Nonselectivity of Gillnet Fishery on Jaw-tagged Adult Steelhead, *Salmo gairdneri*

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ABSTRACT—In 1978, three small lots of actively migrating adult steelhead, Salmo gairdneri, *were marked with an operculum punch (a small hole punched in the operculum) or an operculum punch and a metal jaw tag. The objective of the study being done at Bonneville Dam on the Columbia River was to determine whether jaw-tagged steelhead were more susceptible to being captured in gill nets than non-jaw-tagged steelhead. An analysis of mark recoveries obtained from the gillnet fishery upstream from Bonneville Dam showed no statistical difference in recoveries between jaw-tagged and non-jaw-tagged steelhead.*

Introduction

Since 1968, the National Marine Fisheries Service (NMFS) has been conducting experiments to determine whether transporting juvenile Pacific salmon, *Oncorhynchus* spp., and steelhead, *Salmo gairdneri*, around a series of dams on the Snake and Columbia Rivers is a feasible method of increasing smolt survival during seaward migrations (Ebel et al., 1973; Slatick et al., 1975). Evaluation of these experiments depended on a facility capable of separating returning adults tagged with internal magnetic coded wire tags (CWT) from nontagged adults. Such a trap was installed in the fish ladder at Little Goose Dam on the Snake River (Ebel, 1974). Jaw tags placed on adults with CWT intercepted at this trap provided a means of subsequent visual identification of these fish when they were recovered at upstream hatcheries or other locations (Slatick, 1976). In August 1978, a similar facility began operating in the Washington shore fishway of Bonneville Dam (Fig. 1) on the Columbia River.

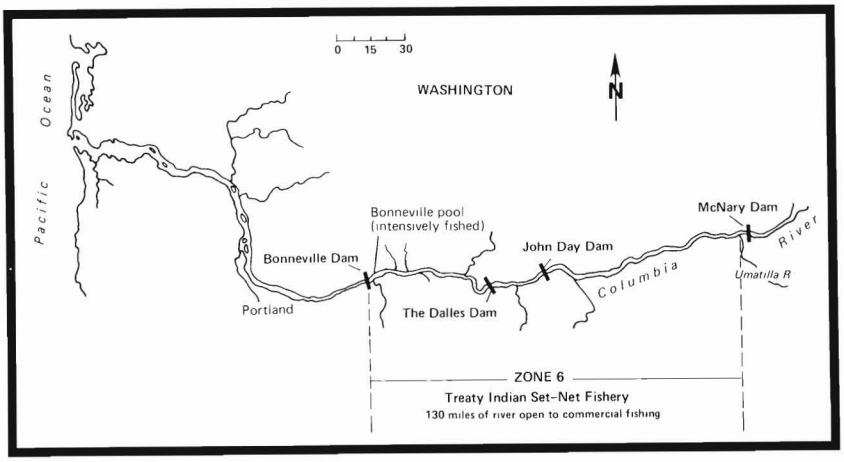

Figure 1.—Map of study area showing the Columbia River and the treaty Indian gillnet zone above Bonneville Dam.

An intensive gillnet fishery exists during the fall in the reservoir above Bonneville Dam. Adult salmonids passing upstream over the dam during the fishing season are susceptible to the fishery. Since our normal marking procedure required placing a jaw tag on specific wire-tagged fish intercepted at the dam, a question arose as to whether jaw-tagged fish were more susceptible to being caught in gillnets than non-jaw-tagged fish. This report describes an experiment designed to answer the question.

Methods and Procedures

Steelhead used in the experiment from 25 to 31 August 1978 were trapped in the Fisheries Engineering Research Laboratory located at Bonneville Dam on the Columbia River (Collins and Elling, 1960). Three groups of fish were released: A test and a control group consisting of randomly selected untagged adult steelhead (100/group), and a smaller test group of 19 steelhead which were previously marked with CWT as juveniles in the transportation study.

Each fish was marked with a ¼-inch (6.35 mm) diameter hole punched in its right operculum. These small holes were placed in one of three positions: Upper, center, or lower area of the operculum (Control, Test 1, and Test 2 Groups, respectively) (Fig. 2). Fish from Test Groups 1 and 2 were also marked with jaw tags made of monel or tempered aluminum bands (National Band

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Company, size 12 through 24)[1] which were shaped and tightened around their lower mandible (Fig. 3). Untagged fish destined for the Control Group and Test Group 1 were alternately marked with an operculum punch only (control) or an operculum punch and a jaw tag (test) throughout the marking period so that bias due to size and migratory behavior would be reduced to a minimum. After being tagged, fish were released into the fish ladder to continue their upstream migration. Recoveries of these fish from the gillnet fishery were obtained from the sampling program conducted by state and Federal agencies during the duration of the fishery, from 25 August to 3 October 1978.

Test Groups 1 and 2 were combined to set up a 2×2 contingency table for determining differences in recovery rate between test and control releases. Formulas developed by Kappenman (1983) provided the means to determine whether there was independence ($G_1 > G_2$) between the two tagging methods (no gillnet selectivity) or dependence ($G_2 > G_1$) and therefore selectivity of jaw-tagged fish in the gillnet fishery. The G formulas are:

$$G_1 = \sum_{i,j} x_{ij} \log e_{1_{ij}},$$

$$G_2 = \sum_{i,j} x_{ij} \log e_{2_{ij}},$$

where

$$e_{1_{ij}} = (x_i - 1)\frac{(x_1\, j - 1)}{n-1},$$

$$e_{2_{ij}} = x_{ij} - 1,$$

x_{ij} = the observations in the cells of the 2×2 contingency table, and

n = the total number of observations in the contingency table.

[1]Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

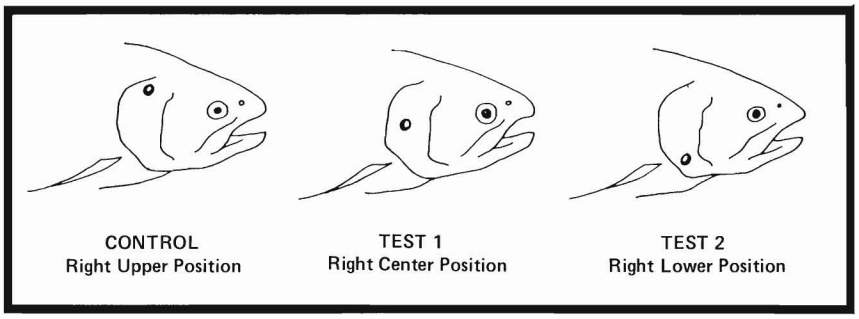

Figure 2.—Position of opercular punches used on the test fish.

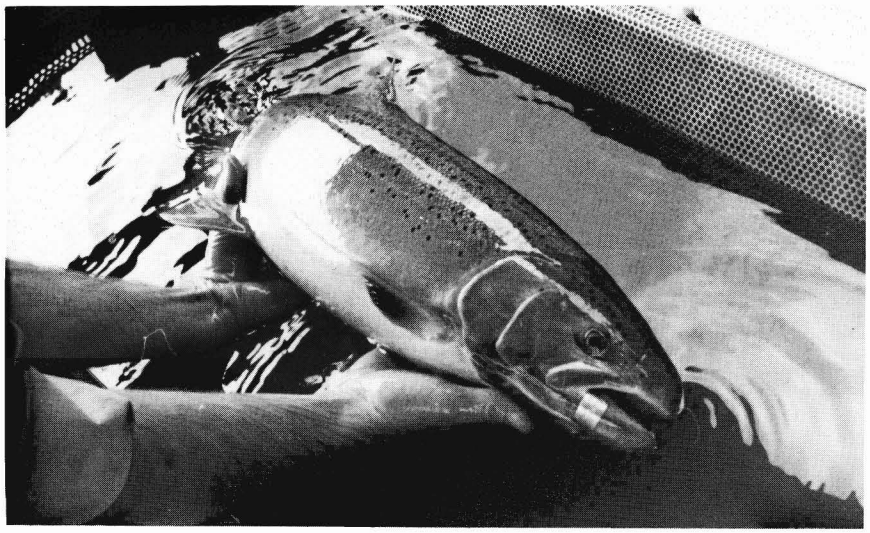

Figure 3.—Position of a jaw tag placed on a steelhead.

Results and Discussion

A total of 6,172 steelhead were sampled from the gillnet fishery, and 27 marked fish were recovered: 9 (9 percent) from the Control Group, 16 (16 percent from Test Group 1, and 2 (10.5 percent) from Test Group 2 (Table 1). The recovery rate for the combined Test Groups was 15 percent versus 9 percent for the Control Group. Although the percentage return of test fish was higher, the difference was not sufficient to indicate gillnet selectivity on jaw-tagged fish ($G_1 = 944.424 > G_2 = 944.318$). It should be pointed out that the differences in recovery rates may be less than indicated in Table 1. Even though fishery agency personnel were checking the fishery carefully, there was potential for some bias toward

Table 1.—Comparative recovery of marked steelhead from the gillnet fishery above Bonneville Dam.

Mark	Fish marked	Fish recovered	
		Number	Percent
Upper operculum punch (Control)	100	9	9.0
Jaw tag and center operculum punch (Test 1)	100	16	16.0
Jaw tag and lower operculum punch (Test 2)	19	2	10.5
Tests 1 and 2 combined	119	18	15.0
Totals	219	27	

recovery of test fish because operculum punches were harder to see than jaw tags. Consequently, a few control fish might have been overlooked in the sampling process. Since the test results showed the same probability of recovery for jaw-tagged as for non-jaw-tagged fish in the gillnet fishery, we concluded that jaw tags can be used as a tagging method for additional upstream evaluation without concern about potential bias from gillnet selectivity.

Acknowledgments

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