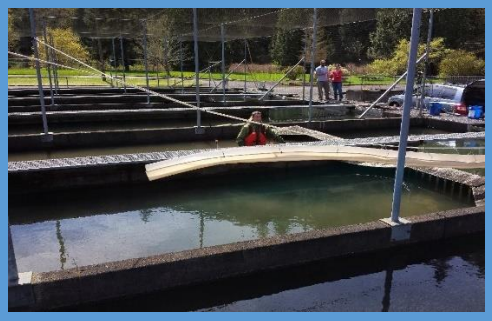
WDFW



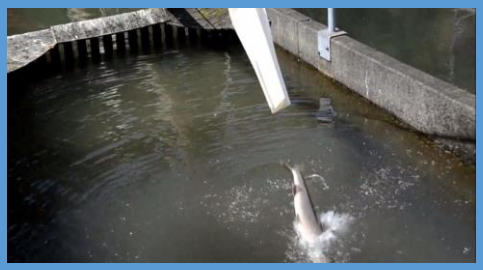
Demonstration Study: Safe Efficient Effective Transport

Hatchery Steelhead Passage: 250 ft Whooshh System

April 2014

Kalama Falls Hatchery

Kalama, Washington



WDFW Demonstration Study: Safe, Effective Transport of Steelhead through the Whooshh Fish Transport System

Where:	Kalama Falls Hatchery Kalama, Washington
Date:	April 10, 2014
Conditions:	Sunny, mild ~65^{0}C
Whooshh fish transport system:	Berlin Whooshh transport tube rough equivalent T147
Length:	250 ft/ 73 meters
Test fish:	Hatchery program Late-run Winter Steelhead
Sample:	Collected about 1 wk prior to test

Study Summary: Fish were crowded into about a 3 ft area in the holding raceway, netted in groups of several fish, and captured by hand via caudle peduncle and near head. A photo was taken of each side of the fish before it was either hand carried to the Whooshh accelerator entry and Whooshh transported or held for 12 seconds (average of first two handling times) prior to release via ~4 ft throw/drop back into the holding raceway (Control fish). No anesthesia was used in the study. After sending a calibration fish through the Whooshh system as a system check, the fish were alternated either Whooshh or control. All fish were handled by WDFW personnel. Sam Gibbons, hatchery manager, performed the control and treatment procedures. 18 Whooshh treatment fish and 17 control fish were evaluated (Table 1). Handling and transport times of a portion of the fish were collected and recorded in an excel spreadsheet by John Beeman of USGS (Table 2).

Table 1: Hatchery Steelhead Study Fish Characteristics

	Fish counts		
Group type	Treatment raceway	Control raceway	Note
unmarked study fish	18	17	fish meeting study protocols
unmarked other fish	0	1	dropped into raceway outside of protocol
opercle punched fish	3	0	including 1 large fish dropped into common area
marked other fish	0	1	Floy tagged, outside of protocol
total number per raceway	21	19	
total number of fish	40		

A total 35 fish met study protocol standards of healthy, unmarked and otherwise not subjected to any additional stress as in a drop scenario. The 35 fish were divided between the treatment groups: Whooshh transported and the control group.

Handling time was defined as elapsed time from having the fish held in both hands, photographed and released into the Whooshh device. The mean of the first two observations (12 s) was used for the

control fish handling time. A total of 16 handling time measurements were recorded giving an average of 11.6 seconds, range from 10-19 seconds and median of 13.3 seconds.

Table 2: Handling and Transport Times of a subset of the total number of fish in the study

	Recorded times[1]				
	Handling time (s)		Handling time note	Travel time (s)	Travel time note
	11.6		calibration fish	36	calibration fish
	13.6		first treatment fish	21	first treatment fish
	19		first control fish	10	
	17			29	
	11			14	
	15			9	
	16			15	
	12			12	
	19			11	
	12			12	
	11			13	
	13			14	
	10			9	
	10			12	
	17			12	
	13			10	
				13	
count	16			13	
average	11.6			13	
			count	18	Calibration fish not included
			average time (s)	13.4	
			average velocity (ft/s)	18.6	

Travel time was only relevant to Whooshh transported fish. Travel time was defined as elapsed time within the Whooshh accelerator and transport system from entry to exit. The average time was 13.4 seconds, times ranged from 9 to 29 seconds with a median of 12.5 seconds.

Events of the day are video documented at https://www.youtube.com/watch?v=6Gd-DCGku5U. Steelhead were transported 250 ft to a new raceway at an average rate of ~13 seconds/fish and at an average velocity of 18.6 feet/second. In all cases the combined fish out of water time, handling plus travel times, was less than one minute. All fish appeared to be unaffected by handling and those in the treatment group appeared to be unaffected by Whooshh transport. All control fish dropped back into the holding raceway behaved normally. All fish exiting the Whooshh tube immediately swam in a direction of their own choosing without any observable injury or aberrant behavior.

Conclusion: The Whooshh fish transport system safely, efficiently and effectively transported hatchery Steelhead.

Appendix – Engineering notes

- The Kalama Steelhead study was performed using an older Whoosh tube style referred to as a Berlin.
- The Berlin tube is roughly equivalent to the T147 tube in terms of cross sectional dimension.
- Berlin tube was hung using wire hangers loosely connected to a suspension wire, the precursor to the current “S” hooks used with the T-series tubes today.
- There was no deceleration system present in this test set up.
- Roots blower with silencers was used in creating the pressure differential within the WFTS.
- The accelerator used in this study was the prototype of our gen IV processing unit accelerator. It is functionally equivalent to the current live fish system, however it lacks several of the newer features designed to better control and protect live fish transport through the unit.