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2024 Spring Survival Study at MCN with Split-leaf Spill Operations: Preliminary Results

Ryan Harnish, Kate Deters, Bob Mueller, Jayson Martinez, Scott Titzler, Tao Fu, Jill Janak, Daniel Deng

Pacific Northwest National Laboratory

USACE POC: Chuck Barnes

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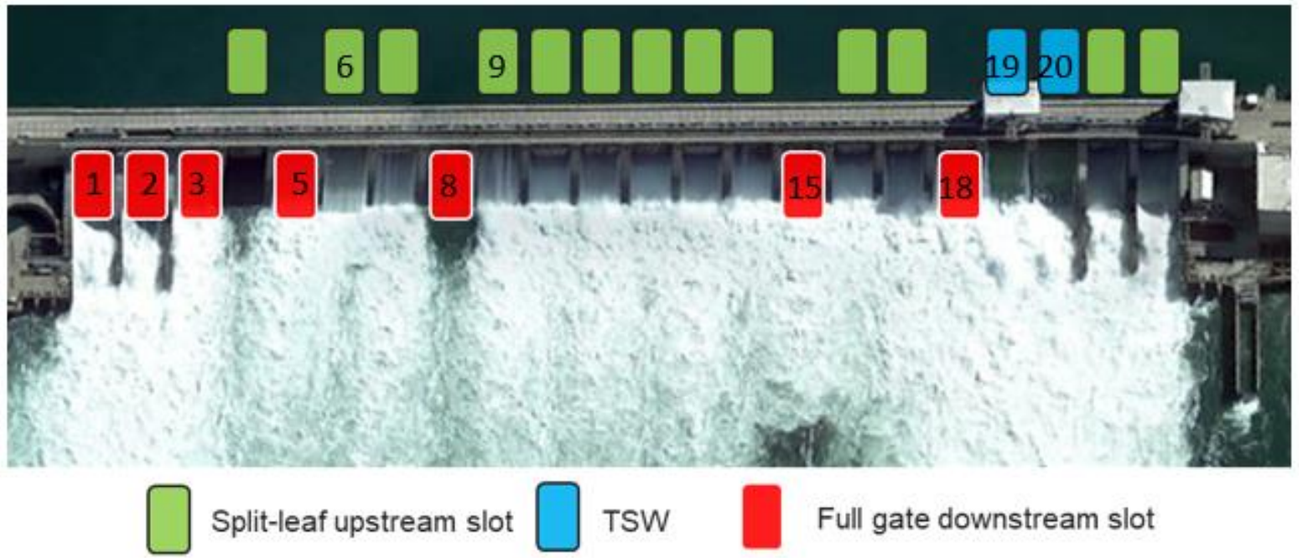
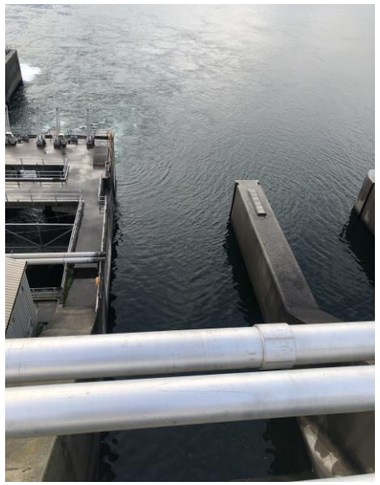
Introduction

- Overloaded condition of spillway cranes and hoists limits their ability to move double-leaf (full) spillway gates
- In spring 2024, 13 spill gates operated in the upstream slot in split-leaf configuration, 5 spill bays remained closed in the downstream slot in full double-leaf configuration, and full gates 1 & 2 open 4 ft



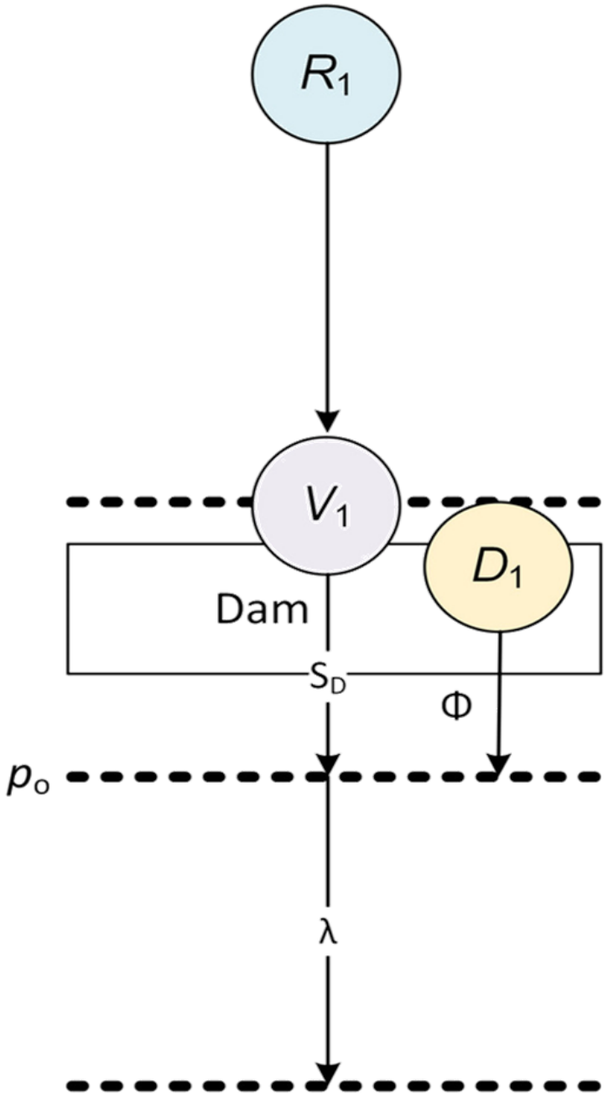
Objectives

- Estimate MCN spillway survival from dam face to downstream extent of project influence
- Estimate survival through all passage routes at MCN
- Estimate forebay residence time and tailrace egress time at MCN
- Estimate spillway passage efficiency (SPE)
- Estimate forebay survival



Study Design

ViRDCt Dam Passage Survival Model



R_1 Live fish released far enough upstream of the dam to allow tagging/handling recovery and distribute as run-of-river fish

V_1 Live fish detected passing the dam form a virtual release group for estimating dam passage survival

D_1 Dead fish released at the dam to correct the bias that occurs from detecting V_1 fish that died during passage

Φ Assumption: The probability of dead-released fish arriving at the tailrace array and being detected (Φ) are representative of the probabilities of arrival and detection of fish from the V_1 group that die during dam passage

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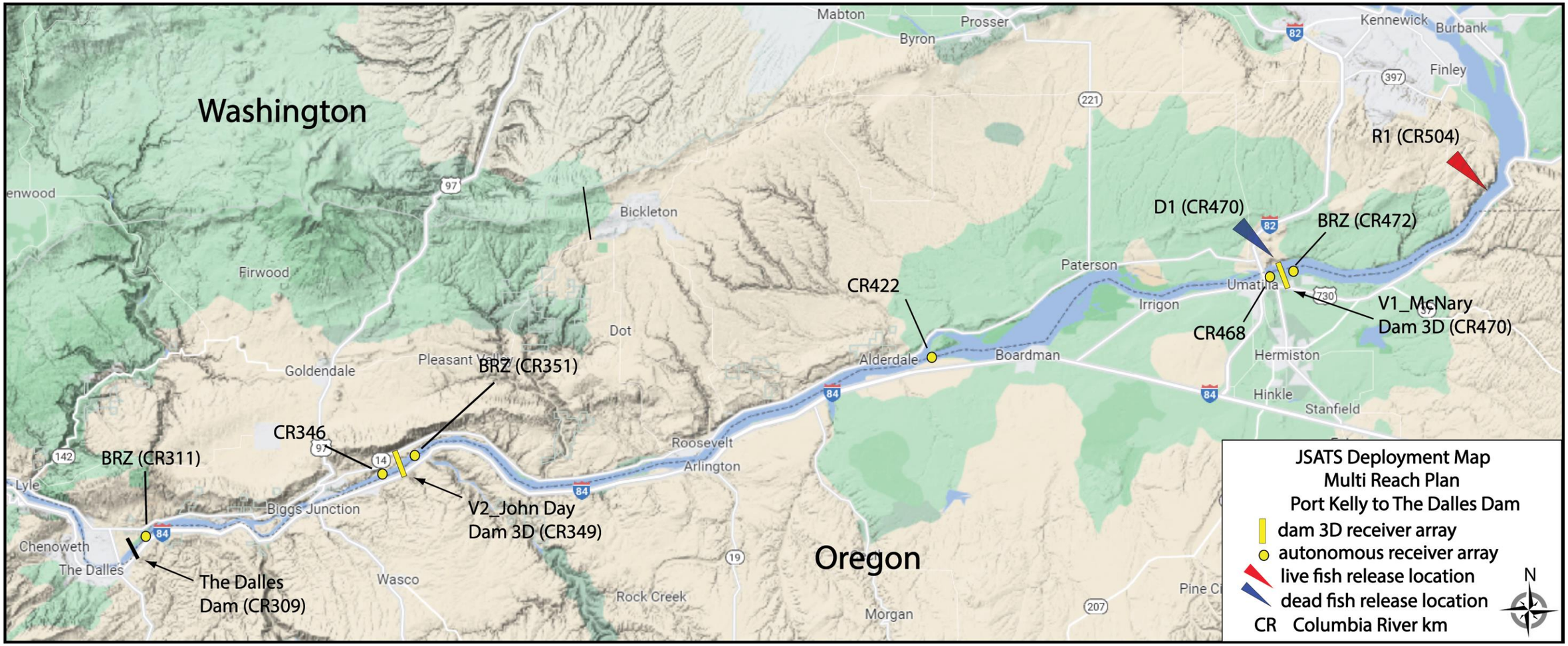
Study Design

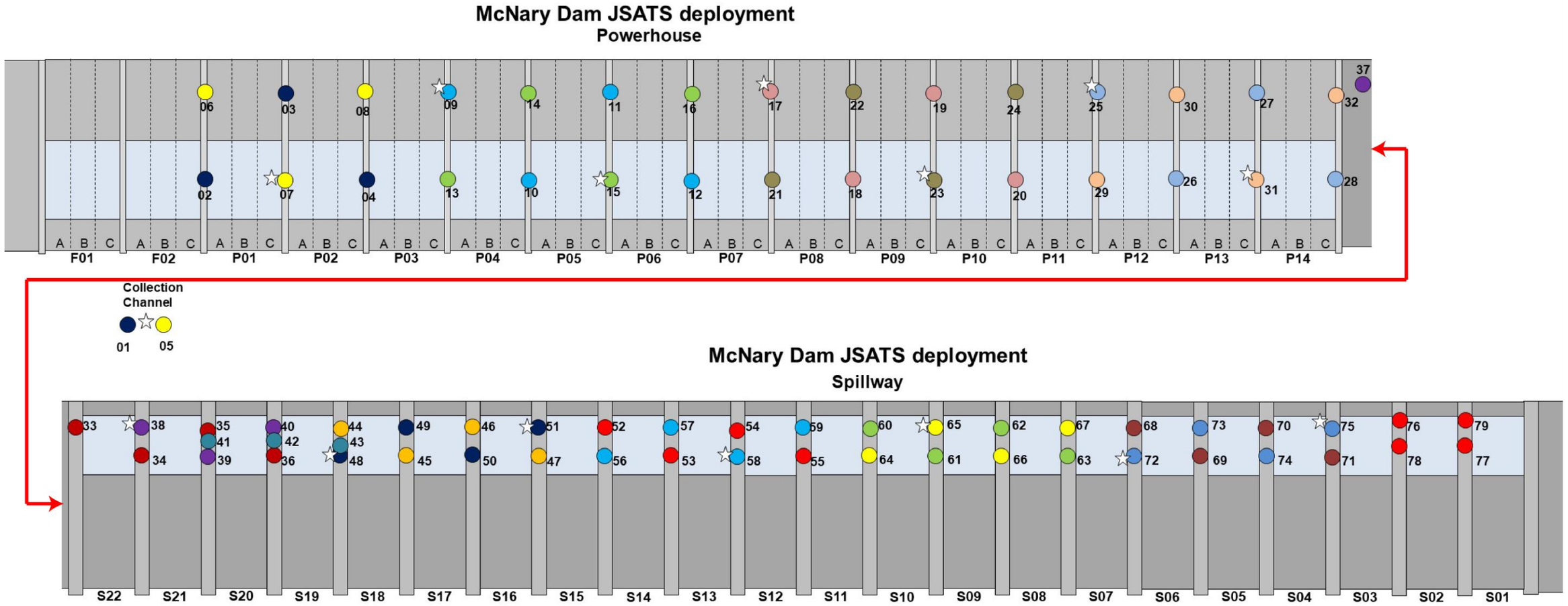
Detection Arrays and Release Locations



Study Design

Receiver Deployment at MCN

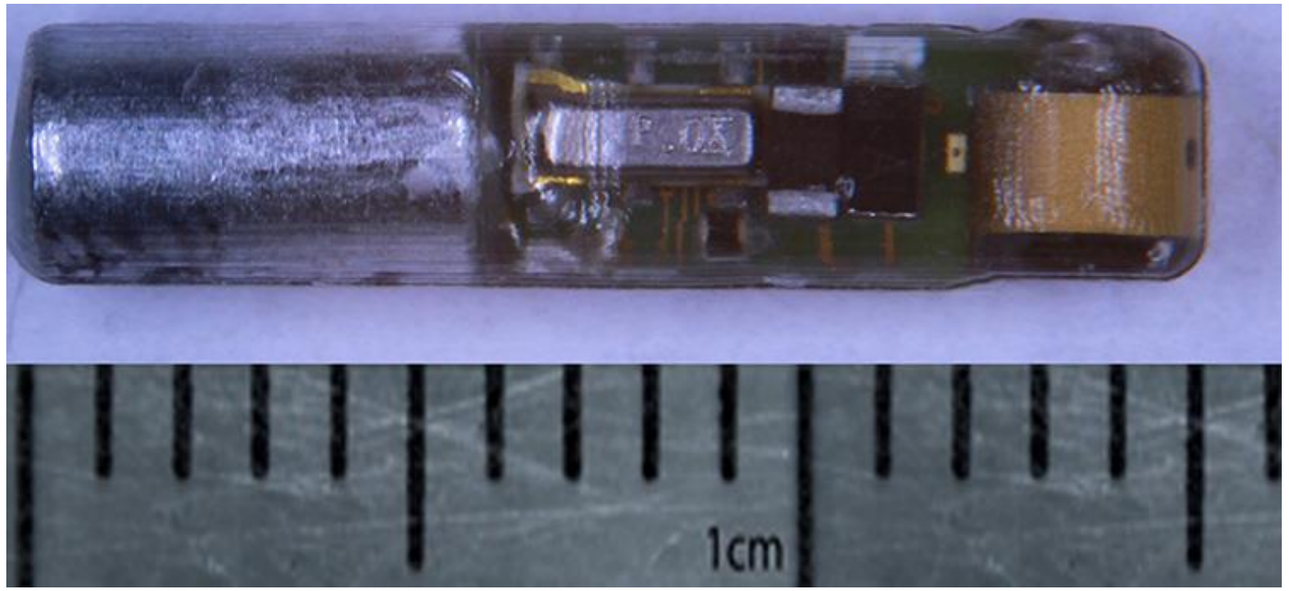
Forebay Cabled Array



Study Design

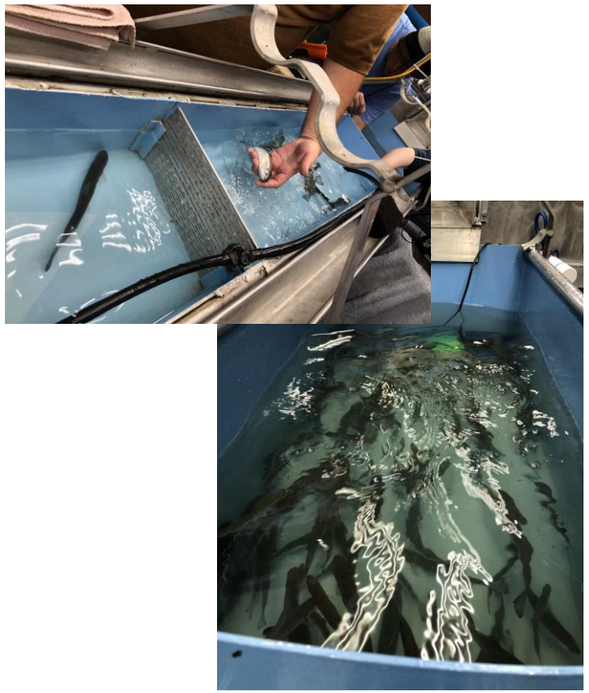
Acoustic Transmitter

- ATS SS400
- Dimensions: 15.0 mm x 3.38 mm
- Mass in air: 0.216 g
- Mass in water: 0.106 g
- Source level: 156 dB
- Tag life: ~60 days at 3-s pulse rate interval
- Carrier frequency: 416.7 kHz



Study Design

Fish Rejected at Collection and Tagging



Rejects at Collection									
	<95 mm	Previously tagged	Descaling >20%	Physical Injuries	Disease / Infection	Deformed	Mortality	Other/not recorded	Total Rejected
Yearling Chinook	1	21	7	35	4	0	1	10	79
Juvenile Steelhead	0	29	9	27	8	2	0	2	77

Rejects at Tagging									
	<95 mm	Previously tagged	Descaling >20%	Physical Injuries	Disease / Infection	Deformed	Mortality	Other/not recorded	Total Rejected
Yearling Chinook	0	2	1	19	0	0	25	6	53
Juvenile Steelhead	0	0	4	20	2	0	2	0	28

Study Design

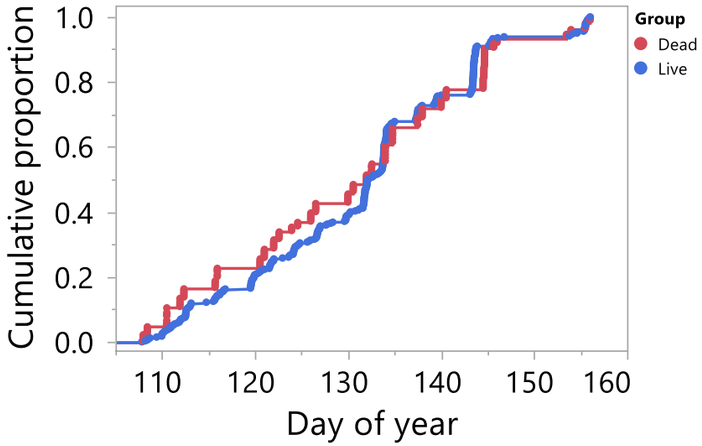
Tagging and Release Numbers

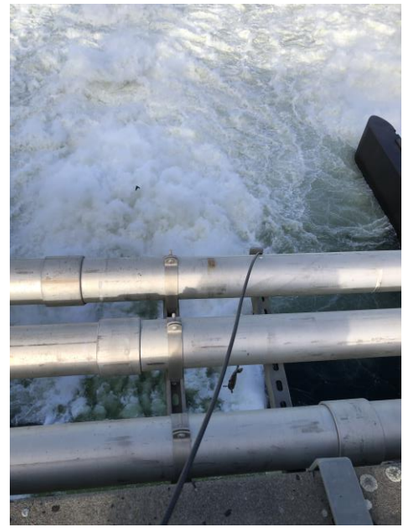
	Yearling Chinook						Juvenile Steelhead					
Release Date	Rejected at Collection	Collected	Tagged	Post-tagging Mort	Other removed	Released	Rejected at Collection	Collected	Tagged	Post-tagging Mort	Other removed	Released
4/15/2024	12	48	48			48	2	29	29			29
4/17/2024	15	70	70			70	7	35	35			35
4/19/2024	13	82	67	2		65	9	48	46			46
4/23/2024	0	16	16			16	6	114	111			111
4/27/2024	5	63	58	2		56	4	67	67			67
4/29/2024	1	29	0			0	10	112	110			110
5/1/2024	1	47	45			45	2	11	11		1	10
5/3/2024	6	78	73			73	3	52	49	1		48
5/7/2024	0	0	0			0	9	121	115			115
5/9/2024	6	88	78			78	5	47	47			47
5/11/2024	0	0	1			1	6	241	229	1		228
5/15/2024	2	106	102	2		100	0	18	14			14
5/17/2024	4	46	30			30	12	94	88			88
5/21/2024	6	224	210	3	1	206	2	60	55	2		53
5/23/2024	5	54	53		1	52	0	0	0			0
5/31/2024	2	70	45	9		36	0	0	0			0
6/2/2024	1	37	28	1		27	0	32	31			31
Total	**79**	**1056**	**926**	**19**		**903**	**77**	**1079**	**1037**	**4**		**1032**

Survival

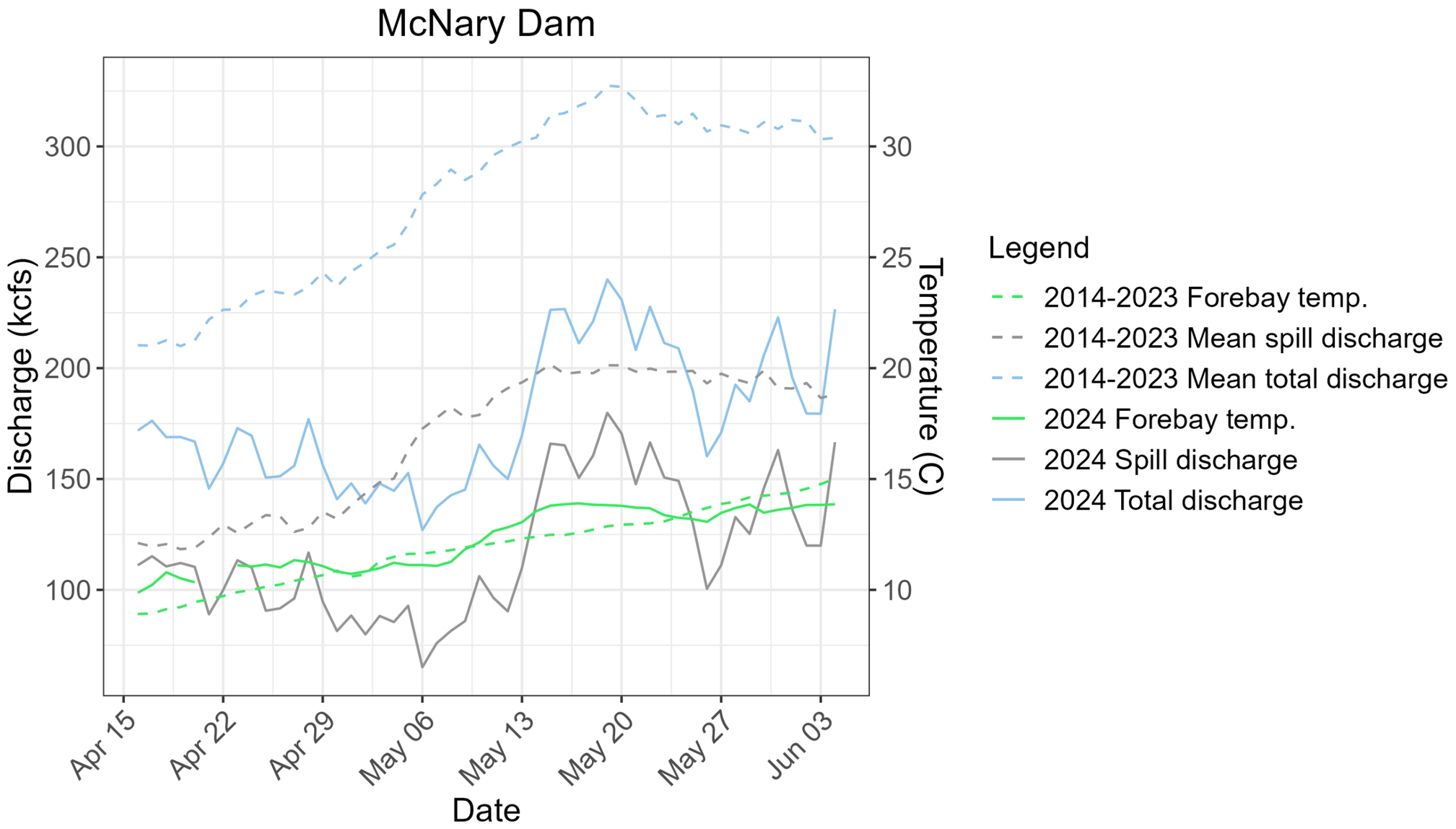
ViRDCt Model Assumption Tests – ROR Juveniles

- 21/206 (10.2%) dead-released fish detected at MCN tailrace array
- The temporal distribution of dead-released fish did not differ from that of live-released fish that died during dam passage
- The spatial (i.e., route) distribution of dead-released fish did not differ from that of live-released fish that died during dam passage
- The dead-released detection rate did not differ by passage route

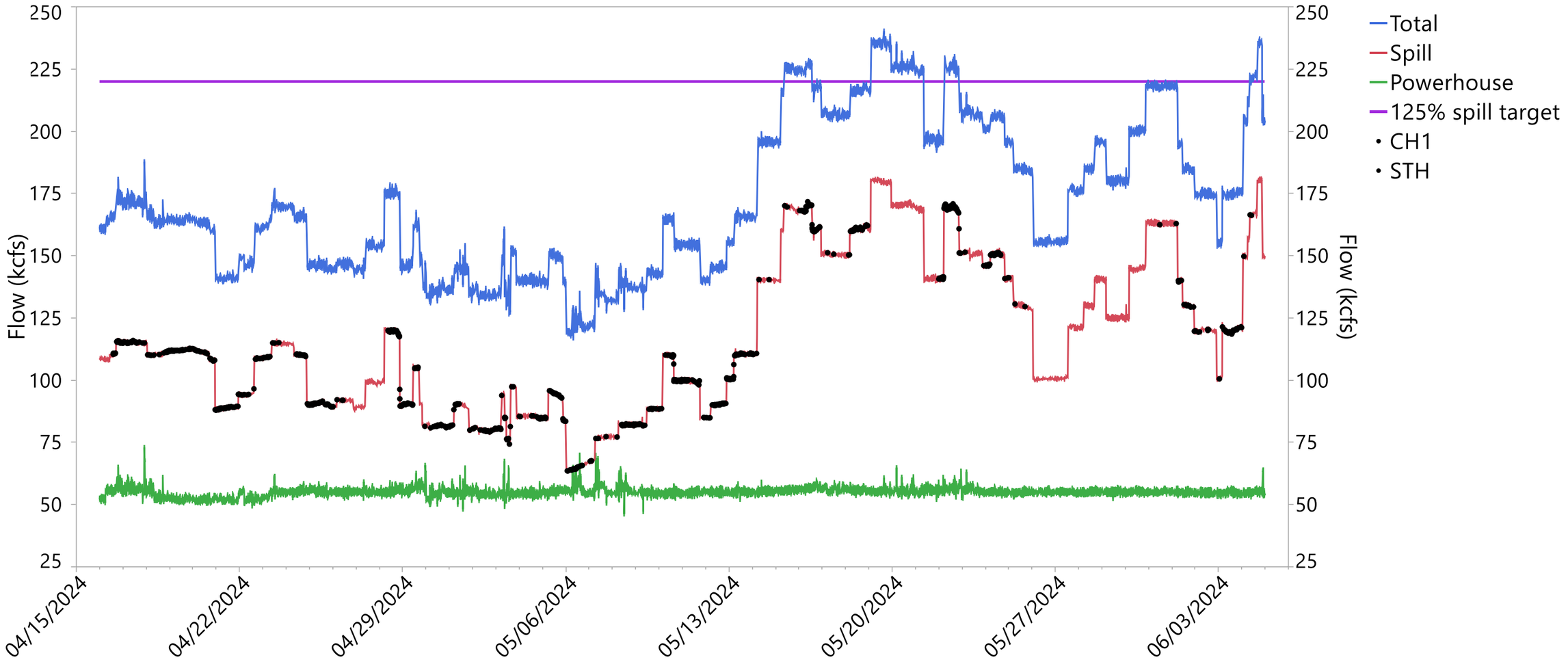




Environmental Conditions



Operational Conditions



MCN Forebay Survival

Species	2024 $\hat{S}$ ($\widehat{SE}$)	2014 $\hat{S}$ ($\widehat{SE}$)	2012 $\hat{S}$ ($\widehat{SE}$)
Yearling Chinook	0.9908 (0.0033)	0.9962 (0.0013)	0.9974 (0.0015)
Juvenile Steelhead	0.9970 (0.0018)	0.9967 (0.0012)	0.9971 (0.0015)

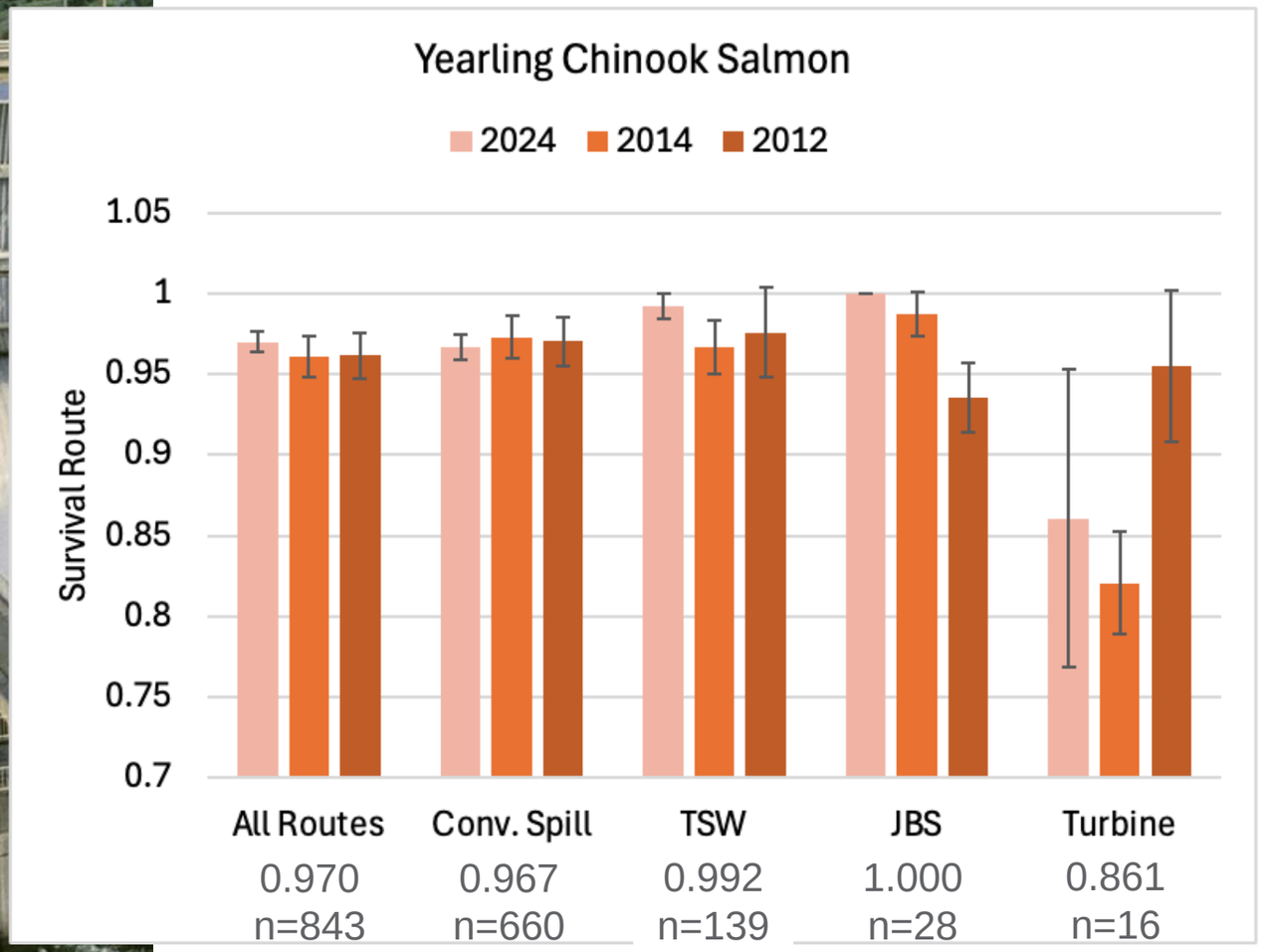
Passage Routing

Routes	2024 %	2014 %	2012 %
Yearling Chinook			
Conv. spill	78.3%[1]	59.5%	64.1%
TSW	16.5%	11.9%	8.3%
SPE	94.8%	71.4%	72.5%
JBS	3.3%	19.8%	24.3%
Turbine	1.9%	8.9%	3.2%
Juvenile Steelhead			
Conv. spill	51.9%[2]	44.6%	59.9%
TSW	43.5%	39.7%	23.3%
SPE	95.4%	84.3%	83.2%
JBS	3.7%	13.0%	14.5%
Turbine	0.9%	2.7%	2.3%

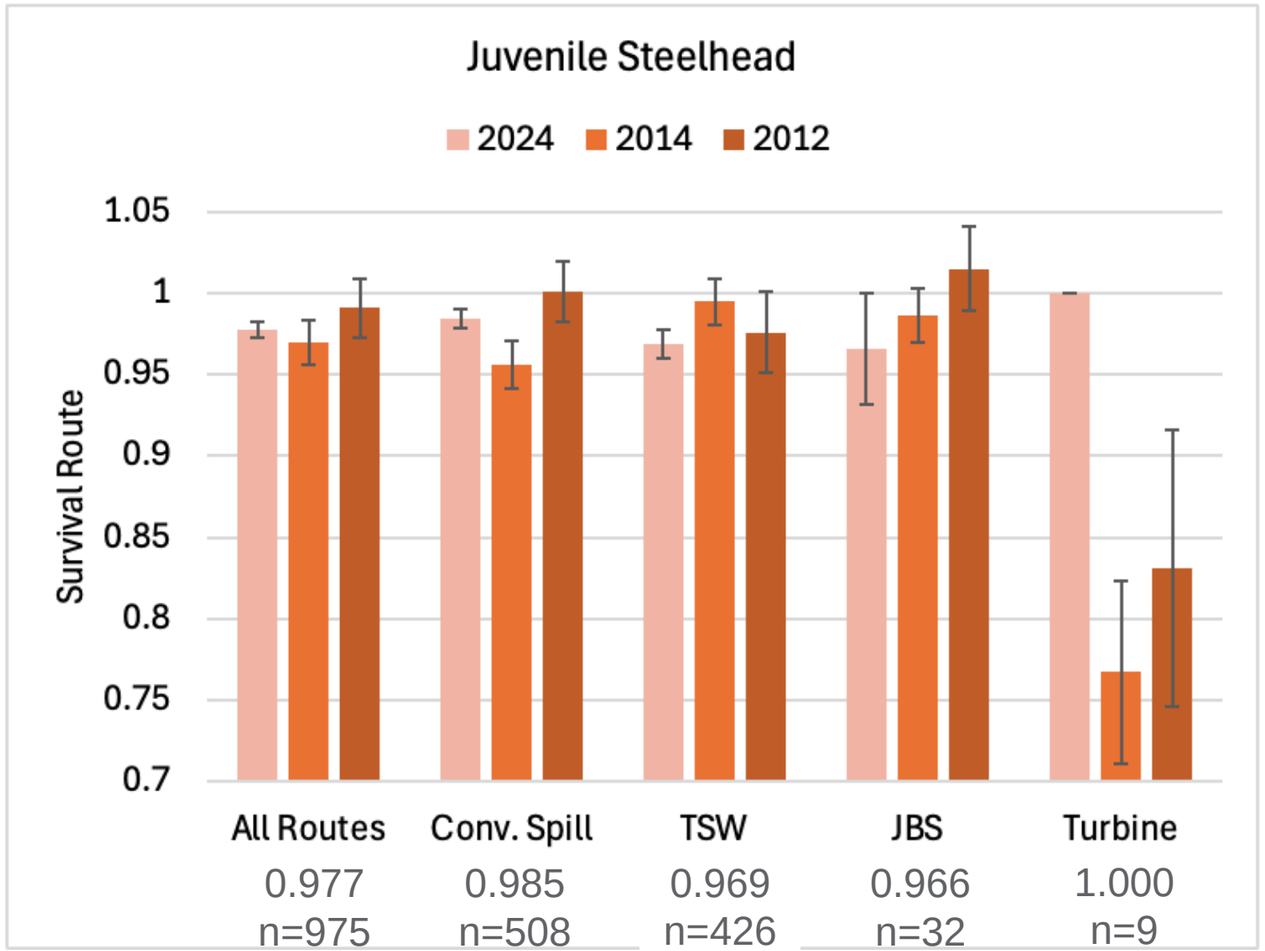
[1] 75.1% split-leaf
3.2% full gate

[2] 50.4% split-leaf
1.5% full gate

MCN Dam Passage Survival



Split-leaf bays: $\hat{S}$ = 0.967; n=633
Full gate bays: $\hat{S}$ = 0.962; n=27

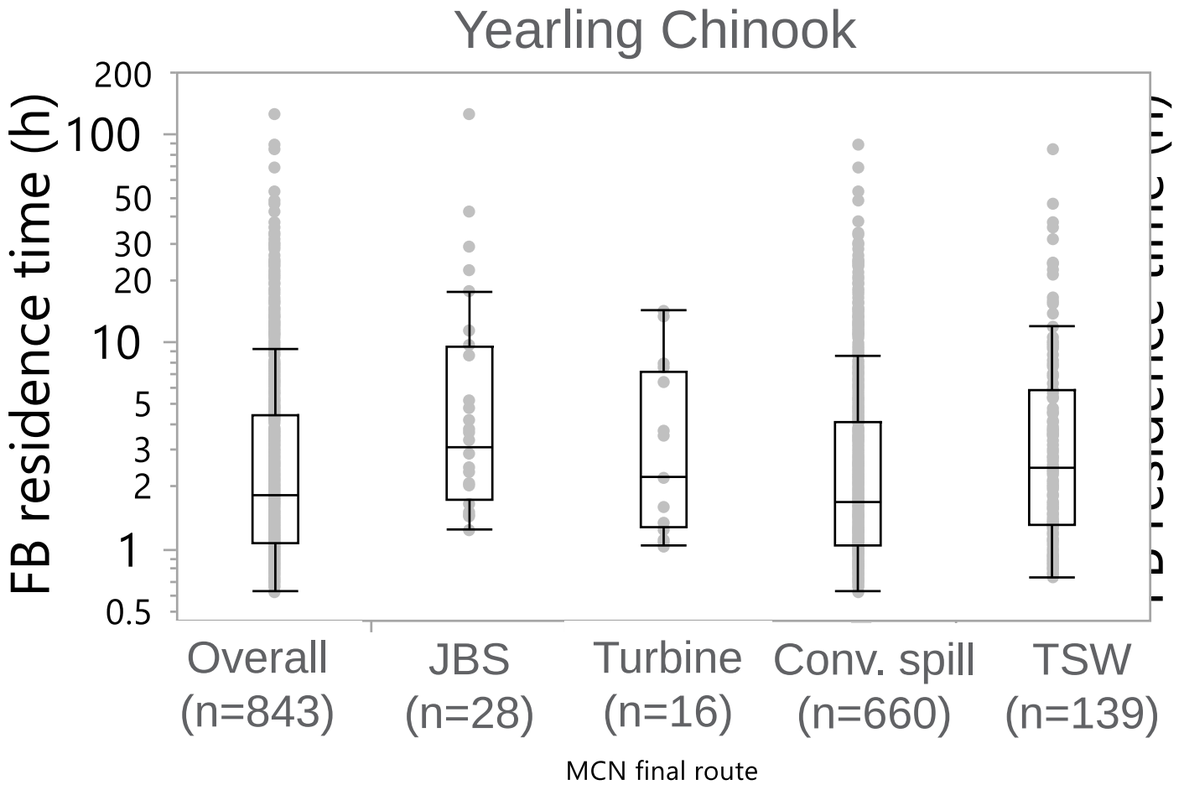


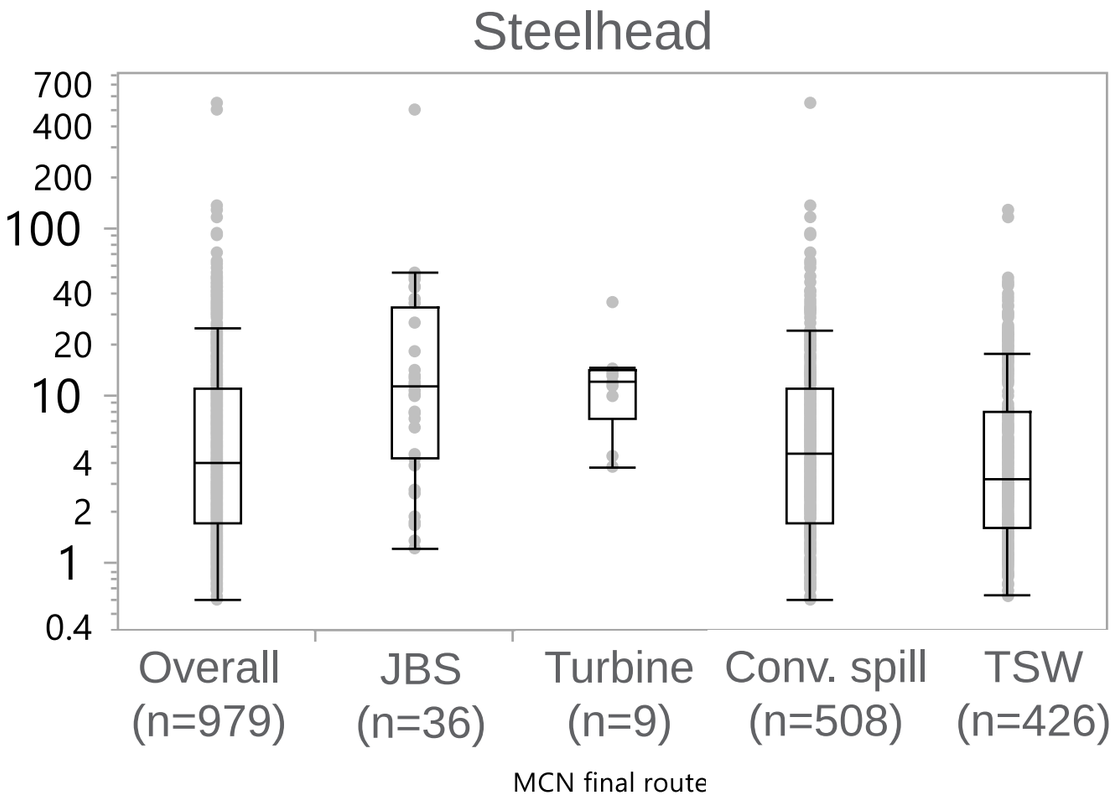
Split-leaf bays: $\hat{S}$ = 0.984; n=493
Full gate bays: $\hat{S}$ = 1.000; n=15

MCN-to-JDA Survival

Routes	2024 *n*	2024 $\hat{S}$ ($\widehat{SE}$)
Yearling Chinook		
All routes	843	0.6619 (0.0164)
Conv. spill	660	0.6648 (0.0184)
TSW	139	0.6559 (0.0404)
JBS	28	0.6442 (0.0908)
Turbine	16	0.6261 (0.1212)
Juvenile Steelhead		
All routes	975	0.7888 (0.0131)
Conv. spill	508	0.8102 (0.0175)
TSW	426	0.7782 (0.0202)
JBS	32	0.6886 (0.0821)
Turbine	9	0.4451 (0.1659)

Forebay Residence Times





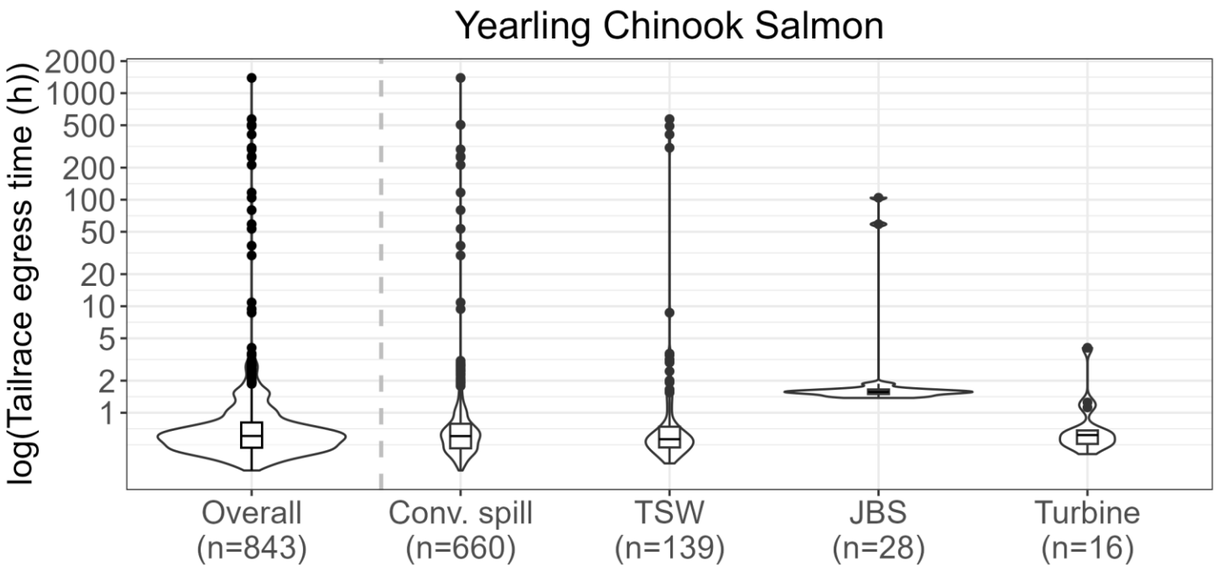
2024 median = 1.8 h

2014 median = 1.7 h
2012 median = 1.8 h

2024 median = 3.9 h

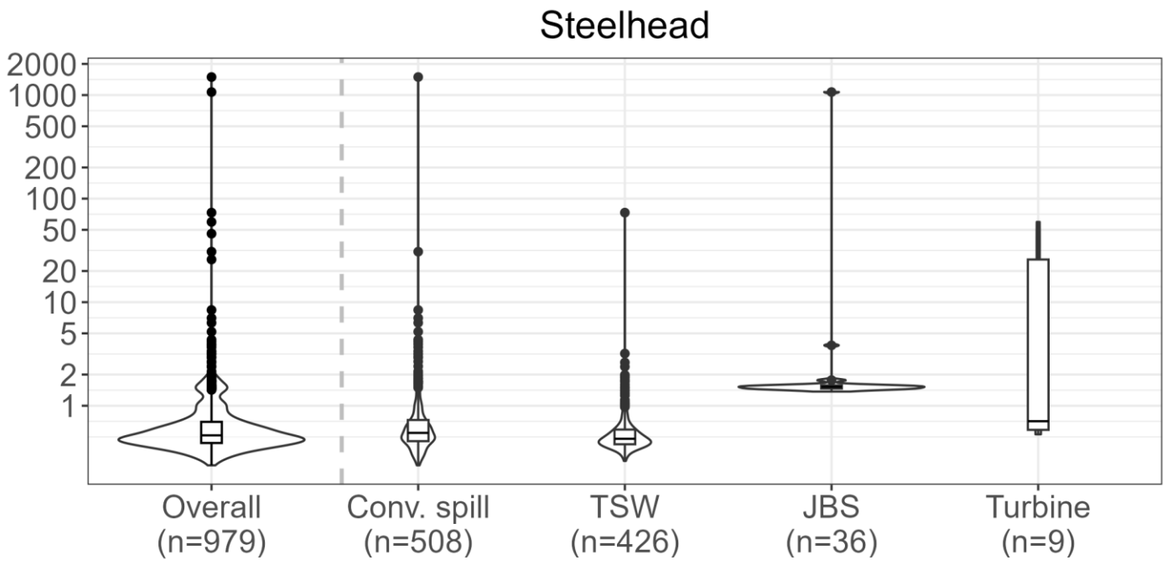
2014 median = 2.6 h
2012 median = 1.8 h

Tailrace Egress Times



2024 median = 0.61 h

2014 median = 0.44 h
2012 median = 0.41 h



2024 median = 0.52 h

2014 median = 0.37 h
2012 median = 0.34 h

Summary

- Forebay survival >0.99 for CH1 and STH
- CH1 SPE higher in 2024 (95%) compared to 2012 and 2014 (71-72%)
  - Higher conventional spill and TSW passage in ’24
- STH SPE higher in 2024 (96%) compared to 2012 and 2014 (83-84%)
  - Higher TSW passage in ’24 but similar conventional spill passage
- JBS and turbine passage much lower in 2024
- Overall dam passage survival 0.970 for CH1 and 0.977 for STH
  - Similar to 2012 and 2014
- Route-specific dam passage survival ≥0.966 for all route/species combinations except for CH1 through turbines (n = 16)
- CH1 FB residence times shortest for conventional spill, longest for JBS
  - Overall median similar to 2012 and 2014

Summary (cont.)

- STH FB residence times shorter for conventional spill and TSW
  - Overall median 1.3 – 2.1 h longer than 2012 and 2014
- CH1 TR egress times longest for JBS, similar for other routes
  - Overall median 10-12 min longer than 2012 and 2014
- STH TR egress times shortest for conventional spill and TSW
  - Overall median 9-11 min longer than 2012 and 2014

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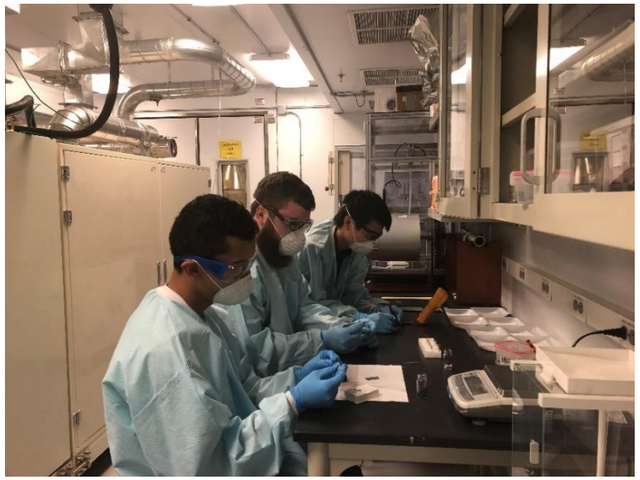
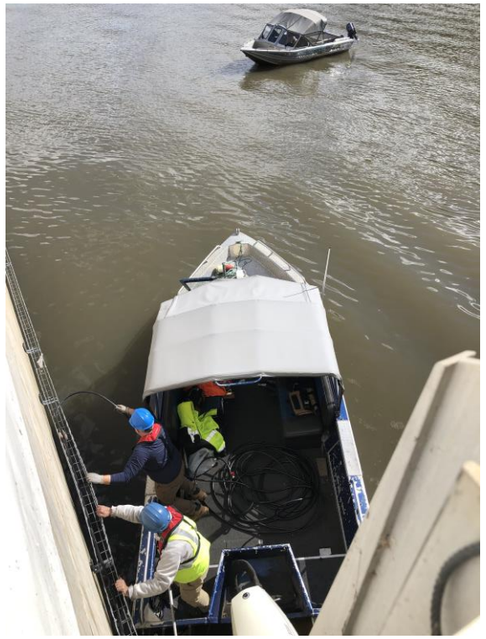
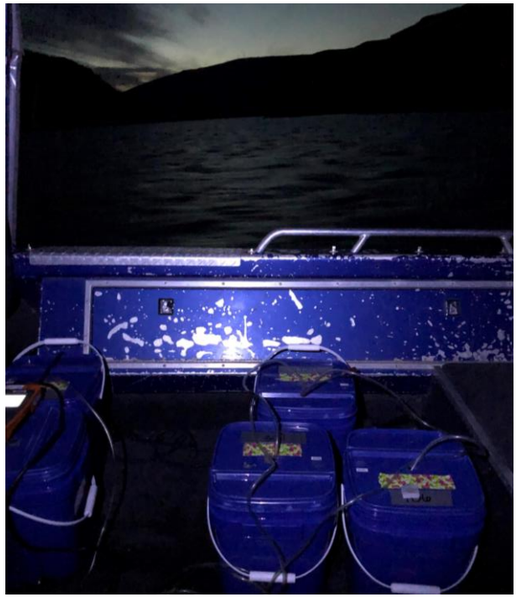
Thank you







Zhiqun.deng@pnnl.gov; Ryan.Harnish@pnnl.gov; http://JSATS.pnnl.gov/

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