

The Use of Three Types of PIT tag antennas at Zosel Dam on the Okanogan River

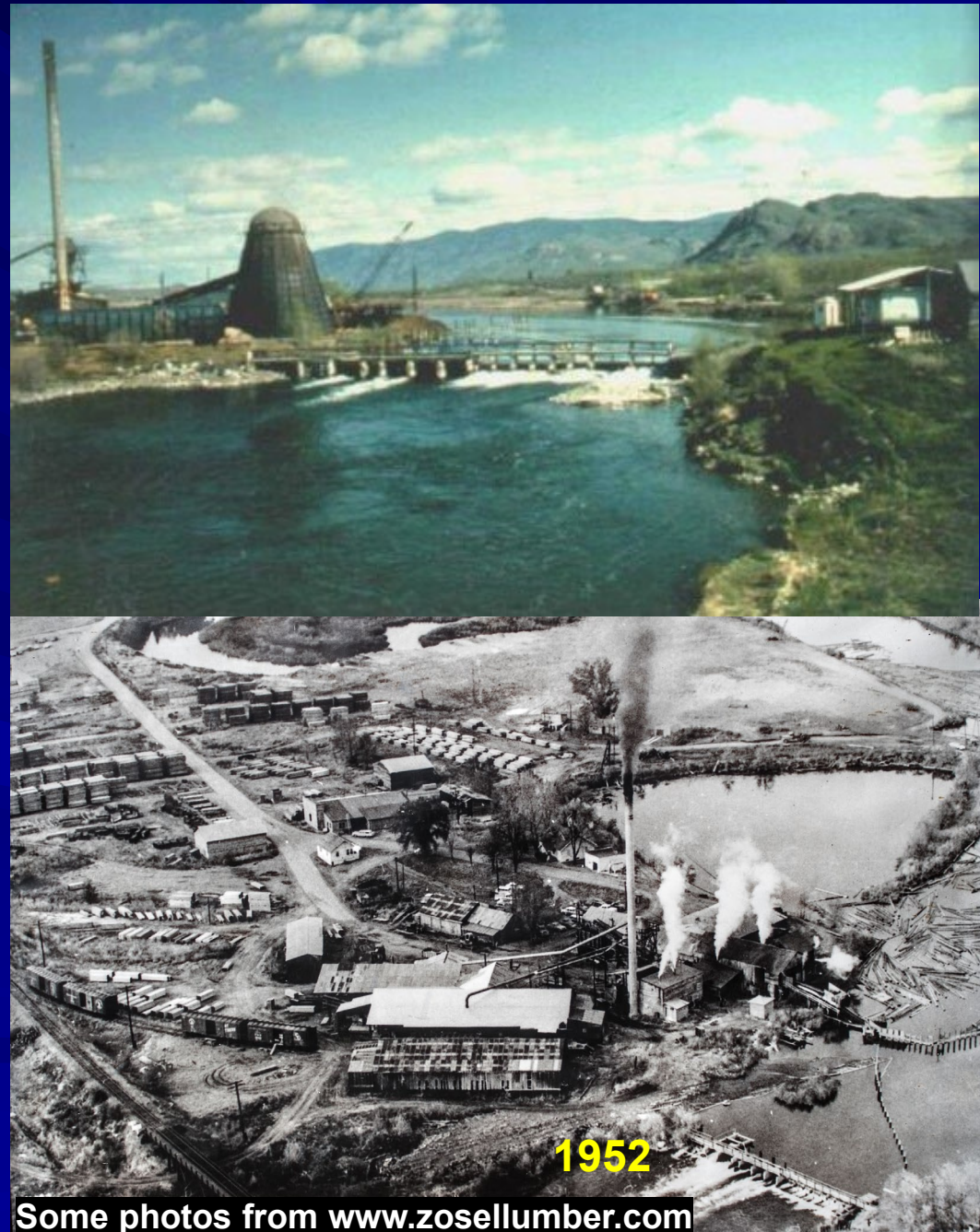
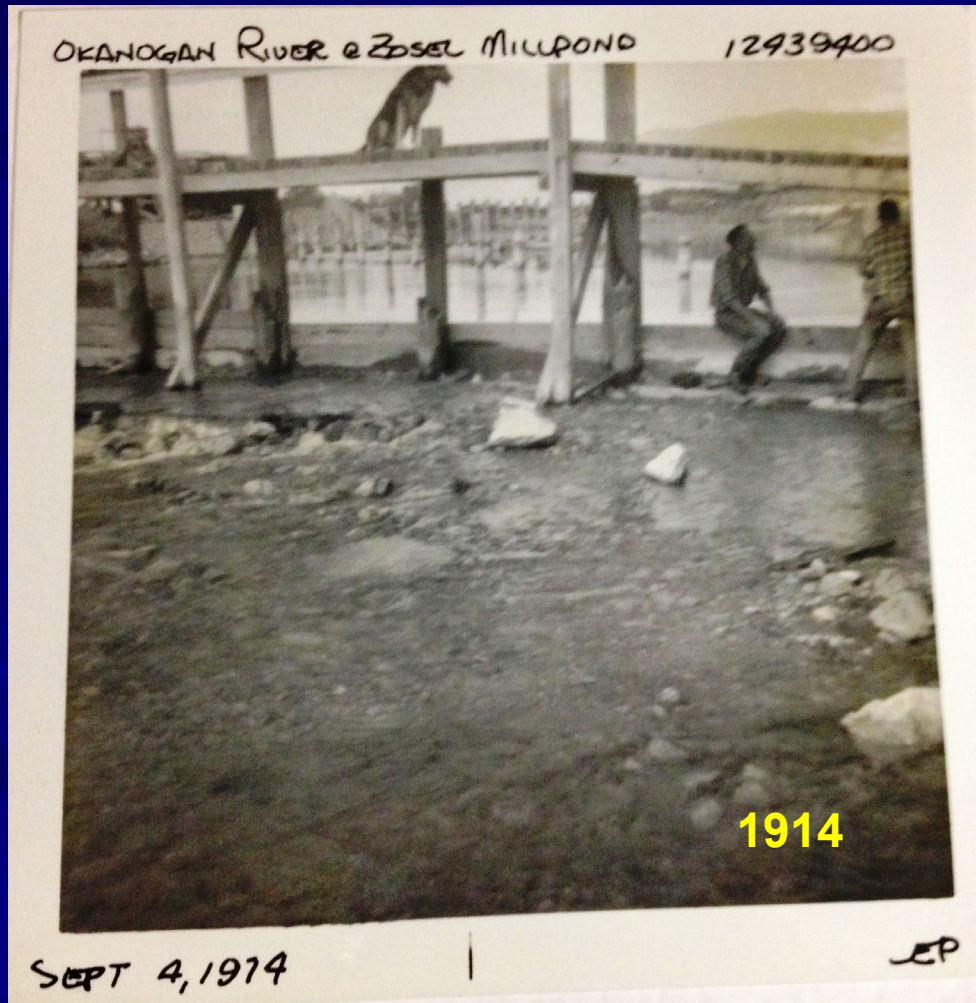
Jeffrey K. Fryer, Ph.D.
Columbia River Inter-Tribal Fish Commission



2024 PIT Tag Workshop,
January 30, 2024
Skamania, WA

Zosel Dam

Built 1927 at the outlet of Osoyoos Lake for delivery of logs to Zosel Mill in Oroville, WA



DEPARTMENT OF FISHERIES
State of Washington

C.B.

FILE IN BOOKCASE

Report of the Preliminary Investigations Into
the Possible Methods of Preserving
the Columbia River Salmon
and Steelhead at the
Grand Coulee Dam



Prepared for
THE UNITED STATES BUREAU OF RECLAMATION

by
The State of Washington, Department of Fisheries, in
cooperation with the Department of Game, and
the United States Bureau of Fisheries

N.S. Washington, Dept. of Fisheries

B. M. BRENNAN, Director of Fisheries

January, 1938

Technical Library
Bureau of Reclamation
Denver, Colorado

Fish first counted at the
old Zosel Dam in 1935

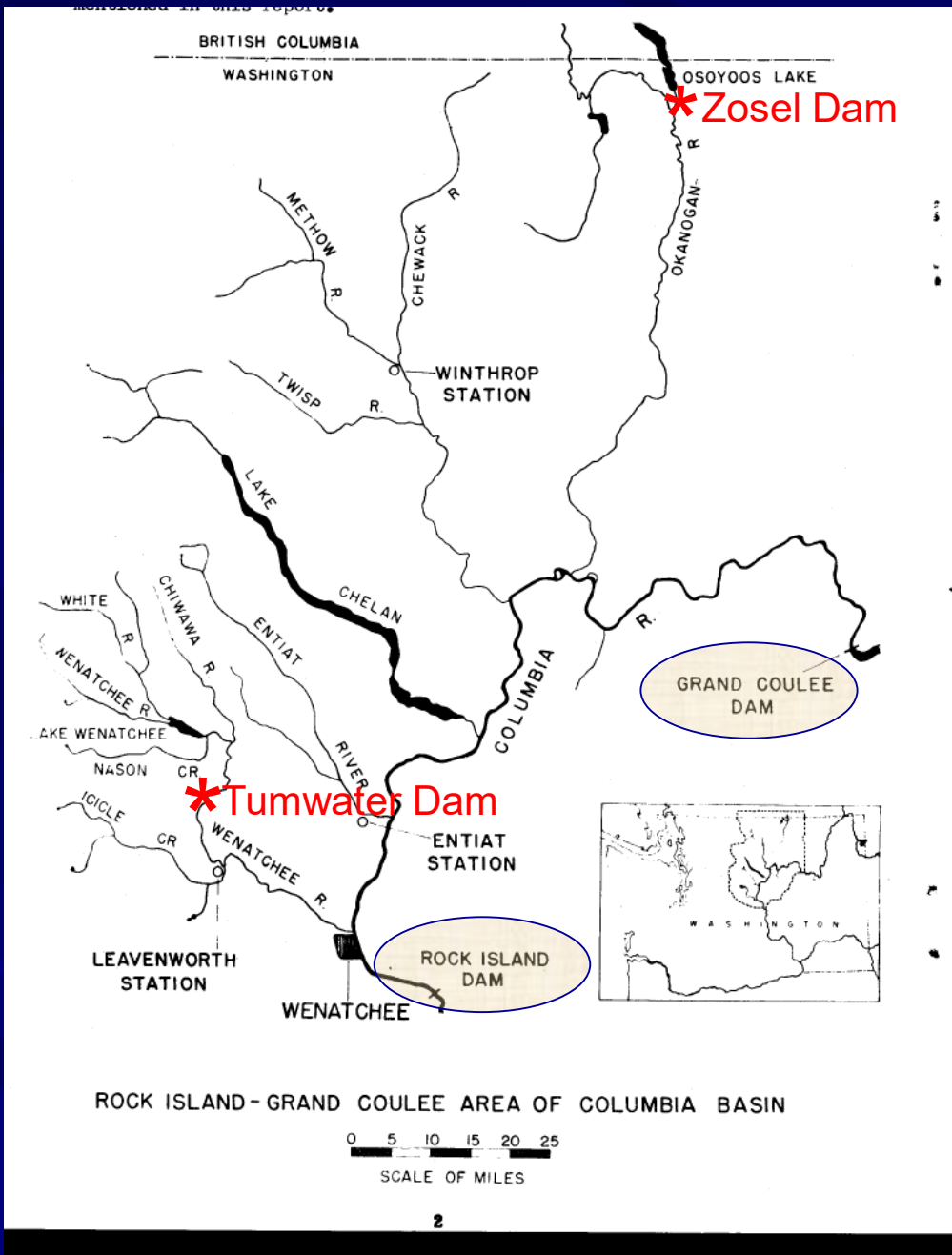


Catalogued

20-51 Callan

REFERENCES

1935-1937 Sockeye Counts at Rock Island, Zosel, and Tumwater dams



SPAWNING PLACE OF THE BLUEBACK

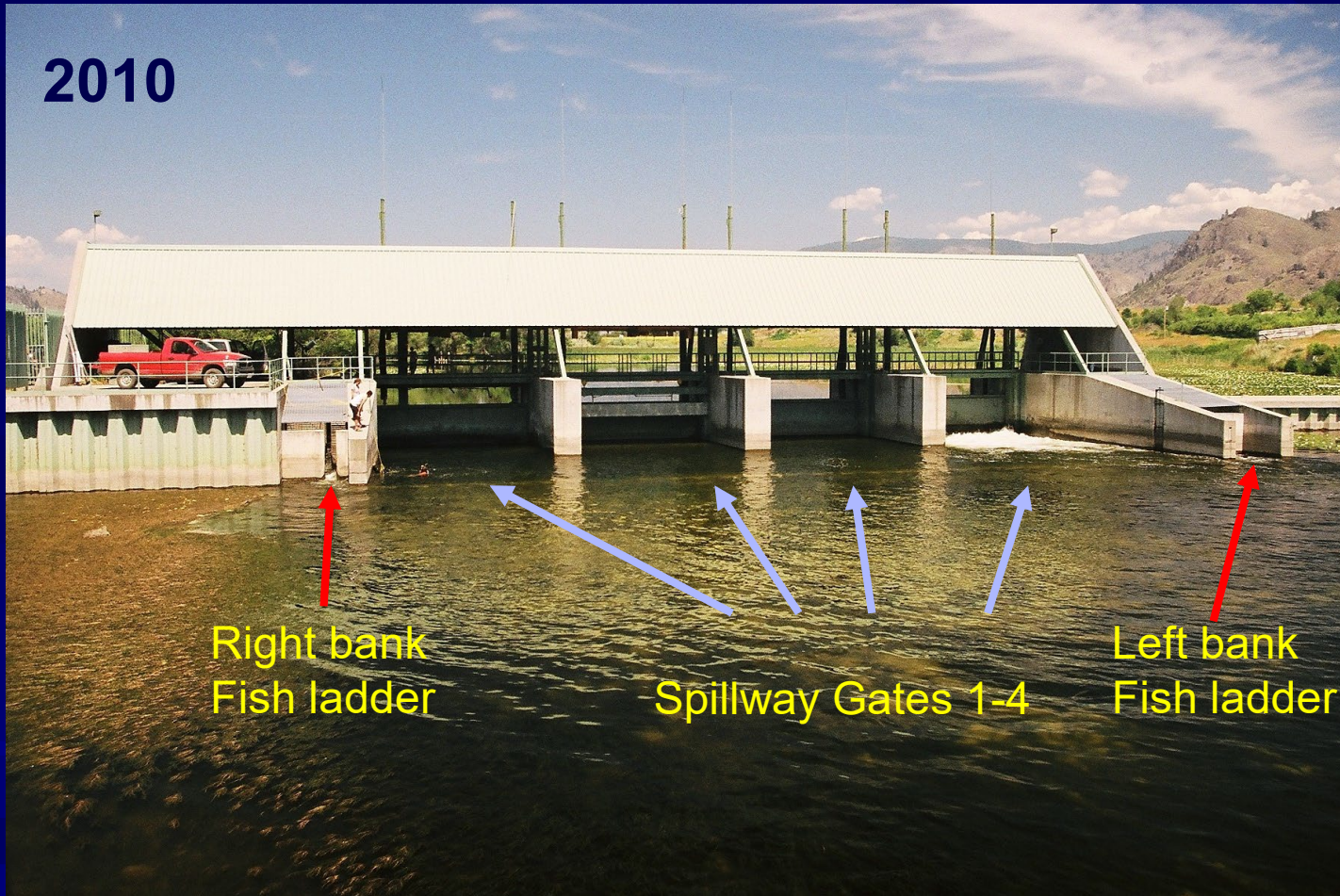
Table 5. Number and Percentages of Blueback Going Over Rock Island, Tumwater, and Oroville Dams in 1937.

Year	Rock Island		Tumwater Dam		Oroville Dam		Percentage of blueback going over Rock Is. migrating to the upper river.
	Number going over	Number	% of those going over Rock Island	Number	% of those going over Rock Island		
1935	14012	889	6.4	264	1.9	91.7	
1936	16516	29	.2	895	5.4	94.4	
1937	14523	65	.4	2162	14.2	85.4	

Estimate to upper river does not account for:

- Mortality prior to Zosel and Tumwater which could have been substantial
- Night passage (likely at Zosel)

Zosel Dam after 1987 rebuild

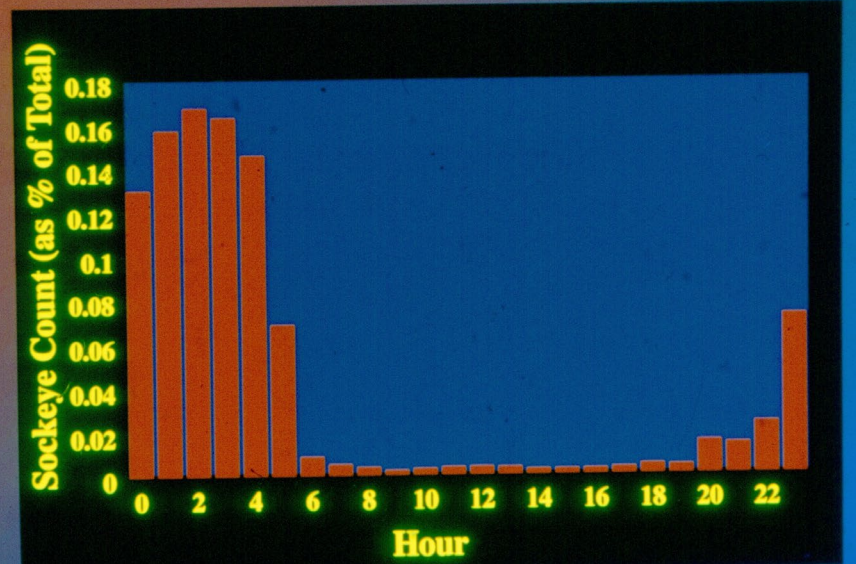


- Rebuilt by Washington State Department of Ecology in joint venture with British Columbia.
- Only dam owned by WA State
- Key site for salmon
 - Sockeye spawn upstream
 - Okanagan Nation-led Steelhead and Chinook restoration efforts

CRITFC/Douglas Public Utility District Zosel Dam Video Fish Counting at Zosel Dam 1991-93



Sockeye Salmon Counts as a Function of Time of Day



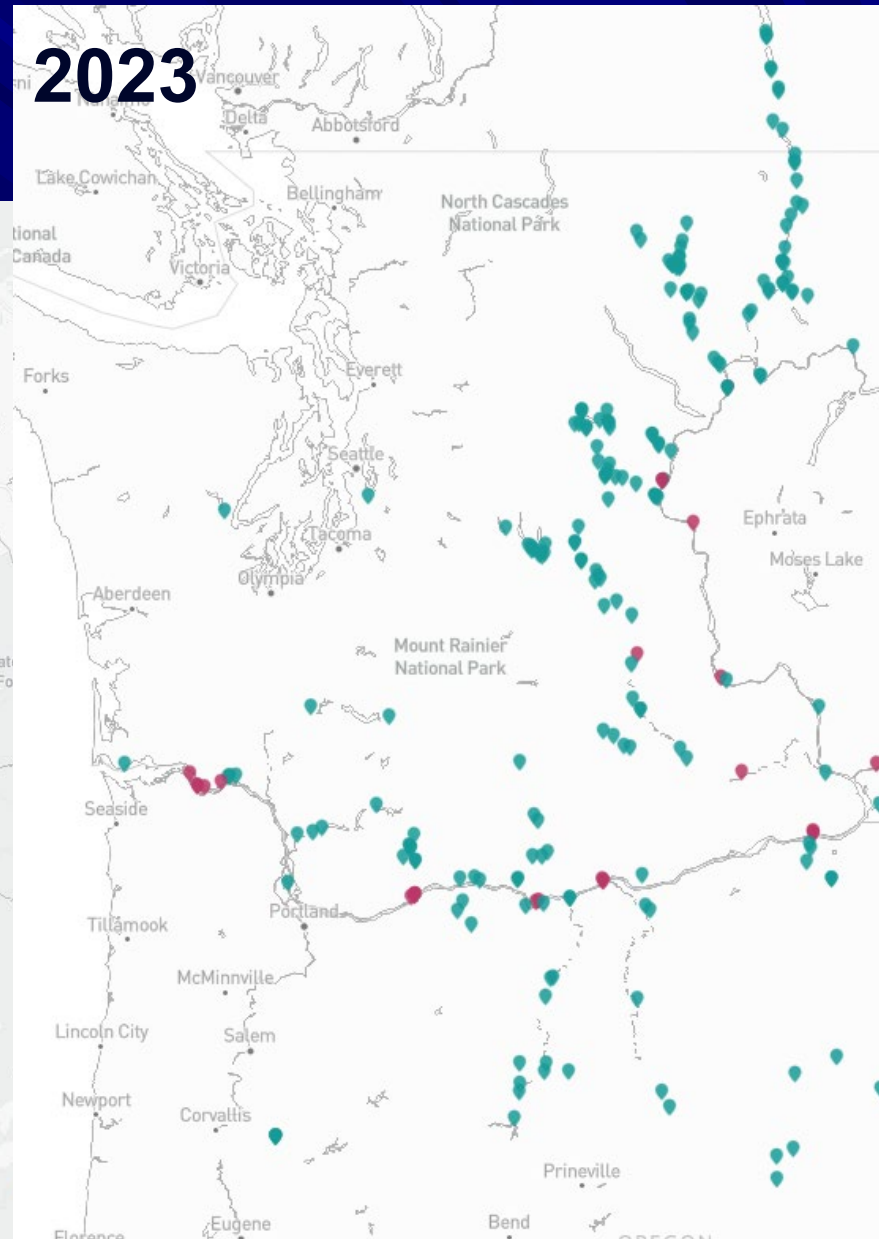
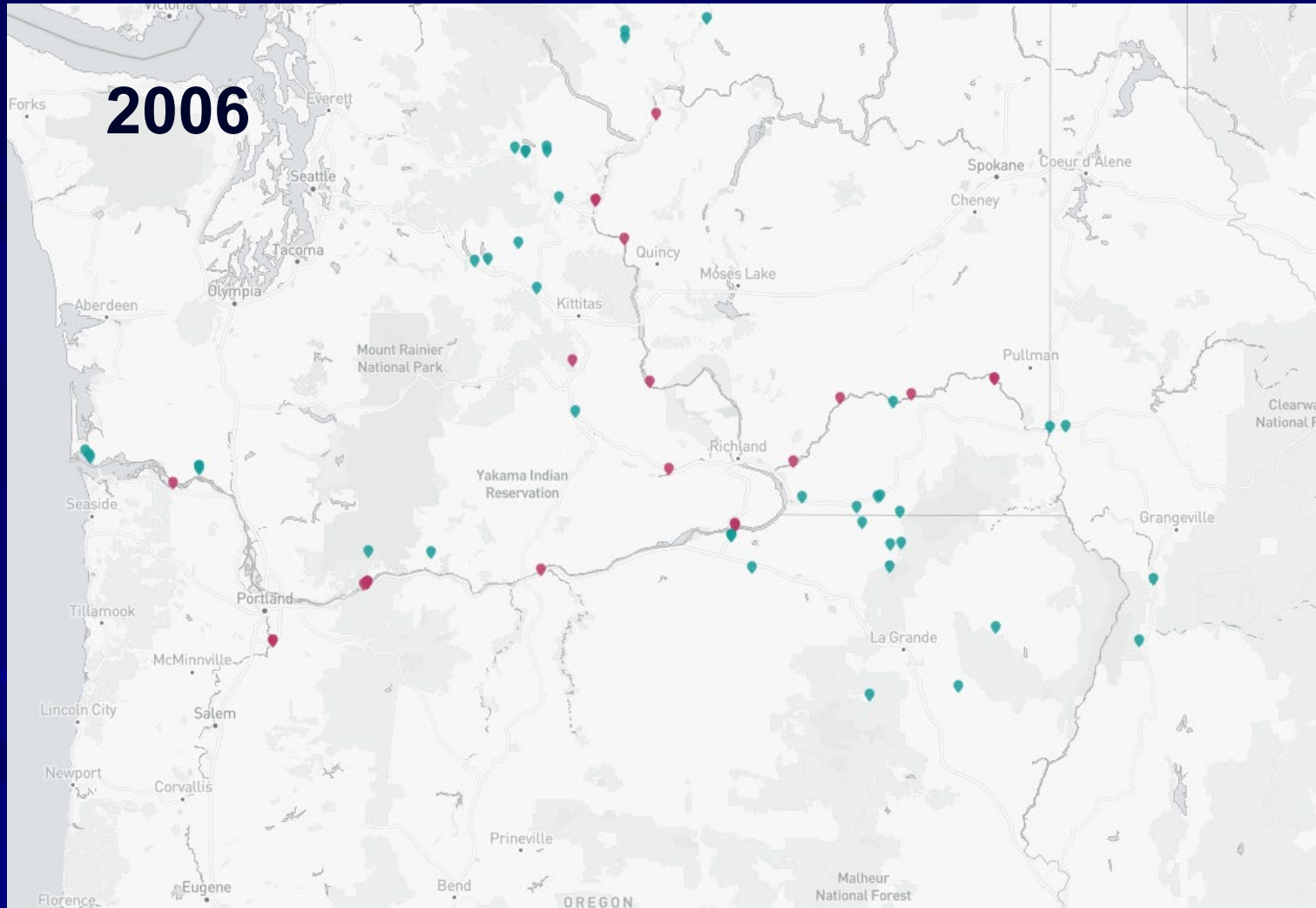
Adult Sockeye Monitoring with Underwater Video by the Confederated Tribes of the Colville Reservation At Zosel Dam



- Year-round Operation for Steelhead, Sockeye, Chinook and Coho
- Operated 2005 - 2017



Development of Basin PIT Tag system open new opportunities...



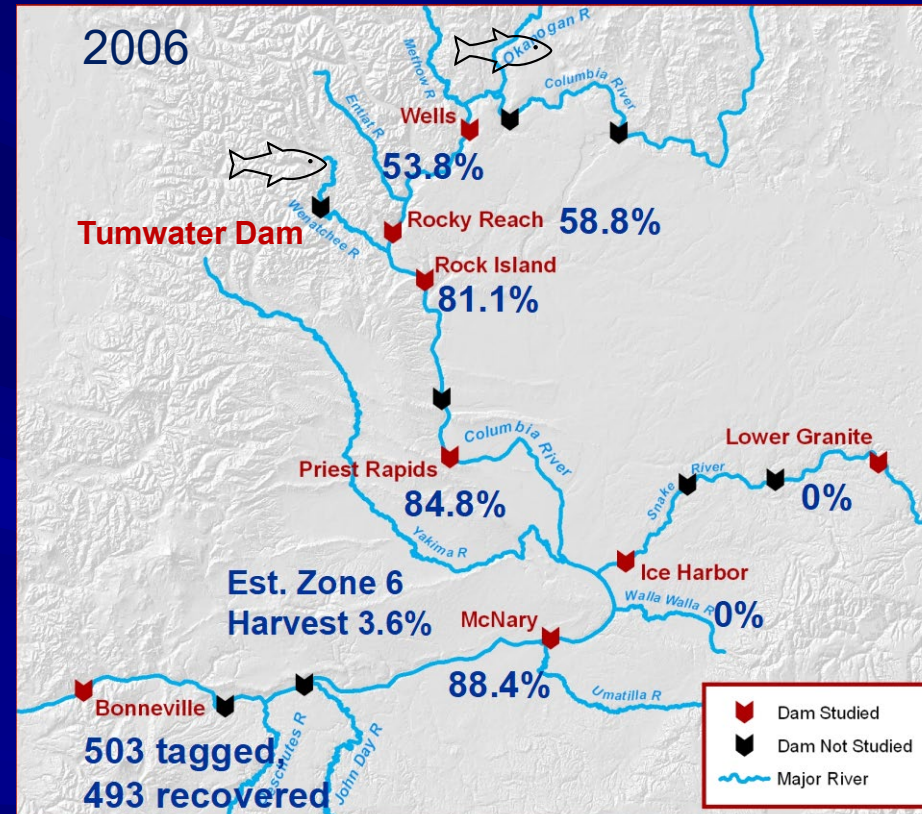
2008 Columbia Basin Accords funded two CRITFC projects that would benefit from PIT tag monitoring at Zosel Dam

- *Upstream Migration Timing*
 - Funded PIT tagging of Sockeye, Chinook, and steelhead at Bonneville Dam. (Sockeye PIT tagging was funded by the PSC Southern Fund started in 2006.)
- *Okanagan and Wenatchee Sockeye Salmon Limiting Factors*
 - Principle participants: Okanagan Nation Alliance (ONA), Canada Department of Fisheries and Oceans, and Yakama Nation.

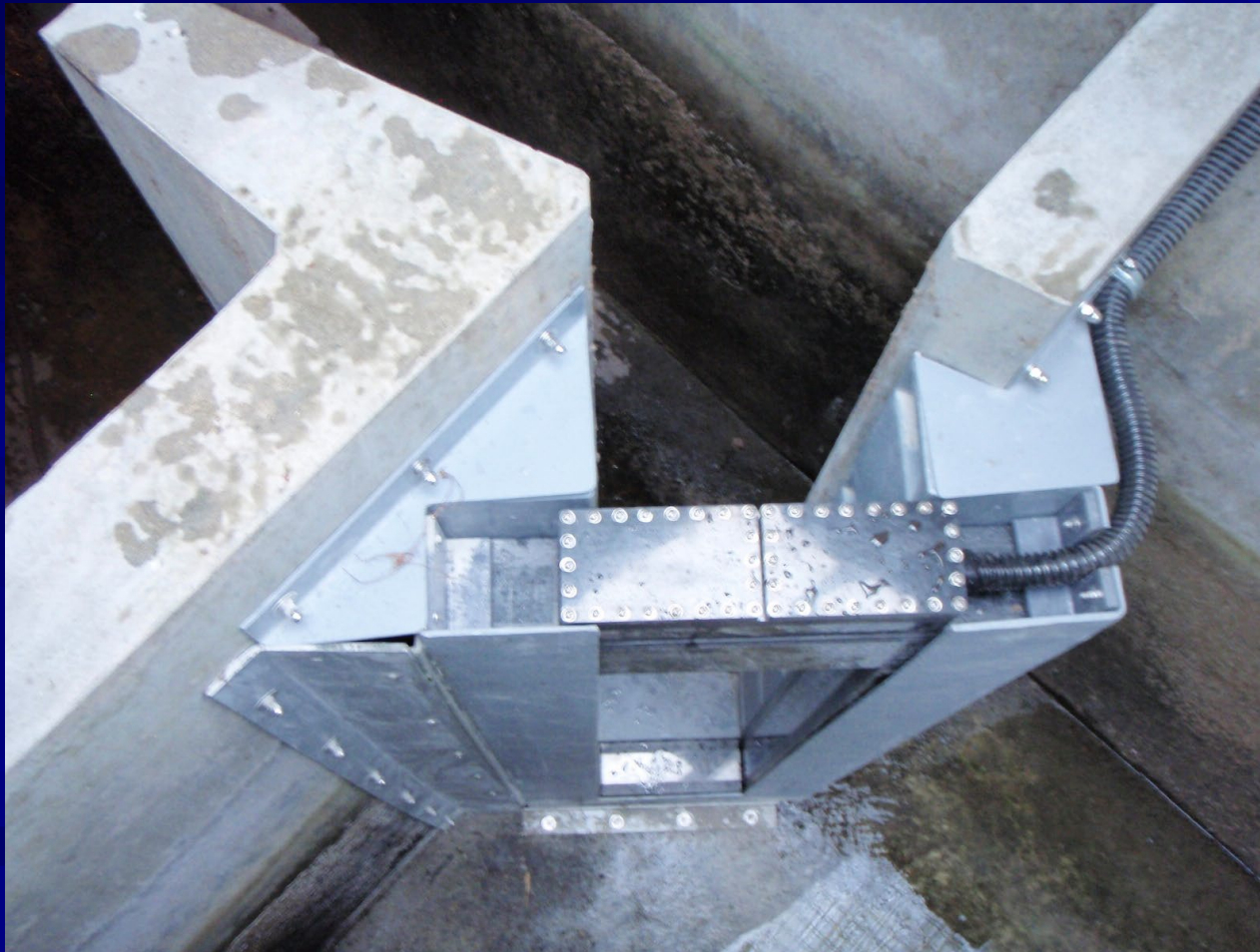
What are limiting factors?

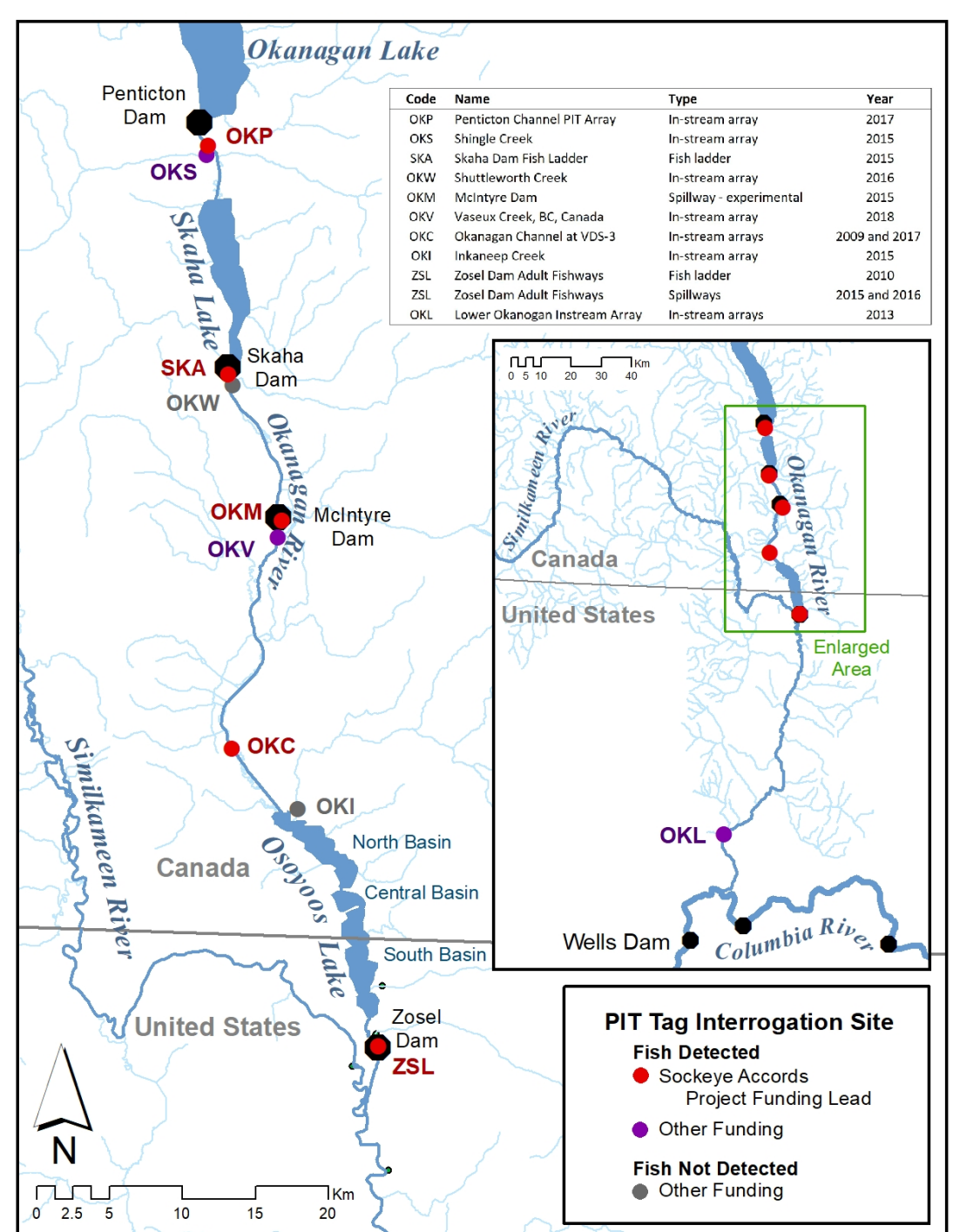
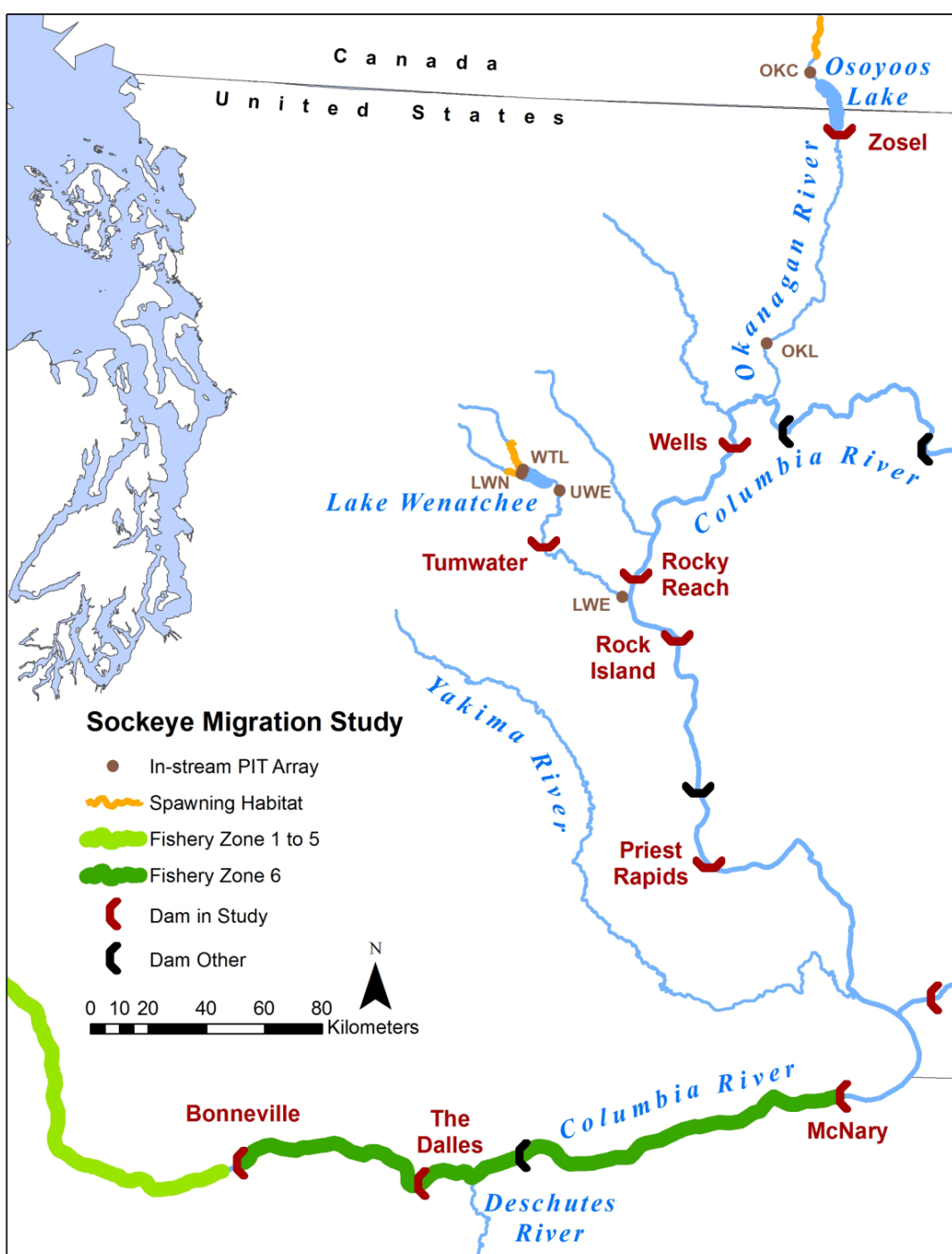
- Adult Survival?
- Juvenile survival or tributary issues?

Decision to focus Limiting Factors project on adult survival through PIT and acoustic tagging studies.

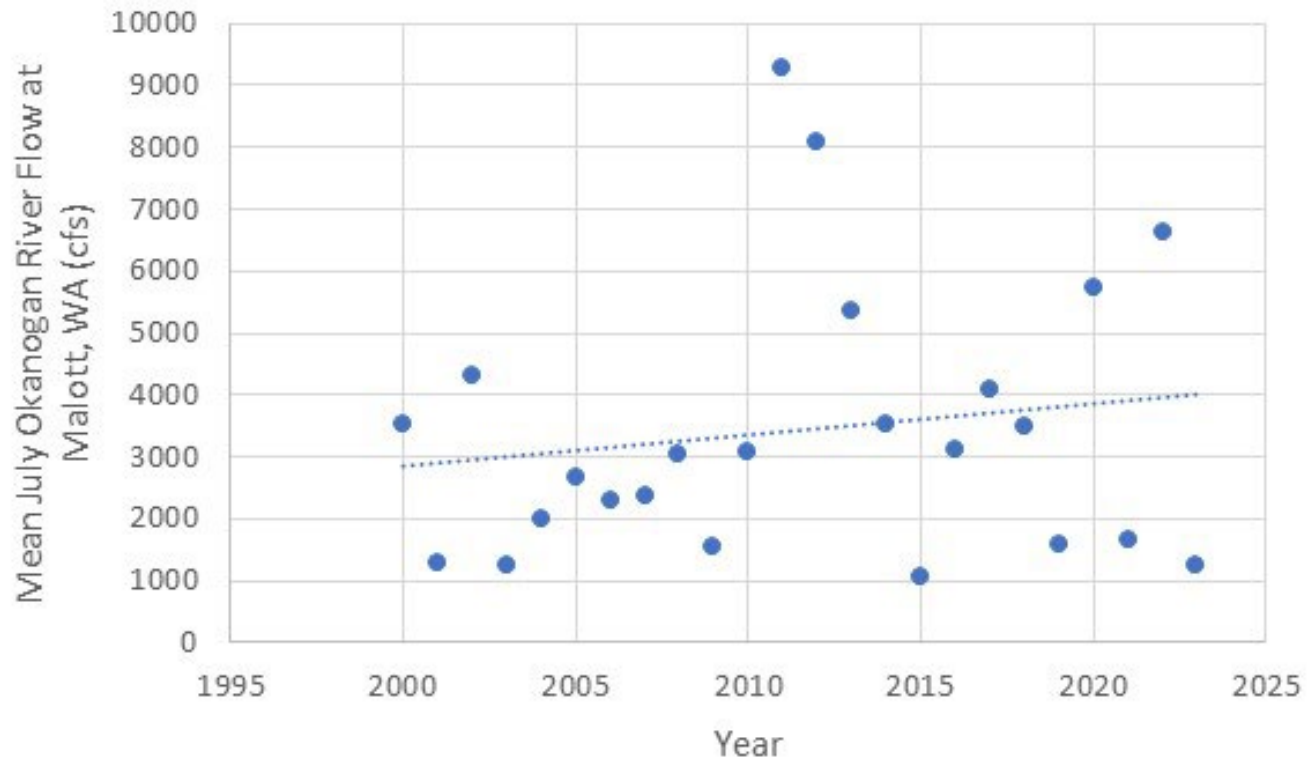


Zosel Ladder PIT tag detectors installed 2010, electronics updated in 2021





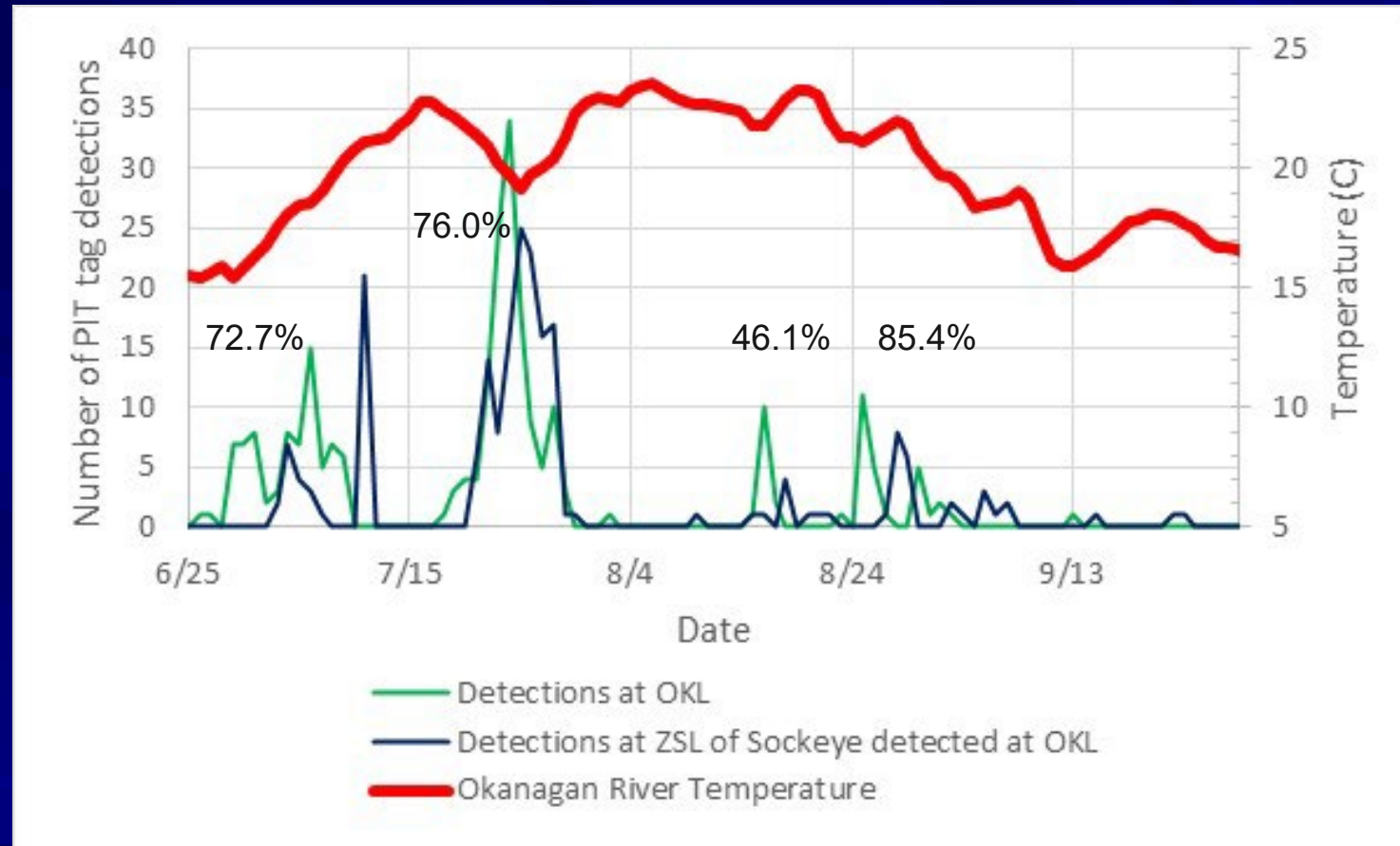
PIT tag detection rates at Zosel Dam and mean July Okanogan flow (2011-2022)



In 6 out of 13 years, ZSL missed less than 3% of tagged adult Sockeye Salmon moving upstream

In 7 out of 13 years (including 2011-2013), ZSL missed greater than 55% of tagged adult Sockeye Salmon moving upstream

2014 OKL to Zosel Survival in Okanagan Basin



Overall 74.1% survival OKL-ZSL

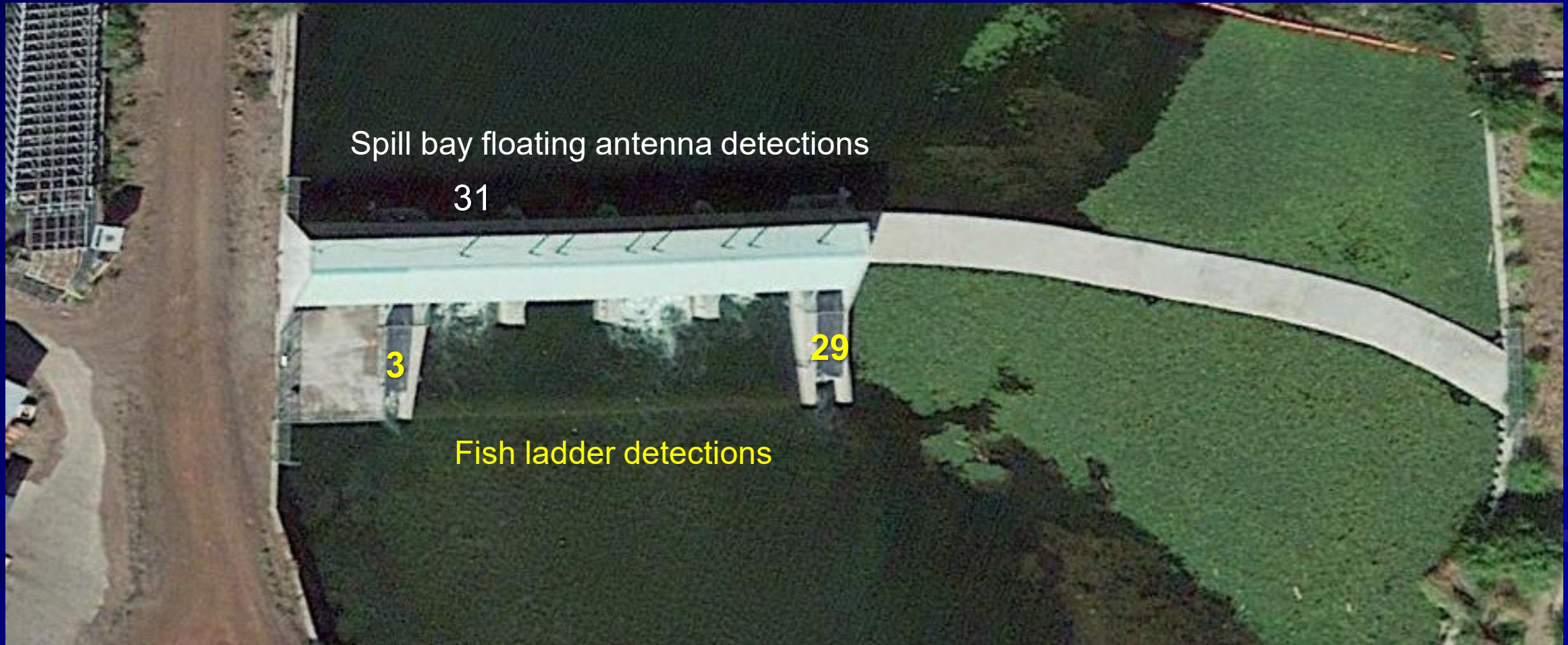
Zosel Dam with open spillways



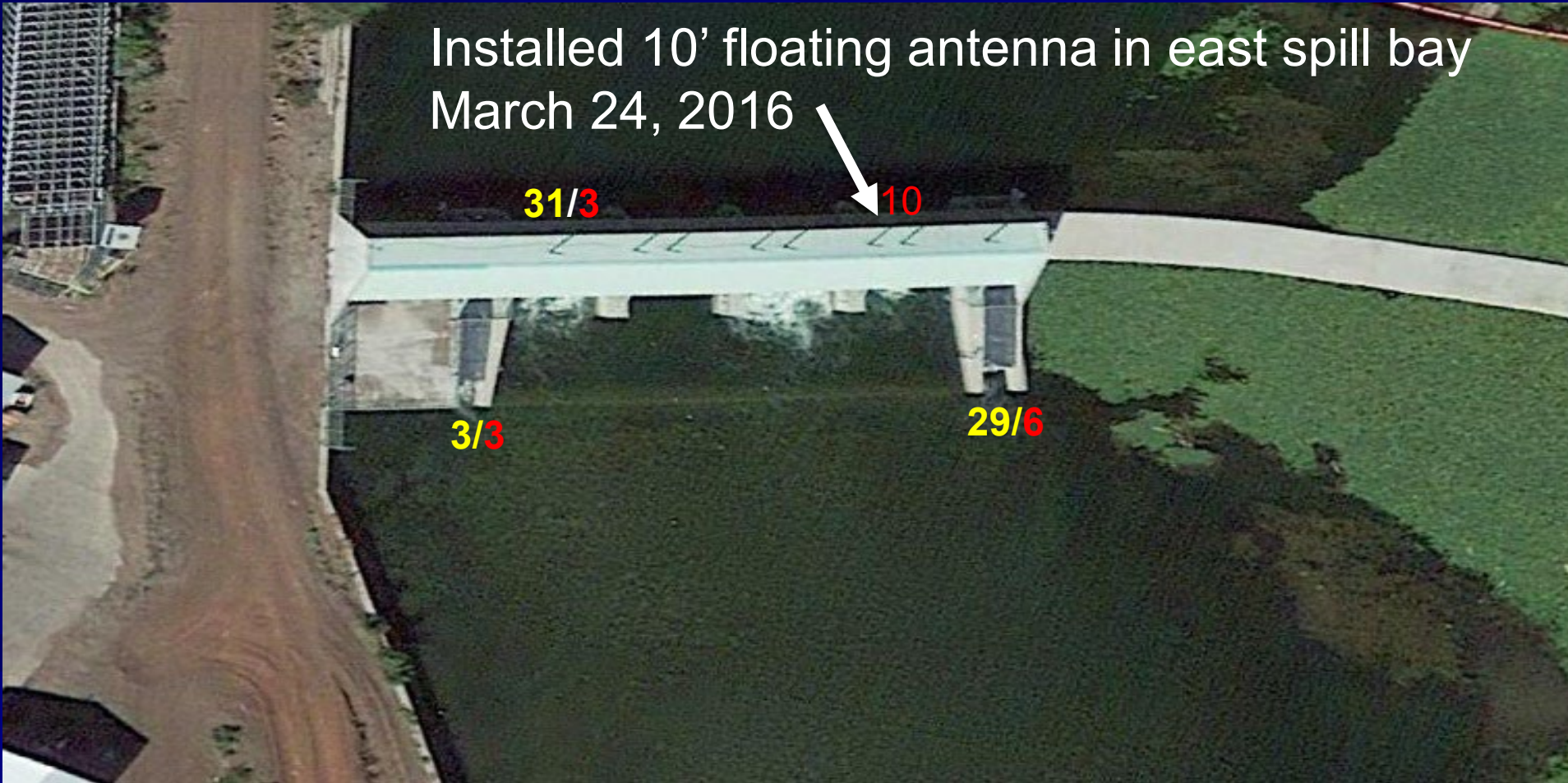
Installed 10' floating antenna in west spill bay March 31, 2015



Juvenile PIT Tag Detections at Zosel Dam in 2015 (low flow year)



Juvenile PIT Tag Detections at Zosel Dam in 2016 (high flow year)



Floaters not deployed in 2017 due to damage incurred in 2016 and anticipated high flows



Installed Zosel floating antennas with new rigging April 25, 2018



Floater Problems?





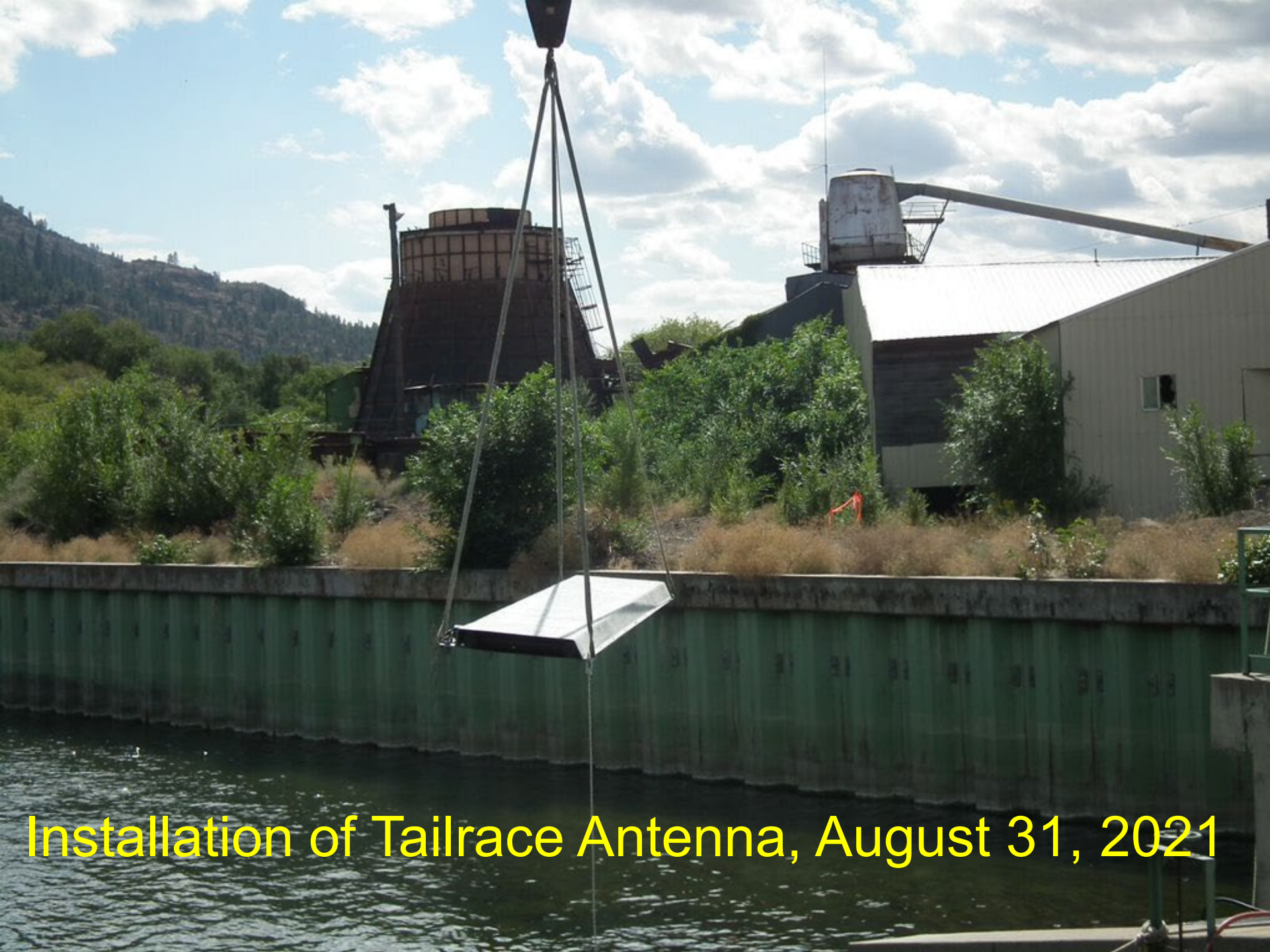


Latest floater upgrade

March 5, 2020:

- Replaced 10' floaters with 15' floaters.
- Upgrade from FS1001 to IS1001 which increased the maximum number of antennas supported from 6 to 12.





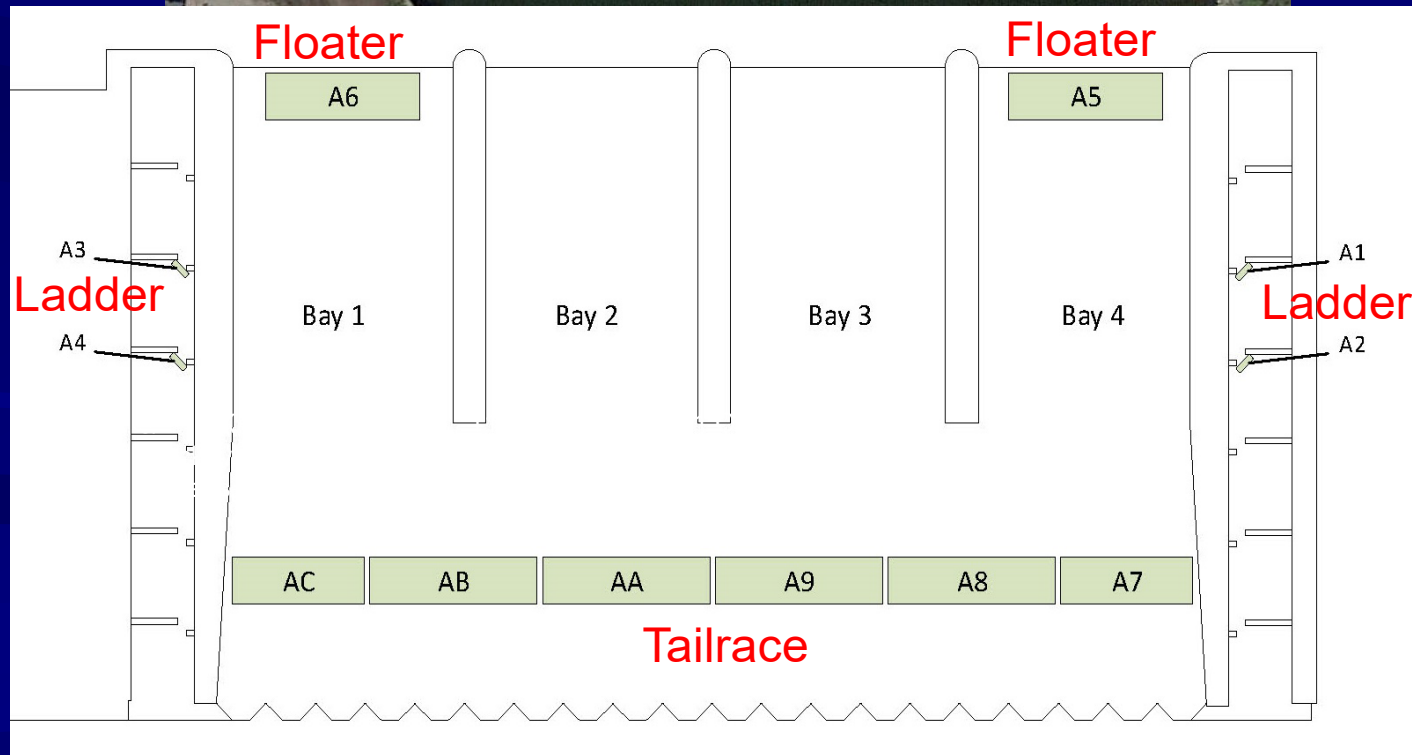
Installation of Tailrace Antenna, August 31, 2021





Zosel Dam: 12 antennas of three different types!

ZSL post-installation (9/1/21) data

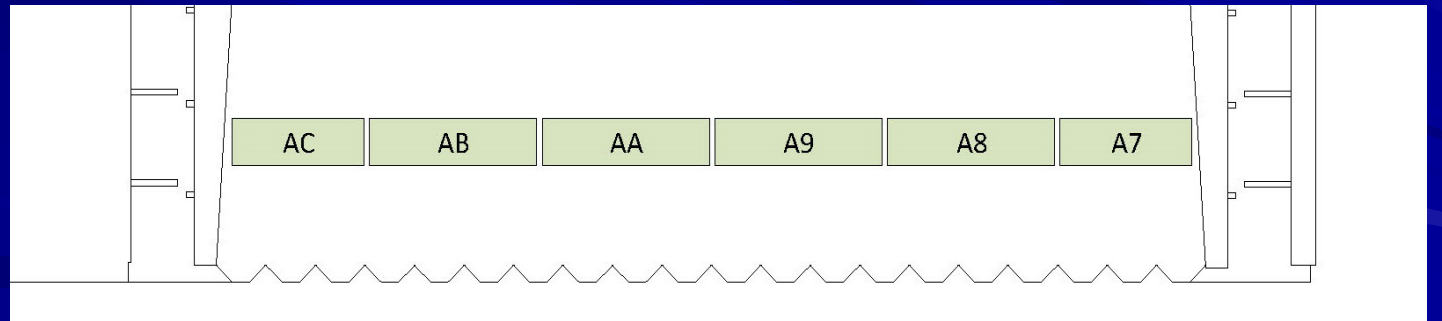


	N	Mean Time (days)	% Last at Upper Ladder Antenna
Sockeye	30	6.1	53.3%
Chinook	48	14.9	6.3%
Coho	43	2.1	25.6%

In 2023, 11.3% of Sockeye last detected in tailrace

Shed tags

- Started up antenna 9/1, on 9/2 shed tags showed up on antennas AA and A9, on 9/13 A8, on 11/18 AB. All 6 antennas have had shed tags.
- Mostly from juvenile Chinook released upstream. Is this an indicator of high predation in Zosel head pond?
- Antennas dead or with shed tags >50% of time:
 - 3 antennas in 2021
 - 4 antennas in 2022
 - 4 antennas in 2023
- 3 antennas not currently being monitored)

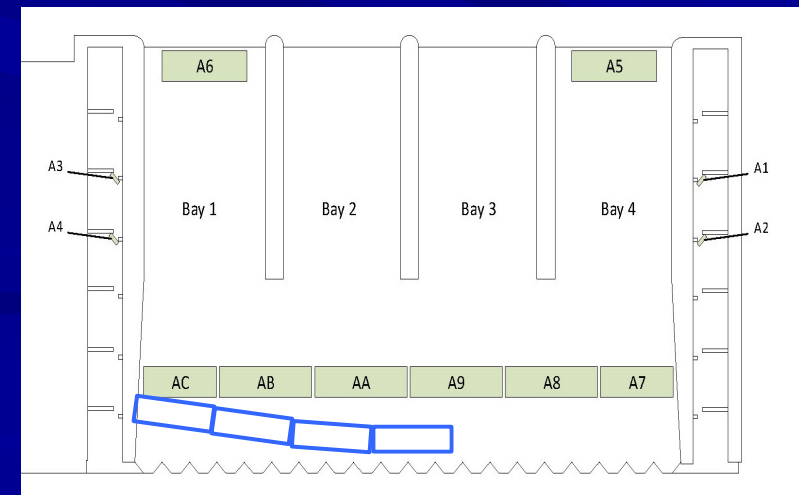


Top 9 Shed Tags stuck on ZSL antennas by number of days

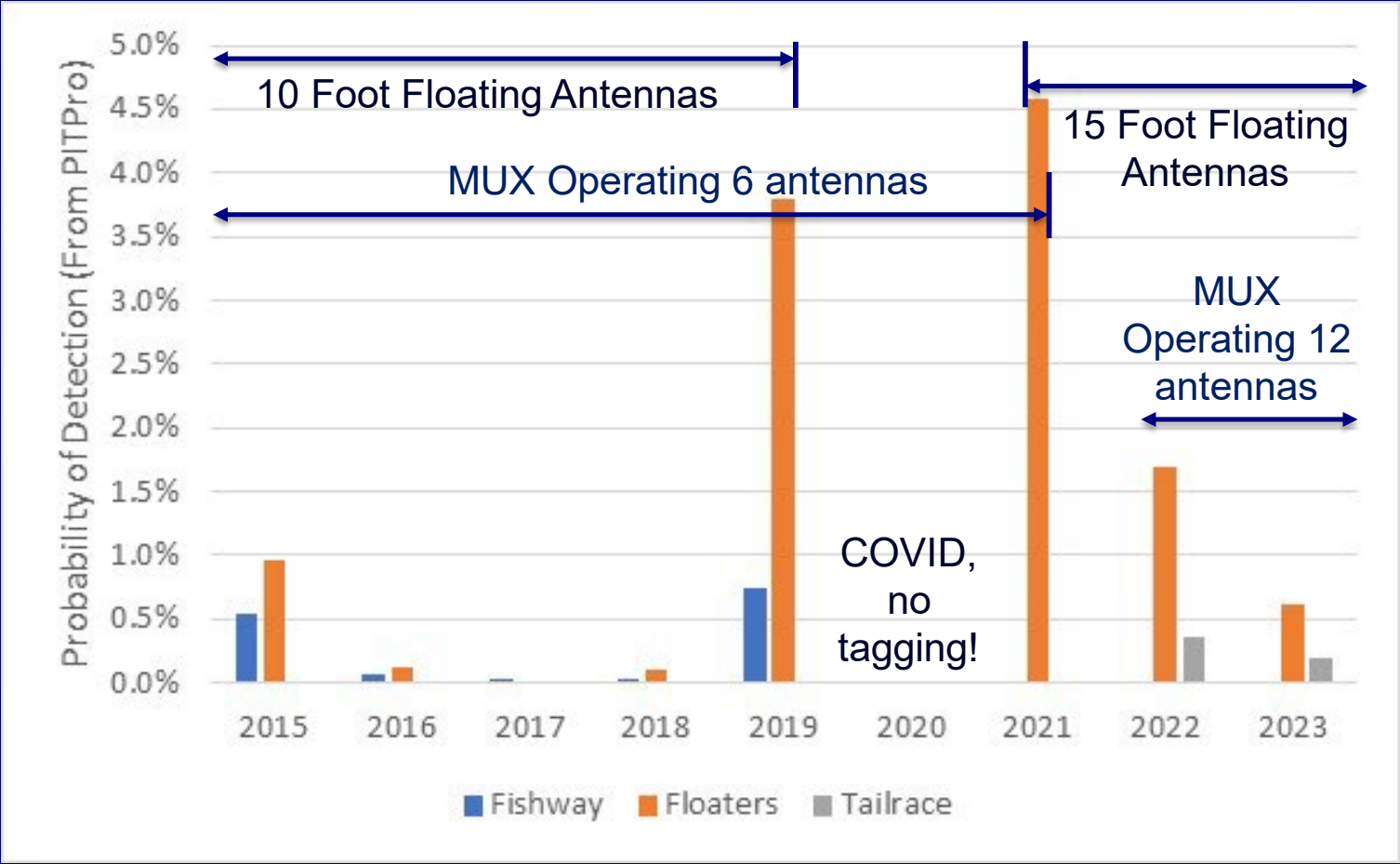
Tag	Species	Release Site	Total Detections ¹	First Date	Last Date	Days	Antennas
3DD.003DF37E5C	Chinook	OKANR	37,932	9/5/2021	9/19/2022	379.0	A7, A8, A9
3DD.003DF37D42	Chinook	OKANR	18,395	5/18/2022	5/3/2023	349.9	A8, A9
3DD.003BE6BB40	Sockeye	OSOYOL	175,699	11/19/2021	8/26/2022	280.0	AB
3DD.003DEA4B2F	Sockeye	OSOYOL	75,286	6/16/2022	3/18/2023	275.0	A9,AA
3DD.003DF39BC3	Chinook	OKANR	274,857	9/2/2021	6/3/2022	274.0	AA
3DD.003D931B19	Chinook	OKANR	227,174	9/30/2021	6/23/2022	265.9	A8, A9
3DD.003DF363EB	Chinook	OKANR	57,679	6/14/2022	2/27/2023	258.0	A7, A8
3DD.003DF3974A	Chinook	OKANR	255,469	9/14/2021	5/19/2022	247.0	A8
3DD.003E175575	Chinook	OKANR	39,799	10/25/2022	5/3/2023	190.0	A9

- All tagged as juveniles upstream and not detected downstream of ZSL; ZSL head pond mortalities.
- All multi-antenna shed tag detections are on adjacent antennas.

1. The maximum number of daily detections was originally 1440, after February 22, 2022, maximum=288 (5-minute intervals).



Probability of detection of downstream migrating juvenile Sockeye tagged in Okanagan Basin by antenna type for 2015-2023 (using PITPro)



Antenna Considerations for Zosel Dam

Consideration	Antenna Type		
	Ladder	Floating	Tailrace
Installation Cost (includes antenna cost)	Good/Lower Cost	Moderate	Bad/High Cost
Maintenance Cost	Moderate	Good/Lower Cost	Bad/High Cost
Reliability/Durability	Moderate	Good/Lower Cost	Bad/High Cost
Adult Detection	High Flow: Bad/High Cost Low Flow: Moderate	Bad/High Cost	Moderate
Juvenile Detection	Good/Lower Cost	Moderate	Good/Lower Cost
Scoring:	Good/Lower Cost	Bad/High Cost	Moderate

Where to go from here?

- Each antenna type has its advantages and disadvantages but all provide valuable data.
- What to do with tailrace array?
 - Fixing costs \$60K with no guarantee that problems won't recur.
 - Replace with instream array downstream?
- Further improvements in juvenile detection:
 - Separate upper and lower antennas on MUX to reduce detection interval (in proposed budget) and increase rates. Hopefully, this will also restore ladder detection rate to 100%
 - Possibly two new floating antennas?
 - Added maintenance costs
 - Not useful in low flow years
 - Add a fourth antenna type to Zosel?



Antenna at McIntyre Dam (OKM)

Acknowledgements

- BPA Contract administrators: Christine Petersen, Tori Bolden, Maureen Kavanagh, and others.
- ONA: Elinor McGrath, Macus Ong, Carley Simpson and staff
- Washington Department of Ecology: Al Josephy
- Oroville-Tonasket Irrigation District: Jay O'Brien, Derek Mendoza, and Marc Egerton
- CCT: Sonya Schaller, Andrea Pearl, and John Arterburn
- Yakama Nation: Kraig Mott
- Biomark: Steve Anglea, Brett Turley, and Kyle Meier

