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# A Coded Wire Tag Assessment of Salmon River (Langley) Coho Salmon: 1989 Tag Application and 1990-91 Spawner Enumeration


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# A CODED WIRE TAG ASSESSMENT OF SALMON RIVER (LANGLEY) COHO SALMON: 1989 TAG APPLICATION AND 1990-91 SPAWNER ENUMERATION

by

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## ABSTRACT

Farwell, M.K., N.D. Schubert and L.W. Kalnin. 1991. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1989 tag application and 1990-91 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2114: 32 p.

In 1986, the Department of Fisheries and Oceans implemented a plan to improve the assessment data for coho salmon (*Oncorhynchus kisutch*) through the long term evaluation of key stocks. The Salmon River (Langley) was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution and exploitation rate. An estimated 26,911 (corrected for long term tag loss) coho smolts were released with coded wire tags (CWT) in spring of 1989 at an average size of 94.9 mm and 8.9 g. The adult escapement was estimated in fall and winter 1990-91 using the Petersen mark-recapture method. Escapement was estimated at 4,986 coho adults of which an estimated 791 had coded wire tags and 179 (18.4%) had lost the coded wire tag. Survival to escapement was 2.9%.


**Key Words:** Coho salmon, Salmon River (Langley), key stream, coded wire tag, escapement, survival.


## RÉSUMÉ

Farwell, M.K., N.D. Schubert and L.W. Kalnin. 1991. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1989 tag application and 1990-91 spawner enumeration. Can. Manuscr. Rep. Fish. Aquat. Sci. 2114: 32 p.

En 1986, le ministère des Pêches et Océans a entrepris une évaluation à long terme des stocks clés pour améliorer la base de données sur le saumon coho (*Oncorhynchus kisutch*). Il a choisi de faire cette évaluation dans la rivière Salmon (Langley) et d'établir des données précises sur l'échappée annuelle, la survie, la répartition des captures et le taux d'exploitation. Au printemps de 1989, environ 26 911 (chiffre ajusté pour tenir compte des pertes à long terme de micromarques magnétisées codées) jeunes saumons mesurant en moyenne 94,9 mm, pesant en moyenne 8,9 g, et pourvus d'une micromarque magnétisée codée ont été relâchés. L'échappée des adultes a été estimée à l'automne et au printemps de 1990-91 au moyen de la technique Petersen de marquage-recapture. L'échappée a été estimée à 4 986 poissons, dont 791 avaient encore leur micromarque et 179 (18,4%) l'avaient perdue. La survie à l'échappée des cohos géniteurs de 1987 de la rivière Salmon était de 2,9%.


**Mots clés:** Saumon coho, rivière Salmon (Langley), cours d'eau important, micromarque magnétisée codée, échappée, survie.

## INTRODUCTION

In 1986, the Department of Fisheries and Oceans implemented a plan to improve coho salmon assessment data through the long term evaluation of key stocks. The Salmon River was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution and exploitation rate.

The Salmon River was designated a key stream for three reasons. First, recent escapements of Salmon River coho comprised 4% of the Fraser River total (Farwell **et al.** 1987). The status of this stock, therefore, is an important measure of the status of the Fraser River coho resource. Second, data collected from the 1976-78 brood years (Schubert 1982a; Schubert and Fleming 1989) provided a time series of comparable data. Third, simplified logistics limited project costs.

This report documents, for the 1987 brood, the 1989 coho smolt coded wire tag (CWT) application and 1990-91 coho adult escapement estimation studies. Previous reports documented the evaluation of the 1984-86 brood years (Schubert and Kalnin 1990; Farwell **et al.** 1991; Kalnin and Schubert 1991). This report describes field methodologies, analytic techniques and study results, including smolt timing, age and size and adult age, length, sex, adipose fin clip (AFC) incidence and estimates of escapement and long term CWT loss. The study did not estimate the escapement of precocious males (jacks). The report concludes with a discussion of data limitations.

## STUDY AREA

The Salmon River flows northwest for 33 km, entering the Fraser River west of Fort Langley (Fig. 1). Coghlan Creek, the principal tributary, joins the mainstem 14 km upstream from the Fraser River. The system, with an average annual discharge of 1.41 $m^3/s$ (Environment Canada 1986), drains 85 $km^2$ of agricultural and residential land. During the Fraser River spring freshet, the Salmon River passes through a pumphouse located at the river mouth. No provisions were made for fish passage. Up to 31% of the coho smolts are killed when they pass through the pumps (Russell MS 1981).

Coho adults enter the river at ages $3_2$ and $4_3$ and spawn in the middle and upper reaches from November to January (Schubert 1982b; Schubert and Fleming 1989). Coho escapements averaged 3,000 and 2,400 in 1970-79 and 1980-86, respectively (Farwell **et al.** 1987).

## METHODS

### JUVENILE PROGRAM

#### Fish Capture

Fence traps similar to those described by Schubert (1982a) operated in the Salmon River (30 m above the Coghlan Creek confluence) from April 21 to May 27, 1989 and in Coghlan Creek (50 m above the Salmon River confluence) from April 19 to May 27, 1989.

Captured fish were enumerated at least once daily. Coho smolts were transferred to holding boxes or to the tagging site for tagging and sampling. Coho fry were not enumerated because the 6 mm fence mesh did not fully restrict their passage. The remaining catch was identified to species and released below the fence. Steelhead and cutthroat trout were recorded as smolt or presmolt. Smolts had a silver coloration and a nose-fork (NF) length greater than 11 cm. Presmolts had distinct parr marks and a NF length less than 11 cm.

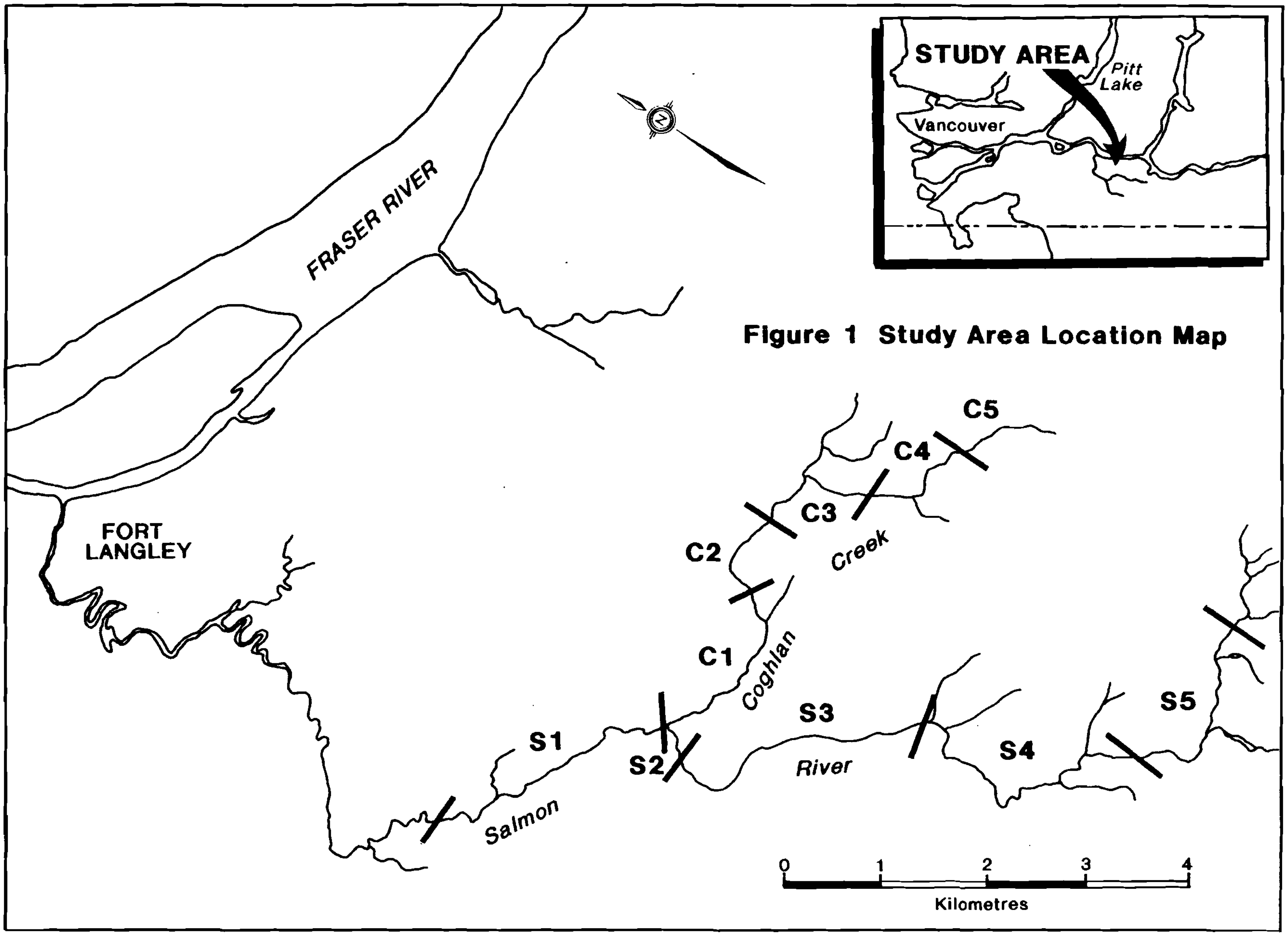


Figure 1 Study Area Location Map

**Coded Wire Tagging**

The CWT equipment and methods were described by Armstrong and Argue (1977). Coded wire tagging occurred from April 21 to May 15, 1989 at intervals of one to three days. On each day, smolts were sorted by size (NF length greater or less than 100 mm) and separate nose moulds and implant depths were used for each group. Implant depth was checked for each group by bisecting the skull of a tagged smolt along the median plane. If the CWT was not in the preferred position in the cartilaginous wedge of the skull, the implant depth was adjusted and the procedure repeated until CWT placement was correct. The nose mould was then marked to permit correct placement after nose mould changes.

The smolts were anaesthetized with Tricaine Methane Sulfonate (TMS), marked by adipose fin removal, coded wire tagged and passed through a quality control device to ensure the CWT was present. Any diseased, damaged or undersize (NF length less than 55 mm) smolts were released untagged. A representative sample of approximately 250 smolts was removed from the recovery bucket and retained for 24 hours for assessment of AFC quality, delayed mortality and CWT loss. Any coho without a CWT or with a poor AFC was retagged or reclipped. All smolts were then transported and released, or held until morning when water temperatures were more suitable for transport.

**Transport**

Coded wire tagged smolts were released at the Salmon River mouth to avoid pump related mortality. The smolts were transported in five gallon plastic buckets supplied with air from a twelve volt air pump. Transport required less than fifteen minutes.

**Sampling**

Fifty coho smolts per site were sampled twice weekly for scales, length and weight. The smolts were anaesthetized with TMS, a scale smear was removed with a scalpel from each preferred region, NF length was measured to the nearest millimetre, and mean wet weight (±0.1g) was determined in aggregate on an Ohaus triple beam balance.

## ADULT PROGRAM

**Fish Capture**

Coho adults were captured in reaches S1 to S5 and C1 to C5 (Fig. 1) from October 31 to November 30, 1990. Coho were attracted from log jams and cut banks with an electroshocker using direct current. Voltage (600 volts) and frequency (15 to 30 milliseconds) were adjusted daily to ensure the fish were undamaged, but stunned sufficiently to permit capture. Stunned coho were captured in a dip net, permitted to recover in a 60 l container of water, disk tagged and released.

**Disk Tag Application**

Coho adults (NF length greater than 30 cm) were Petersen disk tagged in a wooden tray (10 cm x 10 cm x 100 cm) constructed with a flexible plastic bottom and a meter stick recessed in one side. The tags consisted of two 2.2 cm diameter laminated cellulose acetate disks and one 0.7 cm diameter transparent plastic buffer disk threaded through centrally punched holes onto a 7.7 cm long nickel pin. The pin was inserted with pliers through the musculature and pterygiophore bones approximately 1.2 cm below the anterior portion of the dorsal fin insertion. The disk tags, arranged with one on each side of the fish and with a buffer disk on the pin head side, were secured by twisting the pin into a double knot. One disk per pair was numbered with a unique code. Green disk tags were used to reduce colour contrast, thereby minimizing recovery and predation biases.

Each disk tagged fish received a secondary mark to allow the assessment of disk tag loss. One or two 0.7 cm diameter holes were punched through the right operculum of males and females, respectively, using a single hole paper punch. Care was taken to avoid gill tissue damage.

Date and location (reach) of capture, disk tag number, NF length (to the nearest 0.1 cm), sex and adipose fin status were recorded for each fish released with a disk tag. Release condition was recorded as 1 (swam away vigorously), 2 (swam away sluggishly) or 3 (required ventilation). Recovered disk tagged carcasses were enumerated and sampled (described below) to assess handling mortality.

**Stream Surveys**

Weekly stream surveys were conducted from November 20, 1990 to January 3, 1991. Complete surveys, conducted by a two to four person crew walking in an upstream direction, required up to two days.

Live adults were counted and carcasses were recorded by date, reach, sex (confirmed by abdominal incision) and mark type (disk tag, secondary mark or AFC). Each marked carcass and every tenth unmarked carcass was sampled. Carcasses less than 30 cm NF length were recorded as jacks. All carcasses were then cut in two with a machete and returned to the river. Sample data, recorded by date and reach, included post-orbital-hypural plate (POH) length (to the nearest 0.1 cm), sex, female spawning success (0%, 50% or 100% spawned), adipose fin and carcass condition, and scale samples. The head of AFC coho was removed posterior to the eye orbit for later CWT identification. Adipose fin condition was recorded as unclipped, complete (flush with dorsal surface), partial (nub present) or questionable (appeared clipped but fungus or decomposition obscured area). The condition of AFC carcasses was recorded as fresh (gills red or mottled), moderately fresh (gills white, body firm), moderately rotten (body intact, flesh soft) or rotten (skin and bones), and the absence of one or both eyes was noted.

**Escapement Estimation**

**Total Escapement:** The 1990-91 escapement of Salmon River coho adults was calculated from the mark-recapture data using the Petersen formula (Chapman modification) (Ricker 1975). Total escapement was the sum of escapement by sex:

1) Estimated Salmon River system coho escapement ($N_t$):

$$N_t = N_m + N_f$$

where:

$N_m$ = estimated escapement of adult males;

$$= \frac{(M_m + 1)(C_m + 1)}{(R_m + 1)}$$

$N_f$ = estimated escapement of females, analogous to above.

2) Estimated 95% confidence limits of $N_t$:

$$N_t \pm 1.96\sqrt{V_t}$$

where:

$N_t$ = total escapement estimate;

$V_t$ = variance of the escapement estimate;

$= V_m + V_f$

$V_m$ = variance of the adult male escapement estimate;

$$= \frac{(N_m^2)(C_m - R_m)}{(C_m + 1)(R_m + 2)}$$

$N_m$ = adult male escapement estimate;

$C_m$ = number of adult male carcasses examined for disk tags;

$R_m$ = number of disk tagged or secondary marked adult males recovered;

$V_f$ = variance of female escapement estimate, analogous to above.

**Sex Identification Correction:** The disk tag application data were corrected for sex identification error. Error occurred because the development of sexually dimorphic traits was often not advanced and internal examinations could not be made. Correction of recovery data was unnecessary because all carcasses were incised and examined internally. Sex identification error was corrected as described by Staley (1990):

3) Estimated true number of males released with disk tags and secondary marks ($M_m$):

$$M_m = \frac{M^*_m - (M_t R_{m,f})/R_f}{1 - (R_{m,f}/R_f) - (R_{f,m}/R_m)}$$

where:

$M^*_m$ = field estimate of number of males released with disk tags and secondary marks;

$M_t$ = total number of coho adults released with disk tags and secondary marks;

$R_{m,f}$ = number of females recovered with disk tags which were released as males;

$R_{f,m}$ = number of males recovered with disk tags which were released as females;

$R_f$ = number of females recovered with disk tags;

$R_m$ = number of males recovered with disk tags.

4) Estimated true number of females released with disk tags and secondary marks ($M_f$):

$$M_f = M_t - M_m$$

**Adipose Fin Clipped Escapement:** The estimated AFC escapement was the product of the AFC incidence in the carcass recovery sample, the largest of the two available samples, and the mark-recapture escapement estimate. Ninety-five percent confidence limits were calculated from the respective upper and lower confidence limits of the AFC incidence and the escapement estimate. For example, the upper 95% confidence limit of the AFC escapement estimate was the product of the upper limit of the AFC incidence and the upper limit of the total mark-recapture estimate. The mathematical relationships are reported below (Cochran 1977):

5) Estimated AFC escapement ($N_a$):

$$N_a = p(N_t)$$

6) Estimated 95% confidence limits for p:

$$p \pm 1.96\ (se + fpc)$$

where:

p = proportion of the sample with an AFC;

se = standard error;

$$= \sqrt{(1-f)pq/(n-1)}$$

fpc = finite population correction;

$$= \frac{1}{2n}$$

n = sample size;

q = 1-p

$$f = \frac{n}{N_t}$$

**Coded Wire Tagged Escapement:** Escapement by CWT code and long term CWT loss were calculated by applying the CWT composition in the carcass recovery sample to the estimated escapement of AFC adults. Apparent CWT loss was adjusted for post-mortality loss resulting from carcass decomposition and predator activity, when appropriate.

## RESULTS

### JUVENILE PROGRAM

#### Fish Capture

Catch of coho smolts totalled 39,217 in 1989, 25,649 in Salmon River and 13,568 in Coghlan Creek (Appendix 1). The 50% migration and the peak daily catch occurred on May 5 and May 2, respectively, in the Salmon River, and on May 3 and April 27, respectively, in Coghlan Creek. The traps operated throughout the main smolt migration period; therefore, catch records should approximate the true timing of the 1989 smolt migration.

#### Coded Wire Tagging

AFC and CWT releases totalled 33,092 coho smolts in 1989 (Appendix 2). When adjusted for long term CWT loss (18.4%)(Appendix 9) and short term (24-hour) post tagging mortality (111), the number released with CWTs and identifiable AFCs was 26,911.

Short term CWT loss averaged 5.5% (range 0.1% to 29.3%). The incidence of poor AFCs averaged less than 0.1%. The incidence of disease, damage, or structural anomalies averaged 18.1% (5,992)(Appendix 3). The most prevalent condition was "fog eye" (11.5%), a reversible condition associated with capture stress. Three smolts with naturally missing adipose fins were observed.

#### Coho Smolt Age and Size

Coho emigrated from the Salmon River system as yearling (age 1+) (99.6%) and two year old (age 2+) (0.4%) smolts. Smolt size averaged 95.2 mm in the Salmon River and 94.4 mm in Coghlan Creek and 8.9 g in both areas (Appendix 4). Weighted mean smolt size was 94.9 mm and 8.9 g. Salmon River smolt size decreased to a minimum in mid May and increased through the remainder of the migration. Coghlan Creek smolt size showed a similar trend with the minimum occurring in early May.

### ADULT PROGRAM

#### Mark-Recapture

**Disk Tag Application:** Four hundred and thirty coho adults were released with disk tags and secondary marks from October 31 to November 30, 1990 (Table 1)(Appendix 5). Of that total, 120 had AFCs. Condition at release was good, except 51 (11.9%) required ventilation (Table 2). No difference ($p > 0.05$; chi-square) was noted in the proportion of this group recovered on the spawning grounds.

Table 1. Disk tag application, carcass examination and mark recovery, by sex, of Salmon River system coho adults, 1990-91.

| | | | Marked carcasses recovered[b] | | | | |
|---|---|---|---|---|---|---|---|
| | Disk tags applied | Carcasses examined[b] | Disk tag and secondary mark | Secondary mark only | Disk tag only | Total | Percent recovered |
| Male | 215[a] | 387 | 41 | 0 | 1 | 42 | 19.5% |
| Female | 215[a] | 477 | 31 | 1 | 1 | 33 | 15.4% |
| Adipose present | 310 | 696 | 49 | 0 | 2 | 51 | 16.5% |
| Adipose absent | 120 | 168 | 23 | 1 | 0 | 24 | 20.0% |
| Total | 430 | 864 | 72 | 1 | 2 | 75 | 17.4% |

[a] Adjusted for sex identification errors.
[b] Jacks excluded.

Table 2. Disk tag application and recovery of Salmon River system coho adults, by release condition, 1990-91.

| Release condition | Disk tags applied | Disk tags recovered | Percent recovered |
|---|---|---|---|
| Fish swam away without assistance | 379 | 64 | 16.9% |
| Fish required ventilation | 51 | 10 | 19.6% |
| Total | 430 | 75[a] | 17.4% |

[a] Includes 1 with a secondary mark only.

An estimated 2.4% of the males and 6.3% of the females were misidentified at the time of tagging (Appendix 6). When adjusted for sex identification error, an estimated 215 (50.0%) males and 215 (50.0%) females were released with disk tags and secondary marks.

**Spawning Ground Recovery:** Eight hundred and sixty-four adults and 16 jacks were recovered on the spawning grounds from November 20, 1990 to January 3, 1991 (Table 1; Appendix 7). Of the adults, 387 (44.8%) were male and 477 (55.2%) were female, 75 (8.7%) had disk tags or secondary marks and 168 (19.4%) had an AFC. Of those with disk tags or secondary marks, 2 (2.7%) had no secondary mark and 1 (1.3%) had lost the disk tag. At these levels, the incidence of fish which may have lost both marks would not have influenced study results. One of the jacks had an AFC. Twenty-three of the AFC adults were disk tagged. The proportion of the disk tagged AFC coho which was recovered (20.0%) was not significantly different ($p > 0.05$; chi square) than that of disk tagged coho with no AFC (16.5%).

## Sampling Selectivity

**Period:** Temporal bias in the application sample was examined by comparing between periods the mark incidence in the recovery sample (Table 3). No significant difference ($p > 0.05$; chi square) was noted in females or males.

Recovery bias was examined by stratifying the application sample by period and comparing the proportions recovered (Table 4). A significant difference ($p < 0.05$) was noted, with coho tagged later in the study recovered at higher rates.

**Location:** Spatial bias in the application sample was examined by comparing between sections the mark incidence in the recovery sample (Table 5). Mark incidence, which ranged from 3.5% to 11.8%, was significantly different from that expected ($p < 0.05$; G-test). Mark incidence was lowest in the upper Salmon River.

Recovery bias was examined by stratifying the application sample by section and comparing the proportions recovered (Table 6). A significant difference ($p < 0.05$) was noted, with the lowest recovery from coho tagged in the lower Salmon River.

**Fish Size:** Size related bias in the application sample was examined by comparing the continuous POH length-frequency distributions of marked and unmarked spawning ground recoveries. No significant difference was noted in males or females ($p > 0.05$; Kolmogorov-Smirnov two sample test).

Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the continuous NF length frequency distributions of each. Although the proportion recovered increased with NF length (Table 7), the difference was not significant ($p > 0.05$).

**Fish Sex:** Sex related bias in the application sample was examined by comparing the sex ratio of the marked and unmarked spawning ground recoveries (Table 8). A significant difference was noted ($p > 0.05$; chi-square) with the sample biased toward males.

Recovery bias was examined by partitioning the application sample into recovered and non-recovered components and comparing the sex ratio

Table 3. Incidence of disk tags or secondary marks in coho adults recovered on the Salmon River system spawning grounds, by period and sex, 1990-91.

| Recovery period | Recovered with disk tag or secondary mark | | | Total recoveries[a] | | | Percent with disk tag or secondary mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| 20-Nov to 28-Nov | 21 | 8 | 29 | 161 | 171 | 332 | 13.0% | 4.7% | 8.7% |
| 07-Dec to 14-Dec | 20 | 22 | 42 | 194 | 249 | 443 | 10.3% | 8.8% | 9.5% |
| 21-Dec to 04-Jan | 1 | 3 | 4 | 32 | 57 | 89 | 3.1% | 5.3% | 4.5% |
| Total | 42 | 33 | 75 | 387 | 477 | 864 | 10.9% | 6.9% | 8.7% |

[a] Excludes jacks.

Table 4. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application period, 1990-91.

| Application period | Disk tags applied | Marked carcasses recovered | Percent recovered |
|---|---|---|---|
| 31-Oct to 10-Nov | 156 | 13 | 8.3% |
| 11-Nov to 18-Nov | 115 | 25 | 21.7% |
| 19-Nov to 30-Nov | 159 | 36 | 22.6% |
| Total | 430 | 75[a] | 17.4% |

[a] Includes 1 with a secondary mark only.

Table 5. Incidence of disk tags and secondary marks, by section, in the Salmon River system spawning ground recovery sample, 1990-91.

| | | Carcasses examined | | Carcasses recovered with disk tags or secondary marks | |
|---|---|---|---|---|---|
| Location | Section[a] | Number[b] | Percent of total | Number | Mark Incidence |
| Salmon River | Lower | 131 | 15.2% | 8 | 6.1% |
| | Middle | 110 | 12.7% | 12 | 10.9% |
| | Upper | 174 | 20.1% | 6 | 3.5% |
| Coghlan Creek | Lower | 170 | 19.7% | 16 | 9.4% |
| | Upper | 279 | 32.3% | 33 | 11.8% |
| Total | - | 864 | 100.0% | 75 | 8.7% |

[a] Salmon River: lower - S1 and S2; middle - S3; upper - S4 and S5;
Coghlan Creek: lower - C1; upper - C2, C3, C4 and C5.
[b] Excludes jacks.

Table 6. Proportion of the disk tag application sample recovered on the Salmon River system spawning grounds, by application section, 1990-91.

| | | Disk tags applied | | Disk tags recovered | |
|---|---|---|---|---|---|
| Location | Section[a] | Number | Percent of total | Number | Percent recovered |
| Salmon River | Lower | 144 | 33.5% | 8 | 5.6% |
| | Middle | 42 | 9.8% | 8 | 19.1% |
| | Upper | 78 | 18.1% | 11 | 14.1% |
| Coghlan Creek | Lower | 63 | 14.7% | 13 | 20.6% |
| | Upper | 103 | 24.0% | 34 | 33.0% |
| Total | - | 430 | 100.0% | 75[b] | 17.4% |

[a] See Table 5 for section descriptions.
[b] Includes 1 with a secondary mark only.

Table 7. Disk tag application and recovery of Salmon River system coho adults, by nose-fork length, 1990-91.

| Nose-fork length (cm) | Disk tags applied | Carcasses recovered with disk tags | Percent recovered |
|---|---|---|---|
| 30-39 | 3 | 0 | 0.0% |
| 40-49 | 64 | 8 | 12.5% |
| 50-59 | 271 | 43 | 15.9% |
| 60-69 | 88 | 22 | 25.0% |
| 70-79 | 3 | 1 | 33.0% |
| Total | 430[a] | 75[b] | 17.4% |

[a] Includes 1 coho adult not measured at release.
[b] Includes 1 with a secondary mark only.

Table 8. Sex composition of Salmon River system coho adults in the disk tag application and spawning ground recovery samples, 1990-91.

| | | Application sample[a] | | | Spawning ground recovery sample[b] | | |
|---|---|---|---|---|---|---|---|
| Sex | | Recovered | Not Recovered | Total | Disk tag or secondary mark | Unmarked | Total |
| Male | N | 42 | 173 | 215 | 42 | 345 | 387 |
| | % | 56.0 | 48.7 | 50.0 | 56.0 | 43.7 | 44.8 |
| Female | N | 33 | 182 | 215 | 33 | 444 | 477 |
| | % | 44.0 | 51.3 | 50.0 | 44.0 | 56.3 | 55.2 |
| Total | | 75 | 355 | 430 | 75 | 789 | 864 |

[a] Corrected for sex identification error.
[b] Excludes jacks.

in each (Table 8). No significant difference was noted ($p > 0.05$). Furthermore, no significant difference was noted in the proportion of males (19.5%) and females (15.4%) released with disk tags and recovered on the spawning grounds (Table 1).

**Spawning Success:** Spawning success, estimated from the internal examination of female spawning ground recoveries, was estimated at 97.9% (Appendix 8). Spawning success of marked (96.8%) and unmarked (98.3%) females was not significantly different ($p > 0.05$; difference in proportions test).

**Estimation of Spawner Population**

**Total Escapement:** The 1990-91 escapement of Salmon River coho adults, calculated from mark-recapture data, was 4,986 (Table 9). Upper and lower 95% confidence limits were 6,097 and 3,874, respectively. The escapement of female and male coho adults was 3,037 and 1,949, respectively.

**Adipose Fin Clipped Adults:** Based on the coho adult AFC incidence in the spawning ground sample (19.4%; Table 1), the 1990-91 escapement of AFC adults was 970, with upper and lower 95% confidence limits of 1,095 and 844, respectively (Table 9). Of that total, an estimated 333 returned with CWT code 02 57 25, 458 with CWT code 02 63 22, and 179 (18.4%) had lost the CWT (Appendix 9). CWT loss was not influenced by carcass condition or predators ($p > 0.05$; chi-square) (Appendix 10). Survival from smolt release to adult escapement was 2.9%; however, the survival was significantly higher ($p < 0.05$, chi-square) in late (code 02 63 22) (3.5%) versus early (code 02 57 25) (2.3%) releases. There were no differences between CWT code distributions by recovery reach or period ($p > 0.05$, chi- square).

**Age, Length and Sex**

The age and length of 115 coho salmon recovered on the spawning grounds is summarized by sex in Appendix 11. The females were 98.4% age $3_2$ and 1.6% age $4_3$. The males were 3.6% age $2_2$, 94.6% age $3_2$ and 1.8% age $4_3$. Mean NF length of male adults and females in the application sample was 54.1 cm and 56.9 cm, respectively (Appendix 11). No significant difference ($p > 0.05$; single class ANOVA) was noted between those with and without an AFC. Females were significantly longer than males ($p < 0.05$; single class ANOVA). Mean POH length of male adults and females in the recovery sample was 44.2 cm and 46.8 cm, respectively (Appendix 11). No significant difference ($p > 0.05$; single class ANOVA) was noted between those with and without an AFC. Females were significantly longer than males ($p < 0.05$; single class ANOVA).

Females comprised 50.0% of the application sample, 55.2% of the recovery sample (Table 8) and 60.9% of the Petersen population estimate.

## DISCUSSION

### GENERAL

**Juvenile Program**

The 1989 release of 26,911 coded wire tagged coho smolts was larger than in any previous study year (Table 11). Similarly, the AFC incidence in the escapement was higher than in previous years, suggesting that the higher catch reflected a higher sampling rate rather than elevated smolt production.

Long term CWT loss averaged 14.9% over the four year study, within the range reported elsewhere (e.g. Schubert and Fleming 1989). Brood

Table 9. Escapement estimates, by sex and AFC status, for Salmon River system coho adults, 1990-91.

| | Escapement estimate | 95% confidence limit | |
|---|---|---|---|
| | | Lower | Upper |
| Male | 1,949 | 1,406 | 2,492 |
| Female | 3,037 | 2,067 | 4,006 |
| Total | 4,986 | 3,874 | 6,097 |
| AFC Adult | 970 | 844 | 1,095 |

Table 10. Smolt release, adult escapement, and survival to adult escapement of coded wire tagged 1987 brood Salmon River system coho salmon.

| CWT Code | Brood year | Number released[b] | Spawning ground recoveries[a] | | Estimated AFC escapement | Percent survival to escapement |
|---|---|---|---|---|---|---|
| | | | Number | % | | |
| 02 57 25 | 1987 | 14,185 | 56 | 34.4% | 333 | 2.3% |
| 02 63 22 | 1987 | 12,726 | 77 | 47.2% | 458 | 3.5% |
| No pin | - | - | 30 | 18.4% | 179 | - |

[a] Excludes 5 recovered without heads.
[b] Adjusted for long term CWT loss.

Table 11. Smolt release, escapement, survival and long term CWT loss in 1984-87 brood Salmon River coho salmon.

| Dominant brood year | Dominant escapement year | Number of smolts released with CWT's | Escapement | | CWT escapement | Survival to escapement (%) | Long term CWT loss | Percent of escapement with AFCs |
|---|---|---|---|---|---|---|---|---|
| | | | Female | Total | | | | |
| 1984 | 1987-88 | 7,891 | 5,197 | 11,947 | 373 | 4.7% | 21.6% | 3.4% |
| 1985 | 1988-89 | 20,022 | 5,779 | 9,152 | 1,082 | 5.4% | 13.5% | 14.4% |
| 1986 | 1989-90 | 24,634 | 4,458 | 8,427 | 864 | 3.5% | 6.2% | 10.9% |
| 1987 | 1990-91 | 26,911 | 3,037 | 4,986 | 791 | 2.9% | 18.4% | 19.4% |

year CWT loss varied considerable and was not related to short term loss. The chief utility of the latter is as an immediate operational feedback on tagger performance rather than as a predicter of long term CWT loss.

The 1989 juvenile program reported the first smolts with a naturally missing adipose fin since this study began. The incidence (< 0.01%) was too low to influence estimates of the AFC escapement or long term CWT loss.

**Adult Program**

The apparant efficiency of 1990-91 field activities improved over 1989-90 and 1988-89 (Table 12). This was especially notable in the proportion of the escapement which was disk tagged, which increased by 25% over 1989-90. Improvement probably reflected the pattern of freshets, which tended to precede the major immigration in 1990.

**ADULT CAPTURE TECHNIQUE**

A basic assumption underlying Petersen mark-recapture studies is that capture and tagging must not influence the subsequent catchability of the fish. Previous studies in the Salmon River identified a significant difference in the spawning success of marked versus unmarked females which may have been related to electroshocking stress (Schubert and Kalnin 1990; Kalnin and Schubert 1991; Farwell **et al.** 1991). The present study showed no difference in the spawning success of marked and unmarked females. This suggests that, at least in 1990-91, the use of electricity for fish capture was unlikely to have biased study results.

**SAMPLING SELECTIVITY**

A second assumption underlying Petersen mark-recapture studies is that the population is sampled in a random or representative manner (Ricker 1975). In studies when nonrepresentative sampling occurs, accurate results may still be achieved if one sample is representative (Robson 1969). As in previous years, it was not possible to test for representativeness because the true population parameters were not known. Instead, we examined the samples for four biases, temporal, spatial, fish size and fish sex, as indicators of weaknesses in the study design. Biases were identified in both the tag application and recovery samples (Table 13). The application sample had a spatial and fish sex bias, while the recovery sample had a temporal and spatial bias.

The spatial bias in both the application and recovery samples could potentially bias study results; however, because the direction of the biases were dissimilar, estimation error was probably minor. To investigate this assumption, we stratified the data by section and estimated the escapement using Schaefer's modification of the Petersen method for use with stratified populations (Ricker 1975). This estimate (5,206) was 3.5% higher than the Petersen estimate but well below it's upper 95% confidence limit. We concluded, therefore, that the assumption was valid; however, because similar spatial biases were reported for the 1989-90 escapement (Farwell **et al.** 1991), spatial patterns should be assessed before undertaking future studies.

**ESCAPEMENT AND SURVIVAL**

The 1990-91 escapement of 4,986 was the the third consecutive year of escapement declines in the Salmon River (Table 11). Escapement declined by 41% from 1989-90 and by 58% from 1987-88 (Table 11). Female escapement declined by 32% and 42% over the same periods. Similar but

Table 12. Adult study efficiency as indicated by the proportion of the Salmon River adult escapement which was disk tagged, censused and recovered, 1987-88 to 1990-91.

| | | Application Sample | | Census sample | | Marks recovered | |
|---|---|---|---|---|---|---|---|
| Year | Escape-ment | Total | Percent of total escape-ment | Total | Percent of total escapement | Total | Percent recovered |
| 1987-88 | 11,947 | 1,322 | 11.1% | 3,302 | 27.6% | 352 | 26.6% |
| 1988-89 | 9,152 | 717 | 7.8% | 1,377 | 15.0% | 107 | 14.9% |
| 1989-90 | 8,427 | 495 | 5.9% | 1,327 | 15.7% | 80 | 16.2% |
| 1990-91 | 4,986 | 430 | 8.6% | 864 | 17.3% | 75 | 17.4% |
| Mean | 8,628 | 741 | 8.3% | 1,718 | 18.9% | 154 | 18.8% |

Table 13. Results of statistical tests for bias in the 1990-91 Salmon River escapement estimation study.

| Test | Application Sample | Recovery Sample |
|---|---|---|
| Period | No bias | Bias towards later period |
| Location | Bias in upper Salmon River | Bias in lower Salmon River |
| Fish size | No bias | No bias |
| Fish sex | Bias to males | No bias |

less severe declines were also noted in the survival from smolt to escapement, i.e. excluding harvest. The survival of 1990-91 adults averaged 2.9%, a decline of 17% from 1989-90 and 38% from 1987-88 (Table 11). The reason for this decline will not be known until estimates of CWT harvest are finalized.

**SUMMARY**


1. The Salmon River (Langley) coho stock is one of a group of British Columbia stocks being monitored to evaluate responses to management actions by measuring, with known precision, annual escapement, marine survival, harvest distribution, and exploitation rate.

2. Coded wire tags (CWTs) and adipose fin clips (AFCs) were applied to emigrant smolts from April 21 to May 15, 1989. Smolts were captured at fence traps in the Salmon River and Coghlan Creek, the principal tributary. Tagged smolts were transported and released downstream of a pumphouse at the river mouth.

3. A total of 26,911 coho smolts were release with CWTs and AFCs. Size averaged 94.9 mm NF length and 8.9 g wet weight.

4. Adult spawners were enumerated by a mark-recapture study from October 31, 1990 to January 3, 1991. Coho adults were captured using an electroshocker and marked with Petersen disk tags and opercular punches. The escapement was censused by the recovery of carcasses following spawning.

5. The 1990-91 coho adult escapement was estimated from a disk tag application sample of 430, a recovery sample of 864, and a recovery of 75 carcasses with disk tags or secondary marks. The estimated escapement was 4,986 coho adults, of which 3,037 were female, 1,949 were male, and 970 had adipose fin clips.

6. The estimated return to the spawning grounds of CWT codes 02 57 25 and 02 63 22 were 333 and 458, respectively. Survival from smolt release to spawning ground recovery for these two CWT codes was 2.3% and 3.5%, respectively, while CWT loss was 18.4%.

7. The age composition of coho adults, measured from the recovery sample, was 98.3% age $3_2$ and 1.7% age $4_3$. Adult POH length averaged 44.2 cm for males and 46.8 cm for females.

8. Biases were identified in both the application and recovery samples. None of the biases were likely to have influenced the accuracy of the escapement estimate.


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# APPENDICES

Appendix 1a. Daily fence trap catches in the Salmon River, 1989.

| Date | Water temp. (C) a | Water level (m) a | Coho smolt | Cutthroat Smolt | Cutthroat Parr | Rainbow Smolt | Rainbow Parr | Lamprey | Sculpin | Stickle-back | Cray-fish | Sucker |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21-Apr | - | 1.40 | 78 | 11 | 1 | 8 | - | 0 | 0 | 0 | 0 | 0 |
| 22-Apr | 10.0 | 1.20 | 108 | 10 | 5 | 10 | - | 0 | 1 | 0 | 0 | 0 |
| 23-Apr | 9.5 | 1.14 | 159 | 24 | 2 | 29 | - | 1 | 5 | 0 | 0 | 0 |
| 24-Apr | 9.5 | 1.05 | 252 | 17 | 3 | 5 | - | 0 | 1 | 0 | 0 | 0 |
| 25-Apr | 9.5 | 0.98 | 183 | 14 | 1 | 2 | - | 0 | 2 | 0 | 0 | 1 |
| 26-Apr | 11.0 | 0.95 | 974 | 17 | 1 | 7 | - | 2 | 1 | 0 | 3 | 0 |
| 27-Apr | 11.0 | 0.96 | 1304 | 61 | 4 | 23 | - | 7 | 1 | 0 | 0 | 2 |
| 28-Apr | 10.5 | 0.93 | 1373 | 21 | 7 | 11 | - | 4 | 1 | 0 | 0 | 0 |
| 29-Apr | 12.0 | 0.93 | 1357 | 16 | 2 | 23 | - | 5 | 0 | 0 | 0 | 0 |
| 30-Apr | 12.0 | 0.88 | 1070 | 2 | 1 | 20 | - | 7 | 3 | 0 | 0 | 0 |
| 01-May | 11.5 | 0.88 | 508 | 25 | 0 | 10 | - | 3 | 0 | 0 | 0 | 0 |
| 02-May | 12.0 | 0.88 | 2111 | 291 | 4 | 119 | - | 7 | 0 | 0 | 0 | 0 |
| 03-May | 12.5 | 0.85 | 1041 | 106 | 2 | 26 | - | 0 | 1 | 0 | 0 | 0 |
| 04-May | 11.0 | 0.88 | 1603 | 102 | 3 | 25 | - | 5 | 3 | 0 | 0 | 0 |
| 05-May | 12.0 | 0.84 | 954 | 130 | 3 | 20 | - | 2 | 4 | 0 | 1 | 0 |
| 06-May | 13.0 | 0.82 | 808 | 109 | 1 | 19 | - | 0 | 0 | 0 | 0 | 0 |
| 07-May | 14.0 | 0.83 | 1636 | 94 | 4 | 63 | - | 4 | 1 | 0 | 1 | 0 |
| 08-May | 12.0 | 0.82 | 1916 | 8 | 0 | 1 | - | 0 | 0 | 0 | 0 | 0 |
| 09-May | 12.0 | 0.80 | 1202 | 86 | 3 | 62 | - | 5 | 0 | 0 | 0 | 0 |
| 10-May | 11.0 | 0.79 | 864 | 89 | 4 | 38 | - | 0 | 0 | 0 | 0 | 0 |
| 11-May | 10.0 | 0.83 | 536 | 103 | 3 | 33 | - | 0 | 0 | 0 | 0 | 0 |
| 12-May | 9.0 | 0.83 | 275 | 110 | 5 | 25 | - | 0 | 1 | 0 | 1 | 0 |
| 13-May | 9.0 | 0.81 | 651 | 76 | 11 | 15 | - | 1 | 0 | 0 | 0 | 0 |
| 14-May | 11.5 | 0.80 | 581 | 97 | 2 | 15 | - | 0 | 3 | 0 | 1 | 0 |
| 15-May | 10.5 | 0.79 | 458 | 65 | 6 | 8 | - | 0 | 1 | 0 | 1 | 0 |
| 16-May | 12.0 | 0.85 | 877 | 30 | 3 | 28 | - | 1 | 1 | 0 | 0 | 0 |
| 17-May | 10.5 | 0.8 | 331 | 55 | 4 | 16 | - | 0 | 1 | 0 | 2 | 0 |
| 18-May | 9.5 | 1.14 | 649 | 263 | 22 | 52 | - | 0 | 0 | 0 | 0 | 0 |
| 19-May | 10.0 | 1.09 | 504 | 130 | 10 | 36 | - | 1 | 0 | 0 | 0 | 0 |
| 20-May | 9.0 | 0.98 | 439 | 135 | 13 | 16 | - | 0 | 0 | 0 | 0 | 0 |
| 21-May | 11.0 | 0.9 | 125 | 32 | 3 | 16 | - | 0 | 4 | 0 | 1 | 0 |
| 22-May | 10.0 | 0.96 | 64 | 11 | 4 | 0 | - | 0 | 2 | 0 | 0 | 0 |
| 23-May | 10.0 | 0.88 | 21 | 26 | 2 | 2 | - | 0 | 0 | 0 | 1 | 0 |
| 24-May | 10.0 | 1.25 | 206 | 210 | 12 | 57 | - | 0 | 0 | 0 | 0 | 0 |
| 25-May | 10.0 | 1.25 | 307 | 55 | 7 | 24 | - | 1 | 1 | 0 | 0 | 0 |
| 26-May | 10.0 | 1.09 | 124 | 41 | 2 | 31 | - | 0 | 0 | 0 | 0 | 0 |
| 27-May b | 10.5 | 2.49 | - | - | - | - | - | - | - | - | - | - |
| Total | - | - | 25,649 | 2,672 | 160 | 895 | - | 56 | 38 | 0 | 12 | 3 |

a. Recorded at approximately 0800 hrs.

b. Trap out due to high water.

Appendix 1b. Daily fence trap catches in Coghlan Creek, 1989.

| Date | Water temp. (C) a | Water level (m) a | Coho smolt | Cutthroat | | Rainbow | | Lamprey | Sculpin | Stickle-back | Cray-fish | Sucker |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Smolt | Parr | Smolt | Parr | | | | | |
| 19-Apr | - | 1.00 | 89 | 6 | 14 | 12 | - | 0 | 0 | 0 | 0 | 0 |
| 20-Apr | - | 1.00 | 248 | 12 | 15 | 9 | - | 0 | 0 | 0 | 0 | 0 |
| 21-Apr | - | 1.19 | 303 | 145 | 22 | 58 | - | 0 | 0 | 0 | 0 | 0 |
| 22-Apr | 9.5 | 1.07 | 131 | 6 | 2 | 0 | - | 0 | 1 | 0 | 0 | 0 |
| 23-Apr | 9.0 | 1.05 | 200 | 15 | 4 | 0 | - | 1 | 1 | 0 | 0 | 0 |
| 24-Apr | 9.0 | 1.00 | 254 | 15 | 6 | 6 | - | 0 | 0 | 0 | 0 | 0 |
| 25-Apr | 9.0 | 0.99 | 508 | 33 | 6 | 5 | - | 1 | 0 | 0 | 2 | 0 |
| 26-Apr | 10.0 | 0.98 | 608 | 63 | 10 | 7 | - | 2 | 0 | 0 | 4 | 0 |
| 27-Apr | 10.5 | 0.98 | 1012 | 79 | 19 | 16 | - | 3 | 0 | 0 | 0 | 0 |
| 28-Apr | 10.0 | 1.00 | 1011 | 39 | 3 | 6 | - | 0 | 0 | 0 | 1 | 0 |
| 29-Apr | 12.0 | 0.98 | 314 | 18 | 5 | 5 | - | 0 | 0 | 0 | 0 | 0 |
| 30-Apr | 11.0 | 0.98 | 644 | 58 | 3 | 25 | - | 0 | 0 | 0 | 0 | 0 |
| 01-May | 11.0 | 1.00 | 621 | 61 | 8 | 11 | - | 3 | 2 | 0 | 1 | 0 |
| 02-May | 11.0 | 0.98 | 377 | 64 | 8 | 6 | - | 2 | 0 | 0 | 0 | 0 |
| 03-May | 12.0 | 1.00 | 721 | 82 | 2 | 7 | - | 1 | 1 | 0 | 0 | 0 |
| 04-May | 10.5 | 0.96 | 386 | 78 | 1 | 4 | - | 0 | 0 | 0 | 0 | 0 |
| 05-May | 11.0 | 0.97 | 827 | 81 | 5 | 12 | - | 5 | 2 | 0 | 1 | 1 |
| 06-May | 12.0 | 0.98 | 479 | 17 | 8 | 4 | - | 0 | 0 | 0 | 0 | 0 |
| 07-May | 13.0 | 0.96 | 556 | 116 | 2 | 15 | - | 0 | 1 | 0 | 4 | 0 |
| 08-May | 11.0 | 1.00 | 784 | 2 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 |
| 09-May | 10.5 | 0.94 | 243 | 42 | 1 | 8 | - | 0 | 0 | 0 | 1 | 0 |
| 10-May | 10.0 | 0.96 | 343 | 45 | 0 | 6 | - | 0 | 0 | 0 | 1 | 0 |
| 11-May | 9.0 | 0.98 | 300 | 52 | 1 | 1 | - | 0 | 0 | 0 | 0 | 0 |
| 12-May | 8.5 | 0.95 | 283 | 49 | 2 | 8 | - | 0 | 0 | 0 | 2 | 0 |
| 13-May | 9.0 | 0.95 | 180 | 45 | 1 | 3 | - | 0 | 0 | 0 | 1 | 0 |
| 14-May | 11.0 | 0.95 | 192 | 101 | 4 | 2 | - | 0 | 1 | 0 | 0 | 0 |
| 15-May | 10.0 | 0.94 | 270 | 51 | 1 | 1 | - | 0 | 0 | 0 | 1 | 0 |
| 16-May | 11.0 | 0.80 | 314 | 83 | 9 | 2 | - | 0 | 0 | 0 | 0 | 0 |
| 17-May | 10 | 0.91 | 158 | 5 | 1 | 1 | - | 0 | 0 | 0 | 0 | 0 |
| 18-May | 9 | 1.14 | 526 | 168 | 7 | 17 | - | 0 | 2 | 0 | 0 | 0 |
| 19-May | 9.5 | 1.05 | 23 | 4 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 |
| 20-May | 9 | 0.95 | 199 | 66 | 6 | 4 | - | 0 | 0 | 0 | 0 | 0 |
| 21-May | 10 | 0.98 | 134 | 64 | 3 | 3 | - | 0 | 1 | 0 | 1 | 0 |
| 22-May | 9.5 | 0.86 | 78 | 20 | 2 | 1 | - | 0 | 0 | 0 | 0 | 0 |
| 23-May | 9.5 | 1 | 39 | 17 | 1 | 0 | - | 0 | 0 | 0 | 0 | 0 |
| 24-May | 9.5 | 1.43 | 211 | 43 | 9 | 17 | - | 0 | 1 | 0 | 0 | 0 |
| 25-May | 9 | 1.2 | 2 | 1 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 |
| 26-May | 10 | 1.02 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 |
| 27-May b | 10 | 2.03 | - | - | - | - | - | - | - | - | - | - |
| Total | - | - | 13,568 | 1,846 | 191 | 282 | - | 18 | 13 | 0 | 20 | 1 |

a. Recorded at approximately 0800 hrs.

b. Trap out due to high water.

Appendix 2a. Salmon River coded wire tagging results (codes 02 57 25 and 02 63 22), 1989.

| CWT code | Tagging date | Maximum holding time (days) | Pre-tagging mort-ality | Total number marked | 24 hour CWT rejection N a | 24 hour CWT rejection (%) | Post tagging mortality Immediate | Post tagging mortality 24-hour b | Total released with CWTs c |
|---|---|---|---|---|---|---|---|---|---|
| 02 57 25 | 21-Apr | 1 | 0 | 78 | - | - | 0 | 0 | 64 |
| | 25-Apr | 1 | 0 | 182 | 234 | 5.5 | 0 | 0 | 149 |
| | 26-Apr | 1 | 0 | 972 | - | - | 6 | 0 | 788 |
| | 27-Apr | 1 | 0 | 1,314 | 186 | 14.5 | 7 | 0 | 1,066 |
| | 28-Apr | 1 | 19 | 1,365 | 156 | 1.3 | 28 | 0 | 1,091 |
| | 29-Apr | 1 | 0 | 19 | - | - | 0 | 2 | 14 |
| | 01-May | 2 | 2 | 2,852 | 256 | 6.6 | 0 | 0 | 2,327 |
| | 02-May | 1 | 0 | 2,109 | 311 | 8.4 | 0 | 0 | 1,721 |
| | 03-May | 1 | 0 | 1,062 | - | - | 1 | 0 | 866 |
| | Total (Mean) | | 21 | 9,953 | 1,143 | (7.5) | 42 | 2 | 8,085 |
| 02 63 22 | 04-May | 1 | 46 | 1,555 | 220 | 4.0 | 32 | 0 | 1,243 |
| | 05-May | 1 | 3 | 961 | - | - | 1 | 0 | 783 |
| | 08-May | 3 | 1 | 2,403 | - | - | 0 | 0 | 1,961 |
| | 09-May | 1 | 3 | 3,105 | 275 | 1.9 | 7 | 0 | 2,528 |
| | 10-May | 1 | 0 | 863 | 262 | 0.5 | 0 | 0 | 704 |
| | 11-May | 1 | 0 | 536 | 260 | 0.8 | 0 | 0 | 437 |
| | 12-May | 1 | 0 | 271 | - | - | 4 | 0 | 218 |
| | 15-May | 3 | 0 | 1,688 | 344 | 0.1 | 0 | 0 | 1,377 |
| | Total (Mean) | | 53 | 11,382 | 1,361 | (1.7) | 44 | 0 | 9,251 |
| Total (Mean) | | (1.3) | 74 | 21,335 | 2,504 | (4.6) | 86 | 2 | 17,337 |

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD subsample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 2b. Coghlan Creek coded wire tagging results (codes 02 57 25 and 02 63 22), 1989.

| CWT code | Tagging date | Maximum holding time (days) | Pre-tagging mort-ality | Total number marked | 24 hour CWT rejection N a | 24 hour CWT rejection (%) | Post tagging mortality Immediate | Post tagging mortality 24-hour b | Total released with CWTs c |
|---|---|---|---|---|---|---|---|---|---|
| 02 57 25 | 21-Apr | 3 | 3 | 622 | 176 | 3.5 | 11 | 0 | 499 |
| | 25-Apr | 3 | 0 | 1,095 | - | - | 1 | 0 | 893 |
| | 26-Apr | 1 | 1 | 496 | 291 | 9.6 | 0 | 0 | 405 |
| | 27-Apr | 1 | 3 | 603 | 207 | 8.2 | 0 | 1 | 491 |
| | 28-Apr | 1 | 0 | 1,009 | 208 | 29.3 | 2 | 0 | 822 |
| | 29-Apr | 1 | 1 | 1,011 | 226 | 1.3 | 0 | 2 | 823 |
| | 01-May | 2 | 0 | 620 | - | - | 0 | 0 | 506 |
| | 02-May | 1 | 0 | 1,318 | - | - | 0 | 0 | 1,075 |
| | 03-May | 1 | 0 | 717 | 298 | 1.0 | 0 | 0 | 585 |
| | Total (Mean) | | 8 | 7,491 | 1,406 | (9.8) | 14 | 3 | 6,098 |
| 02 63 22 | 04-May | 1 | 0 | 385 | 192 | 0.5 | 1 | 0 | 313 |
| | 05-May | 1 | 1 | 821 | 253 | 5.5 | 2 | 0 | 668 |
| | 08-May | 3 | 1 | 1,832 | 341 | 3.2 | 1 | 0 | 1,494 |
| | 09-May | 1 | 0 | 252 | - | - | 0 | 0 | 206 |
| | 10-May | 1 | 0 | 337 | - | - | 0 | 0 | 275 |
| | 11-May | 1 | 0 | 300 | - | - | 0 | 0 | 245 |
| | 12-May | 1 | 0 | 285 | 253 | 1.0 | 0 | 0 | 233 |
| | 15-May | 3 | 0 | 54 | - | - | 2 | 0 | 42 |
| | Total (Mean) | | 2 | 4,266 | 1,039 | (3.3) | 6 | 0 | 3,476 |
| Total (Mean) | | (1.5) | 10 | 11,757 | 2,445 | (7.0) | 20 | 3 | 9,574 |

a. Sample size held to assess tag loss.
b. Based on mortality rate observed in QCD subsample expanded to entire tag lot.
c. Adjusted for long term CWT loss (see text).

Appendix 3. Incidence of anomalies encountered while coded wire tagging wild Salmon River system coho salmon smolts, 1989.

| Location | Number inspected | Fog eye | Neascus | Fin rot | General damage | Missing adipose fin |
|---|---|---|---|---|---|---|
| Salmon River | 21,335 | 2,708 | 1,694 | 0 | 3 | 1 |
| | % | 12.7% | 7.9% | 0.0% | 0.014% | 0.005% |
| Coghlan Creek | 11,757 | 1,087 | 496 | 0 | 1 | 2 |
| | % | 9.2% | 4.2% | 0.0% | 0.009% | 0.017% |
| Total | 33,092 | 3,795 | 2,190 | 0 | 4 | 3 |
| | % total | 11.5% | 6.6% | 0.0% | 0.012% | 0.009% |

Appendix 4. Mean length and weight of coho salmon smolts in the Salmon River system, 1989.

| Location | Sample date | Sample size | Nose-Fork length Mean | Nose-Fork length Standard deviation | Mean wet weight (g) |
|---|---|---|---|---|---|
| Salmon River | 25-Apr | 50 | 101.1 | 17.1 | 8.9 |
| | 28-Apr | 50 | 95.4 | 13.3 | 9.3 |
| | 02-May | 50 | 96.3 | 11.3 | 8.8 |
| | 05-May | 50 | 96.2 | 11.2 | 9.9 |
| | 09-May | 50 | 95.6 | 10.0 | 9.0 |
| | 12-May | 50 | 93.1 | 9.9 | 8.5 |
| | 16-May | 50 | 89.9 | 9.2 | 7.3 |
| | 19-May | 50 | 90.4 | 5.7 | 7.1 |
| | 23-May | 50 | 94.7 | 12.4 | 9.1 |
| | 26-May | 50 | 105.6 | 17.3 | 12.7 |
| | Total | 500 | 95.2 a | - | 8.9 a |
| Coghlan Creek | 25-Apr | 50 | 98.6 | 11.3 | 10.1 |
| | 28-Apr | 50 | 97.5 | 9.6 | 9.5 |
| | 02-May | 50 | 93.0 | 10.4 | 8.3 |
| | 05-May | 50 | 91.1 | 5.9 | 8.0 |
| | 09-May | 50 | 93.8 | 15.4 | 9.1 |
| | 12-May | 50 | 92.6 | 6.5 | 8.6 |
| | 16-May | 50 | 92.5 | 5.5 | 8.4 |
| | 19-May | 23 | 92.0 | 5.3 | 8.4 |
| | 23-May | 50 | 95.1 | 9.0 | 8.8 |
| | Total | 423 | 94.4 a | - | 8.9 a |
| Total | - | 923 | 94.9 a | - | 8.9 a |

a. Weighted by proportion of smolt migration in time periods.

Appendix 5a. Coho adult disk tag application results in the Salmon River, 1990-91. a

| | | Adipose present | | | Adipose absent | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Reach b | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| 31-Oct | S1 | 11 | 7 | 18 | 5 | 3 | 8 | 16 | 10 | 26 |
| | S3 | 4 | 1 | 5 | 1 | 1 | 2 | 5 | 2 | 7 |
| 02-Nov | S1 | 9 | 4 | 13 | 3 | 0 | 3 | 12 | 4 | 16 |
| | S2 | 2 | 3 | 5 | 3 | 6 | 9 | 5 | 9 | 14 |
| | S3 | 2 | 1 | 3 | 3 | 1 | 4 | 5 | 2 | 7 |
| | S4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 05-Nov | S1 | 12 | 21 | 33 | 6 | 5 | 11 | 18 | 26 | 44 |
| 07-Nov | S2 | 1 | 3 | 4 | 1 | 1 | 2 | 2 | 4 | 6 |
| | S3 | 3 | 1 | 4 | 0 | 0 | 0 | 3 | 1 | 4 |
| | S4 | 1 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 3 |
| 14-Nov | S1 | 3 | 4 | 7 | 0 | 0 | 0 | 3 | 4 | 7 |
| | S2 | 3 | 3 | 6 | 0 | 0 | 0 | 3 | 3 | 6 |
| | S3 | 3 | 4 | 7 | 2 | 1 | 3 | 5 | 5 | 10 |
| | S4 | 3 | 3 | 6 | 2 | 1 | 3 | 5 | 4 | 9 |
| 16-Nov | S3 | 2 | 4 | 6 | 1 | 0 | 1 | 3 | 4 | 7 |
| | S4 | 8 | 4 | 12 | 3 | 6 | 9 | 11 | 10 | 21 |
| 19-Nov | S1 | 9 | 13 | 22 | 1 | 2 | 3 | 10 | 15 | 25 |
| | S5 | 6 | 6 | 12 | 5 | 7 | 12 | 11 | 13 | 24 |
| 21-Nov | S3 | 1 | 2 | 3 | 0 | 1 | 1 | 1 | 3 | 4 |
| | S4 | 2 | 6 | 8 | 0 | 4 | 4 | 2 | 10 | 12 |
| 28-Nov | S5 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 2 | 5 |
| 30-Nov | S3 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 3 |
| | S4 | 2 | 1 | 3 | 0 | 0 | 0 | 2 | 1 | 3 |
| Total | S1 | 44 | 49 | 93 | 15 | 10 | 25 | 59 | 59 | 118 |
| | S2 | 6 | 9 | 15 | 4 | 7 | 11 | 10 | 16 | 26 |
| | S3 | 16 | 13 | 29 | 8 | 5 | 13 | 24 | 18 | 42 |
| | S4 | 16 | 16 | 32 | 6 | 11 | 17 | 22 | 27 | 49 |
| | S5 | 7 | 7 | 14 | 7 | 8 | 15 | 14 | 15 | 29 |
| | Total | 89 | 94 | 183 | 40 | 41 | 81 | 129 | 135 | 264 |

a. Not corrected for sex identification error.

b. Salmon River reaches:
S1 - below Coghlan Creek.
S2 - Coghlan Creek to 64 Ave.
S3 - 64 Ave. to 56 Ave.
S4 - 56 Ave. to 248 St.
S5 - 248 St. to 256 St.

Appendix 5b. Coho adult disk tag application results in Coghlan Creek, 1990-91. a

| Date | Reach b | Adipose present | | | Adipose absent | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| 31-Oct | C1 | 3 | 3 | 6 | 1 | 0 | 1 | 4 | 3 | 7 |
| 02-Nov | C2 | 4 | 4 | 8 | 0 | 1 | 1 | 4 | 5 | 9 |
| 05-Nov | C1 | 6 | 4 | 10 | 1 | 1 | 2 | 7 | 5 | 12 |
| 14-Nov | C1 | 6 | 5 | 11 | 1 | 1 | 2 | 7 | 6 | 13 |
| 16-Nov | C1 | 9 | 7 | 16 | 4 | 0 | 4 | 13 | 7 | 20 |
| | C5 | 9 | 6 | 15 | 5 | 2 | 7 | 14 | 8 | 22 |
| 19-Nov | C3 | 10 | 8 | 18 | 4 | 2 | 6 | 14 | 10 | 24 |
| | C4 | 9 | 6 | 15 | 6 | 2 | 8 | 15 | 8 | 23 |
| 21-Nov | C1 | 4 | 6 | 10 | 1 | 0 | 1 | 5 | 6 | 11 |
| | C2 | 3 | 4 | 7 | 2 | 1 | 3 | 5 | 5 | 10 |
| 30-Nov | C3 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| | C4 | 4 | 3 | 7 | 1 | 1 | 2 | 5 | 4 | 9 |
| | C5 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 4 | 4 |
| Total | C1 | 28 | 25 | 53 | 8 | 2 | 10 | 36 | 27 | 63 |
| | C2 | 7 | 8 | 15 | 2 | 2 | 4 | 9 | 10 | 19 |
| | C3 | 11 | 9 | 20 | 4 | 2 | 6 | 15 | 11 | 26 |
| | C4 | 13 | 9 | 22 | 7 | 3 | 10 | 20 | 12 | 32 |
| | C5 | 9 | 8 | 17 | 5 | 4 | 9 | 14 | 12 | 26 |
| | Total | 68 | 59 | 127 | 26 | 13 | 39 | 94 | 72 | 166 |

a. Not corrected for sex identification error.

b. Coghlan Creek reaches:
C1 - Salmon River to Hwy. 1.
C2 - Hwy. 1 to 248 St.
C3 - 248 St. to 64 Ave.
C4 - 64 Ave. to 256 St.
C5 - Above 256 St.

Appendix 6. Disk tag recoveries in the Salmon River system, by application and recovery date and location, 1990-91.

| Application sample | | | | | Recovery sample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Reach c | NF length (cm) | Sex | Adipose fin | Date | Reach | POH length (cm) | Sex | | Time out (days) |
| 31-Oct | S1 | 55.5 | M | A | 28-Nov | C1 | 42.5 | M | | 28 |
| 31-Oct | S3 | 65.0 | F | A | 28-Nov | S3 | 45.7 | F | | 28 |
| 02-Nov | S3 | 54.2 | M | A | 21-Dec | S4 | 41.6 | M | | 49 |
| 02-Nov | S3 | 60.0 | F | P | 14-Dec | S3 | 50.2 | F | | 42 |
| 02-Nov | S3 | 60.0 | M | A | 14-Dec | S3 | 48.8 | M | | 42 |
| 02-Nov | C2 | 63.5 | F | P | 07-Dec | C2 | - | F | b | 35 |
| 02-Nov | C2 | 59.0 | M | P | 28-Nov | C1 | 46.1 | M | | 26 |
| 05-Nov | S1 | 48.0 | M | P | 28-Nov | C1 | 38.1 | M | | 23 |
| 05-Nov | S1 | 60.0 | F | P | 28-Nov | S1 | 47.0 | F | | 23 |
| 05-Nov | C1 | 59.5 | F | P | 28-Nov | C2 | - | F | | 23 |
| 05-Nov | C1 | 55.0 | M | P | 28-Nov | C1 | 43.4 | M | | 23 |
| 07-Nov | S4 | 51.5 | F | P | 07-Dec | S3 | 40.0 | M | a | 30 |
| 07-Nov | S2 | 50.5 | M | A | 28-Nov | C1 | 39.0 | M | | 21 |
| 14-Nov | C1 | 55.5 | F | P | 14-Dec | S1 | 46.0 | F | | 30 |
| 14-Nov | C1 | 53.0 | M | P | 14-Dec | C1 | 41.8 | M | | 30 |
| 14-Nov | S2 | 55.5 | F | P | 28-Nov | S1 | 46.0 | F | | 14 |
| 14-Nov | S3 | 55.0 | M | A | 14-Dec | S3 | 45.2 | M | | 30 |
| 16-Nov | S3 | 55.0 | F | P | 14-Dec | S3 | 45.6 | F | | 28 |
| 16-Nov | S3 | 57.5 | M | P | 07-Dec | S3 | 46.0 | F | a,b | 21 |
| 16-Nov | S3 | 59.0 | M | A | 14-Dec | S3 | 49.3 | M | | 28 |
| 16-Nov | S4 | 58.5 | F | A | 14-Dec | S3 | - | F | | 28 |
| 16-Nov | S4 | 60.0 | F | P | 14-Dec | S4 | 49.0 | F | | 28 |
| 16-Nov | S4 | 52.0 | M | P | 14-Dec | S3 | 42.1 | F | a | 28 |
| 16-Nov | S4 | 48.0 | F | P | 27-Dec | S4 | 39.7 | F | | 41 |
| 16-Nov | C1 | 57.0 | M | P | 28-Nov | C1 | 45.2 | M | | 12 |
| 16-Nov | C1 | 46.0 | M | P | 14-Dec | S1 | 37.0 | M | | 28 |
| 16-Nov | C1 | 59.5 | F | P | 28-Nov | S1 | - | F | | 12 |
| 16-Nov | C1 | 49.0 | M | P | 07-Dec | C1 | 39.7 | M | | 21 |
| 16-Nov | C1 | 48.5 | M | A | 28-Nov | C2 | 42.1 | M | | 12 |
| 16-Nov | C1 | 56.0 | M | P | 28-Nov | S1 | 45.5 | M | | 12 |
| 16-Nov | C5 | 63.0 | F | P | 26-Nov | C4 | 50.0 | F | | 10 |
| 16-Nov | C5 | 69.0 | M | A | 26-Nov | C4 | 53.7 | M | | 10 |
| 16-Nov | C5 | 60.5 | M | P | 26-Nov | C4 | 48.0 | M | | 10 |
| 16-Nov | C5 | 53.5 | M | P | 14-Dec | C3 | 41.5 | M | | 28 |
| 16-Nov | C5 | 66.0 | F | P | 07-Dec | C4 | 53.9 | F | | 21 |
| 16-Nov | C5 | 47.0 | M | P | 07-Dec | C5 | 37.0 | M | | 21 |
| 16-Nov | C5 | 60.0 | M | A | 26-Nov | C4 | 48.0 | M | | 10 |
| 16-Nov | C5 | 70.0 | M | A | 26-Nov | C4 | 57.0 | M | | 10 |
| 16-Nov | C5 | 58.0 | M | P | 26-Nov | C5 | 39.7 | M | | 10 |
| 19-Nov | C3 | 60.0 | M | A | 28-Nov | C2 | 46.2 | M | | 9 |
| 19-Nov | C3 | 58.0 | F | P | 28-Nov | C2 | 46.4 | F | | 9 |
| 19-Nov | C3 | 59.0 | F | A | 24-Dec | C3 | 48.5 | F | | 35 |
| 19-Nov | C3 | 65.0 | M | P | 07-Dec | C2 | 50.6 | M | | 18 |
| 19-Nov | C3 | 59.5 | M | P | 28-Nov | C2 | 44.3 | M | | 9 |
| 19-Nov | C3 | 57.0 | M | P | 07-Dec | C1 | 44.5 | M | | 18 |
| 19-Nov | C4 | 54.5 | M | A | 14-Dec | C3 | 42.4 | M | | 25 |
| 19-Nov | C4 | 61.0 | M | P | 14-Dec | C3 | 47.1 | M | | 25 |

Appendix 6. Disk tag recoveries in the Salmon River system, by application and recovery date and location, 1990-91.

| Application sample | | | | | Recovery sample | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Reach c | NF length (cm) | Sex | Adipose fin | Date | Reach | POH length (cm) | Sex | Time out (days) |
| 19-Nov | C4 | 57.5 | F | A | 07-Dec | C5 | 49.0 | F | 18 |
| 19-Nov | C4 | 54.0 | F | P | 07-Dec | C2 | 43.6 | F | 18 |
| 19-Nov | C4 | 51.0 | M | P | 07-Dec | C3 | 38.7 | M | 18 |
| 19-Nov | C4 | 52.5 | M | A | 28-Nov | C2 | 40.9 | M | 9 |
| 19-Nov | C4 | 56.5 | M | P | 26-Nov | C3 | 43.8 | M | 7 |
| 19-Nov | C3 | 58.5 | F | A | 07-Dec | C3 | 46.2 | F | 18 |
| 19-Nov | S5 | 49.0 | M | A | 26-Nov | C3 | 38.0 | M | 7 |
| 19-Nov | S5 | 59.0 | M | P | 12-Dec | S4 | 47.8 | M | 23 |
| 19-Nov | S5 | 55.5 | F | P | 07-Dec | S3 | 44.0 | F | 18 |
| 19-Nov | S1 | 50.0 | F | P | 14-Dec | C3 | 41.6 | F | 25 |
| 19-Nov | S1 | 53.5 | F | P | 07-Dec | C1 | 41.8 | F | 18 |
| 19-Nov | S1 | 58.0 | M | P | 07-Dec | C1 | 43.7 | M | 18 |
| 21-Nov | C2 | 58.0 | F | A | 28-Nov | C2 | 49.3 | F | 7 |
| 21-Nov | C2 | 56.0 | M | P | 28-Nov | C1 | 44.7 | M | 7 |
| 21-Nov | C2 | 64.0 | M | P | 07-Dec | C3 | - | M | 16 |
| 21-Nov | C2 | 48.0 | M | A | 28-Nov | C1 | 38.0 | M | 7 |
| 21-Nov | C2 | 62.0 | F | P | 07-Dec | C2 | 49.7 | F | 16 |
| 21-Nov | C1 | 61.5 | M | P | 07-Dec | C1 | 48.8 | M | 16 |
| 21-Nov | C1 | 60.0 | M | P | 14-Dec | S1 | 47.0 | M | 23 |
| 21-Nov | C1 | 51.0 | M | A | 28-Nov | C1 | 40.6 | M | 7 |
| 28-Nov | S5 | 59.5 | F | A | 27-Dec | S4 | 47.6 | F | 29 |
| 28-Nov | S5 | 56.0 | M | P | 14-Dec | S4 | 45.0 | M | 16 |
| 30-Nov | C5 | 65.0 | F | P | 12-Dec | C4 | 52.5 | F | 12 |
| 30-Nov | C5 | 60.0 | F | A | 12-Dec | C4 | 48.5 | F | 12 |
| 30-Nov | C4 | 65.0 | F | P | 12-Dec | C4 | 52.2 | F | 12 |
| 30-Nov | C4 | 51.0 | F | P | 07-Dec | C2 | 39.4 | F | 7 |
| 30-Nov | S3 | 60.0 | M | P | 07-Dec | S3 | 46.5 | M | 7 |
| 30-Nov | S4 | 53.0 | F | P | 14-Dec | S3 | 42.5 | F | 14 |

Summary:

| | | | | |
|---|---|---|---|---|
| Females initially identified as males: | 2 | 6.3% | Mean days out = | 19.7 |
| Males initially identified as females: | 1 | 2.4% | Maximum days out = | 49.0 |
| | | | Minimum days out = | 7.0 |

POH and NF regressions:
- Adult males: POH length = 0.76 NF length + 1.14
  NF length = 1.16 POH length + 5.01
- Adult females: POH length = 0.75 NF length + 3.92
  NF length = 1.13 POH length + 5.17

a. Incorrect sex identification during disk tag application
b. No secondary mark on recovery
c. Salmon River: S1 - below Coghlan Cr; S2 - Coghlan Cr. to 64 Ave; S3 - 64 Ave to 56 Ave; S4 - 56 Ave to 248 St; S5 - 248 St to 256 St. Coghlan Creek: C1 - Salmon R. to Hwy 1; C2 - Hwy 1 to 248 St; C3 - 248 St to 64 Ave; C4 - 64 Ave to 256 St; C5 - above 256 St.

Appendix 7a. Summary of live observations and dead counts of coho salmon in the Salmon River, 1990-91.

| | | | Dead count | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Adipose fin present | | | | Adipose fin absent | | | | | | | |
| Date | Reach | Live count | Male | Female | Jack | Adult total | Male | Female | Jack | Adult total | Adult total | Disk tag and secondary mark | Secondary mark only | Disk tag only |
| 20-Nov | S1 | 8 | 6 | 8 | 1 | 14 | 3 | 1 | 0 | 4 | 18 | 0 | 0 | 0 |
| | S4 | 18 | 1 | 2 | 0 | 3 | 4 | 2 | 0 | 6 | 9 | 0 | 0 | 0 |
| 26-Nov | S4 | 61 | 18 | 22 | 4 | 40 | 6 | 7 | 0 | 13 | 53 | 0 | 0 | 0 |
| | S5 | 28 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 0 |
| 28-Nov | S1 | 23 | 21 | 31 | 1 | 52 | 3 | 1 | 0 | 4 | 56 | 3 | 0 | 1 |
| | S2 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | S3 | 21 | 4 | 4 | 0 | 8 | 0 | 2 | 0 | 2 | 10 | 1 | 0 | 0 |
| 07-Dec | S3 | 15 | 17 | 18 | 0 | 35 | 5 | 3 | 0 | 8 | 43 | 4 | 0 | 0 |
| | S4 | 11 | 9 | 9 | 0 | 18 | 2 | 1 | 0 | 3 | 21 | 0 | 0 | 0 |
| 12-Dec | S4 | 10 | 5 | 6 | 0 | 11 | 0 | 2 | 0 | 2 | 13 | 1 | 0 | 0 |
| | S5 | 6 | 3 | 5 | 0 | 8 | 1 | 7 | 0 | 8 | 16 | 0 | 0 | 0 |
| 14-Dec | S1 | - | 10 | 23 | 0 | 33 | 3 | 5 | 0 | 8 | 41 | 3 | 1 | 0 |
| | S2 | 3 | 2 | 3 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 |
| | S3 | 6 | 14 | 22 | 1 | 36 | 4 | 4 | 0 | 8 | 44 | 7 | 0 | 0 |
| | S4 | - | 9 | 14 | 3 | 23 | 5 | 2 | 0 | 7 | 30 | 2 | 0 | 0 |
| 21-Dec | S1 | 1 | 3 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| | S3 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | S4 | - | 4 | 4 | 0 | 8 | 1 | 0 | 0 | 1 | 9 | 1 | 0 | 0 |
| 27-Dec | S4 | 3 | 2 | 5 | 0 | 7 | 2 | 7 | 0 | 9 | 16 | 2 | 0 | 0 |
| | S5 | - | 2 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| 03-Jan | S1 | - | 1 | 2 | 0 | 3 | 0 | 1 | 0 | 1 | 4 | 0 | 0 | 0 |
| | S2 | - | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | S3 | 2 | 4 | 6 | 0 | 10 | 1 | 1 | 0 | 2 | 12 | 0 | 0 | 0 |
| | S5 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Total | S1 | - | 41 | 65 | 2 | 106 | 9 | 8 | 0 | 17 | 123 | 6 | 1 | 1 |
| | S2 | - | 3 | 5 | 0 | 8 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 |
| | S3 | - | 39 | 51 | 1 | 90 | 10 | 10 | 0 | 20 | 110 | 12 | 0 | 0 |
| | S4 | - | 48 | 62 | 7 | 110 | 20 | 21 | 0 | 41 | 151 | 6 | 0 | 0 |
| | S5 | - | 6 | 8 | 1 | 14 | 2 | 7 | 0 | 9 | 23 | 0 | 0 | 0 |
| | Total | - | 137 | 191 | 11 | 328 | 41 | 46 | 0 | 87 | 415 | 24 | 1 | 1 |

Appendix 7b. Summary of live observations and dead counts of coho salmon in Coghlan Creek, 1990-91.

| | | | Dead count | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Adipose fin present | | | | Adipose fin absent | | | | | Disk tag and secondary mark | Secondary mark only | Disk tag only |
| Date | Reach | Live count | Male | Female | Jack | Adult total | Male | Female | Jack | Adult total | Adult total | | | |
| 26-Nov | C3 | 12 | 3 | 1 | 0 | 4 | 1 | 0 | 0 | 1 | 5 | 2 | 0 | 0 |
| | C4 | 40 | 14 | 12 | 1 | 26 | 12 | 5 | 0 | 17 | 43 | 5 | 0 | 0 |
| | C5 | 23 | 1 | 1 | 0 | 2 | 1 | 0 | 0 | 1 | 3 | 1 | 0 | 0 |
| 28-Nov | C1 | 42 | 36 | 49 | 2 | 85 | 6 | 2 | 0 | 8 | 93 | 10 | 0 | 0 |
| | C2 | 28 | 11 | 16 | 1 | 27 | 7 | 4 | 1 | 11 | 38 | 6 | 0 | 0 |
| 07-Dec | C1 | 51 | 23 | 23 | 0 | 46 | 2 | 3 | 0 | 5 | 51 | 5 | 0 | 0 |
| | C2 | 16 | 11 | 14 | 0 | 25 | 2 | 0 | 0 | 2 | 27 | 5 | 0 | 0 |
| | C3 | 21 | 13 | 17 | 0 | 30 | 4 | 2 | 0 | 6 | 36 | 3 | 0 | 0 |
| | C4 | 24 | 5 | 10 | 0 | 15 | 1 | 2 | 0 | 3 | 18 | 1 | 0 | 0 |
| | C5 | - | 4 | 1 | 0 | 5 | 0 | 3 | 0 | 3 | 8 | 2 | 0 | 0 |
| 12-Dec | C4 | - | 5 | 11 | 0 | 16 | 3 | 6 | 0 | 9 | 25 | 2 | 0 | 0 |
| | C5 | - | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 |
| 14-Dec | C1 | - | 7 | 4 | 0 | 11 | 1 | 0 | 0 | 1 | 12 | 1 | 0 | 0 |
| | C2 | 9 | 3 | 2 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 |
| | C3 | - | 19 | 22 | 0 | 41 | 2 | 3 | 0 | 5 | 46 | 4 | 0 | 1 |
| 24-Dec | C3 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 1 | 0 | 0 |
| 03-Jan | C1 | - | 6 | 8 | 0 | 14 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 |
| | C2 | - | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | C3 | 2 | 1 | 4 | 0 | 5 | 0 | 2 | 0 | 2 | 7 | 0 | 0 | 0 |
| | C4 | - | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | C5 | 3 | 2 | 4 | 0 | 6 | 1 | 3 | 0 | 4 | 10 | 0 | 0 | 0 |
| Total | C1 | - | 72 | 84 | 2 | 156 | 9 | 5 | 0 | 14 | 170 | 16 | 0 | 0 |
| | C2 | - | 26 | 33 | 1 | 59 | 9 | 4 | 1 | 13 | 72 | 11 | 0 | 0 |
| | C3 | - | 36 | 44 | 0 | 80 | 7 | 9 | 0 | 16 | 96 | 10 | 0 | 1 |
| | C4 | - | 25 | 34 | 1 | 59 | 16 | 13 | 0 | 29 | 88 | 8 | 0 | 0 |
| | C5 | - | 7 | 7 | 0 | 14 | 2 | 7 | 0 | 9 | 23 | 3 | 0 | 0 |
| | Total | - | 166 | 202 | 4 | 368 | 43 | 38 | 1 | 81 | 449 | 48 | 0 | 1 |

Appendix 8. Spawning success of female coho adult spawning ground recoveries, 1990-91.

| | | Percent spawned | | | |
|---|---|---|---|---|---|
| | | 0% | 50% | 100% | Weighted mean |
| Disk tag or secondary mark | Number | 1 | 0 | 30 | 31 |
| | Percent | 3.2% | 0.0% | 96.8% | 96.8% |
| Unmarked | Number | 1 | 1 | 88 | 90 |
| | Percent | 1.1% | 1.1% | 97.8% | 98.3% |
| Total | Number | 2 | 1 | 118 | 121 |
| | Percent | 1.7% | 0.8% | 97.5% | 97.9% |

Appendix 9. Observed and estimated coho adult escapement, by CWT code, in the Salmon River, system, 1990-91.

| | | CWT Code | | No CWT | | |
|---|---|---|---|---|---|---|
| | Total | 02 57 25 | 02 63 22 | Jack | Adult | CWT Lost |
| Estimated AFC escapement | 970 | - | - | - | - | - |
| No. AFCs recovered | 168 | - | - | - | - | - |
| Observed CWT codes | 133 | 56 | 77 | - | 30 | - |
| Estimated escapement by code | - | 333 | 458 | - | 179 | - |

a. Adults only.
b. Excludes 5 recovered without heads.

Appendix 10. Incidence of CWT loss by carcass condition, eye status and AFC condition in AFC coho adult carcasses in the Salmon River system, 1990-91.

| Group | Sample size a | CWT absent | CWT loss (%) |
|---|---|---|---|
| Condition 1 | 17 | 1 | 5.6% |
| Condition 2 | 81 | 13 | 16.0% |
| Condition 3 | 59 | 14 | 24.1% |
| Condition 4 | 6 | 2 | 28.6% |
| Eyes present | 134 | 25 | 18.7% |
| Eyes absent | 29 | 5 | 17.2% |
| Complete AFC | 136 | 21 | 15.3% |
| Partial AFC | 22 | 7 | 30.4% |
| Questionable AFC | 2 | 1 | 50.0% |

a. Excludes 5 recovered without heads

Appendix 11. Mean length, by sex and age, of Salmon River system coho spawners, 1990-91.

| | | | | | Length (cm) | | |
|---|---|---|---|---|---|---|---|
| Sample | Age | Sex | Sample size | Percent | Mean | Standard deviation | Range |
| Application sample a, b | - | Male | 221 | 51.8% | 54.1 | 6.4 | 35.5 - 78.0 |
| | - | Female | 206 | 48.2% | 56.9 | 4.9 | 38.5 - 69.0 |
| Recovery sample c | 4/3 | Male | 1 | 0.9% | 42.1 | - | - - - |
| | | Female | 1 | 0.9% | 45.3 | - | - - - |
| | 3/2 | Male | 53 | 46.1% | 45.1 | 5.3 | 34.1 - 57.0 |
| | | Female | 58 | 50.4% | 46.9 | 4.0 | 36.8 - 57.5 |
| | 2/2 | Male | 2 | 1.7% | 22.4 | 4.3 | 18.1 - 26.8 |
| | Total | Male | 56 | 48.7% | 44.2 | 6.7 | 18.1 - 57.0 |
| | | Female | 59 | 51.3% | 46.8 | 3.9 | 36.8 - 57.5 |

a. Not adjusted for sex identification errors.
b. NF length.
c. POH length.