

AN ESTIMATE OF CODED WIRE TAGGED
COHO RETURNING TO THE BIG
QUILCENE RIVER IN 1981

by

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INTRODUCTION

Quilcene National Fish Hatchery (NFH) has experienced large returns of coho salmon in recent years. The Olympia Fisheries Assistance Office has been evaluating the hatchery's coho program through the use of coded wire tagging (CWT) studies. In most hatchery program evaluations of this type, no estimate is made of the number of fish which return to the river of origin but do not enter a hatchery. Quilcene NFH personnel take enough eggs to meet program requirements and allow the remaining coho to pass upstream. Recoveries of CWT fish at the hatchery rack and in the fishery do not provide complete information on survival and distribution of specific release groups of fish. To achieve a more precise estimate of these important variables, information is needed on the total return of coho and the number of CWT fish returning to the Big Quilcene River.

Spawning ground surveys for coho salmon normally recover a small percentage of the available fish (Eames and Hino, 1981). Estimates of total escapement and CWT coho in 1981 were developed using mark-recapture techniques.

STUDY AREA

The Big Quilcene River originates on the eastern slopes of the Olympic Mountains in western Washington at an elevation of 5,000 - 6,000 feet. The river flows eastward, emptying into Hood Canal at Quilcene Bay, near the town of Quilcene. The total length of the mainstem is a little less than 19 miles although a natural fish migration barrier is present at river mile 7.6. The gradient above river mile 3.5 becomes fairly steep, particularly above river mile 5.0. The lower portion of the river gradually widens into a broad valley. The mean annual flow of the Quilcene River is about 200 cubic feet per second (cfs) with summer low flows dropping to 20 cfs or less (Williams et al. 1975).

Quilcene NFH is located at about river mile 2.7 (Figure 1). Coho and chum are the primary salmon using this system with coho production being dominated by releases from Quilcene NFH.

METHODS

Capture and Tagging

Coho salmon were dipped from the Big Quilcene River with hand nets just below the Quilcene NFH fish weir on October 28, 1981, and November 2, 1981. The

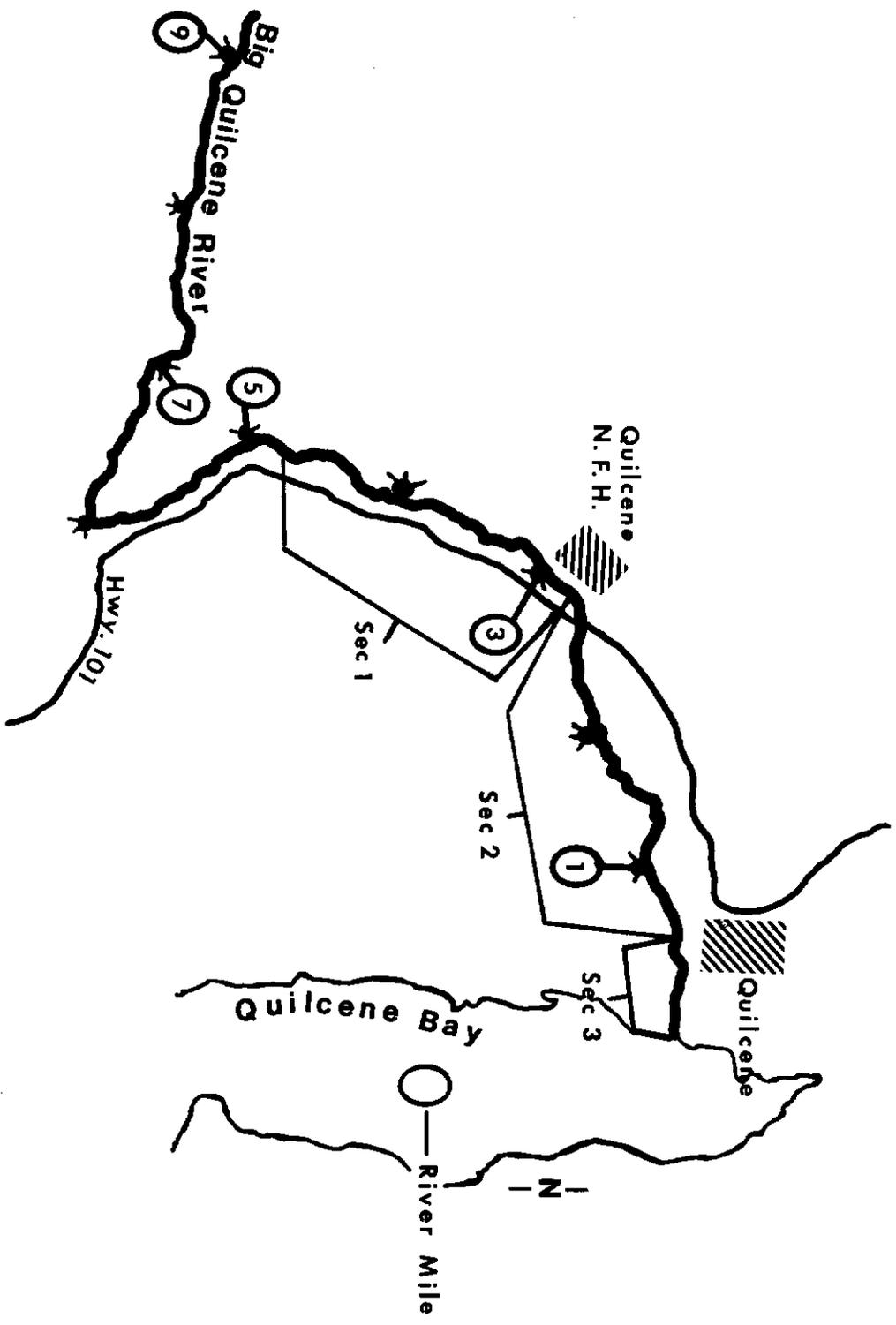


Figure 1. Big Quilcene River with locations of sample sites use in spawning around surveys. Section 1, river mile 4.7 to 2.7; Section 2, river mile 2.7 to 0.5; Section 3, river mile 0.5 to 0.0.

fish were placed singly into a padded box where an individually-numbered metal buttend (jaw) tag was clamped on the left mandible. Jaw tags varied in size and were matched to the size of the mandible. Precocious male coho under 45 centimeters (jacks) were not jaw tagged. To assess tag loss, a 6 millimeter hole was punched in the left operculum of every fish as another means of identification. Jacks were included in this procedure. The sex, length and presence of an adipose fin clip or other tags were recorded. The fish were then released back into the river.

Tag Recovery

Jaw tags were recovered during foot surveys beginning on November 2, 1981 and ending on December 3, 1981. The area surveyed was divided into three sections (Figure 1). The two upper sections, one above Quilcene NFH and one below, were sampled at least once every 7 days. Section three was located at the mouth of the river and was only sampled once because it lacked suitable spawning habitat and was subject to tidal influence. All fish carcasses in adequate condition were sampled. The criteria for fish in adequate condition were as follows:

1. the fish must be dead (gills had ceased movement)
2. the snout, left operculum, and lower left jaw must be intact
3. adipose fin area must not be obscured by fungus or damage
4. the species of fish must be identifiable
5. the caudal peduncle must be intact.

Once a carcass was determined to be in adequate condition, the species, sex, jaw tag, adipose fin clip, and presence of other tags were noted. If fish had an adipose fin clip, the snout was removed and taken to the laboratory where the CWT was removed and its origin determined. To distinguish previously sampled carcasses, the tails were cut off just anterior to the caudal peduncle.

The following formula was used to calculate the population estimate:

$$N = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)}$$

where: N = population estimate
n₁ = number of fish tagged
n₂ = number of fish carcasses recovered
m₂ = number of tagged fish carcasses recovered.

Use of the above formula requires six assumptions. The basic assumptions are:

1. the population is closed
2. all animals have the same probability of being caught in the first sample (initial tagging)

3. the second sample (spawning ground surveys) is a simple random sample
4. marking does not affect the catchability of an animal
5. animals do not lose their marks between the two samples
6. sampled animals are identified correctly as marked or unmarked.

Several authors have examined these assumptions as they applied to similar salmon mark-recapture studies (Eames et al, 1981; Ricker, 1975; Seber, 1973). After reviewing their evaluations, we concluded that the six assumptions were satisfied in this study.

The estimated number of CWT fish in the river was derived by the ratio of $X = (a)(b)/c$ where:

X = CWT fish estimate
 a = population estimate
 b = CWT fish carcasses recovered
 c = carcasses recovered.

The variance for the population estimate was derived from the formula:

$$\text{variance} = N^2 \left(\frac{N}{n_1 n_2} + 2 \left(\frac{N}{n_1 n_2} \right)^2 + 6 \left(\frac{N}{n_1 n_2} \right)^3 \right)$$

used by Eames and Hino (1981)

where: N = population size
 n₁ = number of fish tagged
 n₂ = number of fish carcasses recovered.

RESULTS AND DISCUSSION

Table 1, presents a summary of the jaw tagging data from October 28 and November 2, 1981. The ratio of males to females that were jaw tagged was nearly 1:1 with the mean length of males slightly larger than females.

Table 1. Summary of data gathered during tagging on October 28 and November 3, 1981 on the Big Quilcene River.

	<u>Male</u>	<u>Female</u>	<u>Jack</u>
Number tagged	105	106	*59
Mean length (cm)	60.6	58.3	32.4
Range in length (cm)	74-45	69-38	39-24

*jacks did not receive jaw tags, only operculum punch

Table 2 presents all spawning ground surveys by date and stream section as well as counts of live, dead and tagged fish. All jaw tagged and CWT fish recoveries took place between November 2 and 9, with 85% of all carcass recoveries taking place that same time period.

After November 9, we were unable to survey sections 1 and 2 (Figure 1) every seven days because of high flows. Following these high flows, no more than ten carcasses were found on a single sampling day.

The river is relatively confined to its channel with few gravel bars or obstructions where most carcasses are deposited. It appears that this, coupled with the extended period of high flow had washed a large number of carcasses out of the sample sections.

Population and CWT Fish Estimates

Before using a single or stratified population estimate, a chi-square test was used to determine if sub-populations were established within section one and two. No significant difference was found between sections, so stratified estimates were not developed.

We calculated a population estimate of 3,644, with a standard deviation of 1,060, and a 95% confidence limit of 2,118 to 7,044 (Table 3). This wide confidence limit is not surprising because of the small number of carcasses and jaw tags recovered (Table 4). Eames and Hino (1981) found broad confidence limits at Big Beef Creek and concluded that even under ideal conditions spawning ground surveys shouldn't be expected to recover a substantial portion of the escapement. The estimate for CWT fish remaining outside the hatchery was 102.

CONCLUSIONS

Coho escapement into the Quilcene River in 1981 was far in excess of hatchery needs and the river's biological escapement goal. The Washington Department of Fisheries has established a spawning escapement goal of 700 coho for the entire Quilcene River (Zillges, 1977) and 500 above Quilcene NFH. This goal has been greatly exceeded in recent years resulting in a wastage of fish. Included in the escapement are a large number of CWT fish. To acquire the information needed to assess the success of the coho program and help reduce excess fish in the river, we offer the following recommendations.

1. The fish ladder at the hatchery should be left open and the electrical weir operated during the entire coho run.
2. No more than 500 fish with an approximate 1:1 sex ratio, be released upstream from the hatchery. Remaining fish in excess of hatchery needs should be disposed of in accordance with Fish and Wildlife Service policy.

Table 3. Summary of estimates made from the data collected from the Big Quilcene River.

Population estimate	3,644
Variance	1,123,381
Standard deviation	1,060
95% confidence limit	2118 and 7044
CWT fish estimate	102

Table 4. Summary of data gathered from spawning ground surveys on the Big Quilcene River.

Number tagged	211
Fisherman recoveries	2
Number of carcasses sampled	242
Number of jaw tags recovered	13
Number of CWT recovered	7

3. The fish being released upstream should extend over the natural timing of the run.
4. All fish with missing adipose fins should be sacrificed and snouts removed for CWT information.
5. An occasional spawning ground survey below the hatchery, especially toward the end of the run should be conducted, to insure that a large segment of the run is not remaining in the river.

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