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2023 Juvenile Lamprey Study at Lower Granite Dam and Lower Monumental Dam: Preliminary Results

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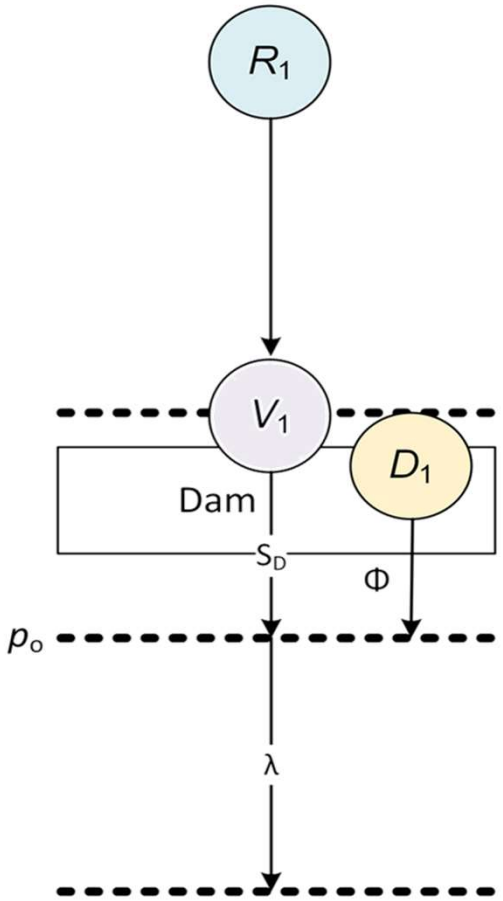
AFEP Review, January 22, 2024

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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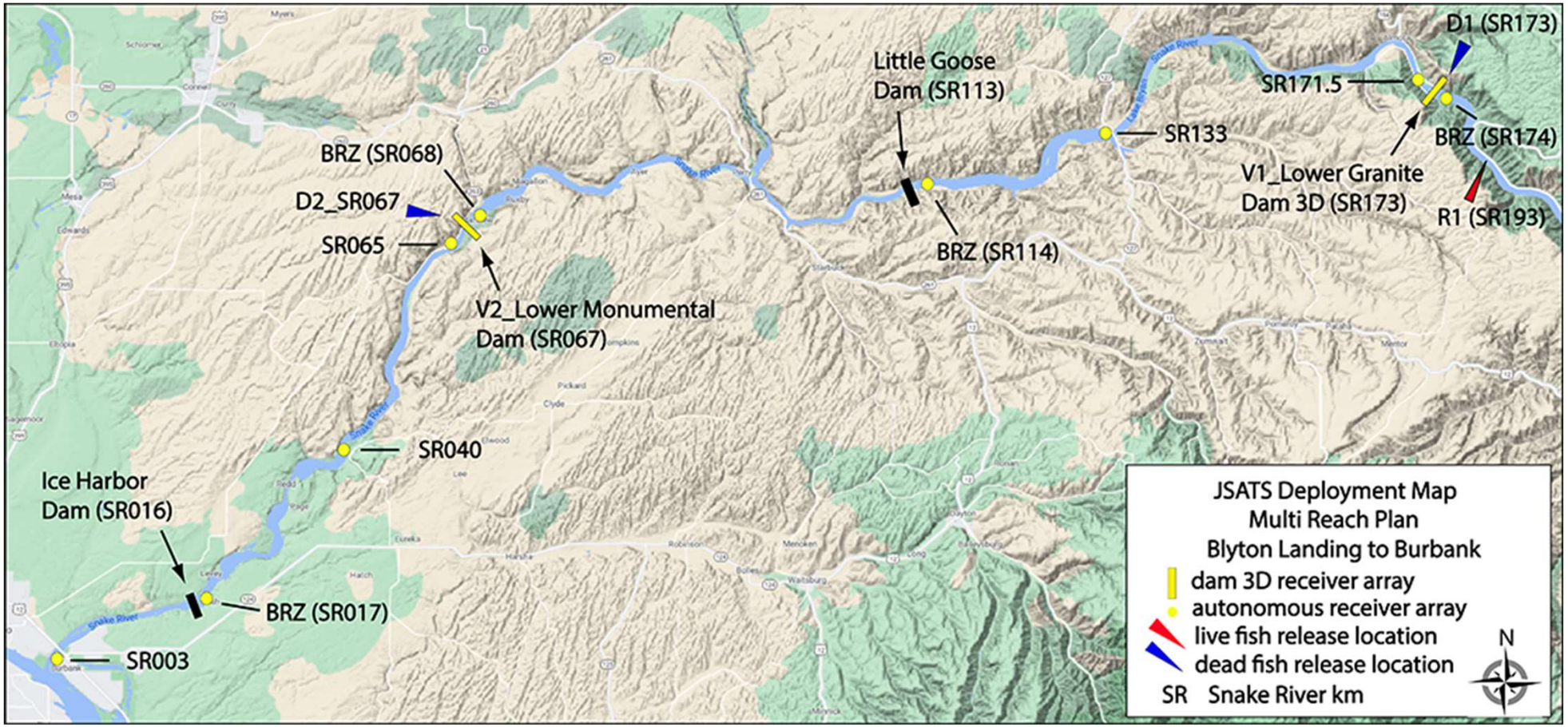
Study Design

Detection Arrays and Release Locations



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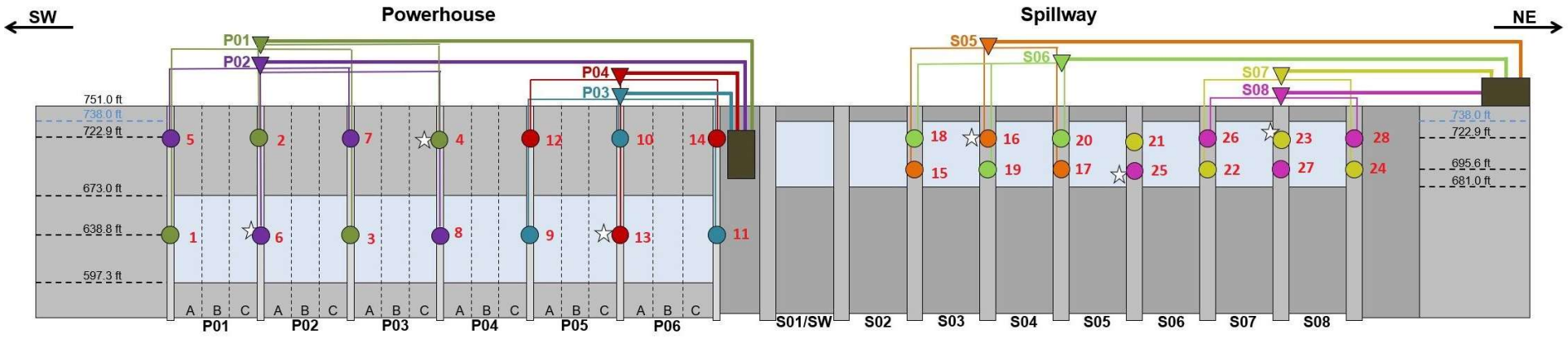
Study Design

Receiver Deployment at LGR

Forebay Cabled Array



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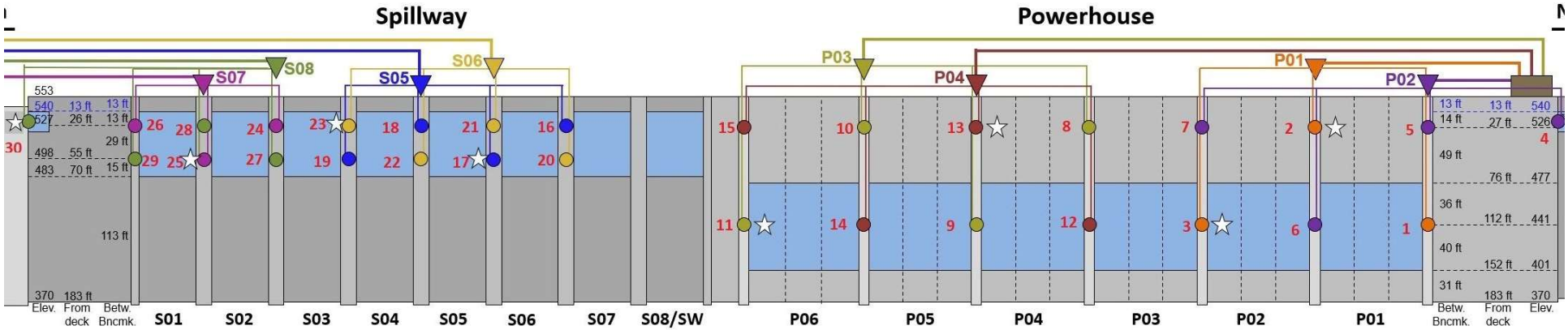
Study Design

Receiver Deployment at LMN

Forebay Cabled Array



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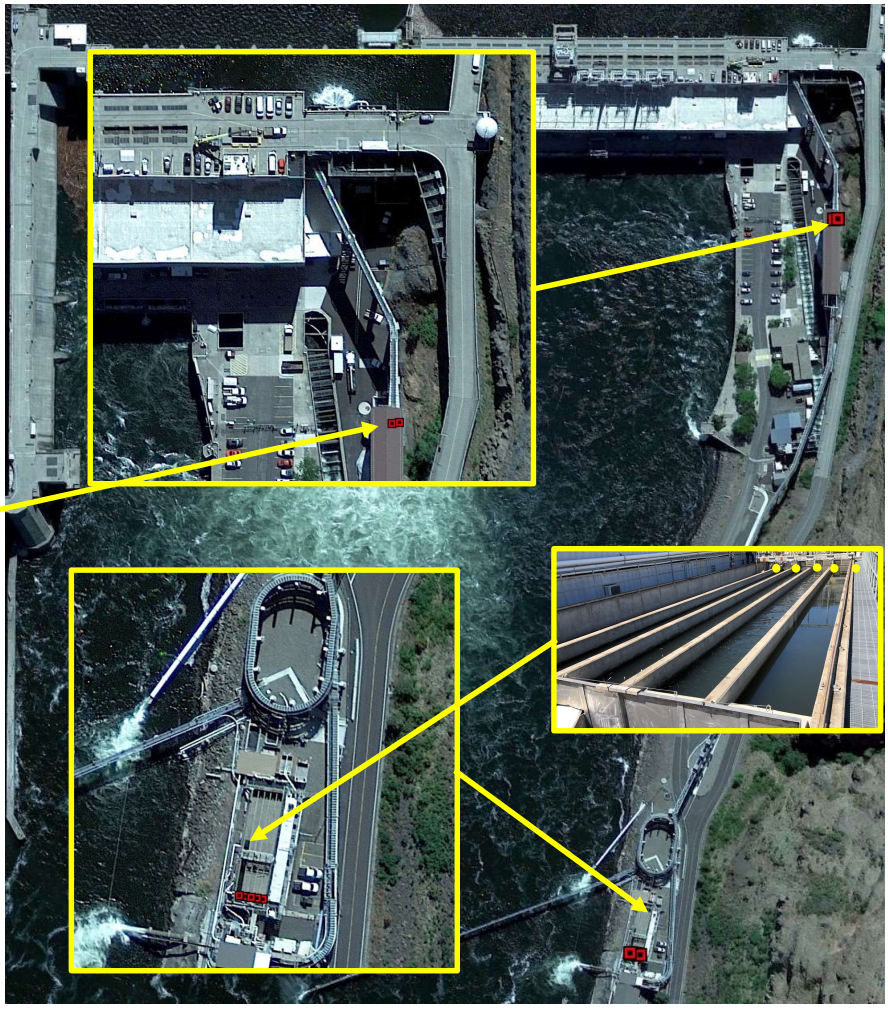
Study Design

Receiver Deployment at LGR

JBS and Raceways



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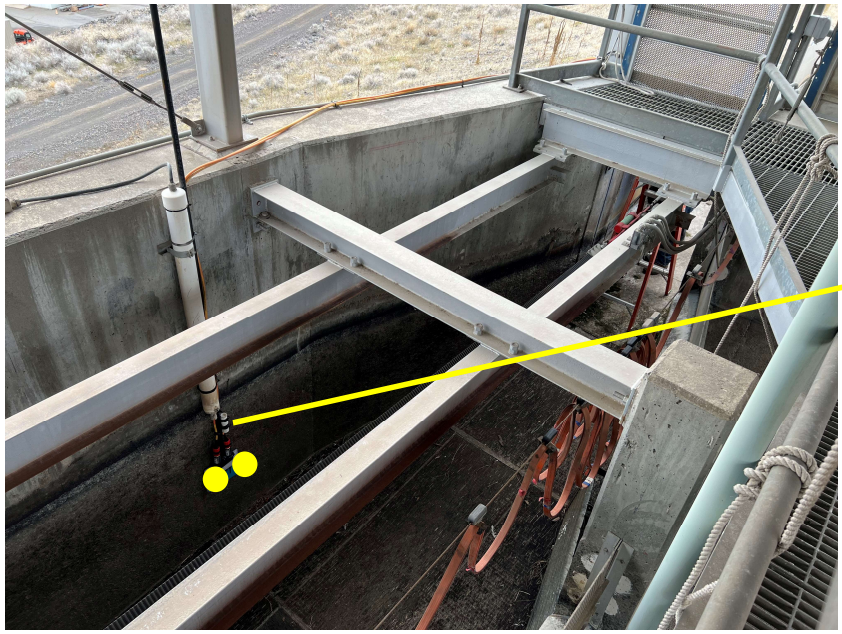
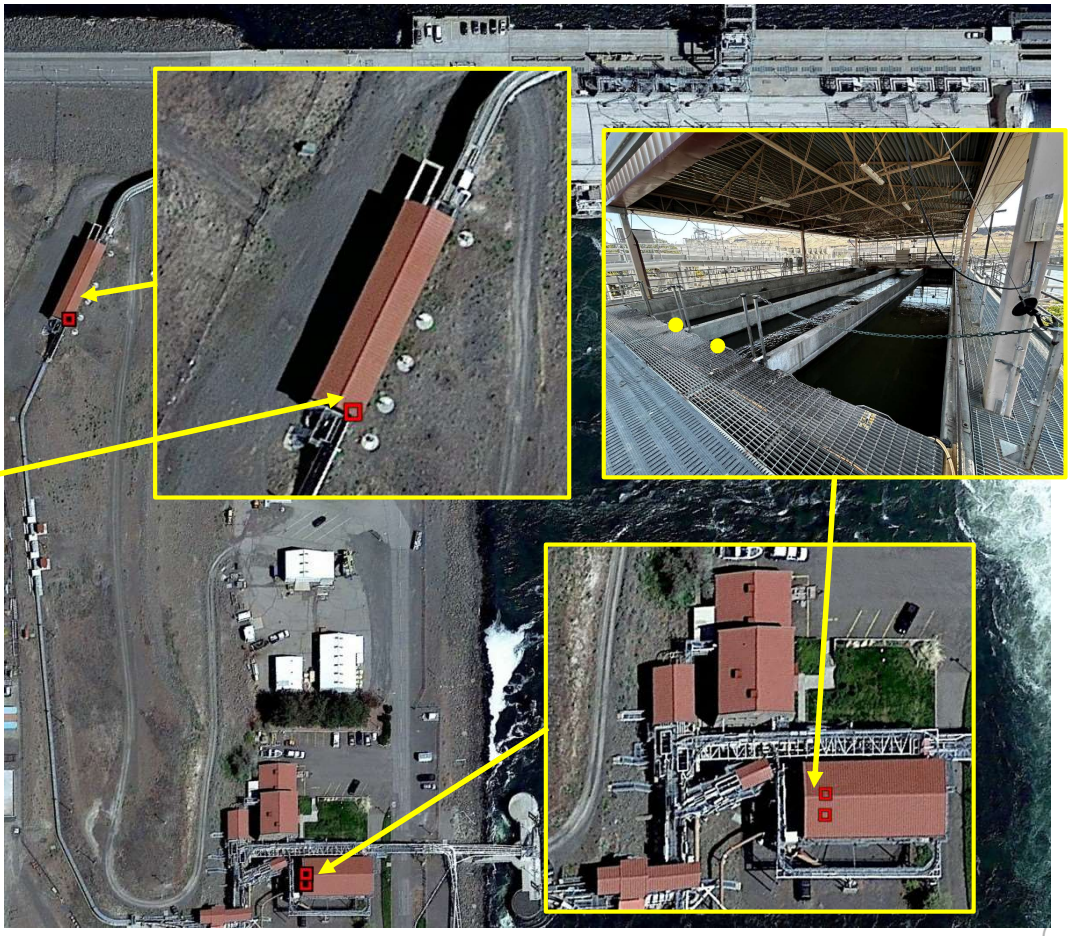
Study Design

Receiver Deployment at LMN

JBS and Raceways

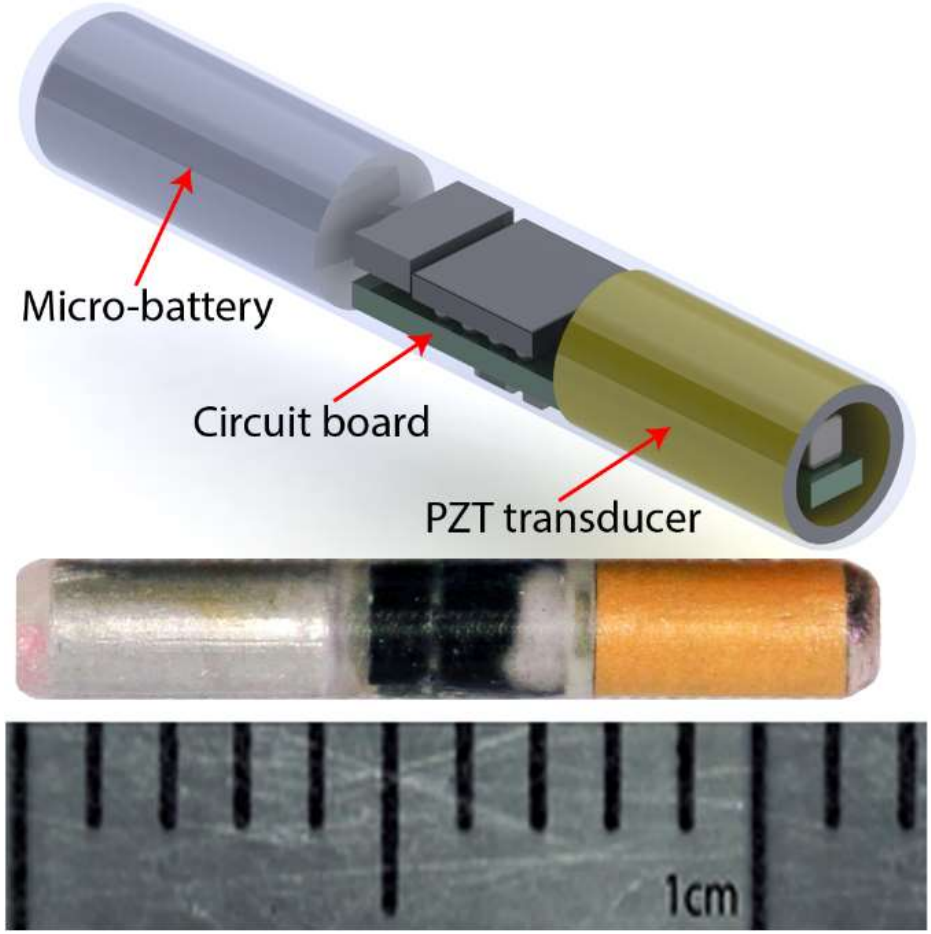




Study Design

Acoustic Transmitter

- Designed for juvenile lamprey and eels
- Dimensions: 12.0 mm x 2.0 mm
- Mass: 0.08 g
- Source level: 148 dB
- Tag life: ~30 days at 5-s pulse rate interval
- Carrier frequency: 416.7 kHz



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Survival

ViRDCt Model Assumption Tests – ROR Juveniles

- The temporal distribution of dead-released fish did not differ from that of live-released fish that died during dam passage at LGR and LMN
- The spatial (i.e., route) distribution of dead-released fish did not differ from that of live-released fish that died during dam passage at LGR and LMN
- The dead-released detection rate did not differ by route (powerhouse vs. spillway) at LGR or LMN

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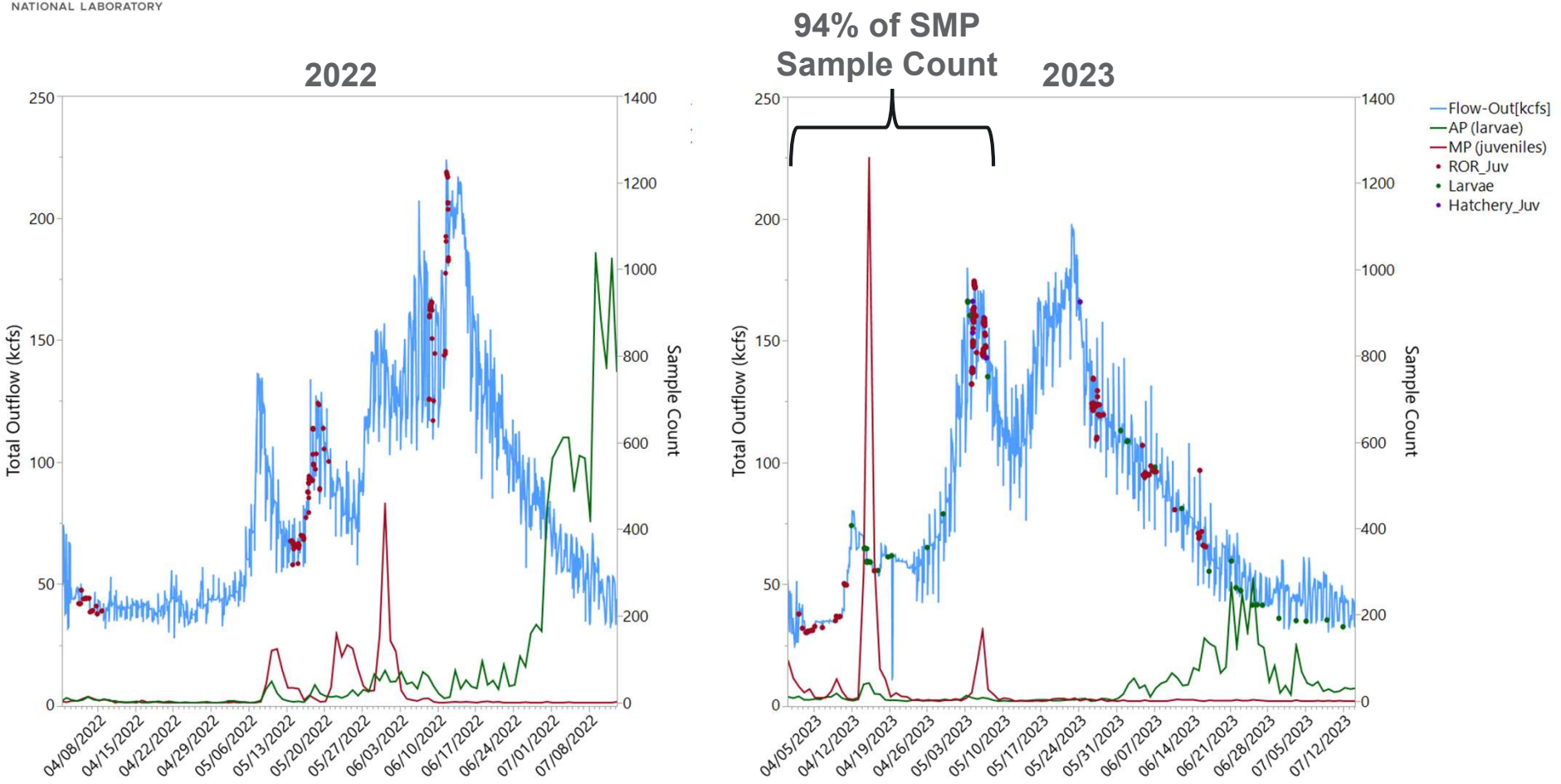
Lamprey Passage Timing at LGR



Survival - LGR

LGR Dam Passage – ROR juveniles

Season	Routes	Live N	$\hat{S}$	$\hat{S}$ (SE)
Full Season (Apr-Jun)	All	312	0.8060	0.0462
Early Apr – Early May	All	119	0.8450	0.0696
Late May – June	All	193	0.7909	0.0590
Full Season (Apr-Jun)	PH	185	0.7986	0.0556
Full Season (Apr-Jun)	SW	127	0.8191	0.0591

2022
Full season: 0.9111
May-Jun: 0.9823

Survival - LGR

46 of 262 (18%) of larval lamprey released upstream of LGR were detected passing LGR

LGR Dam Passage – ROR larvae

Season	Routes	Live N	$\hat{S}$	$\hat{S}$ (SE)
Full Season (mid-Apr – mid-Jul)	All	46	0.2925	0.1589

JBS	3%
Turbines	39%
RSW	11%
Deep spill	48%

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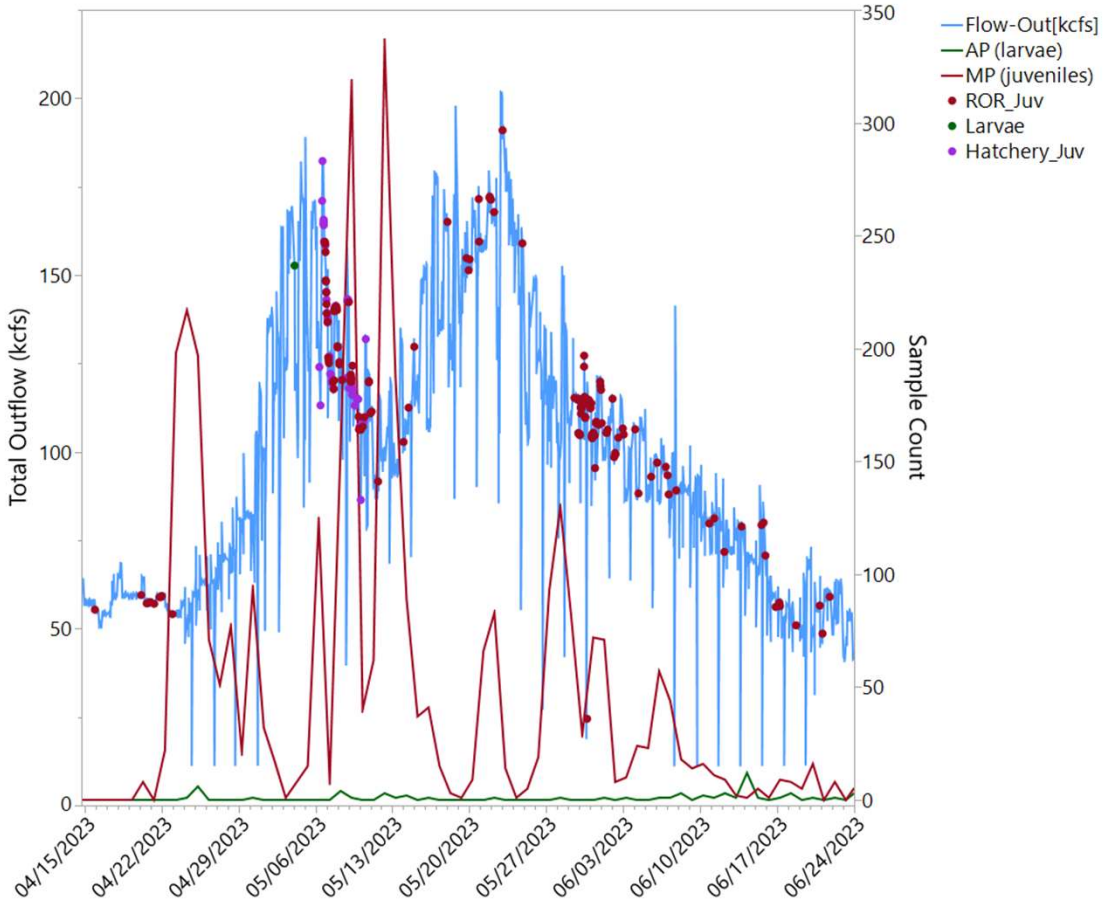
Lamprey Passage Timing at LMN

Juvenile lamprey sampled in JFF

- Mar 1 – Oct 1 2023
  - Total: 3,538
  - March: 85 (2%)
  - April: 981 (28%)
  - May: 2,093 (59%)
  - June: 373 (11%)
  - Jul – Sep: 6 (<1%)

Larval lamprey sampled in JFF

  - Total: 78



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Survival - LMN

LMN Dam Passage – ROR juveniles

Season	Routes	Live N	$\hat{S}$	$\hat{S}$ (SE)
Full Season (mid-Apr – Jun)	All	179	0.8119	0.0653
Full Season (mid-Apr – Jun)	PH	69	0.7781	0.0999
Full Season (mid-Apr – Jun)	SW	110	0.8218	0.0755

LMN-to-Ice Harbor Pool – ROR juveniles

Season	Routes	Live N	$\hat{S}$	$\hat{S}$ (SE)
Full Season	All	179	0.8571	0.0673

Survival

Detection Probability Estimates – ROR Juveniles

Detection Location	AT ROR juv. *p* (SE)	PIT ROR juv. *p* (SE)
LGR Forebay	1.0000 (0.0000)	NA
LGR	0.9959 (0.0040)	0.1445 (0.0545)
LGR Tailrace	0.9877 (0.0071)	NA
Central Ferry	0.9915 (0.0060)	NA
LGS Forebay	0.9897 (0.0073)	NA
LGS	NA	Not estimable
LMN Forebay	0.9889 (0.0078)	NA
LMN	0.9862 (0.0097)	0.0526 (0.0512)
LMN Tailrace	0.9854 (0.0103)	NA
IHR Pool	0.9912 (0.0088)	NA
IHR Forebay	0.9881 (0.0118)	NA
IHR	NA	Not estimable
MCN	NA	0.1429 (0.1323)

Likely overestimated. Of the 7 fish detected downstream of MCN, 1 was detected at MCN

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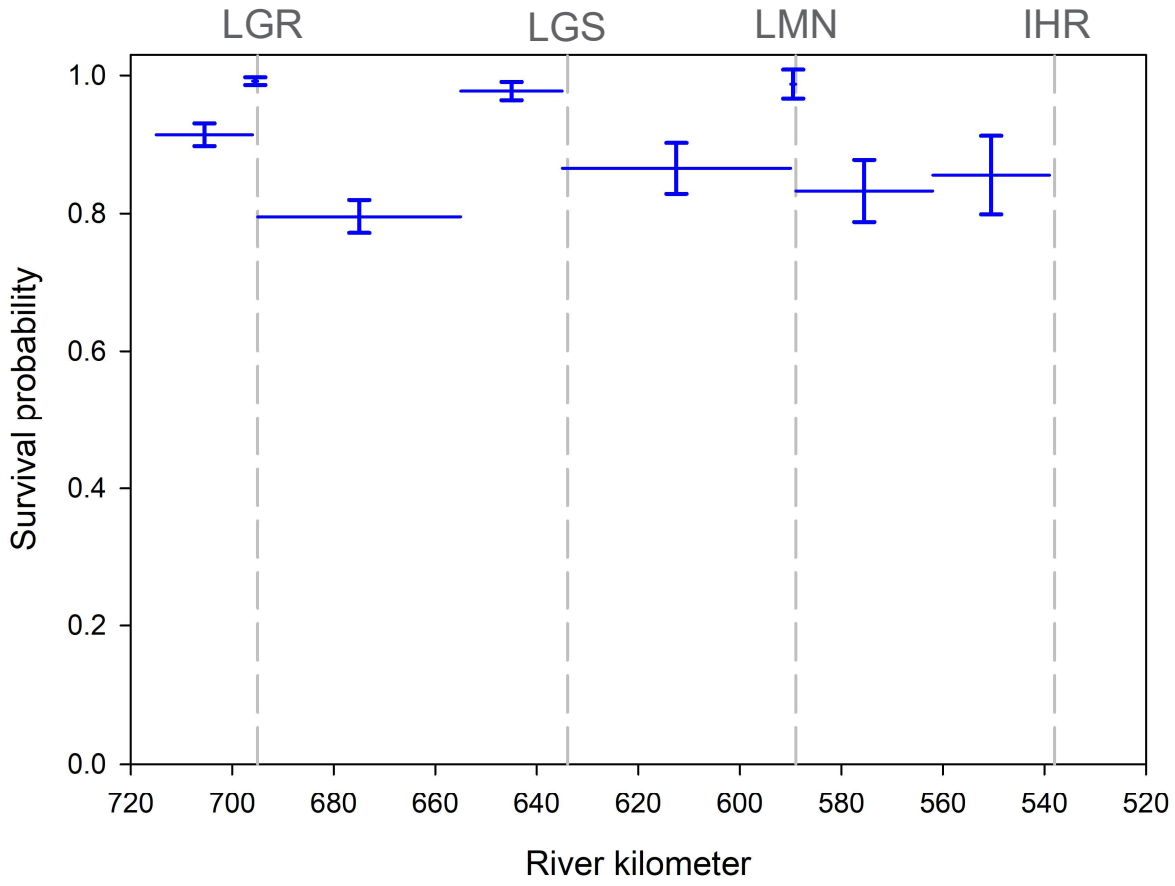
Survival

Reach Estimates – ROR Juveniles



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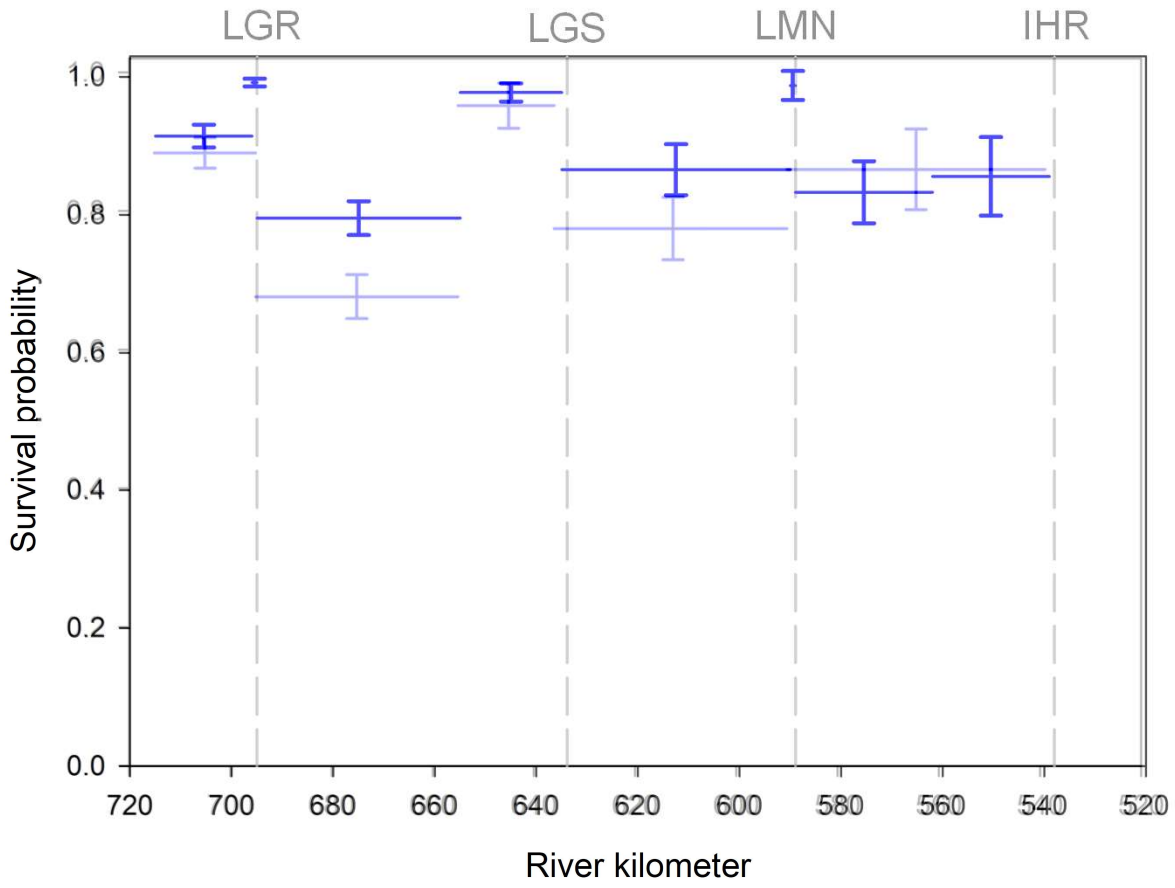
Survival

Reach Estimates – ROR Juveniles (2023 vs. 2022)



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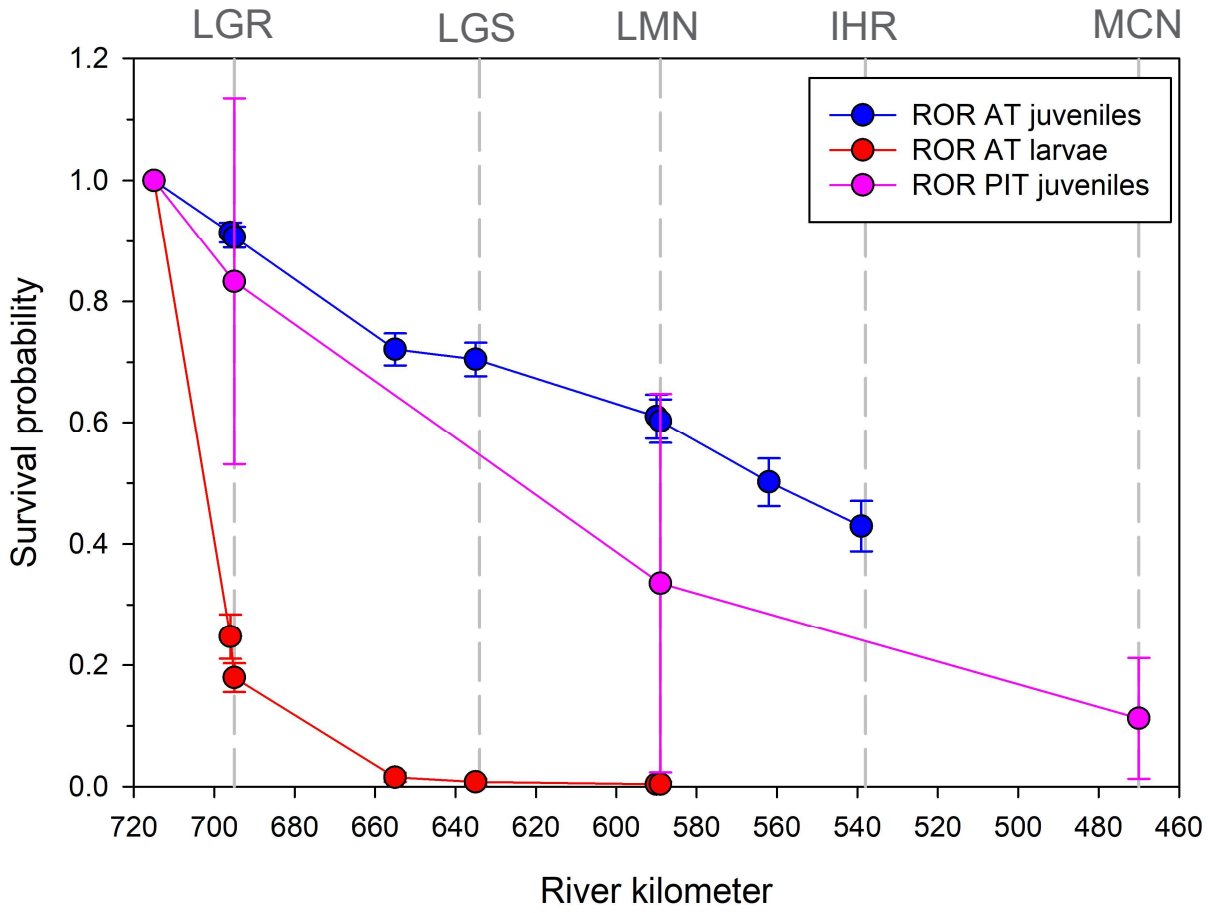
Survival

Cumulative – ROR Juveniles & Larvae



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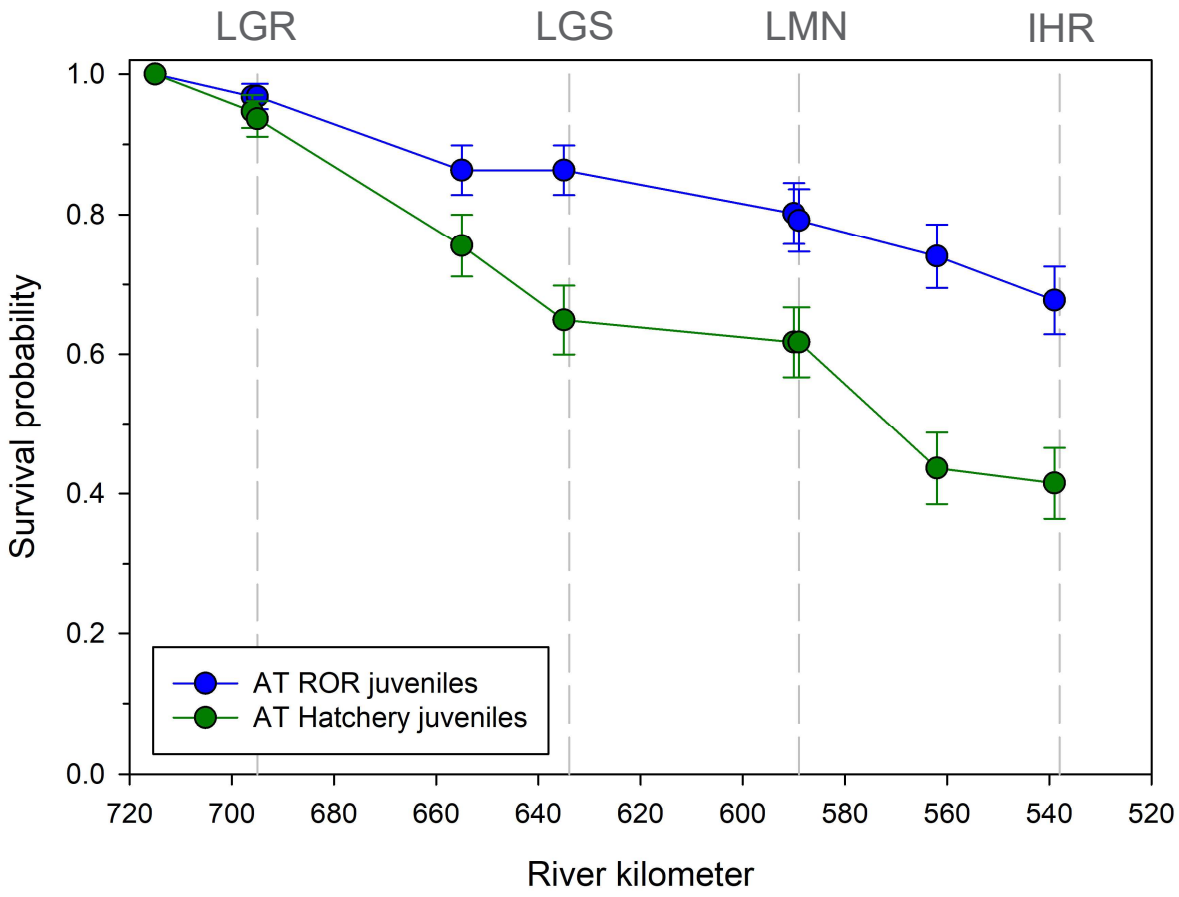
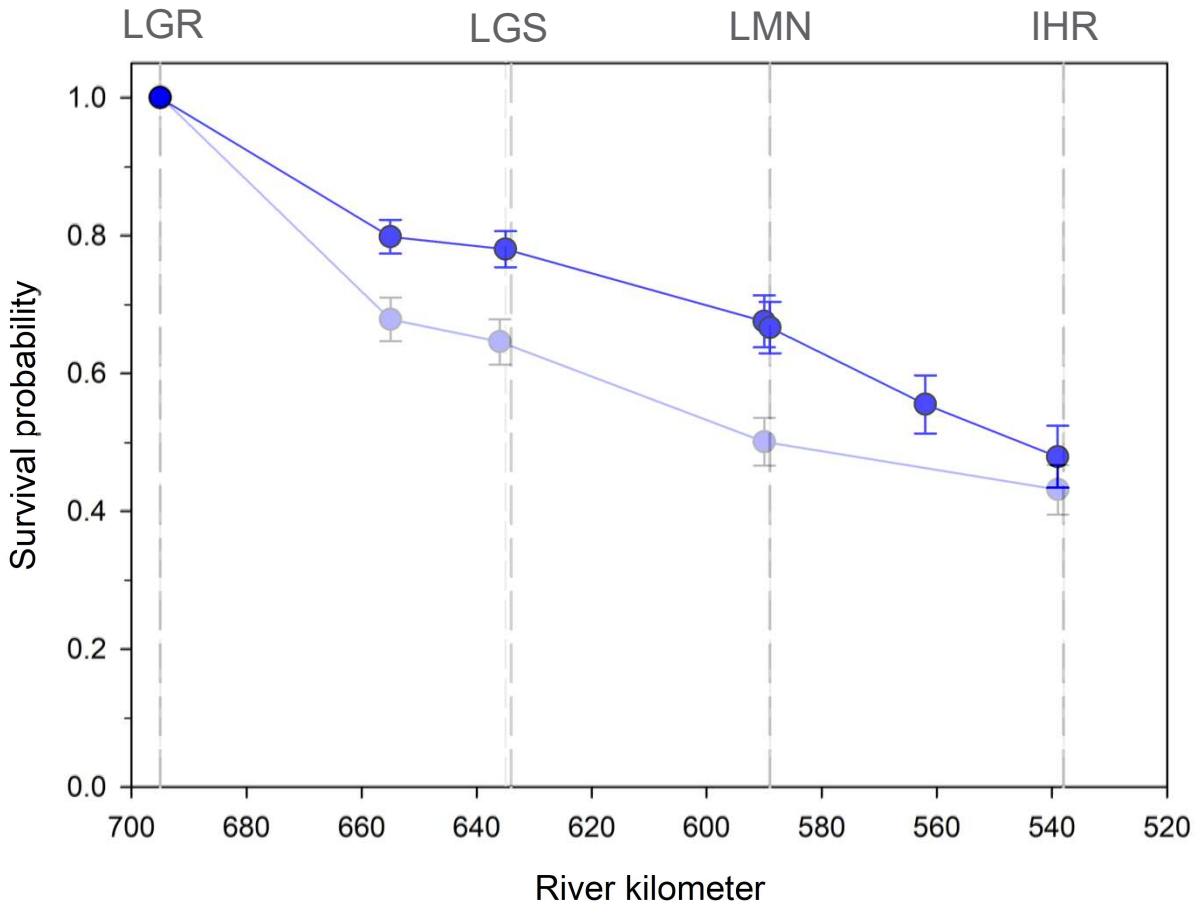
Survival

Cumulative – May 3 & 5 ROR & Hatchery Juveniles



Survival

Cumulative – ROR Juveniles (2023 vs. 2022)



Behavior - LGR

Factors Affecting Passage Routing – ROR Juveniles

	Total N	JBS %	Turbine %	PH %	RSW %	Deep Spill %	Spillway %
Day	198	4	64	68	4	28	32
Night	114	8	37	45	13	42	55
GC	259	6	48	54	8	37	46
PS	51	4	80	84	2	14	16
Overall	**312**	**5**	**54**	**59**	**7**	**33**	**41**

2022

	Total N	JBS %	Turbine %	PH %	RSW %	Deep Spill %	Spillway %
Overall	**270**	**?**	**?**	**54**	**12**	**34**	**46**

*GC: Gas Cap; PS: Performance Standard

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Behavior - LMN

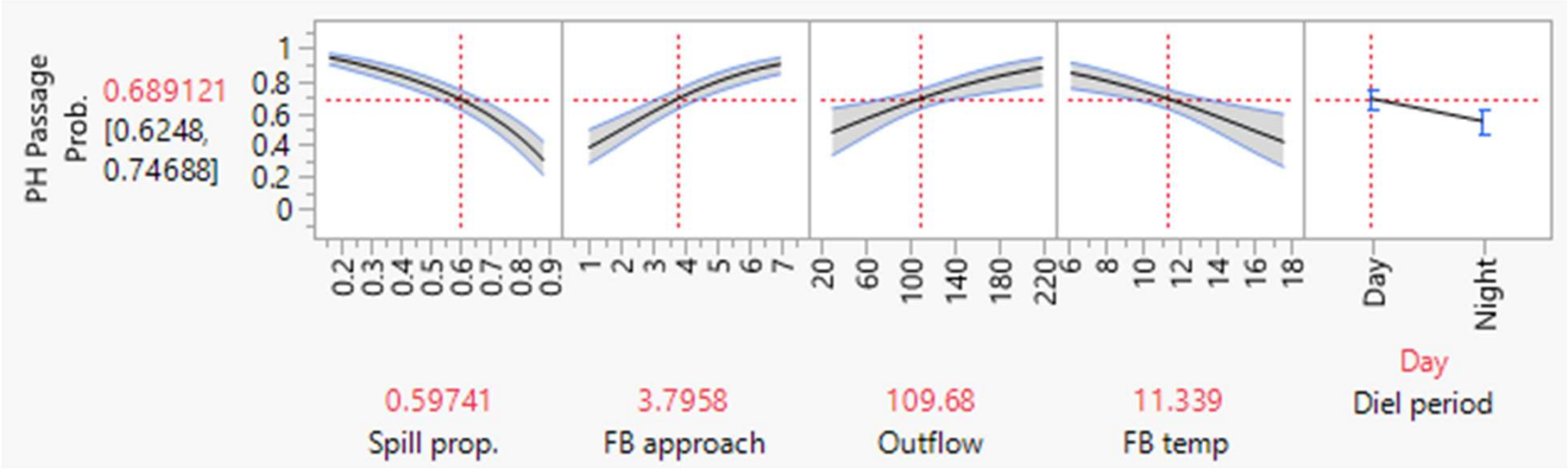
Factors Affecting Passage Routing – ROR Juveniles

	Total N	PH %	RSW %	Deep Spill %	Spillway %
Day	83	41	5	54	59
Night	96	36	10	53	64
GC	98	28	9	63	72
PS	77	53	6	40	47
Overall	**179**	**39**	**8**	**54**	**61**

*GC: Gas Cap; PS: Performance Standard

Behavior - LGR

Factors Affecting Passage Routing – ROR Juveniles (2022 & 2023)



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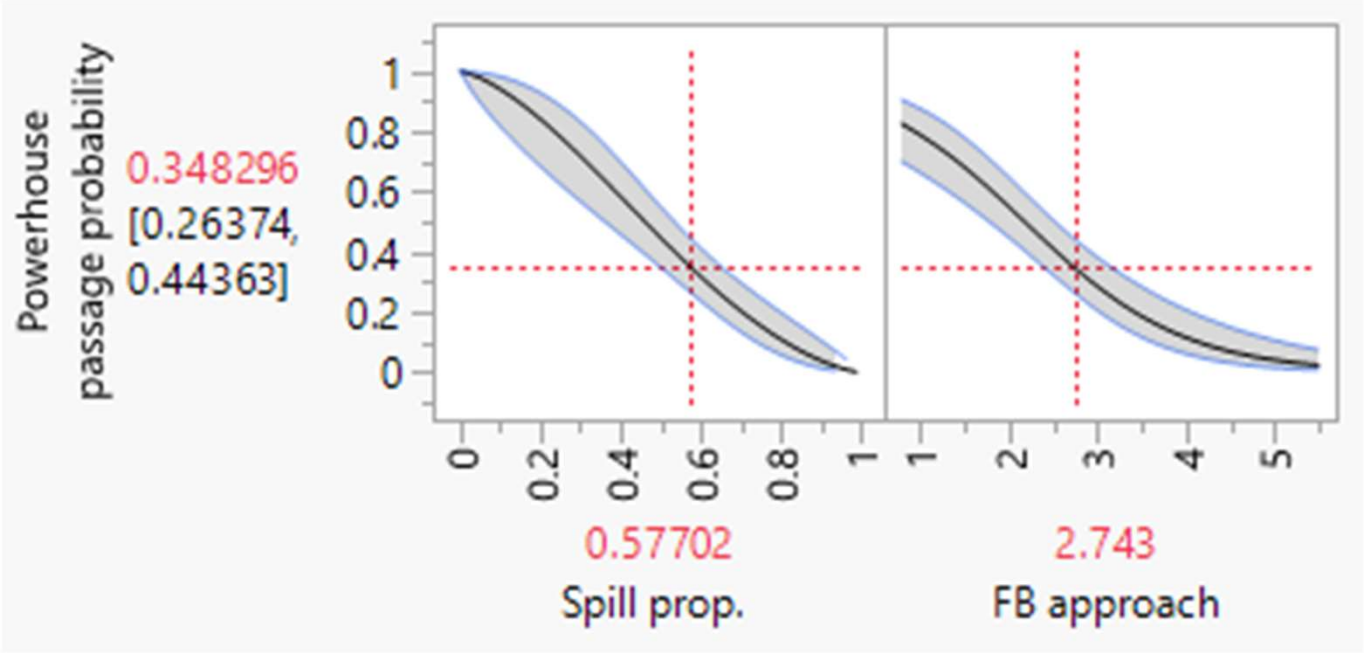
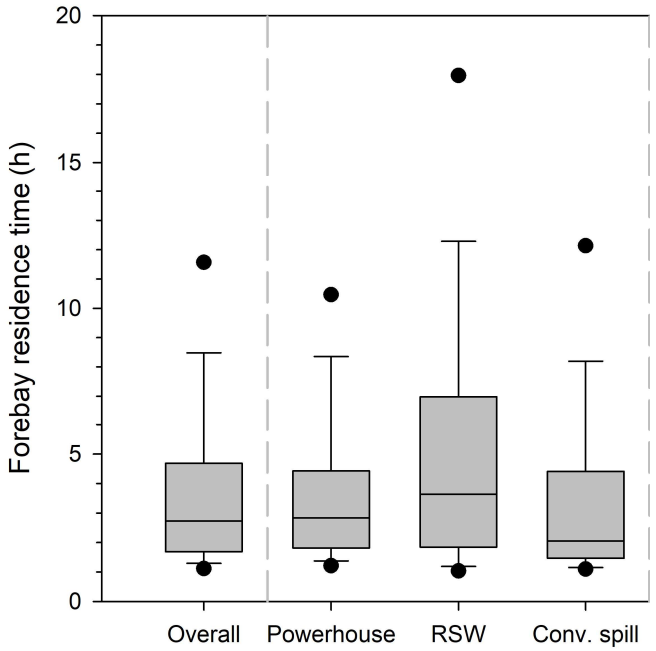
Behavior - LMN

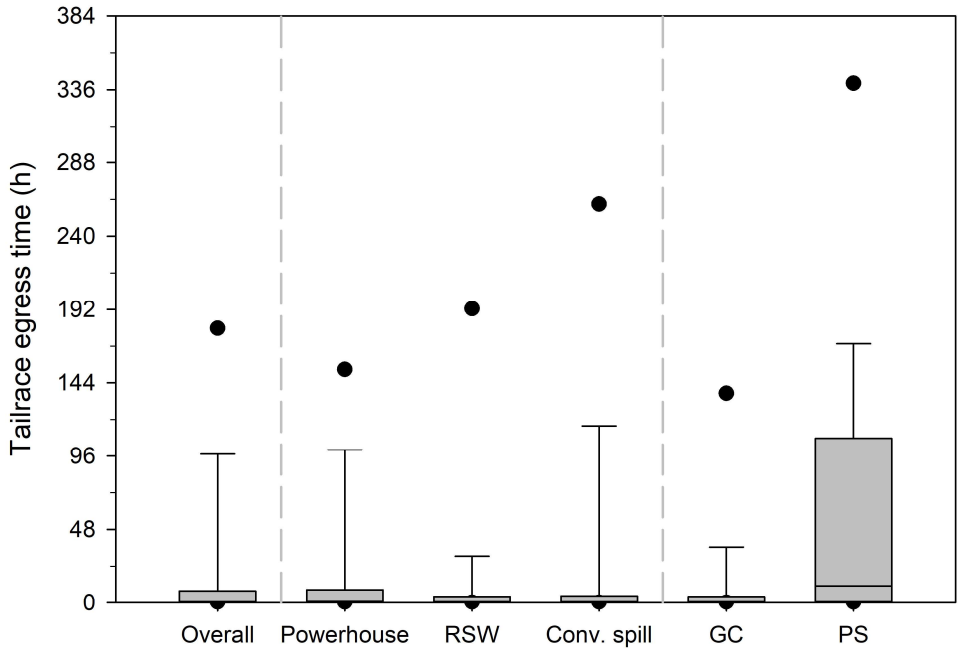
Factors Affecting Passage Routing – ROR Juveniles



Behavior - LGR

Forebay Residence & Tailrace Egress Times – ROR Juveniles





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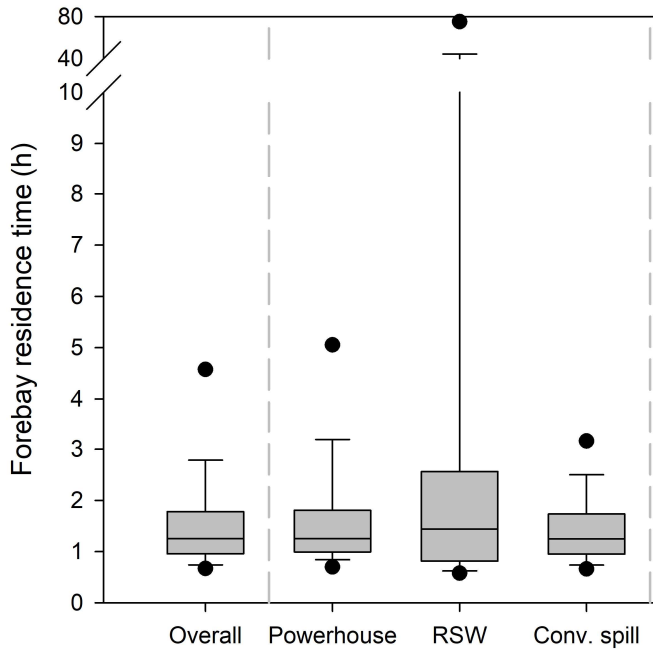
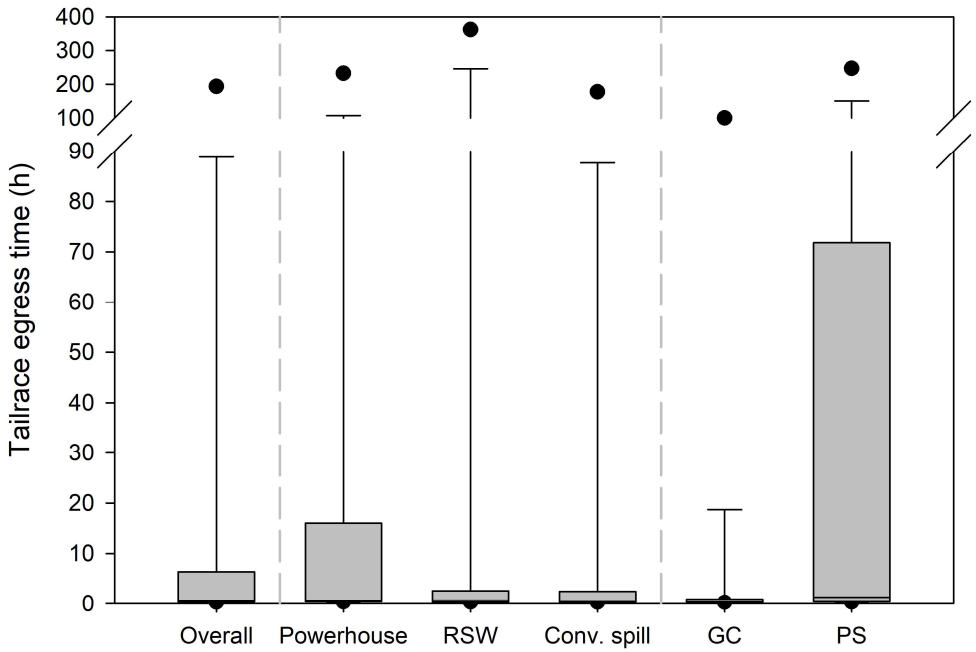
Behavior - LMN

Forebay Residence & Tailrace Egress Times – ROR Juveniles





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Preliminary Summary

- LGR dam passage survival is lower in 2023 compared to 2022 for ROR juveniles
- LGR-to-CF survival is higher in 2023 compared to 2022 and LGR-to-IHR similar in 2023 and 2022 for ROR juveniles
- ROR juvenile survival is similar for powerhouse and spillway passed fish
- Larval fish did not appear to migrate
- Survival of artificially propagated juvenile lamprey lower than ROR juveniles
- Very high uncertainty associated with PIT estimates
- Forebay residence times generally quite low (<5 h)
- Tailrace egress times highly variable and highest during PS spill
- Passage routing affected by spill, cross-channel approach location, total discharge, forebay temperature, diel period

Acknowledgments

- **US Army Corps of Engineers** for funding the study
- **Corps-Tribal Lamprey Work Group** for project coordination and guidance
- **Yakama Nation Fisheries** for supplying fish for surgeon training and dead fish releases
  - Ralph Lampman, Tyler Beals, Davey Lumley
- **U.S. Army Corps of Engineers Staff** for field support:
  - Elizabeth Holdren, David Miller, Denise Griffith, Axel Addis, Deb Snyder, Brooke Gerard
- **Fish collection from various agencies**:
  - Matt Paulsen, Paul Burke, Darren Chase, Shawn Rapp, Lauren Thielman, Mark Morasch, Mary Spanos and many technicians
- **Pacific Northwest National Laboratory Staff**:
  - Emily Akins, Kevin Baar, Brandon Boehnke, Jill Janak, Adam Hall, Pascal Elsinghorst, Brianna Friedman, Adrian Garza, Kris Hand, Joe Hawkins, Kathy Lavender, Xingmin Lin, Brian Mason, Adam Meyers, Kristian Nelson, Aaron Newton, Taylor Oxman, Guanze Peng, Brett Pflugrath, Jackie Razey, Rodrigo Ruiz, Cassy Shaffer, John Stephenson, Thuy-Dung Tran, Dana Vesty, Meijuan Wang, Hongliang Xu, and many more.
- **Columbia Basin Research, University of Washington** for reviewing the statistical results
  - Rebecca Buchanan, Rich Townsend
- **U.S. Department of Energy** for co-funding the technology development

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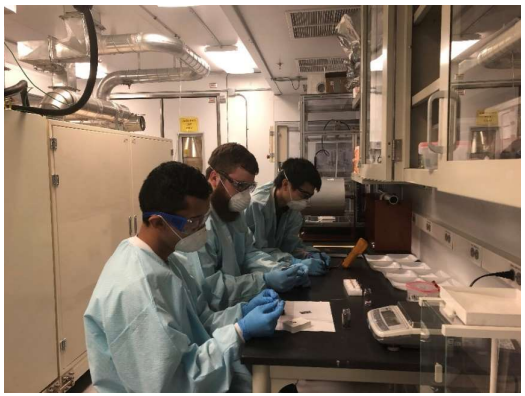
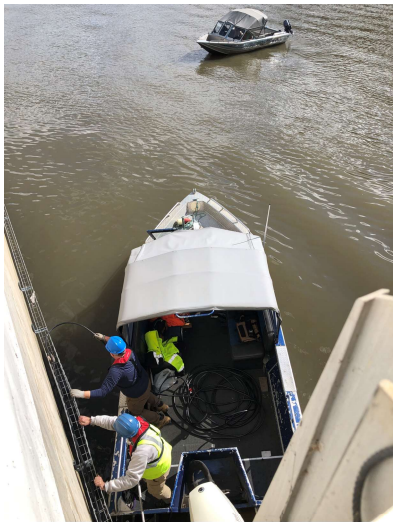
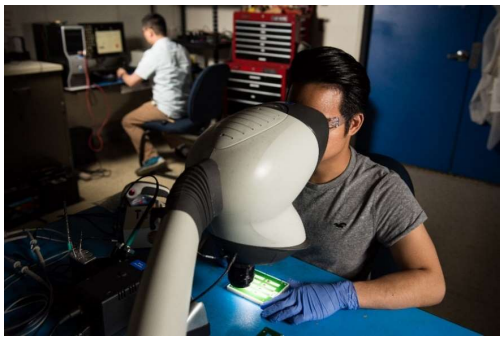
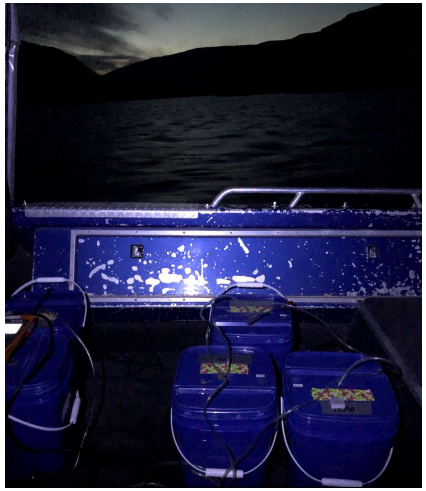
Thank you









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