

# Evaluation of the Cougar Dam floating fish collector based on acoustic- and PIT-tagged juvenile Chinook salmon

John Beeman, Noah Adams, Scott Evans, Philip Haner, Hal  
Hansel, Amy Hansen, Gabriel Hansen, Tyson Hatton, Eric  
Kofoot, Jamie Sprando, Matt Sholtis, Collin Smith

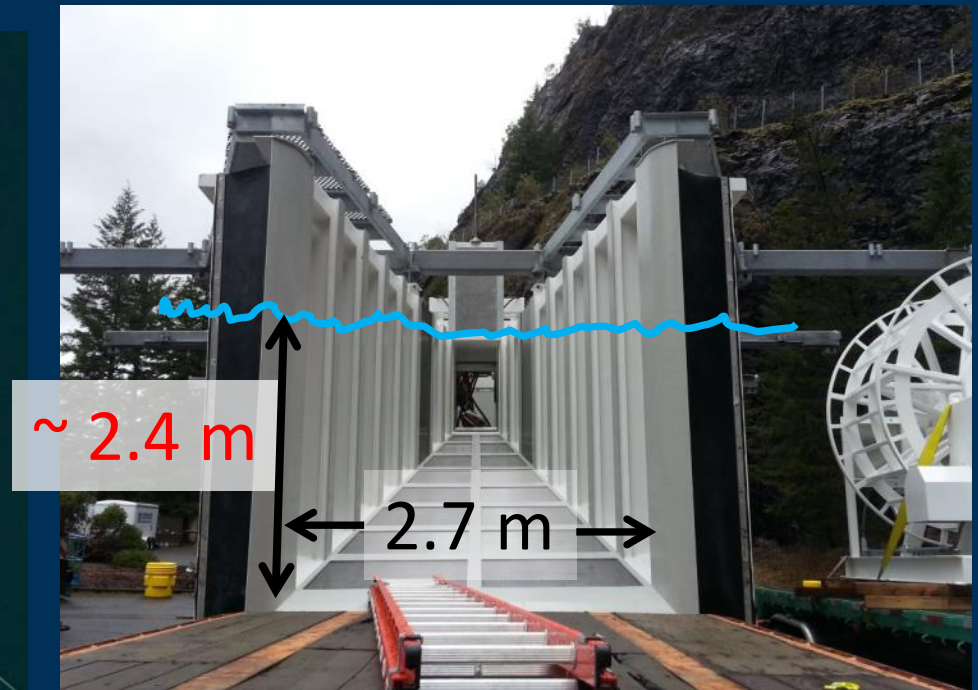
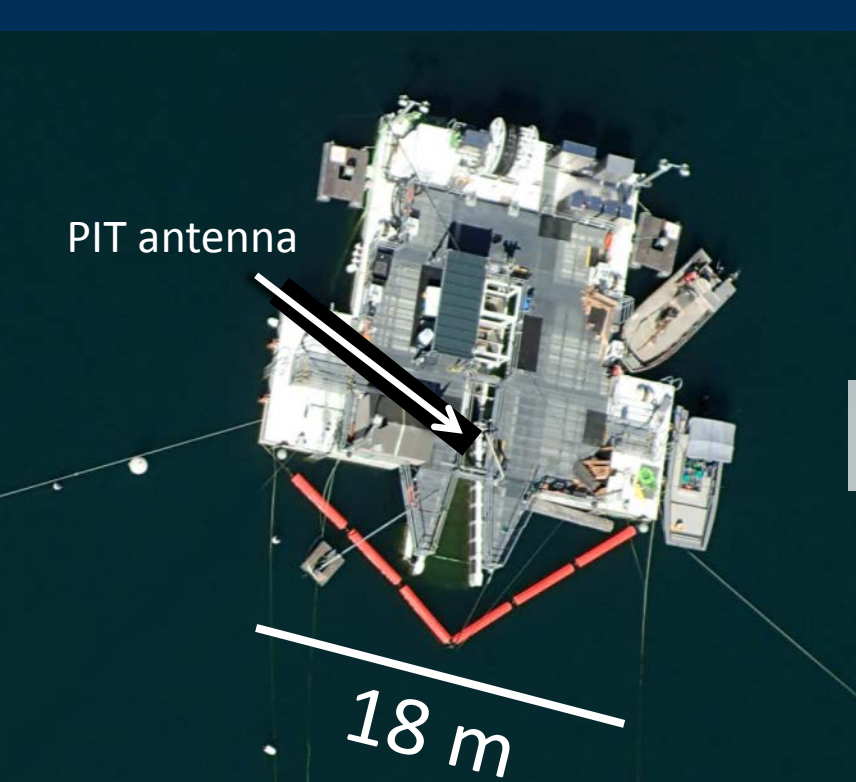
# Outline

- Background, study fish, monitoring methods
- Hydraulic and biological performance
- *Focus = fish behavior*
- Summary



# Operating Conditions

- Low ( $\sim 72$  cfs) or High ( $\sim 121$  cfs) inflow
  - $58.7$  attraction flow +  $13.6$  bypass flow =  $72$  cfs @ Low
  - $108.2$  attraction flow +  $13.7$  bypass flow =  $121$  cfs @ High
- Randomized block, 9/14-1/04, 7-d trts



# General Methods



62°F

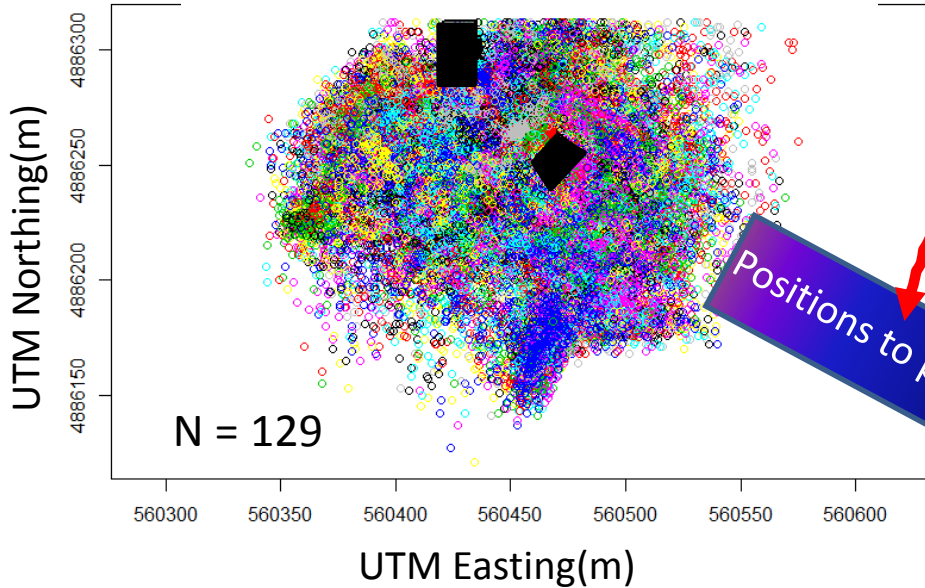
02 SEP 2015 03:00 pm

# Biological Performance Metrics

- Travel Percentages
  - % released reaching forebay log boom
  - % @ BRZ reaching cul-de-sac
    - % of those w/ position estimates
  - % cul-de-sac within 10 m & 1 m of PFFC entrance
- Total number captured in PFFC
- Capture Efficiency (JSATS+PIT only)
  - $\text{PFFC} / (\text{PFFC} + \text{WTC})$
  - $\text{PFFC} / \# \text{ in cul-de-sac}$

# Where Fish Were: Utilization Distributions

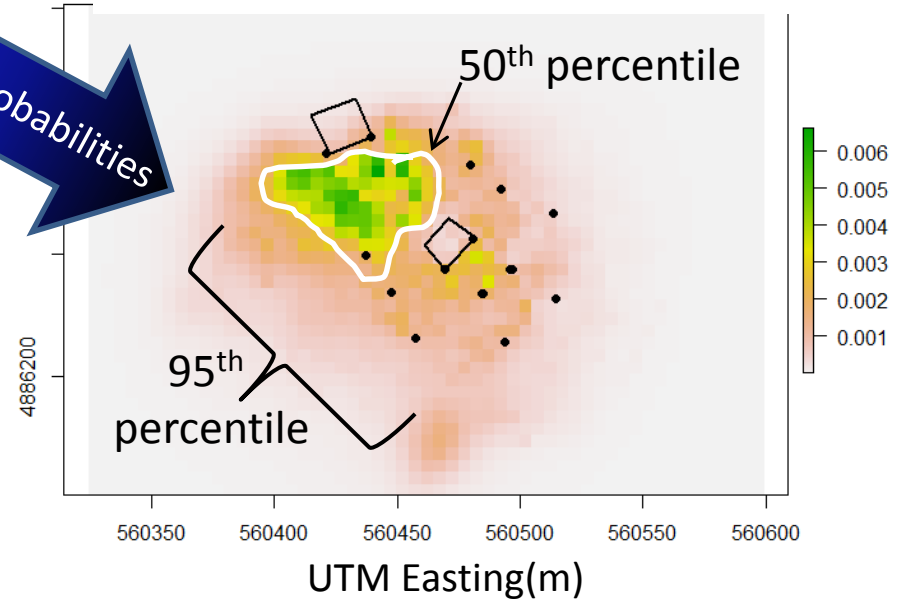
Low inflow, daytime, 0-3 m depth



N = 129

**Dynamic Brownian Bridge Mov. Model**  
Probability of presence in a 5 x 5 m cell  
Average within fish, then among fish

Low inflow, daytime, 0-3 m depth



Kranstauber et al. 2012. A dynamic Brownian bridge movement model to estimate utilization distributions for heterogeneous animal movement. *Journal of Animal Ecology* 81:738-746.

Schematic based on 2014 conditions

# Hydraulic Info: Near & Inside PFFC

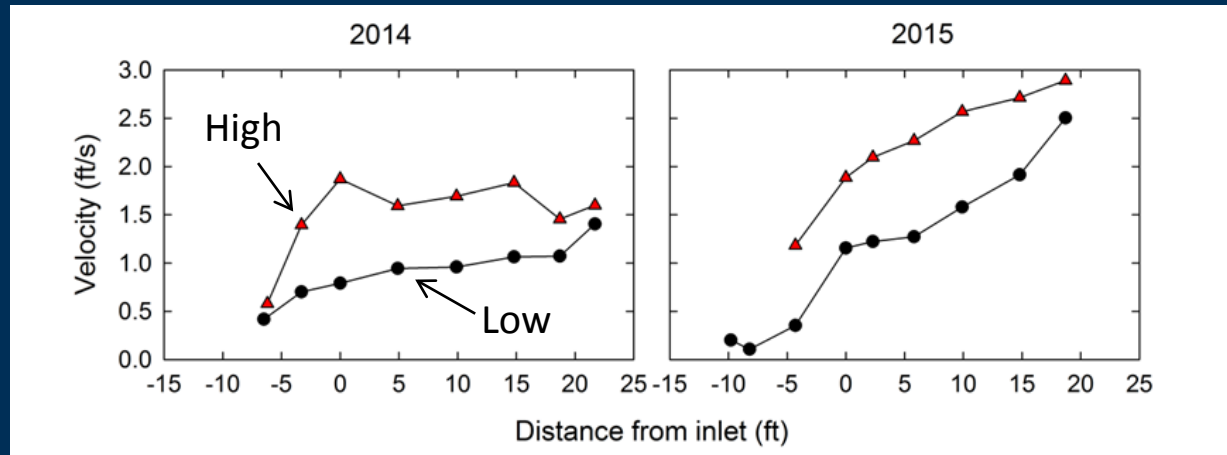


HDR, Inc.  
21 ft ~ 4 ft/s

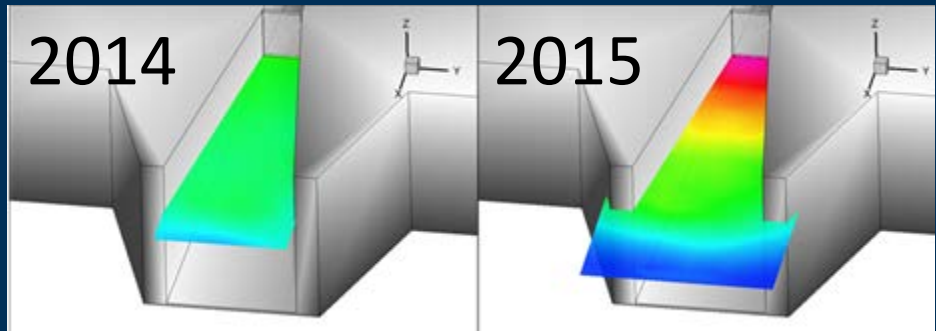
19 ft

0 ft

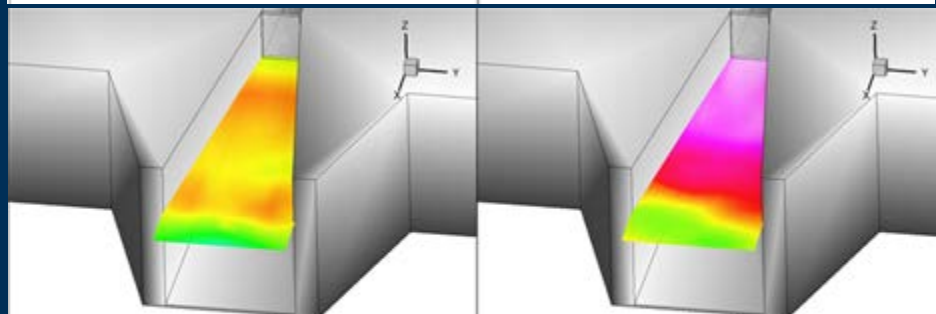
-6 ft



Low



High



# Hydraulic Info: Outside PFFC

PFFC entrance

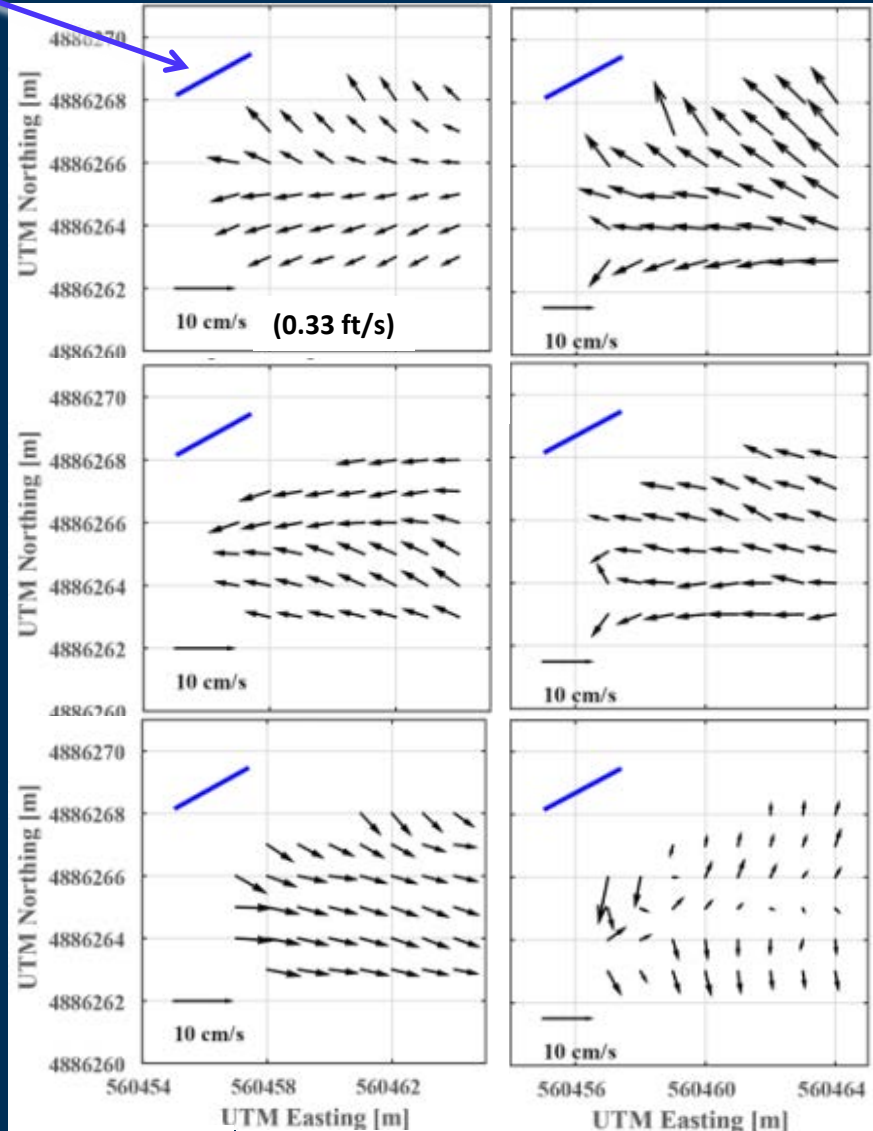
Low

High

Depth  
0.8 m

1.4 m

2.7 m

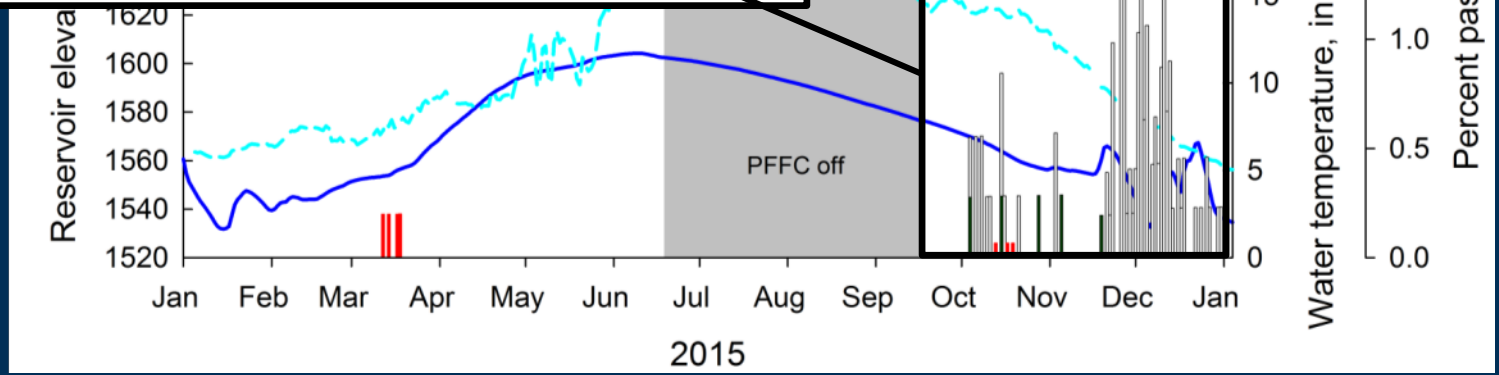
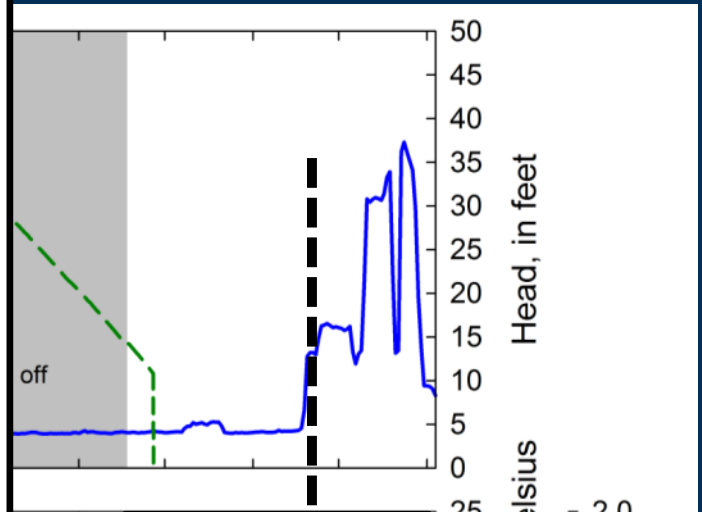
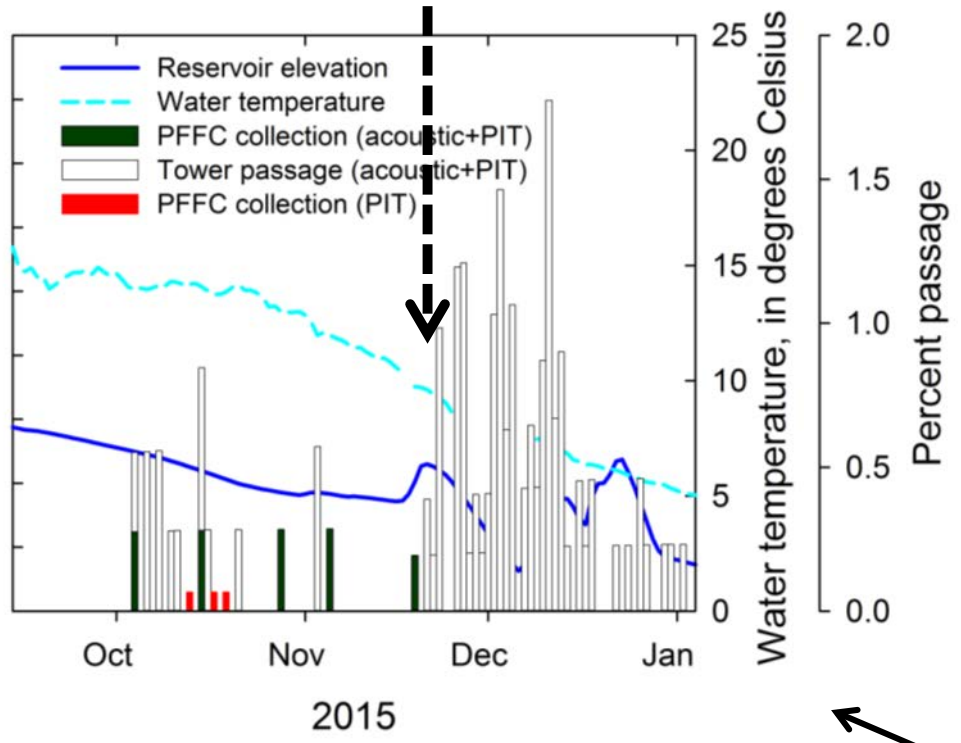


Side-looking ADCP,  
June 16-17, 2015,  
2 x 4 m cells shown,  
Vertical width  $\sim \pm 0.2$  m





# Dam ops, Temperature, Fish Passage



# Most Tagged Fish Detected in Cul-de-sac

		Category	N	Percent
During PFFC ops (> 9/14)	Total	Released	522	--
		Detected at Log Boom (in total)	491	94.1
	During PFFC ops (> 9/14)	Det. @ Log Boom during PFFC ops	490	--
		Detected in Cul-de-sac	471	96.1
		Positioned in Cul-de-sac	459	97.5

# Some Within 10 m, Few Within 1 m

Category*	PFFC Low		PFFC High	
	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>
Positioned in Cul-de-sac	366		412	
Within 10 m of PFFC (@ 0-6 m deep)	117	<b>32.0</b>	106	<b>25.7</b>
Within 10 m of PFFC (@ 0-3 m deep)	60	<b>16.4</b>	54	<b>13.1</b>
Within 1 m of PFFC (@ 0-6 m deep)	9	<b>2.5</b>	5	<b>1.2</b>
Within 1 m of PFFC (@ 0-3 m deep)	1	<b>0.3</b>	3	<b>0.7</b>

\* During PFFC ops (> 9/14)

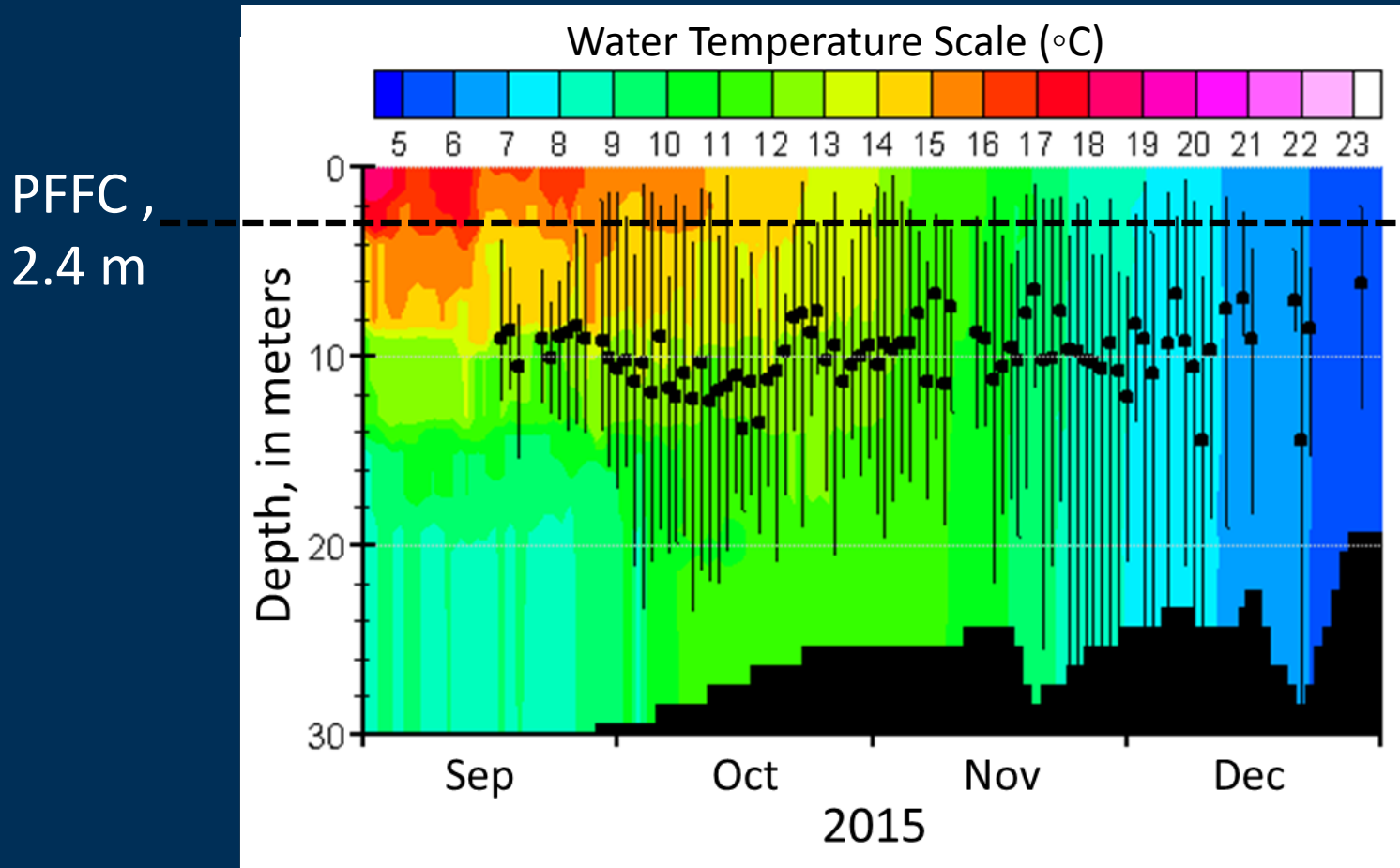
# Few Tagged Fish Collected by PFFC

Category	PFFC Low	PFFC High
N Detected in PFFC (via PIT <sup>1</sup> )	1	4
N Captured in PFFC	1	4
N Passing Tower (@PFFC ops)	32	48
Collection Efficiencies	PFFC Low	PFFC High
PFFC/(PFFC+Tower)	<b>3.0%</b> (97.0% at tower)	<b>7.7%</b> (92.3% at tower)
PFFC/# in cul-de-sac	<b>0.3%</b> (8.3% at tower)	<b>0.9%</b> (11.1% at tower)

<sup>1</sup> Estimated PIT detection probability : 0.98 prior to Nov 8, 0.75 after Dec 10, zero in between

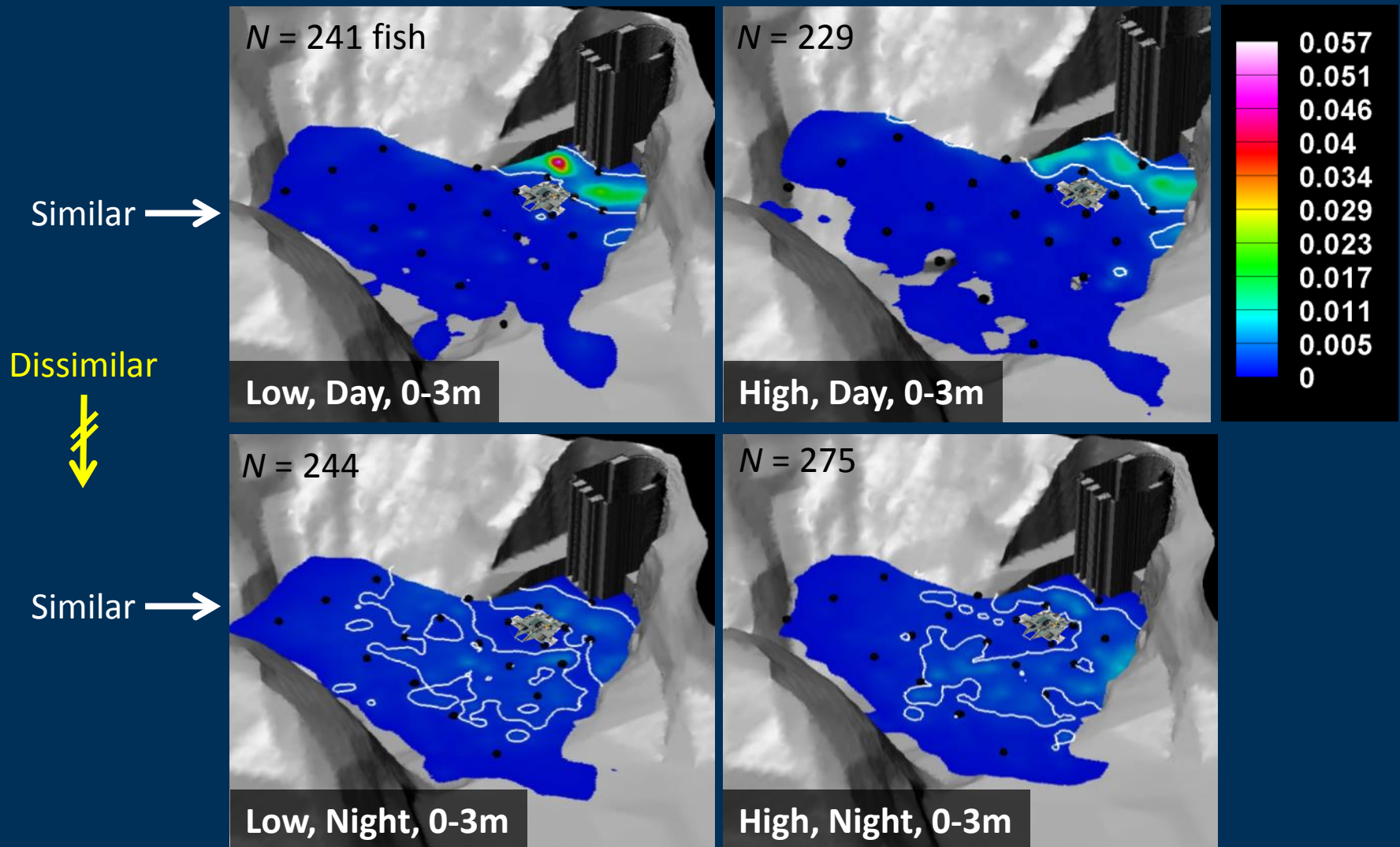
<sup>2</sup> 5 unique fish

# Cul-de-sac Temperature and Fish Depth Within 20m of PFFC Entrance

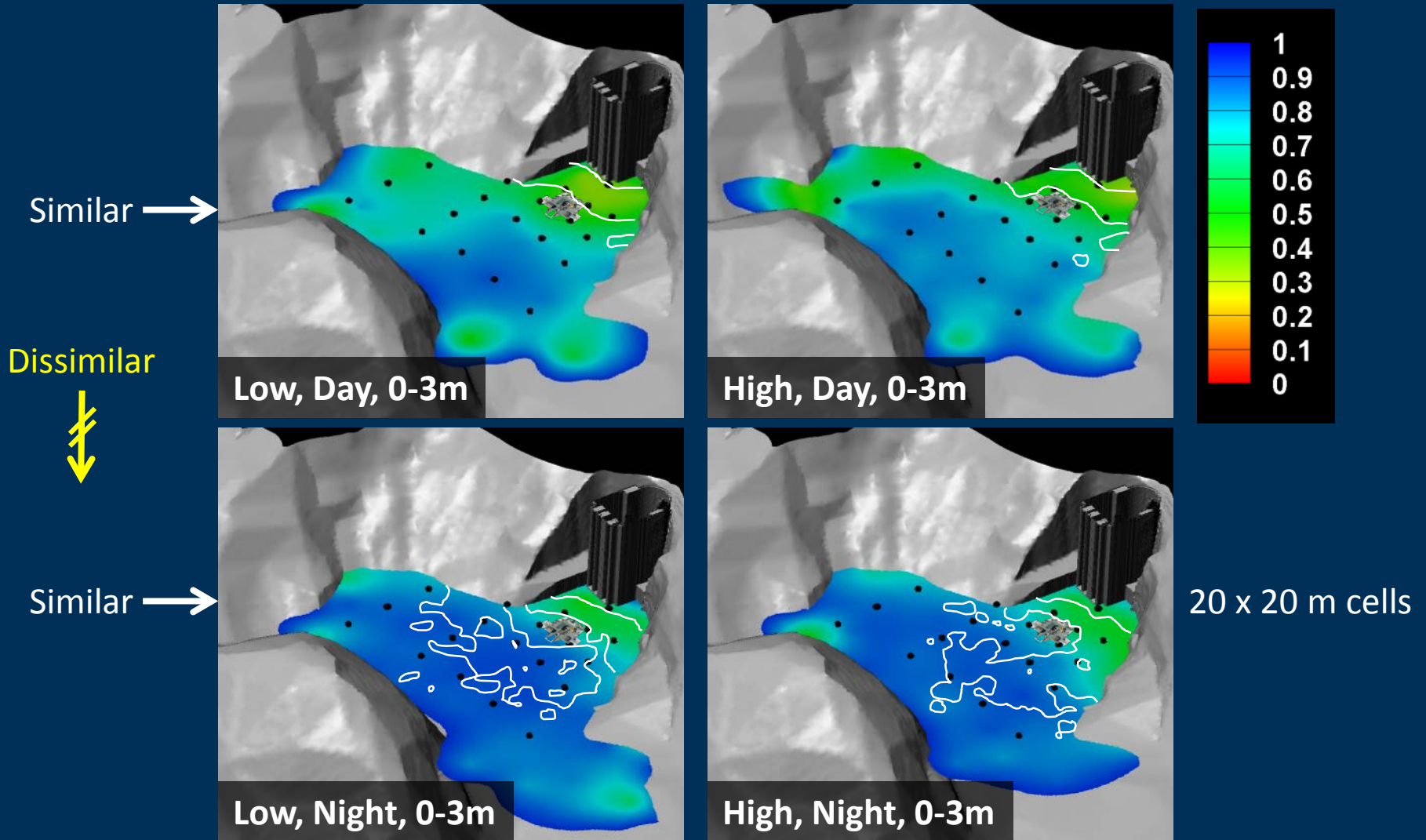


Min, max, and mean daily fish depths

# Utilization Distribution



# Tortuosity

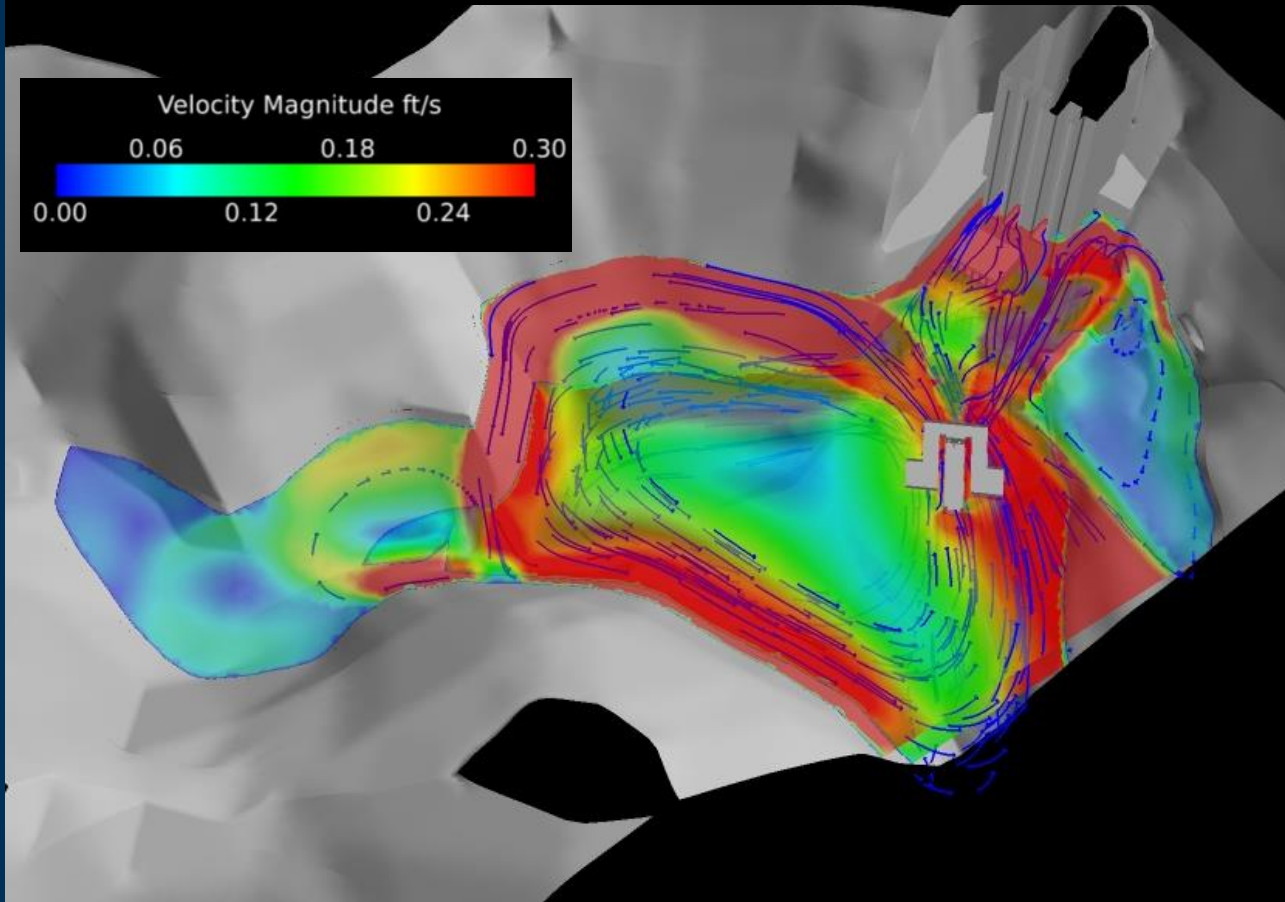
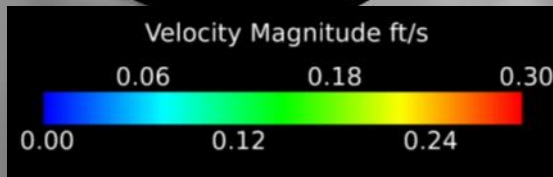


1.0 = straight line distance, 0.5 = double straight line distance, ~0 = wow!

# Predicted Water Velocities

## Pre-PFFC Simulation

Cougar CFD Model  
Portable Floating Fish Collector (PFFC) Alternative Run – Pool El. 1571  
Outflow = 1180 cfs through WTC Weirs  
PFFC Flow = 115cfs





# Summary (1 of 2)

- Hydraulics of PFFC 2.0 better than PFFC 1.0
  - Better internal velocity profile,  $> V_{\max}$
  - Area of influence outside entrance is small
- Biological results:
  - Few fish collected
    - Core utilization area near tower, most dispersed at night
    - Tortuosity: Day  $>$  night
    - Fish depths mostly  $>$  PFFC entrance
  - Fish distribution similar @ Low & High, but diel diffs
    - Effect of PFFC presence? = “working on it”

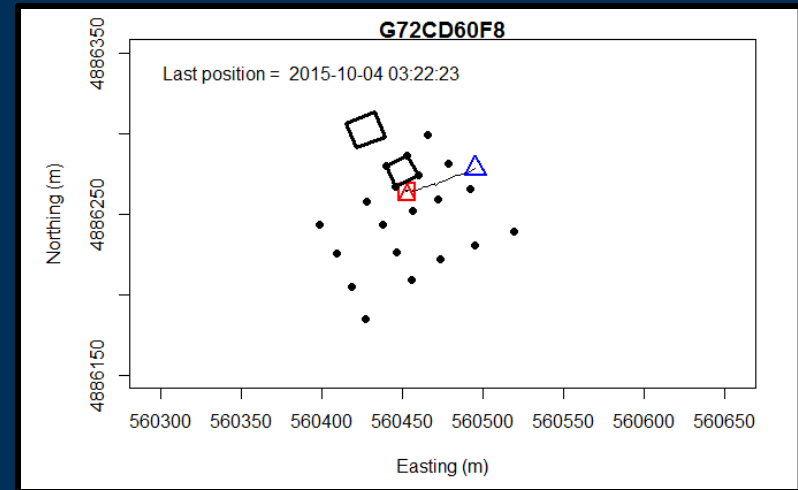
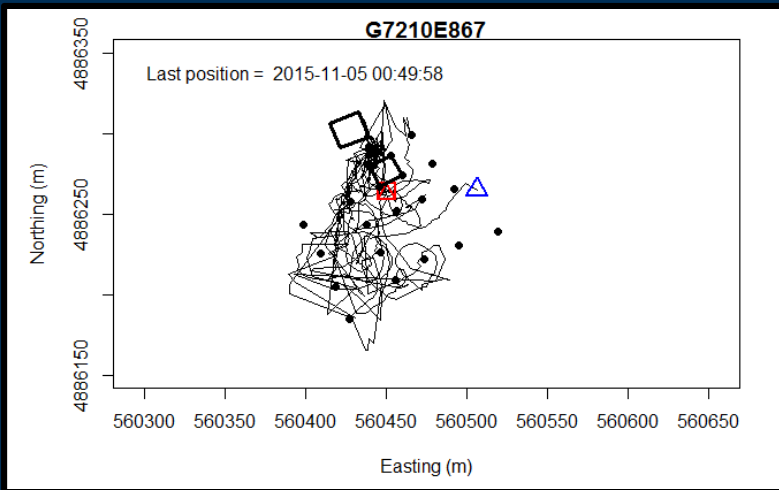
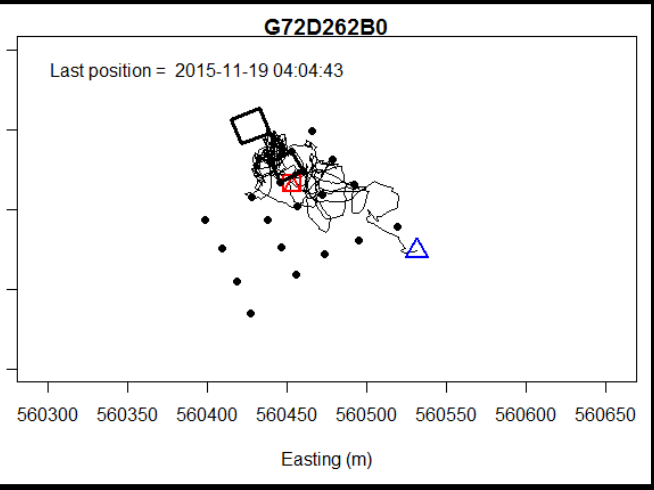
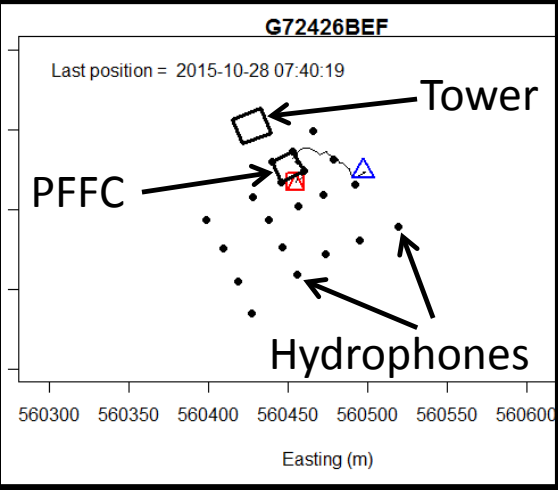
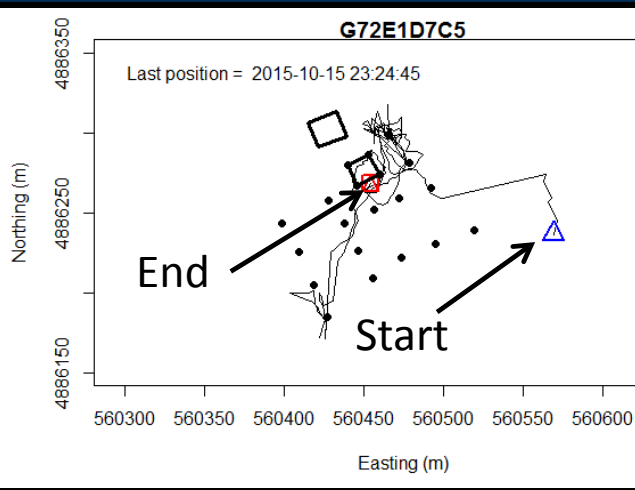
# Summary (2 of 2)

- Unknowns from PFFC 2.0
  - Entrance rates vs. rejection rates
    - Little biological data from inside PFFC 2.0
  - Effects of PFFC presence & operation on fish behavior
    - What if it was turned 90 or 180 degrees?
    - Could use pre-PFFC data to inform (2011, 2012)
  - Would guide nets help?
    - Could simulate with existing data

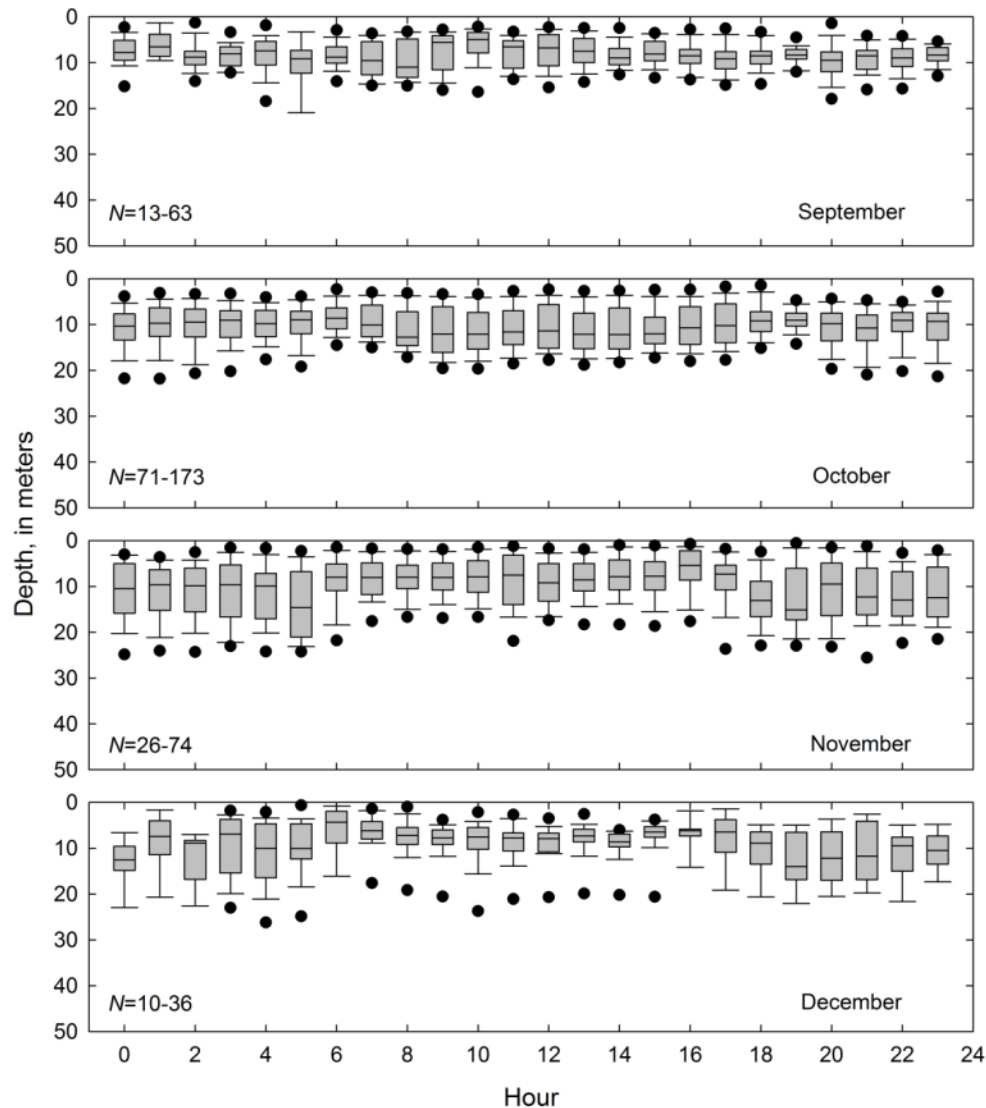
# Acknowledgements

- USACE:
  - Terry Berling, Ben Cram, Jane Dalglish, Scott Fielding, Todd Pierce, Katie Rayfield, Mary Karen Scullion, Greg Taylor
- Wild Fish Surrogate Program
  - Eric Billman, Rob Chitwood, Karen Cogliati, Carl Schreck
- Staff at McKenzie River Hatchery
  - Kurt Kremers and staff
- USGS colleagues at CRRL

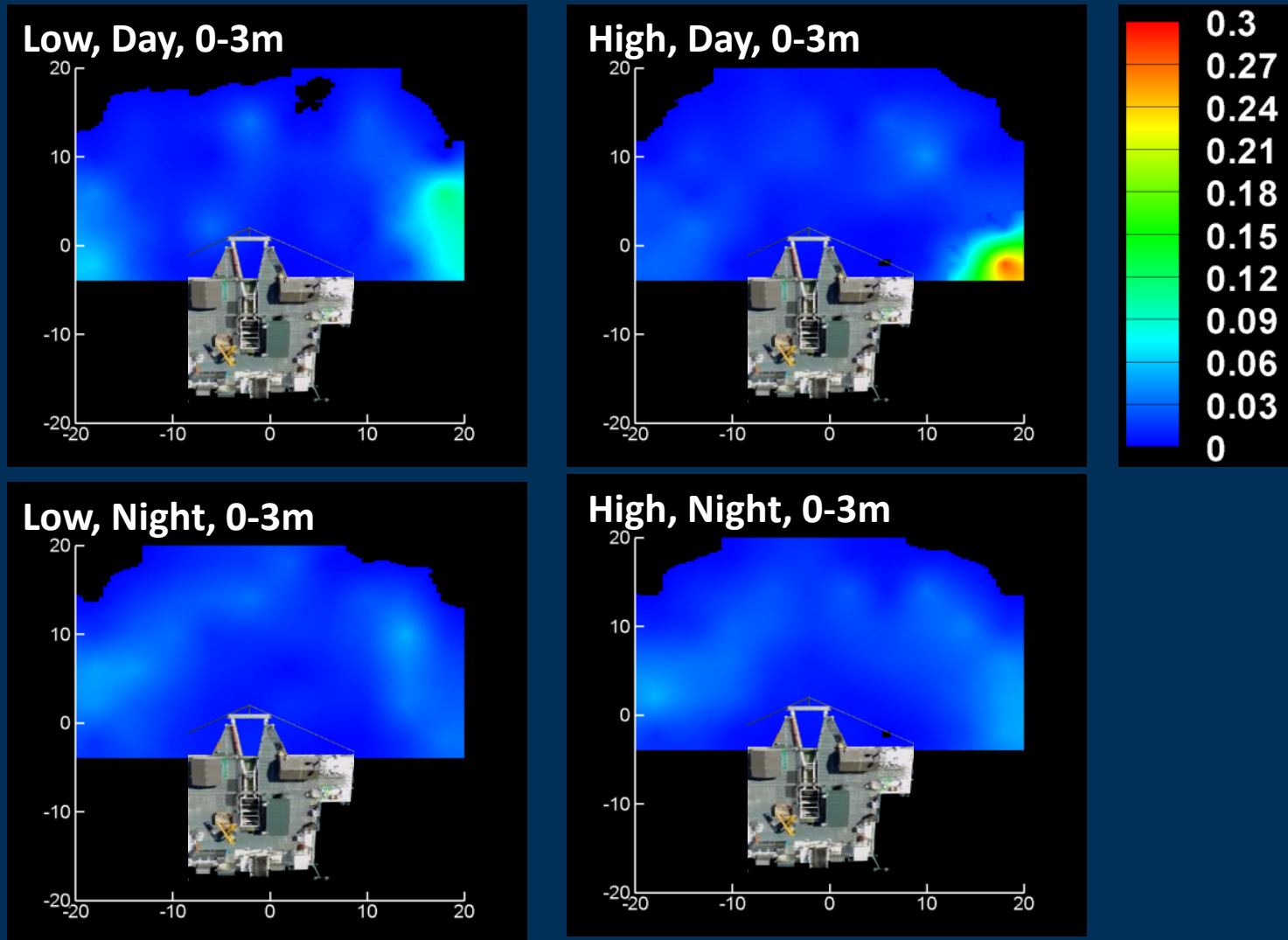
# Fish Paths prior to collection in the PFFC



# Fish Depths within 20 m of the PFFC Entrance, Fall 2015



# Fish Distributions within 20 m of PFFC

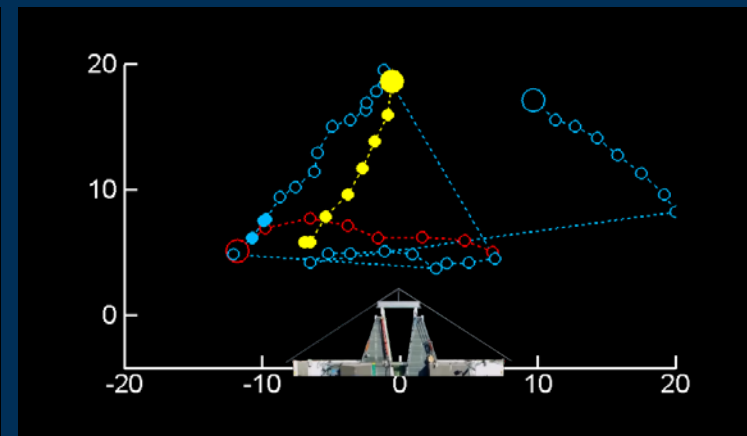
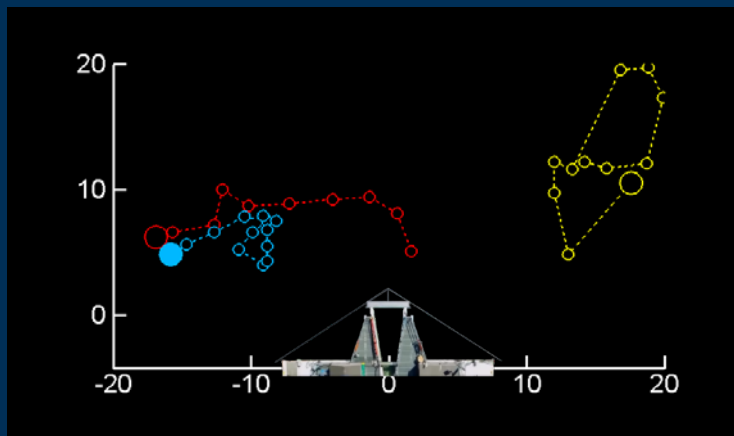


# Little Evidence of Attraction Within 20m

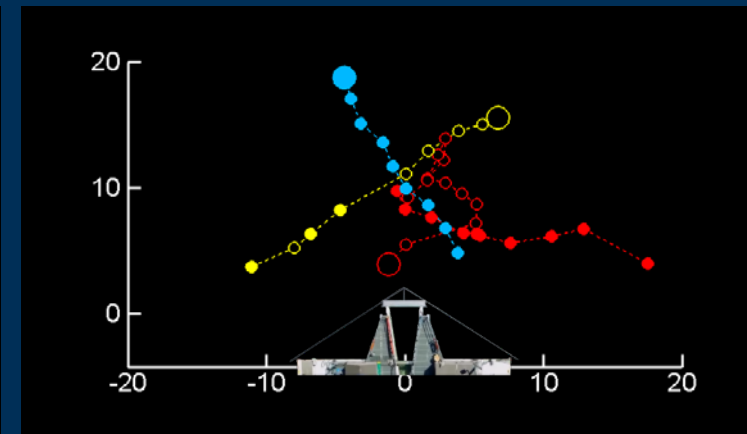
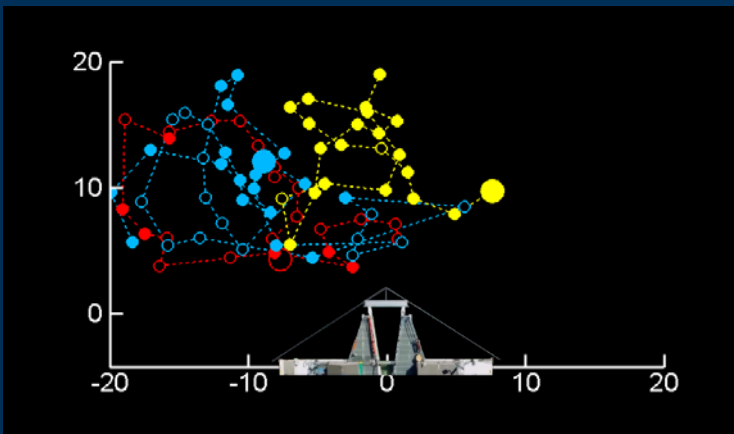
Day

Night

Low



High



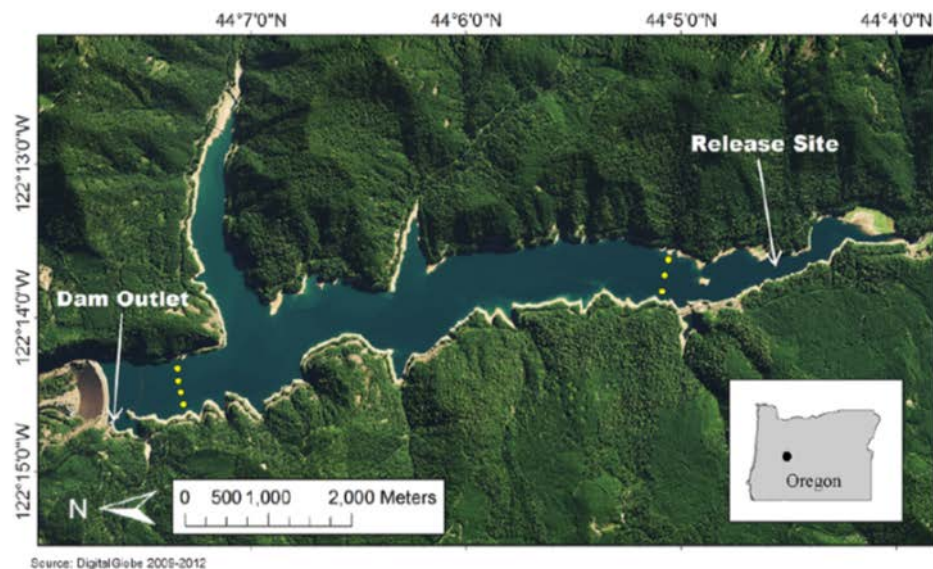
- Depth  $\leq 3\text{ m}$
- Depth  $> 3\text{ m}$

Large circle = start of fish track

**Table 1.** Summary information of Chinook salmon tagged and released by USGS at Cougar Reservoir, Oregon, in 2015.

[PIT, passive integrated transponder tag; Acoustic+PIT, acoustic tag plus PIT tag]

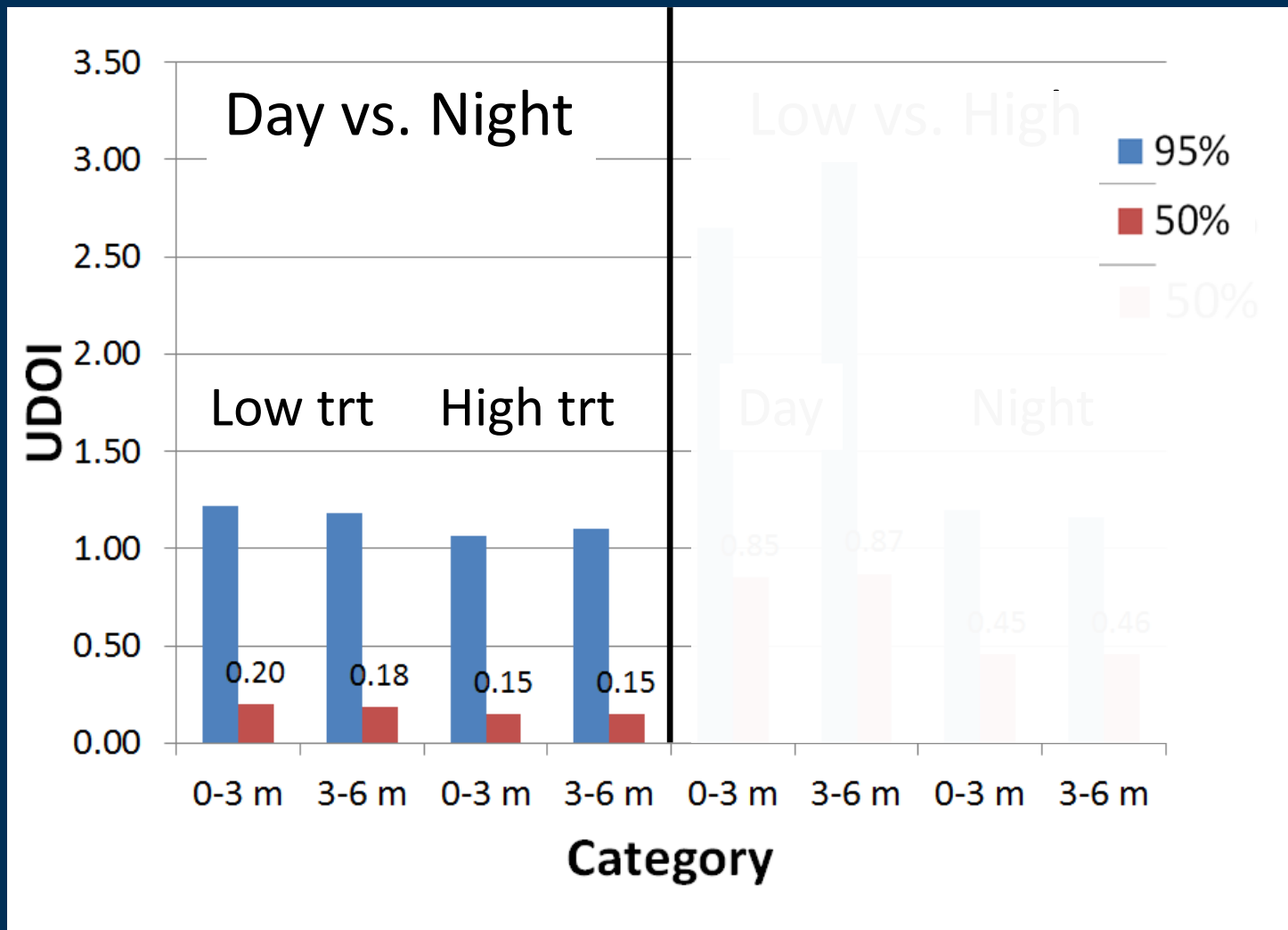
Fish origin	Release period	Tag type	N	Fork length (millimeters)			Weight (grams)		
				Mean	SD	Range	Mean	SD	Range
Surrogate	March	PIT	503	133.5	16.6	80–175	29.9	10.2	5.8–59.5
Surrogate	June	PIT	505	81.1	9.8	65–110	6.4	2.5	2.8–14
Surrogate	September	PIT	489	114.8	13.7	70–145	19.1	6.1	4.2–45.6
Surrogate	Sept–Nov	Acoustic+PIT	532	135.3	19.0	99–180	28.9	13.5	9.6–67.3
Natural	October	Acoustic+PIT	2	129.5	7.8	124–135	22.6	2.8	20.6–24.5



**Figure 5.** Orthoimage showing arrays of autonomous hydrophones (small circles) deployed in Cougar Reservoir, Oregon, 2012. The spring release location is indicated with an arrow and the fall release location is approximately 2 river kilometers upstream of that site on the right side of the image.



# UD Overlap Indices\*



# Fish Depths in cul-de-sac

