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1992 Juvenile and Adult Coho Salmon Enumeration Studies at Black Creek, Vancouver Island

T. C. Nelson, J. R. Irvine, and R. E. Bailey

Biological Sciences Branch
Department of Fisheries and Oceans
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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1992 JUVENILE AND ADULT COHO SALMON
ENUMERATION STUDIES
AT BLACK CREEK, VANCOUVER ISLAND

by

T. C. Nelson¹, J. R. Irvine, and R. E. Bailey

Science Branch

Department of Fisheries and Oceans

Pacific Biological Station

Nanaimo, British Columbia V9R 5K6

¹ LGL Limited environmental research associates, 9768 Second Street, Sidney, B.C. V8L 3Y8

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ABSTRACT

Nelson, T. C., J. R. Irvine, and R. E. Bailey. 1994. 1992 juvenile and adult coho salmon enumeration studies at Black Creek, Vancouver Island. Can. Manuscr. Rep. Fish. Aquat. Sci. 2290: x + 70 p.

Coho smolts leaving Black Creek between April 13 and June 18, 1992 were trapped, adipose clipped, and coded-wire tagged (marked). A total of 50,271 smolts were captured at an enumeration fence and 50,073 of these (99.6%) were marked and released downstream. It is likely that some additional unmarked smolts emigrated from Black Creek uncounted. A high number of coho fry (3,091) were caught in 1992, and 2,919 (94.4%) of these were successfully adipose clipped, tagged with half-length coded-wire tags, and released. Mortalities due to trapping and tagging were low for smolts (0.28%) and notable for fry (4.7%). The calculated freshwater age structure of Black Creek smolts was 91.2% age 1, 8.5% age 2, and 0.1% age 3. All smolt data were stratified into three predetermined sampling periods. The proportional representation of migrating age-2 smolts during the entire study period was highest (67.6%) during the first sampling period. For both age-1 and age-2 smolts, mean stratified lengths varied significantly among sampling periods (the largest smolts from both age groups were observed during the first sampling period). The mean length of sampled fry increased significantly over the course of the study.

Coho escapements to Black Creek in 1992 were monitored by an adult enumeration fence operated between October 20 and December 8, and by conducting mark-recapture, carcass, and area-under-the-curve (AUC) visual surveys upstream of the fence from October 26 to December 14. Escapement estimates for adult and jack coho were derived using four methods: 1) a pooled Petersen estimate; 2) an iterative Darroch estimate (adults only); 3) the AUC method; and 4) the minimum (known) number of fish in the system above the enumeration fence. For adult coho, the pooled Petersen estimate (1,720) and the iterative Darroch estimate (1,721) were almost identical; the AUC estimate for adults (1,702) was slightly lower than these estimates and higher than the minimum known number of adults in the system (1,670). For jack coho, the pooled Petersen estimate (2,348) was substantially higher than both the AUC estimate (546) and the minimum known number of jacks (1,645). The mean postorbital-hypural lengths of adult male, female, and jack coho were 46.6 cm, 51.4 cm, and 29.5 cm, respectively. Female coho were significantly larger than adult male coho. Adult males significantly outnumbered females; the total number of males (adult plus jack) outnumbered females by more than 3:1. Adult and jack coho were predominantly freshwater age 1 (91.2 and 83.8%, respectively). Smolt-to-jack returns were highest for large smolts that migrated during the beginning of the smolt migration.

RÉSUMÉ

Nelson, T. C., J. R. Irvine, and R. E. Bailey. 1994. 1992 juvenile and adult coho salmon enumeration studies at Black Creek, Vancouver Island. Can. Manuscr. Rep. Fish. Aquat. Sci. 2290: x + 70 p.

Les saumons cohos juvéniles qui ont quitté Black Creek entre le 13 avril et le 18 juin 1992 ont été capturés et marqués par coupe de la nageoire adipeuse et insertion d'un fil codé. Au total, 50 271 saumoneaux ont ainsi été capturés à une barrière de dénombrement et 50 073 d'entre eux (99,6 %) ont été marqués et libérés en aval. Il est probable qu'un certain nombre de saumoneaux aient migré sans être dénombrés. Un nombre élevé d'alevins cohos ont été capturés (3 091) en 1992 et 2 919 (94,4 %) ont été marqués par coupe de la nageoire adipeuse et fixation d'un fil codé coupé en deux. Le taux de mortalité résultant de la capture et du marquage a été faible pour les saumoneaux (0,28 %) mais appréciable pour les alevins (4,7 %). La structure calculée des âges en eau douce des saumoneaux de Black Creek était de 91,2 % de poissons d'âge 1, de 8,5 % de poissons d'âge 2 et de 0,1 % de poissons d'âge 3. Toutes les données sur les saumoneaux ont été stratifiées selon trois périodes de prélèvement. La proportion de saumoneaux d'âge 2 (67,6 %) ayant migré pendant la première période de prélèvement est plus élevée que celle notée pour toute la période d'étude. Dans le cas des saumoneaux d'âges 1 et 2, les longueurs moyennes stratifiées variaient de façon significative entre les périodes de prélèvement (les plus gros saumoneaux de chaque groupe d'âge ont été notés au cours de la première période de prélèvement. La longueur moyenne des alevins échantillonnés a augmenté considérablement pendant la durée de l'étude.

Les échappées de cohos qui ont atteint Black Creek en 1992 ont été contrôlées à l'aide d'une barrière de comptage des adultes exploitée du 20 octobre au 8 décembre de même que par marquage-recapture, dénombrement des carcasses et relevés visuels par la méthode de la surface sous la courbe réalisés en amont de la barrière du 26 octobre au 14 décembre. La valeur des échappées d'adultes et de jeunes mâles a été estimée à l'aide de quatre méthodes: 1) une estimation de Petersen des valeurs regroupées; 2) une estimation itérative de Darroch (adultes); 3) la méthode de la surface sous la courbe et 4) le nombre minimum (connu) de poissons en amont de la barrière de comptage. Dans le cas des adultes, l'estimation des données regroupées de Petersen (1 720) et celle de la méthode itérative de Darroch (1 721) étaient presque identiques; l'estimation par la surface sous la courbe était légèrement inférieure (1 702) mais supérieure au nombre minimum connu d'adultes présents (1 670). Dans le cas des jeunes mâles, l'estimation de Petersen (2 348) était de beaucoup supérieure à celle de la méthode de la surface sous la courbe (546) et au nombre minimum connu (1 645). Les longueurs moyennes post-orbitaire - hypural des mâles adultes, des femelles adultes et des jeunes mâles étaient, respectivement, de 46,6, 51,4 et 29,5 cm. Les femelles étaient plus grosses que les mâles adultes. Les mâles adultes étaient beaucoup plus nombreux que les femelles, le nombre total de mâles adultes (et de jeunes mâles) étant au moins trois fois plus important que celui des femelles. Les adultes et les jeunes mâles étaient surtout représentés par des poissons ayant passé un an en eau douce (respectivement de 91,2 % et 83,8 %). Le rapport entre les saumoneaux et les jeunes mâles était plus élevé pour les gros saumoneaux qui avaient migré au début de la période de migration des saumoneaux.

INTRODUCTION

This report presents results of the coho salmon (*Oncorhynchus kisutch*) smolt enumeration and coded-wire tagging study, and summarizes the adult coho fence count, upstream mark-recapture, and area-under-the-curve (AUC) escapement studies at Black Creek in 1992. The main objectives of the program were to:

- 1) describe the size and age distribution of the coho smolts leaving Black Creek;
- 2) insert full-length coded-wire tags (CWTs) into coho smolts and half-length CWTs into emigrant coho fry;
- 3) obtain results required to examine the relationships between physical environmental factors and smolt and adult migration; smolt migration timing and size and subsequent oceanic harvest distribution; and adult escapement and smolt production;
- 4) estimate numbers of returning salmon and to collect coded-wire tagged heads from these fish; and
- 5) collect data on length, sex, maturity, and age at return.

Achieving these objectives involved the operation of fences to monitor the downstream migration of juvenile salmonids and the upstream movement of maturing salmon, counting all migrants, sampling lengths, weights, and ages of coho, and coded-wire tagging of as large a portion of the coho smolts and emigrant fry as possible. All smolt data were stratified into the three predetermined sampling periods used in Nelson et al. (1994), the selection of which was based on data provided in Fielden et al. (1989), Bocking et al. (1991), and Nass et al. (1993a) to characterize the various phases of seaward migration.

STUDY STREAM

Black Creek is a low-gradient (approximately 0.6%) stream on the east coast of Vancouver Island, B.C. (Figure 1). The system is approximately 26 km long, 5-6 m wide in its middle reaches, and has a catchment area of 72.5 km². For most of its length it meanders through agricultural land, small lakes, swampy areas, and

beaver ponds. In the lower watershed, there are several tributaries including Millar Creek. Maximum discharges of $50\text{-}60\text{ m}^3\cdot\text{s}^{-1}$ have been estimated during floods. Black Creek supports populations of coho salmon, cutthroat trout (*O. clarki*), and steelhead trout (*O. mykiss*). Annual escapement estimates for coho are highly variable, ranging from as low as 749 adult spawners in 1987 to 15,000 in earlier years (Hancock and Marshall 1985; Clark and Irvine 1989; Labelle 1990). Coho spawn throughout the watershed, but the best spawning grounds are in Millar Creek, in mainstem areas adjacent to the Sturgess Road Bridge, and in the upper reaches in the vicinity of the Duncan Main logging road (Figure 1). Since 1978, and in those years when it was surveyed, the estimated coho smolt production from Black Creek has varied from a low of 29,776 in 1989 (Bocking et al. 1991) to 119,602 in 1990 (Nass et al. 1993a).

The juvenile and adult fish counting fences were located downstream of the Seaview Road bridge, in Miracle Beach Provincial Park. This location is above tidal influence. For upstream mark-recapture and AUC escapement surveys, the watershed was subdivided into six strata which contained 13 index reaches, each 250 m long (Irvine et al. 1992) (Figure 1). The locations of stratum boundaries were determined by tributary confluences and/or major transitions in stream gradient or some other habitat characteristic, and the index reaches were selected to be representative of the habitat within their stratum.

SPRING FIELD STUDIES

METHODS

Fence Operations

The Black Creek smolt fence was constructed according to methods described by Conlin and Tutty (1979) using wooden-framed panels screened with 6.4 mm mesh steel hardware cloth. It was installed and operated as per Bocking et al. (1991), and Nass et al. (1993a). Plywood holding boxes with Vexar-screened windows to allow water exchange were anchored downstream of the fence to hold sorted fish from the trap boxes. The Black Creek smolt fence and holding facilities were operated continuously from April 13 to June 18, 1992. The fence was maintained at 100% efficiency during this period, as there were no flood or other events during the period that would allow fish to pass undetected. Fry traps (1 mm mesh), similar to those used by Northcote (1969), were operated

between the fence and the stream margins to monitor upstream movements of coho fry. A broomstick trap was also operated to capture upstream-migrating adult fish.

Biophysical Monitoring

Maximum, minimum, and present water temperatures ($\pm 0.5^\circ \text{C}$) were recorded daily at the counting fence between 0800 and 0900 h using a max-min thermometer. Water levels were recorded daily using two staff gauges. The downstream gauge ("Gauge 1" in Appendices A and D) was located beneath the Seaview Road Bridge; the upstream gauge ("Gauge 2" in Appendices A and D) was located approximately 200 m upstream from the Seaview Road bridge, outside the influence of the counting fences.

Weather conditions were monitored daily. Precipitation was ranked on a scale of 0 to 5 with 0 being no precipitation and 5 being heavy precipitation. Percentage cloud cover, wind direction, and wind speed were also noted.

In addition to the daily biophysical measurements recorded by technicians during fence operation, water stage and water temperature were recorded automatically every three hours during the entire year using a Unidata 6003 datalogger. The datalogger was equipped with a Unidata 6508b hydrostatic pressure depth probe (0 to 3 m, ± 0.012 m) and a 6507a thermistor temperature sensor (-1.2 to 45°C , $\pm 0.2^\circ \text{C}$). The datalogger was installed beside the upstream staff gauge, well above the influence of the spring or fall counting fences. Pressure depth probe readings were highly correlated with readings from the adjacent staff gauge (Gauge 2), but the actual measurements differed. Output from the automated datalogger is presented in Figure 2, which illustrates the relationship of daily mean water levels and temperatures throughout 1992.

Trapping Efficiency

Mark-recapture trials were used to estimate the catch efficiency of the enumeration fence and trap boxes. In 1992, two groups of 100 smolts were anaesthetized using tricaine methane sulphonate (MS-222), given a unique caudal clip, and released between 100 and 200 m upstream of the fence. Throughout the entire trapping period, technicians monitored all smolts captured for recaptures from the trapping efficiency tests. All recaptures were recorded (recapture date, clip location), anaesthetized, adipose clipped, and coded-wire tagged (see **Coded-Wire Tagging** section) prior to release downstream of the fence.

Fish Counts

Each morning, all coho captured since the previous day were counted and sorted into groups based on their size. Coho smolts greater than 70 mm fork length were classified as either small (less than 120 mm in length) or large (greater than or equal to 120 mm in length). All coho less than or equal to 70 mm were categorized as fry. Any mortality due to capture, predation, holding, or tagging was recorded.

All non-coho fish migrating downstream were counted and released below the fence. We assumed that adult cutthroat or steelhead caught in the downstream traps were kelts (spawned out). All fin clips observed on non-coho species were recorded.

Biosampling

Random samples of up to 25 coho fry and 25 coho smolts were selected from each day's catch. These fish were anaesthetized in tricaine methane sulphonate (MS-222), measured to the nearest mm (fork length), and weighed using a Libra 65001 scale (± 0.1 g). Mean lengths and weights were calculated using random samples for all coho juveniles and stratified by age class and sampling period (Bocking et al. 1991; Nass et al. 1993a). Mean lengths and weights between consecutive sampling periods were compared for each age class using t-tests. A mean length and weight for the entire smolt population was calculated from random samples collected across all sampling periods.

Scale sampling procedures followed Ketchen's stratified method (Ricker 1975). During each sampling period (described below) we attempted to collect scale samples from 10 smolts in each 5 mm size class. Scale samples were not collected from coho fry. Smolts of the required sizes were selected from the catch to supplement the random samples when necessary. The calculated age-length distribution was used to determine the proportional representation of each age class within each sampling period; a chi-square test was used to detect differences between these proportions. Ages of smolts based on scale pattern analysis were reported using the European method of age designation, wherein age-1 smolts had one freshwater annulus, age-2 smolts had two freshwater annuli, etc. Scale samples were interpreted by personnel at the Department of Fisheries and Oceans Fish Ageing Laboratory in Nanaimo, B.C.

Coded-Wire Tagging

Coded-wire tagging was performed by experienced taggers using a Northwest Marine Technology Ltd. (NMT) Mark IV tag injector. An MS-222 bath was used to anaesthetize smolts prior to tagging. The baths were changed regularly and recovery basins were repeatedly flushed with fresh water. All tagged fish were adipose fin clipped.

Since 1988, Black Creek coho smolts have been tagged using different tag codes to differentiate subsequent recoveries by sampling period and size. In 1992, it was intended to apply sequential coded-wire tags and stratify the releases by sequence group; however, due to unforeseen circumstances, sequential tags were applied in conjunction with non-sequential tags, and the timing periods were disregarded. Tag codes were changed only when completely used. Smolts greater than or equal to 120 mm (large) and smolts less than or equal to 120 mm (small) were tagged with different codes. Other data were stratified by the sampling periods used in previous years (up to May 10, May 11-June 02, and June 03 on). The majority of large and small coho were sorted by hand prior to being anaesthetized, but smolts that were close to 120 mm were sorted (measured) while under anaesthesia. The smolts from one of the size categories were then tagged while the other size category was held in a separate holding pen for tagging later in the day. This latter group of smolts included a small number of smolts that were subjected to two anaesthetic baths. No differential mortality was observed between the two size categories over a 24-hour holding period.

In total, there were six different tag codes used for smolts at Black Creek. Coho fry were tagged with half-length CWTs, and the same tag code was used for fry tagging in all three sampling periods (Table 1). Tagging was done every day, except in a few instances when fish were held for two days before tagging. All tagged juveniles were transferred to a holding box and allowed to recover fully from the tagging operation before being released.

Tag Retention

There were seven 24-hour tag retention checks performed in 1992, five for smolts and two for fry. Wherever possible, 100 fish or more were used for a test.

Filament Tagging

In 1992, as part of a larger study, we began an evaluation of visual implant filament tags (produced by NMT Ltd.). Between 1 and 20 May, 1992, the fluorescent filament tags were injected into a group of adipose-clipped and CWT

(unique code) smolts; simultaneously, a second (control) group of smolts (approximately the same size and from the same population as the first group) was adipose-clipped and injected with a CWT (unique code) only. Smolts were not randomly assigned to treatments, however the tagging treatment was alternated daily, and the ratio of smolts greater than and less than 120 mm equalized across treatments on alternating days. Filament tags were injected while the fish were anaesthetized for fin clipping and CWT injection. Filament tags were implanted into adipose tissue of the eyelid immediately posterior to the eye, using a NMT Mark IV tag injector, equipped with a fixed needle, and operated in a manner similar to that for implanting CWTs in the cheek musculature of largemouth bass (Fletcher et al. 1987).

RESULTS

Biophysical Observations

Daily biophysical measurements are provided in Appendix A. Prior to fence installation, water levels were generally decreasing and water temperatures increasing (Figure 2). Following a substantial increase in water level in mid-April, water levels generally declined throughout the study, except during a freshet in late April and three smaller freshets in mid-May, late May, and mid-June (Figure 3). During the period of fence operation, water levels ranged from a maximum of 76 cm in mid-April to a minimum of 14 cm in early June; water temperatures ranged from a minimum of 6° C in late April to a maximum of 19° C in late May.

Trapping Efficiency

The trapping efficiency of the fence was tested twice (Table 2). On April 27, 100 coho smolts were upper caudal clipped and released upstream; a total of 90 of this release group were recaptured (90.0%). On May 12, 100 smolts were lower caudal clipped and released upstream; a total of 74 of this release group were recaptured (74.0%). Clipped fish from both trap efficiency tests were still being recovered late in the study (14 June and 15 June, respectively). It is likely that some of these clipped fish either residualized in the system or migrated after the last day of fence operation; therefore, the percentages recovered underestimate trapping efficiency.

Fish Counts

Coho Smolts

Total daily catches of juvenile coho are provided in Appendix B. A total of 50,271 coho smolts were counted at the Black Creek fence between April 13 and June 18 (Table 3). During this period, there were 88 pre-tagging mortalities (0.17%) and 58 smolts (0.12%) which either escaped during handling or were released untagged due to injury or poor condition.

Coho smolts migrated from Black Creek in 1992 in numerous pulses (Figure 4). Peak modal catches were made on April 17 (2,161), April 30 (3,389), and May 13 (3,859). Large coho (greater than 120 mm fork length) comprised 58.7% of the population. The period of fence operation appeared to cover most of the migration, although some smolts were still leaving the system when the fence operation ended.

Coho Fry

Daily catches of coho fry are given in Appendix B. A total of 3,091 downstream-migrating coho fry were caught at the fence during the study. Peak daily catches occurred on April 20 (329) and June 16 (565) (Figure 5). A total of 257 upstream-migrating coho fry were captured in the fry traps below the fence; all were released above the fence.

Other Species

Daily catches of non-coho are presented in Appendix C and summarized in Table 4. Cottids were the most numerous non-coho captured. Stickleback, lamprey, steelhead smolts, cutthroat trout smolts, and both wild and hatchery cutthroat trout kelts were also encountered regularly. No upstream-migrating fish were captured in the broomstick trap in 1992.

Biosampling

Age

The calculated age-length distribution for wild coho smolts leaving Black Creek is given in Table 5. Age sample data (X) includes non-random samples; the calculated age representation (Y) is based on random sampling. The calculated freshwater age structure of Black Creek smolts was 91.2% age 1, 8.5% age 2, and 0.1% age 3. The proportional representation of migrating age-2 smolts during the entire study period was highest (67.6%) during the first sampling period.

When compared over the three sampling periods, the age ratio of age 1:age 2 changed from 7.4:1 in period 1, to 19.0:1 in period 2, and to 12.7:1 in period 3; the differences among these age ratios were significant ($\chi^2 = 19.2$, $df = 2$, $P < 0.001$). No scale samples were taken from fry, but it is assumed that all fry were age 0+.

Length and Weight

The mean fork-length of the Black Creek coho smolt population was 126.7 mm and the mean weight was 18.88 g (Table 6). Individual length and weight measurements and the means of these measurements appeared to be normally distributed within sampling periods. Age-1 smolts were significantly smaller (length and weight; t-tests, $P < 0.001$) during the third period than in the first. There was only one age-3 smolt identified in the random samples; five additional age-3 smolts were identified from non-random sampling. All six age-3 smolts were collected during the first sampling period. The length-frequency distribution of successfully aged smolts is presented in Figure 6.

The mean length and weight of all fry sampled from the fence (moving downstream) was 48.9 mm and 1.20 g, respectively. Mean lengths increased during the study:

Mean Lengths and Standard Deviations (mm) of Sampled Coho Fry

	<u>n</u>	<u>Mean</u>	<u>SD</u>
Period 1	569	42.0	4.36
Period 2	378	55.7	5.66
Period 3	147	58.0	4.64

A comparison of the mean lengths of sampled fry between sampling periods found significant differences between Period 1 and Period 2 (t-test, $P < 0.001$) and between Period 2 and Period 3 (t-test, $P < 0.001$).

Coded-Wire Tagging

Coded-Wire Tag Releases

A total of 50,125 coho smolts were coded-wire tagged using six distinct codes. Of these tagged smolts, there were 52 known tagging-related mortalities (Table 1). A total of 2,956 coho fry were tagged with half-length tags, all of which were the same code. Of these tagged fry, there were 34 known tagging-related mortalities.

Tag Retention

Tag retention tests were performed five times on coho smolts and two times on coho fry (all 24-h tests; Table 7). Mean tag retention rates were 99.6% for smolts and 98.0% for fry.

Filament Tagging

Included in the total number of smolts released tagged (50,073) were two unique groups of CWT smolts for inclusion in the filament tagging project. In addition to an adipose clip and CWT, smolts from the first group (9,870 smolts released tagged) were also injected with a filament tag. Smolts from the second group ("control" group; 10,277 smolts released tagged) received an adipose clip and CWT only (Table 1).

FALL FIELD STUDIES

METHODS

Biophysical Monitoring

Biophysical conditions were monitored and recorded as described in the earlier section of the report, Spring Field Studies.

Coho Population Estimates

Counting Fence Operations

A collapsible adult counting fence was installed (Figure 1) prior to the first fall rains according to the methods and designs described in Labelle (1990) and Bocking et al. (1992). The fence was composed of a series of wood-frame panels with aluminum tube (2.5 cm diameter) insets spaced 2.5 cm apart. To increase the catch of small adult and jack (precocious male) coho, which were able to squeeze between the aluminum tubing, additional "jack panels" (mesh size 3 cm; Bocking et al. 1992) were placed on top of the main fence panels during low-flow and low-debris conditions. An aluminum-frame trap box was installed at each end of the fence; both trap boxes were operated when flows permitted.

Salmonids caught in the trap boxes at the counting fence were counted and the majority released upstream (a sample of adipose-clipped jacks was sacrificed for coded-wire tag recovery). All coho were classified as adult or jack, and the sex of each fish was recorded. All fin clips were recorded and degrees of maturity estimated (Bocking et al. 1992; Nass et al. 1993b). The orbital region of adipose-clipped jacks was illuminated using a hand-held ultraviolet light and examined for the presence of a fluorescent filament tag. Any mortalities at the fence, either naturally occurring or due to handling, were recorded. All coho released upstream were given a uniquely numbered Ketchum No. 1 operculum tag². Operculum tags were applied to fish during transfer to a canvas cradle where fish were sampled for length and scales. All coho released upstream without a tag (escaped prior to tag application) were also recorded.

Mark-Recapture

In this report we refer to fish with operculum tags as tagged fish and adipose-clipped fish (fish that had been previously coded-wire tagged) as marked fish. Live coho were recovered upstream throughout the escapement period using electrofishing equipment. Most electrofishing surveys were conducted by blocking the downstream end of a recovery area with a small block net and then electrofishing the area. One person operated the block net, one person operated the electrofisher, and one person operated a dip net. The use of block nets greatly reduced the number of escaping coho.

All live untagged coho recovered upstream during surveys were also given a numbered operculum tag. Fish that had been previously operculum tagged but which had since lost their tag (identified by a tear on the operculum) were classified as primary recaptures. All operculum tags applied at the counting fence were classified as primary tags; tags applied to untagged fish upstream were classified as secondary tags. Recovery effort was conducted approximately in proportion to the distribution of coho in the river as determined from the AUC stream walk surveys.

Mark recapture estimates of escapement were generated using the pooled Petersen method and an iterative Darroch model. Standard errors (and confidence intervals) around the pooled Petersen were calculated using the Chapman hypergeometric model as described in Seber (1982, p. 60). An iterative maximum likelihood method was used for the Darroch estimate using initial values computed using least squares (Arnason et al., in prep). For adult coho, there were three temporal release strata (20-26 October, 30 October-6 November, and 7-23 November) and two recovery strata (16-26 November and 1-4 December).

² Ketchum Manufacturing Sales Ltd., 396 Berkley Ave., Ottawa, Ont., Canada, K2A 2G6

All coho captured during mark-recapture surveys were examined for operculum tags and/or evidence of tag loss. Tag loss was recorded when clear evidence of tearing, due to the former presence of an operculum tag, was observed. The tear usually appeared as a straight slit in the operculum, approximately 0.5 cm in length.

Area-Under-The-Curve (AUC)

AUC escapement estimates were calculated by obtaining periodic fish population estimates, plotting these against time, and then dividing the area under these curves expressed in fish-day units by the length of time (days) fish were estimated to be alive in the areas surveyed. The first migration of fish past the enumeration fence occurred on October 20 and the last day living fish were in the system was assumed to be December 15. To obtain fish population estimates between these dates, five surveys were conducted at 13 index sites within six strata (Figure 1). An attempt was made to select index sites that included both good and marginal habitat for fish spawning and holding, and that were representative of the respective stratum as a whole (Irvine et al. 1992). Fish were counted by two observers walking upstream through each 250 m index site. The observers used wooden poles (2 m in length) to displace coho salmon hiding under cutbanks, rocks, and debris.

Five observer efficiency tests were conducted in 1992. Each test consisted of verifying the counts of a foot survey crew over a 250 m index reach with a separate electrofishing crew. These data were combined with observer efficiency measurements made at Black Creek during the previous five years. The number of fish observed (dependant variable) was assumed to be a function of the verified number of fish (counts from the electrofishing crew).

Fish populations were estimated using software described by Irvine et al. (1993) that followed the following procedure: 1) fish counts at each index site were corrected for observer efficiency; 2) the estimated mean fish density per survey site for each stratum and survey day was calculated; 3) the stratified mean density for each survey day was calculated; and 4) the stratified mean density was expanded to the stream length.

Residence time (survey life) is the average time in days that fish are present and alive in the survey area and are available to be counted by the surveyors. Residence time differs from stream life in that the latter includes time spent in other areas of the system where fish may hold but cannot be visually counted (e.g. Northy Lake, Figure 1). To estimate residence time, two groups of fish were

tagged (within 24- and 26-hour periods, respectively) with Petersen disk tags³ (as well as operculum tags) at the counting fence and released upstream (100 orange tags applied October 23-24; 102 blue tags applied October 30-31). Coho tagged with Petersen disk tags were subsequently observed and recorded on upstream foot surveys, and those counts were expanded and graphed to produce both total and observed tag curves, and subsequent estimates of residence time (English et al. 1992).

Age, Length, and Sex Composition

All live coho captured at the fence and during upstream surveys were measured for postorbital-hypural length and examined for fin clips, sex (adult males, females, and jacks), and maturity. Adult males and jacks were differentiated by a length delimiter of 35 cm (Bocking et al. 1992). Scale samples (Henry 1961) were taken from random captures of "new" coho (not previously handled), both at the fence and upstream. Ages based on scale pattern analysis were reported using the European (decimal) method of age designation (e.g., 2.1), wherein the first number is the number of freshwater annuli and the second number is the number of marine annuli. Scale samples were interpreted by personnel at the Department of Fisheries and Oceans Fish Ageing Laboratory in Nanaimo, B.C.

During upstream surveys, only new coho (previously untagged) were sampled for age, length, and sex. Maturities were recorded for both newly captured coho and for recaptured fish. Sex ratios were calculated from the total recovery sample of new live fish (fence and upstream). In 1992, average lengths were calculated for all new live recoveries (pooled sample of both fence and upstream recoveries) and were stratified by sex and age (adult or jack). Separate average lengths (fence and upstream) were not calculated in 1992 because of the low number of new fish recovered upstream.

Coded-Wire Tag Recoveries

Adult and jack coho carcasses recovered were counted and the date and location of recovery, operculum tag number (if tagged), length, and any fin clips were recorded. Heads were removed from adipose-clipped carcasses, labelled with a unique number (E-label), and individually wrapped, and frozen. Data recorded for each carcass included date, recovery location, sex, length, maturity, any tag numbers, and other fin clips. Once counted, all carcasses were cut in half to

³ Floy Tag and Manufacturing Co. Inc., 4616 Union Bay Place N.E., Seattle, WA 98105 USA

prevent re-sampling during future surveys. Frozen heads were transferred to J. O. Thomas and Associates, Vancouver, B.C., where coded-wire tags were removed and decoded.

To determine the contribution of marked smolts from the 1991 and 1992 smolt emigrations to the 1992 escapement we used the three-step process described in Bocking (1991) and Bocking et al. (1990). Assuming that the survival of unmarked fish was equal to or greater than that of marked fish, this method estimates the minimum contribution of each tag code to the escapement.

Adipose-clipped adult males, adult females, and jacks were counted separately. The estimates of total escapement of adipose-clipped coho was based on the pooled Petersen population estimate of adults and jacks. The population estimate for all adult coho was apportioned into separate male and female population estimates using the calculated sex ratio observed in the total live recovery of new fish. Given an estimate of the total number of adipose clips for each sex and cohort escaping to the stream, the number of adipose clips for each tag code was estimated by the allocation of adipose clips to tag codes based on their relative frequency in the sample of decoded tags.

RESULTS

Biophysical Monitoring

Daily biophysical measurements are provided in Appendix D. Mean daily water temperatures and water levels during the period of fence operation are presented in Figure 7. Daily water temperatures ranged from 12.0° C in late-October to 1.0° C in early December. Water levels increased steadily from mid- to late October, dropped through mid-November, rose sharply to flood levels on November 21, and then stabilized through mid-December.

Coho Population Estimates

Counting Fence

A summary of fence counts and associated operculum tag release data is provided in Appendix E. Although water levels reached flood stage on November 21, crews were able to keep the fence intact and in the vertical position. Although water levels at the fence reached within a few centimetres of the top of the fence panels, the fence was not topped by water (some fish may have jumped over the

panels at this time, but none were observed doing so, and the numbers would have been minimal). Jack panels were removed during the flood period. The fence was dropped on December 8 following a small pulse of coho ($n = 10$); we believe that this group was the final or close to the final pulse to occur in 1992.

Between October 20 and December 8, 1,670 adult and 1,676 jack coho were captured at the enumeration fence (Table 8). The daily numbers of adult and jack coho captured at the fence are illustrated in Figure 8. Upstream migration peaked on 31 October for adults and October 23 for jacks. Of all coho captured at the fence, a total of two adults⁴ and 79 jacks were sacrificed for coded-wire tag recovery, and an additional three adults escaped untagged during handling; the remaining adults ($n = 1665$) and jacks ($n = 1597$) were tagged with an operculum tag and released upstream.

Mark-Recapture

A summary of mark-recapture data is provided in Appendix F. Upstream mark-recapture surveys were conducted between October 26 and December 14 (Table 9). A total of 189 live adult coho and 98 live jack coho were examined upstream, of which 183 adults and 67 jacks were primary recaptures (tagged at the fence). Primary recaptures included fish that had lost the operculum tag. Tag loss rates for primary recaptures of adults and jacks were 30.1% and 18.4%, respectively. Tag loss may have resulted from improper attachment of the tag to the operculum, and tags becoming entangled in root wads and other debris and being torn off by the fish as it freed itself from the debris.

The various population estimates (including the minimum escapement estimate) are presented in Table 10. The minimum (known) escapement estimates of adult and jack coho above the enumeration fence in 1992 are 1,670 and 1,645, respectively. The minimum escapement estimates are the number of adult and jack coho released at the fence (does not include sacrifices) plus the number of "new" fish (untagged and no tag loss) handled upstream (in both the mark-recapture and carcass surveys; see Appendices F and G).

For adult coho, the pooled Petersen estimate (1,720) and the iterative Darroch estimate (1,721) were almost identical; the AUC estimate for adults (1,702) was slightly lower than these estimates. For jack coho, the pooled Petersen estimate (2,348) was substantially higher than the AUC estimate (546).

⁴ The two adults sacrificed at the fence were both males less than 35 cm in length and were believed to be jacks; successful decoding of the coded-wire tags from these individuals revealed that they were in fact adult coho.

It was not possible to produce an admissible Darroch estimate for jacks without pooling all release strata information.

Stream life estimates, stratified by age and sex, are provided in Table 11, and individual stream life values are presented in Appendix H. Adult stream life ranged from 16-40 d and jack stream life ranged from 13-35 d. Average stream life for jacks (28 d) was close to that for adult males (30 d). Average stream life for females was 20 d. Stream life data for Black Creek coho have been used in some previous years to generate escapement estimates using an open model (Labelle 1994). Stream life data were not used in 1992 to estimate escapement but are included in this report to be consistent with reports from previous years.

Area-Under-The-Curve

When the untransformed observer efficiency data were examined, there was increasing variability in the proportion of fish seen at higher densities, and the residuals were found to have a heteroscedastic distribution. The natural logarithmic transformation [$\ln(\text{number of fish} + 1)$] improved this situation and, therefore, regression parameters calculated on transformed data (Table 12) were used to expand the visual survey fish count data.

Estimates of residence time ranged between 8.1 and 13.2 days (Table 13). English et al. (1992) found estimates generated using the total tag curve method were more robust than estimates generated using the observed tag curve method. The residence time value used to generate AUC escapement estimates (12.94 d) was the mean of the total residence time estimates generated using the two tag colours. Figure 9 illustrates the escapement curve derived from the visual surveys conducted in index sites (adult coho only). The escapement estimates for adult and jack coho were 1,702 and 546, respectively.

Age, Length, and Sex Composition

Figure 10 illustrates the length-frequency distribution of the escapement based on all live recoveries of new fish (fence plus upstream). Adult males ranged in size from 28-66 cm, ($\bar{x} = 46.6$ cm), females ranged from 34-67 cm ($\bar{x} = 51.4$ cm), and jacks ranged from 18-34 cm ($\bar{x} = 29.5$ cm) (Table 14). Females were significantly larger than adult males (t-test, $P < 0.001$). For 1992, we did not calculate and compare mean lengths for new coho captured at the fence and during upstream recoveries because of the low number of new fish captured during upstream surveys.

The total count of adult male coho ($n = 881$) was greater than the total count of female coho ($n = 793$) and the difference was significant (χ^2 , $P < 0.05$).

When adult and jack males were combined, the total number of all male coho (2,587) outnumbered females by more than three to one (Table 15).

The freshwater age distributions of the coho escapement are shown in Table 16. There were 182 scale samples aged successfully; however, all scale samples taken were resorbed to some extent. Results from the scale ageing analysis indicate that most returning adults (91.2%) spent one year in freshwater, as did the majority of the jacks (83.8%).

Coded-Wire Tag Recoveries

A total of 1,481 adipose-clipped adult coho and 1,354 adipose-clipped jacks were observed among the total number of new fish that we handled at the fence and upstream (sacrifices included; Table 17). Based on the calculated mark rates observed in the total live recovery of new fish, (and pooled Petersen population estimate of fish above the fence), we estimate that 88.5% (1,522) of returning adults and 79.4% (1,864) of returning jacks were adipose clipped in 1992.

The percentage of smolts tagged in the springs of 1991 and 1992 that were recovered in the respective 1992 escapements of adult and jack coho varied among the tagging dates (Table 18). The total percentage of smolts tagged in 1991 that escaped to Black Creek as adults in 1992 was 2.86%. The total percentage of smolts tagged in 1992 that escaped to Black Creek as jacks in 1992 was 3.72%. A high proportion of the total smolt-to-jack escapement (9.76%) was observed for large smolts (greater than 120 mm) that migrated during April in 1992.

Filament Tag Recoveries

Eighty-four filament tagged jacks (all new fish) were observed during the fall field program (81 during fence operations, two during live recapture upstream, and one as a carcass). From CWT decoding, we estimate that 197 filament tagged jacks escaped to Black Creek (tag code 081011, Table 18).

DISCUSSION

The 1992 spring field studies at Black Creek were very successful. CWT releases of coho smolts totalled 50,073; this number was 99.6% of the total

number of smolts observed at the enumeration fence (50,271). The period of fence operation appeared to cover a very high proportion of the smolt migration, and the fence was maintained (no floods) during 100% of the period of operation.

In general, migrating smolts were in good condition in 1992; the mean length (126.7 mm) of sampled smolts was high in comparison with previous years (58.7% of the smolts sampled were greater than or equal to 120 mm). Mortalities due to trapping and tagging were low for smolts (0.28%). Coho fry were unusually abundant at the enumeration fence in 1992. A total of 3,091 fry were caught at the fence, of which 2,919 (94.4%) were released tagged. Tag loss for fry was less than 2.0%, and mortalities due to trapping and tagging were notable (4.7%).

The 1992 fall field studies at Black Creek were also very successful. The minimum (known) numbers of adult and jack coho above the counting fence accounted for 97.1% and 70.1%, respectively, of the pooled Petersen escapement estimates. These figures indicate that the majority of the returning fish were counted and sampled for sex, length, and adipose-clip status. The above-fence escapement estimate (pooled Petersen) for all coho in 1992 was 4,068, of which 1,720 were adults (42%) and 2,348 were jacks (58%).

The AUC escapement estimate for adults was within 1.0% of the pooled Petersen estimate for adults. The AUC estimate for jacks was much less than the respective pooled Petersen estimate; AUC escapement estimates for jacks have been low in most previous years (Irvine et al. 1992). We may have overestimated the efficiency of observing jacks which would result in an insufficient expansion of the data and produce a consistent low bias in the escapement estimates for jacks. In addition, we have always assumed that the residence time for jacks was the same as for adults, and this is probably not a valid assumption.

We statistically tested for differences in length between adult male and female coho and found females to be significantly longer. This is consistent with previous studies at Black Creek (Bocking et al. 1992; Nass et al. 1993b; Nelson et al. 1994). In the field, all male coho greater than or equal to 35 mm in length (postorbital-hypural) were classified as adult males. The 35 cm length was determined by analyzing the lengths of successfully decoded (CWT) returning coho. There were three confirmed (by successfully decoded CWTs) adult males collected in 1992 that were under 35 cm in length.

We calculated the percentage of migrating smolts in 1991 and 1992 which returned to spawn as adults or jacks in 1992, respectively, by dividing the estimated escapement of adipose clips, stratified by sex, by the number of smolts tagged (adipose clipped) and released in the respective migrating year. The number of smolts tagged and released in 1991 and 1992 was 53,284 and 50,073,

respectively. The estimated adult escapement of adipose clips (pooled Petersen estimate, $n = 1,522$) represented 2.86% of the smolts released in 1991. The estimated jack escapement of adipose clips ($n = 1,864$) represented 3.72% of the smolts released in 1992.

It is likely that some smolts migrated prior to the first day of fence operation, and that some smolts were downstream of the fence site when the fence was erected. The difference in the mark rate at release in 1992 (99.9%) and the mark rate of jacks at return in 1992 (79.4%) suggests that a substantial number of smolts or fry migrated from system before and/or after the period of fence operation, or that significant straying occurred from unmarked stocks.

Data for jacks at Black Creek in 1992 indicate that smolts greater than 120 mm in length were more likely to return as jacks than were smaller smolts, and this likelihood was most pronounced at the beginning of the smolt migration. This observation is consistent with previous studies at Black Creek.

1992 was the eighth consecutive year that Black Creek coho smolts were counted and coded-wire tagged and accurate escapement estimates were obtained. As the primary indicator for wild coho in the Strait of Georgia, data from this study form an integral part of the coho stock assessment process. Our knowledge of the production dynamics and spawning escapement requirements of coho increased considerably with the collection of information in 1992.

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TABLES

Table 1. Coded-wire tag release data for Black Creek juvenile coho, by size group, 1992.

Size group ¹	Tag code	Tagging dates	Number tagged	Tag morts	Number released tagged ²	Number released untagged ³
<u>Small</u>						
	081007	04/13 - 06/13	8352	1	8351	5
	081832 ⁴	05/16 - 06/18	1798	7	1791	6
		Subtotal	10150	8	10142	11
<u>Large</u>						
	081008	04/13 - 04/29	9553	4	9549	15
	081009	04/30 - 06/13	8770	7	8763	5
	081833 ⁴	05/16 - 06/18	1475	3	1472	14
		Subtotal	19798	14	19784	34
<u>Small and large (filament program)</u>						
	081010 ⁵	05/01 - 05/20	10287	10	10277	9
	081011 ⁶	05/01 - 05/20	9890	20	9870	4
		Subtotal	20177	30	20147	13
		Grand total (smolts)	50125	52	50073	58
<u>Fry</u>						
	201010213	04/13 - 06/18	2956	34	2919	23

¹small is < 120 mm; large is > = 120 mm

²not corrected for tag loss; total tag loss was 0.437% for smolts and 1.980% for fry (see Table 7)

³No. released untagged = known escapees + fish released due to poor condition

⁴sequential CWTs

⁵control group (CWT only)

⁶filament group (CWT + filament)

Table 2. Results of trap efficiency tests conducted at Black Creek, 1992.

Date of release	Number smolts released	Fin clip	Number recovered	Date of last recovery	Percent recovered
04/27	100	upper caudal	90	06/14	90.0
05/12	100	lower caudal	74	06/15	74.0

Table 3. Coho smolt catches by tagging period at Black Creek, 1992. Mortalities include smolts killed by trapping and predation.

Sampling period	Smolt size ¹		Total (S + L)	Pre-tagging mortalities	Number released untagged ²	Number available for tagging
	Small	Large				
04/13 - 05/10	6611	18675	25286	52	18	25216
05/11 - 06/02	13847	10417	24264	26	20	24218
06/03 - 06/18	326	395	721	10	20	691
Total	20784	29487	50271	88	58	50125

¹small is < 120 mm; large is > = 120 mm

²Number released untagged = known escapees + fish released due to poor condition

Table 4. Total number of non-coho fish caught at the Black Creek smolt enumeration fence, April - June 1992. All fish captured were moving downstream.

Species	Life stage ¹	Total number caught
Steelhead	smolt (W)	269
	kelt (W)	5
Cutthroat	fry	59
	parr	14
	smolt (W)	200
	adult (W)	2
	kelt (H)	58
	kelt (W)	37
Cottids	-	722
Lamprey	-	40
Stickleback	-	248

¹H = hatchery (fin clip observed); W = wild (no clips observed)

Table 5. Age-length distribution of Black Creek coho smolts, by sampling period, 1992. Age representation was determined according to Ketchen's stratified subsampling method (Ricker 1975, p. 67).

Sampling period	Size class (mm)	Age sample (X)	Age groups in (X)			Length sample (Y)	Calculated age representation in (Y)		
			1	2	3		1	2	3
<u>04/13 - 05/10</u>									
	< 80	0	0	0	0	1	0.0	0.0	0.0
	80-84	1	1	0	0	1	1.0	0.0	0.0
	85-89	1	1	0	0	2	2.0	0.0	0.0
	90-94	2	2	0	0	2	2.0	0.0	0.0
	95-99	2	2	0	0	2	2.0	0.0	0.0
	100-104	11	11	0	0	14	14.0	0.0	0.0
	105-109	8	7	1	0	37	32.4	4.6	0.0
	110-114	6	6	0	0	57	57.0	0.0	0.0
	115-119	10	7	3	0	81	56.7	24.3	0.0
	120-124	11	10	1	0	98	89.1	8.9	0.0
	125-129	9	9	0	0	92	92.0	0.0	0.0
	130-134	9	8	1	0	92	81.8	10.2	0.0
	135-139	8	8	0	0	57	57.0	0.0	0.0
	140-144	10	10	0	0	50	50.0	0.0	0.0
	145-149	7	4	3	0	32	18.3	13.7	0.0
	150-154	6	5	1	0	19	15.8	3.2	0.0
	155-159	5	3	2	0	15	9.0	6.0	0.0
	160-164	8	4	4	0	14	7.0	7.0	0.0
	> = 165	41	28	7	6	19	13.0	3.2	2.8
	Total	155	126	23	6	685	600	81	3
<u>05/11 - 06/02</u>									
	< 80	0	0	0	0	1	0.0	0.0	0.0
	80-84	1	1	0	0	0	0.0	0.0	0.0
	85-89	1	1	0	0	1	1.0	0.0	0.0
	90-94	8	8	0	0	11	11.0	0.0	0.0
	95-99	8	8	0	0	21	21.0	0.0	0.0
	100-104	10	10	0	0	50	50.0	0.0	0.0
	105-109	9	9	0	0	88	88.0	0.0	0.0
	110-114	6	5	1	0	98	81.7	16.3	0.0
	115-119	9	9	0	0	75	75.0	0.0	0.0
	120-124	7	7	0	0	55	55.0	0.0	0.0
	125-129	11	10	1	0	50	45.5	4.5	0.0
	130-134	6	6	0	0	37	37.0	0.0	0.0
	135-139	9	8	1	0	26	23.1	2.9	0.0
	140-144	7	7	0	0	18	18.0	0.0	0.0
	145-149	8	8	0	0	16	16.0	0.0	0.0
	150-154	8	7	1	0	10	8.8	1.3	0.0
	155-159	2	2	0	0	1	1.0	0.0	0.0
	160-164	1	0	1	0	2	0.0	2.0	0.0
	> = 165	1	0	1	0	1	0.0	1.0	0.0
	Total	112	106	6	0	561	532	28	0

Table 5. Age-length distribution of Black Creek coho smolts, by sampling period, 1992. Age (cont.) representation was determined according to Ketchen's stratified subsampling method (Ricker 1975, p. 67).

Sampling period	Size class (mm)	Age sample (X)	Age groups in (X)			Length sample (Y)	Calculated age representation in (Y)		
			1	2	3		1	2	3
<u>06/18 - 06/24</u>									
	< 80	0	0	0	0	0	0.0	0.0	0.0
	80-84	0	0	0	0	0	0.0	0.0	0.0
	85-89	0	0	0	0	0	0.0	0.0	0.0
	90-94	2	2	0	0	0	0.0	0.0	0.0
	95-99	3	3	0	0	6	6.0	0.0	0.0
	100-104	5	5	0	0	10	10.0	0.0	0.0
	105-109	11	11	0	0	25	25.0	0.0	0.0
	110-114	9	9	0	0	26	26.0	0.0	0.0
	115-119	7	7	0	0	23	23.0	0.0	0.0
	120-124	7	6	1	0	27	23.1	3.9	0.0
	125-129	9	7	2	0	33	25.7	7.3	0.0
	130-134	8	8	0	0	24	24.0	0.0	0.0
	135-139	9	9	0	0	15	15.0	0.0	0.0
	140-144	10	10	0	0	15	15.0	0.0	0.0
	145-149	4	4	0	0	5	5.0	0.0	0.0
	150-154	2	2	0	0	2	2.0	0.0	0.0
	155-159	1	1	0	0	2	2.0	0.0	0.0
	160-164	2	0	2	0	3	0.0	3.0	0.0
	> = 165	2	1	1	0	3	1.5	1.5	0.0
	Total	91	85	6	0	219	203	16	0
	Grand total	358	317	35	6	1465	1335	125	3

(X) = random and non-random samples

(Y) = random samples only

Table 6. Means and standard deviations for lengths and weights of Black Creek smolts, by age and sampling period, 1992. Data from successfully aged random samples only.

Age	Sampling period	Fork length (mm)			Weight (g)		
		N	Mean	SD	N	Mean	SD
1	04/13 - 05/10	101	127.0	20.4	101	19.37	10.65
	05/11 - 06/02	103	120.2	19.0	103	17.34	7.91
	06/03 - 06/18	81	124.3	16.6	81	17.18	7.32
	Total age-1 ¹	285	123.8	19.0	285	18.01	8.86
2	04/13 - 05/10	23	151.6	22.1	23	23.70	21.26
	05/11 - 06/02	6	142.2	21.6	6	27.17	11.00
	06/03 - 06/18	5	149.0	22.7	5	29.66	12.26
	Total age-2 ¹	34	149.6	23.6	34	25.19	18.40
3	04/13 - 05/10	1	171.0	0.0	1	49.80	0.00
	05/11 - 06/02	0	-	-	0	-	-
	06/03 - 06/18	0	-	-	0	-	-
	Total age-3 ²	1	171.0	0.0	1	49.80	0.00
Grand total (all ages)		320	126.7	21.0	320	18.88	10.64

¹ total means and standard deviations are calculated from pooled data across sampling periods

² total means and standard deviations are calculated from pooled data from both age groups across sampling periods

Table 7. Coded-wire tag retention and loss rates for Black Creek juvenile coho, 1992.

Life stage	Date	Hours held	Sample size	Number tags lost	Tag retention (%)	Tag loss (%)
Smolts						
	04/21	24	100	0	100.0	0.000
	04/28	24	100	0	100.0	0.000
	05/07	24	132	0	100.0	0.000
	05/11	24	222	1	99.5	0.450
	05/09	24	132	2	98.5	1.515
		Total	686	3	99.6	0.437
Fry						
	04/21	24	100	3	97.0	3.000
	05/18	24	102	1	99.0	0.980
		Total	202	4	98.0	1.980

Table 8. Total number of coho captured and released at the Black Creek enumeration fence, 1992.

Category	Number captured	Number sacrificed for sampling	Number released		Total
			Tagged	Untagged	
Adults	1670	2	1665	3	1668
Jacks	1676	79	1597	0	1597

Table 9. Summary of foot survey and electrofishing efforts at Black Creek, by date and stratum, 1992.

Date	Stratum ¹	Method ²	Distance sampled (m)
10/26	A	FS	500
10/26	B	FS	500
10/26	C	FS	500
10/26	E	FS	500
10/27	D	FS	750
10/27	F	FS	500
11/10	E	FS	500
11/10	F	FS	500
11/11	D	FS	750
11/14	A	FS	500
11/14	B	FS	500
11/14	C	FS	500
11/15	E	FS	500
11/15	F	FS	500
11/16	C	EF	250
11/16	D	EF/FS	750
11/18	B	EF	250
11/18	C	EF	250
11/18	D	EF	250
11/25	F	EF	500
11/26	D	EF	750
12/01	F	EF	500
12/01	F	EF/FS	250
12/02	C	EF	250
12/02	D	EF/FS	250
12/03	A	FS	500
12/03	E	FS	500
12/03	F	FS	500
12/04	B	EF/FS	500
12/04	C	EF/FS	500
12/04	D	EF/FS	750
12/07	A	FS	500
12/07	E	FS	500
12/07	F	FS	500
12/14	C	EF/FS	250
12/14	D	EF/FS	250

¹ see Figure 1 for stratum locations²FS = foot survey; EF = electrofishing survey

Table 10. Escapement estimates for adult and jack coho for Black Creek, 1992.

Estimator	Category	N	Lower 95% CL	Upper 95% CL
<u>Pooled Petersen</u>				
	Adult	1720	1675	1765
	Jack	2348	2037	2659
<u>Iterative Darroch</u>				
	Adult	1721	1672	1762
	Jack	N/A	N/A	N/A
<u>AUC¹</u>				
	Adult	1702	N/A	N/A
	Jack	546	N/A	N/A
<u>Minimum (above fence)²</u>				
	Adult	1670	N/A	N/A
	Jack	1645	N/A	N/A

¹confidence limits not calculated for AUC because of non-random sampling

²the minimum (known) escapement above the fence is the number of fish released at the fence plus the number of new fish (untagged and no tag loss) handled upstream (both live and dead)

Table 11. Stream life values for coho salmon at Black Creek, November - December, 1992.

Category	Sex	n	Stream life (days)		
			Range	Mean	SD
Adult					
	Male	7	22-40	30	7.4
	Female	7	16-28	20	3.9
	Combined (M + F)	14	16-40	25	7.9
Jack					
	Male	7	13-35	28	8.3

Table 12. Parameters for linear and log-linear ($\ln + 1$) regressions between the number of adult or jack coho observed during visual surveys and the number seen or captured during electrofishing surveys conducted at Black Creek from 1987 - 1992.

Category	n ¹	Linear			Log-linear		
		Slope	Constant	r ²	Slope	Constant	r ²
Adults	45	0.887	-0.834	0.92	1.033	-0.327	0.90
Jacks	37	0.552	0.441	0.63	0.863	-0.151	0.72

¹n = the number of observer efficiency tests performed when at least one fish was seen or captured.

Table 13. Residence time (survey life) estimates, in days, for Black Creek coho, 1992.

	Orange tags	Blue tags	Mean
Total curve	13.2	12.6	12.9
Observed curve	11.2	8.1	9.7

Table 14. Summary of length data from new¹ live coho captured at the enumeration fence and upstream at Black Creek, 1992.

Category	Sample size			Length (cm) ²		
	Fence	Upstream	Total	Range	Mean	SD
Adult males	866	3	869	28 - 66	46.6	6.93
Females	783	1	784	34 - 67	51.4	5.51
Jacks	1619	30	1649	18 - 34	29.5	2.54

¹"new fish" are fish not previously handled at the enumeration fence and are identified by the absence of an operculum tag or tag scar

²postorbital-hypural length

Table 15. Sex ratios and chi-square results for new¹ live coho captured at the enumeration fence and upstream at Black Creek, 1992.

Adult males only				Adult males and jacks			
Number adult males	Number adult females	Ratio M:F	Chi- square	Number adult males and jacks	Number adult females	Ratio (M + J):F	Chi- square
881	793	1.11	4.52	2587	793	3.26	951.14

Note: critical value of chi square = 3.84 (df = 1) in all cases

¹"new fish" are fish not previously handled at the enumeration fence and are identified by the absence of an operculum tag or tag scar

Table 16. Freshwater age distribution of returning adult and jack coho at Black Creek, 1992, as determined from scale pattern analysis.

	Freshwater age						Total aged	Total sampled
	Adults			Jacks				
	1	2	Total	1	2	Total		
Number	93	9	102	67	13	80	182	312
Percent	91.2	8.8		83.8	16.3			

Table 17 Estimates of total escapement of adipose-clipped coho to Black Creek, 1992.

Category	Sample size ¹ (A)	Adipose clips ¹ (B)	Mark rate (%) (C = B/Ax100)	Population estimate ² (D)	Percent of population sampled (E = A/Dx100)	Total estimated adipose clips (F = B/AxD)
Male	881	762	86.5	905	97.3	783
Female	793	719	90.7	815	97.3	739
(M + F)	1674	1481	88.5	1720	97.3	1522
Jack	1706	1354	79.4	2348	72.7	1864
Total	3380	2835	83.9	4068	83.1	3412

¹from all new live fish handled at the fence and upstream; includes fish sacrificed at the fence

²population estimates from the pooled Petersen population model (Table 10); adult male and female estimates are derived using the adult male:female ratio in the live sample (composition was 52.6% adult male and 47.4% female)

Table 18. Contribution of 1991 and 1992 coho smolt migrations, by tag code and tagging dates, to the 1992 escapement to Black Creek.

1992 ADULTS																	
Smolt year	CWT code ¹	Tagging dates	Size at release (mm)	Decoded adipose clips			Estimated adipose clips ²			No. Smolts		Contribution to escapement			Smolt to 1992 adult ⁵ escapement (percent) ⁶		
				M	F	T	M	F	T ³	Clipped	Unclipped	M	F	T ⁴			
1991	081002	04/22 - 05/14	<120	8	1	9	174.0	37.0	211.0	9444	74	175	37	213	2.23		
	081004	05/15 - 05/19	<120	8	3	11	174.0	110.9	284.9	10552	4	174	111	285	2.70		
	081005	05/19 - 05/27	<120	7	3	10	152.3	110.9	263.1	10289	8	152	111	263	2.56		
	081006	05/28 - 06/24	<120	6	0	6	130.5	0.0	130.5	4022	8	131	0	131	3.24		
		Total			29	7	36	500.3	258.7	758.9	34307	94	633	259	892	2.59	
		081001	04/22 - 05/12	>= 120	2	8	10	43.5	295.6	339.1	9863	143	44	300	344	3.44	
		081003	05/13 - 06/24	>= 120	5	5	10	108.8	184.8	293.5	9114	15	109	185	294	3.22	
		Total			7	13	20	152.3	480.4	632.6	18977	158	153	485	638	3.33	
		Total decoded			36	20	56	0	783	739	1522	53284	252	786	744	1530	2.86
		Strays			0	0	0										
	No data			724	696	1420											
	No pin			2	4	6											
	Lost pin			0	0	0											
	Total observed			762	720	1482											

Table 18. Contribution of 1991 and 1992 coho smolt migrations, by tag code and tagging dates, to the 1992 escapement to Black Creek (cont.).

1992 JACKS															
Smolt year	CWT code	Tagging dates	Size at release (mm)	Decoded adipose clips			Estimated adipose clips ²			No. Smolts		Contribution to escapement			Smolt to 1992 jack escapement (percent) ⁶
				M	F	T	M	F	T ³	Clipped	Unclipped	M	F	T ⁴	
1992	081007	04/13 - 06/13	<120	3	0	3	53.8	0.0	53.8	8351	5	54	0	54	0.64
	081832	05/16 - 0/18	<120	0	0	0	0.0	0.0	0.0	1791	6	0	0	0	0.00
	Total			3	0	3	53.8	0.0	53.8	10142	11	53.8	0	53.8	0.53
	081008	04/13 - 04/29	>= 120	52	0	52	932.0	0.0	932.0	9549	15	933	0	933	9.76
	081009	04/30 - 06/18	>= 120	28	0	28	501.8	0.0	501.8	8763	5	502	0	502	5.73
	081833	05/16 - 06/18	>= 120	0	0	0	0.0	0.0	0.0	1472	14	0	0	0	0.00
	Total			80	0	80	1433.8	0.0	1433.8	19784	34	1436	0	1436	7.24
	081010	05/01 - 05/20	(all)	10	0	10	179.2	0.0	179.2	10277	9	179	0	179	1.74
	081011	05/01 - 05/20	(all)	11	0	11	197.2	0.0	197.2	9870	4	197	0	197	2.00
	Total			21	0	21	376.4	0.0	376.4	20147	13	377	0	377	1.87
	Total decoded			104	0	104	1864	0	1864	50073	58	1866	0	1866	3.72
	Strays			0	0	0									
No data			1257	0	1257										
No pin			10	0	10										
Lost pin			0	0	0										
Total observed			1371	0	1371										

abbreviations are: M = male, F = female

¹1991 CWT release data from Nelson et al. 1994

²total decoded estimated adipose clips are from Table 17

³calculated from observed adipose clips totals

⁴calculated from estimated adipose clips totals

⁵male and female combined

⁶escapement is defined as the number of fish that escaped the marine fisheries and returned to Black Creek

FIGURES

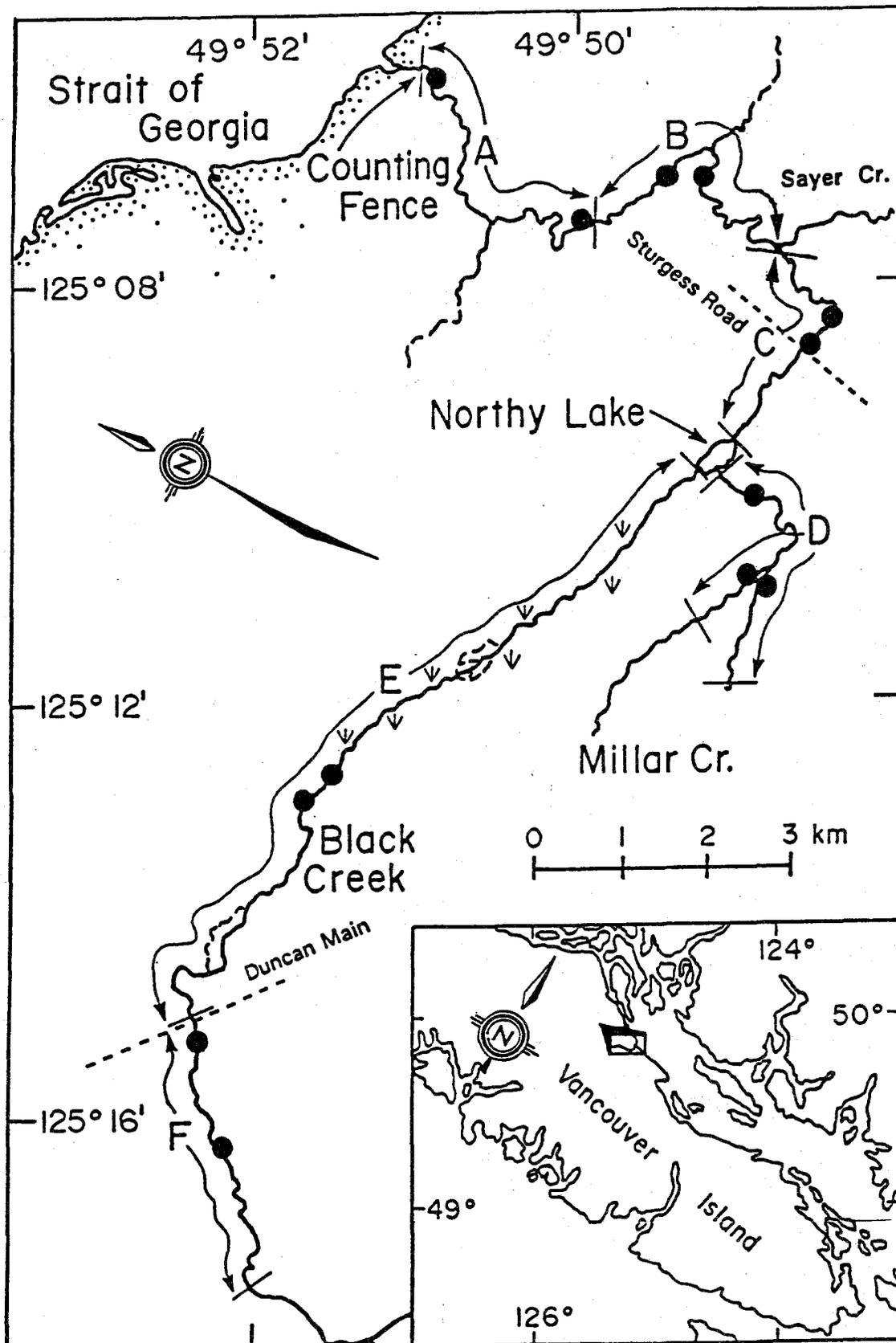


Figure 1. Map of Black Creek study area, showing location of smolt and adult counting fences, upstream recovery strata (A-F), and index reaches (identified by black dots).

BLACK CREEK 1992

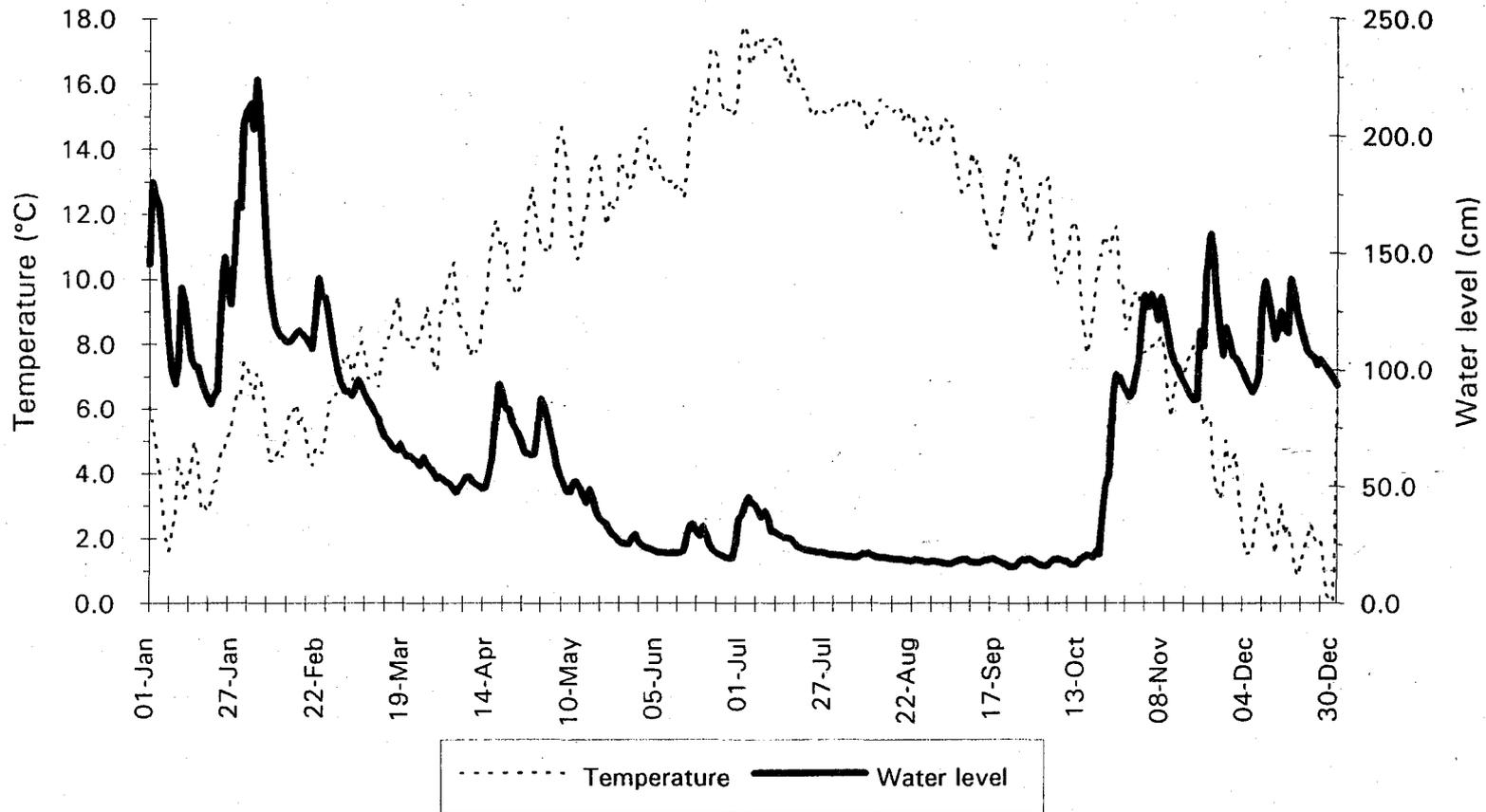


Figure 2. Water temperatures and levels at Black Creek, 1992. Data are daily means of records logged every three hours on the automated datalogger located 200 m upstream of the Seaview Road Bridge.

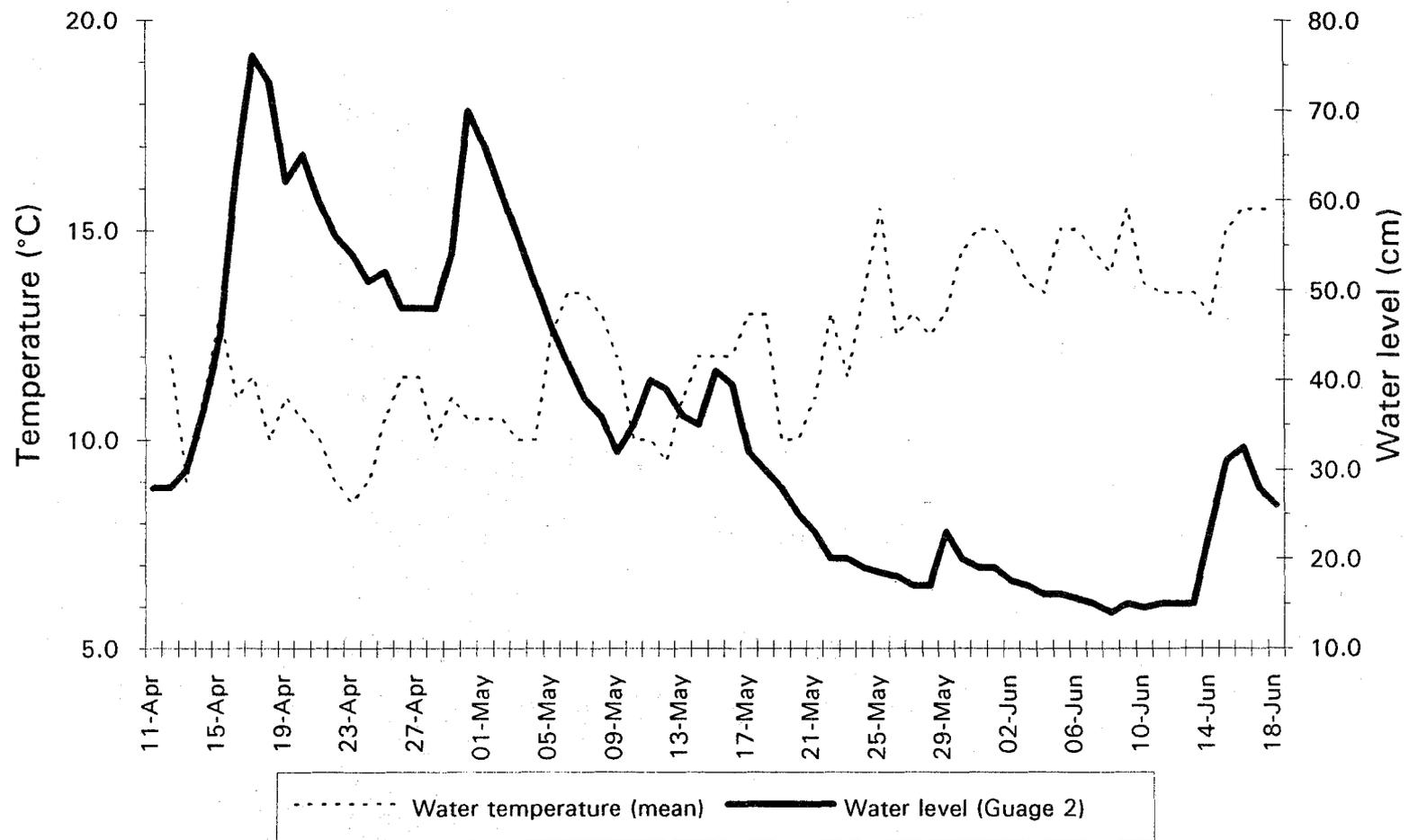


Figure 3. Water temperatures and levels at Black Creek during April, May, and June, 1992. Data from Appendix A.

COHO SMOLTS 1992

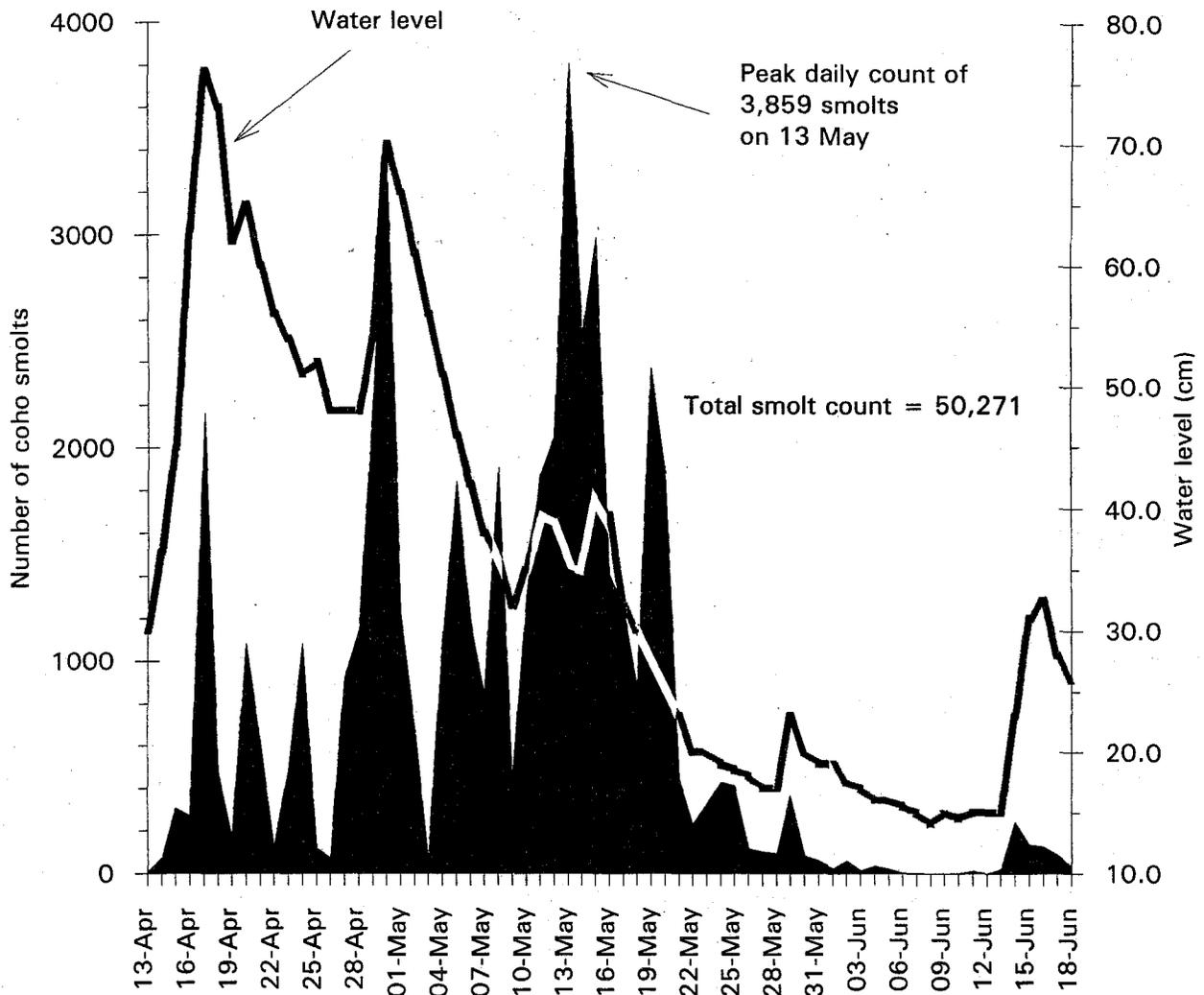


Figure 4. Total daily catches of coho smolts and associated water levels, by date, at Black Creek, 1992.

COHO FRY 1992

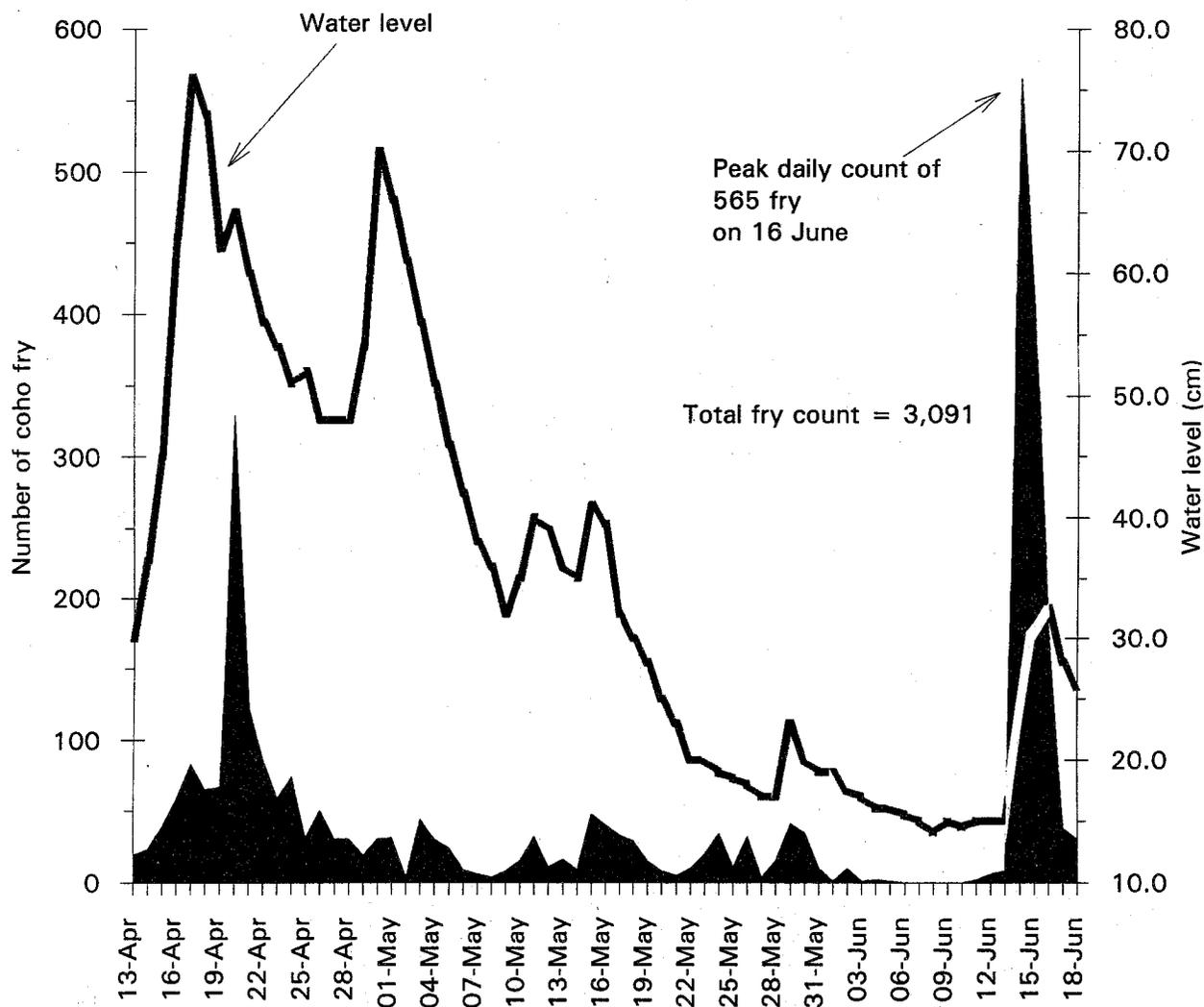


Figure 5. Total daily catches of coho fry and associated water levels, by date, at Black Creek, 1992.

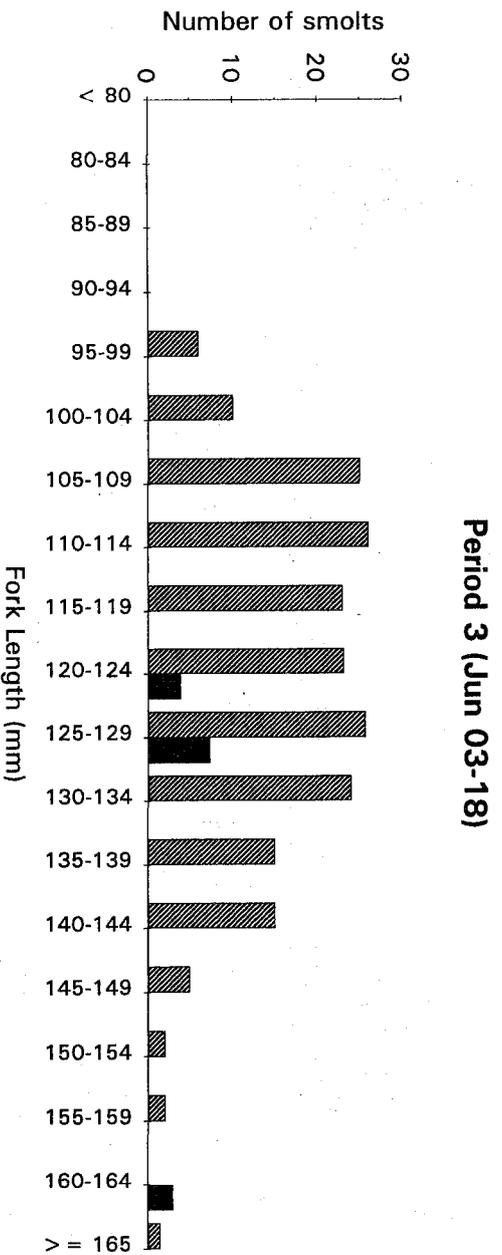
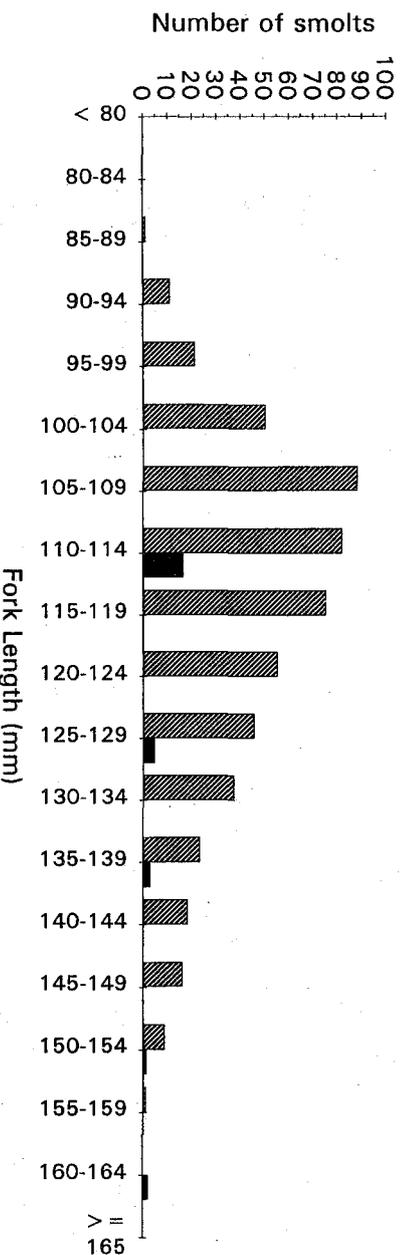
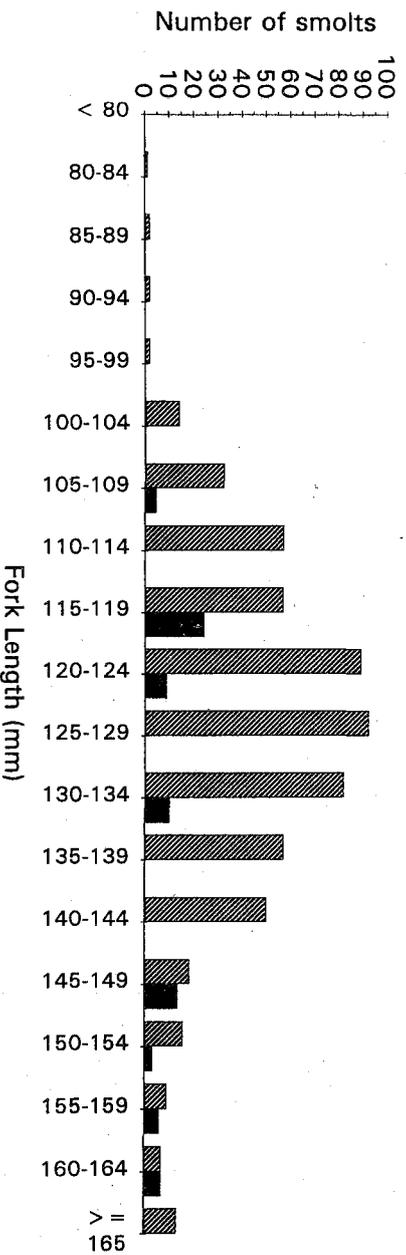


Figure 6. Calculated age-length representation of age-1 and age-2 coho smolts, by sampling period, at Black Creek, 1992. (Data from Table 5.)

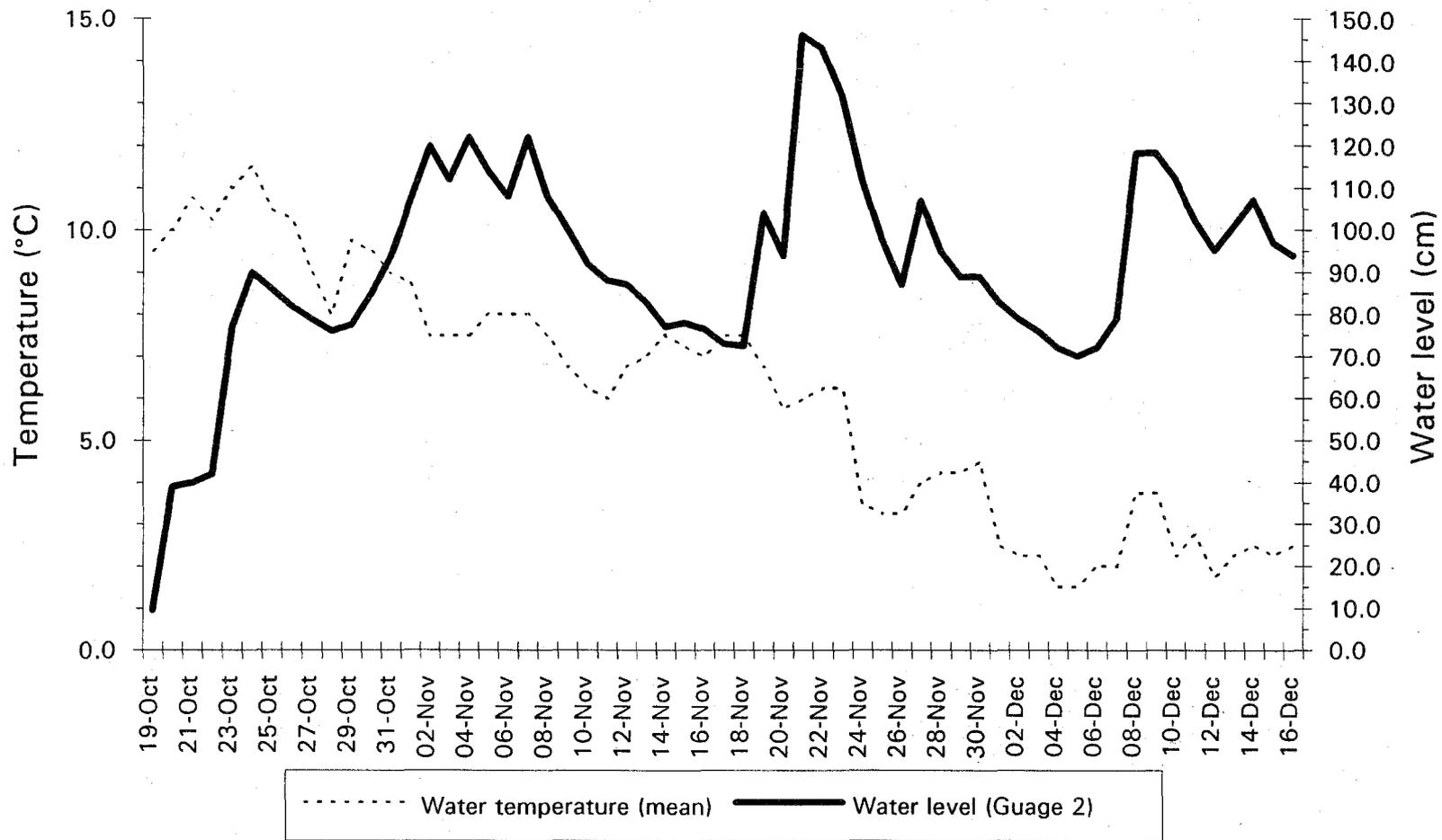


Figure 7. Water temperatures and levels at Black Creek during October, November, and December, 1992. Data from Appendix D.

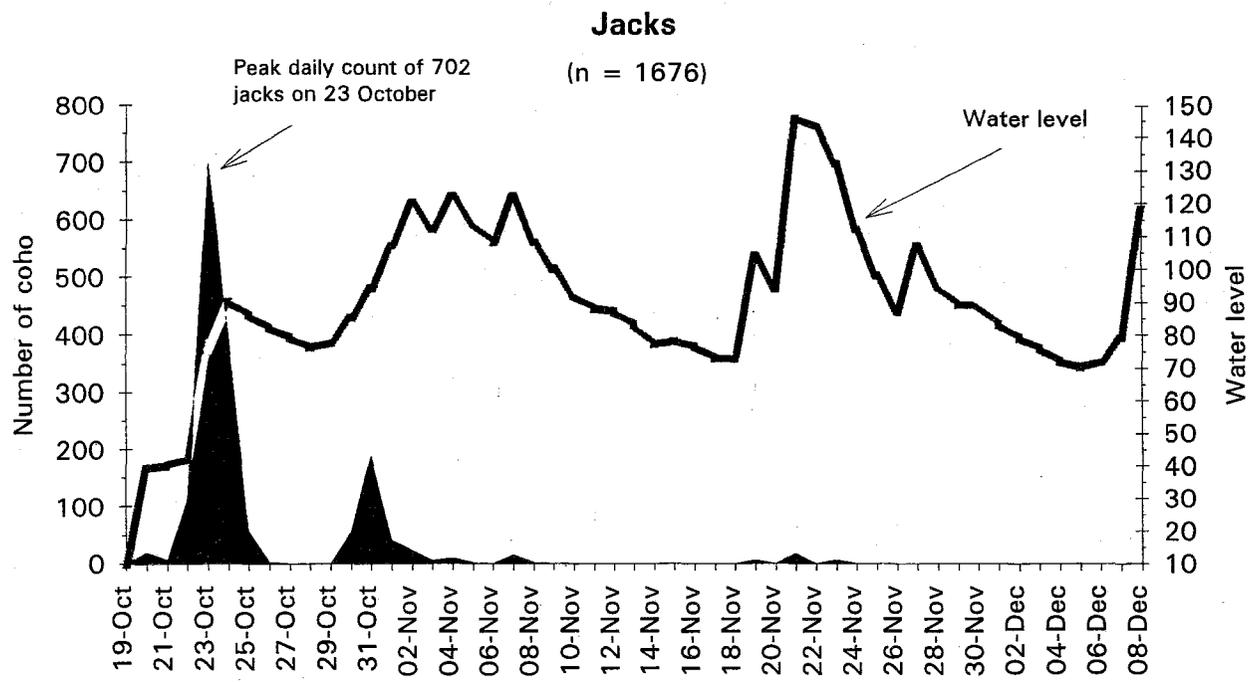
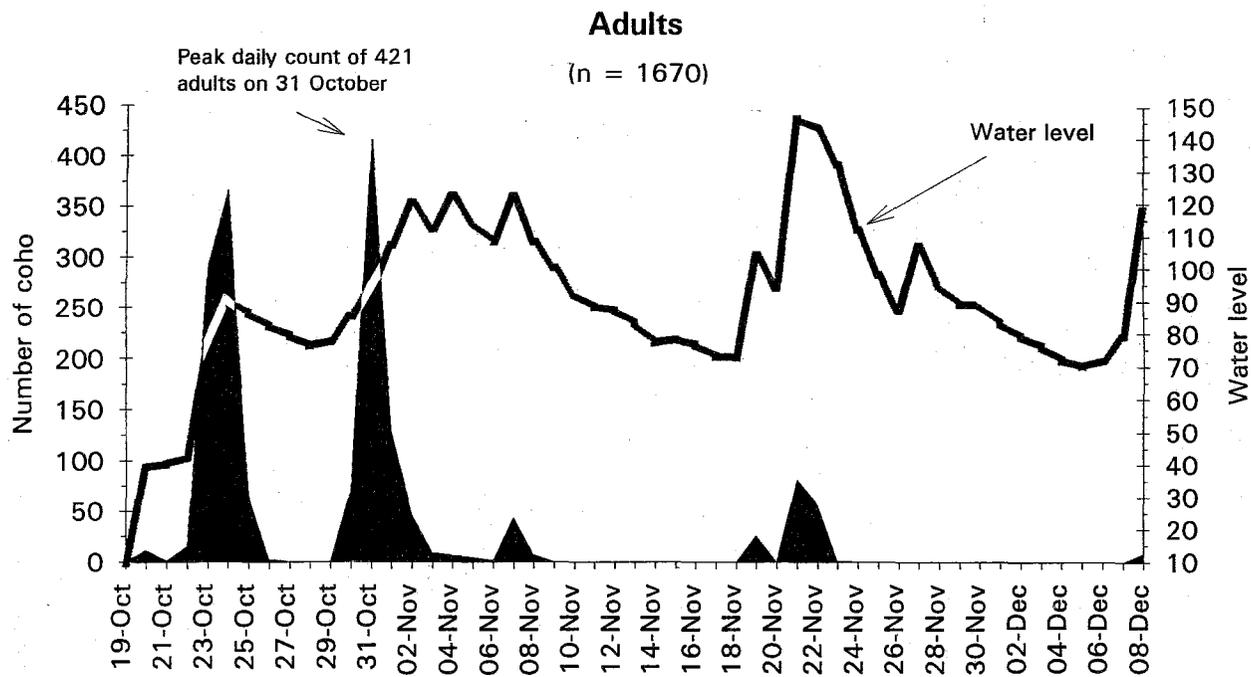


Figure 8. Daily fence counts of adult and jack coho salmon, and associated water levels, by date, at Black Creek, 1992.

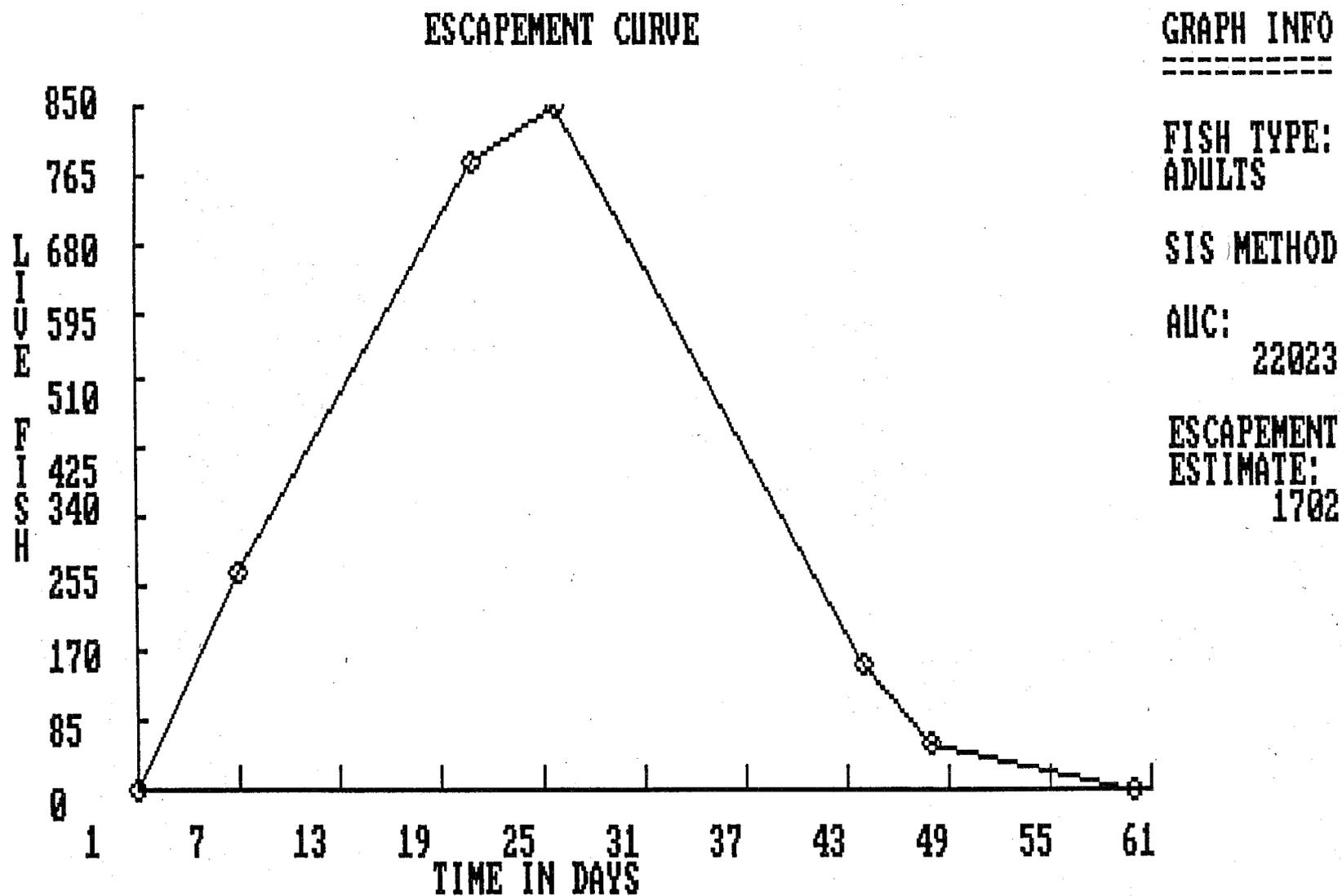
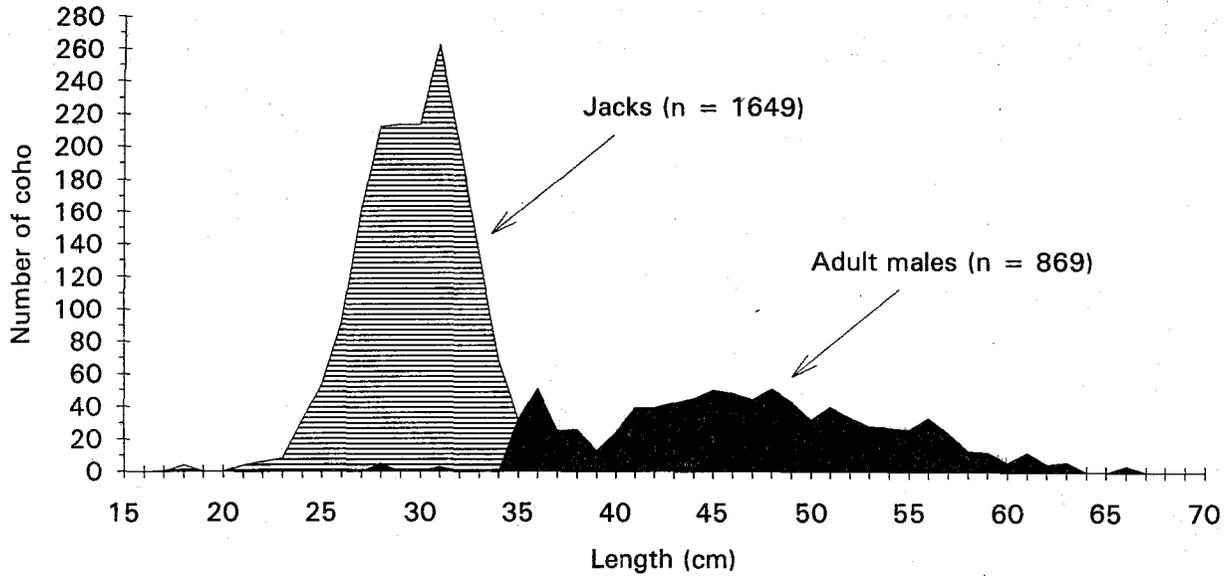


Figure 9. Escapement curve determined from AUC surveys of live coho salmon at Black Creek, 1992 (numbers of live coho versus time). Day 1 is October 20, 1992. Illustration produced using software described in Irvine et al. (1993).

Jacks and adult males



Females

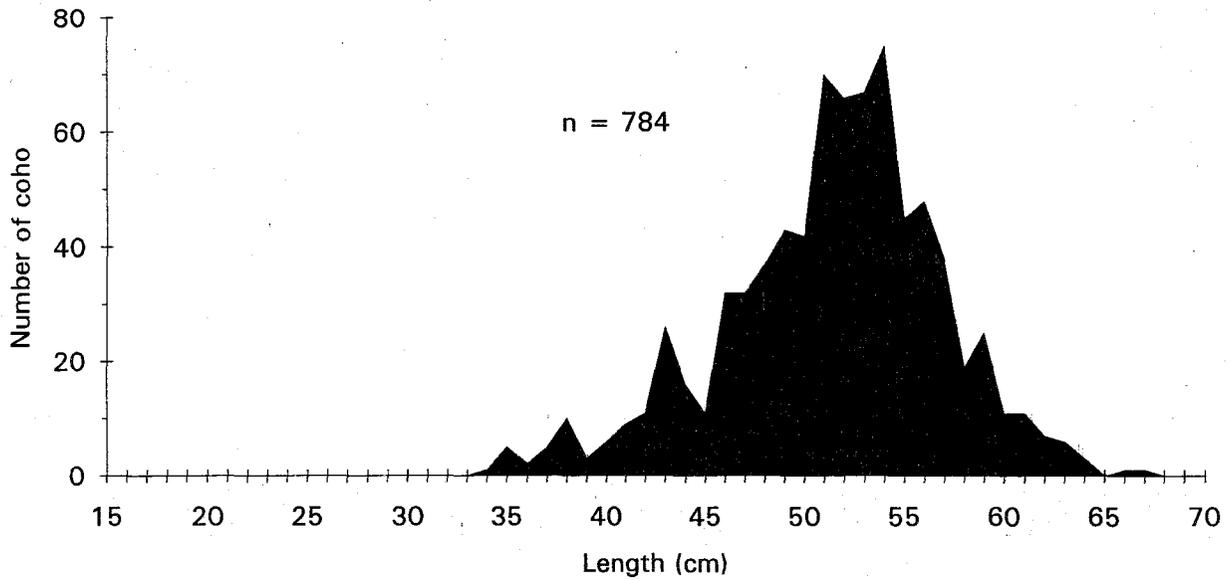


Figure 10. Length-frequency distributions for returning coho salmon at Black Creek, 1992, from all live recovery data of new fish.

Appendix A

Biophysical data for Black Creek, April 11 - June 18, 1992.

Appendix A. Biophysical data for Black Creek, April 11 - June 18, 1992.

Date	Time (24 hr)	Maximum water temp. (°C)	Minimum water temp. (°C)	Present water temp. (°C)	Water level		Rain 0-5	Wind direction	Wind speed km/hr	Cloud cover (%)
					Gauge 1 (cm)	Gauge 2 (cm)				
04/11/92	0800				50.0	28.0				5
04/12/92	0800			12.0	50.0	28.0				95
04/13/92	0800			9.0	52.5	30.0	2			100
04/14/92	0800			11.0	57.5	36.5	0			75
04/15/92	0800			13.0	67.5	45.0	2			100
04/16/92	0800			11.0	80.0	63.0	3	SE	20	100
04/17/92	0700	13.0	10.0	10.0	90.0	76.0		SE	5	80
04/18/92	0800	11.0	9.0	9.0	102.5	73.0		NW	5	5
04/19/92	0800	11.0	11.0	11.0	90.0	62.0		NW	10	90
04/20/92	0800	12.0	9.0	9.0	97.5	65.0				25
04/21/92	0800	11.0	9.0	11.0	95.0	60.0				97
04/22/92	0800	10.0	8.0	8.0	85.0	56.0		NW	5	20
04/23/92	0800	10.0	7.0	7.0	90.0	54.0				10
04/24/92	0800	11.0	7.0	8.0	90.0	51.0		SE	5	95
04/25/92	0800	12.0	9.0	10.0	87.5	52.0	1	SW	6	100
04/26/92	0800	14.0	9.0	11.0	68.5	48.0	1			100
04/27/92	0900	12.0	11.0	11.0	67.5	48.0				95
04/28/92	0800	14.0	6.0	11.0	72.5	48.0		NW	5	100
04/29/92	0800	12.0	10.0	10.0	77.5	54.0	1	NW	5	100
04/30/92	0700	12.0	9.0	9.0	100.0	70.0				10
05/01/92	0800	11.0	10.0	10.0	90.0	66.0				100
05/02/92	0800	11.0	10.0	10.0	87.0	61.0		NW	5	10
05/03/92	0800	11.0	9.0	9.0	75.0	56.0		NW	5	0
05/04/92	0800	11.0	9.0	10.0	75.0	51.0		NW	5	70
05/05/92	0800	14.0	11.0	13.0	70.0	46.0		NWN	5	10
05/06/92	0800	16.0	11.0	12.0	67.5	42.0		NW	5	10
05/07/92	0800	16.0	11.0	12.0	62.5	38.0		NW	10	10
05/08/92	0800	14.0	12.0	12.0	60.0	36.0		SW	10	100
05/09/92	0800	14.0	10.0	10.0	55.0	32.0	5	SW	5	100
05/10/92	0800	11.0	9.0	9.0	60.0	35.0		NW	5	10
	Mean	12.3	9.4	10.3	75.8	50.4				
	Max	16.0	12.0	13.0	102.5	76.0				
	Min	10.0	6.0	7.0	50.0	28.0				
05/11/92	0800	12.0	8.0	8.0	60.0	40.0				10
05/12/92	0800	11.0	8.0	8.0	60.0	39.0				10
05/13/92	0800	13.0	9.0	9.0	55.0	36.0		NW	10	5
05/14/92	0700	14.0	10.0	10.0	53.0	35.0		NW	10	10
05/15/92	0730	14.0	10.0	10.0	57.5	41.0		NW	5	5
05/16/92	0800	14.0	10.0	11.0	55.0	39.5		NW	5	0

Appendix A. Biophysical data for Black Creek, April 11 - June 18, 1992.
(cont.)

Date	Time (24 hr)	Maximum water temp. (°C)	Minimum water temp. (°C)	Present water temp. (°C)	Water level		Rain 0-5	Wind direction	Wind speed km/hr	Cloud cover (%)
					Gauge 1 (cm)	Gauge 2 (cm)				
05/17/92	0800	15.0	11.0	11.0	50.0	32.0		NW	5	
05/18/92	0800	15.0	11.0	11.0	47.5	30.0				95
05/19/92	0800	13.0	7.0	8.0	47.5	28.0		NW	10	10
05/29/92	0730	14.0	6.0	9.0	45.0	25.0		NW	15	10
05/21/92	0800	14.0	8.0	11.0	45.0	23.0				5
05/22/92	0800	16.0	10.0	11.0	42.5	20.0				60
05/22/92	0800	13.0	10.0	11.0	42.5	20.0				10
05/24/92	0800	16.0	11.0	12.0	42.0	19.0				10
05/25/92	0800	19.0	12.0	12.0	40.0	18.5				85
05/26/92	0800	14.0	11.0	11.0	40.0	18.0		NW	5	5
05/27/92	0800	15.0	11.0	11.0	40.0	17.0				60
05/28/92	0800	14.0	11.0	11.0	40.0	17.0				90
05/29/92	0800	14.0	12.0	13.0	45.0	23.0		NW	5	5
05/30/92	0800	17.0	12.0	13.0	42.5	20.0		NW	5	10
05/31/92	0800	18.0	12.0	14.0	41.0	19.0		NW	5	80
06/01/92	0800	17.0	13.0	13.0	40.0	19.0		NW	15	80
06/02/92	0800	18.0	11.0	11.0	40.0	17.5		NW	20	5
	Mean	14.8	10.2	10.8	46.6	25.9				
	Max	19.0	13.0	14.0	60.0	41.0				
	Min	11.0	6.0	8.0	40.0	17.0				
06/03/92	0800	17.0	10.5	11.5	39.0	17.0		NW	5	15
06/04/92	0800	17.0	10.0	11.0	38.0	16.0		NW	20	7
06/05/92	0800	18.0	12.0	12.0	38.0	16.0		NW	10	5
06/06/92	0800	18.0	12.0	12.0	38.0	15.5		NE	10	0
06/07/92	0800	16.0	13.0	13.0	37.5	15.0		NE	5	10
06/08/92	0800	15.0	13.0	13.0	37.5	14.0		NW	5	80
06/09/92	0800	18.0	13.0	13.0	38.0	15.0	2			100
06/10/92	0800	16.0	11.5	12.0	37.5	14.5				50
06/11/92	0800	15.0	12.0	12.0	37.5	15.0	1			100
06/12/92	0830			12.0	37.5	15.0	1			100
06/13/92	0800	15.0	12.0	13.0	37.5	15.0	2			100
06/14/92	0800	14.0	12.0	12.0	42.5	23.0		SW	10	60
06/15/92	0800	18.0	12.0	12.0	50.0	31.0		NW	5	20
06/16/92	0830	18.0	13.0	14.0	52.5	32.5		NW	5	85
06/17/92	0800	18.0	13.0	13.0	47.5	28.0		NW	10	27
06/18/92	0830	18.0	13.0	13.0	45.0	26.0		NW	5	7
	Mean	16.7	12.1	12.4	40.8	19.3				
	Max	18.0	13.0	14.0	52.5	32.5				
	Min	14.0	10.0	11.0	37.5	14.0				

Appendix B

**Catches of juvenile coho at the Black Creek counting fence,
by date and sampling period, 1992.**

Appendix B. Catches of juvenile coho at the Black Creek counting fence, by date and sampling period, 1992.¹

Capture date	Operation hours	Total fry catch ²	Total smolt (S) catch ²	Total smolt (L) catch ²	Total smolt (S + L) catch ²	Total pre-tag fry morts ³	Total pre-tag smolt (S) morts ³	Total pre-tag smolt (L) morts ³	Total fry released untagged ⁴	Total smolt (S) released untagged ⁴	Total smolt (L) released untagged ⁴	Total fry available for tagging ⁵	Total smolts (S + L) available for tagging ⁵
04/13/92	24	19	1	8	9	0	0	0	0	0	0	19	9
04/14/92	24	23	11	63	74	0	0	0	0	0	0	23	74
04/15/92	24	39	50	256	306	0	1	0	0	0	2	39	303
04/16/92	24	59	33	236	269	0	0	0	0	0	0	59	269
04/17/92	24	83	251	1910	2161	39	1	1	15	2	4	29	2154
04/18/92	24	65	47	429	476	14	0	0	0	0	2	51	474
04/19/92	24	67	37	137	174	12	0	0	0	0	1	55	173
04/20/92	24	329	181	902	1083	17	1	1	0	0	2	312	1078
04/21/92	24	122	106	513	619	4	0	1	3	0	1	115	617
04/22/92	24	86	25	99	124	3	1	0	0	0	1	83	122
04/23/92	24	59	114	371	485	0	0	0	3	0	0	56	485
04/24/92	24	74	163	920	1083	0	0	0	0	0	0	74	1083
04/25/92	24	31	33	84	117	1	0	0	0	0	0	30	117
04/26/92	24	50	17	54	71	1	0	0	0	0	0	49	71
04/27/92	24	30	157	764	921	0	0	0	1	0	0	29	921
04/28/92	24	30	221	917	1138	3	0	0	0	0	0	27	1138
04/29/92	24	19	340	1907	2247	0	0	1	0	1	2	19	2243
04/30/92	24	30	793	2596	3389	3	12	12	0	0	0	27	3365
05/01/92	24	31	255	970	1225	0	8	7	0	0	0	31	1210
05/02/92	24	4	216	476	692	0	0	0	0	0	0	4	692
05/03/92	24	44	28	39	67	0	0	0	0	0	0	44	67
05/04/92	24	30	282	740	1022	0	0	0	1	0	0	29	1022
05/05/92	24	24	473	1368	1841	0	0	0	0	0	0	24	1841
05/06/92	24	9	334	851	1185	0	0	0	0	0	0	9	1185
05/07/92	24	6	374	476	850	0	0	0	0	0	0	6	850
05/08/92	24	4	1002	902	1904	0	3	0	0	0	0	4	1901
05/09/92	24	8	269	186	455	0	2	0	0	0	0	8	453
05/10/92	24	15	798	501	1299	0	0	0	0	0	0	15	1299
Subtotal		1390	6611	18675	25286	97	29	23	23	3	15	1270	25216
05/11/92	24	32	1072	802	1874	0	1	0	0	1	2	32	1870
05/12/92	24	11	1235	818	2053	0	1	0	0	2	0	11	2050
05/13/92	24	16	2082	1777	3859	0	2	2	0	0	0	16	3855
05/14/92	24	9	1481	1464	2945	0	2	4	0	0	3	9	2936
05/15/92	24	48	1397	1592	2989	0	2	1	0	2	2	48	2982
05/16/92	24	40	791	621	1412	0	4	0	0	0	0	40	1408
05/17/92	24	33	722	529	1251	0	0	0	0	0	0	33	1251
05/18/92	24	29	605	277	882	0	1	0	0	1	1	29	879
05/19/92	24	15	1581	795	2376	15	0	0	0	3	3	0	2370
05/20/92	24	8	1204	682	1886	0	0	0	0	0	0	8	1886
05/21/92	24	5	274	169	443	0	0	0	0	0	0	5	443

Appendix B. Catches of juvenile coho at the Black Creek counting fence, by date and sampling period, 1992.¹
(cont.)

Capture date	Operation hours	Total fry catch ²	Total smolt (S) catch ²	Total smolt (L) catch ²	Total smolt (S+L) catch ²	Total pre-tag fry morts ³	Total pre-tag smolt (S) morts ³	Total pre-tag smolt (L) morts ³	Total fry released untagged ⁴	Total smolt (S) released ⁴ untagged	Total smolt (L) released ⁴ untagged	Total fry available for tagging ⁵	Total smolts (S+L) available for tagging ⁵
05/22/92	24	10	180	51	231	0	0	1	0	0	0	10	230
05/23/92	24	20	223	101	324	0	0	0	0	0	0	20	324
05/24/92	24	34	294	134	428	0	0	0	0	0	0	34	428
05/25/92	24	11	233	178	411	0	1	0	0	0	0	11	410
05/26/92	24	32	75	42	117	0	0	0	0	0	0	32	117
05/27/92	24	4	67	34	101	0	1	0	0	0	0	4	100
05/28/92	24	15	42	50	92	0	0	0	0	0	0	15	92
05/29/92	24	41	171	196	367	0	0	0	0	0	0	41	367
05/30/92	24	35	49	31	80	0	0	0	0	0	0	35	80
05/31/92	24	10	30	32	62	0	2	0	0	0	0	10	60
06/01/92	24	1	10	12	22	0	0	1	0	0	0	1	21
06/02/92	24	10	29	30	59	0	0	0	0	0	0	10	59
Subtotal		469	13847	10417	24264	15	17	9	0	9	11	454	24218
06/03/92	24	1	2	13	15	0	0	0	0	2	13	1	0
06/04/92	24	2	14	21	35	0	5	5	0	0	0	2	25
06/05/92	24	1	5	15	20	0	0	0	0	0	0	1	20
06/06/92	24	0	1	1	2	0	0	0	0	0	0	0	2
06/07/92	24	0	0	1	1	0	0	0	0	0	0	0	1
06/08/92	24	0	0	0	0	0	0	0	0	0	0	0	0
06/09/92	24	0	0	0	0	0	0	0	0	0	0	0	0
06/10/92	24	0	0	0	0	0	0	0	0	0	0	0	0
06/11/92	24	2	6	4	10	0	0	0	0	0	0	2	10
06/12/92	24	6	0	0	0	0	0	0	0	0	0	6	0
06/13/92	24	8	5	14	19	0	0	0	0	0	0	8	19
06/14/92	24	565	97	145	242	0	0	0	0	1	0	565	241
06/15/92	24	403	66	67	133	0	0	0	0	1	0	403	132
06/16/92	24	176	67	57	124	0	0	0	0	2	0	176	122
06/17/92	24	38	47	40	87	0	0	0	0	0	1	38	86
06/18/92	24	30	16	17	33	0	0	0	0	0	0	30	33
Subtotal		1232	326	395	721	0	5	5	0	6	14	1232	691
Grand total		3091	20784	29487	50271	112	51	37	23	18	40	2956	50125

¹ abbreviations are: S = small (smolt < 120 mm); L = large (smolt ≥ 120 mm); S+L = both small and large (all smolts)

² total catch = No. tagged + total pre-tag morts + No. escapees + No. released untagged

³ total pre-tag morts = trap morts + pred morts + sacs

⁴ total No. released untagged = No. released untagged (due to poor condition) + No. escapees

⁵ No. available for tagging = total catch - pre-tag morts - escapees - No. released untagged

Appendix C

Catches of non-coho fish at the Black Creek counting fence, by date, 1992.

Appendix C. Catches of non-coho fish at the Black Creek counting fence, by date, 1992.

Date	Steel-head fry	Steel-head parr	Steel-head smolt adipose clipped	Steel-head smolt no clip	Steel-head adult adipose clipped	Steel-head adult no clip	Steel-head kelt adipose clipped	Steel-head kelt no clip	Cut-throat fry	Cut-throat parr	Cut-throat smolt adipose clipped	Cut-throat smolt no clip	Cut-throat adult adipose clipped	Cut-throat adult no clip	Cut-throat kelt adipose clipped	Cut-throat kelt no clip	Cottids	Lamprey	Stickle-back
04/13/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	3
04/14/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	1
04/15/92	0	0	0	1	0	0	0	0	0	1	0	0	0	0	3	0	15	0	2
04/16/92	0	0	0	0	0	0	0	0	0	1	0	5	0	0	7	1	12	0	2
04/17/92	0	0	0	40	0	0	0	2	0	7	0	21	0	0	28	10	33	0	13
04/18/92	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	8	0	14
04/19/92	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	0	12
04/19/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	7
04/20/92	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	1	20	0	23
04/21/92	0	0	0	0	0	0	0	0	0	1	0	3	0	0	4	0	20	0	12
04/22/92	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	8	0	4
04/23/92	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	5	0	6
04/24/92	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	31	0	2
04/25/92	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	4	0	3
04/26/92	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	9	0	3
04/27/92	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	7	0	3
04/28/92	0	0	0	5	0	0	0	0	0	0	0	3	0	0	1	0	11	1	10
04/29/92	0	0	0	26	0	0	0	0	0	0	0	5	0	0	1	6	8	0	12
04/30/92	0	0	0	35	0	0	0	0	0	0	0	7	0	0	0	6	14	0	6
05/01/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	6	0	12
05/02/92	0	0	0	0	0	0	0	1	0	0	0	7	0	0	0	1	10	0	10
05/03/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	4
05/04/92	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	1	0	5
05/05/92	0	0	0	14	0	0	0	0	0	0	0	11	0	0	0	0	14	0	2
05/06/92	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	7	0	8
05/07/92	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
05/08/92	0	0	0	18	0	0	0	0	0	0	0	23	0	0	0	0	9	0	5
05/09/92	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	8	1	5
05/10/92	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	6	0	3
05/11/92	0	0	0	12	0	0	0	0	0	0	0	9	0	0	0	1	3	3	0
05/11/92	0	0	0	8	0	0	0	0	0	0	0	10	0	0	0	0	4	1	1
05/12/92	0	0	0	11	0	0	0	0	0	0	0	13	0	0	0	1	8	1	2
05/13/92	0	0	0	13	0	0	0	0	0	2	0	16	0	0	0	3	6	1	1
05/14/92	0	0	0	18	0	0	0	0	0	0	0	7	0	0	0	0	3	1	1
05/15/92	0	0	0	23	0	0	0	0	0	0	0	11	0	0	0	0	11	0	3

Appendix C (cont.). Catches of non-coho fish at the Black Creek counting fence, by date, 1992.

Date	Steel-head fry	Steel-head parr	Steel-head smolt adipose clipped	Steel-head smolt no clip	Steel-head adult adipose clipped	Steel-head adult no clip	Steel-head kelt adipose clipped	Steel-head kelt no clip	Cut-throat fry	Cut-throat parr	Cut-throat smolt adipose clipped	Cut-throat smolt no clip	Cut-throat adult adipose clipped	Cut-throat adult no clip	Cut-throat kelt adipose clipped	Cut-throat kelt no clip	Cottids	Lamprey	Stickle-back
05/16/92	0	0	0	9	0	0	0	0	0	0	0	7	0	0	0	0	2	0	0
05/18/92	0	0	0	2	0	0	0	0	0	0	0	3	0	0	3	0	3	1	2
05/19/92	0	0	0	3	0	0	0	0	0	0	0	8	0	0	0	0	16	2	4
05/20/92	0	0	0	3	0	0	0	0	0	1	0	3	0	0	0	1	12	0	0
05/21/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1
05/22/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	1	0
05/23/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	1	2
05/24/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	1	2
05/25/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	3	0
05/26/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	2	5
05/27/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	26	1	1
05/28/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	29	1	0
05/29/92	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	19	1	0
05/30/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	1
05/31/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	1	1
06/01/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	2	0
06/02/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	3	0
06/03/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	0
06/04/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	0
06/05/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
06/06/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
06/07/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
06/08/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
06/09/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
06/10/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/11/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1
06/12/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
06/13/92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
06/14/92	0	0	0	0	0	0	0	0	10	0	0	0	0	0	2	0	6	0	3
06/15/92	0	0	0	0	0	0	0	1	31	0	0	0	0	0	1	0	7	2	5
06/16/92	0	0	0	0	0	0	0	0	11	0	0	0	0	0	1	0	15	1	8
06/17/92	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	9	2	10
Total	0	0	0	269	0	0	0	5	59	14	0	200	0	2	58	37	722	40	248

Appendix D

Biophysical data for Black Creek, October 19 - December 16, 1992.

Appendix D. Biophysical data for Black Creek, October 19 - December 16, 1992.

Date	Time (24 hr)	Maximum water temp. (°C)	Minimum water temp. (°C)	Present water temp. (°C)	Water level		Rain 0-5	Wind direction	Wind speed km/hr	Cloud cover (%)
					Gauge 1 (cm)	Gauge 2 (cm)				
10/19/92	1100			9.5	37.5	9.5	2	SE	20	100
10/20/92	1000	10.5	9.5	10.5	55.0	39.0	0		0	98
10/21/92	0730	11.5	10.0	11.0	55.0	40.0	0		0	99
10/22/92	0730	11.0	9.5	9.5	58.0	42.0	3	SE	15	100
10/23/92	0700	11.0	11.0	11.0	82.0	77.0	2	SE	10	100
10/24/92	0730	12.0	11.0	11.0	80.0	90.0	0		0	80
10/25/92	0830	12.0	9.0	9.0	75.0	86.0	0		0	7
10/26/92	0700	11.0	9.5	9.5	80.0	82.0	0		0	10
10/27/92	0730	10.0	8.0	9.0	75.0	79.0	0		0	10
10/28/92	0730	8.5	7.5	8.5	72.0	76.0	0		0	100
10/29/92	0730	11.0	8.5	11.0	67.5	77.5	0		0	98
10/30/92	0830	9.5	9.5	9.5	85.0	85.0	1		0	100
10/31/92	0730	9.0	9.0	9.0	85.0	94.0	3	SE	5	100
11/01/92	0800	9.5	8.0	8.0	92.5	107.0	0		0	10
11/02/92	0730	8.0	7.0	7.0	108.0	120.0	0		0	10
11/03/92	0800	7.5	7.5	7.5	97.5	112.0	0		0	95
11/04/92	0800	7.5	7.5	7.5	110.0	122.0	1		0	100
11/05/92	0830	8.0	8.0	8.0	100.0	114.0	0		0	100
11/06/92	0800	8.5	7.5	8.0	95.0	108.0	1		0	100
11/07/92	0800	8.5	7.5	8.0	110.0	122.0	0		0	15
11/08/92	0730	8.0	7.0	7.0	96.0	108.0	0		0	15
11/09/92	0800	8.0	5.5	5.5	87.5	100.0	0	NW	5	10
11/10/92	0800	7.5	5.0	6.0	72.5	92.0	0		0	100
11/11/92	0800	7.0	5.0	6.0	72.5	88.0	3		0	100
11/12/92	0800	7.5	6.0	7.0	76.0	87.0	0		0	100
11/13/92	0800	7.0	7.0	7.0	72.5	83.0	1		0	100
11/14/92	0730	8.5	6.5	6.5	69.0	77.0	0		0	100
11/15/92	0730	7.5	7.0	7.0	69.0	78.0	1		0	100
11/16/92	0830	7.5	6.5	7.0	67.5	76.5	1		0	100
11/17/92	0800	7.5	7.5	7.5	67.5	73.0	0		0	40
11/18/92	0815	8.0	7.0	7.0	73.5	72.5	0		0	100
11/19/92	0830	7.5	6.0	6.0	93.0	104.0	0		0	30
11/20/92	0730	6.5	5.0	5.0	85.0	94.0	0		0	50
11/21/92	0830	6.0	6.0	6.0	133.0	146.0	4	SE	5	100
11/22/92	0835	5.0	7.5	7.5	130.0	143.0	0	NW	20	5
11/23/92	0700	9.0	3.5	3.5	120.0	132.0	0		0	12
11/24/92	0800	4.0	3.0	3.0	102.5	112.0	0		0	22
11/25/92	0800	3.5	3.0	3.0	90.0	98.0	0		0	75

Appendix D (cont.). Biophysical data for Black Creek, October 19 - December 16, 1992.

Date	Time (24 hr)	Maximum water temp. (°C)	Minimum water temp. (°C)	Present water temp. (°C)	Water level		Rain 0-5	Wind direction	Wind speed km/hr	Cloud cover (%)
					Gauge 1 (cm)	Gauge 2 (cm)				
11/26/92	0830	3.5	3.0	3.0	79.0	87.0	1		0	100
11/27/92	0800	5.0	3.0	5.0	95.0	107.0	1		0	100
11/28/92	0800	5.0	3.5	3.5	85.0	95.0	0		0	42
11/29/92	0800	4.5	4.0	4.0	80.0	89.0	0		0	100
11/30/92	0830	5.0	4.0	4.5	80.0	89.0	0		0	40
12/01/92	0830	4.0	1.0	1.0	75.0	83.0	0		0	40
12/02/92	0830	3.0	1.5	2.0	74.0	79.0	0		0	20
12/03/92	0800	3.0	1.5	1.5	75.0	76.0	0		0	30
12/04/92	0845	1.5	1.5	1.5	68.0	72.0	0		0	100
12/05/92	0830	1.5	1.5	1.5	65.0	70.0	0		0	45
12/06/92	0800	2.5	1.5	1.5	68.0	72.0	0		0	92
12/07/92	0830	2.5	1.5	2.0	74.0	79.0	0		0	95
12/08/92	0800	4.0	3.5	2.0	108.0	118.0	3	SE	20	100
12/09/92	0800	5.0	2.5	2.5	105.0	118.0	0		0	42
12/10/92	0800	2.5	2.0	2.0	100.0	112.0	1		0	100
12/11/92	0800	3.5	2.0	2.0	92.0	102.0	1		0	100
12/12/92	0800	2.0	1.5	1.5	85.0	95.0	0		0	80
12/13/92	0800	3.0	1.5	3.0	90.0	101.0	1		0	100
12/14/92	0800	3.0	2.0	2.0	97.0	107.0	1		0	100
12/15/92	0830	3.0	1.5	1.5	87.0	97.0	0		0	25
12/16/92	0830	2.5	2.5	2.5	85.0	94.0	2	SE	15	100
Mean		6.5	5.4	5.8	84.1	91.3				
Max		12.0	11.0	11.0	133.0	146.0				
Min		1.5	1.0	1.0	37.5	9.5				

Appendix E

Black Creek fence counts and associated operculum tag release data for returning adult and jack coho salmon, by date, 1992.

Appendix E. Black Creek fence counts and associated operculum tag release data for returning adult and jack coho salmon, by date, 1992.

Date	Number captured	Number adipose clipped	Number filament tagged	Number sacrificed	Number released untagged	Number released tagged
Adults						
10/20/92	12	12	0	0	0	12
10/21/92	1	1	0	0	0	1
10/22/92	15	14	0	0	0	15
10/23/92	293	263	0	0	2	291
10/24/92	367	329	0	0	1	366
10/25/92	66	62	0	0	0	66
10/26/92	2	2	0	0	0	2
10/30/92	71	56	0	2	0	69
10/31/92	421	380	0	0	0	421
11/01/92	130	112	0	0	0	130
11/02/92	47	41	0	0	0	47
11/03/92	9	8	0	0	0	9
11/04/92	6	5	0	0	0	6
11/05/92	4	3	0	0	0	4
11/06/92	1	1	0	0	0	1
11/07/92	44	37	0	0	0	44
11/08/92	7	5	0	0	0	7
11/19/92	26	18	0	0	0	26
11/21/92	82	71	0	0	0	82
11/22/92	57	48	0	0	0	57
11/23/92	1	1	0	0	0	1
12/08/92	8	8	0	0	0	8
Total	1670	1477	0	2	3	1665

Appendix E. Black Creek fence counts and associated operculum tag release data for returning adult and jack coho salmon, by date, 1992.
(cont.)

Date	Number captured	Number adipose clipped	Number filament tagged	Number sacrificed	Number released untagged	Number released tagged
Jacks						
10/20/92	20	16	2	3	0	17
10/21/92	7	7	0	3	0	4
10/22/92	111	95	1	8	0	103
10/23/92	702	569	41	11	0	691
10/24/92	398	316	17	8	0	390
10/25/92	57	42	0	1	0	56
10/26/92	3	3	0	2	0	1
10/30/92	55	40	2	43	0	12
10/31/92	190	149	14	0	0	190
11/01/92	42	34	0	0	0	42
11/02/92	23	19	0	0	0	23
11/03/92	5	3	0	0	0	5
11/04/92	10	4	1	0	0	10
11/05/92	2	2	1	0	0	2
11/07/92	16	9	1	0	0	16
11/08/92	2	0	0	0	0	2
11/19/92	6	4	0	0	0	6
11/21/92	19	13	1	0	0	19
11/23/92	6	2	0	0	0	6
12/08/92	2	0	0	0	0	2
Total	1676	1327	81	79	0	1597

Appendix F

Summary of mark-recapture data for coho salmon collected upstream of the counting fence at Black Creek, 1992.

Appendix F. Summary of mark-recapture data for coho salmon collected upstream of the counting fence at Black Creek, 1992. Operculum tags were applied to all new fish and tag loss fish prior to release. Data presented are for live fish only.

Date	Number captured	Number new ¹ fish	Number new ¹ fish adipose clipped	Number new ¹ fish filament	Number primary recaps ²	Number secondary recaps ³	Number sacrificed	Number released
Adults								
11/16/92	9	0	0	0	9	0	0	9
11/18/92	14	0	0	0	14	0	0	14
11/25/92	87	3	3	0	84	0	0	87
11/26/92	14	1	1	0	13	0	0	14
12/01/92	49	0	0	0	49	0	0	49
12/02/92	10	0	0	0	9	1	0	10
12/04/92	6	0	0	0	5	1	0	6
Total	189	4	4	0	183	2	0	189
Jacks								
11/16/92	2	0	0	0	2	0	0	2
11/18/92	7	1	1	1	6	0	0	7
11/25/92	45	20	18	1	25	0	0	45
11/26/92	13	2	2	0	11	0	0	13
12/01/92	25	6	5	0	18	1	0	25
12/02/92	3	0	0	0	3	0	0	3
12/04/92	3	1	1	0	2	0	0	3
Total	98	30	27	2	67	1	0	98

¹ new fish are fish captured upstream of the fence that do not possess an operculum tag or tag scar (tag loss)

² primary recaptures are fish that were initially counted and tagged at the fence (includes tag loss fish)

³ secondary recaptures are recaptures of fish that were initially counted and tagged upstream of the counting fence (new fish)

Appendix G

**Recovery data for coho salmon recovered as carcasses
in Black Creek, by date, 1992.**

Appendix G. Recovery data for coho salmon recovered as carcasses in Black Creek, by date, 1992.

Date	Number recovered	Number new fish ¹ recovered	Number new fish ¹ ad clipped	Number new fish ¹ filament	Number primary recaptures ²	Number secondary recaptures ³	Number new recovered below fence	Number recovered below fence ad clipped
Adults								
10/20/92	1	0	0	0	1	0	1	1
10/21/92	4	0	0	0	4	0	4	3
10/22/92	4	1	1	0	4	0	3	2
10/26/92	1	0	0	0	1	0	0	0
10/27/92	1	0	0	0	1	0	0	0
10/30/92	1	0	0	0	1	0	0	0
11/01/92	3	0	0	0	3	0	0	0
11/02/92	1	0	0	0	1	0	0	0
11/04/92	1	0	0	0	1	0	0	0
11/05/92	2	0	0	0	2	0	0	0
11/14/92	3	0	0	0	3	0	0	0
11/15/92	1	0	0	0	1	0	0	0
11/16/92	4	0	0	0	4	0	0	0
11/17/92	2	0	0	0	2	0	0	0
11/18/92	5	0	0	0	5	0	0	0
11/19/92	1	0	0	0	1	0	0	0
11/20/92	1	0	0	0	1	0	0	0
11/21/92	2	0	0	0	2	0	0	0
11/22/92	5	0	0	0	5	0	0	0
11/24/92	1	0	0	0	1	0	0	0
11/25/92	2	0	0	0	2	0	0	0
11/26/92	2	0	0	0	2	0	0	0
11/29/92	1	0	0	0	1	0	0	0
12/01/92	1	0	0	0	0	1	0	0
12/02/92	6	0	0	0	5	1	1	1
12/03/92	4	0	0	0	4	0	0	0
12/04/92	4	0	0	0	4	0	0	0
12/07/92	1	0	0	0	1	0	0	0
12/08/92	2	0	0	0	2	0	0	0
12/09/92	1	0	0	0	1	0	0	0
12/16/92	2	0	0	0	2	0	0	0
Total	70	1	1	0	68	2	9	7

Appendix G. Recovery data for coho salmon recovered as carcasses in Black Creek, by date, 1992.
(cont.)

Date	Number recovered	Number new fish ¹ recovered	Number new fish ¹ ad clipped	Number new fish ¹ filament	Number primary recaptures ²	Number secondary recaptures ³	Number new recovered below fence	Number recovered below fence ad clipped
Jacks								
10/21/92	0	0	0	0	0	0	8	5
10/22/92	5	5	5	1	0	0	9	7
10/24/92	1	1	1	0	0	0	0	0
10/27/92	1	1	1	0	0	0	0	0
10/28/92	1	1	1	0	0	0	0	0
11/10/92	2	0	0	0	2	0	0	0
11/14/92	3	0	0	0	3	0	0	0
11/15/92	3	2	2	0	1	0	0	0
11/16/92	2	0	0	0	2	0	0	0
11/17/92	1	1	1	0	0	0	0	0
11/18/92	1	0	0	0	1	0	0	0
11/19/92	2	1	1	0	1	0	0	0
11/21/92	3	1	0	0	2	0	0	0
11/22/92	2	2	2	0	0	0	0	0
11/23/92	1	1	1	0	0	0	0	0
11/25/92	2	0	0	0	2	0	0	0
12/01/92	3	0	0	0	3	0	0	0
12/02/92	2	0	0	0	2	0	0	0
12/03/92	2	1	1	0	1	0	0	0
12/14/92	2	1	1	0	1	0	0	0
Total	39	18	17	1	21	0	17	12

¹new fish are fish captured upstream of the fence that do not possess an operculum tag or tag scar (tag loss)

²primary recaptures are fish that were initially counted and tagged at the fence (includes tag loss fish)

³secondary recaptures are recaptures of fish that were initially counted and tagged upstream of the counting fence (new fish)

Appendix H

**Stream life values for individual coho salmon
recovered as carcasses in Black Creek, 1992.**

Appendix H. Stream life values for individual coho salmon recovered as carcasses in Black Creek, 1992.

Sex	Date tagged	Date recovered	Days dead	Stream life (days)
M	10/23/92	12/03/92	1	40
M	10/23/92	12/03/92	1	40
M	10/25/92	12/03/92	6	33
M	10/31/92	11/26/92	4	22
M	10/31/92	12/02/92	>7	25
M	10/31/92	12/02/92	>7	25
M	11/07/92	12/07/92	2	28
F	10/24/92	11/18/92	6	19
F	10/24/92	11/14/92	2	19
F	10/24/92	11/14/92	2	19
F	10/24/92	11/14/92	4	17
F	10/24/92	11/18/92	5	20
F	10/30/92	11/18/92	3	16
F	10/31/92	12/04/92	>6	28
J	10/23/92	11/25/92	>4	29
J	10/23/92	11/10/92	5	13
J	10/23/92	12/02/92	5	35
J	10/24/92	12/03/92	6	34
J	10/25/92	12/01/92	2	35
J	10/31/92	12/02/92	5	27
J	10/31/92	11/25/92	>4	21

Abbreviations are: M = male; F = female; J = jack