Technical Report 2003-04

Effects of the Shad Fishery on Passage of Adult Chinook Salmon through the Oregon-shore Fishway Ladder at The Dalles Dam – 2002

M. A. Jepson, C.L. Williams, and C.A. Peery
Idaho Cooperative Fish and Wildlife Research Unit
Moscow, ID 83844-1141

and

M. L. Moser
National Marine Fisheries Service
2725 Montlake Blvd. East, Seattle, WA 98112

For

U. S. Army Corps of Engineers
Portland and Walla Walla Districts

2003

Table of Contents

Abstract

A fishery for American shad *Alosa sapidissima* at the exit of the Oregon-shore ladder at The Dalles Dam in the spring of 2002 had the potential to disrupt passage of adult chinook salmon *Oncorhynchus tshawytscha* through the ladder. We evaluated the effects of the shad fishery on passage by monitoring chinook salmon with radio transmitters as they passed through the Oregon-shore fishway. Passage times for 33 radio-tagged chinook salmon that exited the ladder during the period the shad fishery were compared to passage times for 60 radio-tagged chinook salmon that passed the dam prior to the shad fishery. We found that median time for chinook salmon to pass through and exit the ladder before the shad fishery was significantly shorter than the median passage time observed during the shad fishery. However, the median time for chinook salmon to pass on fishery days when the trapnet was deployed was not significantly different from the median time observed on fishery days when the trapnet was not deployed. Similarly, the effect of the fishery on passage rates was confounded with cooler mean daily water temperatures observed in the forebay of the dam during the fishery.

Acknowledgements

Many people assisted in the field work and data compilation for this project and the successful completion was made possible through their efforts. They include: Ken Tolotti and Carol Morat for downloading and maintaining radio receivers, Dan Joosten and Christine Nauman for interpretting and summarizing the telemetry data, Matt Keefer and Brian Burke for their critical review of this report, and Ted Bohn for administering the database. This study was funded by the U.S. Army Corps of Engineers, Portland and Walla Walla Districts, with assistance provided by David Clugston.

Introduction

Members of the Yakama Indian Nation conducted a fishery for American shad *Alosa sapidissima* at The Dalles Dam in 2002 using a trapnet tied to the foredeck wall of the dam and anchored in place with the trap mouth across one of the two fish-ladder exit portals. The fishery was open from 10 -18 June 2002, but the trap was deployed on only four of the nine available days (10, 12, 13, and 18 June 2002). Days with no shad fishery included a weekend when fishing was closed by regulation and days when increased 'ladder fallback' frequency (salmon swimming downstream past the counting window) coincided with trap deployment (Anonymous, 2002). We monitored adult spring–summer chinook salmon *Oncorhynchus tshawytscha* outfitted with radio transmitters to determine if passage through the Oregon-shore ladder was retarded by the shad fishery.

Methods

A trapnet designed to catch shad and exclude salmon was set at the Oregon-shore ladder exit during the fishery (Figure 1). The design was based on the observation that shad are strongly surface-oriented in the fish ladder while salmon tend to migrate closer to the bottom. The trapnet was tied to the foredeck wall of the dam and anchored in place with the trap mouth across one of the two fish-ladder exit portals (Figure 2). Fishers used dipnets to remove the shad from the trap and any salmon entering the trapnet were quickly dipped out and released upstream.

In 2002, telemetry monitoring at The Dalles Dam included one underwater antenna several weirs upstream from the transition pool and one at the top of the Oregon-shore ladder. For this evaluation, we defined passage time as the interval between the last record on the antenna upstream of the transition pool and the last record at the top of the ladder. We excluded passage times for fish reascending the fish ladder if they had passed the dam once and fallen back downstream. We used the Kruskal-Wallis Test to evaluate any effects of the shad fishery on salmon migrations by comparing the distributions of ranked passage times of radio-tagged chinook salmon that moved

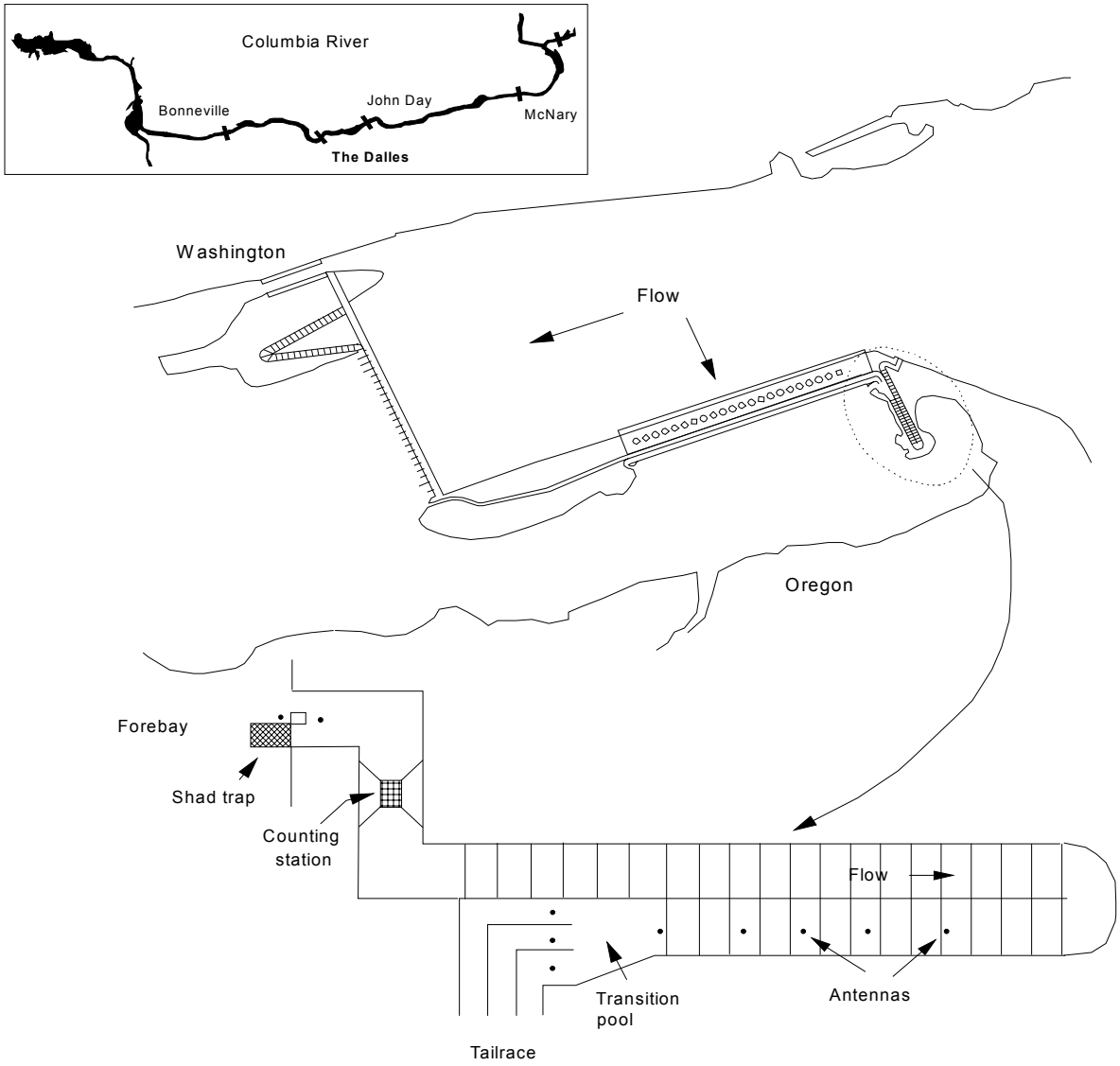

Figure 1. The Dalles Dam, with detailed schematic (not to scale) showing telemetry antennas and shad trap locations in Oregon-shore fishway during 2002. Inset shows location of The Dalles Dam in lower Columbia River.

through the Oregon-shore ladder during the 16 d prior to, and during the shad fishery. We used the Chi-square Test to test for significant differences in the proportionate use of the Oregon and Washington shore ladders during the 16 d prior to, and during the shad fishery. Alpha levels were 0.05 for all statistical tests. All fish used in this study were collected and outfitted with transmitters at Bonneville Dam.

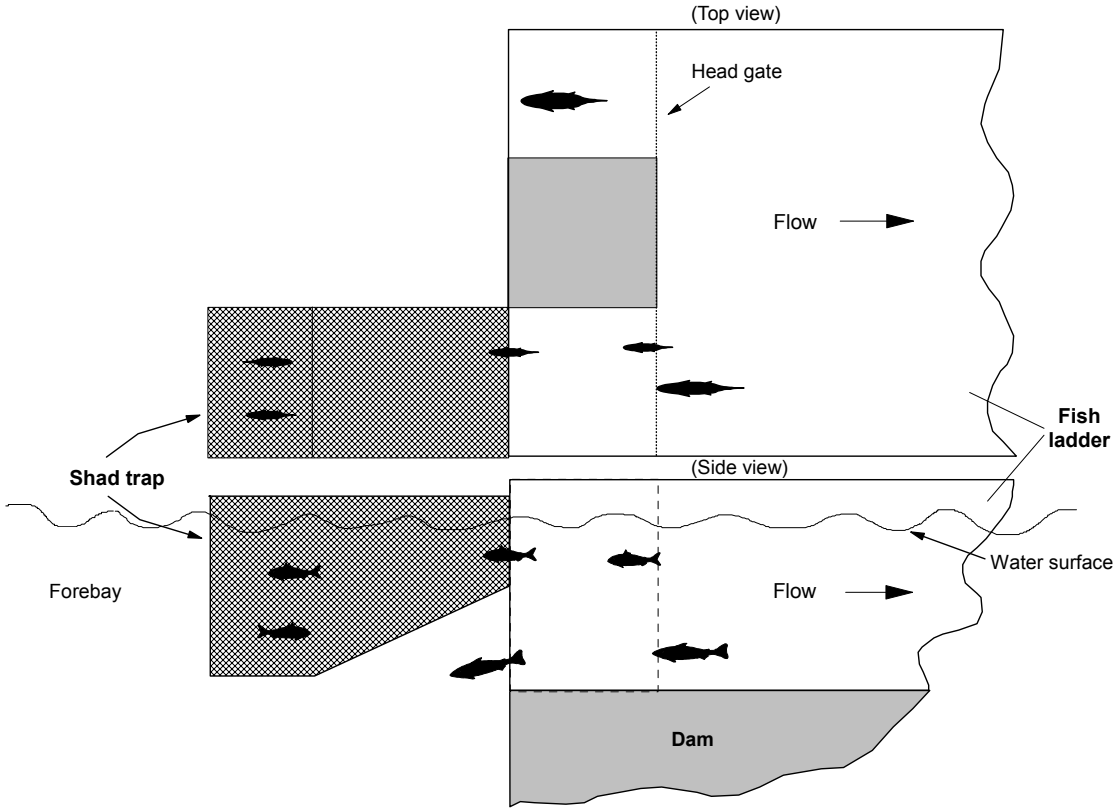

Figure 2. Top (top panel) and side (bottom panel) views of the exit to Oregon-shore fishway ladder at The Dalles Dam with the shad trap deployed. Trap dimensions were 6 m long, 3 m wide, and from 1.8 to 3.7 m depth.

The telemetry monitoring was not designed to experimentally test hypotheses related to the shad fishery at The Dalles Dam. Our analyses related to the shad fishery were retrospective and our use of these 'ad hoc' statistical analyses were to identify general relationships between adult fish passage and the shad fishery.

Results and Discussion

Radio-tagged salmon passed The Dalles Dam from early April to early August in 2002 (Figure 3). Thirty-three radio-tagged chinook salmon passed through the Oregon-shore ladder during the shad fishery (10-18 June, 2002). Of the 33, 17 passed on days when the trapnet was deployed. Sixty radio-tagged chinook salmon passed the Oregon-shore ladder in the 16 days prior to the shad fishery (25 May-09 June, 2002).

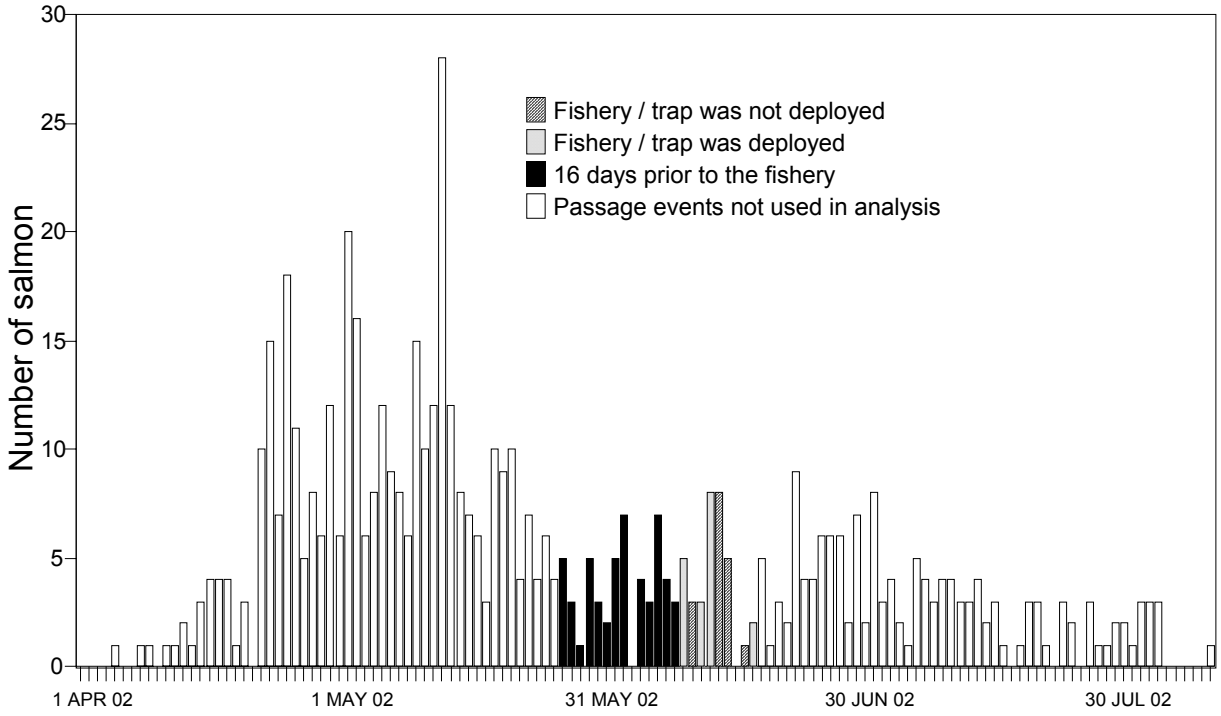

Figure 3. Number of radio-tagged spring-summer chinook salmon that exited the Oregon-shore ladder at The Dalles Dam in 2002.

The median times for chinook salmon to pass from the lower end of the Oregon-shore ladder to the ladder exit was 1.71 h (n=17) on fishery days when the trapnet was deployed and 1.70 h (n=16) on fishery days when the trapnet was not deployed (Figure 4). These values were not significantly different (*P*= 0.87, Kruskal-Wallis Test). The median time for chinook salmon to pass the Oregon-shore ladder during the 16 days preceding the fishery was 1.35 h (n=60). There was a significant difference between this value and the median time to pass on fishery days when the trapnet was deployed (*P* = 0.0288, Kruskal-Wallis Test) and on fishery days when the trapnet was not deployed (*P*=0.0482, Kruskal-Wallis Test). We also compared the median times to pass before the fishery to the median time to pass on fishery days, independent of whether the trap was deployed or not (median = 1.71 h, n=33), and these values were significantly different (*P* = 0.0075, Kruskal-Wallis Test). Based on the Kruskal-Wallis

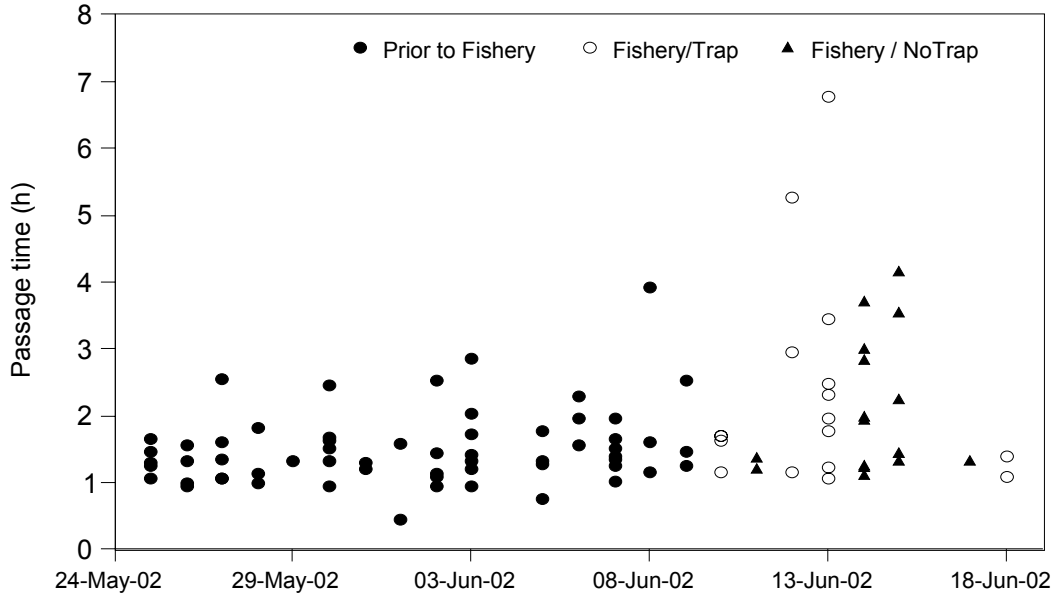

Figure 4. Times for chinook salmon with radio transmitters to pass through the Oregon-shore fishway ladder at the Dalles Dam in 2002.

tests alone, we determined that the shad fishery as it was operated at The Dalles Dam in 2002, significantly affected the passage times of adult chinook salmon that exited the Oregon-shore ladder. Passage times were more variable during the four-day fishery (s.d. = 1.57 h) than during days prior to the fishery (s.d. = 0.57 h), primarily because of two radio-tagged salmon that took two to four hours longer to pass during the fishery (Figure 4).

Mean daily water temperatures in the forebay of The Dalles Dam were approximately 1.5 °C colder during the fishery (14.2 °C, n =9), independent of trap deployment, than before the fishery (15.7 °C, n= 16) (USACE, 2003). In a 1996 radiotelemetry study, we confirmed that chinook passage times at Lower Columbia River dams decreased with increasing passage date (Bjornn et al., 2000). This may be due to temperature, which was positively correlated with passage date. In the current study, cooler water temperatures observed during the fishery may partially explain the longer passage times observed during this period. Consequently, conclusions made

based solely on statistical testing may be suspect, as the treatment of interest was potentially confounded with other variables (namely passage date and/or temperature).

The Yakama Indian Nation operated a shad fishery at The Dalles Dam in 1996 for 23 days (3 - 25 June). The median time for radio-tagged salmon to pass the Oregon-shore ladder during the 1996 shad fishery was 1.4 h (n=54) (Peery et al., 1999), approximately 20 minutes less than the median value in 2002 (1.75 h, n=18). By comparison, the median time for radio-tagged salmon to pass the Oregon-shore ladder 16 days prior to the 1996 shad fishery was 1.4 h (n=62), slightly longer than the median time observed prior to the 2002 fishery (1.35 h, n=60).

Over two-thirds (68.2%, n=60) of the radio-tagged salmon that passed The Dalles Dam 16 days before the 2002 shad fishery used the Oregon-shore ladder and 31.8% (n=28) used the Washington-shore ladder. Similarly, 65.4% (n=26) of radio-tagged salmon used the Oregon-shore ladder and 34.6% used the Washington-shore ladder on fishery days when the trapnet was deployed. On fishery days when the trap was not deployed, slightly less than half (46%, n=35) of the radio-tagged salmon that passed the dam used the Oregon-shore ladder while 54% used the Washington-shore ladder. The proportions of radio-tagged salmon using the two ladders did not differ significantly when all three conditions (before fishery, fishery/trap, fishery/no trap) were considered (P = 0.064, Chi-square test) but we did find a significant difference between the proportionate use of the two ladders when we compared passage events from before the fishery to those during the fishery, when no trap was deployed (P = 0.021, Chi-square test). In 1996, the percentage of the radio-tagged salmon using the Oregon-shore ladder to pass The Dalles Dam dropped significantly from 78.3% (n=83) before the shad fishery to 59% (n=100) during the fishery but we found no significant difference in proportionate ladder use in 2002 when we compared passage events from before the fishery to those during the fishery when the trap was deployed (P = 0.839, Chi-square test). The decreased proportion of radio-tagged salmon using the Oregon-shore ladder in 2002 on fishery days when the trap was not deployed is not readily explainable.

The shad fishery was discontinued earlier than planned because of the high number of ladder fallbacks by salmon observed at the count station when the trapnet was deployed. Ladder fallback, as defined here, refers to fish that passed the counting window moving upstream but then swam back downstream of the counting window. Data provided to the Yakama Tribe by the United States Army, Corps of Engineers, on 17 June 2002 indicated high ladder fallback rates were coinciding with the presence of the trapnet at the ladder exit. Ladder fallback rates exceeded the guidelines for two consecutive days and the shad fishery was therefore closed on 18 June 2002. While we had no antennas deployed immediately downstream of the Oregon-shore counting window during 2002, we observed no radio-tagged salmon reaching the ladder exit antennas, then swimming back down the ladder and exiting the fishway on days when the trapnet was deployed. The tribal fishery monitor mentioned that the high ladder fallback rates might have been due to a misalignment of the trapnet against the ladder exit (Anonymous, 2002). This, along with the cooler forebay water temperatures, may explain the significantly longer passage times during the shad fishery compared to the median passage time observed prior to the fishery.

Literature Cited

Anonymous, 2002. Report on the 2002 tribal shad fishery at The Dalles Dam. Yakama Indian Nation. P.O. Box 151, Toppenish, WA 98948. pages 1-4.

Bjornn, T.C., M.L. Keefer, C.A. Peery, K.R. Tolotti, R.R. Ringe, P.J. Keniry and L.C. Stuehrenberg. 2000. Migration of adult spring and summer chinook salmon past Columbia and Snake river dams, through reservoirs, and distribution into tributaries – 1996. U. S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID, and National Marine Fisheries Service, Seattle, WA. Technical Report 2000-5.

Peery, C.A., T.C. Bjornn, K.R. Tolotti and L.C. Stuehrenberg. 1999. Effects of a shad fishery on passage of adult chinook salmon through the Oregon-shore fishway ladder at the Dalles Dam - 1996. U. S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID, and National Marine Fisheries Service, Seattle, WA. Technical Report 99-4.

USACE. 2003. Columbia River Data Access in Real Time (JavaDART) adult passage and river environment data, courtesy of USACE and the University of Washington: http://www.cqs.washington. edu/dart/javadart/.