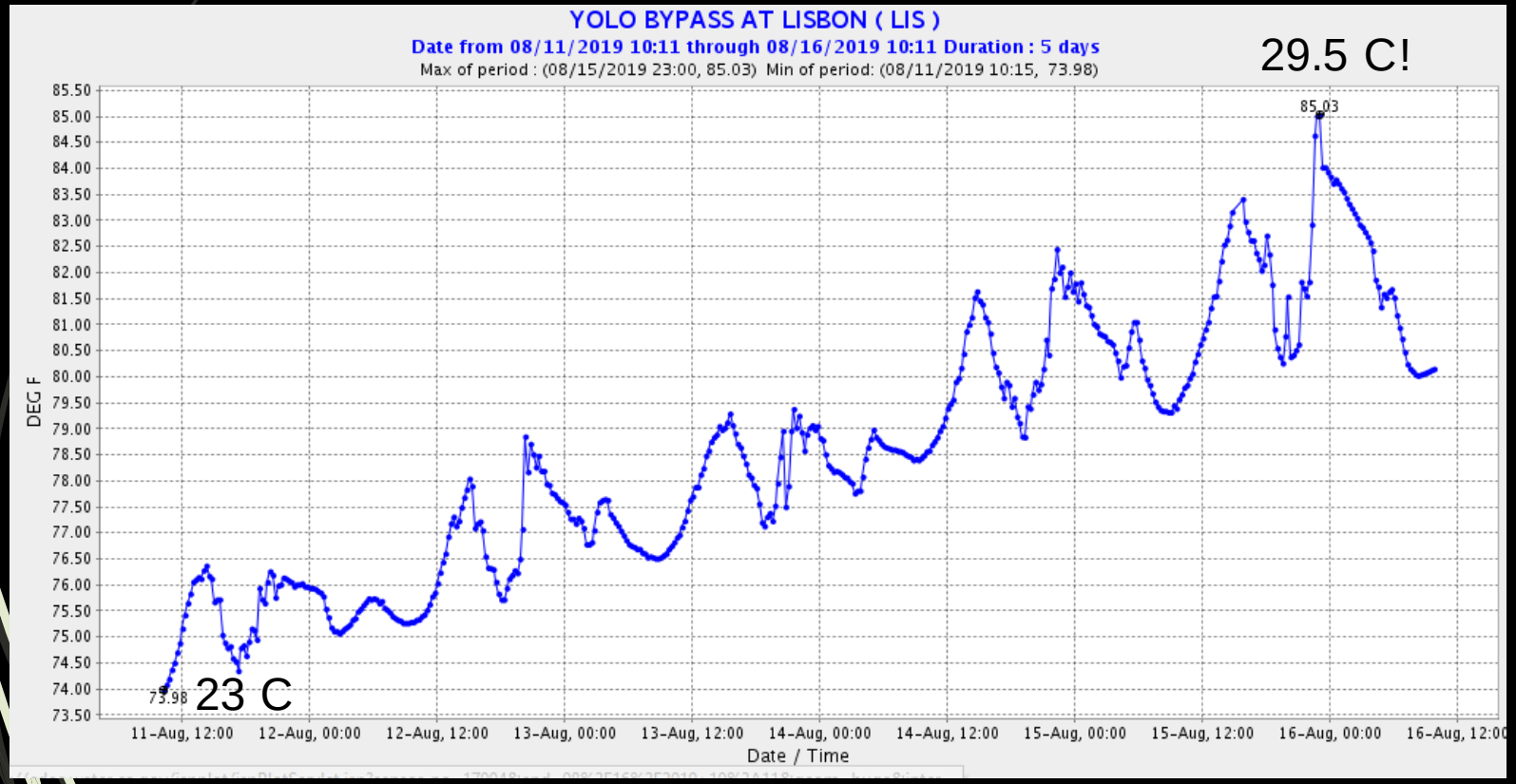


Adapted from Komoroske et al. 2014

Field Testing of Thermal Limits (CT_{max})

Do hatchery Delta Smelt have greater thermal plasticity than previously thought?

Recent Heat Wave Temps (CDEC)



CT_{max} = ~30 C for FCCL Delta Smelt acclimated to 20 C (Davis et al. 2019)

How high can they go?

Preparing for Future Work

- Use in conjunction with management actions (e.g. flow-related & wetland restoration)
- Field testing of temperature tolerance
- Pilot test new enclosures for rearing earlier life stages
- Concept designs & testing of enclosures for larger #s

Questions?