THE CONDITION, PERFORMANCE, AND BEHAVIOR OF SNAKE RIVER JUVENILE SALMONIDS WITHIN THE CORPS OF ENGINEERS TRANSPORTATION PROGRAM.

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Introduction

Migrating juvenile salmonids are collected at dams on the lower Snake and Columbia rivers and transported around the remaining downstream dams in an effort to reduce mortality. To determine what aspects of the transportation process might be limiting survival of juvenile migrants we examined the condition, performance, and behavior of juvenile chinook salmon before, during, and after barge transportation.

Methods

Yearling spring chinook salmon were evaluated during the early, middle, and late portions of the migration from 1992 to 1994. Fish were collected from Lower Granite Dam on the Snake River, the farthest upstream of the four Lower Snake River dams. As fish encounter the powerhouse they are screened in to the gatewell; after which they travel through a fish bypass system and arrive at the juvenile fish facility located approximately 0.5 km downstream. The fish are then barged past the remaining seven dams downstream and released near Bonneville Dam on the Columbia River. Fish were sampled from the gatewell, the fish facility, and from the barge before the start of the trip and at shortly before the fish were released. Plasma cortisol was measured in all fish as an indicator of stress (Donaldson, 1981;

Schreck, 1981), and measures of fish condition and health included gill Na^+/K^+ ATPase activity (an indicator of smoltification), as well as infection level of *Renebacterium salmoninarum*, the causative agent of bacterial kidney disease.

Post-release migration behavior of yearling spring chinook was used to assess the performance of fish following transportation. Radiotransmitters were implanted into the stomach of individual chinook prior to the barge trip, and individuals were tracked for up to 5 days following release.

Results

Collection at Lower Granite Dam was stressful to juvenile chinook as indicated by a significant increase in plasma cortisol in fish at the downstream side of the dam (Figure 1). Early in the season plasma cortisol levels typically declined during barge transportation; by the end of the trip they no longer differed from values seen in fish collected from the gatewell. At the peak of the migration season, when barges are typically loaded to capacity, little or no decrease in plasma cortisol was observed during the 36 h of transportation. Late in the season, when numbers of migrants had usually decreased, results were variable.

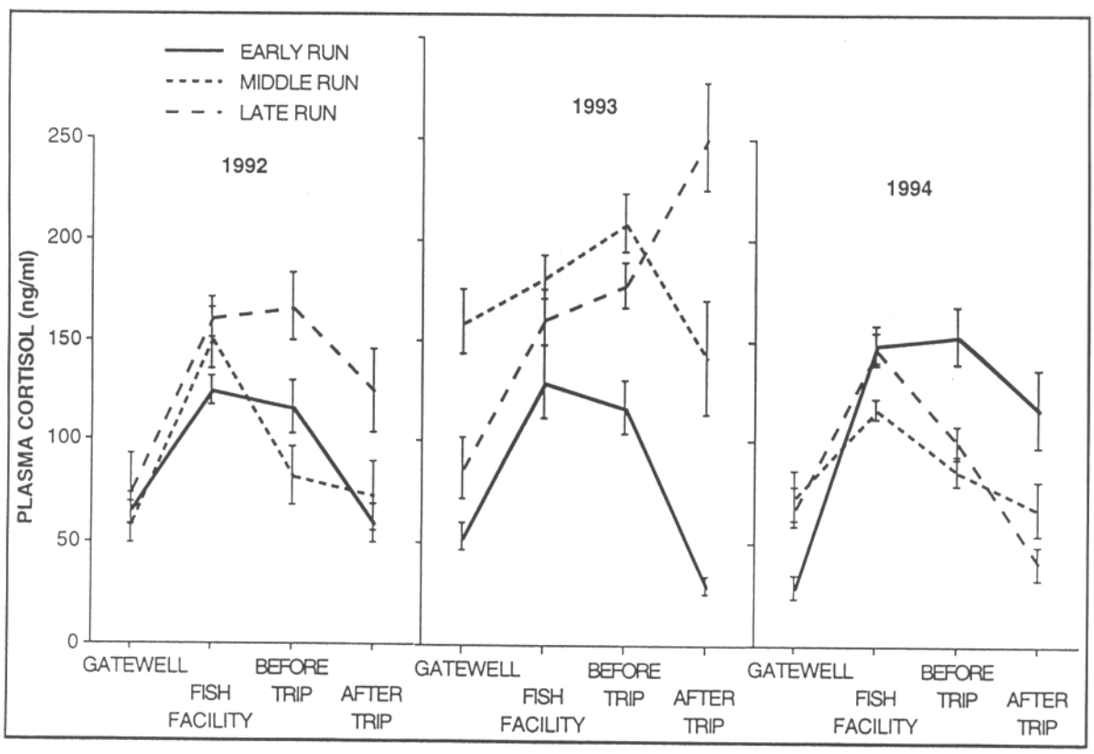

Figure 1. Plasma cortisol (mean ± SE) of juvenile chinook during collection and transportation.

Gill Na^+/K^+ ATPase activity increased with each succeeding sampling date, suggesting that later season migrants had progressed further along the smoltification process (Figure 2). In 1993, gill Na^+/K^+ ATPase activity increased significantly during the course of the barge trip, as well as between dates.

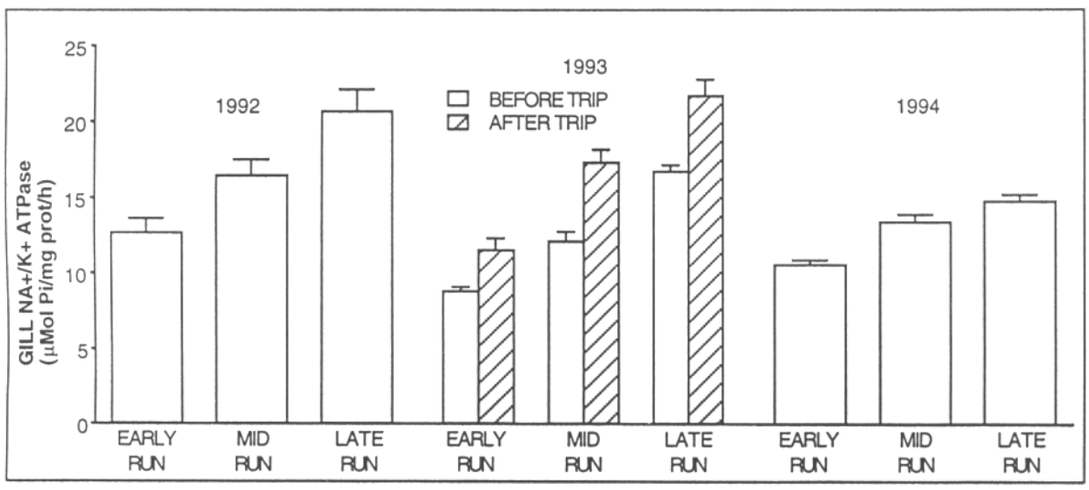

Figure 2. Gill Na^+/K^+ ATPase activity (mean ± SE) of juvenile chinook migrants.

The prevalence of *R. salmoninarum* varied considerably from year to year (Figure 3). In both 1992 and 1994, the percentage of fish showing moderate to high levels of infection increased over the course of the migration season.

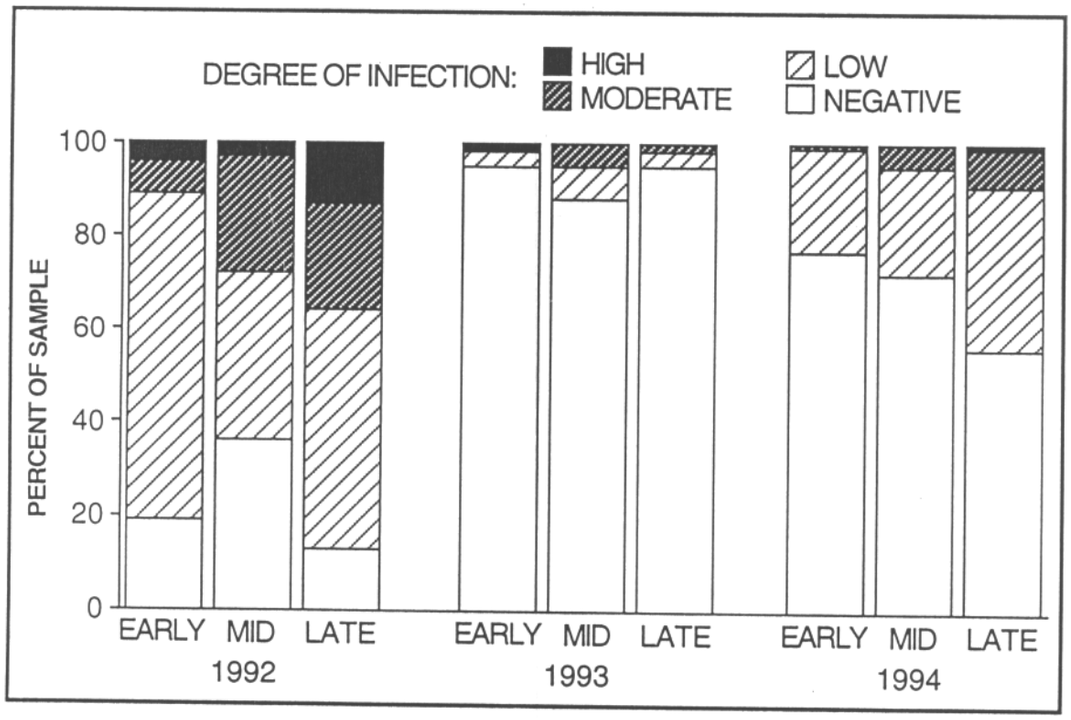

Figure 3. Percentage of fish showing various degrees of infection with *R. Salmoniarum.*

Upon release from the barge, all radiotagged yearling spring chinook dispersed rapidly, moving downstream at steady rate of 1.5 km/h to 4 km/h. Typically, 70-80% of radiotagged fish successfully migrated at least 140 km downstream.

Discussion

Migrating juvenile spring chinook were invariably stressed by the collection and bypass process at Lower Granite Dam, but the response to transportation varied. In instances of low loading density recovery from the stress of collection was observed, but recovery was not observed in high density conditions. We suggest that loading density may be an important factor in determining the amount of recovery, if any, that occurs during barge transportation.

It is likely that fish condition also modulates the response to transportation. On the last sampling date in 1992 plasma cortisol remained elevated during the entire barge trip despite the fact that loading density was relatively low (0.12 kg/L); accordingly, fish collected on this date had the highest gill Na^+/K^+ ATPase values of the season. This same group of fish also showed the highest levels of infection with *R. salmoninarum* of any seen during the entire study, and it is possible that many of these fish may have been in poor condition generally.

We found that both conditions aboard barges and condition of the fish themselves may vary widely. We suggest that the utility of using barge transportation to increase survival of juvenile chinook salmon may depend on very specific sets of circumstances, and perhaps the optimal transportation strategy is an adaptive approach in which the decision to transport is determined by conditions present at that specific moment in time.

Literature Cited

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This study was funded by the Walla Walla District, U.S. Army Corps of Engineers.