

Direct Fish Injury and Survival Evaluation of the New Fish Weir at Foster Dam, Oregon, 2018

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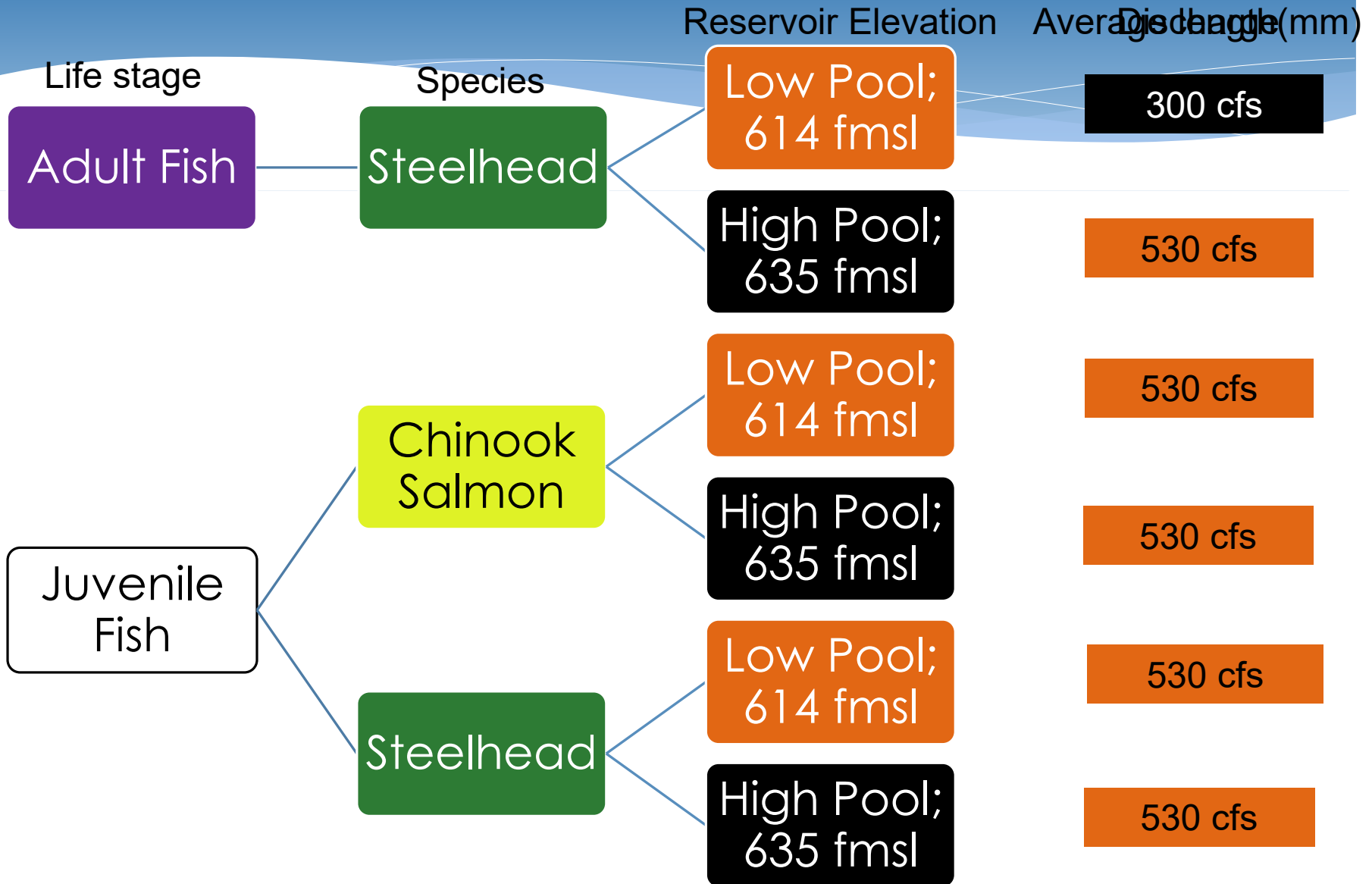


Background

- The USACE Foster Juvenile Downstream Passage Product Delivery Recovery Team (PDT) designed a new fish weir to improve downstream passage.
- Required the new fish weir be evaluated for direct survival and injury of juvenile Chinook Salmon and Steelhead and adult Steelhead.
- The previous weir was evaluated for direct survival/injury of Steelhead in 2012.

Objectives

- Evaluate the new weir's operational effects on direct (immediate) fish injury and survival at summer and winter reservoir elevations;
- Identify and characterize whether improvements to fish passage are evident or whether additional improvements are necessary to enhance fish survival at Foster Dam.
- Detect a difference of 5% ($\alpha=0.05$) between survival/injury estimates of different testing scenarios for juvenile salmonids (e.g. between species, reservoir elevations, old/new weir);
- Obtain a precision of $\pm 10\%$ with 90% confidence for survival/injury estimates of adult Steelhead;

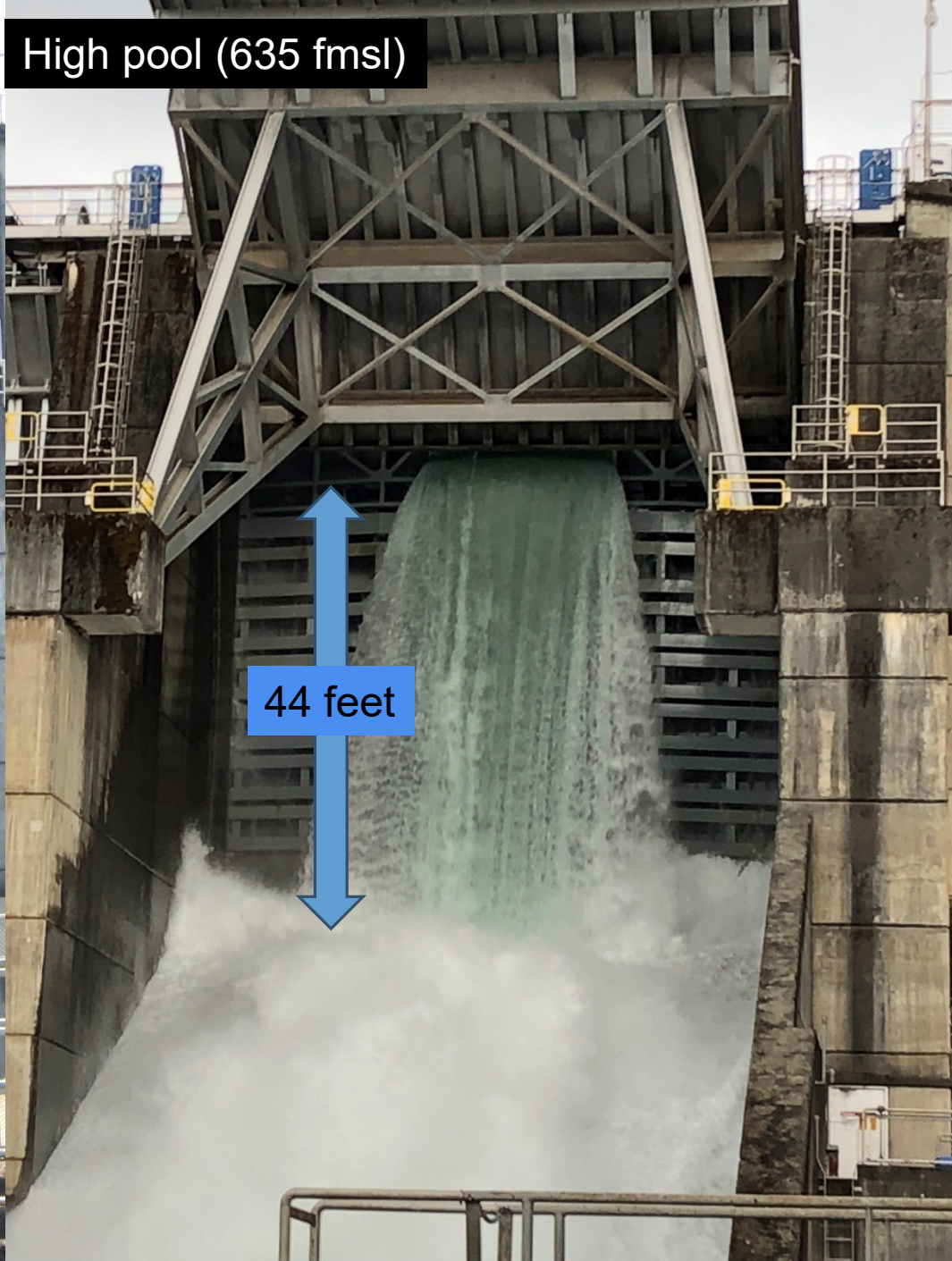


Low pool (614 fmsl)



23 feet

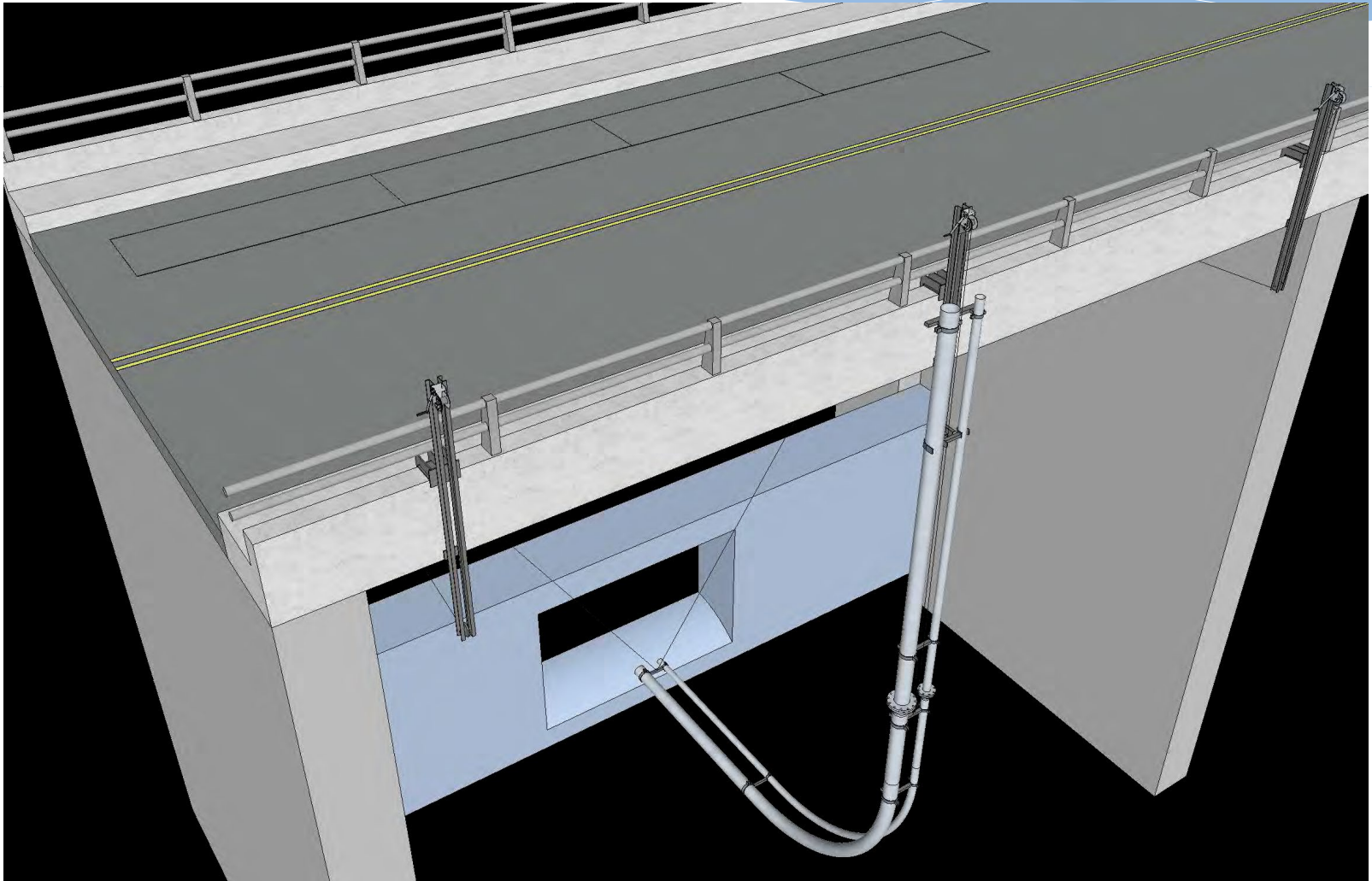
High pool (635 fmsl)



44 feet

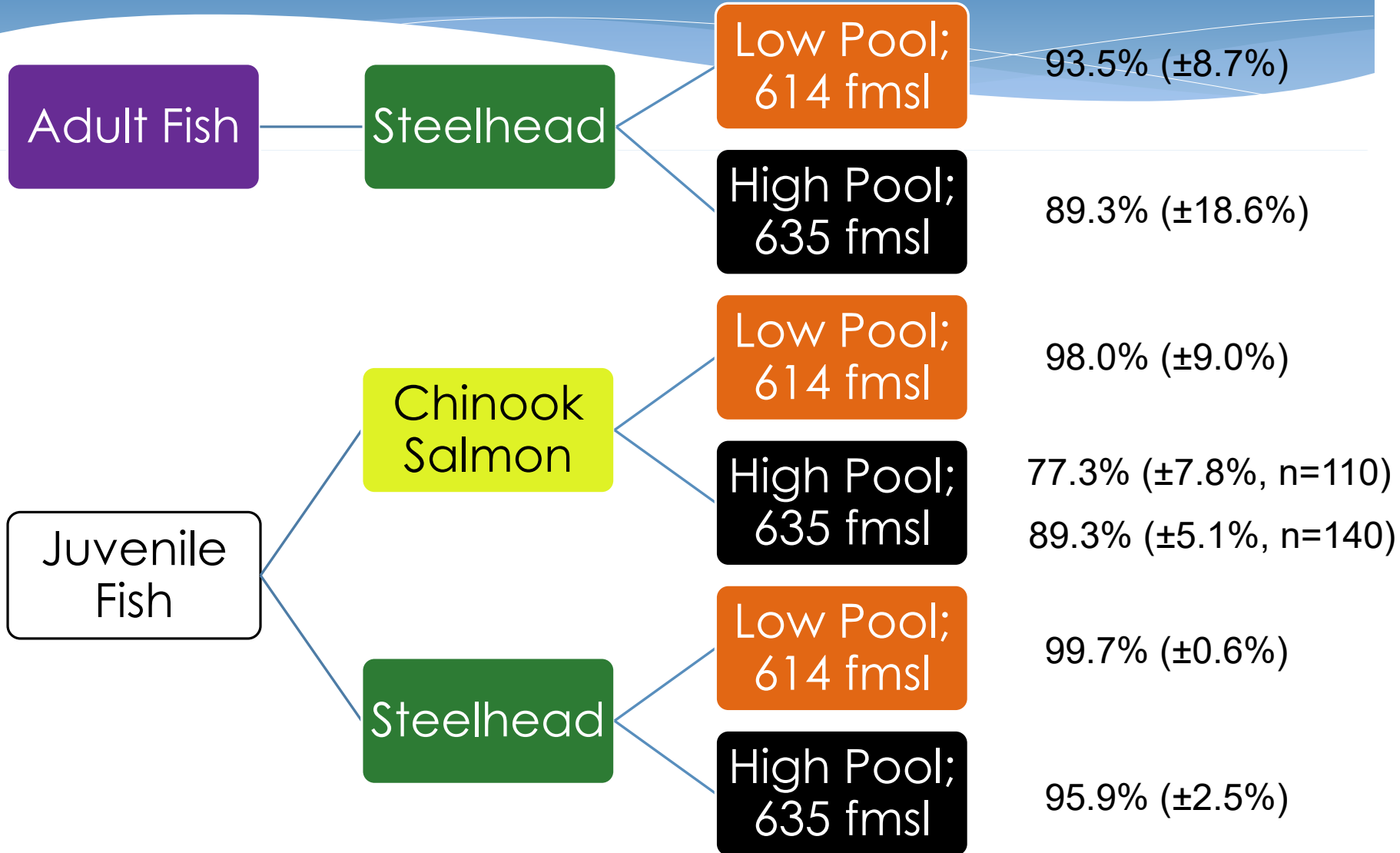
Methods

- Juvenile fish were obtained from the South Santiam Fish Hatchery and the Wild Fish Surrogate Lab at Oregon State University;
- Adult Steelhead were obtained directly from the Adult Fish Facility at Foster Dam.
- HI-Z tagged juvenile and adult fish were released through 4-inch and 8-inch diameter stainless steel pipes, respectively;
- Control fish were released directly into the tailrace;



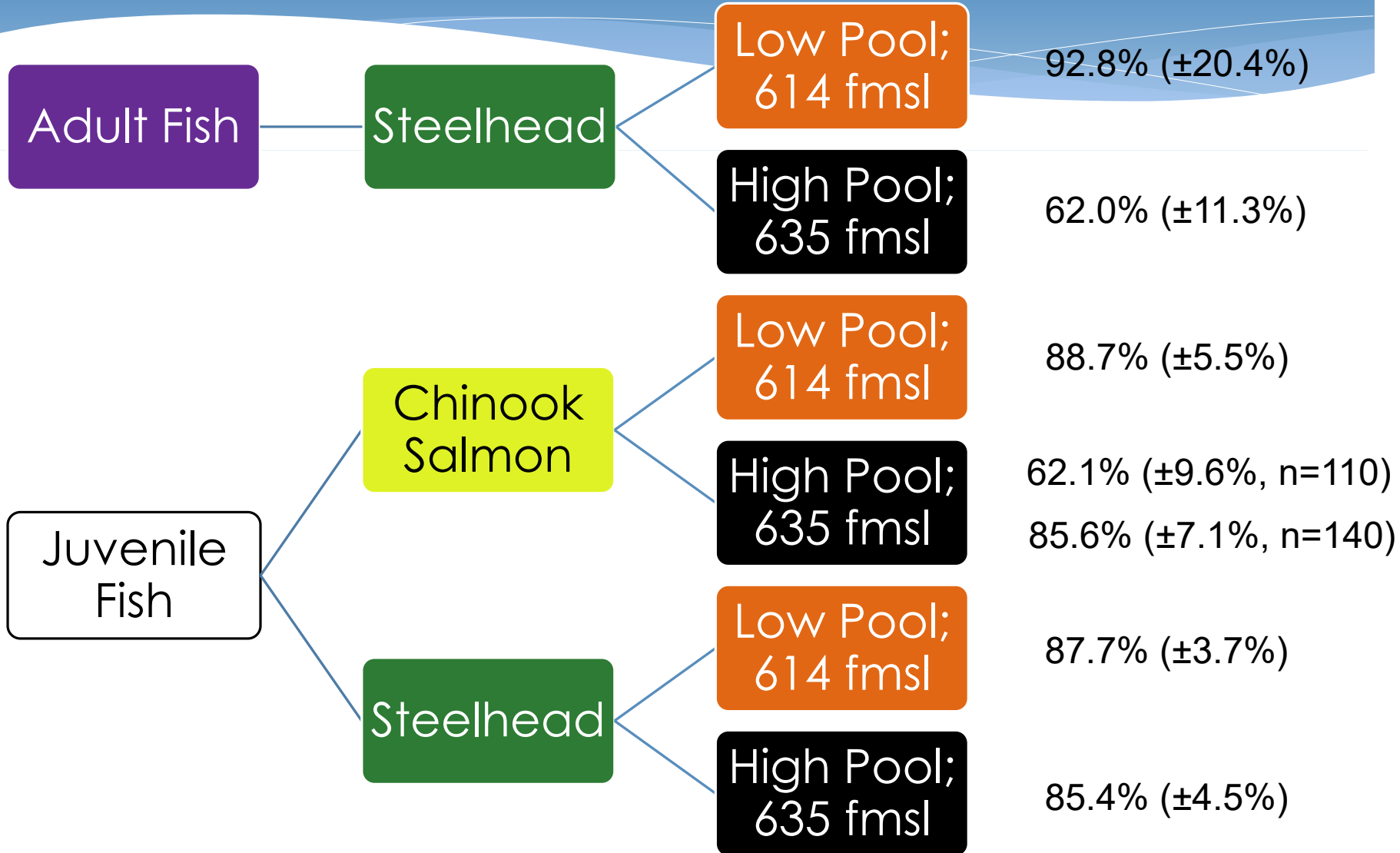
48-hour Survival Results

48 hour survival



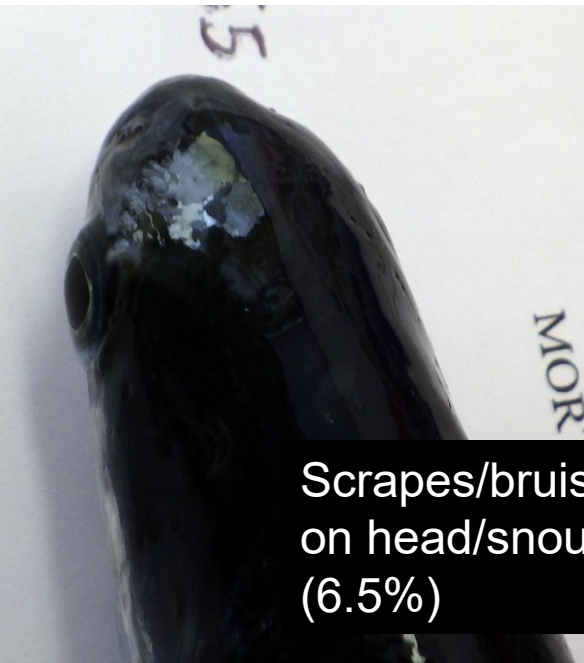
Injury-free Results

Injury-free rates



Juvenile Steelhead – Low Pool Injuries

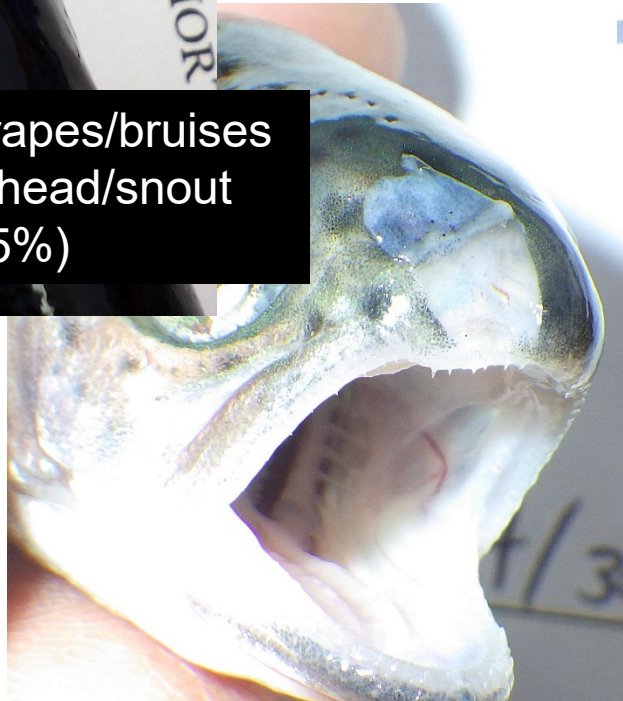
Low Pool injuries:
Treatment – 12.3%
Control – 0%



Scrapes/bruises
on head/snout
(6.5%)



Eye damage (5.5%)



Juvenile Steelhead – High Pool Injuries

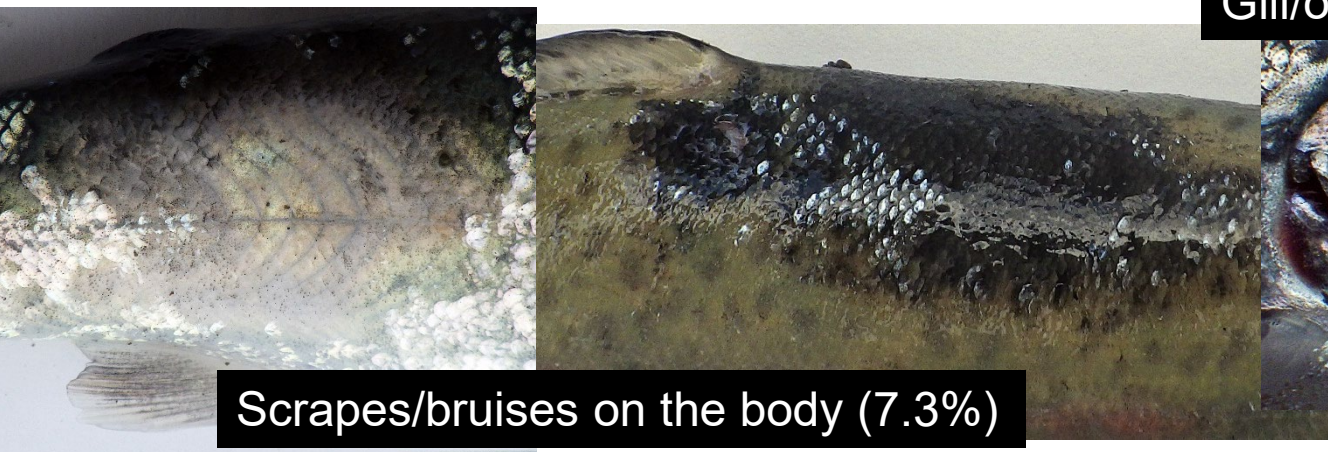
High Pool injuries:
Treatment – 14.6%
Control – 0%



Scrapes/bruises on head/snout (7.3%)



Gill/operculum damage (4.9%)



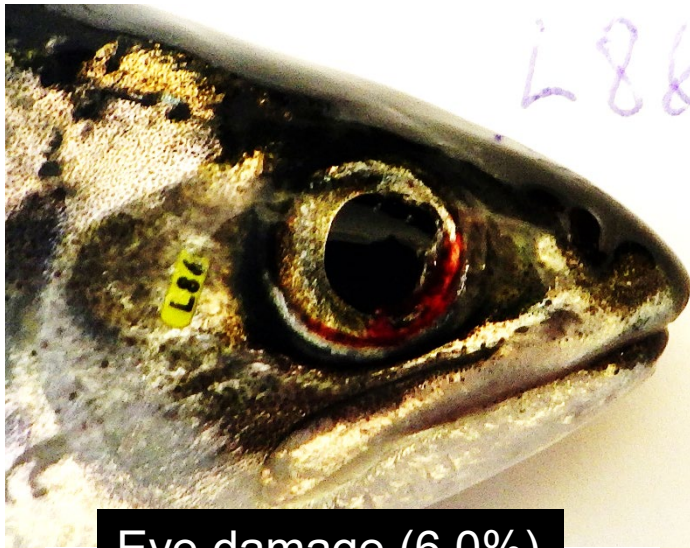
Scrapes/bruises on the body (7.3%)

Juvenile Chinook – Low Pool Injuries

Low Pool injuries:

Treatment – 13.7%

Control – 2.7% (scale loss)



Eye damage (6.0%)



Operculum/gill damage (5.6%)



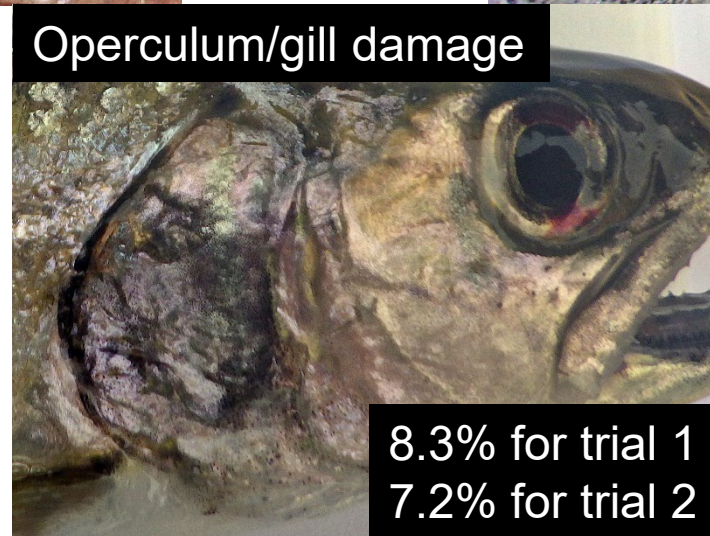
Juvenile Chinook – High Pool Injuries

High Pool injuries:

Trial 1 – 39.4%

Trial 2 – 16.5%

Control – 1.3%

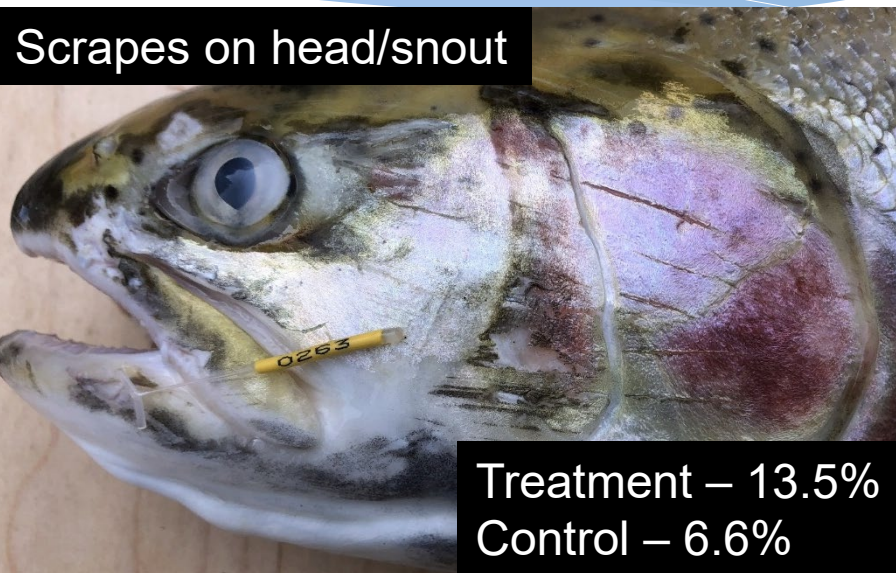
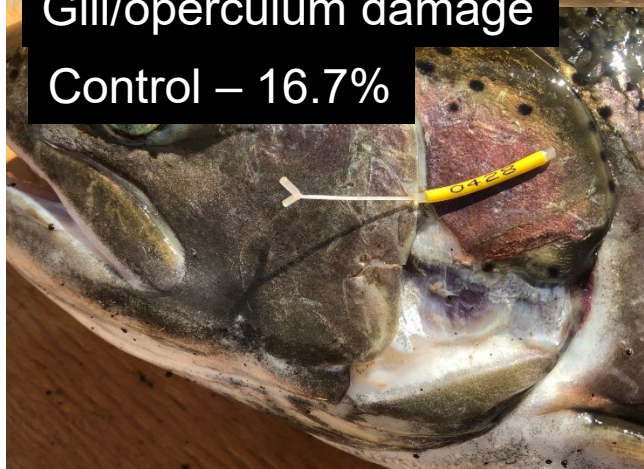


Adult Steelhead – Low Pool Injuries

Low pool injuries:
Treatment – 26.9%
Control – 20%

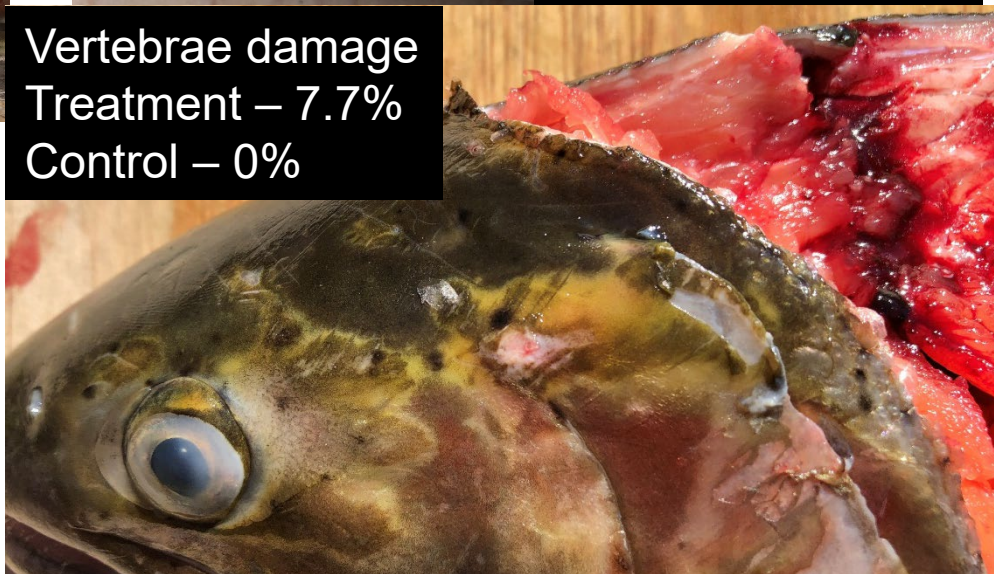


Treatment – 15.4%
Gill/operculum damage
Control – 16.7%



Scrapes on head/snout

Treatment – 13.5%
Control – 6.6%



Vertebrae damage
Treatment – 7.7%
Control – 0%

Adult Steelhead – High Pool Injuries

High pool injuries:

Treatment – 40.0%

Control – 0%

Scrapes to head/snout (30.0%)

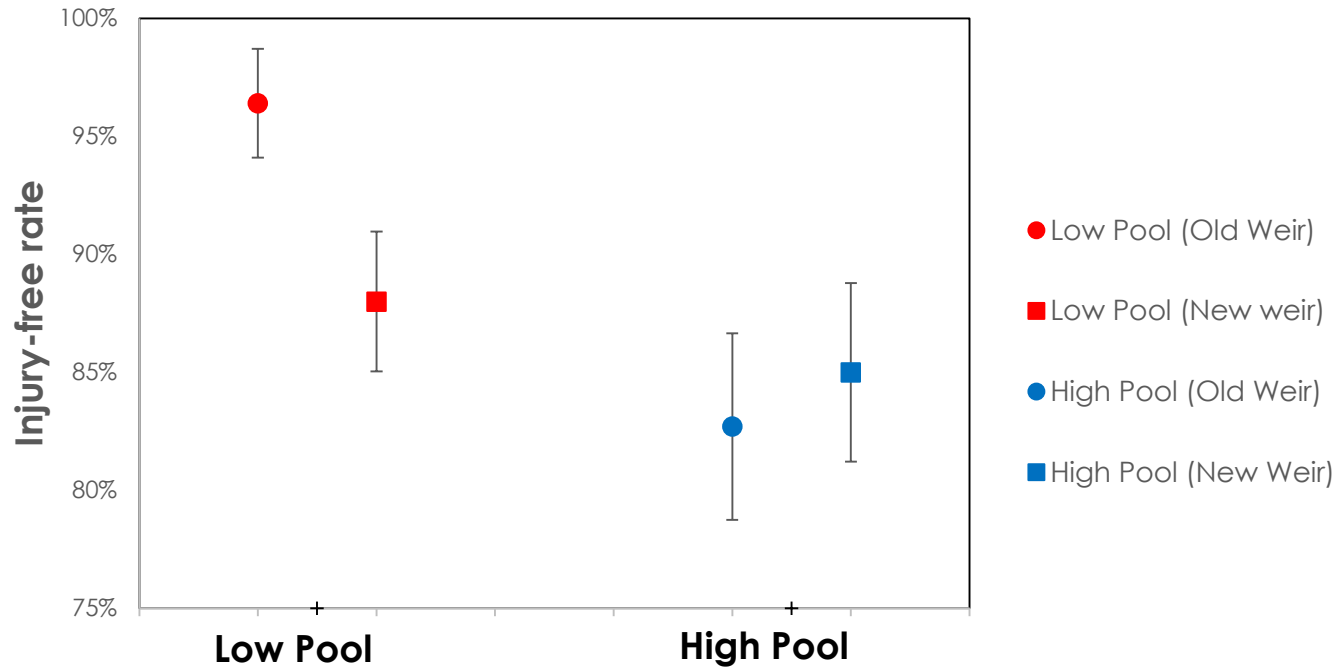


Gill/operculum damage (18.0%)



Juvenile Steelhead Injury-free Comparison: Old vs. New Weir

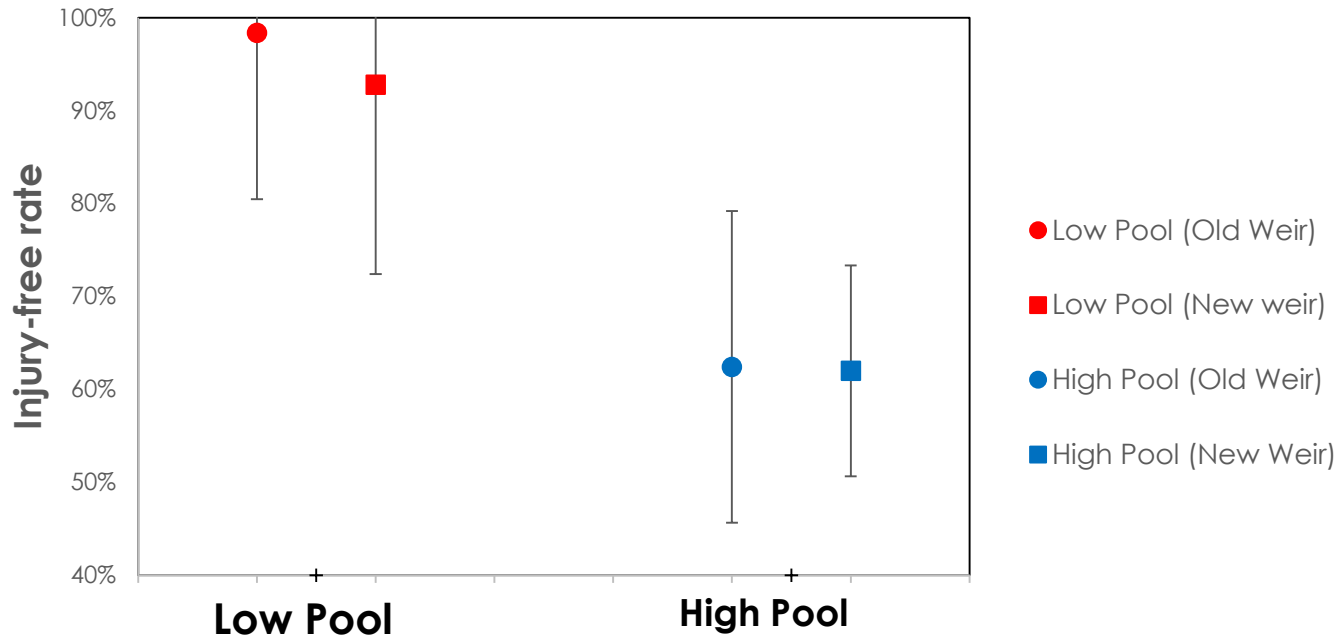
Juvenile Steelhead



- The new weir caused more injury to juvenile Steelhead at low pool than the previous weir.

Comparison to Old Weir for Injury-Free rate on Adult Steelhead

Adult Steelhead



- No significant differences observed for either reservoir elevation.

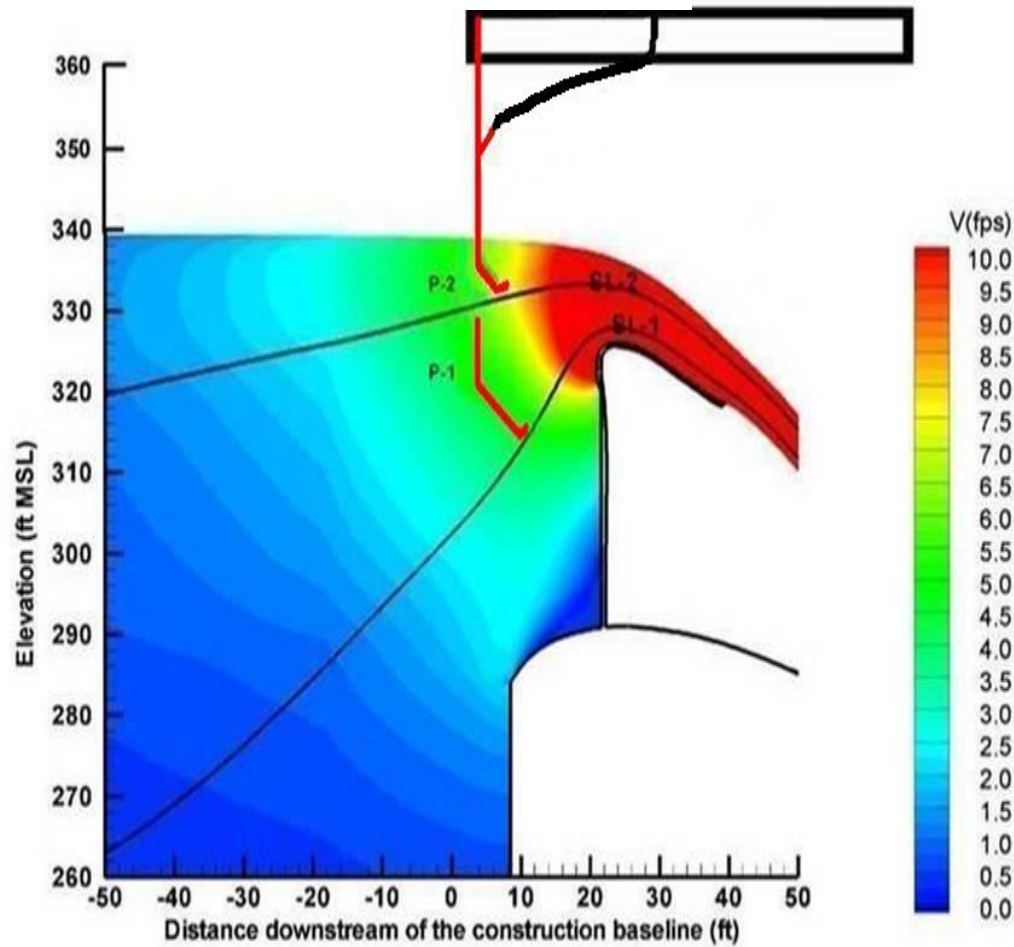
Summary

- The high pool (summer reservoir elevation) causes more injury to juvenile and adult fish.
- High survival rates of juvenile Chinook Salmon and Steelhead were observed at low pool (98 and 99.7%, respectively), however, relatively high rates of injury were observed (11.3 and 12.0%, respectively).
- Relatively high rates of sub-lethal injury were observed for both species – this evaluation did not monitor the long-term effects of those injuries.

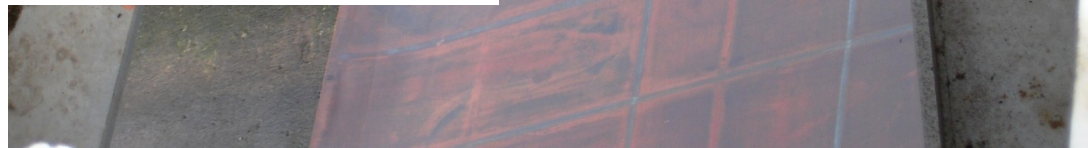
Possible factors that influence fish injury and survival at the Foster weir

- The sharp angle the weir discharge jet contacts the spillway chute
- The shallow depth and lateral dispersion of the weir discharge jet after contact with the spillway chute
- The roughness of the spillway chute

McNary Dam - 2007



48 h survival ranged from 98.2 to 99.3%
MF rates ranged from 97.1 to 99.6%





River Mill Dam (2007) – juvenile Steelhead
Paved Spillway Channel

48 h survival: 100% at 500 cfs

99.7% at 1,000 cfs

Injury rates: 4.0% at 500 cfs

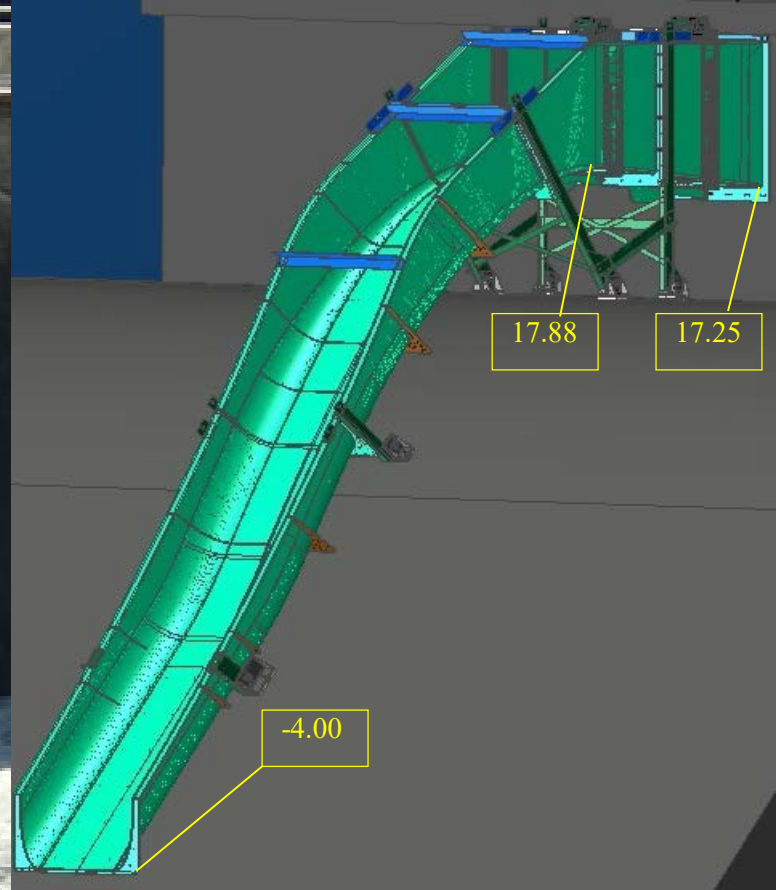
1.7% at 1,000 cfs



River Mill Dam (2007) – juvenile Steelhead
Fish Bypass Chute

48 h survival: 99.7% at 400 cfs
98.3% at 100 cfs

Injury rates: 0.9% at 400 cfs
6.0% at 100 cfs



Hiram M. Chittenden Locks (2017)
Juvenile Coho Salmon – 125 cfs

48 h survival: 100%
MF rate: 100%



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Acknowledgements/Questions



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