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# ABUNDANCE, AGE, SIZE, SEX AND CODED WIRE TAG RECOVERIES FOR CHINOOK SALMON ESCAPEMENTS OF KITSUMKALUM RIVER, 1989-1990

by

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# TABLE OF CONTENTS


LIST OF TABLES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . iv

LIST OF FIGURES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . vi

LIST OF APPENDICES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . vii

ABSTRACT . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . viii

RÉSUMÉ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ix

INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1
  STUDY AREA . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1

METHODS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
  POPULATION ESTIMATION . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
    Population Stratification . . . . . . . . . . . . . . . . . . . . . . . . . . 2
    Potential Biases . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4
    Calculations . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6
    Strays . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6
  TAGGING . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
  RECOVERY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
  BIOLOGICAL AND PHYSICAL SAMPLING . . . . . . . . . . . . . . . . . . 8
  CODED WIRE TAGGING AND RECOVERY . . . . . . . . . . . . . . . . . . 9

RESULTS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13
  TAGGING . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13
  RECOVERY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14
  POPULATION ESTIMATES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15
  AGE, LENGTH AND SEX COMPOSITION . . . . . . . . . . . . . . . . . . . 15
  CODED WIRE TAGGING AND RECOVERY . . . . . . . . . . . . . . . . . . 16

DISCUSSION AND CONCLUSIONS . . . . . . . . . . . . . . . . . . . . . . . . . 18
  POPULATION ESTIMATION . . . . . . . . . . . . . . . . . . . . . . . . . . . . 18
  AGE, LENGTH AND SEX COMPOSITION . . . . . . . . . . . . . . . . . . . 19
  CODED WIRE TAGGING AND RECOVERY . . . . . . . . . . . . . . . . . . 19

SUMMARY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 21

ACKNOWLEDGEMENTS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 21

REFERENCES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 22

APPENDICES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 56

# LIST OF TABLES


TABLE | Page

1. Summary of methods for the Kitsumkalum River chinook salmon enumeration programs, 1989-90 . . . . 23
2. Summary of live tagging and carcass recovery effort for chinook salmon in Kitsumkalum River, 1989. . . . . 24
3. Summary of live tagging and carcass recovery effort for chinook salmon in Kitsumkalum River, 1990. . . . . 24
4. Live tagging and dead recovery statistics for chinook salmon in the upper and lower Kitsumkalum River, 1989. . . . . 25
5. Tag rate (incidence), tag recovery rate, and tag loss for the live tagging and dead recovery operations in the upper and lower Kitsumkalum River, 1989. . . . . 26
6. Live tagging and dead recovery statistics for chinook salmon in the upper and lower Kitsumkalum River, 1990. . . . . 27
7. Tag rate (incidence), tag recovery rate, and tag loss for the live tagging and dead recovery operations in the upper and lower Kitsumkalum River, 1990. . . . . 28
8. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Kitsumkalum River based on in situ live chinook tagging and recovery of carcasses. . . . . 29
9. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Kitsumkalum River based on in situ live chinook tagging and recovery of carcasses, 1990. . . . . 30
10. Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1989. . . . . 31
11. Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1990. . . . . 33
12. Freshwater age composition of deadpitch Kitsumkalum River chinook salmon, 1989 . . . . 35
13. Freshwater age composition of deadpitch Kitsumkalum River chinook salmon, 1990 . . . . 36
14. Petersen estimates, by age, of chinook salmon escapement to the Kitsumkalum River, 1989 37
15. Petersen estimates, by age, of chinook salmon escapement to the Kitsumkalum River, 1990. 38
16. Estimates of the total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River and weighted estimate, 1989. . . . . 39
17. Estimates of the total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River and weighted estimate, 1990. . . . . 40
18. Estimates of total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1989 (Method A) . . . . 41
19. Estimates of total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1990 (Method A). . . . . 42
20. CWT and adipose clip release data for hatchery reared chinook salmon returning to the Kitsumkalum River, 1989 and 1990. . . . . 43
21. Estimates of total escapement of hatchery reared chinook salmon (Method A) to the upper and lower Kitsumkalum River, by tag code, 1989. . . . . 44
22. Estimates of total escapement of hatchery reared chinook salmon (Method A) to the upper and lower Kitsumkalum River, by tag code, 1990. . . . . 45
23. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1989 (Method A). . . . . 46

LIST OF TABLES - (Cont'd)

24. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1990 (Method A). . . . . . 47
25. Adjusted number of CWT chinook salmon to the upper and lower Kitsumkalum River, 1989, by tag code (Method B). . . . . . 48
26. Adjusted number of CWT chinook salmon to the upper and lower Kitsumkalum River, 1990, by tag code (Method B) . . . . . 49
27. Estimates of total escapement of CWT chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1989 (Method B). . . . . . 50
28. Estimates of total escapement of CWT chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1990 (Method B). . . . . . 51
29. Estimates of total escapement of hatchery reared chinook salmon (Method B) to the upper and lower Kitsumkalum River, by tag code, 1989. . . . . . 52
30. Estimates of total escapement of hatchery reared chinook salmon (Method B) to the upper and lower Kitsumkalum River, by tag code, 1990. . . . . . 53
31. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1989 (Method B). . . . . . 54
32. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1990 (Method B). . . . . . 55

# LIST OF FIGURES

FIGURE Page

1. Map of the Kitsumkalum River study area. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3

# LIST OF APPENDICES


| APPENDIX | | Page |
|---|---|---|
| A1. | Numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River, 1989, by date. | 57 |
| A2. | Chinook salmon carcass recovery, by date, for the upper and lower Kitsumkalum River, 1989. | 58 |
| B1. | Numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River, 1990, by date. | 59 |
| B2. | Chinook salmon carcass recovery, by date, for the upper and lower Kitsumkalum River, 1990. | 61 |

# ABSTRACT

Nass, B.L. and R.C. Bocking 1992. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Kitsumkalum River, 1989-1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2147: ix + 62p.

Estimates of escapement were derived for the Kitsumkalum River for 1989-90 using live tagging and carcass recovery operations. This study is part of the chinook key stream program. The Petersen estimate of chinook escapement was 18,287 in 1989 and 21,039 in 1990. Total escapement estimates are the summation of individual estimates generated by sex and river section (upper and lower). Age 6 chinook comprised the largest proportion of the escapement in both years but the specific age structure varied between years and between sections of the river.

Estimated escapement of adipose clipped chinook to the entire system was 544 in 1989 and 474 in 1990. These estimates were further stratified by age, sex and tag code. The total hatchery contribution (marked and unmarked) to the escapement was estimated by expanding the number of observed adipose clips by the adipose clip mark rate at release. In 1989 the hatchery contribution was 2.6% and 2.6% for male and female chinook escapements, respectively. The hatchery contribution in 1990 was 1.8% for males and 2.5% for females. These hatchery contribution estimates were compared with those estimated using the Mark Recovery Program (Kuhn 1988) method of coded wire tag expansions. Using the MRP method, the total hatchery contribution was 2.4% for males and 2.4% for females in 1989. The hatchery contribution in 1990 was estimated at 1.6% for males and 2.3% for females.

Key words: Kitsumkalum, chinook, key stream, escapement, coded wire tags, age composition, hatchery, live tagging.

# RÉSUMÉ

Nass, B.L. and R.C. Bocking 1992. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Kitsumkalum River, 1989-1990. Can. Manuscr. Rep. Fish. Aquat. Sci. 2147: ix + 62p.

Les échappées de la rivière Kitsumkalum de 1989 et 1990 ont été estimées par marquage et récupération de carcasses. La présente étude a été réalisée dan le cadre du programme des cours d'eau clés utilisés par le saumon qunnat. L'estimation Petersen des échappées de quinnats a donné une valeur de 18 287 poissons pour 1989 et de 21 039 poisson pour 1990. Les échappées totales ont été estimées en faisant la somme des estimations partielles obtenues par sexes et segments de rivière (parties d'amon et d'aval). Au cours de ces deux années, les quinnats d'âge 6 constituaient la plus grande partie des échappées, mais la structure des âges variait tant entre les années les segments de la rivière.

L'échappée totale estimée des quinnats à nageoire adipeuse rognée dans l'ensemble du bassin hyrographique a été de 544 poissons en 1989 et de 474 poissons en 1990. Ces valeurs ont fait l'objet d'une stratification par âges, sexes et codes d'étiquettes. L'apport total de poissons d'élevage (marqués et non marqués) à l'échappée a été estimé en appliquant au nombre de poissons à adipeuse rognée le taux de poissons ainsi marqués au moment de leur remise à l'eau. En 1989, l'apport des poissons d'élevage à l'échappée a été de 2,6%, tant pour les mâles que pour les femelles. En 1990, cette valeur a été de 1,8% pour les mâles et de 2,5% pour les femelles. Ces estimations des apports piscicoles ont été comparées à celles obtenues â l'aide de la méthode des fils codés utilisée pour le programme de marquage et de recapture (Khun, 1988). Selon cette dernière méthode, l'apport total des poissons d'élevage était e 2,4%, tant pour les mâles que pour les femelles, en 1989 et de 1,6% pour les mâles et de 2,3% pour les femelles en 1990.

Mots clés: Kitsumkalum, quinnat, cours d'eau clé, fil codé, composition par âge, pisciculture, marquage.

# INTRODUCTION

In 1984, the Kitsumkalum River was selected as one of the "key stream" systems for assessing the response of chinook salmon stocks to a new harvest management regime. The goal of the new management regime is to rebuild chinook stocks to historical levels. The key stream program began in response to objectives set out in the Canada - U.S. Salmon Treaty.

The major objectives of the key stream program are:

1. to accurately estimate chinook escapement on key streams;

2. to estimate harvest rates and contributions to fisheries and escapement based on coded wire tagged/adipose clip returns, including estimates of the total escapement of coded wire tags to the key streams system; and

3. to estimate the contribution of hatchery and natural production to the escapement.

This manuscript report is the third in a series describing the escapement monitoring and biological sampling of chinook salmon in the Kitsumkalum River. The 1984-86 results are presented in Andrew and Webb (1988) and the 1987-88 results are presented in Carolsfeld et al. (1990).

The 1989-90 escapements of chinook salmon were calculated using the adjusted Petersen method (Ricker 1975) by tagging live chinook and recovering carcasses to produce separate estimates for sexes and sections of the river. A total estimate for the in-river escapement of chinook was calculated by summing the individual estimates.

In this report, potential biases in the Petersen method, and the live tagging approach, and method of stratification are discussed. Assumptions for the methods used and the tests for biases caused by violations of assumptions are also described in the methods section. The results section presents the population estimates, tests for bias in tagging and recovery, population composition (age, length, and sex) and the results of coded wire tagging studies. The results are then discussed with respect to previous studies.

To avoid confusion in terminology relating to tagging and marking, the word "tagging" in this report refers to operculum tagging of live mature chinook in the river and "marking" refers to marking of chinook juveniles with coded wire tags (CWT) and adipose fin clips (AFC).

## STUDY AREA

The physical and geographic aspects of the Kitsumkalum River system have been described in detail by Andrew and Webb (1988). The study area for this project includes the mainstem of the river from its confluence with the Skeena River upstream approximately 20 kilometres to Treston Lake. A three kilometre section of the river known as the Canyon rapids, located approximately 10 km upstream of the confluence with the Skeena River, divides the study area into two sections - the "upper" and "lower" Kitsumkalum (Fig. 1). The canyon section is generally impassable to boat traffic, but does not constitute a barrier to salmon migration.

The Kitsumkalum River system supports five species of Pacific salmon as well as steelhead trout (*Oncorhynchus mykiss*) and cutthroat trout (*O. clarki*) (Hancock et al. 1983). Pink salmon are commonly most abundant, followed by chinook, coho, sockeye and chum salmon (*O. gorbuscha, O. tshawytscha, O. kisutch, O. nerka*, and *O. keta*, respectively). Approximately six kilometres from the confluence with the Skeena River, is the Deep Creek Hatchery which contributes to chinook outplanting. There are two spawning stocks of chinook in the Kitsumkalum system. An early run (not considered in this report) spawns upstream of Kitsumkalum Lake in late July to early August. Late run chinook start migrating into the river in early August. Spawning by these chinook is near completion by early to mid September. Chinook spawners are generally twice as abundant in the "lower" river compared to the "upper" river. Chinook escapements to the Kitsumkalum River have been estimated at 11,825, 8,308, 10,151, 24,508, and 22,755 for the years 1984 to 1988, respectively (Andrew and Webb 1988, Carolsfeld et al. 1990).

Fisheries on Kitsumkalum chinook include sport, commercial, and native food fishery. The sport fishery occurs throughout the river system; whereas, the commercial and native fisheries are limited to areas downstream of the confluence with the Skeena River.

## METHODS

A summary of methods used for each of the study years is presented in Table 1. Live tagging and carcass recovery sampling periods and effort are presented in Tables 2 and 3. The tagging and dead recovery crews both consisted of a four person team. Carcass recovery began during the last week of the tagging operation.

### POPULATION ESTIMATION

Chinook salmon were enumerated using the adjusted Petersen method (Ricker 1975, p. 78) by tagging live adults and jacks throughout the upper and lower sections of the river and then by subsequently examining carcasses for tags and operculum punches (tag loss).

#### Population Stratification

There are four main ways of stratifying the live tagging and carcass recovery data to produce a Petersen estimate of escapement:

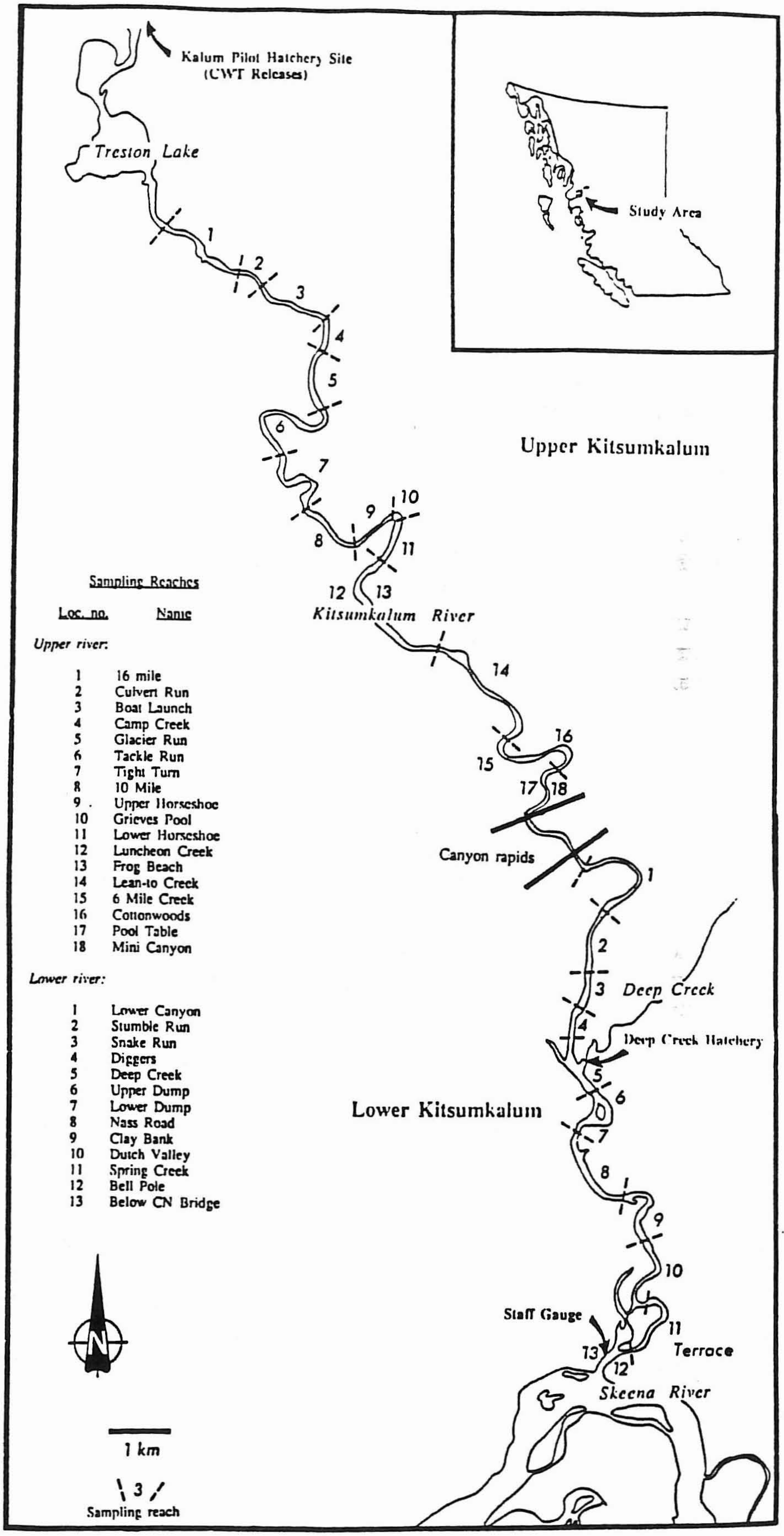


Figure 1 Map of the Kitsumkalum River study area.

1. sexes and river sections pooled;

2. sexes separate with river sections pooled;

3. sexes separate and river sections separate; and

4. sexes pooled with river sections separate.

Separate Petersen estimates may be calculated for each stratum and then summed to obtain an estimate of the whole population. By segregating the data into separate population strata, potential biases created by factors which affect the strata at different rates may be avoided. The main factors of concern are rates of tag application, recovery of carcasses, and tag loss. If spawners in the upper and lower river do not mix following release of tagged individuals in each section, forming two distinct groups for the purpose of enumeration, then there is a potential for substantial bias in unstratified estimates if tagging or dead recovery rates and effort are not identical. Similarly, if the two sexes have different rates of tag application, recovery, or tag loss, then a single population estimate may be biased. Due to the likelihood of factors affecting sexes and river sections at different rates, as documented by Andrew et al. (1988), Petersen estimates were stratified by sex and river section in this study.

## Potential Biases

Petersen estimates are potentially biased by the violation of a number of assumptions inherent to the model. Seven of these assumptions were discussed in Bocking (1991[a]), Carolsfeld et al. (1990), Bocking et al. (1990), and Andrew and Webb (1988), and are repeated here.

1. Tags are consistently applied in proportion to the available population and/or the distribution of recovery effort is proportional to the number of fish present in different river reaches and/or tagged fish become randomly mixed with untagged fish.

To obtain an accurate Petersen estimate, it is important to apply and/or recover tags in proportion to the available population. It is not possible to test whether tagging and dead recovery were conducted on a similar proportion of the population because there is no independent measure of the numbers of fish available for tagging and dead recovery, nor of the timing of the migration and spawning.

A related problem associated with definition of area strata escapement estimates is that tagged fish may stray (washout or migrate) between the upper and lower sections of the river. Movements of tagged fish are indicated by the location of recovery relative to the location of tagging. Individual tag release and recovery locations were grouped into river reaches to facilitate this comparison. In addition, tagged fish may be washed out into the Skeena River where they are not recovered (out of study area). The extent of this latter factor is not addressed in this report. It is not possible to statistically test the extent of mixing of marked and unmarked fish using the data from this study.

2. There is a negligible influx of spawners after the conclusion of tagging.

An influx of spawners following tagging could cause the Petersen calculations to overestimate or underestimate the true population depending on how they mixed with tagged fish. Tagging and recovery periods are established to correspond, as best as possible, with periods of peak spawning and peak die-off.

3. There is no tag loss.

A high incidence of tag loss will cause Petersen calculations to overestimate the true population. Tag loss was determined by the presence of a secondary mark (hole punch) in the operculum of all tagged carcasses. In 1989 and 1990, individuals tagged in the lower river received a left opercular punch and those tagged in the upper river received a right opercular punch. Petersen estimates calculated in this report were derived using only data from secondary marks (opercular punches).

4. All tags are recognized and reported on recovery after the conclusion of tagging.

In this study, no repitches were conducted to reexamine deadpitch carcasses for missed tags and secondary marks, therefore, it was not possible to evaluate tag non-reporting incidence.

5. Recovery efforts are made on the same population that was tagged.

Dead recovery from a population other than the tagged population will cause Petersen calculations to overestimate the true population. Indications that tagging and recovery were conducted on different populations could be inferred from different age frequency and length frequency distributions among the two samples. This method of inference was tested in this study by comparing the mean length of chinook, stratified by area and sex, using a t-test.

6. There is adequate sampling to provide an accurate and precise population estimate.

A small number of tag recoveries in a stratum will cause Petersen estimates to have low precision. Petersen estimates are generally more reliable if a high proportion of tagged fish are recovered in each stratum. In the absence of other sources of bias, approximately 25 to 75 recaptures will produce population estimates with 25% accuracy, and 95% confidence, for populations of $10^2$ and $10^9$ (Ricker 1975). Confidence intervals for the escapement estimates were calculated as described later in the calculations section of the methods.

7. Tagged fish suffer the same natural mortality as untagged fish.

Mortality due to tagging procedures could cause Petersen calculations to overestimate the number of effective spawners. Studies conducted during 1987 and 1988 on the Kitsumkalum showed that there was no statistical difference in the spawning success of tagged or untagged chinook females (Carolsfeld et al. 1990) and, therefore, this assumption is probably not violated.

Statistical tests were conducted on particular sets of data in an attempt to determine whether some of the above biases were acting in this study. Certain biases caused by methods of tagging, recovery, age determination, etc. are discussed below.

Calculations

The adjusted Petersen estimate of each river stratum and sex was calculated as follows (Chapman's formula, cited in Ricker 1975, p. 78):

$$P_{i,r} = \frac{(C_{i,r}+1)(M_{i,r}+1)}{(R_{i,r}+1)} \tag{1}$$

where $P$ is the population estimate, $C$ is the total number of fish recovered, $M$ is the total number of fish tagged, and $R$ is the number of punched fish recovered (secondary marks). The subscript $i$ is the sex stratum and the subscript $r$ is the river section stratum.

Population estimates for sex and river section strata were summed to obtain a total in-river population estimate:

$$P_t = \sum_{i=1}^{n} \sum_{r=1}^{m} P_{i,r} \tag{2}$$

where n is the total number of sex strata (2) and m is the total number of river section strata (2).

Confidence limits for each stratum population estimate were obtained using fiducial limits for the Poisson distribution as described by Ricker (1975, p79; Appendix II, p343). The 95% confidence limits for the total escapement was then determined by assigning equal weights to all strata and summing the lower and upper confidence limits across strata.

Strays

In this study, tagged fish released in one river section and recovered in the other river section were considered to be strays. For the purposes of the Petersen calculations, the total number of strays from the upper Kitsumkalum $u$ to the lower Kitsumkalum $l$ was estimated by expanding the observed number of tagged strays as follows:

$$ES_{u\ to\ l} = TS_{u\ to\ l} \times (M_l / R_l) \tag{3}$$

where $ES$ is the expanded number of strays, $TS$ is the number of tagged strays, $M$ is the number of secondary marks applied and $R$ is the number of secondary marks recovered.

This expanded number of tagged strays from the upper to the lower Kitsumkalum was then used to estimate the number of tagged fish available in the lower river:

$$M'_l = M_l + ES_{u\ to\ l} - ES_{l\ to\ u} \tag{4a}$$

where $M'$ is the adjusted number of marks applied.

The above equation provides the adjusted estimate for the number of tagged fish available for recapture ($M_{i,r}$) used in equation 1.

Straying from the lower river to the upper river was calculated similarly, just with the reversal of locations in the formula. Tagged fish available for recapture in the upper river are then:

$$M'_u = M_u + ES_{l\ to\ u} - ES_{u\ to\ l} \tag{4b}$$

## TAGGING

Chinook were captured using a 72 foot x 12 foot tangle net with size 6 to 7 inch mesh. A floating top line and a sinking lead line fished perpendicular to the river current until beached. Chinook were generally tangled by the kype and teeth while smaller species of fish escaped. Nets were fished in prime spawning sections of the river until actual spawning began, at which time, the deeper holding pools were more actively fished.

Upon capture, all chinook were tagged with Ketchum-kurl-lock tags on the rim of the operculum and a secondary operculum hole punch was applied. Fish captured in the lower Kitsumkalum were given a hole punch in the left operculum and those captured in the upper river were given a hole punch in the right operculum. The postorbital-hypural length was measured using a cloth tape, the absence or presence of an adipose fin was determined, and sex was identified visually. Males less than 50 cm (postorbital-hypural) were classified as jacks.

## RECOVERY

Recovery crews were instructed to dead pitch all available carcasses and record any operculum tags and punches. In both years, crews attempted to keep recovery effort as complete and consistent as possible throughout the study period. Dead chinook were recovered by searching banks and any areas left dry by decreasing water level and areas where the current slowed such as in back eddies and sloughs. Carcasses were also taken opportunistically while travelling from site to site by boat.

Each carcass was examined for the presence of a Ketchum tag, opercular punch hole, missing adipose fin, sex, and post-spawning condition. Heads were removed from adipose clipped carcasses for sampling of CWTs. Data collected from the carcasses is described in the biological and physical sampling methods section. All carcasses were cut in half to prevent recounting in future dead pitches.

Using the recovery database, tagging rate and tag recovery rate were also calculated as follows:

$$tag\ rate = R\ /\ C \tag{5}$$

where *tag rate* is an estimate for the proportion of the population tagged.

$$tag\ recovery\ rate = R\ /\ M \tag{6}$$

where *tag recovery rate* is an estimate of the proportion of tagged fish recaptured.

## BIOLOGICAL AND PHYSICAL SAMPLING

Biological sampling during dead recovery included scales for age determination, postorbital-hypural length, sex, presence of secondary marks (hole punches in operculum) and presence of an adipose clip. Scales were aged at the Department of Fisheries and Oceans scale laboratory in Vancouver. Heads were removed from adipose clipped fish and saved for CWT extraction and decoding at the coded wire tag dissection laboratory in Vancouver.

Ages were read only when a portion of the previous annulus was present and scales were not regenerated. Scales were classified as unreadable if the scales had regenerate centres, they were resorbed, or if they were mounted upside down. Ages were recorded for fish for which there were at least two scales that could be read for both marine and freshwater ages. The aging system follows that described by Gilbert and Rich (1927).

The age composition determined with the available samples is valid only if age sampling was random and there was no bias in readability of scales with age. Ages of older fish are usually more difficult to read than those of younger fish because scales of older fish usually undergo more resorption and regeneration. The data were examined for this potential bias using a t-test to compare the mean lengths of known and unknown-aged males and females. In addition, we also tested for significant differences in mean length between the live tagging sample and the dead recovery sample to expose potential differences between the tagging and dead populations. The tests (t-test) suggest that this potential source of bias is low (6 of 8 tests were not significant) and, therefore, the samples were pooled and used to determine the age and length composition of the population. Because of problems in distinguishing jacks from adult males, age and length information for jacks was grouped with males. We were unable to test for differences in age structure between live and dead samples because of small sample sizes in the live sample.

The population of each age class was then determined by allocating portions of the Petersen estimate to age classes according to the age composition determined from scale samples.

A valid sex ratio was calculated using the Petersen estimates generated for the upper and lower Kitsumkalum.

Chi square ($\chi^2$) tests were used to test for potential differences in tag loss rate. Tag recognition is not likely to be biased by sex, although it was not possible to test this potential bias with the data in this study.

## CODED WIRE TAGGING AND RECOVERY

Juvenile chinook from the 1983 - 1988 brood years were marked at the Deep Creek Hatchery with binary coded wire tags (CWT) using standard methods (Armstrong and Argue 1977). Adipose fins of coded wire tagged juveniles were clipped prior to release of the fish.

Two different methods were used to estimate the hatchery contribution, by tag code, to the total escapement. Method A (the Key Streams approach) applies the adipose fin clip rate (AFC) at release and an adipose clip rate (weighted average of adipose clip rates for live and dead recovery) at return to the estimated escapement, stratified by river section and sex, to derive expanded estimated escapements by tag code. In contrast, Method B (the Mark Recovery Program approach) applies the coded wire tag rate at release (assuming no further CWT loss after release) to the estimated escapement of chinook possessing a CWT (combined data from live and dead recovery), stratified by river section and sex, to derive corrected estimated escapements by tag code. In addition, Method B uses the number of actual CWTs present in the escapement from which to derive the hatchery contribution, whereas Method A uses the number of adipose clips present in the escapement. Note that expansions by the Mark Recovery Program for commercial and sport fisheries use Method B and, therefore, adipose clip expansions for escapements using Method A are not directly comparable. Details of each methodology are presented below.

### Method A

Adipose clipped fish were enumerated by condition (live or dead), sex and river section stratification. The recovery of jack chinook was included with the adult male recoveries in this analysis. The first step was to estimate the number of adipose clipped fish by condition, stratum and sex from the observed number of adipose clips:

$$EAD_{live} = \frac{OAD_{live} \cdot P}{C_{live}} \tag{7}$$

where *EAD* is the estimated number of adipose clips, *OAD* is the number of adipose clips observed, *C* is the number of fish examined, *P* is the population estimate, and *Live* distinguishes between sampling schemes. *EAD* for the dead recovery operation is calculated in the same way except with respective substitutions for *OAD* and *C*. The sex and stratum specific population estimates used here are the Petersen population estimates. The live and dead stratified estimates are then combined to calculate a weighted mean number of adipose clips by stratum and sex:

$$EAD = \frac{(EAD_{live} \cdot MR_{live}) + (EAD_{dead} \cdot MR_{dead})}{C_{live} + C_{dead}} \tag{8}$$

where *MR* is the AFC mark rate at return. We calculated a weighted *EAD* for several reasons. First, this procedure remains consistent with the stratification of the data and accounts for differences in sample size. In addition, there are potential differences in adipose detectability between the live and dead sampling. Observation of adipose fin status is potentially misidentified in the live samples due to detection problems associated with live fish handling. On the other hand, naturally occurring fin rot in the dead sampling may cause error during dead recovery operations. Finally, there could be differential biases in the live and dead recovery due to potential migration timing differences between AFC and non-AFC fish.

Using this weighted estimate of the total number of adipose clips for each sex escaping to each stratum of the river, the number of adipose clips for each tag code can be estimated by the allocation of adipose clips to tag code groups based on their relative frequency in the sample of decoded tags:

$$EAD_{i,r,tc} = \frac{EAD_{i,r} \cdot NDT_{i,r,tc}}{SumNDT_{i,r}} \tag{9}$$

where *NDT* is the number of successfully decoded tags for each tag code, *SumNDT* is the total number of decoded tags for all tag codes, and *i*, *r*, and *tc* denote sex, river strata and tag code, respectively.

This approach of first estimating adipose clipped fish and then allocating these among the successfully decoded CWTs assumes that any adipose clipped fish not decoded (i.e. no pins) were once marked but lost their coded wire tag for some reason. If this assumption is incorrect, the calculation of the number of hatchery origin fish using this method would be positively biased. It is possible, especially in the dead pitch, that some fish identified as hatchery releases by missing adipose fins may be fish that have naturally lost their adipose fins through some other means, e.g. carcass decomposition, or were misidentified. However, if decomposition of adipose fins is occurring then the adipose mark rate (based on hatchery contributions only) in the dead pitch should be higher than the mark rate at release. Other potential sources of bias using Method A are discussed in Bocking (1991[a]).

The hatchery contribution to each year's escapement, stratified by river section and sex, was calculated by expanding the estimated number of adipose clips from each tag code group in proportion to the percentage of juvenile fish having an adipose clip at time of release:

$$EHC_{i,r,tc} = \frac{EAD_{i,r,tc} \cdot (RC_{tc} + RUC_{tc})}{RC_{tc}} \tag{10}$$

where $EHC$ is the estimated hatchery contribution, $RC$ is the number of chinook released with an adipose fin clip for each tag code group ($tc$), and $RUC$ is the number of chinook released without an adipose fin clip for each tag code group ($tc$).

These estimates of hatchery contributions, stratified by brood year ($t$), river ($r$), sex ($i$) and tag code ($tc$) can then be summed to give the hatchery contribution of all tag codes to the entire escapement:

$$EHC_{i,r,t} = \sum_{i=1}^{n} EHC_{t,i,r,tc} \tag{11}$$

where $n$ is the number of tag codes for a given brood year $t$.

Due to the potentially different ages at maturity of males and females, it is important that the allocation of adipose clipped fish to tag codes be carried out separately by sex whenever possible. In this study, the sex of all fish sampled for CWTs was recorded so that it was possible to estimate the total escapement of tag codes by sex (males included jacks). Final hatchery contribution estimates were made separately for fish of Kitsumkalum origin and for strays from other rivers.

Method B

In the second approach used to estimate the hatchery contribution, we estimated the number of successfully decoded CWT chinook in the escapement, stratified by river and sex using the methods described for the Mark Recovery Program (Kuhn et al. 1988). This method is currently used by DFO to estimate hatchery contributions in commercial and sport chinook catches. In contrast to Method A, we did not weight the CWT samples according to live and dead recovery sample size. Instead, we pooled the live and dead recovery data for several reasons. First, the data was pooled because of the low number of CWT recoveries in each sample. Second, we had no reason to believe that tag codes have differing detectability in the live or dead samples. Finally, Method B does not rely on AFC mark rate and, therefore, detectability of AFC's does not effect the results.

Estimating the total number of CWT returns from each of the brood years, and for each tag code was done as follows. First, the observed number of CWT recoveries was adjusted to account for "no pin" (no tag) recoveries:

$$ADJ_{i,r,tc} = OBS_{i,r,tc} \cdot [1 + \frac{LP}{K} + \frac{ND \cdot (K+LP)}{K \cdot (K+LP+NP)}] \tag{12}$$

where *ADJ* is the adjusted number of observed CWT fish, *OBS* is the observed number of CWT fish, K is the sum of all successfully decoded tags for all tag codes recovered, *LP* is the number of lost pin recoveries (cwt detected, but pin lost prior to reading), *ND* is the number of no data recoveries (adipose clip present, but head not taken; head taken and cwt present, but head lost or pin unreadable), *NP* is the number of no pin recoveries, and *i*, *r*, and *tc* are subscripts denoting, sex, river section, and tag code.

This adjusted number of CWT recoveries was then used to estimate the total number of CWT returns for each tag code:

$$EST_{i,r,tc} = \frac{ADJ_{i,r,tc} \cdot P_{i,r}}{C_{i,r}} \tag{13}$$

where *EST* is the estimated number of CWT recoveries for a single tag code, *C* is the number of fish examined, *P* is the population estimate, and *i*, *r*, and *tc* are subscripts denoting sex, river section, and tag code.

This approach of estimating the number of CWT chinook in the escapement assumes that any adipose clipped chinook found without CWTs were never marked. This assumption is only valid if chinook tagged with a particular tag code did not lose the CWT after release from the hatchery (i.e. after accounting for tag loss during a retention test). Since it has been demonstrated that 90% of tag (CWT) losses occur within four weeks of tagging (Blankenship 1990), any fish that have been released within this four week period are likely to continue to have some tag loss prior to being recovered in the fishery or escapement. Violation of the assumption of no tag loss will result in a negative bias in the hatchery contribution estimates. Other potential sources of bias using Method B are discussed in Bocking (1991[a]).

The hatchery contribution to each year's escapement, stratified by river section and sex, was calculated by expanding the estimated number of CWT fish of each tag code group in proportion to the percentage of juvenile fish having a CWT at time of release:

$$EHC_{i,r,tc} = \frac{EAD_{i,r,tc} \cdot (RM_{tc} + RUM_{tc})}{RM_{tc}} \tag{14}$$

where *EHC* is the estimated hatchery contribution, *RM* is the number of chinook released with CWTs for each tag code group (*tc*), and *RUM* is the number of chinook released without CWTs for each tag code group (*tc*).

As for Method A, these estimates of hatchery contribution by tag code were then summed to give the hatchery contribution of all tag codes to the entire escapement, stratified by river section, sex and brood year:

$$EHC_{i,r,t} = \sum_{i=1}^{n} EHC_{t,i,r,tc} \tag{15}$$

where $n$ is the number of tag codes for a given brood year $t$.

Percent hatchery contributions by sex and age were then calculated using the Petersen population estimates.

# RESULTS

## TAGGING

Numbers of chinook examined and tagged during tagging operations in the upper and lower Kitsumkalum River, by date, for the years 1989 and 1990 are presented in Appendices A1 and B1, respectively.

A total of 689 and 848 chinook were live tagged in 1989 in the upper and lower Kitsumkalum River, respectively (Table 4). In 1990, 850 chinook were tagged in the upper river and 830 were tagged in the lower river (Table 6).

## RECOVERY

Numbers of chinook examined and found tagged during carcass recovery operations in the upper and lower Kitsumkalum River, by date, for the years 1989 and 1990 are presented in Appendices A2 and B2, respectively.

In 1989, a total of 624 chinook carcasses were examined in the upper Kitsumkalum River consisting of 289 males, 328 females, and 7 jacks (Table 4). Of these, there were 87 total tag recoveries (50 males, 36 females and 1 jack). In the lower Kitsumkalum, a total of 1843 chinook carcasses were examined and consisted of 620 males, 1207 females, and 16 jacks. Of these, there were 110 total tag recoveries (47 males, 63 females, and 0 jacks). A total tag rate of 13.3% and 5.6% was achieved for the upper and lower Kitsumkalum, respectively (Table 5). Total tag recovery was 12.0% for the upper river and 12.3% for the lower river (Table 5). In addition, the total tag loss rate was 0.0% for the upper river and 4.8% for the lower river (Table 5). Chi square analysis showed a significantly higher tag rate in the upper river compared to the lower river for both males and females ($P < 0.001$) but that there was no difference in tag recovery between the upper and lower river ($P > .05$). Tag rate was significantly higher for males in the upper river compared to females ($P < 0.02$) but no significant difference was found for the lower river ($P > 0.05$). Tag recovery was significantly higher for females in the lower river compared to males ($P < 0.001$) but no significant difference was found for the upper river ($P > 0.1$).

In 1990, a total of 838 chinook carcasses were examined in the upper Kitsumkalum River and consisted of 322 males, 465 females, and 51 jacks (Table 6). Of these, there were 100 total tag recoveries (63 males, 34 females and 3 jacks). In the lower Kitsumkalum, a total of 2136 chinook carcasses were examined and consisted of 760 males, 1292 females, and 84 jacks. Of these, there were 141 total tag recoveries (67 males, 74 females, and 0 jacks). A total tag rate of 10.6% and 6.1% was achieved for the upper and lower Kitsumkalum, respectively (Table 7). Total tag recovery was 10.5% for the upper river and 15.7% for the lower river (Table 7). In addition, the total tag loss rate was 12.4% for the upper river and 6.2% for the lower river (Table 7). Chi square analysis showed a significantly higher tag rate for males in the upper river compared to the lower river ($P < 0.001$). There was no difference for females ($P > 0.3$). There was a significant difference in tag recovery between river sections for females ($P < 0.01$) but not for males ($P > 0.05$). In addition, males had a significantly higher tag rate compared to females in the upper ($P < 0.001$) and lower river ($P < 0.01$). In contrast, females had a significantly higher tag recovery rate in the lower river compared to males ($P < 0.02$). There was no difference in tag recovery between males and females for the upper river ($P > 0.7$).

In 1989, there were a total of four tagged strays to the upper Kitsumkalum from the lower and six tagged strays to the lower Kitsumkalum from the upper (Table 4). In 1990, there were a total of 11 tagged strays to the upper Kitsumkalum from the lower and 11 tagged strays to the lower Kitsumkalum from the upper (Table 6). Based on the number of strays, there was no difference in straying between the upper and lower sections of the river in either of the years ($\chi^2$, 1989: $P > 0.05$, 1990: $P > 0.98$).

## POPULATION ESTIMATES

Mark recapture data used in generating the Petersen population estimates and 95% confidence levels for chinook escapement to the Kitsumkalum River in 1989 and 1990 are presented in Tables 8 and 9, respectively.

In 1989, chinook escapement to the upper and lower Kitsumkalum totalled 18,287. The upper and lower 95% confidence levels were 24,227 and 13,806, respectively. Total escapement included 4,562 to the upper Kitsumkalum and 13,725 to the lower Kitsumkalum.

In 1990, chinook escapement to the upper and lower Kitsumkalum totalled 21,039. The upper and lower 95% confidence levels were 27,358 and 14,434, respectively. Total escapement included 7,364 to the upper Kitsumkalum and 13,675 to the lower Kitsumkalum.

## AGE, LENGTH AND SEX COMPOSITION

Age-length distributions for chinook salmon recovered in the dead pitch in the upper and lower Kitsumkalum River, 1989 and 1990, are presented in Tables 10 and 11, respectively. Total mean length (all ages combined) is weighted according to the number of fish aged in each year group. Oceanic/freshwater age composition as calculated from scale samples is presented in Tables 12 and 13. Petersen population estimates, stratified by age and sex, are presented in Tables 14 and 15.

In 1989, age 3 to 7 chinook were represented in the deadpitch with age 6 chinook comprising approximately 79% of the total run (Table 10). Age 5 chinook represented another 18% while ages 3, 4, and 7 made up only 3%. Age structure was very similar for the upper and lower sections of the river.

Similarly, in 1990, age 2 to 7 chinook were represented in the deadpitch with age 6 chinook dominating at 70% of the total run (Table 11). Ages 4 and 5 chinook represented another 13% each while ages 2, 3, and 7 made up only 4%. Again, age structure was very similar for the upper and lower sections of the river.

In 1989, 96.4% of the chinook sampled for scales had a freshwater age of 2 (Table 12). Similarly, in 1990, 93.4% of the chinook sampled for scales had a freshwater age of 2 (Table 13).

In 1989, the mean length (postorbital-hypural) of male chinook was larger than the mean length of female chinook in the upper and lower Kitsumkalum however, the difference was statistically significant only in the lower river (t-test, $P < 0.001$). The mean length of male chinook was similar in the upper and lower river ($P > 0.2$). The same was found for female chinook. Mean length of aged and unaged male and female chinook in the upper and lower river was also statistically tested to expose any bias in sampling. Aged male chinook were found to be larger than unaged males in the upper and lower river but the difference was statistically significant only for the lower river (t-test, $P < 0.02$). Similarly, aged female chinook were larger than unaged females in the upper and lower river but the difference was not significant (t-test, $P > 0.05$).

In 1990, the mean length (postorbital-hypural) of male chinook was larger than the mean length of female chinook in the lower river and smaller in the upper river. The difference was statistically significant only in the upper river (t-test, $P<0.01$). The mean length of male chinook was significantly smaller in the upper river compared to the lower river (t-test, $P<0.001$). The mean length of female chinook was smaller in the upper river compared to the lower river but this comparison was not significant ($P>0.2$). Aged male chinook were found to be significantly larger than unaged males in the upper and lower river (t-test, $P<0.001$, $P<0.01$, respectively). Similarly, aged female chinook were larger than unaged females in the upper and lower river but the difference was significant only in the upper river (t-test, $P<0.001$).

Comparison of mean lengths of aged chinook for the years 1989 and 1990 illustrate that male and female chinook in the upper and lower Kitsumkalum were larger in 1989 than in 1990. Differences were significant only for the upper river (t-test, males $P<0.001$; females $P<0.05$).

Sex ratio's were calculated from the Petersen population estimates for 1989 and 1990 (Tables 8 and 9, respectively). Males included jacks in the calculations. In 1989, the ratio of males to females was 0.86 for the total system escapement and 1.07 for the upper river and 0.80 for the lower river. In 1990, the ratio of males to females was 1.09 for the total system escapement and 0.84 for the upper river and 1.26 for the lower river. The number of males compared to the number of females was significantly different from 50:50 ($\chi^2$, $P<.05$) in the lower river in 1989, and in the upper and lower river in 1990.

## CODED WIRE TAGGING AND RECOVERY

Coded wire tagged (adipose clipped) juvenile chinook released into the Kitsumkalum River from the 1983 to 1988 brood years were sampled as adults in the dead recovery programs in 1989 and 1990. Heads from adipose clipped chinook carcasses were collected for coded-wire tag analysis.

The results of coded wire tag returns are presented below and include information on the following:

1. carcass recovery for the upper and lower Kitsumkalum, by date and year (A2, B2);
2. numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River (A1, B1);
3. estimates of the total escapement of adipose clips (Tables 16, 17);
4. the observed and estimated escapement of adipose clips by tag code (Tables 18, 19 and 25-28);
5. the hatchery contribution to the escapement by tag code (Tables 21, 22, 29 and 30);
6. the estimated hatchery contribution to the escapement by age class (Tables 23, 24, 31 and 32)

In 1989, during live tagging operations there were 12 adipose clipped chinook observed in the upper river and 33 in the lower river (Table 16). In addition, adipose clips in the dead recovery totalled 5 in the upper river and 63 in the lower river. The combined adipose clip mark rate was 1.29% in the upper river and 3.55% in the lower river and were significantly different ($\chi^2$, $P<.001$). The total estimated adipose clips (weighted average for live and dead) to the upper and lower Kitsumkalum were 55 and 489, respectively.

In 1990, during live tagging operations there were 17 adipose clipped chinook observed in the upper river and 18 in the lower river (Table 16). In addition, adipose clips in the dead recovery totalled 9 in the upper river and 63 in the lower river. The combined adipose clip mark rate was 1.53% in the upper river and 2.72% in the lower river and were significantly different ($\chi^2$, $P<.01$). The total estimated adipose clips (weighted average for live and dead) to the upper and lower Kitsumkalum were 116 and 358, respectively.

### Hatchery Contributions - Method A

Results from the decoding of adipose clipped fish from the Kitsumkalum River are shown in Tables 18-22. Any CWT fish recovered in the system which were released from another enhancement facility were included in the analysis. In 1989, 5 chinook released in 1984 from Copper River (CWT=23059, 25060) were found in the Kitsumkalum. In 1990, 2 chinook released in 1985 from Hadenchild Creek on the Skeena River (CWT=23909) and 2 chinook released in 1984 from Copper River (CWT=23059, 23060) were found in the river. A total of 47 CWT heads from adipose clipped fish recovered in 1989 were successfully decoded (Table 18) and 77 were decoded in 1990 (Table 19). Age 2 males (jacks) were included with all other adult males for this analysis.

The allocations of the total escapement of adipose clips to tag codes recovered in each portion of the river are shown in Tables 18 and 19. Table 20 lists the number of CWT fish and adipose clipped fish released for each tag code (data from MRP database). The estimated hatchery contribution to the 1989 total escapement of chinook to the Kitsumkalum River was 221 for males and 257 for females (Table 21). The estimated hatchery contribution to the 1990 escapement was 202 for males and 254 for females (Table 22).

Hatchery contributions to the total escapement of chinook each year, by river section and age class, are presented in Table 23 and Table 24. The hatchery contribution to the Kitsumkalum River population of chinook was estimated to be 2.6% for males and 2.6% for females in 1989. The 1990 hatchery contribution to the Kitsumkalum River was 1.8% for males and 2.5% for females. Strays from Hadenchild Creek and Copper River contributed 0.4% of the total CWT returns to the Kitsumkalum River in 1989 and 0.1% in 1990.

### Hatchery Contributions - Method B

The allocations of the total escapement of CWTs to tag codes recovered in each portion of the river are shown in Tables 25-30. The estimated hatchery contribution to the 1989 escapement of chinook to the Kitsumkalum River was 201 for males and 234 for females (Table 29). The estimated hatchery contribution to the 1990 escapement of chinook was 180 for males and 235 for females (Table 30).

The hatchery contributions to the total escapement of chinook each year, by river section and age class, are presented in Table 31 and Table 32. The 1989 hatchery contribution to the Kitsumkalum River population of chinook was estimated to be 2.4% for males and 2.4% for females. The 1990 hatchery contribution to the Kitsumkalum River was 1.6% for males and 2.3% for females. Strays from Copper River contributed 0.4% of the total CWT returns in 1989 and 0.1% in 1990.

# DISCUSSION AND CONCLUSIONS

## POPULATION ESTIMATION

Previous studies of chinook escapement to the Kitsumkalum River have shown that several factors can bias the population estimates generated from the Petersen model (Andrew and Webb, 1988; Carolsfeld et al, 1990). In particular, these studies illustrated that it is necessary to stratify the data by river section and sex in order to eliminate or minimize the effects of differential tagging and tag recovery between sexes and river sections. The results of our study are consistent with previous studies in that we also found evidence of statistically significant differences in tag rate and/or tag recovery rate between sexes in the upper and lower Kitsumkalum. More specifically, in both 1989 and 1990, male and female chinook in the upper river had a significantly higher tag rate than chinook in the lower river. Differences between sexes also were evident. Male chinook had a significantly higher tag rate compared to females in the upper river. In addition, females had a higher tag recovery rate compared to males in the lower river, despite that there was no significant difference in tag rate. Therefore, we followed the stratification procedures outlined earlier to generate the total escapement estimate. We suggest that future studies follow the same stratification procedures.

We examined the extent of straying between the upper and lower sections of the Kitsumkalum River to assess the possible bias straying could cause in the Petersen escapement estimates. In 1989 and 1990, a slightly higher proportion of tagged chinook strayed from the upper section to the lower section than vis-versa, although the difference in straying between directions was not significant ($\chi^2$, $P>.05$). In addition, the data suggest that males tend to stray more than females and supports previous studies. These results suggest that straying does not pose a serious bias in calculating the separate escapement estimates however it should probably be analyzed more rigorously.

Confidence intervals for the Petersen estimates varied by sex and between years. In 1989, upper and lower confidence limits for the Kitsumkalum study area were 24.5% and 32.4% of the escapement estimate, respectively. Similarly in 1990, upper and lower confidence limits for the Kitsumkalum study area were 31.4% and 30.0% of the escapement estimate, respectively. These confidence limits are higher than the recommended 25% accuracy for salmon management purposes (Ricker 1975)>. On this basis, increased tagging and recovery effort would be desirable.

## AGE, LENGTH AND SEX COMPOSITION

Age 6 chinook represented the largest percentage of the escapement to the Kitsumkalum in 1989 and 1990 and is consistent with prior investigations (Andrew and Webb, 1988; Carolsfeld et al. 1990). Age 5 chinook represented the next largest contribution.

The mean postorbital-hypural length of male and female chinook in both the upper and lower Kitsumkalum were larger in 1989 than in 1990. We could not compare our data with previous years data as it was not presented by stratum.

Females (53.8%) represented a larger proportion of the total escapement compared to males (46.2%) in 1989 and males (52.2%) represented a larger proportion of the total escapement compared to females (47.8%) in 1990. Although these proportional contributions are close to 50:50, the actual numbers of males and females were significantly different in 1989 and 1990. Previous reports have also shown variability in the sex ratio between years (Andrew and Webb, 1988; Carolsfeld et al. 1990).

## CODED WIRE TAGGING AND RECOVERY

In this study, we used the adipose clip rate in the tagging and dead recovery of chinook in the river to estimate the number of adipose clips in the escapement (Method A). Sampling for adipose clipped fish was random. The total mark rate at recovery was 2.8% in 1989 and 2.3% in 1990.

Estimates of the total hatchery contribution to the Kitsumkalum River were different using Method A (AFC) and Method B (CWT rate). Method A produced higher hatchery contribution estimates (male 2.6%, female 2.6% in 1989 and male 1.8%, female 2.5% in 1990) than Method B (male 2.4%, female 2.4% in 1989 and male 1.6%, female 2.3% in 1990). Bocking (1991[a]) discusses potential reasons for these differences.

Although we have tried to address as many potential sources of bias as possible in the estimation of the escapement of CWTs described above, we have not explicitly included the following factors:

1. The low number of recoveries of adipose clips and decoded CWTs (less than 1 CWT in some brood years) likely make the precision of the estimates so low as to be of relatively little use in those brood years; and

2. The sample of heads obtained for the decoding of CWTs may not be a random sample from the population and might contain a bias due to size selectivity or other factors.

We have not formally estimated the level of precision of the estimates of escapement by adipose clipped fish and individual tag codes as potential sources of bias can render these misleading. An approximation of the level of precision can be obtained by examining the number of adipose clips/CWT recoveries on which a given estimate is based. There were between 7 and 55 adipose clips decoded for each sex (jacks and males pooled) and river strata. The 95% confidence limits for 65 recoveries (based on a Poisson frequency distribution) would be approximately $\pm$ 25% and significantly greater for 7 to 55 recoveries. These estimates of precision are conservative because the expansion factors used to estimate the total number of adipose clips/marks in the escapement are also estimated with error. Improvements in the precision of the CWT contribution estimates will not likely be realized until significantly more marks are applied at release. Recovery effort has been fairly constant since 1987 and it is probably not feasible to increase the number of fish examined dramatically. Crews examined 20 - 22 % of the estimated population size for adipose clips. We, therefore, recommend that further efforts be made to increase coded wire tagging of juveniles rather than increasing recovery effort.

## SUMMARY


1. Total escapement estimates for chinook salmon to the Kitsumkalum River using a combination of live tagging and carcass recovery were 18,287 in 1989 and 21,039 in 1990. These estimates are the summation of individual Petersen estimates stratified by river section and sex.

2. The 1989 and 1990 chinook escapement was largely represented by age 6 fish.

3. Males and females varied in their proportional contribution between years and river sections. The difference in numbers of males and females was statistically significant in both years and in both sections.

4. The mean postorbital-hypural length of chinook salmon was greatest in 1989 compared to 1990. Males tended to be larger than females in both years.

5. The total estimated return of adipose clipped chinook to the Kitsumkalum River was 544 in 1989, and 474 in 1990.

6. The total estimated hatchery contribution to the chinook escapement, based on adipose clips (Method A) was 477 (2.6%) in 1989 and 456 (2.2%) in 1990. The contribution estimates derived using the adjusted CWTs recovered (Method B) were lower: 435 (2.4%) in 1989 and 415 (2.0%) in 1990.


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Table 1. Summary of methods for the Kitsumkalum River chinook salmon enumeration programs, 1989-90.

| | Method and Materials | |
|---|---|---|
| Item | 1989 | 1990 |
| Population estimate | * Petersen estimate, sum of separate estimates for sexes and river strata | * Petersen estimate, sum of separate estimates for sexes and river strata |
| Live tagging (a) | * Cattle ear tags applied in situ to live fish recovered in river | * Cattle ear tags applied in situ to live fish recovered in river |
| Secondary marking | * Single hole opercular punch<br>Left for lower river<br>Right for upper river | * Single hole opercular punch<br>Left for lower river<br>Right for upper river |
| Recovery of fish | * Carcass recovery by foot, boat | * Carcass recovery by foot, boat |
| Coded wire tagging (CWT) | * Collection of heads from adipose clipped fish in dead recovery and some during live tagging | * Collection of heads from adipose clipped fish in dead recovery and some during live tagging |
| Biological and physical sampling | * Ages from scales and CWT<br>* Sex ratios from sex specific population estimates for strata<br>* Postorbital-hypural length | * Ages from scales and CWT<br>* Sex ratios from sex specific population estimates for strata<br>* Postorbital-hypural length |

(a) Tags manufactured by Ketchum Manufacturing Sales Ltd., 396 Berkley Ave., Ottawa, Ontario, Canada, K2A 2G6. The tags used (size no. 3, 1 1/8" x 1/4") are recommended for sheep and swine.

Table 2. Summary of live tagging and carcass recovery effort for chinook salmon in Kitsumkalum River, 1989.

| | Tagging Period | Effort (days) | Carcass Recovery Period | Effort (days) |
|---|---|---|---|---|
| Upper River | Aug 22 - Sep 7 | 11 | Sep 8 - Sep 23 | 11 |
| Lower River | Aug 21 - Sep 1 | 11 | Aug 29 - Sep 29 | 20 |

Table 3. Summary of live tagging and carcass recovery effort for chinook salmon in Kitsumkalum River, 1990.

| | Tagging Period | Effort (days) | Carcass Recovery Period | Effort (days) |
|---|---|---|---|---|
| Upper River | Aug 21 - Sep 6 | 15 | Sep 3 - Oct 4 | 19 |
| Lower River | Aug 20 - Sep 4 | 10 | Aug 27 - Oct 5 | 21 |

Table 4. Live tagging and dead recovery statistics for chinook salmon in the upper and lower Kitsumkalum River, 1989.

| Category | Upper River | Lower River | Total |
|---|---|---|---|
| Live Tagging (a) | | | |
| Males examined | 410 | 448 | 858 |
| Females examined | 256 | 402 | 658 |
| Jacks examined | 32 | 13 | 45 |
| Total examined | 698 | 863 | 1561 |
| Males tagged/punched | 405 | 438 | 843 |
| Females tagged/punched | 253 | 397 | 650 |
| Jacks tagged/punched | 31 | 13 | 44 |
| Total tagged/punched | 689 | 848 | 1537 |
| Dead Recovery (b) | | | |
| Males recovered | 289 | 620 | 909 |
| Females recovered | 328 | 1207 | 1535 |
| Jacks recovered | 7 | 16 | 23 |
| Total recovered | 624 | 1843 | 2467 |
| Punched only males | 0 | 2 | 2 |
| Punched only females | 0 | 3 | 3 |
| Punched only jacks | 0 | 0 | 0 |
| Total punch only | 0 | 5 | 5 |
| Tagged/punched Males (c) | 50 | 47 | 97 |
| Tagged/punched Females (c) | 36 | 63 | 99 |
| Tagged/punched Jacks (c) | 1 | 0 | 1 |
| Total tagged/punched (c) | 87 | 110 | 197 |
| Stray males | 4 | 5 | 9 |
| Stray females | 0 | 1 | 1 |
| Stray jacks | 0 | 0 | 0 |
| Total strays | 4 | 6 | 10 |

(a) See Appendix A1 for numbers of live chinook captured, tagged and released, by date.

(b) See Appendix A2 for numbers of chinook carcasses recovered, by date.

(c) Tagged recoveries include all operculum punched carcasses (ie. secondary marks).

Table 5. Tag rate (incidence), tag recovery rate, and tag loss rate for the live tagging and dead recovery operations in the upper and lower Kitsumkalum River, 1989.

| Category | Upper River | Lower River | Total |
|---|---|---|---|
| (a) | | | |
| Male tag rate (%) | 15.9 | 6.8 | 9.7 |
| Female tag rate (%) | 11.0 | 5.1 | 6.4 |
| Jack tag rate (%) | 14.3 | 0.0 | 4.3 |
| Total tag rate (%) | 13.3 | 5.6 | 7.6 |
| (b) | | | |
| Male tag recovery rate (%) | 11.4 | 9.6 | 10.4 |
| Female tag recovery rate (%) | 14.2 | 15.6 | 15.1 |
| Jack tag recovery rate (%) | 3.2 | 0.0 | 2.3 |
| Total tag recovery rate (%) | 12.0 | 12.3 | 12.2 |
| (c) | | | |
| Male tag loss rate (%) | 0.0 | 4.8 | 2.3 |
| Female tag loss rate (%) | 0.0 | 4.8 | 3.1 |
| Jack tag loss rate (%) | 0.0 | - | 0.0 |
| Total tag loss rate (%) | 0.0 | 4.8 | 2.7 |

(a) Tag rate = ((no. tagged in dead recovery - no. strays in dead recovery) / total no. in dead recovery) * 100; Table 4.
(b) Tag recovery rate = ((no. tagged in dead recovery - no. strays in dead recovery) / no. live tagged) * 100; Table 4.
(c) Tag loss rate = (no. in dead recovery with punch only / no. in dead recovery with punch and tag) * 100; Table 4.

Table 6. Live tagging and dead recovery statistics for chinook salmon in the upper and lower Kitsumkalum River, 1990.

| Category | Upper River | Lower River | Total |
|---|---|---|---|
| **Live Tagging (a)** | | | |
| Males examined | 524 | 430 | 954 |
| Females examined | 282 | 376 | 658 |
| Jacks examined | 56 | 33 | 89 |
| Total examined | 862 | 839 | 1701 |
| Males tagged/punched | 516 | 426 | 942 |
| Females tagged/punched | 278 | 371 | 649 |
| Jacks tagged/punched | 56 | 33 | 89 |
| Total tagged/punched | 850 | 830 | 1680 |
| **Dead Recovery (b)** | | | |
| Males recovered | 322 | 760 | 1082 |
| Females recovered | 465 | 1292 | 1757 |
| Jacks recovered | 51 | 84 | 135 |
| Total recovered | 838 | 2136 | 2974 |
| Punched only males | 4 | 5 | 9 |
| Punched only females | 5 | 3 | 8 |
| Punched only jacks | 2 | 0 | 2 |
| Total punch only | 11 | 8 | 19 |
| Tagged/punched Males (c) | 63 | 67 | 130 |
| Tagged/punched Females (c) | 34 | 74 | 108 |
| Tagged/punched Jacks (c) | 3 | 0 | 3 |
| Total tagged/punched (c) | 100 | 141 | 241 |
| Stray males | 6 | 7 | 13 |
| Stray females | 5 | 4 | 9 |
| Stray jacks | 0 | 0 | 0 |
| Total strays | 11 | 11 | 22 |

(a) See Appendix B1 for numbers of live chinook captured, tagged and released, by date.

(b) See Appendix B2 for numbers of chinook carcasses recovered, by date.

(c) Tagged recoveries include all operculum punched carcasses (ie. secondary marks).

Table 7. Tag rate (incidence), tag recovery rate, and tag loss rate for the live tagging and dead recovery operations in the upper and lower Kitsumkalum River, 1990.

| Category | Upper River | Lower River | Total |
|---|---|---|---|
| (a) | | | |
| Male tag rate (%) | 17.7 | 7.9 | 10.8 |
| Female tag rate (%) | 6.2 | 5.4 | 5.6 |
| Jack tag rate (%) | 5.9 | 0.0 | 2.2 |
| Total tag rate (%) | 10.6 | 6.1 | 7.4 |
| (b) | | | |
| Male tag recovery rate (%) | 11.0 | 14.1 | 12.4 |
| Female tag recovery rate (%) | 10.4 | 18.9 | 15.3 |
| Jack tag recovery rate (%) | 5.4 | 0.0 | 3.4 |
| Total tag recovery rate (%) | 10.5 | 15.7 | 13.0 |
| (c) | | | |
| Male tag loss rate (%) | 7.0 | 8.3 | 7.7 |
| Female tag loss rate (%) | 17.2 | 4.3 | 8.1 |
| Jack tag loss rate (%) | 66.7 | - | 66.7 |
| Total tag loss rate (%) | 12.4 | 6.2 | 8.7 |

(a) Tag rate = ((no. tagged in dead recovery - no. strays in dead recovery) / total no. in dead recovery) * 100; Table 6.
(b) Tag recovery rate = ((no. tagged in dead recovery - no. strays in dead recovery) / no. live tagged) * 100; Table 6.
(c) Tag loss rate = (no. in dead recovery with punch only / no. in dead recovery with punch and tag) * 100; Table 6.

Table 8. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Kitsumkalum River based on in situ live chinook tagging and recovery of carcasses, 1989. Confidence limits are from fudicial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343). Unsexed chinook were omitted from the analysis.

| | Male | Female | Jack | Total |
|---|---|---|---|---|
| Upper river | | | | |
| Number tagged (a) | 405 | 253 | 31 | 689 |
| Number recovered (b) | 289 | 328 | 7 | 624 |
| Number of tagged fish recovered (c) | 50 | 36 | 1 | 87 |
| Number of tagged strays from lower river (d) | 4 | 0 | 0 | 4 |
| Expanded No. of tagged strays from lower river (e) | 32 | 0 | 0 | 32 |
| Number of tagged fish for Petersen estimate (f) | 391 | 247 | 31 | 669 |
| Petersen estimate | 2229 | 2205 | 128 | 4562 |
| Lower 95% CL | 1699 | 1606 | 39 | 3344 |
| Upper 95% CL | 2992 | 3126 | 233 | 6351 |
| Lower river | | | | |
| Number tagged (a) | 438 | 397 | 13 | 848 |
| Number recovered (b) | 620 | 1207 | 16 | 1843 |
| Number of tagged fish recovered (c) | 47 | 63 | 0 | 110 |
| Number of tagged strays from upper river (d) | 5 | 1 | 0 | 6 |
| Expanded No. of tagged strays from upper river (e) | 47 | 6 | 0 | 53 |
| Number of tagged fish for Petersen estimate (f) | 452 | 403 | 13 | 868 |
| Petersen estimate | 5861 | 7626 | 238 | 13725 |
| Lower 95% CL | 4430 | 5981 | 51 | 10462 |
| Upper 95% CL | 7924 | 9714 | 238 | 17876 |
| Total system | | | | |
| Escapement estimate | 8090 | 9831 | 366 | 18287 |
| Lower 95% CL | 6129 | 7587 | 90 | 13806 |
| Upper 95% CL | 10916 | 12840 | 471 | 24227 |

(a) Total live tagged/punched (Appendix A1).
(b) Total dead recoveries (tagged and untagged); Appendix A2.
(c) Total dead recoveries possessing an operculum punch (Appendix A2).
(d) Total dead recoveries possessing an operculum punch from the other section of the river.
(e) Expanded strays = no. of strays from other section * no. tagged in section / no. tagged dead recoveries.
(f) Tagged fish for Petersen = no. tagged in section + no. strays to section - no. strays to other section.

Table 9. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Kitsumkalum River based on in situ live chinook tagging and recovery of carcasses, 1990. Confidence limits are from fudicial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343). Unsexed chinook were omitted from the analysis.

| | Male | Female | Jack | Total |
|---|---|---|---|---|
| Upper river | | | | |
| Number tagged (a) | 516 | 278 | 56 | 850 |
| Number recovered (b) | 322 | 465 | 51 | 838 |
| Number of tagged fish recovered (c) | 63 | 34 | 3 | 100 |
| Number of tagged strays from lower river (d) | 6 | 5 | 0 | 11 |
| Expanded No. of tagged strays from lower river (e) | 49 | 41 | 0 | 90 |
| Number of tagged fish for Petersen estimate (f) | 520 | 299 | 56 | 875 |
| Petersen estimate | 2629 | 3994 | 741 | 7364 |
| Lower 95% CL | 2062 | 2882 | 302 | 5246 |
| Upper 95% CL | 3350 | 5706 | 1853 | 10909 |
| Lower river | | | | |
| Number tagged (a) | 426 | 371 | 33 | 830 |
| Number recovered (b) | 760 | 1292 | 84 | 2136 |
| Number of tagged fish recovered (c) | 67 | 74 | 0 | 141 |
| Number of tagged strays from upper river (d) | 7 | 4 | 0 | 11 |
| Expanded No. of tagged strays from upper river (e) | 45 | 20 | 0 | 65 |
| Number of tagged fish for Petersen estimate (f) | 422 | 350 | 33 | 805 |
| Petersen estimate | 4734 | 6051 | 2890 | 13675 |
| Lower 95% CL | 3739 | 4834 | 615 | 9188 |
| Upper 95% CL | 5988 | 7571 | 2890 | 16449 |
| Total system | | | | |
| Escapement estimate | 7363 | 10045 | 3631 | 21039 |
| Lower 95% CL | 5801 | 7716 | 917 | 14434 |
| Upper 95% CL | 9338 | 13277 | 4743 | 27358 |

(a) Total live tagged/punched (Appendix B1).
(b) Total dead recoveries (tagged and untagged); Appendix B2.
(c) Total dead recoveries possessing an operculum punch (Appendix B2).
(d) Total dead recoveries possessing an operculum punch from the other section of the river.
(e) Expanded strays = no. of strays from other section * no. tagged in section / no. tagged dead recoveries.
(f) Tagged fish for Petersen = no. tagged in section + no. strays to section - no. strays to other section.

Table 10. Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1989.
Calculated using scale and CWT age samples.

| Length class (mm) | Age | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males (a) | | | | | | | | Females | | | | | | | |
| | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) |
| Upper River | | | | | | | | | | | | | | | | |
| 250-299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300-349 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 350-399 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 400-449 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 450-499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500-549 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 550-599 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 600-649 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 650-699 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 |
| 700-749 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 4 |
| 750-799 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 27 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 22 |
| 800-849 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 20 | 0 | 0 | 0 | 4 | 3 | 0 | 7 | 36 |
| 850-899 | 0 | 0 | 0 | 1 | 3 | 0 | 4 | 35 | 0 | 1 | 0 | 2 | 15 | 1 | 19 | 80 |
| 900-949 | 0 | 0 | 0 | 1 | 8 | 0 | 9 | 43 | 0 | 0 | 0 | 2 | 19 | 0 | 21 | 90 |
| 950-999 | 0 | 0 | 0 | 1 | 18 | 0 | 19 | 67 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 31 |
| 1000-1049 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 23 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 2 |
| 1050-1099 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1100-1149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1150-1199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1200-1249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 1 | 0 | 9 | 32 | 0 | 42 | 253 | 0 | 1 | 0 | 10 | 47 | 1 | 59 | 269 |
| Percent | 0.0 | 2.4 | 0.0 | 21.4 | 76.2 | 0.0 | | | 0.0 | 1.7 | 0.0 | 16.9 | 79.7 | 1.7 | | |
| Mean (d) | 0 | 390 | 0 | 776 | 931 | 0 | 885 (c) | 852 | 0 | 860 | 0 | 821 | 881 | 870 | 870 (c) | 859 |
| SD | 0 | 0 | 0 | 162 | 39 | 0 | 82 (e) | 143 | 0 | 0 | 0 | 50 | 65 | 0 | 62 (e) | 65 |

(a) includes jacks
(b) unknown age
(c) weighted mean
(d) Post-orbital hypural length
(e) weighted standard error

Table 10 (cont). Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1989.
Calculated using scale and CWT age samples.

| Length class (mm) | Age | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males (a) | | | | | | | | Females | | | | | | | |
| | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) |
| Lower River | | | | | | | | | | | | | | | | |
| 250-299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300-349 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 350-399 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 400-449 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 450-499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500-549 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 550-599 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 600-649 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 650-699 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 700-749 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 24 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 5 |
| 750-799 | 0 | 0 | 0 | 7 | 3 | 0 | 10 | 46 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 44 |
| 800-849 | 0 | 0 | 0 | 3 | 1 | 0 | 4 | 46 | 0 | 0 | 0 | 10 | 14 | 0 | 24 | 164 |
| 850-899 | 0 | 0 | 0 | 2 | 10 | 0 | 12 | 76 | 0 | 0 | 0 | 6 | 62 | 1 | 69 | 458 |
| 900-949 | 0 | 0 | 0 | 5 | 22 | 1 | 28 | 169 | 0 | 0 | 0 | 1 | 43 | 1 | 45 | 313 |
| 950-999 | 0 | 0 | 0 | 2 | 19 | 0 | 21 | 114 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 45 |
| 1000-1049 | 0 | 0 | 0 | 2 | 7 | 2 | 11 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 1050-1099 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1100-1149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1150-1199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1200-1249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 2 | 22 | 63 | 3 | 90 | 539 | 0 | 0 | 0 | 20 | 129 | 3 | 152 | 1038 |
| Percent | 0.0 | 0.0 | 2.2 | 24.4 | 70.0 | 3.3 | | | 0.0 | 0.0 | 0.0 | 13.2 | 84.9 | 2.0 | | |
| Mean (d) | 0 | 0 | 620 | 835 | 912 | 963 | 888 (c) | 860 | 0 | 0 | 0 | 813 | 871 | 840 | 863 (c) | 856 |
| SD | 0 | 0 | 113 | 90 | 58 | 57 | 69 (e) | 105 | 0 | 0 | 0 | 42 | 39 | 80 | 41 (e) | 47 |

(a) includes jacks
(b) unknown age
(c) weighted mean
(d) Post-orbital hypural length
(e) weighted standard error

Table 11. Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1990.
Calculated using scale and CWT age samples.

| Length class (mm) | Age | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males (a) | | | | | | | | Females | | | | | | | |
| | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) |
| Upper River | | | | | | | | | | | | | | | | |
| 250-299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300-349 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 350-399 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 400-449 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 450-499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500-549 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 550-599 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 600-649 | 1 | 0 | 1 | 1 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 650-699 | 0 | 0 | 2 | 2 | 0 | 0 | 4 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 700-749 | 0 | 1 | 0 | 2 | 0 | 0 | 3 | 10 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 8 |
| 750-799 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 13 | 0 | 0 | 0 | 1 | 2 | 0 | 3 | 24 |
| 800-849 | 0 | 0 | 0 | 4 | 3 | 0 | 7 | 26 | 0 | 0 | 3 | 1 | 16 | 0 | 20 | 118 |
| 850-899 | 0 | 0 | 4 | 2 | 10 | 0 | 16 | 53 | 0 | 0 | 6 | 7 | 38 | 0 | 51 | 148 |
| 900-949 | 0 | 0 | 6 | 4 | 30 | 0 | 40 | 58 | 0 | 0 | 3 | 0 | 23 | 0 | 26 | 43 |
| 950-999 | 0 | 0 | 5 | 0 | 12 | 0 | 17 | 24 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 3 |
| 1000-1049 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1050-1099 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1100-1149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1150-1199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1200-1249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 7 | 21 | 19 | 57 | 0 | 105 | 259 | 0 | 0 | 12 | 10 | 85 | 0 | 107 | 345 |
| Percent | 1.0 | 6.7 | 20.0 | 18.1 | 54.3 | 0.0 | | | 0.0 | 0.0 | 11.2 | 9.3 | 79.4 | 0.0 | | |
| Mean (d) | 610 | 397 | 808 | 777 | 903 | 0 | 825 (c) | 743 | 0 | 0 | 849 | 820 | 858 | 0 | 853 (c) | 830 |
| SD | 0 | 130 | 149 | 93 | 43 | 0 | 90 (e) | 208 | 0 | 0 | 36 | 56 | 47 | 0 | 47 (e) | 46 |

(a) includes jacks
(b) unknown age
(c) weighted mean
(d) Post-orbital hypural length
(e) weighted standard error

Table 11 (cont). Age-length distribution of deadpitch Kitsumkalum River chinook salmon, 1990.
Calculated using scale and CWT age samples.

| Length class (mm) | Age | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males (a) | | | | | | | | Females | | | | | | | |
| | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) | 2 | 3 | 4 | 5 | 6 | 7 | Total | Unk(b) |
| Lower River | | | | | | | | | | | | | | | | |
| 250-299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300-349 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 350-399 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 400-449 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 450-499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500-549 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 550-599 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 600-649 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 650-699 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| 700-749 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 750-799 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 28 | 0 | 1 | 0 | 1 | 2 | 0 | 4 | 24 |
| 800-849 | 0 | 0 | 0 | 2 | 5 | 0 | 7 | 52 | 1 | 0 | 0 | 5 | 15 | 0 | 21 | 187 |
| 850-899 | 0 | 0 | 1 | 4 | 9 | 1 | 15 | 111 | 0 | 0 | 9 | 5 | 42 | 1 | 57 | 424 |
| 900-949 | 0 | 0 | 4 | 1 | 21 | 1 | 27 | 206 | 0 | 0 | 5 | 5 | 40 | 0 | 50 | 297 |
| 950-999 | 0 | 0 | 2 | 1 | 12 | 0 | 15 | 140 | 0 | 0 | 0 | 1 | 11 | 1 | 13 | 49 |
| 1000-1049 | 0 | 0 | 1 | 0 | 4 | 0 | 5 | 17 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 |
| 1050-1099 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1100-1149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1150-1199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1200-1249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 0 | 11 | 10 | 53 | 2 | 77 | 694 | 1 | 3 | 14 | 17 | 112 | 2 | 149 | 1005 |
| Percent | 1.3 | 0.0 | 14.3 | 13.0 | 68.8 | 2.6 | | | 0.7 | 2.0 | 9.4 | 11.4 | 75.2 | 1.3 | | |
| Mean (d) | 600 | 0 | 833 | 823 | 894 | 885 | 872 (c) | 810 | 820 | 600 | 866 | 843 | 864 | 900 | 857 (c) | 855 |
| SD | 0 | 0 | 165 | 77 | 71 | 49 | 91 (e) | 185 | 0 | 148 | 22 | 47 | 69 | 71 | 66 (e) | 55 |

(a) includes jacks
(b) unknown age
(c) weighted mean
(d) Post-orbital hypural length
(e) weighted standard error

Table 12. Freshwater age composition of deadpitch Kitsumkalum River chinook salmon, 1989 (a).

| | | Male(b) | | Female | |
|---|---|---|---|---|---|
| Location | Age | N | % | N | % |
| Upper River | | | | | |
| | 3.2 | 1 | 2.4 | 1 | 1.7 |
| | 5.1 | 1 | 2.4 | 0 | 0.0 |
| | 5.2 | 7 | 17.1 | 10 | 16.9 |
| | 6.2 | 32 | 78.0 | 47 | 79.7 |
| | 7.2 | 0 | 0.0 | 1 | 1.7 |
| | Total | 41 | 100 | 59 | 100 |
| Lower River | | | | | |
| | 4.1 | 1 | 1.2 | 0 | 0.0 |
| | 5.1 | 4 | 4.8 | 6 | 4.0 |
| | 5.2 | 14 | 16.7 | 12 | 8.0 |
| | 6.2 | 62 | 73.8 | 129 | 86.0 |
| | 7.2 | 3 | 3.6 | 3 | 2.0 |
| | Total | 84 | 100 | 150 | 100 |

(a) Age composition was calculated using only scale samples.
(b) Males include jacks

Table 13. Freshwater age composition of deadpitch Kitsumkalum River chinook salmon, 1990 (a).

| Location | Age | Male(b) N | Male(b) % | Female N | Female % |
|---|---|---|---|---|---|
| Upper River | | | | | |
| | 3.2 | 6 | 6.7 | 0 | 0.0 |
| | 4.2 | 7 | 7.9 | 0 | 0.0 |
| | 5.1 | 1 | 1.1 | 2 | 2.2 |
| | 5.2 | 17 | 19.1 | 6 | 6.5 |
| | 6.2 | 58 | 65.2 | 84 | 91.3 |
| | Total | 89 | 100 | 92 | 100 |
| Lower River | | | | | |
| | 3.1 | 0 | 0.0 | 1 | 0.9 |
| | 4.2 | 3 | 5.6 | 0 | 0.0 |
| | 5.1 | 2 | 3.7 | 5 | 4.3 |
| | 5.2 | 1 | 1.9 | 3 | 2.6 |
| | 6.1 | 4 | 7.4 | 8 | 7.0 |
| | 6.2 | 42 | 77.8 | 97 | 84.3 |
| | 7.2 | 2 | 3.7 | 2 | 1.7 |
| | Total | 54 | 100 | 115 | 100 |

(a) Age composition was calculated using only scale samples.
(b) Males include jacks

Table 14. Petersen estimates, by age, of chinook salmon escapement to the Kitsumkalum River, 1989.

| | Age | Males (a) | | Females | |
|---|---|---|---|---|---|
| | | Number (b) | Percent (c) | Number (b) | Percent (c) |
| Upper river | | | | | |
| | 3 | 57 | 2.4 | 37 | 1.7 |
| | 4 | 0 | 0.0 | 0 | 0.0 |
| | 5 | 504 | 21.4 | 373 | 16.9 |
| | 6 | 1796 | 76.2 | 1757 | 79.7 |
| | 7 | 0 | 0.0 | 37 | 1.7 |
| | Total | 2357 | 100.0 | 2205 | 100.0 |
| Lower river | | | | | |
| | 3 | 0 | 0.0 | 0 | 0.0 |
| | 4 | 134 | 2.2 | 0 | 0.0 |
| | 5 | 1488 | 24.4 | 1007 | 13.2 |
| | 6 | 4275 | 70.1 | 6467 | 84.8 |
| | 7 | 201 | 3.3 | 153 | 2.0 |
| | Total | 6099 | 100.0 | 7626 | 100.0 |

(a) Includes jacks
(b) Age representation is calculated by applying the respective proportions observed in the deadpitch age-length distribution (Table 10) to the Petersen estimates (Table 8).
(c) from Table 10

Table 15. Petersen estimates, by age, of chinook salmon escapement to the Kitsumkalum River, 1990.

| Age | Males (a) Number (b) | Males (a) Percent (c) | Females Number (b) | Females Percent (c) |
|---|---|---|---|---|
| Upper river | | | | |
| 2 | 34 | 1.0 | 0 | 0.0 |
| 3 | 226 | 6.7 | 0 | 0.0 |
| 4 | 674 | 20.0 | 447 | 11.2 |
| 5 | 610 | 18.1 | 371 | 9.3 |
| 6 | 1827 | 54.2 | 3175 | 79.5 |
| 7 | 0 | 0.0 | 0 | 0.0 |
| Total | 3370 | 100.0 | 3994 | 100.0 |
| Lower river | | | | |
| 2 | 99 | 1.3 | 42 | 0.7 |
| 3 | 0 | 0.0 | 121 | 2.0 |
| 4 | 1090 | 14.3 | 569 | 9.4 |
| 5 | 991 | 13.0 | 690 | 11.4 |
| 6 | 5245 | 68.8 | 4550 | 75.2 |
| 7 | 198 | 2.6 | 79 | 1.3 |
| Total | 7624 | 100.0 | 6051 | 100.0 |

(a) Includes jacks

(b) Age representation is calculated by applying the respective proportions observed in the deadpithch age-length distribution (Table 11) to the Petersen estimates (Table 9).

(c) from Table 11

Table 16. Estimates of the total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River and weighted estimate, 1989.

| Location and sex | Live tagging: Sample size (a) A | Live tagging: Observed adipose clips B | Live tagging: Mark rate (%) C=B/A*100 | Dead recovery: Sample size (b) D | Dead recovery: Observed adipose clips E | Dead recovery: Mark rate (%) F=E/D*100 | Petersen population estimate (c) G | Total estimated adipose clips: Live tagging H=C/100*G | Total estimated adipose clips: Dead recovery I=F/100*G | Weighted estimate of adipose clips J (d) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper river | | | | | | | | | | |
| Male (e) | 442 | 7 | 1.58 | 296 | 3 | 1.01 | 2357 | 37 | 24 | 32 |
| Female | 256 | 5 | 1.95 | 328 | 2 | 0.61 | 2205 | 43 | 13 | 26 |
| Total | 698 | 12 | 1.72 | 624 | 5 | 0.80 | 4562 | 80 | 37 | 55 |
| Lower river | | | | | | | | | | |
| Male (e) | 461 | 16 | 3.47 | 636 | 25 | 3.93 | 6099 | 212 | 240 | 228 |
| Female | 402 | 17 | 4.23 | 1207 | 38 | 3.15 | 7626 | 322 | 240 | 261 |
| Total | 863 | 33 | 3.82 | 1843 | 63 | 3.42 | 13725 | 534 | 480 | 489 |

(a) Sample size for estimating adipose clip rates in the live tagging includes all fish captured and released live back into the river minus recaptures (Appendix A1).
(b) Sample size for estimating adipose clip rates in the dead recovery includes all fish examined (Appendix A2).
(c) from Table 8
(d) J=((A * H) + (D * I)) / (A + D)
(e) Males includes jacks

Table 17. Estimates of the total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River and weighted estimate, 1990.

| | Live tagging | | | Dead recovery | | | Petersen | Total estimated adipose clips | | Weighted |
|---|---|---|---|---|---|---|---|---|---|---|
| Location and sex | Sample size (a) A | Observed adipose clips B | Mark rate (%) C=B/A*100 | Sample size (b) D | Observed adipose clips E | Mark rate (%) F=E/D*100 | population estimate (c) G | Live tagging H=C/100*G | Dead recovery I=F/100*G | estimate of adipose clips J (d) |
| Upper river | | | | | | | | | | |
| Male (e) | 580 | 11 | 1.90 | 373 | 2 | 0.54 | 3370 | 64 | 18 | 46 |
| Female | 282 | 6 | 2.13 | 465 | 7 | 1.51 | 3994 | 85 | 60 | 70 |
| Total | 862 | 17 | 1.97 | 838 | 9 | 1.07 | 7364 | 149 | 78 | 116 |
| Lower river | | | | | | | | | | |
| Male (e) | 463 | 5 | 1.08 | 844 | 24 | 2.84 | 7624 | 82 | 217 | 169 |
| Female | 376 | 13 | 3.46 | 1292 | 39 | 3.02 | 6051 | 209 | 183 | 189 |
| Total | 839 | 18 | 2.15 | 2136 | 63 | 2.95 | 13675 | 291 | 400 | 358 |

(a) Sample size for estimating adipose clip rates in the live tagging includes all fish captured and released live back into the river minus recaptures (Appendix B1).
(b) Sample size for estimating adipose clip rates in the dead recovery includes all fish examined (Appendix B2).
(c) from Table 9
(d) J=((A * H) + (D * I)) / (A + D)
(e) Males includes jacks

Table 18. Estimates of total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1989. One decimal place is carried for the estimated adipose clips for calculating the expanded hatchery contribution in Table 21 (Method A).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Decoded | | Estimated | | Decoded | | Estimated | |
| Brood | CWT | adipose clips | | adipose clips | | adipose clips | | adipose clips | |
| year | code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1985 | 23704 | 1 | 0 | 3.6 | 0.0 | 2 | 0 | 26.8 | 0.0 |
| | 23705 | 1 | 0 | 3.6 | 0.0 | 1 | 0 | 13.4 | 0.0 |
| | Subtotal | 2 | 0 | 7.1 | 0.0 | 3 | 0 | 40.2 | 0.0 |
| 1984 | 23346 | 0 | 0 | 0.0 | 0.0 | 1 | 6 | 13.4 | 92.1 |
| | 23347 | 0 | 0 | 0.0 | 0.0 | 2 | 0 | 26.8 | 0.0 |
| | 23348 | 1 | 2 | 3.6 | 13.0 | 1 | 1 | 13.4 | 15.4 |
| | 23349 | 0 | 0 | 0.0 | 0.0 | 1 | 3 | 13.4 | 46.1 |
| | 23350 | 0 | 1 | 0.0 | 6.5 | 1 | 1 | 13.4 | 15.4 |
| | 23351 | 1 | 0 | 3.6 | 0.0 | 3 | 2 | 40.2 | 30.7 |
| | 23352 | 2 | 0 | 7.1 | 0.0 | 1 | 1 | 13.4 | 15.4 |
| | 23353 | 3 | 1 | 10.7 | 6.5 | 0 | 0 | 0.0 | 0.0 |
| | Subtotal | 7 | 4 | 24.9 | 26.0 | 10 | 14 | 134.1 | 214.9 |
| 1983 | 22758 | 0 | 0 | 0.0 | 0.0 | 1 | 1 | 13.4 | 15.4 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 1 | 1 | 13.4 | 15.4 |
| Total hatchery | | 9 | 4 | 32.0 | 26.0 | 14 | 15 | 187.8 | 230.3 |
| Strays: (c) | | | | | | | | | |
| 1984 | 23059 | 0 | 0 | 0.0 | 0.0 | 3 | 0 | 40.2 | 0.0 |
| 1984 | 23060 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 30.7 |
| Total strays | | 0 | 0 | 0.0 | 0.0 | 3 | 2 | 40.2 | 30.7 |
| Total CWT | | 9 | 4 | 32 | 26 | 17 | 17 | 228 | 261 |
| No data (5000) | | 1 | 3 | | | 22 | 36 | | |
| No pin (8000) | | 0 | 0 | | | 2 | 2 | | |
| Lost pin (9000) | | 0 | 0 | | | 0 | 0 | | |
| Observed adipose | | 10 | 7 | | | 41 | 55 | | |

(a) abbreviations are M = male, F= female

(b) includes jacks

(c) Adipose clipped fish that have strayed to Kitsumkalum River from other release locations

Table 19. Estimates of total escapement of adipose clipped chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1990. One decimal place is carried for the estimated adipose clips for calculating the expanded hatchery contribution in Table 22 (Method A).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Decoded adipose clips | | Estimated adipose clips | | Decoded adipose clips | | Estimated adipose clips | |
| Brood year | CWT code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1987 | 24944 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 9.7 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 9.7 |
| 1986 | 24412 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 4.8 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 4.8 |
| 1985 | 23704 | 0 | 0 | 0.0 | 0.0 | 2 | 5 | 15.4 | 24.2 |
| | 23705 | 3 | 3 | 23.0 | 21.0 | 2 | 0 | 15.4 | 0.0 |
| | 23706 | 2 | 4 | 15.3 | 28.0 | 1 | 6 | 7.7 | 29.1 |
| | 23707 | 0 | 0 | 0.0 | 0.0 | 0 | 3 | 0.0 | 14.5 |
| | Subtotal | 5 | 7 | 38.3 | 49.0 | 5 | 14 | 38.4 | 67.8 |
| 1984 | 23346 | 0 | 0 | 0.0 | 0.0 | 2 | 4 | 15.4 | 19.4 |
| | 23347 | 0 | 1 | 0.0 | 7.0 | 2 | 2 | 15.4 | 9.7 |
| | 23348 | 0 | 0 | 0.0 | 0.0 | 3 | 1 | 23.0 | 4.8 |
| | 23349 | 0 | 0 | 0.0 | 0.0 | 1 | 2 | 7.7 | 9.7 |
| | 23350 | 0 | 0 | 0.0 | 0.0 | 2 | 2 | 15.4 | 9.7 |
| | 23351 | 0 | 0 | 0.0 | 0.0 | 2 | 6 | 15.4 | 29.1 |
| | 23352 | 0 | 0 | 0.0 | 0.0 | 3 | 2 | 23.0 | 9.7 |
| | 23353 | 0 | 1 | 0.0 | 7.0 | 1 | 2 | 7.7 | 9.7 |
| | Subtotal | 0 | 2 | 0.0 | 14.0 | 16 | 21 | 122.9 | 101.8 |
| Total hatchery | | 5 | 9 | 38.3 | 63.0 | 21 | 38 | 161.3 | 184.2 |
| Strays: (c) | | | | | | | | | |
| 1985 | 23909 | 0 | 1 | 0.0 | 7.0 | 1 | 0 | 7.7 | 0.0 |
| 1984 | 23059 | 1 | 0 | 7.7 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| 1984 | 23060 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 4.8 |
| Total strays | | 1 | 1 | 7.7 | 7.0 | 1 | 1 | 7.7 | 4.8 |
| Total CWT | | 6 | 10 | 46 | 70 | 22 | 39 | 169 | 189 |
| No data (5000) | | 3 | 2 | | | 5 | 10 | | |
| No pin (8000) | | 4 | 1 | | | 1 | 3 | | |
| Lost pin (9000) | | 0 | 0 | | | 1 | 0 | | |
| Observed adipose | | 13 | 13 | | | 29 | 52 | | |

(a) abbreviations are M = male, F= female

(b) includes jacks

(c) Adipose clipped fish that have strayed to Stamp River from other enhancement facilities

Table 20. CWT and adipose clip release data for hatchery reared chinook salmon returning to the Kitsumkalum River, 1989 and 1990.

| Brood year | CWT release group | Release Numbers CWT | Release Numbers Untagged | CWT loss (%) | Days held | Adipose release status Clipped | Adipose release status Unclipped |
|---|---|---|---|---|---|---|---|
| 1987 | 24944 | 26423 | 362 | 1.4 | 1 | 26785 | 0 |
| 1986 | 24412 | 26784 | 0 | 0 | 1 | 26784 | 0 |
| 1985 | 23704 | 44183 | 263 | 0.4 | 1 | 44360 | 86 |
| | 23705 | 42264 | 236 | 0.4 | 1 | 42434 | 66 |
| | 23706 | 43916 | 3506 | 0.4 | 1 | 44092 | 3330 |
| | 23707 | 43892 | 3679 | 0.4 | 1 | 44068 | 3503 |
| 1984 | 23346 | 25937 | 209 | 0.8 | 1 | 26146 | 0 |
| | 23347 | 26198 | 211 | 0.8 | 1 | 26409 | 0 |
| | 23348 | 25978 | 183 | 0.7 | 1 | 26161 | 0 |
| | 23349 | 26373 | 93 | 0.4 | 1 | 26479 | 0 |
| | 23350 | 25980 | 91 | 0.3 | 0 | 26058 | 13 |
| | 23351 | 26376 | 0 | 0 | 1 | 26376 | 0 |
| | 23352 | 26509 | 0 | 0 | 1 | 26509 | 0 |
| | 23353 | 24512 | 1659 | 0 | 1 | 24512 | 1659 |
| 1983 | 22758 | 30716 | 0 | 0.0 | 1.0 | 30716 | 0 |
| | Total hatchery | 466041 | 10492 | | | 467890 | 8655 |
| Strays (a): | | | | | | | |
| 1985 | 23909 | 27111 | 1747 | 0 | 1 | 27111 | 1747 |
| 1984 | 23059 | 17031 | 237 | 0.5 | 1 | 17117 | 151 |
| 1984 | 23060 | 16227 | 82 | 0.5 | 1 | 16309 | 0 |

(a) adipose clipped fish that have strayed to Kitsumkalum River from other release locations.

Table 21. Estimates of total escapement of hatchery reared chinook salmon (Method A) to the upper and lower Kitsumkalum River, by tag code, 1989. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 18) to account for unclipped hatchery releases and hence to derive hatchery contributions to escapement.

| Brood year | CWT release group | Adipose Release (c) | | Expansion Factor (e) | Expanded hatchery contribution (a) (f) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Upper River | | Lower River | |
| | | Clipped | Unclipped | | M(b) | F | M (b) | F |
| 1985 | 23704 | 44360 | 86 | 1.00 | 3.6 | 0.0 | 26.9 | 0.0 |
| | 23705 | 42434 | 66 | 1.00 | 3.6 | 0.0 | 13.4 | 0.0 |
| | Subtotal | | | | 7.1 | 0.0 | 40.3 | 0.0 |
| 1984 | 23346 | 26146 | 0 | 1.00 | 0.0 | 0.0 | 13.4 | 92.1 |
| | 23347 | 26409 | 0 | 1.00 | 0.0 | 0.0 | 26.8 | 0.0 |
| | 23348 | 26161 | 0 | 1.00 | 3.6 | 13.0 | 13.4 | 15.4 |
| | 23349 | 26479 | 0 | 1.00 | 0.0 | 0.0 | 13.4 | 46.1 |
| | 23350 | 26058 | 13 | 1.00 | 0.0 | 6.5 | 13.4 | 15.4 |
| | 23351 | 26376 | 0 | 1.00 | 3.6 | 0.0 | 40.2 | 30.7 |
| | 23352 | 26509 | 0 | 1.00 | 7.1 | 0.0 | 13.4 | 15.4 |
| | 23353 | 24512 | 1659 | 1.07 | 11.4 | 6.9 | 0.0 | 0.0 |
| | Subtotal | | | | 25.6 | 26.4 | 134.1 | 214.9 |
| 1983 | 22758 | 30716 | 0 | 1.00 | 0.0 | 0.0 | 13.4 | 15.4 |
| | Subtotal | | | | 0.0 | 0.0 | 13.4 | 15.4 |
| | Total hatchery | | | | 32.7 | 26.4 | 187.8 | 230.3 |
| Strays: (d) | | | | | | | | |
| 1984 | 23059 | 17117 | 151 | 1.01 | 0.0 | 0.0 | 40.6 | 0.0 |
| 1984 | 23060 | 16309 | 0 | 1.00 | 0.0 | 0.0 | 0.0 | 30.7 |
| | Total strays | | | | 0.0 | 0.0 | 40.6 | 30.7 |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) from Table 20
(d) Adipose clipped fish that have strayed to Kitsumkalum River from other release locations
(e) expansion factor = (adipose clipped + unclipped releases) / adipose clipped releases
(f) calculated from estimated adipose clips in Table 18

Table 22. Estimates of total escapement of hatchery reared chinook salmon (method A) to the upper and lower Kitsumkalum River, by tag code, 1990. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 19) to account for unclipped hatchery releases and hence to derive hatchery contributions to escapement.

| Brood year | CWT release group | Adipose Release (c) Clipped | Adipose Release (c) Unclipped | Expansion Factor (e) | Expanded hatchery contribution (a) (f) Upper River M(b) | Upper River F | Lower River M (b) | Lower River F |
|---|---|---|---|---|---|---|---|---|
| 1987 | 24944 | 26785 | 0 | 1.00 | 0.0 | 0.0 | 0.0 | 9.7 |
| | Subtotal | | | | 0.0 | 0.0 | 0.0 | 9.7 |
| 1986 | 24412 | 26784 | 0 | 1.00 | 0.0 | 0.0 | 0.0 | 4.8 |
| | Subtotal | | | | 0.0 | 0.0 | 0.0 | 4.8 |
| 1985 | 23704 | 44360 | 86 | 1.00 | 0.0 | 0.0 | 15.4 | 24.3 |
| | 23705 | 42434 | 66 | 1.00 | 23.0 | 21.0 | 15.4 | 0.0 |
| | 23706 | 44092 | 3330 | 1.08 | 16.5 | 30.1 | 8.3 | 31.3 |
| | 23707 | 44068 | 3503 | 1.08 | 0.0 | 0.0 | 0.0 | 15.7 |
| | Subtotal | | | | 39.5 | 51.1 | 39.0 | 71.2 |
| 1984 | 23346 | 26146 | 0 | 1.00 | 0.0 | 0.0 | 15.4 | 19.4 |
| | 23347 | 26409 | 0 | 1.00 | 0.0 | 7.0 | 15.4 | 9.7 |
| | 23348 | 26161 | 0 | 1.00 | 0.0 | 0.0 | 23.0 | 4.8 |
| | 23349 | 26479 | 0 | 1.00 | 0.0 | 0.0 | 7.7 | 9.7 |
| | 23350 | 26058 | 13 | 1.00 | 0.0 | 0.0 | 15.4 | 9.7 |
| | 23351 | 26376 | 0 | 1.00 | 0.0 | 0.0 | 15.4 | 29.1 |
| | 23352 | 26509 | 0 | 1.00 | 0.0 | 0.0 | 23.0 | 9.7 |
| | 23353 | 24512 | 1659 | 1.07 | 0.0 | 7.5 | 8.2 | 10.3 |
| | Subtotal | | | | 0.0 | 14.5 | 123.4 | 102.4 |
| | Total hatchery | | | | 39.5 | 65.6 | 162.5 | 188.2 |
| Strays: (d) | | | | | | | | |
| 1985 | 23909 | 27111 | 1747 | 1.06 | 0.0 | 7.5 | 8.2 | 0.0 |
| 1984 | 23059 | 17117 | 151 | 1.01 | 7.7 | 0.0 | 0.0 | 0.0 |
| 1984 | 23060 | 16309 | 0 | 1.00 | 0.0 | 0.0 | 0.0 | 4.8 |
| | Total strays | | | | 7.7 | 7.5 | 8.2 | 4.8 |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) from Table 20
(d) Adipose clipped fish that have strayed to Kitsumkalum River from other release locations
(e) expansion factor = (adipose clipped + unclipped releases) / adipose clipped releases
(f) calculated from estimated adipose clips in Table 19

Table 23. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1989. Contributions were calculated using expansion Method A for the estimated number of adipose clips (Table 21).

| | | | | Hatchery contribution (b) | | | | Stray contribution (b) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimated escapement (a) | | Male (c) | | Female | | Male (c) | | Female | |
| | Age | Male (c) | Female | Number | % | Number | % | Number | % | Number | % |
| Upper River | | | | | | | | | | | |
| | 3 | 57 | 37 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0 | 0 | 7.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 504 | 373 | 25.6 | 5.1 | 26.4 | 7.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 1796 | 1757 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 7 | 0 | 37 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 2357 | 2205 | 32.7 | 1.4 | 26.4 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lower River | | | | | | | | | | | |
| | 3 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 134 | 0 | 40.3 | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 1488 | 1007 | 134.1 | 9.0 | 214.9 | 21.3 | 40.6 | 2.7 | 30.7 | 3.0 |
| | 6 | 4275 | 6467 | 13.4 | 0.3 | 15.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 7 | 201 | 153 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 6099 | 7626 | 187.8 | 3.1 | 230.3 | 3.0 | 40.6 | 0.7 | 30.7 | 0.4 |

(a) from Table 14
(b) from Table 21
(c) Includes jacks

Table 24. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1990. Contributions were calculated using expansion Method A for the estimated number of adipose clips (Table 22).

| | | Estimated escapement (a) | | Hatchery contribution (b) | | | | Stray contribution (b) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Male (c) | | Female | | Male (c) | | Female | |
| | Age | Male (c) | Female | Number | % | Number | % | Number | % | Number | % |
| Upper River | | | | | | | | | | | |
| | 2 | 34 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 226 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 674 | 447 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 610 | 371 | 39.5 | 6.5 | 51.1 | 13.8 | 0.0 | 0.0 | 7.5 | 2.0 |
| | 6 | 1827 | 3175 | 0.0 | 0.0 | 14.5 | 0.0 | 7.7 | 0.4 | 0.0 | 0.0 |
| | 7 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 3370 | 3994 | 39.5 | 1.2 | 65.6 | 1.6 | 7.7 | 0.2 | 7.5 | 0.2 |
| Lower River | | | | | | | | | | | |
| | 2 | 99 | 42 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 0 | 121 | 0.0 | 0.0 | 9.7 | 8.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 1090 | 569 | 0.0 | 0.0 | 4.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 991 | 690 | 39.0 | 3.9 | 71.2 | 10.3 | 8.2 | 0.8 | 0.0 | 0.0 |
| | 6 | 5245 | 4550 | 123.4 | 2.4 | 102.4 | 2.3 | 0.0 | 0.0 | 4.8 | 0.1 |
| | 7 | 198 | 79 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 7624 | 6051 | 162.4 | 2.1 | 188.1 | 3.1 | 8.2 | 0.1 | 4.8 | 0.1 |

(a) from Table 15
(b) from Table 22
(c) Includes jacks

Table 25. Adjusted number of CWT chinook salmon to the upper and lower Kitsumkalum River, 1989, by tag code. One decimal place is carried for the adjusted CWT's for estimating the total number of CWT's in Table 27 (Method B).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Decoded Adipose clips (d) | | Adjusted CWTs | | Decoded Adipose clips (d) | | Adjusted CWTs | |
| Brood Year | CWT code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1985 | 23704 | 1 | 0 | 1.1 | 0.0 | 2 | 0 | 4.3 | 0.0 |
| | 23705 | 1 | 0 | 1.1 | 0.0 | 1 | 0 | 2.2 | 0.0 |
| | Subtotal | 2 | 0 | 2.2 | 0.0 | 3 | 0 | 6.5 | 0.0 |
| 1984 | 23346 | 0 | 0 | 0.0 | 0.0 | 1 | 6 | 2.2 | 17.4 |
| | 23347 | 0 | 0 | 0.0 | 0.0 | 2 | 0 | 4.3 | 0.0 |
| | 23348 | 1 | 2 | 1.1 | 3.5 | 1 | 1 | 2.2 | 2.9 |
| | 23349 | 0 | 0 | 0.0 | 0.0 | 1 | 3 | 2.2 | 8.7 |
| | 23350 | 0 | 1 | 0.0 | 1.8 | 1 | 1 | 2.2 | 2.9 |
| | 23351 | 1 | 0 | 1.1 | 0.0 | 3 | 2 | 6.5 | 5.8 |
| | 23352 | 2 | 0 | 2.2 | 0.0 | 1 | 1 | 2.2 | 2.9 |
| | 23353 | 3 | 1 | 3.3 | 1.8 | 0 | 0 | 0.0 | 0.0 |
| | Subtotal | 7 | 4 | 7.8 | 7.0 | 10 | 14 | 21.6 | 40.5 |
| 1983 | 22758 | 0 | 0 | 0.0 | 0.0 | 1 | 1 | 2.2 | 2.9 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 1 | 1 | 2.2 | 2.9 |
| Total hatchery | | 9 | 4 | 10.0 | 7.0 | 14 | 15 | 30.2 | 43.4 |
| Strays: (c), (d) | | | | | | | | | |
| 1984 | 23059 | 0 | 0 | 0.0 | 0.0 | 3 | 0 | 6.5 | 0.0 |
| 1984 | 23060 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 5.8 |
| Total strays | | 0 | 0 | 0.0 | 0.0 | 3 | 2 | 6.5 | 5.8 |
| Total CWT | | 9 | 4 | 10.0 | 7.0 | 17 | 17 | 36.7 | 49.2 |
| No data (5000)(d) | | 1 | 3 | | | 22 | 36 | | |
| No pin (8000)(d) | | 0 | 0 | | | 2 | 2 | | |
| Lost pin (9000)(d) | | 0 | 0 | | | 0 | 0 | | |
| Observed adipose | | 10 | 7 | | | 41 | 55 | | |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) CWT fish that have strayed to Kitsumkalum River from other release locations
(d) from Table 18

Table 26. Adjusted number of CWT chinook salmon to the upper and lower Kitsumkalum River, 1990, by tag code. One decimal place is carried for the adjusted CWT's for estimating the total number of CWT's in Table 28 (Method B).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Decoded Adipose clips (d) | | Adjusted CWTs | | Decoded Adipose clips (d) | | Adjusted CWTs | |
| Brood Year | CWT code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1987 | 24944 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 2.5 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 2.5 |
| 1986 | 24412 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 1.2 |
| | Subtotal | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 1.2 |
| 1985 | 23704 | 0 | 0 | 0.0 | 0.0 | 2 | 5 | 2.5 | 6.2 |
| | 23705 | 3 | 3 | 3.9 | 3.5 | 2 | 0 | 2.5 | 0.0 |
| | 23706 | 2 | 4 | 2.6 | 4.7 | 1 | 6 | 1.3 | 7.4 |
| | 23707 | 0 | 0 | 0.0 | 0.0 | 0 | 3 | 0.0 | 3.7 |
| | Subtotal | 5 | 7 | 6.5 | 8.3 | 5 | 14 | 6.3 | 17.3 |
| 1984 | 23346 | 0 | 0 | 0.0 | 0.0 | 2 | 4 | 2.5 | 5.0 |
| | 23347 | 0 | 1 | 0.0 | 1.2 | 2 | 2 | 2.5 | 2.5 |
| | 23348 | 0 | 0 | 0.0 | 0.0 | 3 | 1 | 3.8 | 1.2 |
| | 23349 | 0 | 0 | 0.0 | 0.0 | 1 | 2 | 1.3 | 2.5 |
| | 23350 | 0 | 0 | 0.0 | 0.0 | 2 | 2 | 2.5 | 2.5 |
| | 23351 | 0 | 0 | 0.0 | 0.0 | 2 | 6 | 2.5 | 7.4 |
| | 23352 | 0 | 0 | 0.0 | 0.0 | 3 | 2 | 3.8 | 2.5 |
| | 23353 | 0 | 1 | 0.0 | 1.2 | 1 | 2 | 1.3 | 2.5 |
| | Subtotal | 0 | 2 | 0.0 | 2.4 | 16 | 21 | 20.2 | 26.0 |
| | Total hatchery | 5 | 9 | 6.5 | 10.6 | 21 | 38 | 26.5 | 47.0 |
| Strays: (c), (d) | | | | | | | | | |
| | 23909 | 0 | 1 | 0.0 | 1.2 | 1 | 0 | 1.3 | 0.0 |
| | 23059 | 1 | 0 | 1.3 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| | 23060 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 1.2 |
| | Total strays | 1 | 1 | 1.3 | 1.2 | 1 | 1 | 1.3 | 1.2 |
| | Total CWT | 6 | 10 | 7.8 | 11.8 | 22 | 39 | 27.8 | 48.3 |
| No data (5000)(d) | | 3 | 2 | | | 5 | 10 | | |
| No pin (8000)(d) | | 4 | 1 | | | 1 | 3 | | |
| Lost pin (9000)(d) | | 0 | 0 | | | 1 | 0 | | |
| Observed adipose | | 13 | 13 | | | 29 | 52 | | |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) CWT fish that have strayed to Kitsumkalum River from other release locations
(d) from Table 19

Table 27. Estimates of total escapement of CWT chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1989. One decimal place is carried for the estimated CWTs for calculating the expanded hatchery contribution in Table 29 (Method B).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Adjusted CWT's (d) | | Estimated CWT's | | Adjusted CWT's (d) | | Estimated CWT's | |
| Brood year | CWT code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1985 | 23704 | 1.1 | 0.0 | 3.5 | 0.0 | 4.3 | 0.0 | 24.0 | 0.0 |
| | 23705 | 1.1 | 0.0 | 3.5 | 0.0 | 2.2 | 0.0 | 12.0 | 0.0 |
| | Subtotal | 2.2 | 0.0 | 7.1 | 0.0 | 6.5 | 0.0 | 36.0 | 0.0 |
| 1984 | 23346 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 17.4 | 12.0 | 82.3 |
| | 23347 | 0.0 | 0.0 | 0.0 | 0.0 | 4.3 | 0.0 | 24.0 | 0.0 |
| | 23348 | 1.1 | 3.5 | 3.5 | 13.2 | 2.2 | 2.9 | 12.0 | 13.7 |
| | 23349 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 8.7 | 12.0 | 41.2 |
| | 23350 | 0.0 | 1.8 | 0.0 | 6.6 | 2.2 | 2.9 | 12.0 | 13.7 |
| | 23351 | 1.1 | 0.0 | 3.5 | 0.0 | 6.5 | 5.8 | 36.0 | 27.4 |
| | 23352 | 2.2 | 0.0 | 7.1 | 0.0 | 2.2 | 2.9 | 12.0 | 13.7 |
| | 23353 | 3.3 | 1.8 | 10.6 | 6.6 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Subtotal | 7.8 | 7.0 | 24.8 | 26.4 | 21.6 | 40.5 | 120.0 | 192.1 |
| 1983 | 22758 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 2.9 | 12.0 | 13.7 |
| | Subtotal | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 2.9 | 12.0 | 13.7 |
| | Total hatchery | 10.0 | 7.0 | 31.9 | 26.4 | 30.2 | 43.4 | 168.0 | 205.8 |
| Strays: (c)(d) | | | | | | | | | |
| 1984 | 23059 | 0.0 | 0.0 | 0.0 | 0.0 | 6.5 | 0.0 | 36.0 | 0.0 |
| 1984 | 23060 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 0.0 | 27.4 |
| | Total strays | 0.0 | 0.0 | 0.0 | 0.0 | 6.5 | 5.8 | 36.0 | 27.4 |
| | Total CWT | 10.0 | 7.0 | 31.9 | 26.4 | 36.7 | 49.2 | 204.0 | 233.2 |
| Escapement est. (e) | | 2357 | 2205 | | | 6099 | 7626 | | |
| Sample Size (f) | | 738 | 584 | | | 1097 | 1609 | | |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) CWT fish that have strayed to Kitsumkalum River from other release locations
(d) from Table 25
(e) Petersen estimate from Table 14
(f) total live and dead recovery from Table 16.

Table 28. Estimates of total escapement of CWT chinook salmon to the upper and lower Kitsumkalum River, by tag code, 1990. One decimal place is carried for the estimated CWTs for calculating the expanded hatchery contribution in Table 30 (Method B).

| | | Upper River (a) | | | | Lower River | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Adjusted CWT's (d) | | Estimated CWT's | | Adjusted CWT's (d) | | Estimated CWT's | |
| Brood year | CWT code | M (b) | F | M (b) | F | M (b) | F | M (b) | F |
| 1987 | 24944 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 9.0 |
| | Subtotal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 9.0 |
| 1986 | 24412 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 4.5 |
| | Subtotal | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 4.5 |
| 1985 | 23704 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 6.2 | 14.7 | 22.5 |
| | 23705 | 3.9 | 3.5 | 13.8 | 19.0 | 2.5 | 0.0 | 14.7 | 0.0 |
| | 23706 | 2.6 | 4.7 | 9.2 | 25.3 | 1.3 | 7.4 | 7.4 | 26.9 |
| | 23707 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.7 | 0.0 | 13.5 |
| | Subtotal | 6.5 | 8.3 | 23.0 | 44.2 | 6.3 | 17.3 | 36.8 | 62.9 |
| 1984 | 23346 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 5.0 | 14.7 | 18.0 |
| | 23347 | 0.0 | 1.2 | 0.0 | 6.3 | 2.5 | 2.5 | 14.7 | 9.0 |
| | 23348 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 1.2 | 22.1 | 4.5 |
| | 23349 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 2.5 | 7.4 | 9.0 |
| | 23350 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 14.7 | 9.0 |
| | 23351 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 7.4 | 14.7 | 26.9 |
| | 23352 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 2.5 | 22.1 | 9.0 |
| | 23353 | 0.0 | 1.2 | 0.0 | 6.3 | 1.3 | 2.5 | 7.4 | 9.0 |
| | Subtotal | 0.0 | 2.4 | 0.0 | 12.6 | 20.2 | 26.0 | 117.9 | 94.3 |
| | Total hatchery | 6.5 | 10.6 | 23.0 | 56.9 | 26.5 | 47.0 | 154.7 | 170.7 |
| Strays: (c)(d) | | | | | | | | | |
| | 23909 | 0.0 | 1.2 | 0.0 | 6.3 | 1.3 | 0.0 | 7.4 | 0.0 |
| | 23059 | 1.3 | 0.0 | 4.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 23060 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 4.5 |
| | Total strays | 1.3 | 1.2 | 4.6 | 6.3 | 1.3 | 1.2 | 7.4 | 4.5 |
| | Total CWT | 7.8 | 11.8 | 27.6 | 63.2 | 27.8 | 48.3 | 162.1 | 175.2 |
| Escapement est. (e) | | 3370 | 3994 | | | 7624 | 6051 | | |
| Sample Size (f) | | 953 | 747 | | | 1307 | 1668 | | |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) CWT fish that have strayed to Kitsumkalum River from other release locations
(d) from Table 26
(e) Petersen estimate from Table 15
(f) total live and dead recovery from Table 17.

Table 29. Estimates of total escapement of hatchery reared chinook salmon (Method B) to the upper and lower Kitsumkalum River, by tag code, 1989. The expansion factor is used to expand the estimated CWT chinook in the escapement to account for untagged hatchery releases and hence to derive hatchery contributions to escapement.

| Brood Year | CWT release group | Release Numbers (c) CWT | Release Numbers (c) Untagged | Expansion Factor (e) | Expanded hatchery contribution (a)(f) Upper River M(b) | Upper River F | Lower River M (b) | Lower River F |
|---|---|---|---|---|---|---|---|---|
| 1985 | 23704 | 44183 | 263 | 1.01 | 3.6 | 0.0 | 24.1 | 0.0 |
| | 23705 | 42264 | 236 | 1.01 | 3.6 | 0.0 | 12.1 | 0.0 |
| | Subtotal | | | | 7.1 | 0.0 | 36.2 | 0.0 |
| 1984 | 23346 | 25937 | 209 | 1.01 | 0.0 | 0.0 | 12.1 | 83.0 |
| | 23347 | 26198 | 211 | 1.01 | 0.0 | 0.0 | 24.2 | 0.0 |
| | 23348 | 25978 | 183 | 1.01 | 3.6 | 13.3 | 12.1 | 13.8 |
| | 23349 | 26373 | 93 | 1.00 | 0.0 | 0.0 | 12.0 | 41.3 |
| | 23350 | 25980 | 91 | 1.00 | 0.0 | 6.6 | 12.0 | 13.8 |
| | 23351 | 26376 | 0 | 1.00 | 3.5 | 0.0 | 36.0 | 27.4 |
| | 23352 | 26509 | 0 | 1.00 | 7.1 | 0.0 | 12.0 | 13.7 |
| | 23353 | 24512 | 1659 | 1.07 | 11.4 | 7.1 | 0.0 | 0.0 |
| | Subtotal | | | | 25.6 | 27.0 | 120.4 | 193.0 |
| 1983 | 22758 | 30716 | 0 | 1.00 | 0.0 | 0.0 | 12.0 | 13.7 |
| | Subtotal | | | | 0.0 | 0.0 | 12.0 | 13.7 |
| | Total hatchery | | | | 32.7 | 27.0 | 168.6 | 206.8 |
| Strays: (d) | | | | | | | | |
| 1984 | 23059 | 17031 | 237 | 1.01 | 0.0 | 0.0 | 36.5 | 0.0 |
| 1984 | 23060 | 16227 | 82 | 1.01 | 0.0 | 0.0 | 0.0 | 27.6 |
| | Total strays | | | | 0.0 | 0.0 | 36.5 | 27.6 |
| | Total CWT | | | | 32.7 | 27.0 | 205.1 | 234.3 |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) from Table 20
(d) Adipose clipped fish that have strayed to Kitsumkalum River from other release locations
(e) expansion factor = (CWT+ untagged releases) / CWT releases.
(f) calculated from estimated CWT's in Table 27

Table 30. Estimates of total escapement of hatchery reared chinook salmon (Method B) to the upper and lower Kitsumkalum River, by tag code, 1990. The expansion factor is used to expand the estimated CWT chinook in the escapement to account for untagged hatchery releases and hence to derive hatchery contributions to escapement.

| Brood Year | CWT release group | Release Numbers (c) CWT | Release Numbers (c) Untagged | Expansion Factor (e) | Expanded hatchery contribution (a)(f) Upper River M(b) | Upper River F | Lower River M (b) | Lower River F |
|---|---|---|---|---|---|---|---|---|
| 1987 | 24944 | 26423 | 362 | 1.01 | 0.0 | 0.0 | 0.0 | 9.1 |
| | Subtotal | | | | 0.0 | 0.0 | 0.0 | 9.1 |
| 1986 | 24412 | 26784 | 0 | 1.00 | 0.0 | 0.0 | 0.0 | 4.5 |
| | Subtotal | | | | 0.0 | 0.0 | 0.0 | 4.5 |
| 1985 | 23704 | 44183 | 263 | 1.01 | 0.0 | 0.0 | 14.8 | 22.6 |
| | 23705 | 42264 | 236 | 1.01 | 13.9 | 19.1 | 14.8 | 0.0 |
| | 23706 | 43916 | 3506 | 1.08 | 9.9 | 27.3 | 8.0 | 29.1 |
| | 23707 | 43892 | 3679 | 1.08 | 0.0 | 0.0 | 0.0 | 14.6 |
| | Subtotal | | | | 23.8 | 46.4 | 37.6 | 66.3 |
| 1984 | 23346 | 25937 | 209 | 1.01 | 0.0 | 0.0 | 14.9 | 18.1 |
| | 23347 | 26198 | 211 | 1.01 | 0.0 | 6.4 | 14.9 | 9.1 |
| | 23348 | 25978 | 183 | 1.01 | 0.0 | 0.0 | 22.3 | 4.5 |
| | 23349 | 26373 | 93 | 1.00 | 0.0 | 0.0 | 7.4 | 9.0 |
| | 23350 | 25980 | 91 | 1.00 | 0.0 | 0.0 | 14.8 | 9.0 |
| | 23351 | 26376 | 0 | 1.00 | 0.0 | 0.0 | 14.7 | 26.9 |
| | 23352 | 26509 | 0 | 1.00 | 0.0 | 0.0 | 22.1 | 9.0 |
| | 23353 | 24512 | 1659 | 1.07 | 0.0 | 6.7 | 7.9 | 9.6 |
| | Subtotal | | | | 0.0 | 13.1 | 118.9 | 95.2 |
| | Total hatchery | | | | 23.8 | 59.5 | 156.5 | 175.1 |
| Strays: (d) | | | | | | | | |
| 1985 | 23909 | 27111 | 1747 | 1.06 | 0.0 | 6.7 | 7.8 | 0.0 |
| 1984 | 23059 | 17031 | 237 | 1.01 | 4.7 | 0.0 | 0.0 | 0.0 |
| 1984 | 23060 | 16227 | 82 | 1.01 | 0.0 | 0.0 | 0.0 | 4.5 |
| | Total strays | | | | 4.7 | 6.7 | 7.8 | 4.5 |
| | Total CWT | | | | 28.5 | 66.2 | 164.3 | 179.6 |

(a) abbreviations are M=male and F=female
(b) includes jacks
(c) from Table 20
(d) Adipose clipped fish that have strayed to Kitsumkalum River from other release locations
(e) expansion factor = (CWT+ untagged releases) / CWT releases.
(f) calculated from estimated CWT's in Table 28

Table 31. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1989. Contributions were calculated using expansion Method B for the estimated number of CWT's (Table 29).

| | | | | Hatchery contribution (b) | | | | Stray contribution (b) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Estimated escapement (a) | | | Male (c) | | Female | | Male (c) | | Female | |
| Age | Male (c) | Female | | Number | % | Number | % | Number | % | Number | % |
| **Upper River** | | | | | | | | | | | |
| 3 | 57 | 37 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 0 | 0 | | 7.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 504 | 373 | | 25.6 | 5.1 | 27.0 | 7.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 1796 | 1757 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 0 | 37 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 2357 | 2205 | | 32.7 | 1.4 | 27.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Lower River** | | | | | | | | | | | |
| 3 | 0 | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 134 | 0 | | 36.2 | 27.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 1488 | 1007 | | 120.4 | 8.1 | 193.0 | 19.2 | 36.5 | 2.5 | 27.6 | 2.7 |
| 6 | 4275 | 6467 | | 12.0 | 0.3 | 13.7 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 201 | 153 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 6099 | 7626 | | 168.6 | 2.8 | 206.7 | 2.7 | 36.5 | 0.6 | 27.6 | 0.4 |

(a) from Table 14
(b) from Table 29
(c) Includes jacks

Table 32. Estimated hatchery contribution to the upper and lower Kitsumkalum River, 1990. Contributions were calculated using expansion Method B for the estimated number of CWT's (Table 30).

| | | Estimated escapement (a) | | Hatchery contribution (b) | | | | Stray contribution (b) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Male (c) | | Female | | Male (c) | | Female | |
| | Age | Male (c) | Female | Number | % | Number | % | Number | % | Number | % |
| Upper River | | | | | | | | | | | |
| | 2 | 34 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 226 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 674 | 447 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 610 | 371 | 23.8 | 3.9 | 46.4 | 12.5 | 0.0 | 0.0 | 6.7 | 1.8 |
| | 6 | 1827 | 3175 | 0.0 | 0.0 | 13.1 | 0.4 | 4.7 | 0.3 | 0.0 | 0.0 |
| | 7 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 3370 | 3994 | 23.8 | 0.7 | 59.5 | 1.5 | 4.7 | 0.1 | 6.7 | 0.2 |
| Lower River | | | | | | | | | | | |
| | 2 | 99 | 42 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 3 | 0 | 121 | 0.0 | 0.0 | 9.1 | 7.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 1090 | 569 | 0.0 | 0.0 | 4.5 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 991 | 690 | 37.6 | 3.8 | 66.3 | 9.6 | 7.8 | 0.8 | 0.0 | 0.0 |
| | 6 | 5245 | 4550 | 118.9 | 2.3 | 95.2 | 2.1 | 0.0 | 0.0 | 4.5 | 0.1 |
| | 7 | 198 | 79 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 7624 | 6051 | 156.5 | 2.1 | 175.1 | 2.9 | 7.8 | 0.1 | 4.5 | 0.1 |

(a) from Table 15
(b) from Table 30
(c) Includes jacks

# APPENDICES

Appendix A1. Numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River, 1989, by date.

| Location | Date | Males | | | | Females | | | | Jacks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip |
| Upper River | | | | | | | | | | | | | |
| | Aug-22 | 6 | 1 | 5 | 1 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| | Aug-25 | 33 | 0 | 33 | 0 | 9 | 1 | 8 | 1 | 8 | 0 | 8 | 0 |
| | Aug-26 | 18 | 1 | 17 | 1 | 10 | 0 | 10 | 0 | 4 | 0 | 4 | 0 |
| | Aug-28 | 43 | 1 | 42 | 1 | 26 | 0 | 26 | 0 | 6 | 0 | 6 | 0 |
| | Aug-29 | 36 | 0 | 36 | 0 | 16 | 0 | 16 | 1 | 2 | 1 | 1 | 1 |
| | Aug-30 | 42 | 2 | 40 | 2 | 20 | 0 | 20 | 0 | 3 | 0 | 3 | 0 |
| | Sep-02 | 49 | 0 | 49 | 0 | 33 | 1 | 32 | 1 | 0 | 0 | 0 | 0 |
| | Sep-04 | 37 | 0 | 37 | 1 | 26 | 0 | 26 | 0 | 2 | 0 | 2 | 0 |
| | Sep-05 | 73 | 0 | 73 | 0 | 48 | 0 | 48 | 0 | 4 | 0 | 4 | 0 |
| | Sep-06 | 43 | 0 | 43 | 0 | 33 | 1 | 32 | 2 | 0 | 0 | 0 | 0 |
| | Sep-07 | 30 | 0 | 30 | 0 | 30 | 0 | 30 | 0 | 3 | 0 | 3 | 0 |
| | Totals | 410 | 5 | 405 | 6 | 256 | 3 | 253 | 5 | 32 | 1 | 31 | 1 |
| Lower River | | | | | | | | | | | | | |
| | Aug-21 | 42 | 0 | 42 | 1 | 49 | 1 | 48 | 2 | 1 | 0 | 1 | 0 |
| | Aug-22 | 36 | 1 | 35 | 1 | 45 | 0 | 45 | 0 | 0 | 0 | 0 | 0 |
| | Aug-23 | 72 | 1 | 71 | 1 | 53 | 1 | 52 | 4 | 2 | 0 | 2 | 0 |
| | Aug-24 | 63 | 4 | 59 | 7 | 61 | 0 | 61 | 2 | 4 | 0 | 4 | 0 |
| | Aug-26 | 41 | 0 | 41 | 0 | 36 | 0 | 36 | 3 | 0 | 0 | 0 | 0 |
| | Aug-27 | 36 | 1 | 35 | 1 | 37 | 0 | 37 | 0 | 0 | 0 | 0 | 0 |
| | Aug-28 | 50 | 1 | 49 | 2 | 43 | 0 | 43 | 2 | 0 | 0 | 0 | 0 |
| | Aug-29 | 39 | 1 | 38 | 1 | 30 | 0 | 30 | 0 | 2 | 0 | 2 | 0 |
| | Aug-30 | 11 | 0 | 11 | 0 | 17 | 1 | 16 | 1 | 2 | 0 | 2 | 0 |
| | Aug-31 | 50 | 1 | 49 | 2 | 29 | 2 | 27 | 3 | 2 | 0 | 2 | 0 |
| | Sep-01 | 8 | 0 | 8 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | Totals | 448 | 10 | 438 | 16 | 402 | 5 | 397 | 17 | 13 | 0 | 13 | 0 |

(a) sacrificed for broodstock.

Appendix A2. Chinook salmon carcass recovery, by date, for the upper and lower Kitsumkalum River, 1989.

| | | Males | | | Females | | | Jacks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Date | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad |
| Upper River | | | | | | | | | | |
| | Sep-08 | 25 | 2 | 1 | 26 | 3 | 2 | 1 | 0 | 1 |
| | Sep-11 | 25 | 1 | 1 | 21 | 1 | 0 | 0 | 0 | 0 |
| | Sep-13 | 22 | 10 | 0 | 28 | 3 | 0 | 0 | 0 | 0 |
| | Sep-14 | 35 | 5 | 0 | 48 | 8 | 0 | 1 | 1 | 0 |
| | Sep-15 | 22 | 5 | 0 | 37 | 6 | 0 | 0 | 0 | 0 |
| | Sep-16 | 6 | 2 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| | Sep-18 | 53 | 7 | 0 | 58 | 6 | 0 | 0 | 0 | 0 |
| | Sep-19 | 55 | 13 | 0 | 44 | 5 | 0 | 4 | 0 | 0 |
| | Sep-20 | 20 | 1 | 0 | 24 | 3 | 0 | 0 | 0 | 0 |
| | Sep-22 | 20 | 3 | 0 | 23 | 0 | 0 | 0 | 0 | 0 |
| | Sep-23 | 6 | 1 | 0 | 14 | 1 | 0 | 1 | 0 | 0 |
| | Totals | 289 | 50 | 2 | 328 | 36 | 2 | 7 | 1 | 1 |
| Lower River | | | | | | | | | | |
| | Aug-29 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | Sep-06 | 17 | 4 | 1 | 37 | 2 | 1 | 0 | 0 | 0 |
| | Sep-07 | 5 | 1 | 0 | 8 | 0 | 0 | 0 | 0 | 0 |
| | Sep-08 | 21 | 3 | 0 | 28 | 1 | 2 | 0 | 0 | 0 |
| | Sep-11 | 38 | 2 | 2 | 57 | 4 | 4 | 0 | 0 | 0 |
| | Sep-12 | 67 | 8 | 2 | 124 | 17 | 3 | 1 | 0 | 0 |
| | Sep-13 | 52 | 1 | 4 | 57 | 3 | 1 | 4 | 0 | 0 |
| | Sep-14 | 47 | 3 | 1 | 97 | 5 | 5 | 2 | 0 | 0 |
| | Sep-15 | 74 | 8 | 3 | 115 | 9 | 2 | 5 | 0 | 0 |
| | Sep-16 | 50 | 5 | 0 | 102 | 4 | 0 | 0 | 0 | 0 |
| | Sep-18 | 91 | 5 | 4 | 168 | 3 | 10 | 3 | 0 | 0 |
| | Sep-19 | 39 | 2 | 4 | 121 | 7 | 8 | 0 | 0 | 0 |
| | Sep-20 | 27 | 3 | 2 | 73 | 2 | 1 | 1 | 0 | 0 |
| | Sep-21 | 11 | 0 | 1 | 18 | 0 | 0 | 0 | 0 | 0 |
| | Sep-22 | 20 | 0 | 1 | 45 | 2 | 0 | 0 | 0 | 0 |
| | Sep-25 | 27 | 0 | 0 | 53 | 0 | 1 | 0 | 0 | 0 |
| | Sep-26 | 10 | 1 | 0 | 43 | 1 | 0 | 0 | 0 | 0 |
| | Sep-27 | 6 | 1 | 0 | 15 | 1 | 0 | 0 | 0 | 0 |
| | Sep-28 | 12 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 |
| | Sep-29 | 5 | 0 | 0 | 13 | 2 | 0 | 0 | 0 | 0 |
| | Totals | 620 | 47 | 25 | 1207 | 63 | 38 | 16 | 0 | 0 |

Appendix B1. Numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River, 1990, by date.

| Location | Date | Males | | | | Females | | | | Jacks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip |
| Upper River | | | | | | | | | | | | | |
| | Aug-21 | 12 | 2 | 10 | 2 | 16 | 0 | 16 | 0 | 1 | 0 | 1 | 0 |
| | Aug-22 | 13 | 1 | 12 | 1 | 6 | 0 | 6 | 0 | 1 | 0 | 1 | 0 |
| | Aug-23 | 10 | 0 | 10 | 0 | 9 | 1 | 8 | 1 | 1 | 0 | 1 | 0 |
| | Aug-24 | 33 | 0 | 33 | 0 | 7 | 1 | 6 | 1 | 1 | 0 | 1 | 0 |
| | Aug-25 | 37 | 3 | 34 | 3 | 11 | 0 | 11 | 0 | 2 | 0 | 2 | 0 |
| | Aug-27 | 41 | 0 | 41 | 1 | 16 | 0 | 16 | 0 | 9 | 0 | 9 | 0 |
| | Aug-28 | 40 | 0 | 40 | 1 | 10 | 0 | 10 | 1 | 10 | 0 | 10 | 0 |
| | Aug-29 | 34 | 0 | 34 | 0 | 18 | 0 | 18 | 0 | 9 | 0 | 9 | 0 |
| | Aug-30 | 35 | 0 | 35 | 0 | 24 | 0 | 24 | 0 | 2 | 0 | 2 | 0 |
| | Aug-31 | 79 | 0 | 79 | 1 | 37 | 0 | 37 | 1 | 7 | 0 | 7 | 0 |
| | Sep-01 | 25 | 0 | 25 | 0 | 11 | 0 | 11 | 0 | 3 | 0 | 3 | 0 |
| | Sep-03 | 47 | 0 | 47 | 0 | 25 | 0 | 25 | 0 | 3 | 0 | 3 | 0 |
| | Sep-04 | 43 | 1 | 42 | 1 | 19 | 0 | 19 | 0 | 1 | 0 | 1 | 0 |
| | Sep-05 | 52 | 1 | 51 | 1 | 52 | 2 | 50 | 2 | 4 | 0 | 4 | 0 |
| | Sep-06 | 23 | 0 | 23 | 0 | 21 | 0 | 21 | 0 | 2 | 0 | 2 | 0 |
| | Totals | 524 | 8 | 516 | 11 | 282 | 4 | 278 | 6 | 56 | 0 | 56 | 0 |

Appendix B1 (cont). Numbers of chinook salmon captured, tagged and released in the upper and lower Kitsumkalum River, 1990, by date.

| Location | Date | Males | | | | Females | | | | Jacks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip | No. Captured | No. Sacs (a) | No. Tagged | No. Ad Clip |
| Lower River | | | | | | | | | | | | | |
| | Aug-20 | 38 | 0 | 38 | 0 | 44 | 1 | 43 | 1 | 7 | 0 | 7 | 0 |
| | Aug-21 | 50 | 2 | 48 | 2 | 49 | 2 | 47 | 2 | 2 | 0 | 2 | 0 |
| | Aug-22 | 41 | 1 | 40 | 1 | 47 | 0 | 47 | 0 | 3 | 0 | 3 | 0 |
| | Aug-23 | 34 | 1 | 33 | 1 | 41 | 0 | 41 | 1 | 4 | 0 | 4 | 0 |
| | Aug-24 | 42 | 0 | 42 | 0 | 32 | 0 | 32 | 1 | 5 | 0 | 5 | 0 |
| | Aug-27 | 52 | 0 | 52 | 0 | 45 | 0 | 45 | 1 | 2 | 0 | 2 | 0 |
| | Aug-28 | 62 | 0 | 62 | 0 | 46 | 0 | 46 | 3 | 4 | 0 | 4 | 0 |
| | Aug-29 | 67 | 0 | 67 | 1 | 34 | 0 | 34 | 0 | 5 | 0 | 5 | 0 |
| | Aug-30 | 38 | 0 | 38 | 0 | 34 | 2 | 32 | 3 | 1 | 0 | 1 | 0 |
| | Sep-04 | 6 | 0 | 6 | 0 | 4 | 0 | 4 | 1 | 0 | 0 | 0 | 0 |
| | Totals | 430 | 4 | 426 | 5 | 376 | 5 | 371 | 13 | 33 | 0 | 33 | 0 |

(a) sacrificed for broodstock.

Appendix B2. Chinook salmon carcass recovery, by date, for the upper and lower Kitsumkalum River, 1990.

| | | Males | | | Females | | | Jacks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Date | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad |
| Upper River | | | | | | | | | | |
| | Sep-03 | 1 | 1 | 0 | 3 | 3 | 0 | 0 | 0 | 0 |
| | Sep-04 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Sep-09 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sep-10 | 15 | 3 | 0 | 12 | 4 | 1 | 2 | 1 | 0 |
| | Sep-11 | 13 | 3 | 0 | 13 | 2 | 0 | 3 | 0 | 0 |
| | Sep-12 | 18 | 4 | 0 | 14 | 1 | 2 | 2 | 0 | 0 |
| | Sep-13 | 27 | 10 | 0 | 28 | 5 | 0 | 3 | 0 | 0 |
| | Sep-14 | 29 | 7 | 0 | 19 | 4 | 1 | 7 | 1 | 0 |
| | Sep-17 | 41 | 9 | 1 | 59 | 3 | 2 | 2 | 0 | 0 |
| | Sep-20 | 34 | 2 | 1 | 57 | 0 | 0 | 8 | 0 | 0 |
| | Sep-21 | 49 | 10 | 0 | 50 | 4 | 0 | 13 | 1 | 0 |
| | Sep-24 | 33 | 10 | 0 | 50 | 2 | 0 | 8 | 0 | 0 |
| | Sep-25 | 6 | 2 | 0 | 15 | 0 | 1 | 0 | 0 | 0 |
| | Sep-26 | 5 | 0 | 0 | 33 | 1 | 0 | 0 | 0 | 0 |
| | Sep-27 | 10 | 2 | 0 | 19 | 2 | 0 | 0 | 0 | 0 |
| | Sep-28 | 6 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 |
| | Oct-01 | 25 | 0 | 0 | 66 | 3 | 0 | 2 | 0 | 0 |
| | Oct-03 | 6 | 0 | 0 | 16 | 0 | 0 | 1 | 0 | 0 |
| | Oct-04 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| | Totals | 322 | 63 | 2 | 465 | 34 | 7 | 51 | 3 | 0 |

Appendix B2 (cont.) Daily chinook salmon carcass recovery, by date, for the upper and lower Kitsumkalum River, 1990.

| | | Males | | | Females | | | Jacks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Date | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad | No. Rcvrd | No. Tag | No. Ad |
| Lower River | | | | | | | | | | |
| | Aug-27 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Aug-29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sep-04 | 2 | 0 | 0 | 3 | 2 | 1 | 0 | 0 | 0 |
| | Sep-06 | 6 | 2 | 0 | 13 | 1 | 0 | 0 | 0 | 0 |
| | Sep-10 | 28 | 6 | 0 | 36 | 6 | 1 | 0 | 0 | 0 |
| | Sep-11 | 47 | 8 | 0 | 42 | 5 | 0 | 3 | 0 | 0 |
| | Sep-12 | 59 | 7 | 3 | 47 | 3 | 2 | 4 | 0 | 0 |
| | Sep-13 | 52 | 9 | 0 | 72 | 10 | 7 | 8 | 0 | 0 |
| | Sep-14 | 130 | 5 | 6 | 181 | 14 | 6 | 17 | 0 | 0 |
| | Sep-17 | 87 | 10 | 1 | 98 | 7 | 3 | 16 | 0 | 0 |
| | Sep-18 | 48 | 5 | 2 | 101 | 4 | 2 | 8 | 0 | 0 |
| | Sep-19 | 70 | 3 | 3 | 152 | 7 | 8 | 13 | 0 | 0 |
| | Sep-20 | 91 | 3 | 6 | 120 | 9 | 5 | 6 | 0 | 0 |
| | Sep-21 | 32 | 0 | 1 | 56 | 1 | 0 | 0 | 0 | 0 |
| | Sep-24 | 0 | 0 | 0 | 93 | 0 | | 0 | 0 | 0 |
| | Sep-25 | 17 | 2 | 0 | 29 | 1 | 2 | 3 | 0 | 0 |
| | Sep-26 | 29 | 2 | 1 | 71 | 1 | 1 | 0 | 0 | 0 |
| | Sep-27 | 26 | 2 | 0 | 55 | 2 | 0 | 2 | 0 | 0 |
| | Sep-28 | 16 | 0 | 1 | 42 | 0 | 1 | 3 | 0 | 0 |
| | Oct-02 | 13 | 2 | 0 | 19 | 0 | 0 | 1 | 0 | 0 |
| | Oct-05 | 6 | 1 | 0 | 61 | 1 | 0 | 0 | 0 | 0 |
| | Totals | 760 | 67 | 24 | 1292 | 74 | 39 | 84 | 0 | 0 |