

April 1, 2005

FROM: Hal Beecher

TO: Lauri Vigue

SUBJECT: Packwood Lake Hydroelectric Project, FERC No. P-2244-012: Preliminary Draft Lake Creek Barrier Analysis 2004

I am reviewing the Lake Creek Barrier Analysis. This study report uses Powers and Orsborn (1985) as a foundation for the analysis. Powers and Orsborn is generally the approach that WDFW supports; it was developed by Pat Powers (WDFW Habitat engineer) and Professor Jack Orsborn (WSU Engineering). However, it is an analysis for general passability, not passability by the "elite" jumpers in the population.

Bruce Crawford was a fish biologist in the Department of Game Region Five (Vancouver, WA) in the late 1970s and early 1980s, before going on to be regional fish program manager there, then regional manager, then assistant director of the Fish Program for Washington Department of Wildlife and WDFW after merger. As a biologist, Bruce was known for conducting good studies and developing well-documented records. I recently asked him to refresh my memory on his observations of steelhead barriers in Washington's southern Cascades. The e-mail reply, pasted below, indicates that steelhead pass waterfalls over 12 feet high, which exceeds the suggested limits indicated on page 3, where the following statements are made:

"Falls where a change in water surface elevation in excess of 11 ft can be considered a barrier (Powers and Orsborn, 1985)" and "Evans and Johnstone (1980) state that for natural bedrock falls, if the vertical drop is >6 ft, it should be considered to be a barrier for salmon and steelhead without further study."

Clearly, application of these criteria would imply that steelhead are absent from areas we know they inhabit; the report should reflect relevant information. This information should also be used to revise Table 3 on p. 6.

On page 4, under Classification of Barriers, point #3 states that migrating fish orient to the highest product of flow x velocity. This is generally true, but I have observed at least one clear exception in the case of steelhead passage at the waterfall on the Little Klickitat River near the confluence of Bowman Creek. On February 14, 1991, Carl Dugger, Steve Manlow, and I watched steelhead ascend a small chute to the side of the main waterfall that carried the bulk of the flow; clearly the steelhead were able to move to a lateral area of reduced flow.

Fish Landing Zone is discussed on p. 5. The discussion implies that steelhead must have velocities in the sustained swimming speed range in the fish landing zone above a falls to avoid being swept back over the falls. Leaping fish can often be seen swimming in air during a leap. They may land in a burst speed effort and so continue upstream through water that exceeds the sustained swimming speed. Using the assumption that fish cannot exceed sustained swimming speed upon landing may lead to incorrect classification of a barrier.

Table 4 on p. 6 lists burst speed for steelhead as 22.4 ft/sec. This is in line with the lower end of the generic burst speed figure of 10-15 body lengths per second for most fish. It is a difficult measurement to obtain, so there is considerable uncertainty about these figures (although in the last few months – fall 2004 to present – I have seen at least one article in one of the American Fisheries Society journals that shed more light on the subject). As steelhead are not known to be sluggish, using the low end speed for a small steelhead (27 inches or about 7 lbs.) will imply impassability for passable chutes.

At the bottom of section 2 on p. 6, it is stated the reduced density of water with entrained air would limit propulsion of swimming fish, but resistance to swimming would also be reduced. Various combinations of layering or mixing of water and air could lead to different conditions affecting swimming ability.

In the Results, velocity at the lip of the falls ranged from 8.3 to 13.5 ft/sec (Table 6, p. 8). Although these exceed sustained swimming speed for steelhead, they are well within burst speed. As leaping steelhead often land with tail beating rapidly, this should not be assumed to indicate a barrier to steelhead passage. Similarly, velocities in the chute above the falls (Table 7, p. 9) are within burst speed range at least at the lower two measured flows.

The report concludes that this complex is impassable to steelhead and salmon. I cannot concur. It might be impassable, but there is enough uncertainty in each of the different components that it could be passable. Steelhead are notorious for proving doubters wrong about their abilities to pass steep areas with waterfalls and cascades. As more steelhead use the upper Cowlitz basin they are likely to test the waterfall-chute complex. It is premature to conclude that the area upstream of the section being analyzed could not be steelhead habitat.

#### Literature Cited

Evans, W.W., and B. Johnstone. 1980. Fish migration and fish passage. USDA Forest Service, Washington, D.C. Rept. EM-71000-12.

Powers, P.D., and J.F. Orsborn. 1985. Analysis of barriers to upstream fish migration: An investigation of the physical conditions affecting fish passage success at culverts and waterfalls. Final Report 1984 (Project No. 82-14). Portland, OR: U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. xiii+120 pp.

**From:** "Crawford, Bruce" <BruceC@iac.wa.gov>  
**To:** "'Hal Beecher'" <BEECHHAB@dfw.wa.gov>  
**Date:** 02/25/2005 3:32:15 PM  
**Subject:** RE: steelhead jumping

Yes there are a couple of reports we made that relate to how high can a steelhead jump. First we (Steve Leider, Jack Tipping, and I) witnessed on

many occasions steelhead jumping the Kalama Falls at the upper Kalama River Hatchery. That waterfall is 12 feet high and has a uniform lip designed by former WDF to force all salmon through their ladder and trap. We observed on numerous occasions during the summer approximately 4 steelhead per hour clearing the falls. We also observed on rare occasions a chinook clearing the falls. However the chinook were always 3 year olds, not the big bruisers (4 & 5 yr olds). the reference to jumping I believe is in the Kalama River Investigations report from 1977,78, or 79.

On another occasion, the question came up as to whether steelhead could get to Trout Lake if Condit dam were not in the way. I was informed that there was a waterfall above BZ Corner that was a total blockage to all anadromous fish, especially salmon. there was some question as to whether steelhead could pass it because there was a record in the USFS Wind River RD files of an interview with an old-timer who claimed that he had seen steelhead near Trout Lake back before Condit was built. I asked Hagadorn surveyors to help me measure the falls at RM 18?? to determine if it was passable. We cross country skied into the site and the surveyor guys who were mountaineers too rappelled into the canyon and using ice axes and stadia rods measured the lowest point on the waterfall where a steelhead could reach from the downstream pool. If my memory serves me correctly, the height was 16 feet. We determined that the steelhead probably didn't get to Trout Lake except perhaps under ideal water conditions when flood flows reduced the jump height to 13 feet. The White Salmon Report should be in the Region five files somewhere along with pictures of the stadia measurements. (One of the guys who measured it later died climbing Mt. Everest.)

Other reasons to believe that 13 feet is somewhere around the maximum is the Shepherd Falls height on the Wind and the Klickitat falls at Fishway Number 5 were both about 12 feet tall before they were modified to allow salmon to pass. In addition we did spawning surveys in the upper East Fork Lewis in the 80s showing wild steelhead above Sunset Falls but only a few fish. Its height was 13 feet. We later brought Roger Bogdon and \_\_\_ in to blast a notch in the falls to let more summer run steelhead upstream. As you know downstream you have both Lucia Falls and Horseshoe Falls at about 10-12 feet. The report on Sunset should be in the Region Five files and also the GP St Helens RD should have it.

Hope this helps. I feel like I just wrote a chapter on steelhead fish passage.

Bruce

-----Original Message-----

From: Hal Beecher [mailto:BEECHHAB@dfw.wa.gov]

Sent: Thursday, February 24, 2005 2:52 PM

To: BruceC@iac.wa.gov

Cc: Alan Wald

Subject: steelhead jumping

Bruce - I recall a report you made of measurements of the falls on the Kalama and E Fk Lewis that you made where steelhead were nearing their limits. Can you steer me to that report?

Hal

