

BIOLOGICAL FISH INJURY AND SURVIVAL EVALUATION AT THE REGULATING OUTLET OF COUGAR DAM, OREGON, 2017

Joanne L. Phipps*, Paul G. Heisey



Objectives

- **Estimate injury and survival rates of juvenile salmonids after passage through the regulating outlet at two gate settings (1.3 and 2.0* ft) to influence design considerations of volitional bypass system at high head dams.**

*Due to uncontrollable delays and limited time to perform testing the 2.0 ft sample size was reduced.

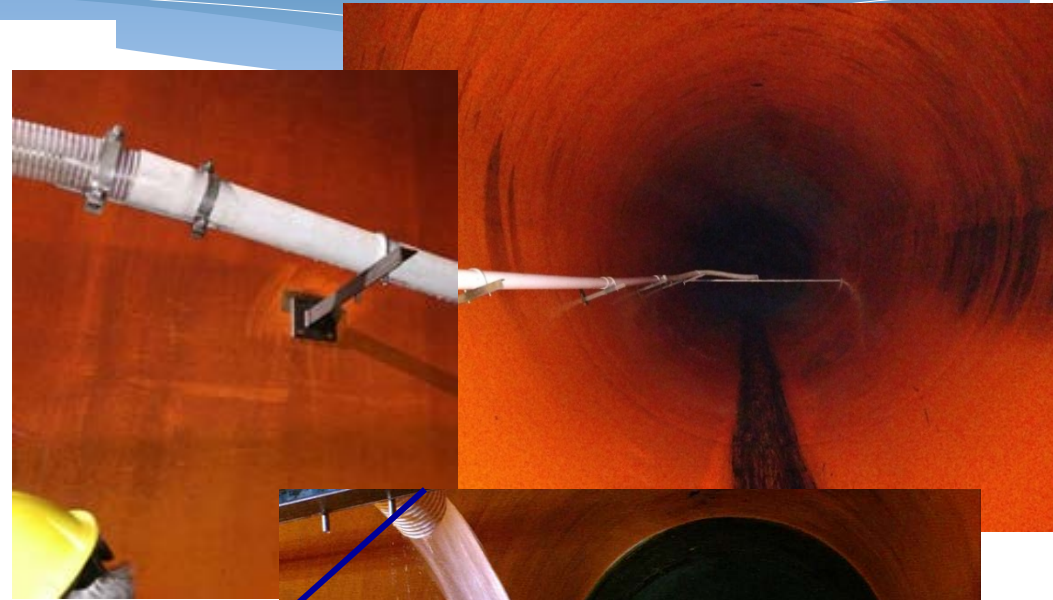
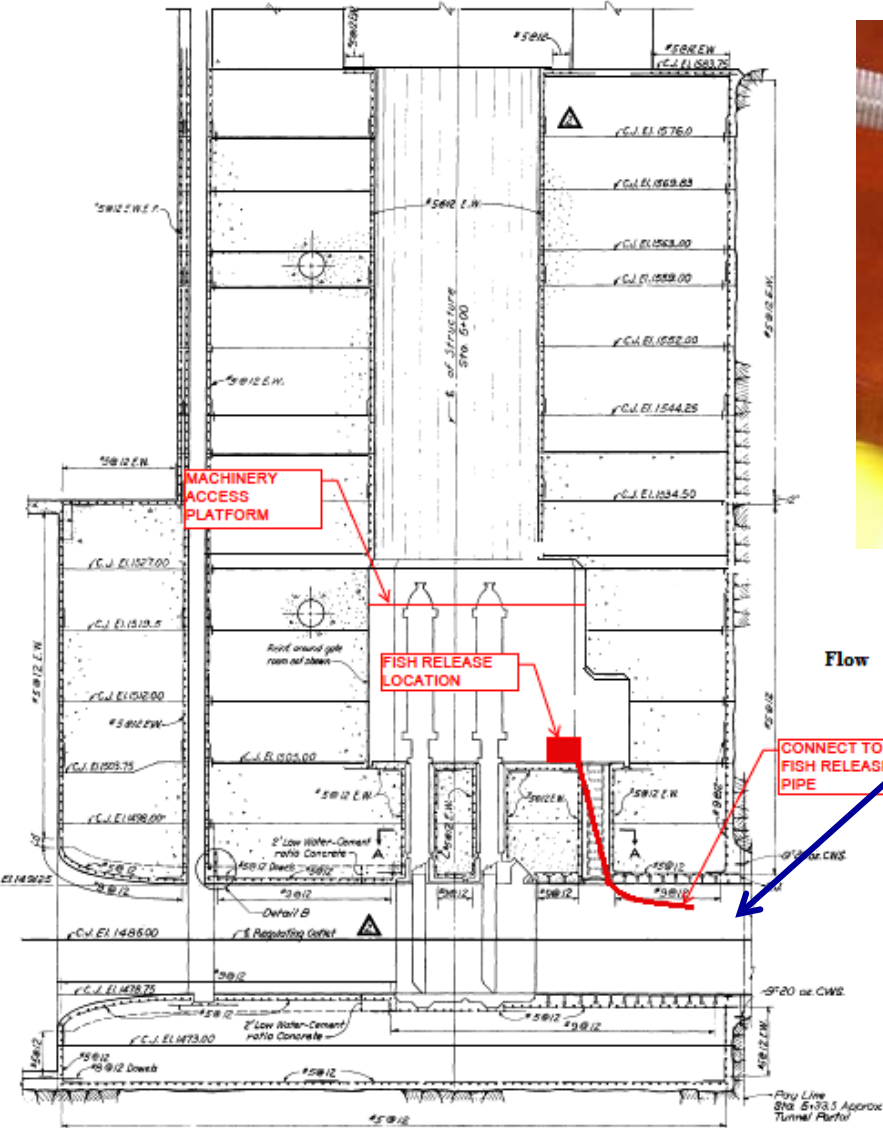
Conditions

- **Temporary 4-in diameter fish release pipe was installed inside the RO 105 ft downstream of the RO flow regulating headgate.**
- **The terminus of release pipe was approximately 2.5 ft. above the projected water line in the RO.**
- **Tested RO at two gate opening, 1.3 and 2.0 ft.**
- **Intake located at elevation 1,485 fmsl.**
- **Corresponding discharges 480 and 730 cfs.**
- **Cougar reservoir at partial drawdown and elevation 1574 fmsl.**

Methods

- **Test conducted 15 – 18 November 2017**
- **HI-Z tag recapture technique used to recapture fish.**
- **Test fish were juvenile Chinook Salmon 160 to 283 mm, 234 mm average.**
- **Test fish acquired from Oregon State University, Corvallis.**
- **Control fish release site was established in the river downstream of the RO channel.**

Fish Release Location

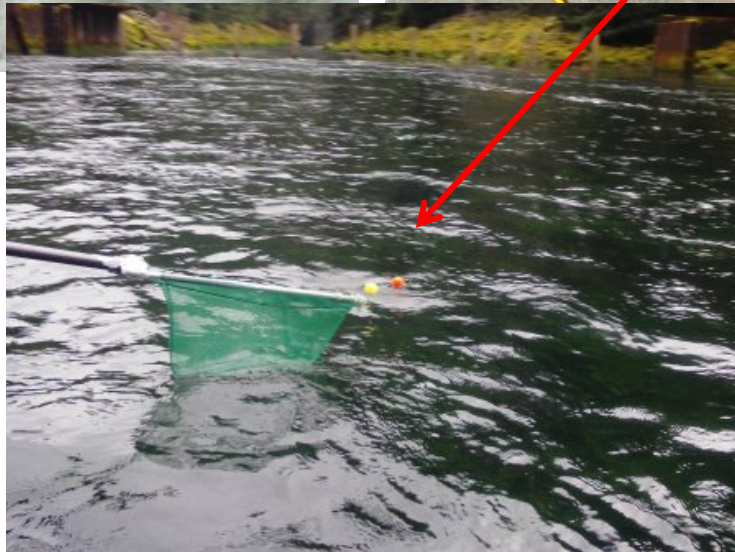


Releasing a juvenile Chinook Salmon

Release hose going down to RO

Netting buoyed fish

48 h fish holding ponds



Sample Size

Juvenile Chinook Salmon

Gate Setting	No. Treatment	No. Control	Length TL mm	
			Range	Average
1.3 ft	227	122	160-283	234
2.0 ft	51			

Results

Survival

	Gate Opening		Controls
	1.3 ft	2.0 ft	
Released	227	51	122
Recaptured	220 (96.9%)	49 (96.1%)	122 (100%)
Survival (1h)	97.3%*	88.2%*	
SE	1.1%	4.5%	

*Estimates significantly different @ alpha=0.05

- 48h survival estimates could not be reliably estimated because of high control mortalities (25%) during the delayed assessment period.

Results

Malady

	Gate Opening		Controls
	1.3 ft	2.0 ft	
No. Examined	220	49	122
No. with Maladies	103	27	9
Malady-Free Rate	57.4%	48.5%	
SE	3.9%	7.8%	

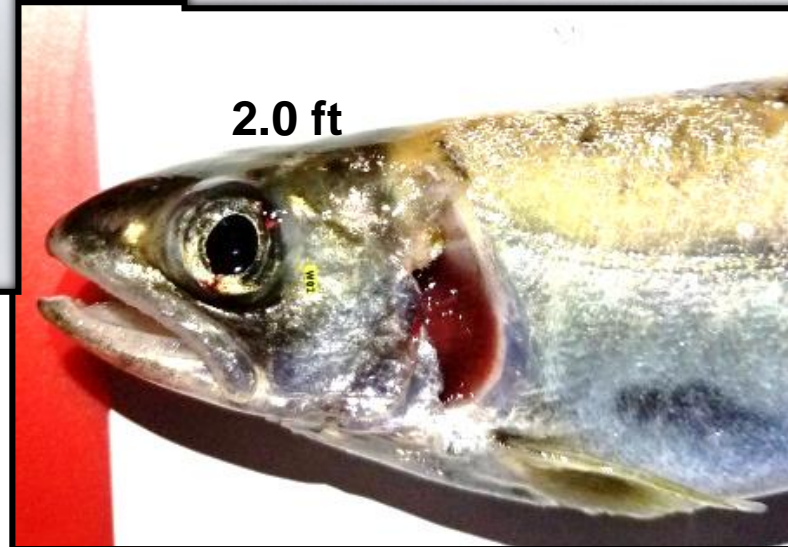
- Malady Free estimates were lower for fish passed through 2.0 ft gate opening than at 1.3 ft gate opening, 48.5% and 57.4%, respectively.

Results

Injury

	Gate Opening		Controls
	1.3 ft	2.0 ft	
No. Examined	220	49	122
No. with Injuries	43 (19.5%)	7 (14.2%)	4 (3.2%)
Injury-Free Rate	83.2%	88.6%	
SE	3.1%	5.4%	

Example of Injuries



Observed Injuries

- **Dominant injuries observed at the 1.3 ft opening was ruptured eyes (29 fish 13.2%) followed by operculum damage (17 fish 7.7%). Sixty of the 220 (27.2%) fish examined after passing at the 1.3 ft opening had only LOE.**
- **Dominant injury for the 2.0 ft opening test was operculum 4 fish (8.2%) and eye injuries 4 fish (8.2%) for the 49 examined fish. An additional eighteen (36.7%) fish displayed only LOE.**
- **The majority of the visible injuries maybe partially due to shear forces due to differences in water velocity between the release pipe exit and the flowing water in the RO channel.**

Summary

- **Time constraints did not allow for a larger sample size for the 2.0 ft. headgate opening test.**
- **The 1 h survival estimates for the juvenile Chinook Salmon passed through gate openings of 1.3 and 2.0 ft were 97.3 and 88.2 %, respectively.**
- **High incidences of injuries for both gate openings was observed (18.6%).**

Summary

- **Injury free estimates, which excluded fish displaying only loss of equilibrium (LOE), were 83.2% and 88.6% for fish passed through gate openings of 1.3 ft and 2.0 ft, respectively.**
- **The predominately observed shear induced injuries may have occurred where the fish exiting the release pipe entered the flow through the RO and/or at the base of the RO chute.**
- **Results are preliminary**

Acknowledgments

- **U. S. Army Corps of Engineers; Portland District
*Fenton Khan***
- **Advanced Mechanical Crew**
- **Normandeau Associates Staff**
- **Project support from Willamette Valley Project -
Foster Dam Staff**
- **Pacific Northwest National Laboratory**



Questions and or Comments

