

Evaluation of an Innovative Fish Passage Device to Provide Upstream Fish Passage at Cle Elum Dam, Washington, 2017

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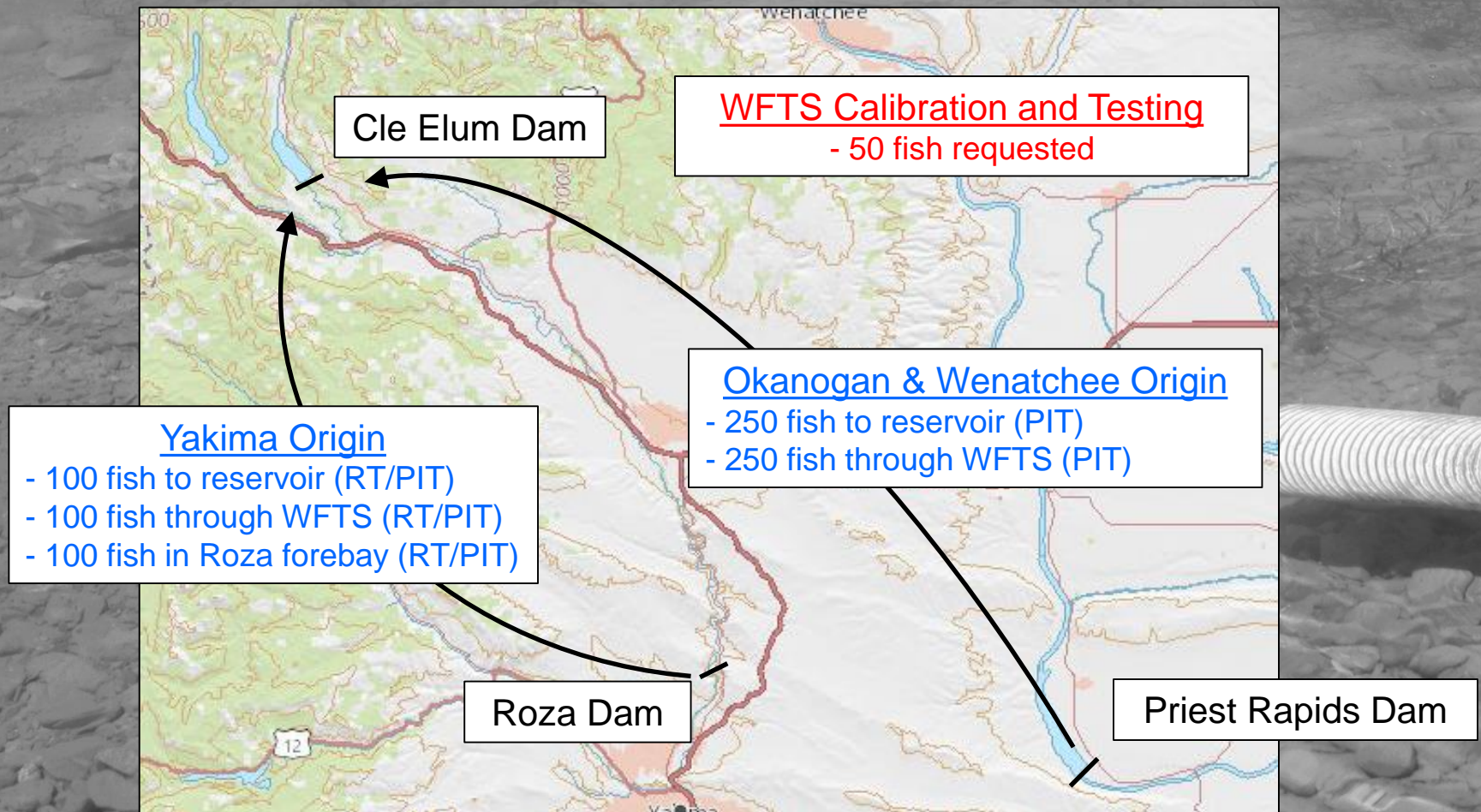
2018 Yakima Basin Science & Management Conference
June 14, 2018

Background

- Yakima Basin Integrated Plan
 - Reservoir fish passage (RFP) one of seven primary elements
 - Efforts to address RFP will be expensive and take many years
 - Cle Elum Dam identified as first RFP project to be addressed
 - Bureau of Reclamation (USBR) and Washington State Department of Ecology (WSDOE)
 - Interested in innovative options to reduce cost and construction time
- Whooshh Fish Transport System (WFTS)
 - One innovative option for upstream passage of adult salmon
 - Positive results from several studies
 - 2016: Chinook salmon passed through 1,100 ft WFTS at Roza Dam
 - 40 ft WFTS in operation at Roza Dam
 - Selected (by USBR/WSDOE) for 2017 Cle Elum evaluation
 - 1,700 ft long, 180 ft high, adult sockeye salmon

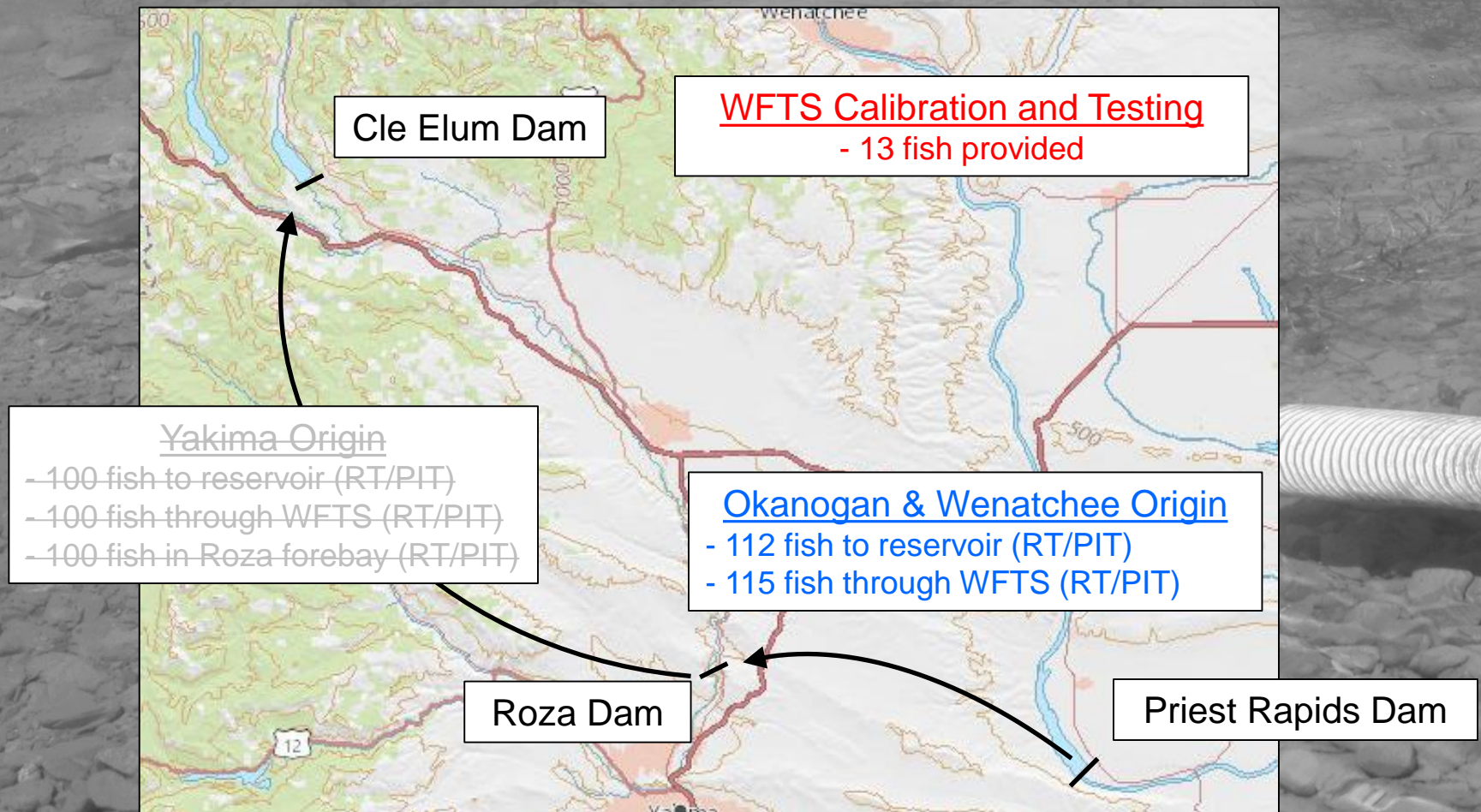
2017 Evaluation

- Original study design



2017 Evaluation

- Revised study design



Paired Releases

Treatment
Group

Alive
(85%)

Dead
(15%)

Mortality from:
(1) Treatment
(2) Other sources

Paired Releases

Treatment
Group

Alive
(85%)

Dead
(15%)

Control
Group

Alive
(89%)

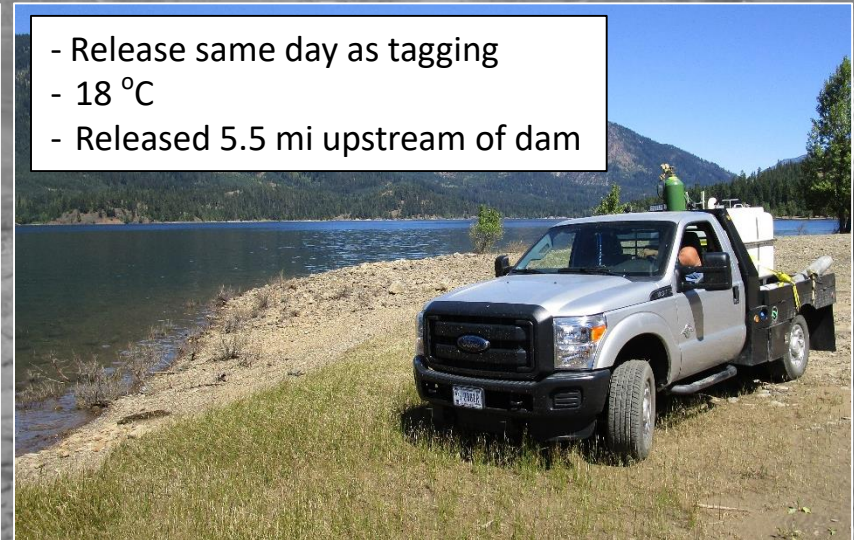
Dead
(11%)

Paired release
survival estimate = $0.85/0.89 = 0.96$

Fish Tagging and Release

Tag date	WFTS	Reservoir
July 14	25	25
July 17	27	27
July 18	32	30
July 19	31	30
Total =	115	112

At Roza Dam

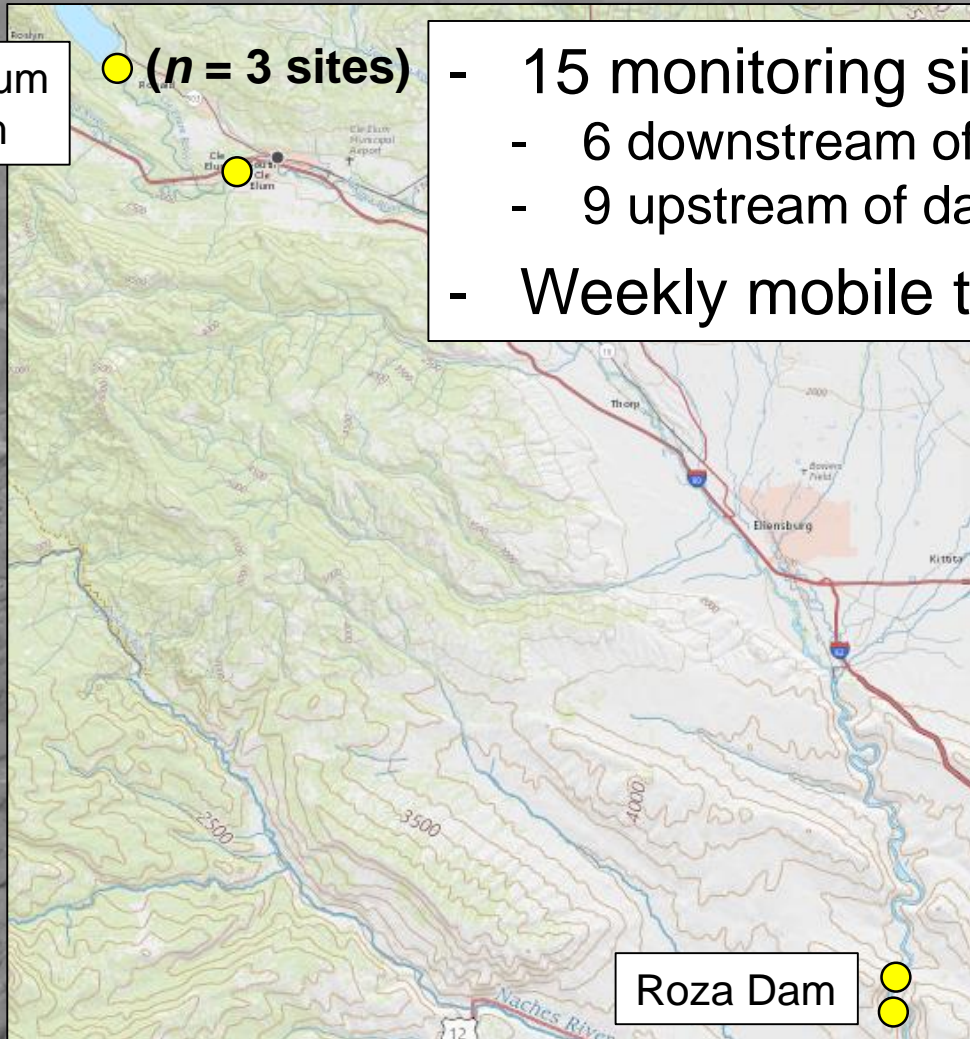


Detection of Tagged Fish

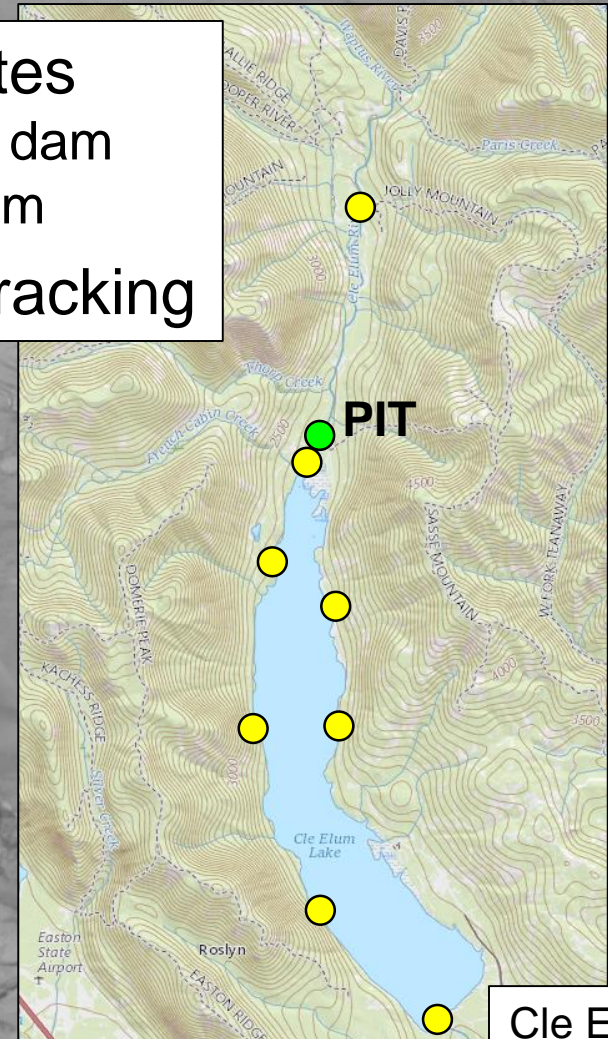
Cle Elum Dam

● ($n = 3$ sites)

- 15 monitoring sites
- 6 downstream of dam
- 9 upstream of dam
- Weekly mobile tracking



Roza Dam



Cle Elum Dam

Mobile Tracking

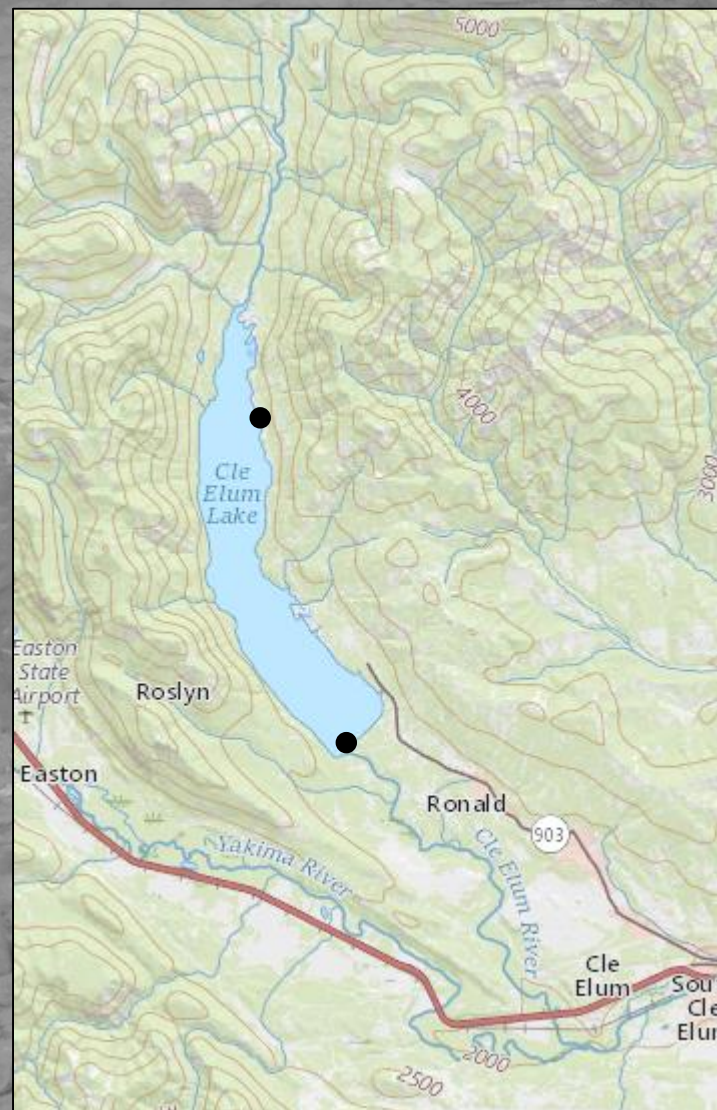


Mobile Tracking

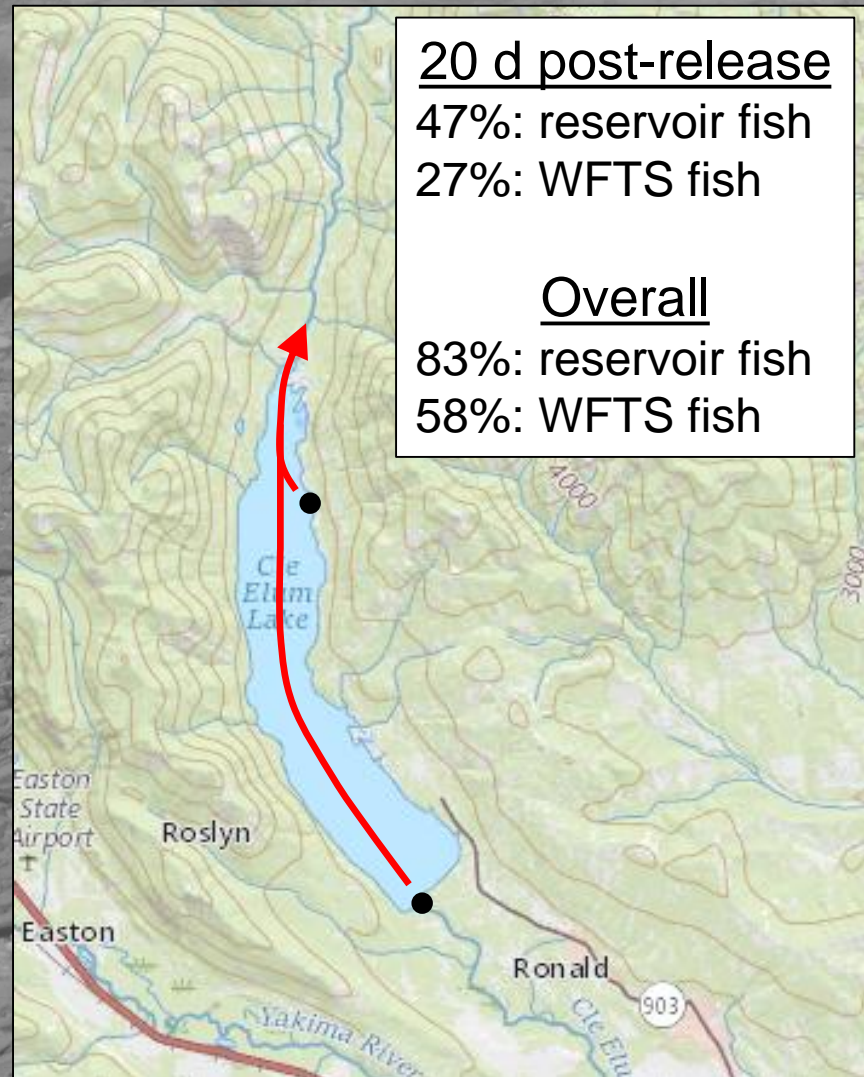


Behavior Patterns

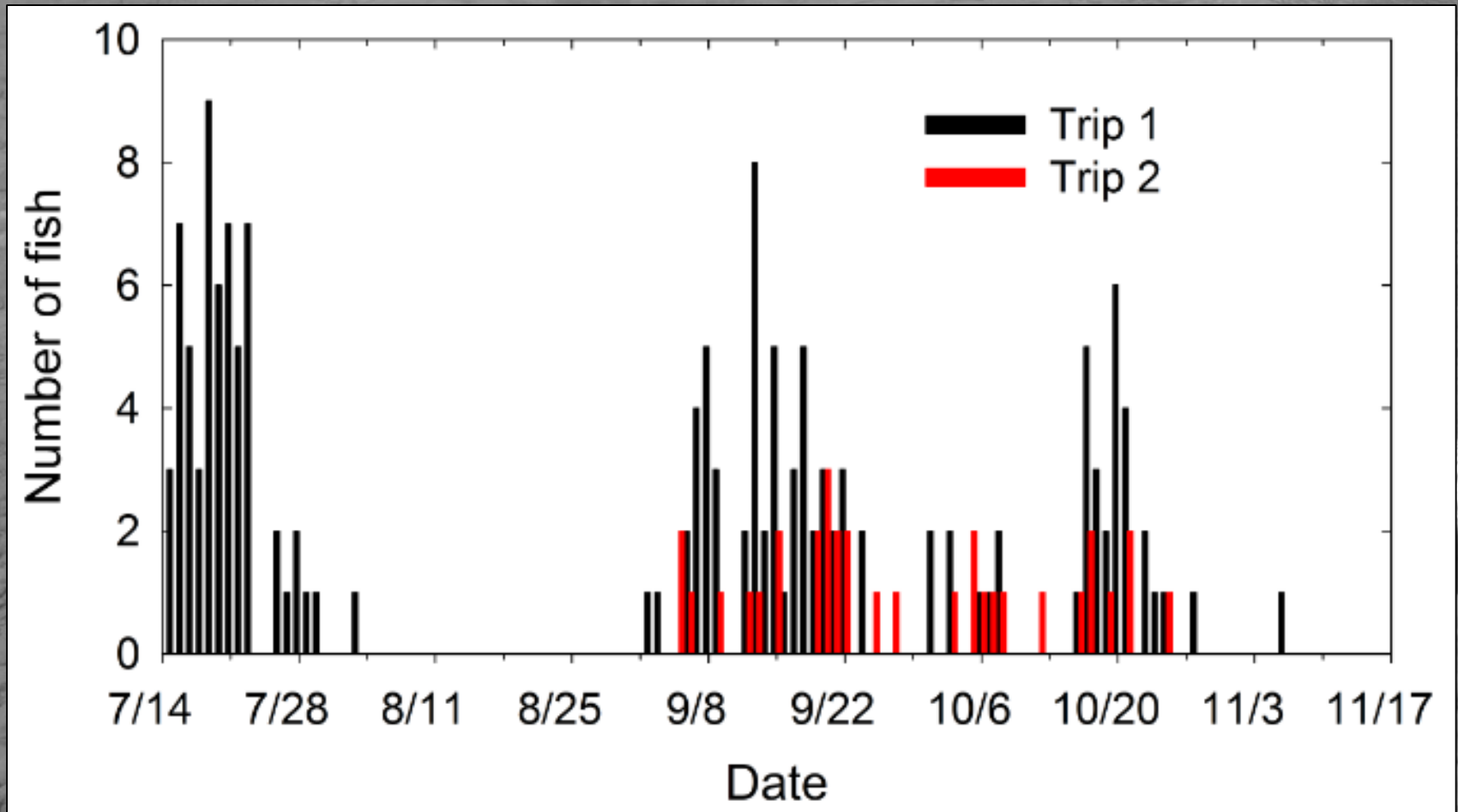
Time period	Activity
July 14 to July 31	Very active (upstream and fallback)
August	Little activity
September and October	Very active (upstream)



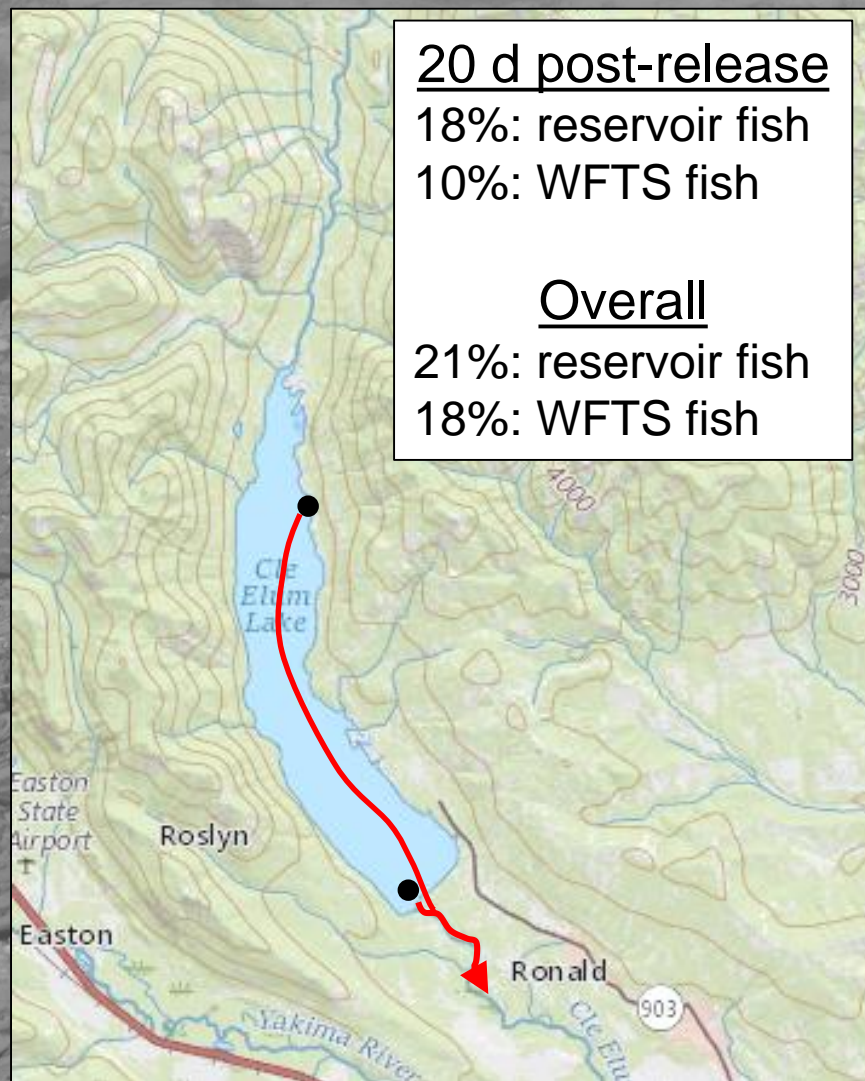
Upstream Movement



Upstream Movements in Reservoir

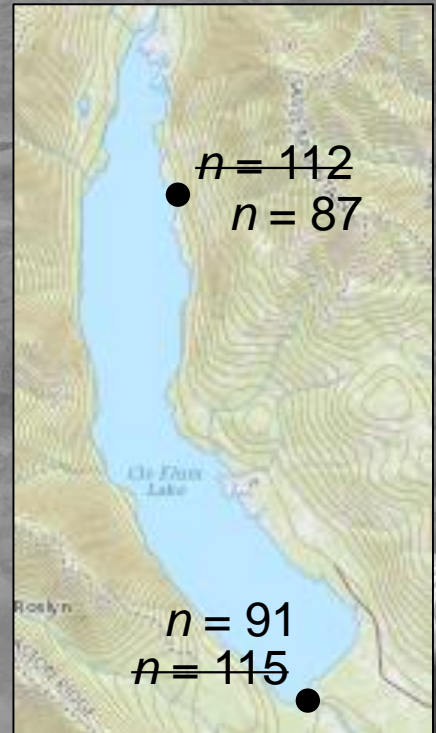


Fallback



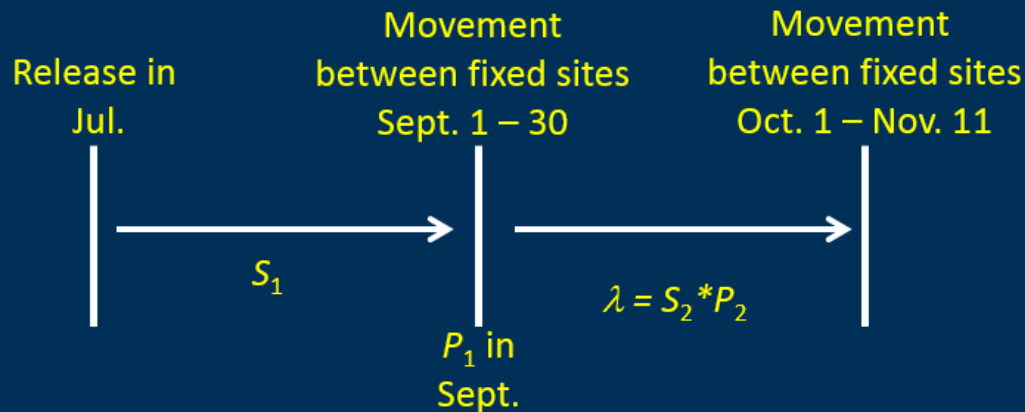
Survival Analysis

- Fallback fish removed from dataset



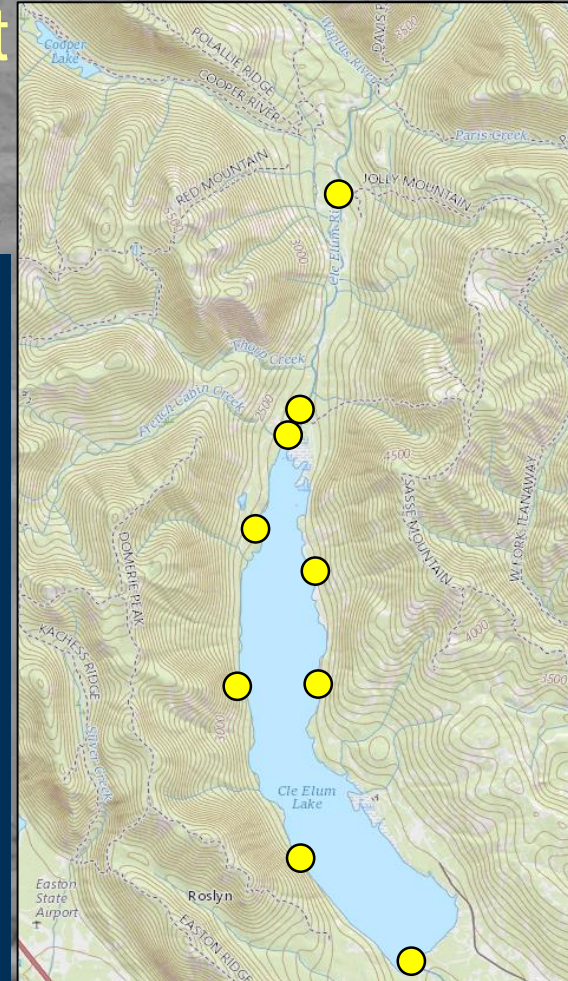
Survival Analysis

- Fallback fish removed from dataset
- Mark-recapture model
 - Based on fish movement



S = survival probability

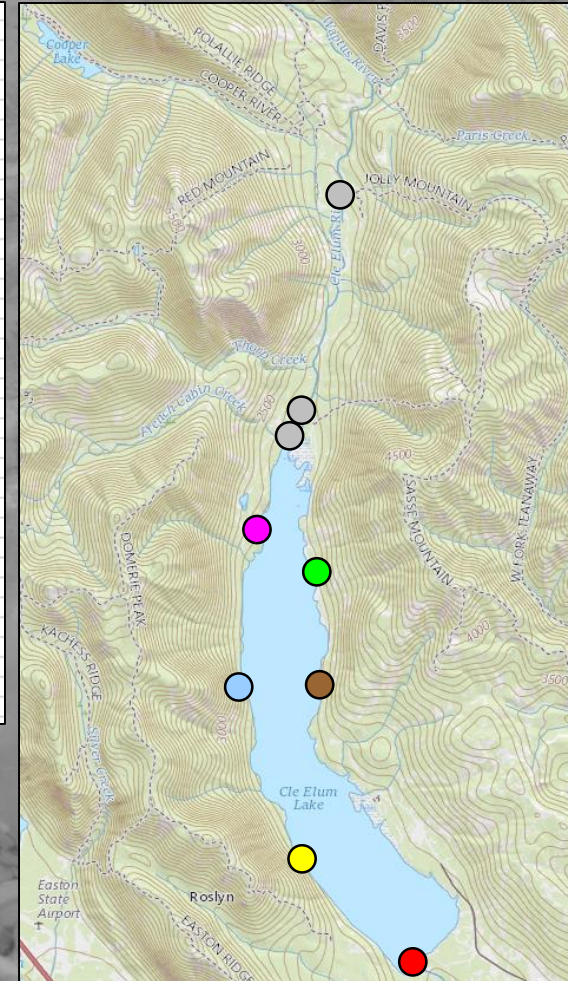
P = detection probability given survived past Sept.



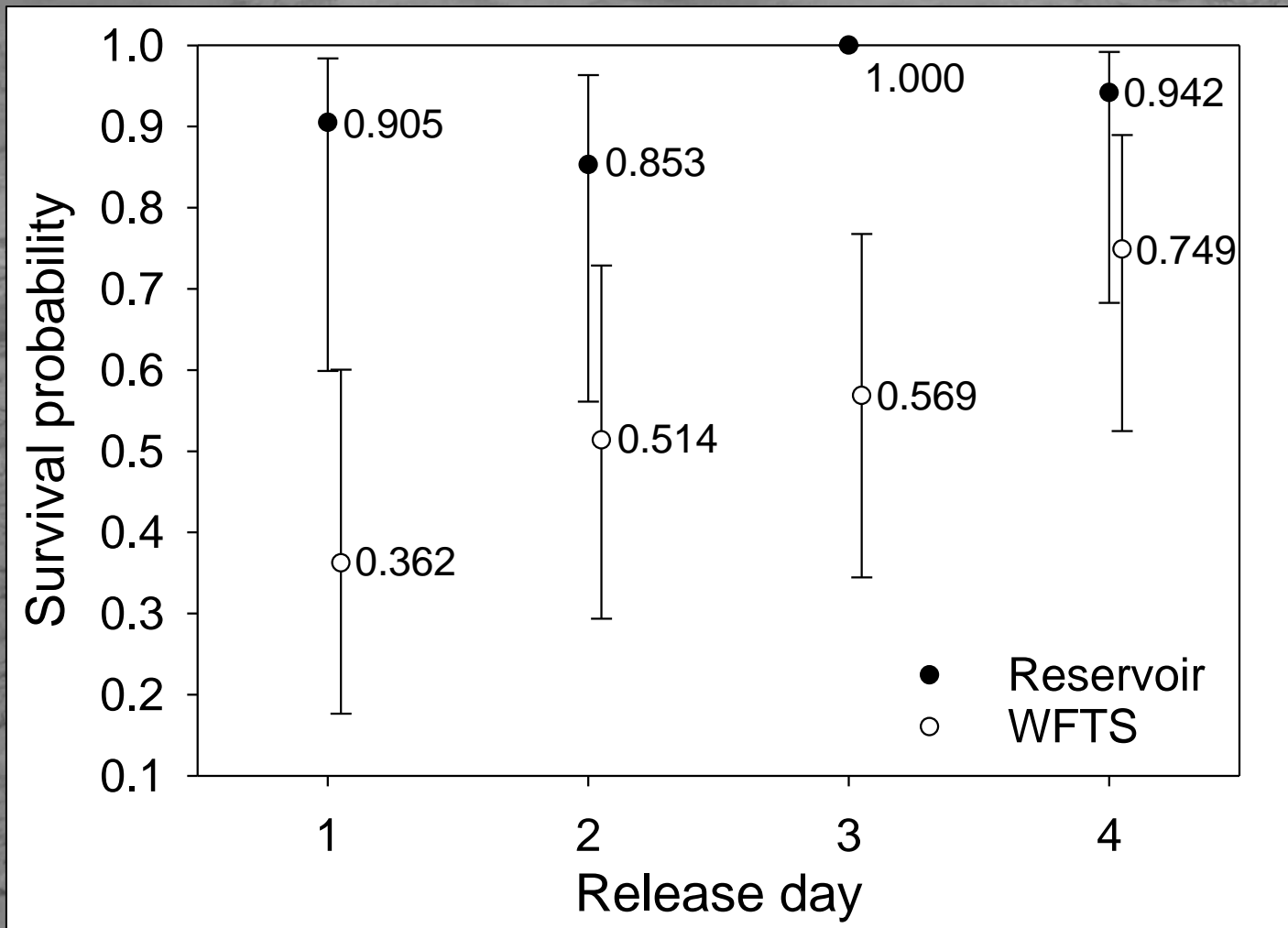
Fish Movement Among Sites

CHCOC	RDATE	RSTIME	RSITE	RCWF	DATETIME
03198A	18JUL2017	11:55:00	RESERVOIR	C10	21JUL2017:10:02:29
03198A	18JUL2017	11:55:00	RESERVOIR	C13	28JUL2017:13:31:00
03198A	18JUL2017	11:55:00	RESERVOIR	C15	30JUL2017:07:28:45
03198A	18JUL2017	11:55:00	RESERVOIR	C14	31JUL2017:04:26:47
03198A	18JUL2017	11:55:00	RESERVOIR	C15	06AUG2017:18:54:57
03198A	18JUL2017	11:55:00	RESERVOIR	C10	12AUG2017:06:57:00
03198A	18JUL2017	11:55:00	RESERVOIR	C13	30AUG2017:23:53:20
03198A	18JUL2017	11:55:00	RESERVOIR	C11	21SEP2017:03:44:41
03198A	18JUL2017	11:55:00	RESERVOIR	C12	21SEP2017:05:22:45
03198A	18JUL2017	11:55:00	RESERVOIR	C11	21SEP2017:08:30:09
03198A	18JUL2017	11:55:00	RESERVOIR	C10	21SEP2017:14:13:04
03198A	18JUL2017	11:55:00	RESERVOIR	C13	21SEP2017:18:27:36
03198A	18JUL2017	11:55:00	RESERVOIR	C10	22SEP2017:06:18:43
03198A	18JUL2017	11:55:00	RESERVOIR	C13	27SEP2017:23:51:36
03198A	18JUL2017	11:55:00	RESERVOIR	C10	28SEP2017:22:23:40
03198A	18JUL2017	11:55:00	RESERVOIR	C13	30SEP2017:18:13:22
03198A	18JUL2017	11:55:00	RESERVOIR	C10	01OCT2017:00:48:04
03198A	18JUL2017	11:55:00	RESERVOIR	C11	01OCT2017:01:43:48
03198A	18JUL2017	11:55:00	RESERVOIR	C13	01OCT2017:04:12:05
03198A	18JUL2017	11:55:00	RESERVOIR	C11	01OCT2017:15:25:04
03198A	18JUL2017	11:55:00	RESERVOIR	C13	01OCT2017:17:18:09
03198A	18JUL2017	11:55:00	RESERVOIR	C10	06OCT2017:23:27:32
03198A	18JUL2017	11:55:00	RESERVOIR	C11	07OCT2017:00:31:55
03198A	18JUL2017	11:55:00	RESERVOIR	C13	07OCT2017:03:17:10
03198A	18JUL2017	11:55:00	RESERVOIR	C10	07OCT2017:05:43:05
03198A	18JUL2017	11:55:00	RESERVOIR	C11	07OCT2017:09:23:20
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03198A	18JUL2017	11:55:00	RESERVOIR	C13	07OCT2017:17:33:49
03198A	18JUL2017	11:55:00	RESERVOIR	C11	08OCT2017:03:37:58
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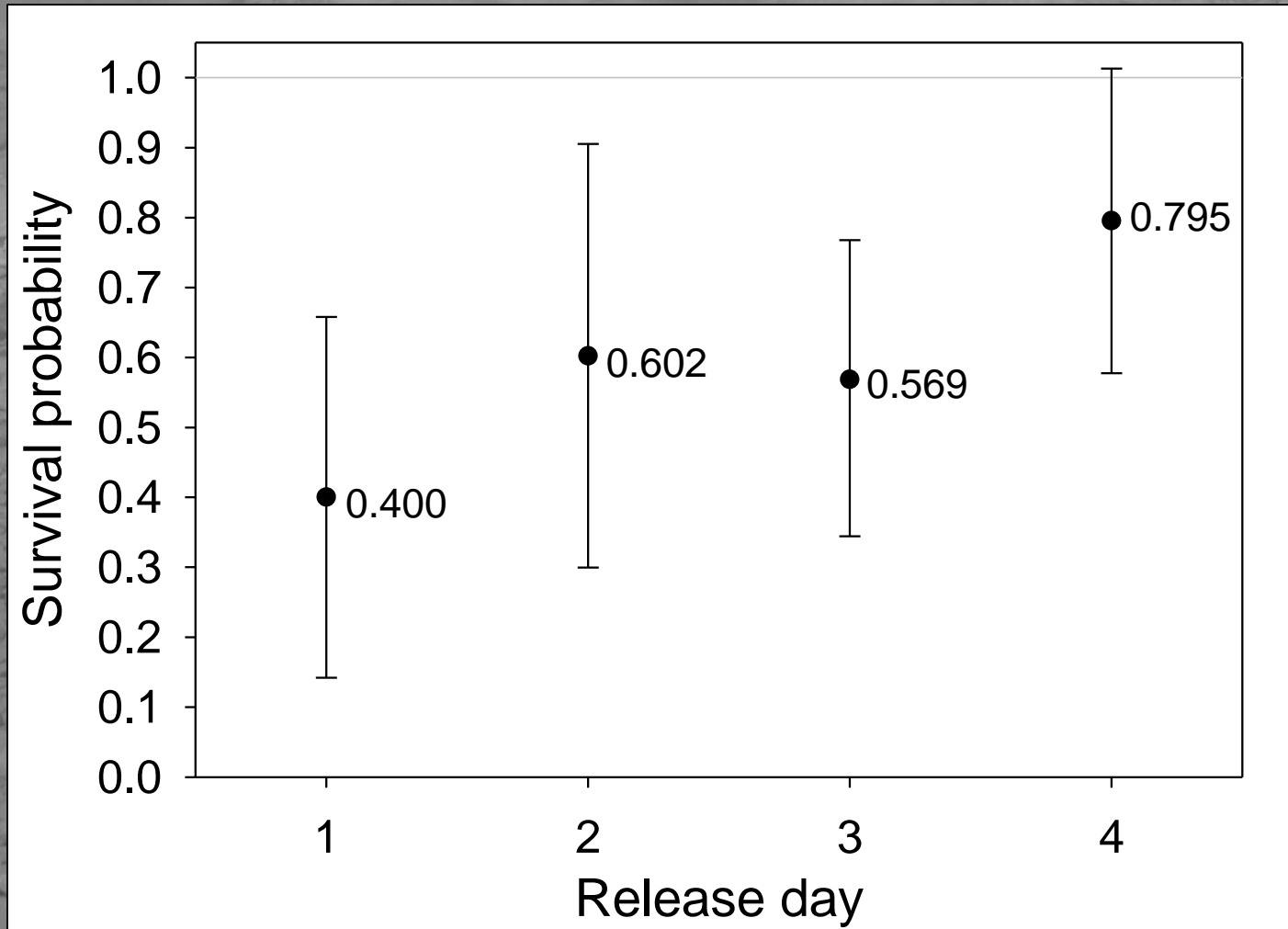
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03198A	18JUL2017	11:55:00	RESERVOIR	C10	15OCT2017:18:44:29
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03198A	18JUL2017	11:55:00	RESERVOIR	C10	21OCT2017:21:12:47
03198A	18JUL2017	11:55:00	RESERVOIR	C11	21OCT2017:22:10:28
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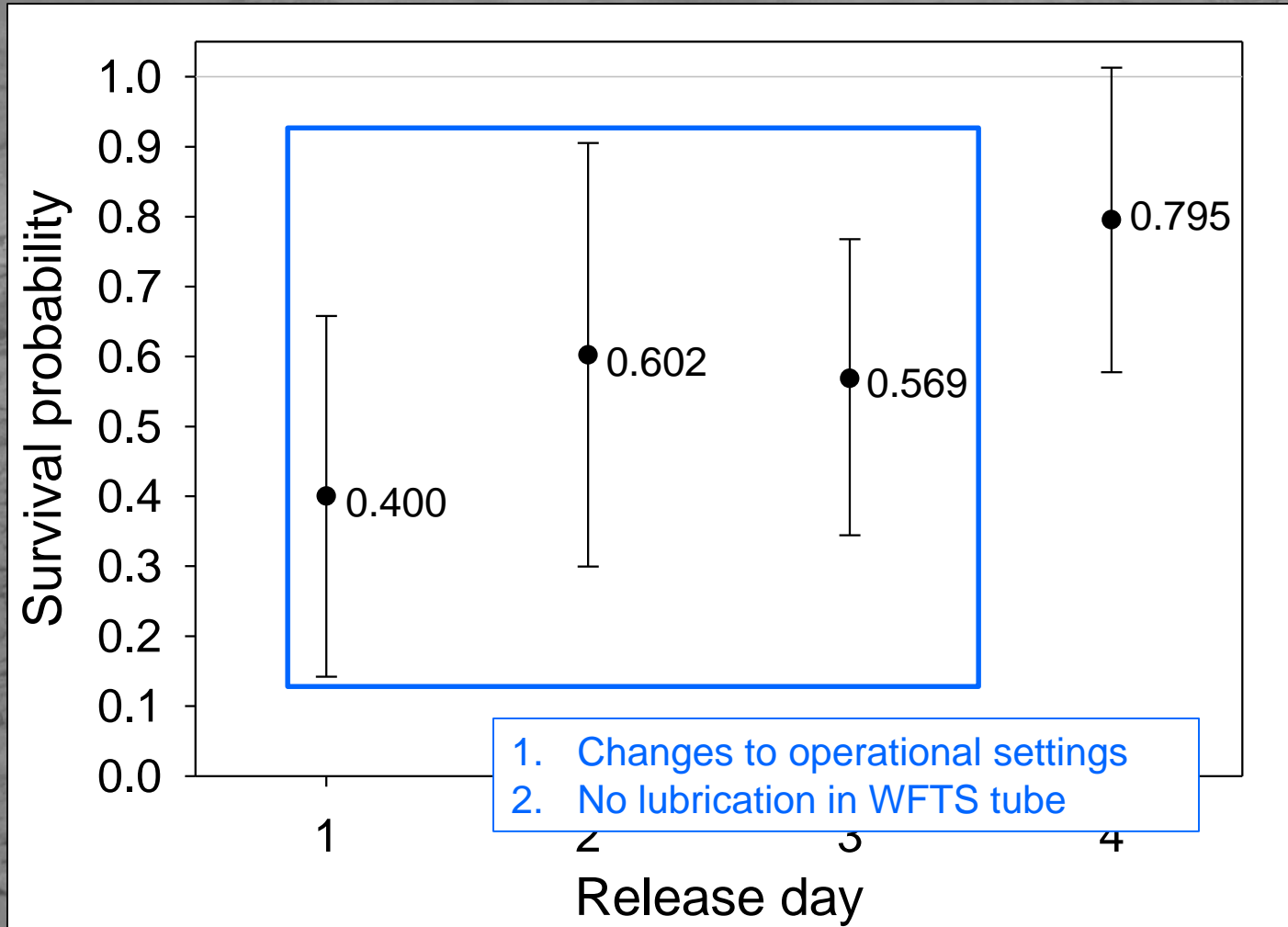
Single Release Survival Estimates



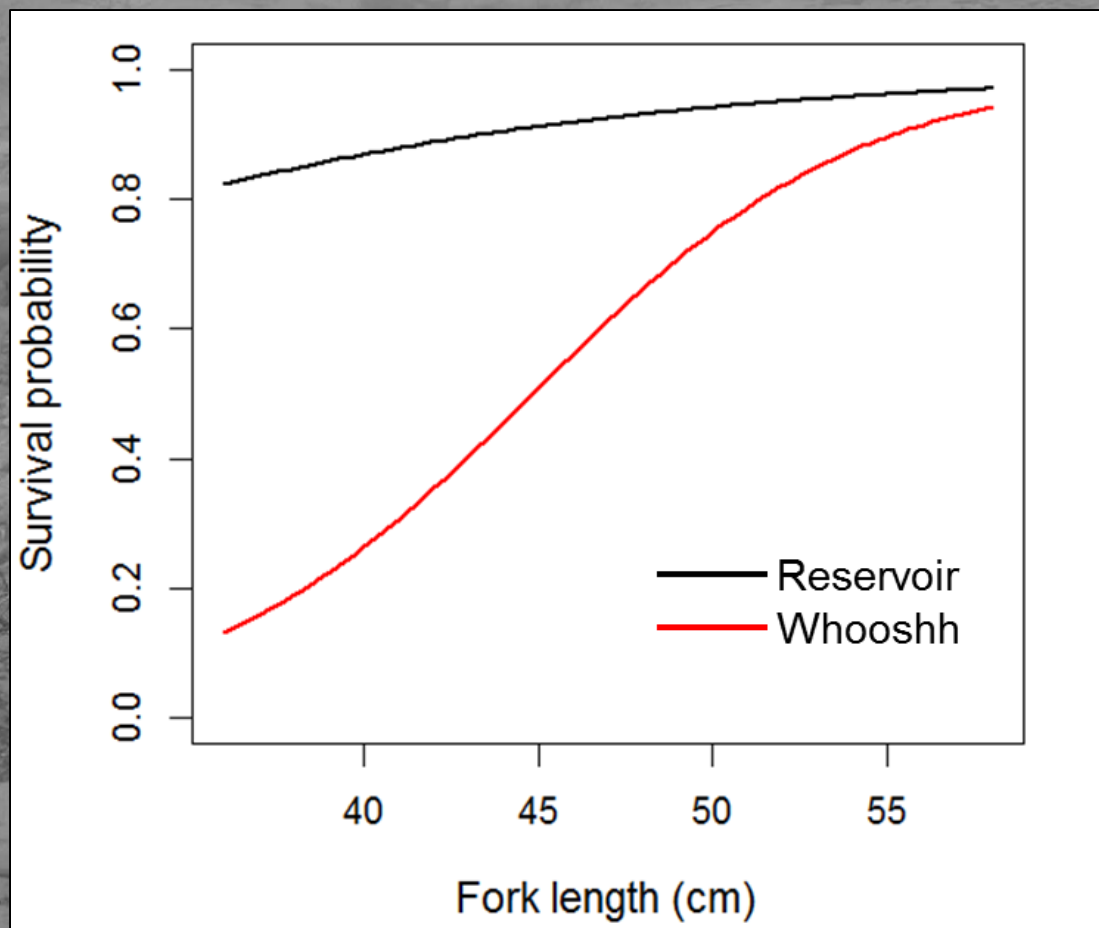
Paired Release Survival Estimates



Paired Release Survival Estimates



Effect of Fish Size



Summary

- WFTS passage survival
 - 40–80%
 - Not a fully functional system
 - No tube lubrication in first 3 days
 - Daily system adjustments
 - Some fish smaller than optimum size
- Sockeye salmon behavior
 - Exploratory movements in first 20 day
 - Limited movement in August
 - Upstream movement in September and October
- Population loss
 - Pre-spawn mortality: 8%
 - Fallback: 21%

Acknowledgments

- USBR and WSDOE: funding
- Richard Visser, Joel Hubble and others with USBR: logistical support and study design
- Dave Fast, Mark Johnston, Brian Saluskin and others with YN: study design, fish transport and release
- Janine Bryan, Jim Otten and Dan Schneider with Whooshh Innovations: logistical support with the WFTS
- Peter Galbreath, Andrew Matala and Jeremiah Newell with CRITFC: genetic analysis and assistance with fieldwork
- USFWS and YN: deployment and operation of PIT-tag site on Cle Elum River

Questions

