Preliminary Report on Juvenile Chinook Production in the Cowichan River during 1993 and 1994

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A PRELIMINARY REPORT ON JUVENILE CHINOOK PRODUCTION IN THE COWICHAN RIVER DURING 1993 AND 1994.

by

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ABSTRACT

J.R. Candy, D.A. Nagtegaal, and B. Riddell. 1996. A preliminary report on juvenile chinook production in the Cowichan River during 1993 and 1994. Can. Manuscr. Fish. Aquat. Sci. 2354 80 p.

As part of an ongoing study to assess the productivity of chinook salmon (*Oncorhynchus tshawytscha*) in the Cowichan River, the Department of Fisheries and Oceans, Pacific Biological Station, began monitoring the downstream migration of chinook juveniles in 1991. Inclined-plane traps and auger traps were used in 1993 and 1994 to collect information on growth, abundance and migration timing. For both years, trap catch was expanded using two methods to give estimates of hatchery and naturally-spawned chinook migrants. The cross-sectional area method estimated 60-61% and the trap-efficiency method estimated 23-36% of known numbers of hatchery fish released above the trapping site. The production of naturally-spawned chinook juveniles was estimated at 350,000-430,000 in 1993 and 130,000-170,000 in 1994. The Cowichan hatchery released approximately 2.9 million juvenile chinook/year. Hatchery migrants tend to move downstream in a large pulse and most of the hatchery fish appeared in the estuary within a week after release.

RÉSUMÉ

J.R. Candy, D.A. Nagtegaal, and B. Riddell. 1996. A preliminary report on juvenile chinook production in the Cowichan River during 1993 and 1994. Can. Manuscr. Fish. Aquat. Sci. 2354 80 p.

En 1991, dans le cabre d'une visant à évaluer la productivité du saumon quinnat (*Oncorhynchus tshawytscha*) dans la rivière Cowichan, la Station biologique du Pacifique (ministère des Pêches et des Océans) a entrepris un programme d'observation de la migration catadrome des saumons quinnats juvéniles. Des pièges en plan incliné et à vis ont été employés au cours des campagnes de 1993 et de 1994 pour la collecte d'information sur la croissance, l'abondance et le rythme migratoire des jeunes saumons quinnats. Pendant ces deux années, les captures réalisées ont été extrapolées à l'aide de deux méthodes visant à donner une estimation du nombre de quinnats migrateurs issus d'écloserie et de frayères naturalles : la première était basée sur la dimension de l'embouchure du piège, et a permis de recenser entre 60 % et 61 % des effecifs visés; la seconde était basée sur la taux de piégeage effectif, et a permis de recenser entre 23 % et 36 % des recrues de saumons quinnats issues des écloseries en amont de la sation de piégeage. Dans le cas du recrutement des quinnats juvéniles issus de frayère naturelles, on a estimé qu'il se situait entre 350 000 et 430 000 et entre 130 000 et 170 000 en 1994. L'écloserie de Cowichan a relâché environ 2,9 millions de quinnats juveniles par année. La catadromie des jeunes migrateurs issus d'écloserie tend à s'opérer par mouvements pulsatoires et le trajet entre la frayère et l'estuaire se fait généralement en une semaine.

INTRODUCTION

The Cowichan watershed is a major salmon producing river on the south-east coast of Vancouver Island. Chum salmon (*Oncorhynchus keta*), chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*) all use this drainage for spawning (Neave 1949). Due to a decline in production of chinook salmon in the Strait of Georgia and the importance of this river to local fisheries, the Cowichan River was chosen as an indicator stock for the status of naturally-spawning chinook in the southern portion of the Strait of Georgia, excluding the Fraser River stocks. The results of this productivity study are used to assess stock rebuilding strategies, evaluate the effects of harvest management policies, and assess interactions between hatchery and naturally-spawned chinook. For the purpose of this report, naturally-spawned fish were those fish that were naturally reared in the river whether the parents were of 'wild' or hatchery origin. Hatchery-reared chinook are artificially propagated in the hatchery prior to release into the river.

The adult portion of the Cowichan River productivity study was initiated in 1988. A counting fence provides escapement numbers and allows the collection of biological data on returning adult chinook. Fence counts were used to test the accuracy of other enumeration techniques such as DFO Fishery Officers swim surveys and mark-recapture methods. (Nagtegaal et al. 1994 a,b,c, and 1995). The juvenile portion of the study was initiated in 1991 to provide estimates of fry production, determine migration timing, and assess in-river interactions between hatchery reared and naturally-spawned populations (Candy et al. 1995).

The juvenile production of chinook salmon in the Cowichan River has been examined twice previously. Both studies were before artificial culture (hatchery) began in 1980. In the mid 1960's Lister et al. (1971) estimated coho and chinook juvenile abundance and adult spawning escapement. They found that in 1966 and 1967 almost all of the wild chinook fry in the Cowichan river emigrated as underyearlings, either as emergent fry (mean=42 mm) in March and April or smolts (mean=60-80 mm) in late May and June. Using an inclined-plane trap they estimated total chinook fry migration to be 2.6 million (1966) and 1.6 million (1967). The estimate for 1967 was considered incomplete due to forced termination of trapping before end of the smolt migration. In 1975 and 1976, chinook smolt production was estimated during an early study in the use of coded wire tags (CWT) (Armstrong and Argue 1977, Argue et al. 1979). Estimates were 581,000 (1975) and 172,300 (1976) based on smolts marked in the river and recaptured in Cowichan Bay. Egg to smolt survival rates ranged from 6.3% to 1.2% in 1976.

The majority of chinook in the Cowichan system are considered to be 'ocean-type' (Healey 1991), which migrate to sea during their first year of life, normally within three months after emergence. Lister et al. (1971), divided the chinook migrants into an early and late group based on size. The "early group" (March-April), comprising the majority of the migrants, consisted of primarily emergent fry averaging approximately 42 mm in length. The "late group" migrants (May-June) were fingerlings averaging over 55 mm. Up to 16% of the chinook migrants were designated as "late group". They spent up to 90 days in freshwater prior to migrating out to sea.

Hatchery production of chinook on the Cowichan River began in 1980 (Cross et al. 1991). From an initial release of 64,681 chinook fry in 1980, production has been increased to between 1.5 and 3 million in recent years. The hatchery incorporates three main release groups (early, late, and lake-pen), but also releases smolts from sea-pen sites in Cowichan Bay and Saanich Inlet. The early release occurs from mid to late April and the late release occurs from mid May to early June at a number of sites along the river. Chinook released from Cowichan Lake are initially reared at the hatchery then transferred to net-pens in the lake. These fish are released at approximately the same time as late release group. Since 1980 a portion of the hatchery releases were marked by coded-wire tagging (CWT) (Jefferts et al. 1963). In 1993, the Cowichan hatchery released 2.97 million juveniles of which 239,346 (8.0%) were marked with CWT (Table 1). In 1994, the Cowichan hatchery released 2.93 million juveniles of which 225,591 (7.7%) were marked with CWT.

This report presents the results of the juvenile chinook production study, which includes migration timing, growth, interaction, and abundance estimates of naturally-spawned and hatchery chinook juveniles in the Cowichan River for 1993 and 1994.

METHODS

STUDY SITE DESCRIPTION

The Cowichan River flows 50 km from Cowichan Lake to Cowichan Bay on the east coast of Vancouver Island through the City of Duncan. The Cowichan drainage area is 840 km^2 and the river has a mean annual discharge of 55 m^3/sec (Inland Waters Directorate, 1988). Skutz Falls and Marie Canyon, 18 km downstream of Cowichan Lake, may partially obstruct salmon migration during years of low flow. Chinook salmon spawn in the main stem of the Cowichan River, principally above Skutz Falls and below Cowichan Lake.

OVERVIEW

We located traps at two sites along the Cowichan River in 1993 and 1994, in a configuration similar to that used in 1992 (Candy et al. 1995). The Block 51 site, just above Skutz Falls, was the only road accessible site situated just below the main chinook spawning area. The second site at the old City of Duncan Pumphouse, at the lower end of the river, allowed us to sample all juveniles from chinook adults passing above the enumeration fence to spawn (Figure 1). The disadvantage with the Pumphouse site is that we were also trapping large numbers of chum fry. In-river residence time of hatchery releases could be obtained by observing the migration at the two sites. Purse seining and beach seining in Cowichan Bay allowed us to determine differences in hatchery and naturally-spawned juvenile estuarine utilization and residence time. Juveniles were also sampled concurrently from the river and the hatchery to compare growth of hatchery and naturally-spawned fish.

GEAR DESCRIPTION

Inclined-plane trap (IPT)(1993,1994)

Aluminum .6 m x 1.2 m inclined-plane traps were used in 1993 and 1994. The traps were kept in position in the river by polypropylene bridles connecting the bottom corners of the trap to a 1.2 cm galvanized cable suspended across the river approximately 20 m upstream. In an attempt to maintain optimum trapping efficiency, the aluminum floatation pontoons on either side of the trap were flooded with water and used as ballast.

Rotary auger trap (1.5 m and 2.4 m diameter) (1993,1994)

This trap[1] consisted of a revolving stainless steel mesh cone and enclosed auger, suspended between two 6.5 m floats. The auger paddles turn in the flow, trapping fish and forcing them back into the live-box. It was positioned in the river by polypropylene bridles connected from the front corners of the trap to a 1.2 cm galvanized cable suspended across the river approximately 18 m upstream.

Beach seine (1993)

A small beach seine (30 m in length and 2.3 m deep) was used to collect juvenile chinook. Mesh size was .4 cm at the wings and 1.2 cm in the main body of the net. A jet-propelled flat bottomed aluminum skiff was used to manoeuvre the net in the estuary and a 4 m inflatable boat was used in the river.

Purse Seine (1993, 1994)

A small purse seine (200 m long and 27 m deep) which fished an area approximately 3851 m^2 was used to examine the distribution of juvenile chinook in Cowichan Bay. The seine net had a marquisette webbing that would retain fish greater than 3 cm. The net was fished from the FRV Caligus (1993, 1994).

TRAPPING/SAMPLING PROCEDURES

1) River and Estuary trapping and sampling

Fish were enumerated three nights a week (Monday, Wednesday, Friday) at both the Pumphouse and Block 51 sites in 1993 and 1994. A standard sampling interval was used from 19:00 to 01:00 from February 26 until April 5 1993 and Feb 28 until April 4 1994. The sampling

[1] manufactured by E.G. Solutions, Corvallis, Ore., USA.

interval was shifted one hour later to 20:00-02:00 in both 1993 and 1994 to coincide with changes from Pacific Standard time to Daylight Savings time. Trapping was terminated May 10 (Block 51) and June 2 (Pumphouse) in 1993, and April 30 (Block 51) and June 10 (Pumphouse) in 1994. Traps were checked at 2 h intervals and approximately 50 chinook were kept for samples each evening. If catches were low, the fish were sometimes left in the trap and checked again in the early morning. During high flow conditions, the traps were checked frequently to remove debris and prevent fish descaling. If catches were extremely large (>1000 fish) the catch was sub-sampled.

In 1993, a 1.5 m auger trap and a IPT were used at the Pumphouse (site 7b, March 1-April 17) and a side-by-side pair of IPT's (site 7b, April 19- May 15; site 7f May 17-June 2). In 1993, at Block 51, a side-by side pair of IPT's were used (site 5b, February 26-May 10). In 1994, we trapped with an 2.4 m auger trap and IPT at the Pumphouse (site 7 a-b, 28 February-April 26, and site e-f, April 27-June 10) and two IPTs at Block 51 (site 5b, March 7-April 30) in 1994. At both the Pumphouse and Block 51, site traps were moved upstream to a narrower faster section of the river during low flow conditions later in the spring (Figure 2).

Flow meter (General Oceanic 2030R)[2] measurements were taken for each sampling evening at the Pumphouse and Block 51 sites in 1993 and 1994. Flow rates were calculated by the number of revolutions in a five minute interval, multiplied by a rotor constant to give flow values in m/s. In addition, water temperature, water clarity (1-clear, 2-cloudy), and atmospheric conditions (1-clear, 2-cloudy, 3-raining), were recorded.

The pattern of diel migration was observed at weekly intervals by continuous 24 h sampling at both the Pumphouse and Block 51 site. Continuous night and day sampling was used to determine the proportion of the nightly migration which was caught in the standard 6 h sampling interval. Sampling events were combined, a mean number of chinook migrants moving during the day and overnight were stratified by year and type (naturally-reared vs hatchery).

Beach seining occurred on June 3 1993 at Road pool and on June 8 1993 in the estuary to assess the number of residual juveniles. Purse seining was carried out along the north and south mouth of the Cowichan River and along the north shore of Cowichan Bay towards Separation Point using sampling sites established by Lister et al. (1971)(Figure 3). Purse seining occurred on June 10, 1993, May, 18 1994, and June 8, 1994.

Hatchery sampling

Approximately 30 hatchery fry were randomly netted from holding ponds at the Cowichan hatchery on a weekly basis from March 4 to May 18, 1993 and March 3 to May 10, 1994. These fish were representative of the three main release groups (early, late, and lake pen). Once moved

[2] General Oceanic, 1295 NW 163rd St., Miami, Florida, USA.

to Cowichan Lake, the lake pen release group were sampled from the net-pens. All juveniles were weighed and measured for fork length.

Trap catch comparisons

To determine the difference in trapping efficiency between the IPT and 1.5 m Auger trap, both were fished simultaneously side-by-side and the catch data compared from 2 h sampling intervals. The proportion of chinook juveniles to the total catch was compared using a chi-square test and the difference in trapping efficiency was examined using a T-test (Zar 1984).

BIOLOGICAL SAMPLING

All fish were examined and the numbers recorded by species, gear/release strategy, date, and time of day. A random subsample of nightly catches were anaesthetized using MS-222 or carbon dioxide and sampled for length and weight. Based on the body size and shape we categorized juvenile chinook as naturally-reared, hatchery, or unknown. We also sampled a portion of the adipose clipped fry to recover CWT information on hatchery release strategies. On a weekly basis, approximately 30 fish from the Pumphouse, Block 51 and hatchery site were frozen for future analysis.

ESTIMATE OF FRY MIGRATION ABUNDANCE

Cross-sectional area estimate of juvenile chinoook abundance

An estimate of juvenile abundance for 1993 and 1994 was calculated using the same cross-sectional area methods used in 1992 (Candy et al. 1995). Estimates were calculated using catch data from the IPT and 1.5 m Auger trap (1993) and the 2.4 m Auger trap (1994) at the Pumphouse site (see Appendix 1 and 2). An estimate of total chinook fry migration was determined by expanding the catch using a ratio of trap cross-sectional area compared to the river cross-sectional area. Most evenings a portion of the fry movement was sampled during a standard 6 h interval (19:00-01:00 PST or 20:00-02:00 DST). The numbers were expanded by an estimate of the percentage sampled determined by overnight and daytime sampling. Nightly estimates of fry numbers were summed over the duration of the run to obtain a total estimate of fry abundance.

Daily total juvenile numbers were determined by expanding the proportion of the catch (R_t) to the ratio of cross-sectional area of the trap mouth (O_t) and the total cross-sectional area of the river (K_d) for sampling interval t. The trap mouth cross-sectional area of 0.543 m^2 for the IPT. The trap mouth cross-sectional area was 0.91 m^2 and 2.33 m^2 for the 1.5 m and 2.4 m auger trap respectively. The river cross-sectional area values were 48.1 m^2 for site 7a-c and 30.1 m^2 for sites 7e-f. The effective fishing area (O_t) was adjusted if the entire cross-sectional area of

the trap mouth was not fishing. The sampling interval t was then multiplied by the proportion of catch (P_t) expected for the entire night as determined by overnight and daytime sampling events (equation 1).

$$(1) \qquad N_d = R_t * \frac{K_d}{O_t} * P_t$$

Where:

N_d was number of fish passing downstream for day d,
K_d was the cross-sectional area of the river at sampling site for that sampling date(m^2),
R_t was the number of fish caught in trap during sampling interval t,
O_t was the effectively fishing cross-sectional area of trap mouth (m^2),
P_t was the proportion of the 24 h catch sampled during time interval t for day d.

The total abundance was then determined by summing the daily totals for the duration of trapping. For those nights when no trapping occurred (Tuesday, Thursday, Saturday, and Sunday) we assumed the number of migrants to be an average value obtained from the previous and post nights sampling.

Trap efficiency estimate of juvenile chinook abundance

At the Pumphouse site, mark-recapture of juvenile migrants was used to provide an estimate of trap efficiency. We marked chum fry, coho fry, hatchery chinook, and naturally-reared chinook fry. Fish caught the previous night were held in a large holding tank, then marked with Bismark brown Y using methods outlined in Ward and Verhoeven (1963). The marked fish were released between 100-500 m above the trap site at the start of a trapping evening. The ratio of marked to unmarked fish recovered in the trap provided an estimate of trap efficiency (E_t)(equation 2).

$$(2) \qquad E_t = \frac{m_t}{M_t}$$

Where:

E_t was the trap efficiency for sampling interval t,
m_t was the number of marked fish recovered for interval t,
M_t was the number of marked fish released for interval t.

Trap efficiency determined by trap site and trap type, was used to expand trap catch to total number of migrants during the sampling interval t. The sampling interval t was then multiplied by the proportion of catch (P_t) expected for the entire night as determined by overnight

and daytime sampling events (equation 3).

(3) $$N_d = R_t * E_t * P_t$$

Where :

N_d was the number of fry passing downstream for day d,
R_t was the number of fish caught in the trap during sampling interval t,
E_t was the trap efficiency for sampling interval t,
P_t was the proportion of the 24 h catch sampled during time interval t for day d.

The total abundance was then determined by summing the daily totals for the duration of trapping. For those nights when no trapping occurred (Tuesday, Thursday, Saturday, and Sunday) we assumed the number of migrants to be an average value obtained from the previous and post nights sampling.

RESULTS

RIVER CONDITIONS

Winter flows on the Cowichan River were considerably lower in 1993 and 1994 than the previous two years (Candy et al. 1995). With the exception of peak flows in late December and January 1994, discharge rates were below the 30-yr average for the entire winter in both years (Figure 4 and 5). Flooding conditions caused by peak flows in early March 1993 prevented trapping for several nights (Figure 6). In 1994, discharge rates followed the typical pattern of higher winter flows starting to abate by late February-early March (Figure 7). Water temperatures rose from 5°C in early March to 15-17°C by the beginning of June 1993. In 1994, water temperatures were at 7°C in early March and 18°C by early June.

In 1993, flow meter readings from the Pumphouse site ranged from 2.3 m/s in mid March to 1.3 m/s by late May (Table 2). In 1994, flow meter reading from the Pumphouse site ranged from 1.5 m/s in mid March to 0.8 m/s in mid June (Table 3). Traps were moved from the lower site (7b) to the upper site (7e) to reduce the effects of trap avoidance when flow meter readings were at 1.3 m/s in 1993 and 0.85 m/s in 1994.

JUVENILE CHINOOK MIGRATION TIMING

Naturally-reared chinook migrants were trapped at a steady rate from March 1 to mid-April in 1993 and 1994 (Figure 8 and 9). No large peaks in numbers migrating downstream were observed but we were unable to trap during flooding from March 19 to March 26, 1993.

The early hatchery release (907,719 smolts) was the first release above the trap site and

occurred on April 7, 1993. Few hatchery chinook were caught on April 7 and 9, presumably most of these fish moved past on April 8 when the trap was not fishing (Figure 8). A second peak of hatchery fish was caught on May 11 corresponding to the May 10 lake-pen release and a third peak of hatchery fish was caught on May 18 corresponding to the May 17 late release. In 1994, an early release (684,279 smolts) occurred on April 18. Continuous trapping over period of this release indicated that the peak of these fish had moved through by April 22 (Figure 9). Less distinct peaks in catch of hatchery fish were found to correspond to the lake-pen and late releases in 1994. By May 17 1993 and May 20 1994 we classified all juvenile chinook as hatchery origin.

In 1993 and 1994 CWT marked chinook generally appeared at the Pumphouse site within a day of release, with the bulk of the marked fish recovered after several sampling nights (Table 4 and 5). In 1993, the last in-river CWT recoveries for the release group occurred one month after the early release, two weeks after the lake pen and late releases. In 1994, the last recovery for the early, late and lake pen release groups occurred on the last sampling evening in June 10, thus some of the early release fish had remained in the river for two months.

JUVENILE CHINOOK GROWTH

A random sample from each release group was measured for length and weight just prior to release, and is summarized with CWT release codes for 1993 (Table 6) and 1994 (Table 7). The juveniles from the early hatchery release group were considerably smaller than fish from the late and lake pen release groups.

With the exception of a few hatchery fish from the early release, there was little change in the mean size (40-44 mm range) of chinook trapped at the Pumphouse site from early March to late April in 1993 indicating the proportion of hatchery fish in the catch after the early release remained low (Table 8). Interception of the early release in 1994 caused an increase in mean size from the 40-44 mm expected from the naturally-spawned fish to 59-67 mm with the addition of hatchery fish in the trap catch. (Table 9). Although the mean size decreased slightly after the peak of the early release past, the mean size remained higher than that seen in 1993. In both 1993 and 1994, the mean size increased to the 75-80 mm range after the late and lake-pen releases with the trap catches composed of almost entirely hatchery fish. In 1994, juvenile length (Figure 10) and weight (Figure 11) stratified by type (hatchery, naturally-spawned, unknown) show by early May an overlap in smaller hatchery and larger naturally-spawned juveniles.

Beach seining in Cowichan Bay and the Road Pool provided information on the number of chinook juveniles remaining in the Cowichan system by early June. Of 25 juvenile chinook seined in Road Pool on June 10 1993, three were thought to be of hatchery origin (one adipose clipped) while the remaining fish were thought to be from natural-spawners (Table 8). Chinook caught beach seining in Cowichan Bay in June 1993 ranged in size from 49-75 mm (mean= 61 mm). Chinook caught purse seining ranged in mean size from 70-90 mm in 1993 and 78-90 mm in 1994 (Table 8 and 9). Most of the fish caught in the beach seining were smaller, assumed to be naturally-spawned fish whereas, the juvenile chinook caught purse seining in deeper water

tended to be larger and were assumed to be predominantly hatchery fish.

TRAP CATCH EFFICIENCY COMPARISON

Both the 1.5 m and 2.4 m Auger trap were found to be considerably more efficient at capturing fish than the IPT (T-test, $P<0.05$). The 1.5 m Auger trap caught approximately 3 times as many chinook fry as the IPT for a standard 2 h sampling period (Figure 12), although the cross-sectional sampling area of the Auger trap was only about 40% greater (0.543 m^2 vs 0.91 m^2). The 2.4 m Auger trap caught greater than 10 times more fish compared to the IPT (Figure 14). The proportion of chinook trapped compared to the total catch of all species remained the same for both Auger traps compared to the IPT (chi-square, $P>0.05$)(Figure 13 and 15).

ABUNDANCE ESTIMATE

Cross-sectional area estimate

In 1993, catch data from the Auger trap was used preferentially over the IPT because the Auger trap sampled a larger proportion of the migrants and was more efficient at sampling during extreme flows. In 1994, only the 2.4 m Auger trap was used. Approximately 45% of the total daily catch could be expected from the 6 h sampling period for 1993 and 1994 based on the diel movement information collected (Figure 16). For sampling durations longer than 9 h (usually 12 h or 24 h) 100% of nightly catch was assumed. It was assumed that 10% of the hatchery fish and naturally-spawned fish moved during daylight hours (Figure 17).

Daily estimates of chinook migrants, calculated using the cross-sectional area method can be seen in Tables 10 and 11. We estimated 426,735 naturally-spawned chinook and 1.5 million hatchery juveniles in 1993, and 126,427 naturally-spawned chinook and 1.4 million hatchery chinook juveniles in 1994 passed the Pumphouse site (Table 10). This estimate accounts for 60 % of the 2.5 million hatchery chinook (1993) and 61% of the 2.3 million hatchery chinook (1994) released above the Pumphouse site.

Trapping efficiency estimate

There was approximately 2.5 to 6 times increase in trapping efficiency between the lower (7a) and upper (7e) Pumphouse sites for a given trap type and species (Table 13). Based on the mark-recapture data we estimated a trap efficiency of 1% (7b) and 6% (7e) for the IPT. We did not measure trapping efficiency for the 1.5 m Auger trap, but comparison of catch data determined that the Auger trap was 3 times more efficient than the IPT so a trapping efficiency of 3% (7b) and 18% (7e) was assigned to the 1.5 m uger trap in 1993. A trap efficiency of 3.5% (7b) and 20.5% was determined by mark-recapture for the 2.4 m Auger trap for 1994.

Again, approximately 45% of the total daily catch could be expected from the 6 h

sampling period for 1993 and 1994. (Figure 16). For sampling durations longer than 9 h (usually 12 h or 24 h) we assumed 100% of nightly catch. We assumed that 10% of the hatchery fish and naturally-spawned fish moved during daylight hours (Figure 17).

Daily estimates of chinook migrants calculated using the trap efficiency method are listed in Tables 10 and 11. Based on these calculations, 349,298 (1993) and 173,387 (1994) naturally-spawned chinook fry and 565,266 (1993) and 845,587 (1994) hatchery fish passed the pumphouse site (Table 12). Trap efficiency methods considerably underestimated (23%-1993, 36%-1994) what we might have expected to catch from hatchery releases above the trap site.

DISCUSSION

ABUNDANCE ESTIMATES

It was estimated that approximately 350,000 to 430,000 naturally-spawned chinook juveniles in 1993 and 130,000 and 170,000 naturally-spawned juveniles in 1994 migrated from the Cowichan River. Downstream movement occurred from early March to mid-May. There was no distinct peak of migration as was seen in 1992. With greater confidence in our ability to distinguish between naturally-spawned and hatchery juveniles, we were able to estimate the naturally-spawned component of the migration after the hatchery releases had occurred. However, there are some concerns regarding successful identification between smaller hatchery and larger wild fish once there is a size overlap which occured by mid-May.

Chinook fry abundance estimates calculated from catch data and the cross-sectional area ratios between the sampling device and river have been reported by others (Healey and Jordan 1982). Fry abundance estimates are very sensitive to changes in the ratio of trap cross-sectional area to river cross-sectional area. In addition, the ratio of cross-sectional areas assumes that fry distribution is uniform both horizontally and vertically. This is not the case for many species which may orientate to different parts of the river (Mains and Smith 1964, Thedinga et al. 1994, McDonald 1960). Taylor and Bradford (1993) found that Stuart River wild chinook tend to migrate along the shore while hatchery fish were more evenly dispersed across the river. Healey and Jordan (1982) determined the potential overestimate due to non-random vertical and horizontal distribution of fry was on the order of 10%. The proportion of the trap mouth opening that was effectively fishing (P) was not measured during our study. It was assumed that the full cross-section of the trap mouth was fishing at all times. This assumption was valid under most circumstances, except possibly under conditions of extremely low flows when no amount of adjustment would improve the ability of the IPT's to trap fish.

Chinook fry abundance estimates calculated by trap efficiency were likely biased as well. It was assumed that fish marked using Bismark Brown have the same capture rate as the unmarked fish. However, stress associated with marking the fish may alter behaviour (i.e. orientation in river, ability to avoid trap) causing differential recovery rates. Efficiency tests from other studies (Thedinga et al. 1994, Roper and Scarnecchia 1996) indicate that trap efficiency can

vary considerably between species, flow rates and fish size. For our study we assumed that trap efficiency was the same for hatchery and naturally-spawned chinook juveniles because not enough naturally-spawned juveniles could be collected to mark and release. It is quite likely that the larger hatchery fish do not behave in the same way as the smaller naturally-spawned juveniles and may avoid the trap at different rates especially under low flow conditions.

We compared our estimates of hatchery chinook abundance with the known number of hatchery fish released above the trapping site. The cross-sectional area method estimated between 60-63% of the hatchery fish released above the trap site. Trap efficiency methods estimated (23%-1993, 36%-1994) hatchery releases above the trap site. Part of the discrepency between expanded estimates can be attributed to the upper trapping site (7e) where the trap efficiency method estimated only 30% of the chinook fry determined by the cross sectional method. The discrepancy between release numbers and our estimates may be due to a number of reasons: 1) uncertainty in expansion factors (i.e proportion of daily catch sampled, cross-sectional area estimates), 2) missing a large part of the migration due to trap avoidance or fish passage when trap was not fishing, or 3) juvenile migrants less than release numbers (i.e. river predation, delayed migration). The 1993 estimate was low partially due to missing most of the early release. In 1994 we probably missed the peaks of lake pen and late hatchery releases. Only continuous trapping would successfully sample large pulses of migrants moving over short durations. Beach seine sampling in early June in the upper river at Road Pool indicated that most hatchery juveniles have moved downstream so delayed migration appears to be minimal. Although there were considerable differences between the estimates of hatchery fish using either of these methods, estimates of naturally-spawning fry were quite comparable.

EGG TO FRY SURVIVAL

Calculation of egg to fry survival is dependent on both good escapement and fry abundance data. According to Nagtegaal et al. (1994c, 1995), chinook escapement was 6676 (1992) and 5047 (1993), based on a combination of fence count, swim survey data, and mark-recapture. The number of female spawners was calculated to be 3621 (1992) and 2977 (1993). Using estimates of female spawner abundance, average fecundity of 4030 eggs/female (1992) and 3861 eggs/female (1993) (Millerd pers. comm.), egg to fry survival was calculated for both cross-sectional area and trap efficiency estimates. Assuming 16% of the population to be considered as "late migrants" (Lister et al. 1971, Argue et al. 1979), the egg to fry survival for the 1992 brood was estimated to range between 2.8% and 3.4%. For the 1993 brood survival was estimated to range between 1.3% and 1.7%. The 1992 and 1993 brood year egg to fry survivals were considerably lower than that estimated (7.4%-16.1%) for the 1991 brood (Candy et al. 1995).

Our estimates of egg to fry survival compare favourably to other studies (Healey 1991, Taylor and Bradford 1993) and to previous estimates for the Cowichan System (Lister et al 1971, Argue et al. 1979) ranging from 1.2% to 6.3%. Differences in survival among years may be due to spawner distribution and environmental conditions. For both the 1992 and 1993 broods, a portion of the spawning occurred in the middle-lower river below what is considered traditional

spawning grounds (Nagtegaal et al. 1994c, 1995). Lower survival recorded for these broods may be due to reduced spawner success because of poorer spawning gravel or possibly superimposition of chum spawning in the middle-lower river sections. In addition, flood conditions were more severe in the winter of 1994 which may have also contributed to lower survival rates of the 1993 brood compared to the 1992 brood.

JUVENILE CHINOOK GROWTH

A steady increase in average naturally-spawned juvenile size over the migration period indicated that a proportion of the population spend some time rearing in the river before moving to the estuary. Healey (1991) noted that this was quite typical of coastal systems like the Cowichan River. Fish caught in the trap are likely a combination of juveniles that emerged from the gravel and immediately moved downstream and those that remained in the river above the traps for some weeks prior to migrating to the estuary. The size range of the naturally-spawned juveniles included newly emerged fry (30-40 mm), but by May, larger fish (>70 mm) were caught. This suggests that emergence occurred between late February and late April. Understandably, the hatchery juveniles grew substantially faster than naturally-spawned juveniles and were generally considerably larger and heavier. By late May, however, the largest naturally-spawned fish overlapped size with the smaller hatchery fish.

JUVENILE CHINOOK INTERACTION

Preliminary observations indicate that hatchery chinook released in the river move quickly to the estuary. Although some hatchery fish were captured up to 2 months after being released, the majority of fish moved downstream in a large pulse over a few days. Hatchery-released fish do not appear to trigger migration of the naturally-spawned juveniles. However, there was a slight increase in naturally-spawned migrants corresponding with the early hatchery release in 1994. There appears to be limited opportunity for interaction between naturally-spawned and hatchery chinook in the river. In 1993 and 1994 we recovered considerably more of the lake pen releases than we had in 1992, although this number was about 1/3 less than was expected from the number released.

Although sampling was limited in the estuary, smaller, presumably naturally-spawned chinook were caught in beach seines near shore. A higher proportion of larger, presumably hatchery chinook were caught in purse seines in the deeper water. Levings (1982) observed that smaller chinook tend to rear in shallower waters in the estuary. Studies of the Campbell and Nanaimo River estuaries (Levings et al. 1986; Healey 1980) noted that hatchery chinook resided in the estuary for a much shorter time period than naturally-spawned juveniles before moving out into the marine environment. They indicated that the potential for interaction between naturally-spawned and hatchery chinook was greatest in the transition zone. These findings suggest that interaction between these two groups in the Cowichan system are probably minimal in both the river and the estuary.

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Table 1. Chinook fry release information by tag code[1], Cowichan hatchery 1985-94.

Tag Code	BY	Number Tagged	% Tag Loss	Number Released	CWT % Mark	Weigh (gm)	Release Date ddmmmyy:ddmmmyy	Release site
023803	85	25365	1.7	25804	98.3	4.3	23May86:24May86	HATCHERY
023804	85	25455	1.7	25895	98.3	4.3	23May86:24May86	HATCHERY
023911	85	11980	1.7	12187	98.3	4.3	23May86:24May86	HATCHERY
024334	87	14298	0.3	14334	99.7	3.4	:18Apr88	BELOW FENCE
024729	87	25360	0.3	25424	99.7	3.4	:18Apr88	BELOW FENCE
024730	87	25869	0.3	25934	99.7	3.4	:18Apr88	BELOW FENCE
024731	87	27428	0.3	27497	99.7	7.1	18Apr88:18May88	LAKE PEN
024732	87	27271	0.2	27339	99.8	7.1	:18May88	LAKE PEN
024733	87	26911	0.2	26978	99.8	7.1	:18May88	LAKE PEN
024734	87	23521	0.3	23580	99.7	7.1	:18May88	LAKE PEN
024735	87	26719	0.3	26786	99.7	3.4	18Apr88:18May88	BELOW FENCE
024945	87	26461	0.5	26594	99.5	4.9	:25May88	ROAD POOL
024946	87	26658	0.5	26792	99.5	4.9	:25May88	ROAD POOL
024947	87	26761	0.5	26895	99.5	4.9	:25May88	ROAD POOL
025008	87	26817	0.5	26952	99.5	4.9	:25May88	ROAD POOL
024860	88	25117	0.5	25243	99.5	3.7	:28Apr89	STOLTZ/BELOW FENCE
025012	88	26595	0.0	54768	48.6	6.5	:21May89	HATCHERY
025013	88	25982	0.0	54154	48.0	6.5	:21May89	HATCHERY
025015	88	23058	7.4	24894	92.6	3.7	:28Apr89	STOLTZ/BELOW FENCE
025016	88	26821	0.0	26821	100.0	3.7	:28Apr89	STOLTZ/BELOW FENCE
025017	88	27611	2.0	28175	98.0	3.7	:28Apr89	STOLTZ/BELOW FENCE
025523	88	27531	1.5	56123	49.1	6.5	:21May89	HATCHERY
025524	88	27205	0.0	55378	49.1	6.5	:21May89	HATCHERY
025749	88	26922	0.0	133331	20.2	6.1	:15May89	LAKE PEN
025750	88	27036	0.0	133446	20.3	6.1	:15May89	LAKE PEN
025751	88	23106	2.5	130107	17.8	6.1	:15May89	LAKE PEN
025752	88	26169	1.0	132842	19.7	6.1	:15May89	LAKE PEN
020352	89	28287	1.0	28573	99.0	3.4	12Apr90:12Apr90	BELOW FENCE
020522	89	27072	1.0	36800	73.6	6.5	22May90:23May90	STOLTZ/BELOW FENCE
020622	89	27787	0.0	37242	74.6	6.5	22May90:23May90	STOLTZ/BELOW FENCE
020623	89	28164	0.0	37619	74.9	6.5	22May90:23May90	STOLTZ/BELOW FENCE

Table 1 - continued.

Tag Code	BY	Number Tagged	% Tag Loss	Number Released	CWT % Mark	Weigh (gm)	Release Date ddmmmyy:ddmmmyy	Release site
020624	89	28331	0.0	37786	75.0	6.5	22May90:23May90	STOLTZ/BELOW FENCE
020938	89	28312	0.0	28312	100.0	3.4	12Apr90:12Apr90	BELOW FENCE
020939	89	26218	0.0	26218	100.0	3.4	12Apr90:12Apr90	BELOW FENCE
026103	89	27145	0.0	27145	100.0	3.4	12Apr90:12Apr90	BELOW FENCE
026255	89	26400	0.0	119674	22.1	7.2	:14May90	LAKE PEN
026256	89	25693	2.0	119497	21.5	7.2	:14May90	LAKE PEN
026257	89	25790	1.0	119325	21.6	7.2	:14May90	LAKE PEN
026258	89	25219	1.0	118748	21.2	7.2	:14May90	LAKE PEN
020333	90	25687	0.0	94172	27.3	8.4	15May91:15May91	LAKE PEN
020334	90	25898	0.0	94384	27.4	8.4	15May91:15May91	LAKE PEN
020335	90	25739	0.0	94224	27.3	8.4	15May91:15May91	LAKE PEN
020336	90	27135	0.0	27135	100.0	3.3	17Apr91:17Apr91	STOLTZ/BELOW FENCE
020337	90	26631	0.0	26631	100.0	3.3	17Apr91:17Apr91	STOLTZ/BELOW FENCE
020338	90	27046	0.0	27046	100.0	3.3	17Apr91:17Apr91	STOLTZ/BELOW FENCE
020339	90	26721	0.5	34318	77.9	6.4	21May91:22May91	SKUTZ/ABOVE SKUTZ FALLS
020340	90	26993	0.5	34592	78.0	6.4	21May91:22May91	SKUTZ/ABOVE SKUTZ FALLS
020341	90	26533	0.0	33995	78.0	6.4	21May91:22May91	SKUTZ/ABOVE SKUTZ FALLS
020342	90	25437	0.0	92182	27.6	4.8	17Jun91:18Jun91	STOLTZ/BELOW FENCE
020343	90	25391	0.0	92136	27.6	4.8	17Jun91:18Jun91	STOLTZ/BELOW FENCE
180513	91	26972	0.0	336330	8.0	5.0	17May92:17May92	LAKE PEN
180514	91	25964	1.0	335584	7.7	5.0	17May92:17May92	LAKE PEN
180515	91	27694	0.0	175107	15.8	4.0	21Apr92:22Apr92	BELOW FENCE
180516	91	27148	1.0	174834	15.5	4.0	21Apr92:22Apr92	BELOW FENCE
180517	91	27471	0.0	248584	11.1	5.3	20May92:21May92	STOLTZ/VIMI POOL
180518	91	27277	0.0	248389	11.0	5.3	20May92:21May92	STOLTZ/VIMI POOL
180519	91	27432	0.5	160695	17.1	3.8	21Apr92:22Apr92	BELOW FENCE
180520	91	27001	0.5	160262	16.8	3.8	21Apr92:22Apr92	BELOW FENCE
180521	91	26871	0.0	27444	97.9	6.3	29May92:29May92	SEA PEN
180522	91	26852	0.0	27424	97.9	6.3	29May92:29May92	SEA PEN
180209	92	24770	0.5	98974	25.0	6.3	25May93:25May93	SEA PENS
180210	92	26383	0.0	327416	8.1	5.9	17May93:19May93	LATE ROAD POOL
180550	92	25311	0.0	326344	7.8	5.9	17May93:19May93	LATE ROAD POOL

Table 1 - continued.

Tag Code	BY	Number Tagged	% Tag Loss	Number Released	CWT % Mark	Weigh (gm)	Release Date ddmmmyy:ddmmmyy	Release site
181042	92	53620	1.0	412953	13.0	6.5	25May93:25May93	HATCHERY
181043	92	54235	0.5	901937	6.0	5.6	10May93:10May93	LAKE PEN
181044	92	55027	0.5	907719	6.1	3.6	07Apr93:07Apr93	EARLY ROAD POOL
021211	93	24875	0.0	103900	23.9	6.2	25May94:25May94	SEA PENS
181319	93	49966	0.0	1001002	5.0	6.3	05May94:05May94	LAKE PENS
181320	93	50420	0.0	684279	7.4	3.8	18Apr94:18Apr94	EARLY ROAD POOL
181321	93	50045	0.3	652354	7.7	6.1	18May94:18May94	LATE ROAD POOL
181322	93	50285	0.0	490079	10.3	6.1	24May94:24May94	HATCHERY

[1]Data retrieved from MRP data base (Kuhn 1988).

Table 2 - Flowmeter reading by site, Cowichan River, 1993.

Date ddmmyy	7A-B-C (m/s)	7E-F (m/s)	5A (m/s)	5B (m/s)
260293			.96322	
010393	1.1795		.28969	
030393	1.3121		1.0208	
050393	1.8488		1.4994	
080393	1.3721		1.5156	
100393	1.4889		1.4351	
120393	1.4141		1.1700	
150393	1.3366		1.2156	
170393	1.6058		1.0450	
190393	1.4527		1.1204	
220393				
260393	2.3372		1.6264	
290393	1.6877		1.6064	
310393	1.6213		1.4261	
020493	1.8655		1.3293	
050493	1.4980		.80762	
070493	1.2889			
090493	1.5357		1.5091	
120493	1.8023		1.4332	
140493	1.4666		1.3490	
160493	1.7886		1.2434	
190493	1.8317		1.1094	
210493	1.8689		1.0843	
230493	1.8037		.96609	
260493	1.5228		1.5138	
280493	2.3052		1.7216	
300493	2.0269			
030593	2.1326			
050593	2.1419			
070593	2.0798			
100593	1.3088			
120593	1.7100			
140593	1.3488			
170593		1.7100		
180593		1.8517		
190593		1.4495		
210593		1.6204		
240593		1.4340		
260593		1.2577		
280593		1.3980		
310593		1.3325		
010693		1.4405		

Table 3 - Flowmeter readings by site, Cowichan River, 1994.

Date ddmmyy	7A-B-C (m/s)	7E-F (m/s)	5A (m/s)	5B (m/s)
280294	.99430			
040394	1.5363			
070394	1.0955			1.6407
090394	.51283			1.5506
110394	.44654			1.6481
140394	1.5720			1.4380
160394	1.4377			1.7125
180394	1.3385			1.6221
210394	1.2385			1.5719
230394	1.3032			1.6428
250394	1.1741			1.6866
280394	1.0898			1.7530
300394	1.1445			1.7199
010494	1.1740			1.7205
040494	1.0555			1.5719
060494	1.0984			1.6671
080494	1.1036			1.6750
110494	1.1030			1.4812
130494	1.1340			1.4403
150494	1.0062			1.4313
180494	1.1341			
190494	1.0122			1.2321
200494	.97209			
210494	.96008			
220494	1.0101			1.3127
250494	.85680			1.1216
270494				1.2169
280494		1.4235		
290494		1.1425		1.1413
020594		1.0363		
040594		1.6836		
050594		1.3849		
060594		1.4081		
090594		1.1529		
110594		1.5701		
130594		1.2428		
160594		1.4262		
180594		1.2530		
190594		1.1547		
200594		1.0767		
240594		.97101		
250594		.75585		
270594		.90141		
300594		.62713		
010694		.66213		

Table 3 - continued.

Date ddmmyy	7A-B-C (m/s)	7E-F (m/s)	5A (m/s)	5B (m/s)
030694		.75594		
060694		.79240		
090694		.84704		
100694		.79043		

Table 4 - Juvenile chinook CWT data collected during fry migration in the Cowichan River and Cowichan Bay, 1993.

Release date	Recovery date	Release code	Tag code	Recovery site	Number of fry
07Apr93	07Apr93	Early	18-10-44	Blk51	11
07Apr93	17May93	Early	18-10-44	Pumphouse	1
07Apr93	19May93	Early	18-10-44	Pumphouse	2
07Apr93	21May93	Early	18-10-44	Pumphouse	4
07Apr93	24Apr93	Early	18-10-44	Pumphouse	6
07Apr93	26Apr93	Early	18-10-44	Pumphouse	2
07Apr93	28Apr93	Early	18-10-44	Pumphouse	1
07Apr93	05May93	Early	18-10-44	Pumphouse	1
07Apr93	10Jun93	Early	18-10-44	Cow. Bay #5	1
07Apr93	10Jun93	Early	18-10-44	Cow. Bay #12	1
10May93	10May93	Lake Pen	18-10-43	Blk51	9
10May93	10May93	Lake Pen	18-10-43	Pumphouse	7
10May93	12May93	Lake Pen	18-10-43	Pumphouse	1
10May93	17May93	Lake Pen	18-10-43	Pumphouse	2
10May93	18May93	Lake Pen	18-10-43	Pumphouse	2
10May93	19May93	Lake Pen	18-10-43	Pumphouse	1
10May93	21May93	Lake Pen	18-10-43	Pumphouse	2
10May93	24May93	Lake Pen	18-10-43	Pumphouse	7
10May93	10Jun93	Lake Pen	18-10-43	Cow. Bay #9	1
17May93	18May93	Late	18-02-10	Pumphouse	8
17may93	18May93	Late	18-05-50	Pumphouse	5
17May93	19May93	Late	18-02-10	Pumphouse	2
17May93	19May93	Late	18-05-50	Pumphouse	3
17May93	21May93	Late	18-02-10	Pumphouse	8
17May93	21May93	Late	18-05-50	Pumphouse	3
17May93	24May93	Late	18-02-10	Pumphouse	6
17May93	24May93	Late	18-05-50	Pumphouse	4
17May93	26May93	Late	18-02-10	Pumphouse	3
17May93	26May93	Late	18-05-50	Pumphouse	8
17May93	28May93	Late	18-02-10	Pumphouse	1
17May93	01Jun93	Late	18-02-10	Pumphouse	1
17May93	10Jun93	Late	18-02-10	Cow. Bay #2	2
17May93	10Jun93	Late	18-02-10	Cow. Bay #3	1
17May93	10Jun93	Late	18-02-10	Cow. Bay #6	1
17May93	10Jun93	Late	18-02-10	Cow. Bay #7	1
17May93	10Jun93	Late	18-05-50	Cow. Bay #7	3
25May93	10Jun93	Hatchery	18-10-42	Cow. Bay #2	1
25May93	10Jun93	Hatchery	18-10-42	Cow. Bay #3	1
25May93	10Jun93	Hatchery	18-10-42	Cow. Bay #7	1
25May93	10Jun93	Sea Pen	18-02-09	Cow. Bay #2	1
25May93	10Jun93	Sea Pen	18-02-09	Cow. Bay #12	1

note: also 12 fish with 'no-pin'.

Table 5 - Juvenile chinook CWT data collected during fry migration in the Cowichan River and Cowichan Bay, 1994.

Release date	Recovery date	Release code	Tag code	Recovery site	Number of fry
18Apr94	18Apr94	Early	18-13-20	Pumphouse	1
18Apr94	19Apr94	Early	18-13-20	Blk 51	12
18Apr94	19Apr94	Early	18-13-20	Pumphouse	14
18Apr94	20Apr94	Early	18-13-20	Pumphouse	31
18Apr94	21Apr94	Early	18-13-20	Pumphouse	1
18Apr94	28Apr94	Early	18-13-20	Pumphouse	1
18Apr94	16May94	Early	18-13-20	Pumphouse	4
18Apr94	18May94	Early	18-13-20	Cow. Bay 9A	1
18Apr94	18May94	Early	18-13-20	Cow. Bay 9B	1
18Apr94	18May94	Early	18-13-20	Cow. Bay 9E	5
18Apr94	18May94	Early	18-13-20	Cow. Bay 9F	2
18Apr94	18May94	Early	18-13-20	Cow. Bay 9G	4
18Apr94	18May94	Early	18-13-20	Cow. Bay 9I	2
18Apr94	19May94	Early	18-13-20	Pumphouse	4
18Apr94	20May94	Early	18-13-20	Pumphouse	8
18Apr94	25May94	Early	18-13-20	Pumphouse	1
18Apr94	28May94	Early	18-13-20	Pumphouse	2
18Apr94	08Jun94	Early	18-13-20	Cow. Bay 9F	1
18Apr94	08Jun94	Early	18-13-20	Cow. Bay 9H	1
18Apr94	08Jun94	Early	18-13-20	Cow. Bay 9I	1
18Apr94	09Jun94	Early	18-13-20	Pumphouse	3
05May94	16May94	Lake Pen	18-13-19	Pumphouse	7
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9B	1
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9C	1
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9E	4
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9F	3
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9G	2
05May94	18May94	Lake Pen	18-13-19	Cow. Bay 9I	4
15May94	19May94	Lake Pen	18-13-19	Pumphouse	6
05May94	20May94	Lake Pen	18-13-19	Pumphouse	6
05May94	09Jun94	Lake Pen	18-13-19	Pumphouse	12
18May94	19May94	Late	18-13-21	Pumphouse	1
18May94	20May94	Late	18-13-21	Pumphouse	15
18May94	25May94	Late	18-13-21	Pumphouse	9
18May94	28May94	Late	18-13-21	Pumphouse	8
18May94	01Jun94	Late	18-13-21	Pumphouse	2
18May94	06Jun94	Late	18-13-21	Pumphouse	7
18May94	08Jun94	Late	18-13-21	Cow. Bay 9B	1
18May94	08Jun94	Late	18-13-21	Cow. Bay 9C	2
18May94	08Jun94	Late	18-13-21	Cow. Bay 9D	1
18May94	08Jun94	Late	18-13-21	Cow. Bay 9G	3
18May94	08Jun94	Late	18-13-21	Cow. Bay 9H	1
18May94	08Jun94	Late	18-13-21	Cow. Bay 9I	1
18May94	08Jun94	Late	18-13-21	Pumphouse	4
18May94	09Jun94	Late	18-13-21	Pumphouse	4

Table 5 - continued.

Release date	Recovery date	Release code	Tag code	Recovery site	Number of fry
18May94	10Jun94	Late	18-13-21	Pumphouse	5
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9B	1
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9C	8
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9D	5
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9F	2
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9G	1
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9I	4
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9H	1
24May94	08Jun94	Hatchery	18-13-22	Cow. Bay 9J	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9B	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9C	2
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9D	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9E	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9G	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9I	1
25May94	08Jun94	Seapen	02-12-11	Cow. Bay 9J	1

note: 7 fish with 'no pin'.

Table 6 - Juvenile chinook release data for the Cowichan hatchery, 1993.

Release[1] code	Tag code	Release date	Length (mm) Mean	Min	Max	Weight (gm) Mean	Min	Max
Early	18-10-44	April 7	71	52	82	4.0	1.2	6.9
Lake Pen	18-10-43	May 10	83	68	95	6.0	3.1	8.5
Late	18-02-10 18-05-50	May 17	82	64	97	6.0	2.7	10.2
Hatchery	18-10-42	May 25	87	78	105	6.5	2.7	13.3
Seapen	18-02-09	May 25	80	91	73	6.3	4.8	8.9

[1] for release site see table 1.

Table 7 - Juvenile chinook fry release data for the Cowichan hatchery, 1994.

Release[1] code	Tag code	Release date	Length (mm) Mean	Min	Max	Weight (gm) Mean	Min	Max
Early	18-13-20	April 18	71	52	82	4.0	1.3	6.9
Lake pen	18-13-19	May 05	83	54	95	6.3	1.5	9.3
Late	18-13-21	May 18	91	80	105	6.9	4.2	10.8
Hatchery	18-13-22	May 24	85	71	100	6.2	2.7	10.4
Seapen	no CWT	May 25	84	74	96	6.3	4.3	9.5

[1] for release site see table 1.

Table 8 - Mean length and mean weight (standard deviation), maximum /minimum values and sample size for juvenile chinook by catch location or hatchery release strategy, 1993.

CHINOOK BIOSAMPLING PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

Date	Length (mm)				Weight (gm)			
ddmmyy	Mean (SD)	Min	Max	N	Mean (SD)	Min	Max	N
010393	39 (2)	37	42	15	. (.)	.	.	0
030393	40 (2)	37	44	34	0.45 (0.07)	0.31	0.59	34
050393	40 (1)	37	42	21	0.45 (0.07)	0.33	0.62	21
080393	40 (2)	37	42	30	0.47 (0.07)	0.33	0.57	30
100393	40 (1)	36	43	104	0.47 (0.07)	0.31	0.66	104
120393	40 (1)	37	43	55	0.49 (0.07)	0.32	0.62	55
150393	40 (1)	37	43	48	0.47 (0.07)	0.35	0.61	48
170393	40 (2)	37	44	98	0.46 (0.07)	0.30	0.65	98
190393	41 (2)	38	45	118	0.50 (0.07)	0.31	0.63	118
260393	42 (2)	40	44	4	0.60 (0.10)	0.45	0.65	4
290393	41 (1)	38	43	22	0.48 (0.07)	0.37	0.62	22
310393	41 (2)	36	45	70	0.49 (0.08)	0.31	0.70	70
020493	41 (1)	38	44	49	0.54 (0.06)	0.41	0.65	49
050493	41 (2)	35	48	57	0.54 (0.14)	0.25	1.19	51
070493	42 (5)	35	65	71	0.53 (0.10)	0.28	0.86	71
090493	41 (2)	37	45	23	0.52 (0.08)	0.33	0.64	23
120493	42 (2)	38	49	49	0.56 (0.12)	0.41	1.05	49
140493	41 (2)	37	47	56	0.52 (0.09)	0.33	0.81	56
160493	46 (10)	40	97	84	0.58 (0.14)	0.40	1.21	84
190493	42 (3)	38	50	31	0.65 (0.22)	0.39	1.36	31
210493	42 (3)	39	57	49	0.63 (0.23)	0.41	1.88	55
230493	42 (3)	38	50	42	0.65 (0.19)	0.43	1.28	42
280493	44 (1)	43	45	2	0.70 (0.13)	0.61	0.79	2
300493	46 (6)	40	57	9	0.94 (0.50)	0.49	1.87	9
030593	43 (3)	40	48	7	0.70 (0.20)	0.47	1.05	7
050593	47 (9)	40	67	11	1.07 (0.84)	0.48	2.78	11
070593	44 (5)	38	54	10	0.78 (0.36)	0.48	1.61	10
100593	60 (17)	42	86	19	1.60 (1.65)	0.57	6.17	19
110593	64 (17)	44	86	15	1.74 (1.83)	0.67	6.17	15
120593	54 (10)	42	78	9	1.65 (1.16)	0.78	4.63	9
140593	50 (4)	45	56	9	1.18 (0.27)	0.86	1.62	9
170593	55 (4)	48	60	10	1.84 (0.34)	1.36	2.48	10
180593	53 (5)	43	59	21	1.65 (0.46)	0.86	2.51	21
190593	68 (15)	51	100	21	3.42 (1.95)	1.24	6.10	21
240593	69 (13)	48	92	68	3.69 (1.61)	1.39	6.30	68
260593	67 (12)	52	98	45	3.64 (1.64)	1.20	6.35	51
280593	60 (7)	50	90	40	2.33 (0.91)	1.39	6.17	40
010693	88 (1)	87	88	2	5.90 (0.21)	5.75	6.04	2

Table 8 - continued.

CHINOOK BIOSAMPLING BLOCK 51 LOCATION, COWICHAN RIVER, 1993

Date	Length (mm)				Weight (gm)			
ddmmyy	Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
010393	40(3)	36	43	12	0.44(0.07)	0.36	0.57	6
030393	40(2)	37	44	43	0.49(0.09)	0.33	0.64	22
050393	41(2)	37	44	54	0.61(0.08)	0.42	0.70	27
080393	40(2)	35	44	72	0.52(0.07)	0.39	0.65	36
100393	40(1)	37	44	136	0.58(0.09)	0.40	0.80	58
120393	41(2)	36	43	50	0.57(0.09)	0.39	0.79	50
150393	41(1)	37	44	52	0.55(0.06)	0.42	0.67	52
170393	41(2)	37	45	175	0.54(0.07)	0.40	0.68	48
190393	57(15)	39	83	50	0.50(0.07)	0.35	0.66	50
260393	45(8)	31	77	126	0.68(0.07)	0.47	0.82	50
290393	42(3)	35	47	229	0.59(0.07)	0.41	0.73	50
310393	42(3)	36	46	195	0.57(0.08)	0.35	0.73	51
020493	43(3)	36	46	130	0.56(0.08)	0.36	0.72	49
050493	44(2)	39	47	92	0.56(0.08)	0.39	0.71	46
070493	51(12)	38	87	136	0.58(0.08)	0.40	0.72	48
090493	44(3)	38	52	77	0.54(0.10)	0.37	0.89	38
120493	44(3)	35	49	100	0.65(0.16)	0.43	1.28	50
140493	42(2)	39	48	35	0.48(0.09)	0.31	0.75	35
160493	42(3)	37	48	46	0.57(0.16)	0.31	1.00	46
190493	44(3)	36	48	62	0.58(0.12)	0.35	0.90	31
210493	46(0)	46	46	33	0.63(0.21)	0.30	1.35	33
230493	43(4)	36	55	42	0.62(0.23)	0.33	1.46	42
280493	43(4)	39	53	14	0.64(0.25)	0.48	1.40	14
100593	74(15)	43	98	18	. (.)	.	.	0

Table 8 - continued.

CHINOOK BIOSAMPLING, BEACH SEINE, ROAD POOL, 1993

Date ddmmyy	Site	Length (mm) Mean(SD)	Min	Max	N	Weight (gm) Mean(SD)	Min	Max	N
030693	03	64(7)	58	80	25	2.91(1.11)	1.84	5.99	25

CHINOOK BIOSAMPLING, BEACH SEINE, COWICHAN BAY, 1993

Date ddmmyy	Site	Length (mm) Mean(SD)	Min	Max	N	Weight (gm) Mean(SD)	Min	Max	N
080693	09	61(5)	49	75	41	2.69(0.70)	1.06	5.11	41

CHINOOK BIOSAMPLING, PURSE SIENE, COWICHAN BAY, 1993

Date ddmmyy	Site[1]	Length (mm) Mean(SD)	Min	Max	N	Weight (gm) Mean(SD)	Min	Max	N
100693	9A	70(6)	58	80	22	4.09(1.05)	2.00	6.34	22
100693	9B	75(8)	62	95	28	5.15(1.88)	1.47	9.69	28
100693	9C	75(9)	60	94	29	5.28(2.08)	1.00	9.59	29
100693	9E	72(8)	60	89	26	4.70(1.73)	2.17	9.04	26
100693	9F	81(8)	72	96	26	5.92(2.27)	0.52	9.94	26
100693	9G	86(8)	72	100	31	6.09(2.92)	0.47	9.67	31
100693	9I	75(8)	60	100	33	5.11(1.48)	2.40	9.06	33
100693	9K	79(8)	68	93	22	6.77(1.76)	4.02	9.74	22

[1] for site locations see figure 3.

Table 8 - continued.

CHINOOK BIOSAMPLING, HATCHERY, 1993

Date ddmmyy	Release[1]	Length (mm) Mean(SD)	Min	Max	N	Weight (gm) Mean(SD)	Min	Max	N
040393	ER	52(2)	47	56	31	1.49(0.26)	0.99	1.97	31
090393	ER	56(3)	48	61	32	1.75(0.30)	1.05	2.45	32
160393	ER	60(3)	54	69	33	2.10(0.38)	1.30	3.10	33
230393	ER	58(6)	48	67	30	2.05(0.66)	1.05	3.50	30
300393	ER	61(5)	52	72	30	2.36(0.76)	1.30	4.05	30
060493	ER	71(5)	58	78	30	3.89(0.91)	1.85	5.30	30
040393	LP	55(3)	47	62	30	1.77(0.29)	1.11	2.54	30
090393	LP	61(4)	52	65	30	2.46(0.52)	1.45	3.70	30
160393	LP	63(3)	56	70	28	2.25(0.83)	0.70	4.35	34
230393	LP	63(4)	55	73	30	2.26(0.50)	1.45	3.70	30
300393	LP	68(5)	55	78	30	3.23(0.74)	1.75	4.80	30
060493	LP	71(6)	58	80	30	3.51(0.86)	1.80	5.05	30
140493	LP	68(8)	45	90	45	3.36(0.96)	1.30	5.70	43
210493	LP	73(4)	66	81	50	4.17(0.67)	3.10	5.80	50
280493	LP	75(6)	60	88	60	4.45(1.20)	2.10	7.00	60
050593	LP	81(6)	70	95	42	6.01(1.34)	3.90	9.57	42
040393	LR	48(4)	40	63	31	1.14(0.20)	0.82	1.74	29
090393	LR	49(5)	42	65	31	1.14(0.25)	0.75	1.70	29
160393	LR	55(4)	45	62	35	1.61(0.33)	0.85	2.30	35
230393	LR	58(8)	47	95	31	1.80(0.36)	1.05	2.55	29
300393	LR	60(5)	50	71	30	2.27(0.58)	1.10	3.50	30
060493	LR	63(5)	51	72	30	2.55(0.63)	1.40	3.70	30
140493	LR	64(7)	21	78	62	2.70(0.75)	1.40	6.00	62
210493	LR	70(6)	53	86	90	3.56(0.95)	1.80	6.30	90
280493	LR	71(7)	54	85	90	3.73(1.07)	1.70	6.45	90
040593	LR	70(8)	52	97	127	3.94(1.18)	1.66	9.36	127
110593	LR	74(7)	56	92	124	4.34(1.24)	1.97	8.36	124
180593	LR	73(7)	57	88	123	4.74(0.99)	1.99	6.15	123

[1] ER - early release, LP - lake pen, LR - late release.

Table 9 - Mean length, mean weight (standard deviation), maximum/minimum values, and sample size for juvenile chinook by catch location or hatchery release strategy, 1994.

CHINOOK BIOSAMPLING PUMPHOUSE LOCATION, COWICHAN RIVER, 1994

Date	Length (mm)				Weight (gm)			
ddmmyy	Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
280294	40(1)	39	41	7	0.48(0.06)	0.41	0.56	7
040394	40(1)	39	41	3	0.46(0.07)	0.40	0.54	3
070394	41(1)	37	43	43	0.52(0.06)	0.40	0.64	43
090394	41(2)	37	44	23	0.48(0.09)	0.35	0.60	23
110394	42(2)	39	44	18	0.57(0.10)	0.39	0.81	18
140394	40(2)	37	46	40	0.51(0.12)	0.33	0.90	40
160394	40(2)	37	44	50	0.49(0.09)	0.25	0.70	50
180394	41(2)	38	47	50	0.58(0.13)	0.39	0.93	50
210394	41(2)	38	47	50	0.51(0.12)	0.33	0.90	50
230394	41(2)	38	46	50	0.59(0.11)	0.39	0.96	50
250394	42(2)	39	46	20	0.57(0.14)	0.41	0.94	20
280394	41(2)	37	48	24	0.53(0.12)	0.40	0.97	24
300394	42(3)	38	49	40	0.55(0.15)	0.37	1.04	40
010494	41(2)	38	50	50	0.55(0.14)	0.39	1.14	50
040494	41(3)	34	48	50	0.53(0.16)	0.24	1.04	50
060494	42(4)	37	58	45	0.63(0.24)	0.35	1.73	45
080494	42(3)	39	52	29	0.62(0.22)	0.38	1.41	29
110494	43(5)	38	56	42	0.70(0.35)	0.39	1.66	42
130494	45(6)	36	59	31	0.81(0.38)	0.38	1.90	31
150494	46(7)	41	64	10	0.89(0.53)	0.50	2.21	10
180494	59(20)	39	78	4	2.54(2.23)	0.44	5.00	4
190494	66(11)	40	80	41	3.21(1.39)	0.50	5.59	41
200494	67(8)	37	78	35	3.02(0.90)	0.35	5.10	35
210494	60(14)	41	75	11	2.55(1.59)	0.53	4.54	11
220494	44(4)	39	48	6	0.77(0.24)	0.46	1.04	6
250494	46(.)	46	46	1	0.84(.)	0.84	0.84	1
280494	67(16)	56	78	2	2.92(1.89)	1.58	4.25	2
290494	57(8)	47	72	10	1.76(0.77)	0.94	3.47	10
020594	50(5)	42	57	9	1.16(0.37)	0.63	1.62	9
030594	52(3)	49	55	3	1.41(0.23)	1.15	1.57	3
040594	53(5)	45	60	8	1.34(0.46)	0.72	2.04	8
050594	57(8)	43	67	9	1.93(0.74)	0.60	3.00	9
060594	82(8)	55	89	17	5.47(1.34)	1.52	7.42	17
090594	82(10)	55	93	19	5.59(1.51)	2.02	7.80	19
110594	83(10)	63	110	33	5.77(1.87)	2.60	9.74	33
130594	82(13)	41	100	26	5.60(1.97)	0.96	8.84	26
160594	82(11)	55	95	13	5.55(1.86)	1.50	7.87	13
180594	75(11)	63	86	5	4.01(1.51)	2.47	5.82	5
190594	79(12)	42	99	32	5.24(1.93)	2.11	9.49	32
200594	83(8)	64	94	16	5.52(1.48)	2.46	7.99	16
240594	87(6)	81	92	3	6.04(1.54)	4.60	7.67	3
250594	85(6)	78	95	7	5.73(1.28)	4.26	7.96	7

Table 9 - continued.

CHINOOK BIOSAMPLING PUMPHOUSE LOCATION, COWICHAN RIVER, 1994

Date	Length (mm)				Weight (gm)			
ddmmyy	Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
280594	87(5)	80	96	10	6.59(1.19)	4.89	8.21	10
300594	91(10)	82	120	13	6.58(1.65)	4.72	10.62	13
010694	78(13)	64	90	4	4.81(2.18)	2.69	6.96	4
060694	87(8)	80	100	7	6.70(1.68)	5.21	9.73	7
090694	77(15)	50	100	43	4.87(2.46)	1.28	10.62	43
100694	91(3)	86	94	5	7.44(1.11)	6.40	9.18	5

Table 9 - continued.

CHINOOK BIOSAMPLING BLOCK 51 LOCATION, COWICHAN RIVER, 1994

Date	Length (mm)				Weight (gm)			
ddmmyy	Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
070394	39(2)	36	44	22	4.94(0.82)	3.67	6.67	22
090394	40(2)	38	44	27	4.87(0.74)	3.50	6.17	27
110394	41(2)	38	44	27	4.66(0.76)	3.12	6.16	27
140394	40(2)	34	44	54	4.49(0.98)	2.32	6.75	54
160394	40(2)	35	44	50	4.59(0.95)	2.90	6.50	50
180394	40(2)	37	45	45	4.69(0.99)	3.30	7.50	45
210394	41(2)	37	44	39	4.92(0.75)	3.20	6.60	39
230394	41(2)	35	46	50	5.08(1.13)	2.50	8.90	50
250394	40(2)	36	43	40	4.44(0.73)	2.80	5.90	40
280394	40(2)	36	51	50	4.01(0.93)	0.50	6.10	50
300394	41(3)	37	50	50	4.45(1.34)	2.50	9.10	50
010494	41(3)	33	52	50	4.43(1.39)	3.00	11.30	50
040494	42(4)	38	54	50	4.85(2.17)	2.70	13.20	50
060494	42(2)	38	50	50	5.31(1.60)	3.30	11.20	50
080494	42(3)	37	52	50	5.16(1.57)	2.50	12.40	50
110494	45(6)	39	60	50	6.77(3.80)	2.90	18.80	50
130494	43(4)	38	55	50	6.27(2.63)	3.10	14.50	50
150494	42(3)	37	49	19	5.77(1.53)	3.80	9.70	19
190494	52(12)	40	77	49	14.91(12.05)	4.50	35.30	49
220494	43(4)	37	54	31	6.73(2.14)	3.70	13.20	31
250494	44(4)	39	51	13	6.83(2.58)	4.20	13.60	13
270494	46(4)	40	52	14	8.08(2.73)	4.30	12.70	14
290494	45(5)	36	52	16	7.85(2.75)	3.20	11.40	16

Table 9 - continued.
CHINOOK BIOSAMPLING, RANDOM SAMPLE, PURSE SEINE, COWICHAN BAY, 1994

Date	Site[1]	Length (mm)				Weight (gm)			
ddmmyy		Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
180594	9A	81(7)	66	93	21	6.10(1.72)	3.29	9.11	21
180594	9B	80(7)	67	90	16	5.75(1.53)	3.32	8.37	16
180594	9C	78(9)	66	97	23	5.60(2.05)	3.35	10.46	23
180594	9D	85(7)	74	96	18	7.26(1.77)	4.96	10.17	18
180594	9E	81(7)	68	96	21	6.31(1.82)	4.04	10.15	21
180594	9F	84(7)	71	101	24	6.96(1.87)	4.57	11.79	24
180594	9G	82(6)	74	98	26	7.13(1.64)	4.73	11.41	26
180594	9I	82(8)	68	98	21	6.33(1.68)	3.63	9.20	21
080694	9A	81(7)	60	94	22	6.84(1.63)	2.53	10.43	22
080694	9B	78(9)	54	98	26	6.16(2.13)	1.98	12.39	26
080694	9C	83(8)	71	95	26	7.58(2.32)	4.56	12.31	26
080694	9D	80(5)	70	92	22	7.17(1.31)	5.03	10.19	22
080694	9E	86(6)	76	96	21	8.00(1.51)	5.83	11.51	21
080694	9F	87(9)	75	109	22	8.76(2.69)	5.33	16.10	22
080694	9G	86(6)	78	98	23	8.18(2.14)	5.37	12.31	23
080694	9H	88(6)	80	100	22	9.45(1.77)	6.86	13.19	22
080694	9I	89(5)	77	96	22	9.33(1.60)	5.95	12.36	22
080694	9J	93(6)	77	103	20	10.54(1.99)	6.12	13.95	20

[1] for site locations see figure 3.

CHINOOK BIOSAMPLING, SELECT SAMPLE, PURSE SEINE, COWICHAN BAY, 1994

Date	Site[1]	Length (mm)				Weight (gm)			
ddmmyy		Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
180594	9A	89(.)	89	89	1	6.92(.)	6.92	6.92	1
180594	9B	81(1)	80	82	2	5.79(0.31)	5.57	6.01	2
180594	9C	91(.)	91	91	1	7.69(.)	7.69	7.69	1
180594	9E	83(5)	75	90	9	6.82(1.12)	5.09	8.41	9
180594	9F	83(4)	78	88	4	6.32(0.85)	5.45	7.48	4
180594	9G	82(6)	75	91	6	6.35(1.40)	5.19	9.02	6
180594	9I	85(10)	72	99	6	7.79(2.12)	5.11	10.68	6
080694	9A	87(8)	75	100	9	8.51(2.37)	5.45	12.99	9
080694	9B	84(5)	80	90	3	7.88(1.63)	6.32	9.57	3
080694	9C	86(5)	78	95	12	8.25(1.35)	5.61	10.63	12
080694	9D	84(4)	80	89	7	8.05(1.16)	6.29	9.65	7
080694	9E	90(.)	90	90	1	9.42(.)	9.42	9.42	1
080694	9F	88(4)	83	92	4	8.99(1.60)	7.38	10.71	4
080694	9G	91(5)	85	98	5	9.41(1.59)	7.89	12.06	5
080694	9H	84(5)	80	89	3	8.52(1.49)	6.93	9.88	3
080694	9I	89(5)	83	97	7	9.07(1.39)	7.79	11.17	7
080694	9J	92(2)	91	94	3	10.23(0.82)	9.29	10.79	3

[1] for site locations see figure 2.

Table 9 - continued.

CHINOOK BIOSAMPLING, HATCHERY, 1994

Date ddmmyy	Release[1]	Length (mm) Mean(SD)	Min	Max	N	Weight (gm) Mean(SD)	Min	Max	N
030394	ER	53(2)	48	58	25	1.39(0.22)	0.95	1.72	25
100394	ER	53(3)	45	60	32	1.51(0.29)	0.85	2.12	32
160394	ER	58(3)	51	63	34	1.96(0.33)	1.22	2.50	34
230394	ER	61(3)	56	67	33	2.43(0.32)	1.80	3.05	33
310394	ER	64(4)	54	71	33	2.53(0.45)	1.42	3.40	33
060494	ER	67(3)	62	71	31	3.11(0.42)	2.28	4.00	31
130494	ER	67(4)	58	74	25	3.09(0.47)	2.10	3.87	25
030394	HA	48(5)	38	60	25	1.07(0.33)	0.54	1.98	25
100394	HA	53(3)	44	58	38	1.49(0.29)	0.80	2.05	38
160394	HA	55(4)	46	63	32	1.66(0.37)	0.97	2.40	32
230394	HA	60(4)	45	66	36	2.31(0.48)	0.78	3.15	36
310394	HA	62(5)	48	71	40	2.53(0.62)	1.02	3.76	40
060494	HA	65(5)	54	74	30	2.68(0.69)	1.03	3.80	30
130494	HA	67(3)	62	72	30	3.05(0.42)	2.30	3.77	30
200494	HA	66(3)	62	74	30	3.82(0.68)	2.63	5.37	30
270494	HA	76(5)	62	85	30	4.55(0.89)	2.41	5.82	30
040594	HA	76(6)	62	87	30	5.05(1.12)	2.45	7.03	30
100594	HA	76(9)	60	110	33	4.99(1.39)	2.67	8.10	33
030394	LP	54(4)	47	64	25	1.54(0.41)	1.00	2.63	25
100394	LP	57(3)	50	63	40	1.96(0.37)	1.33	2.63	40
160394	LP	61(2)	55	67	35	2.27(0.36)	1.73	3.32	35
230394	LP	63(5)	49	71	32	2.71(0.63)	1.14	3.86	32
310394	LP	67(4)	58	74	33	3.05(0.59)	2.06	4.29	33
050494	LP	64(5)	57	77	30	3.22(0.77)	2.05	5.46	30
200494	LP	67(4)	59	76	30	4.16(0.91)	2.40	5.77	30
270494	LP	76(6)	65	90	30	4.91(1.28)	3.10	8.10	30
040594	LP	83(6)	74	95	30	6.12(1.39)	3.96	9.32	30
030394	LR	53(3)	50	59	25	1.49(0.23)	1.20	2.05	25
100394	LR	54(4)	45	61	35	1.64(0.35)	0.90	2.23	35
160394	LR	58(4)	47	65	34	1.96(0.44)	1.10	2.95	34
230394	LR	60(4)	52	68	36	2.25(0.51)	1.33	3.45	36
310394	LR	64(5)	55	75	37	2.49(0.60)	1.50	4.06	37
060494	LR	69(4)	62	79	33	3.64(0.62)	2.64	5.23	33
130494	LR	70(5)	57	80	30	3.60(0.85)	1.85	5.72	30
200494	LR	68(5)	59	75	30	4.09(1.12)	1.02	6.30	30
270494	LR	74(5)	66	82	30	4.29(0.80)	2.95	5.71	30
040594	LR	80(6)	68	91	32	5.27(1.19)	2.92	7.33	32
100594	LR	80(6)	66	89	31	5.48(1.16)	2.94	7.82	31

[1] ER- early release, LP - lake pen, LR - late release, HA - hatchery.

Table 10 - Daily estimates of juvenile chinook calculated using the cross-sectional area method and trap efficiency method for 1993.

	Cross-sectional method		Trap Efficiency method		
Date	Wild	Hatchery	Wild	Hatchery	Comments
01MAR93	1958	0	1235	0	
02MAR93	2414	0	2098	0	
03MAR93	2871	0	2963	0	
04MAR93	2805	0	2345	0	
05MAR93	2741	0	1728	0	
06MAR93	3327	0	2098	0	
07MAR93	3327	0	2098	0	
08MAR93	3915	0	2469	0	
09MAR93	4629	0	5913	0	
10MAR93	5344	0	3444	0	
11MAR93	5412	0	6900	0	
12MAR93	5481	0	3457	0	
13MAR93	6786	0	4279	0	
14MAR93	6786	0	4279	0	
15MAR93	8092	0	5103	0	
16MAR93	9185	0	8353	0	
17MAR93	10280	0	11605	0	
18MAR93	12317	0	11727	0	
19MAR93	14356	0	11852	0	
20MAR93	7439	0	6090	0	
21MAR93	7439	0	6090	0	
22MAR93	7439	0	6090	0	
23MAR93	7439	0	6090	0	
24MAR93	7439	0	6090	0	
25MAR93	7439	0	6090	0	
26MAR93	522	0	329	0	
27MAR93	1305	0	1275	0	
28MAR93	1305	0	1275	0	
29MAR93	2088	0	2222	0	
30MAR93	6199	0	1317	0	
31MAR93	10310	0	6502	0	
01APR93	7960	0	5288	0	
02APR93	5612	0	4074	0	
03APR93	4893	0	4382	0	
04APR93	4893	0	4382	0	
05APR93	4176	0	4691	0	
06APR93	7569	0	2634	0	
07APR93	10963	22317	6914	14074	Early release
08APR93	6981	14682	4403	9259	
09APR93	3002	7048	1893	4444	
10APR93	6903	3758	4398	2370	
11APR93	6903	3758	4398	2370	
12APR93	10806	470	6815	296	

Table 10 - continued.

Date	Cross-sectional method		Trap Efficiency method		Comments
	Wild	Hatchery	Wild	Hatchery	
13APR93	15191	299	9579	189	
14APR93	19577	131	12346	82	
15APR93	17618	260	11604	164	
16APR93	15661	392	10864	250	
17APR93	10340	343	8265	289	
18APR93	10340	343	8265	289	
19APR93	5020	295	5667	333	
20APR93	6397	245	8778	277	
21APR93	7776	197	8778	222	
22APR93	9645	98	10888	111	
23APR93	11516	0	13000	0	
24APR93	6085	0	6870	0	
25APR93	6085	0	6870	0	
26APR93	6085	0	6870	0	
27APR93	6085	0	6870	0	
28APR93	656	0	741	0	
29APR93	623	0	703	0	
30APR93	591	295	667	333	
01MAY93	688	147	777	150	
02MAY93	688	147	777	150	
03MAY93	787	0	889	0	
04MAY93	1033	0	1166	0	
05MAY93	1280	197	1444	222	
06MAY93	885	98	999	111	
07MAY93	492	0	556	0	
08MAY93	836	0	944	0	
09MAY93	836	0	944	0	
10MAY93	1181	2756	1333	3111	Lake pen release
11MAY93	295	100983	333	114000	
12MAY93	787	9744	889	11000	
13MAY93	836	5757	944	6500	
14MAY93	886	1772	1000	2000	
15MAY93	442	14161	500	4991	
16MAY93	442	14161	500	4991	
17MAY93	0	26553	0	7984	trap moved to upper site
18MAY93	0	186993	0	56222	Late release
19MAY93	0	118481	0	35623	
20MAY93	0	108513	0	32625	
21MAY93	0	108513	0	32625	
22MAY93	0	108513	0	32625	
23MAY93	0	108513	0	32625	
24MAY93	0	98547	0	29630	
25MAY93	0	84904	0	25527	
26MAY93	0	71262	0	21426	

Table 10 - continued.

Date	Cross-sectional method		Trap Efficiency method		Comments
	Wild	Hatchery	Wild	Hatchery	
27MAY93	0	53122	0	15971	
28MAY93	0	34984	0	10519	
29MAY93	0	33413	0	10046	
30MAY93	0	33413	0	10046	
31MAY93	0	33413	0	10046	
01JUN93	0	33413	0	9574	
02JUN93	0	33413	0	9574	
Total	426,735	1,480,817	349,298	565,266	

Table 11 - Daily estimates of juvenile chinook calculated using the cross-sectional area method and trap efficiency method for 1994.

	Cross-sectional method		Trap Efficiency method	
DATE	Wild	Hatchery	Wild	Hatchery
28FEB94	357	0	494	0
01MAR94	240	0	333	0
02MAR94	240	0	333	0
03MAR94	240	0	333	0
04MAR94	125	0	173	0
05MAR94	567	0	784	0
06MAR94	567	0	784	0
07MAR94	1009	0	1397	0
08MAR94	1090	0	1509	0
09MAR94	1172	0	1623	0
10MAR94	1044	0	1445	0
11MAR94	918	0	1270	0
12MAR94	1452	0	2010	0
13MAR94	1452	0	2010	0
14MAR94	1988	0	2751	0
15MAR94	3023	0	4185	0
16MAR94	4060	0	5619	0
17MAR94	2975	0	4110	0
18MAR94	1892	0	2619	0
19MAR94	2220	0	3073	0
20MAR94	2220	0	3073	0
21MAR94	2549	0	3527	0
22MAR94	2115	0	5855	0
23MAR94	5913	0	8183	0
24MAR94	3465	0	9593	0
25MAR94	1019	0	1411	0
26MAR94	1121	0	1551	0
27MAR94	1121	0	1551	0
28MAR94	1223	0	1693	0
29MAR94	1630	0	2257	0
30MAR94	2039	0	2822	0
31MAR94	3045	0	4214	0
01APR94	4052	0	5608	0
02APR94	5019	0	6946	0
03APR94	5019	0	6946	0
04APR94	5987	0	8286	0
05APR94	4644	0	6428	0
06APR94	3303	0	4571	0
07APR94	3078	0	4260	0
08APR94	2854	0	3951	0
09APR94	2726	0	3773	0
10APR94	2726	0	3773	0
11APR94	2600	0	3598	0

Table 11 - continued.

DATE	Cross-sectional method		Trap Efficiency method		
	Wild	Hatchery	Wild	Hatchery	
12APR94	4441	0	6147	0	
13APR94	6285	0	8698	0	
14APR94	3804	0	5266	0	
15APR94	1325	0	1834	0	
16APR94	903	0	1250	0	
17APR94	903	0	1250	0	
18APR94	482	58468	667	72829	early release
19APR94	1468	189579	2032	262381	
20APR94	367	67299	508	83829	
21APR94	940	18167	1302	22629	
22APR94	46	711	63	886	
23APR94	33	940	47	1252	
24APR94	33	940	47	1252	
25APR94	23	1170	32	1619	
26APR94	32	2278	23	1385	trap moved to upper site
27APR94	32	2278	23	1385	
28APR94	43	3388	16	1151	
29APR94	255	2807	96	1060	
30APR94	507	2292	191	865	
01MAY94	507	2292	191	865	
02MAY94	761	1780	287	672	
03MAY94	1112	2877	419	1086	
04MAY94	1464	3976	553	1501	
05MAY94	158	4694	60	1595	
06MAY94	191	64592	72	24390	lake pen release
07MAY94	143	50732	54	19156	
08MAY94	143	50732	54	19156	
09MAY94	96	36873	36	13924	
10MAY94	127	38675	48	14603	
11MAY94	159	40478	60	15285	
12MAY94	398	44065	150	16639	
13MAY94	638	47655	241	17995	
14MAY94	426	36853	160	13915	
15MAY94	426	36853	160	13915	
16MAY94	215	26052	81	9837	
17MAY94	337	20877	127	7586	
18MAY94	459	15703	173	5337	late release
19MAY94	646	50267	244	18981	
20MAY94	0	99702	0	33883	
21MAY94	0	57170	0	19428	
22MAY94	0	57170	0	19428	
23MAY94	0	57170	0	19428	
24MAY94	0	14641	0	4976	
25MAY94	0	29569	0	10049	

Table 11 - continued.

DATE	Cross-sectional method		Trap Efficiency method	
	Wild	Hatchery	Wild	Hatchery
26MAY94	0	21673	0	7365
27MAY94	0	13780	0	4683
28MAY94	0	14769	0	5019
29MAY94	0	14769	0	5019
30MAY94	0	15761	0	5356
31MAY94	0	15092	0	5401
01JUN94	0	14426	0	5447
02JUN94	0	14016	0	5035
03JUN94	0	13607	0	4624
04JUN94	0	13334	0	4531
05JUN94	0	13334	0	4531
06JUN94	0	13062	0	4439
07JUN94	0	8116	0	2758
08JUN94	0	8116	0	2758
09JUN94	0	3172	0	1078
10JUN94	0	4091	0	1390
Total	126,427	1,442,883	173,387	845,587

Table 12. Estimates of juvenile chinook abundance passing the Pumphouse site, Cowichan R. from 1992-1994 and number of hatchery fish release above the trap site.

Year	Type	Cross-sectional area method	Trap efficiency method	Hatchery releases above Pumphouse site
1992	Hatchery	737,694	-	1,168,887
	Naturally-spawned	810,240	-	-
1993	Hatchery	1,480,817	565,266	2,463,416
	Naturally-spawned	426,735	349,298	-
1994	Hatchery	1,442,883	845,587	2,337,635
	Naturally-spawned	126,427	173,387	-

Table 13 - Bismark brown marking recovery rate (%) of catch by site and trap at the Pumphouse site, 1993 and 1994. Number of marked fish released in parenthesis.

Site = 7B, Trap=IPT

Date	Hatchery chinook	Chum fry	Coho fry	Coho 1+
120593	1.5(397)	0.3(1825)	.	.
140593	2.1(144)	1.6(1065)	.	.
040494		0.7(1069)	.	.
060494	.	0.9(2926)	.	.
080494	.	1.4(2592)	.	.
110494	.	0.7(2710)	.	.
130494	.	0.1(1506)	.	.
150494	.	0.7(2320)	.	.
190494	.	0.4(4549)	.	.
200494	0.1(725)	.	.	.
220494	0.3(356)	.	.	.
Mean	1.0	0.7		

Site=7B, Trap=8' Auger trap

Date	Hatchery chinook	Chum fry	Coho fry	Coho 1+
010494		2.0(860)	4.8(21)	.
040494		4.1(1069)	.	.
060494		4.9(2926)	.	.
080494		5.9(2592)	.	.
110494		2.8(2710)	.	.
130494		3.6(1506)	7.1(56)	.
150494		5.4(2320)	3.1(162)	.
180494		3.2(3099)	.	.
190494	5.4(427)	6.1(4549)	21.7(46)	.
200494	3.0(725)	.	.	.
210494	1.5(755)	.	.	.
220494	4.2(356)	.	.	.
Mean	3.5	4.2	9.2	

Table 13 - continued.

Site=7E, Trap=IPT

Date	Hatchery chinook	Chum fry	Coho fry	Coho 1+
170593	.	4.9(1392)	.	.
180593	.	2.7(768)	.	.
010693	6.0(414)	7.6(290)	.	.
280494	.	7.3(1593)	.	.
290494	.	2.5(6160)	.	.
020594	.	0.4(2851)	.	.
040594	.	0.3(3489)	.	.
050594	.	0.1(3155)	.	.
Mean	6.0	3.2		

Site=7E, Trap= 8' Auger trap.

Date	Hatchery chinook	Chum fry	Coho fry	Coho 1+
280494	.	33.8(1593)	.	.
290494	.	19.4(6160)	.	.
020594	.	9.1(2851)	.	.
040594	.	5.7(2851)	.	.
050594	.	3.8(3155)	.	.
090594	28.6(189)	0.9(468)	.	23.6(55)
110594	24.5(274)	.	.	7.4(54)
200594	13.6(398)	.	.	.
250594	20.4(265)	.	.	.
270594	14.0(284)	.	.	.
010694	29.5(200)	.	.	.
100694	12.8(125)	.	9.4(338)	.
Mean	20.5	12.1	9.4	15.5

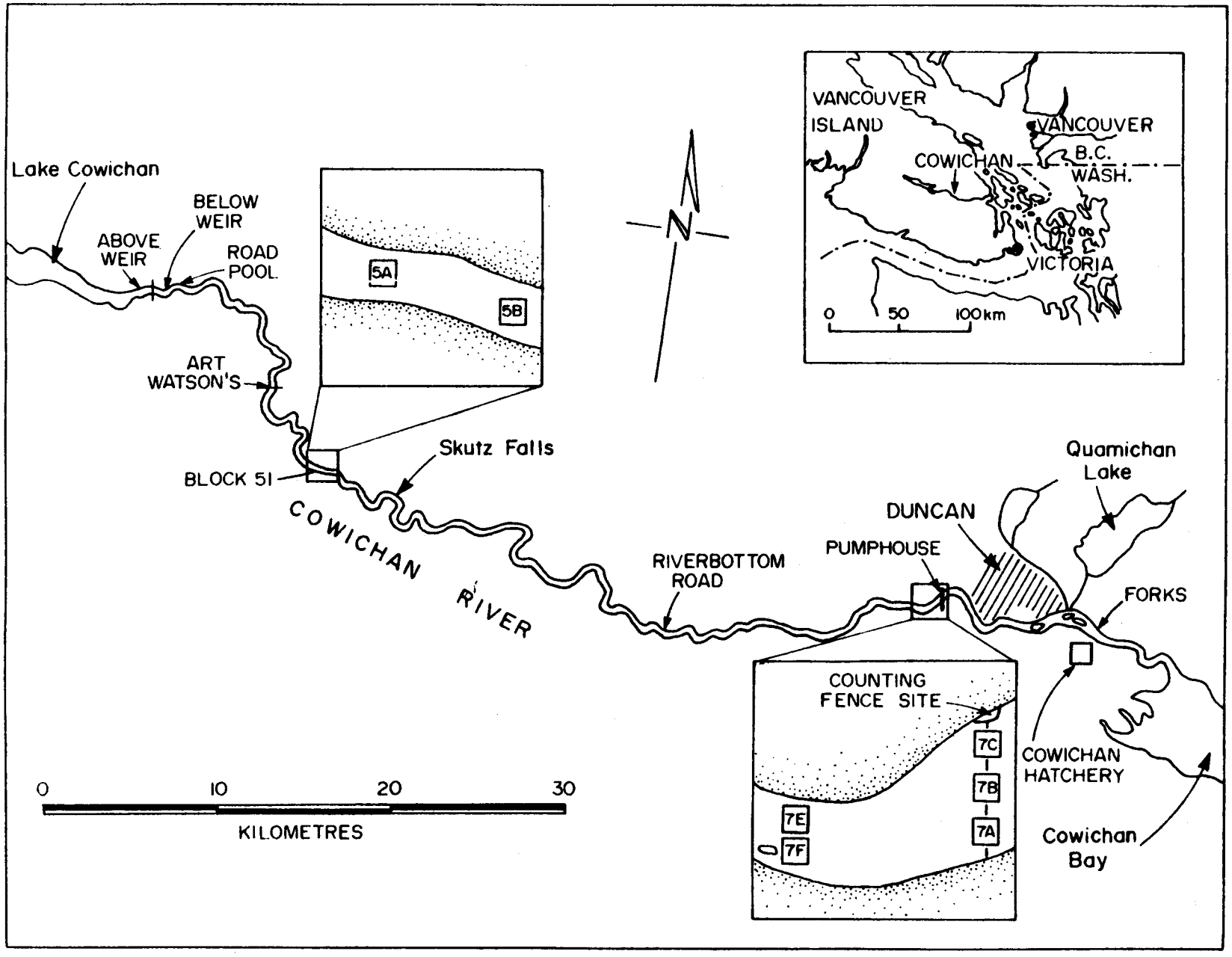

Figure 1. Map shouwing locations on the Cowichan River (insert of Pumphouse and Block 51 trapping sites).

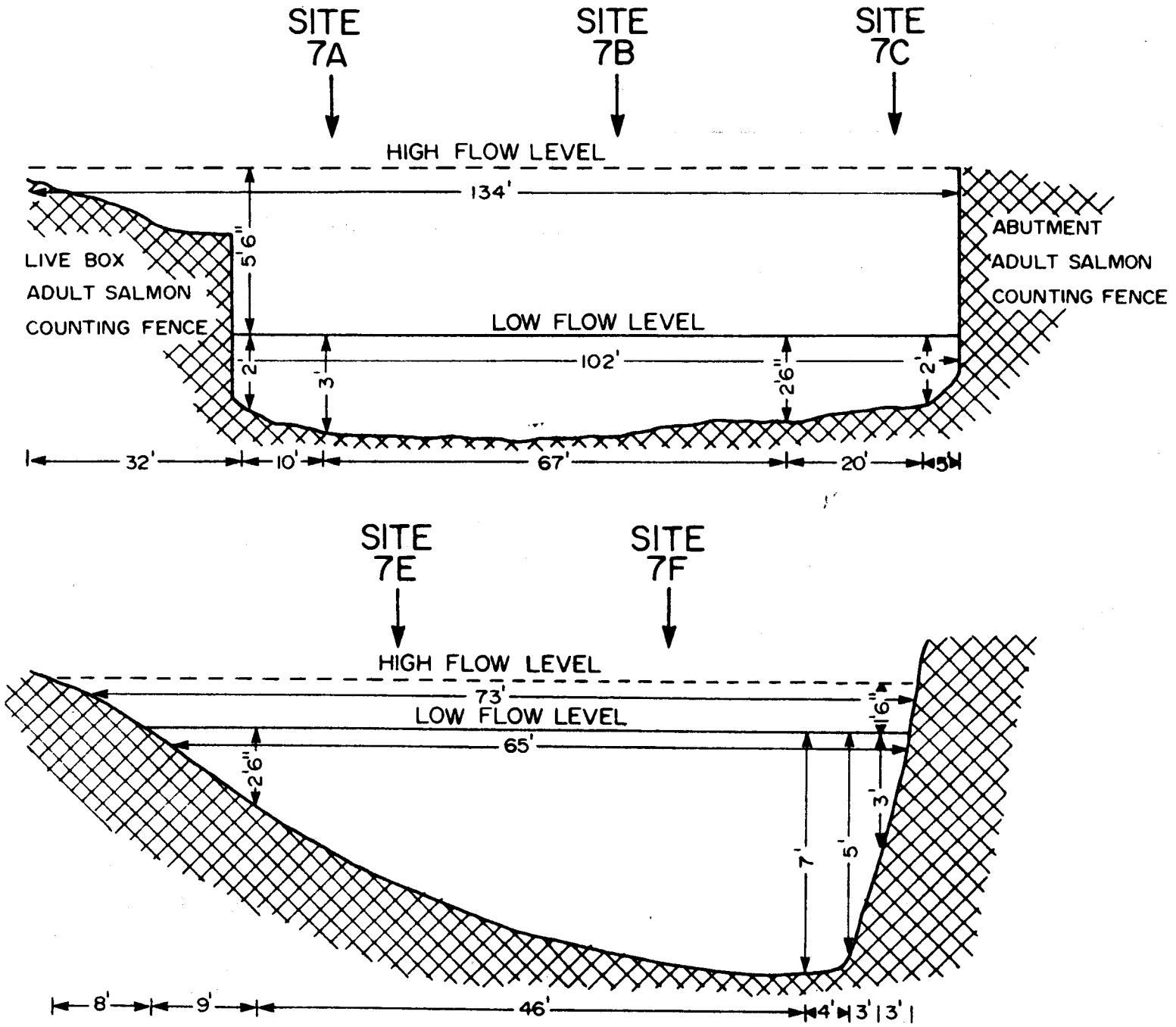

Figure 2 - Cross-section of the Cowichan River at the Pumphouse sites 7a-c 7e-f

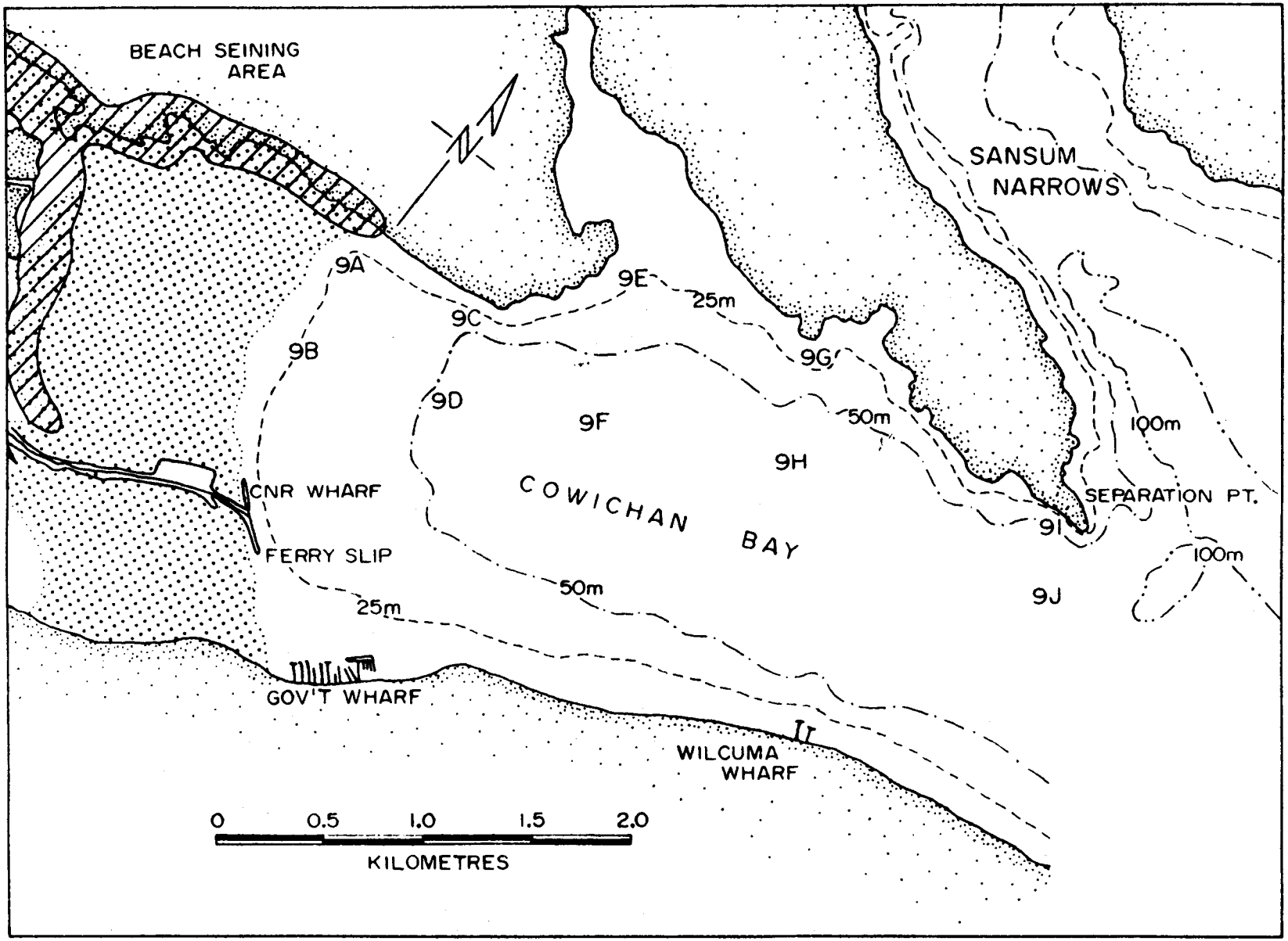

Figure 3 - Map showing Cowichan Bay beach seine and Purse seine sampling sites.

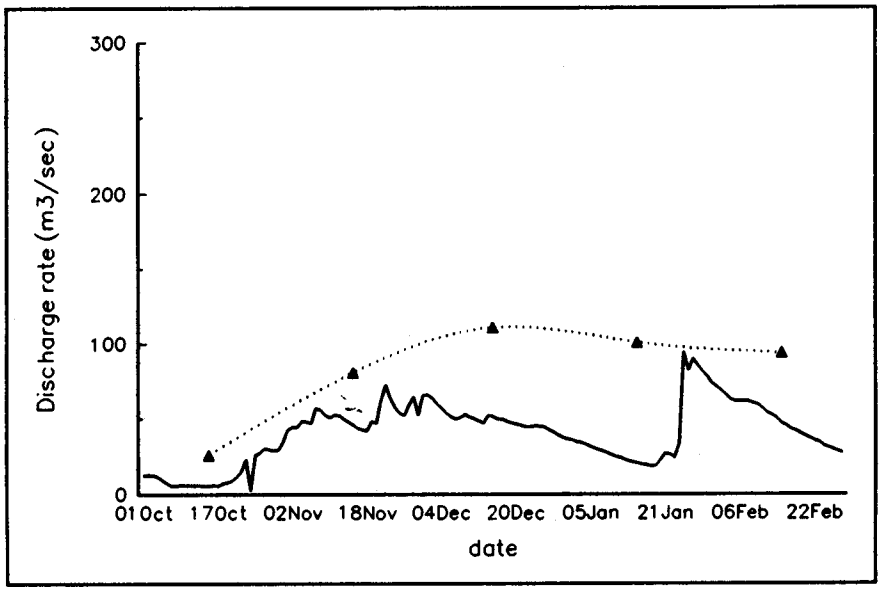

Figure 4. Daily discharge rate from Oct-Feb 1992/93 (solid line) and the 30 yr monthly average (dotted line) from the Duncan site (Water Survey of Canada).

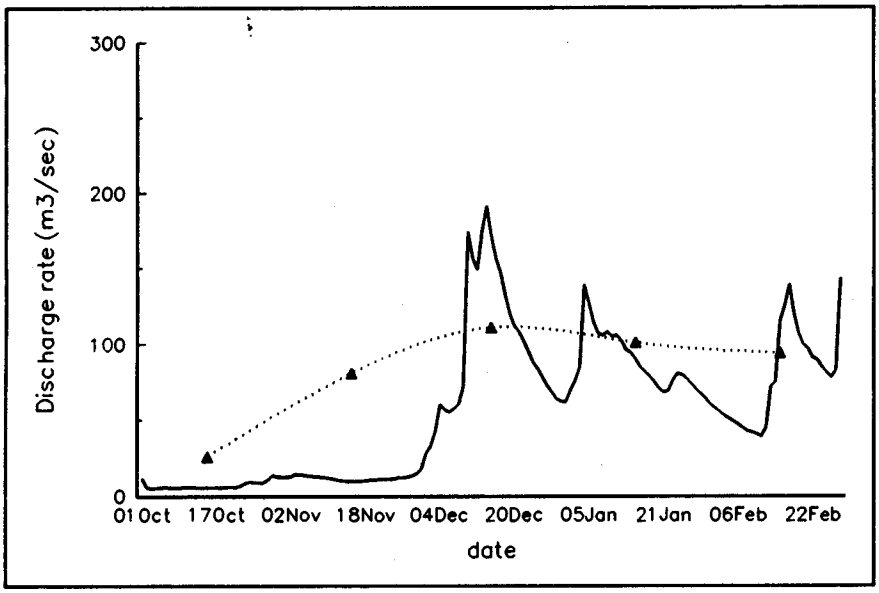

Figure 5 Daily discharge rate from Oct-Feb 1993/94 (solid line) and the 30 year monthly average (dotted line) from the Duncan site (Water survey of Canada).

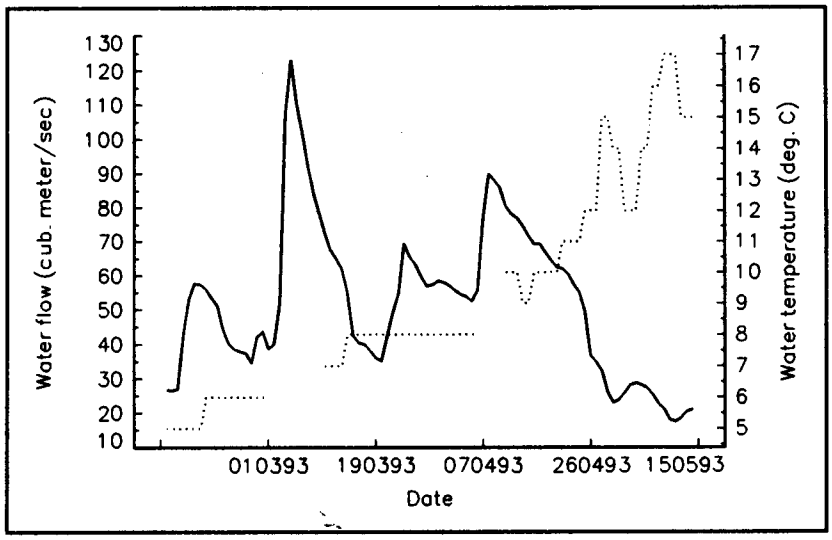

Figure 6 - Discharge rate (solid line) from Duncan site (Water Survey of Canada) and water temperature (dotted line) measured at Pumphouse location, Cowichan River, 1993.

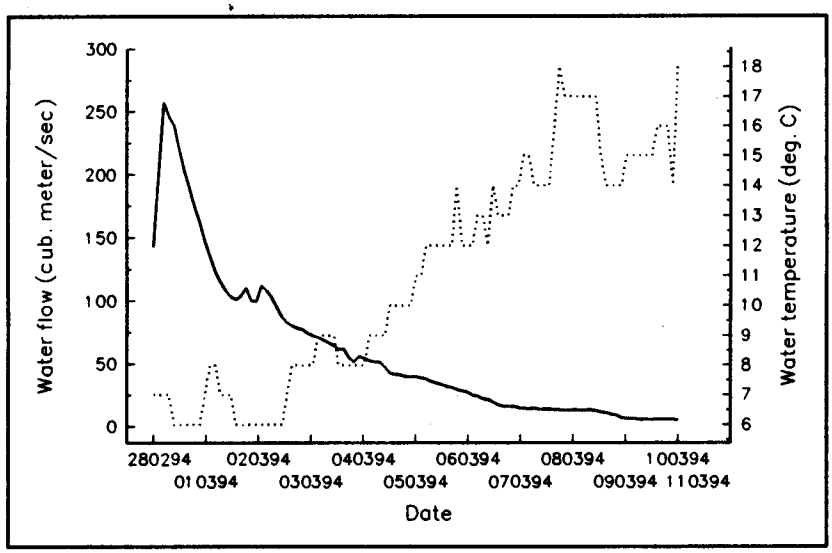

Figure 7 - Discharge rate (solid line) from Duncan site (Water Survey of Canada) and water temperature (dotted line) measured at the Pumphouse location, Cowichan River, 1994.

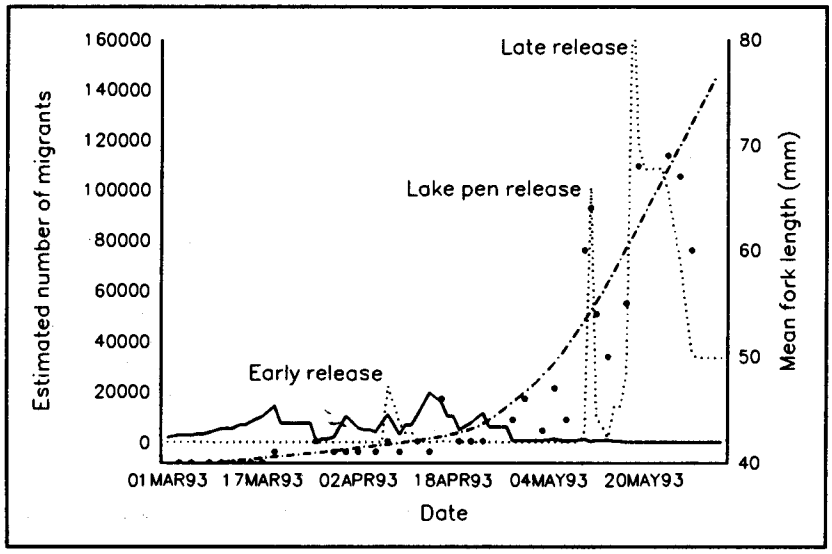

Figure 8 - Migration timing and seasonal trend in mean growth of chinook salmon trapped at the Pumphouse site, Cowichan River, 1993 (solid - naturally-reared, dotted -hatchery).

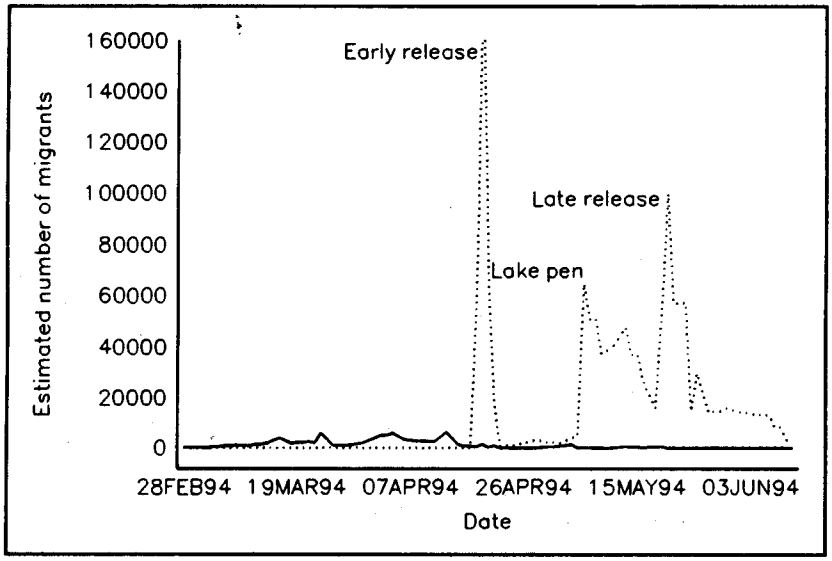

Figure 9 - Migration timing of chinook salmon juveniles trapped at the Pumphouse site, Cowichan River, 1994 (solid - naturally-spawned, dotted - hatchery).
See fig. 10 and 11 for seasonal growth.

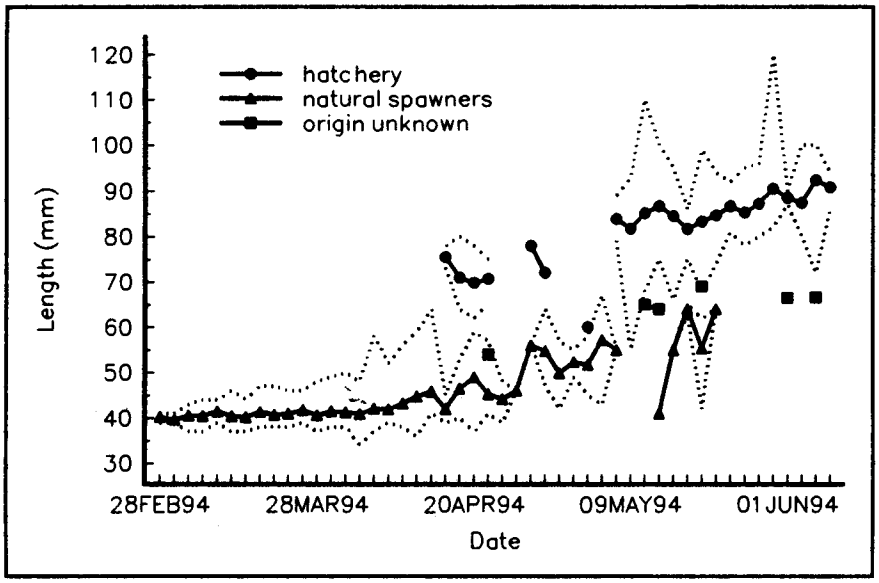

Figure 10 - Juvenile chinook length (solid - mean length, dotted - maximum and minimum length) trapped at the Pumphouse site, 1994.

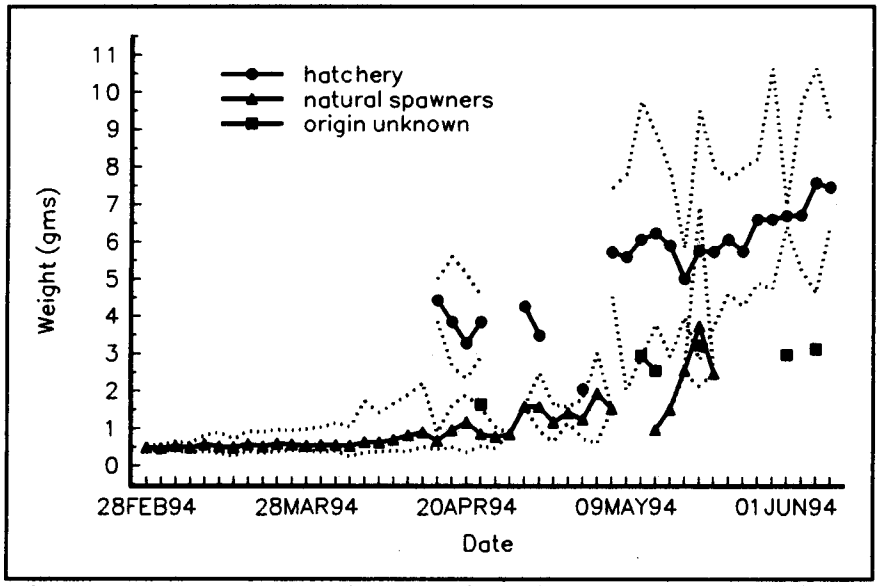

Figure 11 - Juvenile chinook weight (solid - mean weight, dotted - minimum and maximum weight) trapped at the Pumphouse site, 1994.

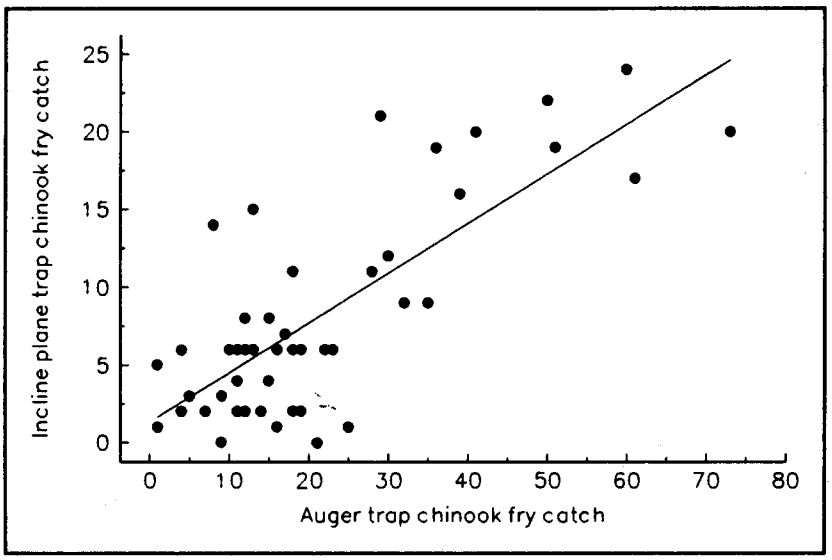

Figure 12 - Comparison of trap catch between the 1.5 m auger trap and the Incline plane trap for 2 h sampling intervals, Cowichan R. 1993.

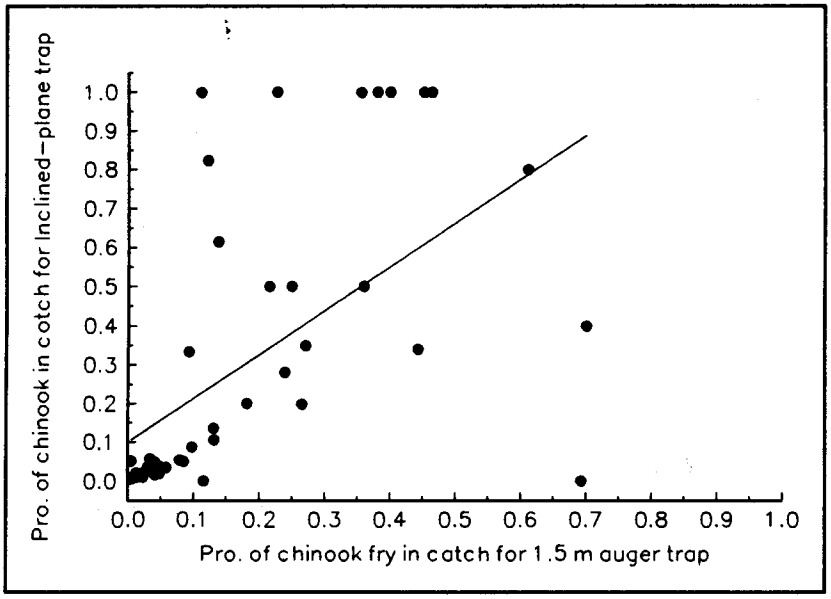

Figure 13 - Comparison of the proportion of chinook in catch between the 1.5 m auger trap and the inclined-plane trap for 2 h sampling intervals, Cowichan R. 1993.

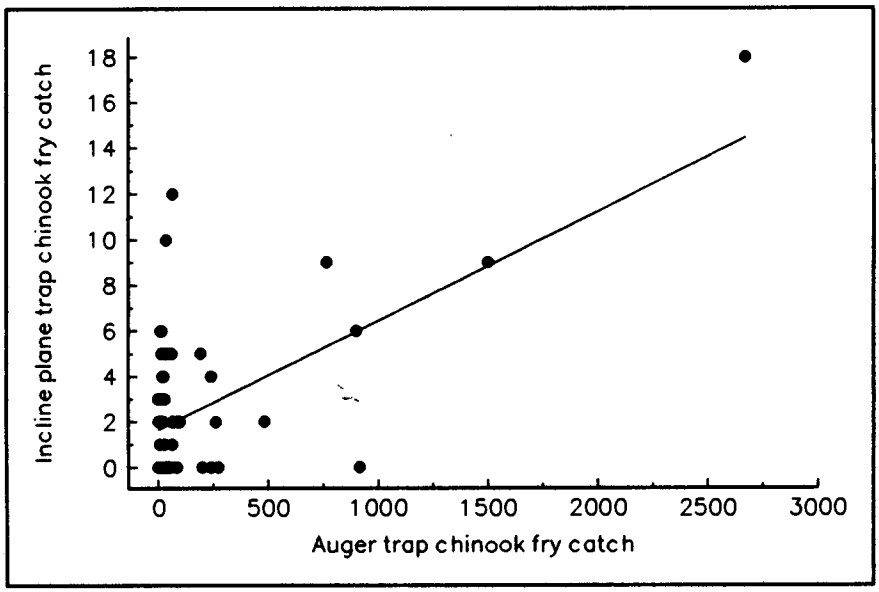

Figure 14 - Comparison of trap catch between 2.4 m auger trap and the Inclined-plane trap for 2 h sampling intervals, Cowichan R. 1994.

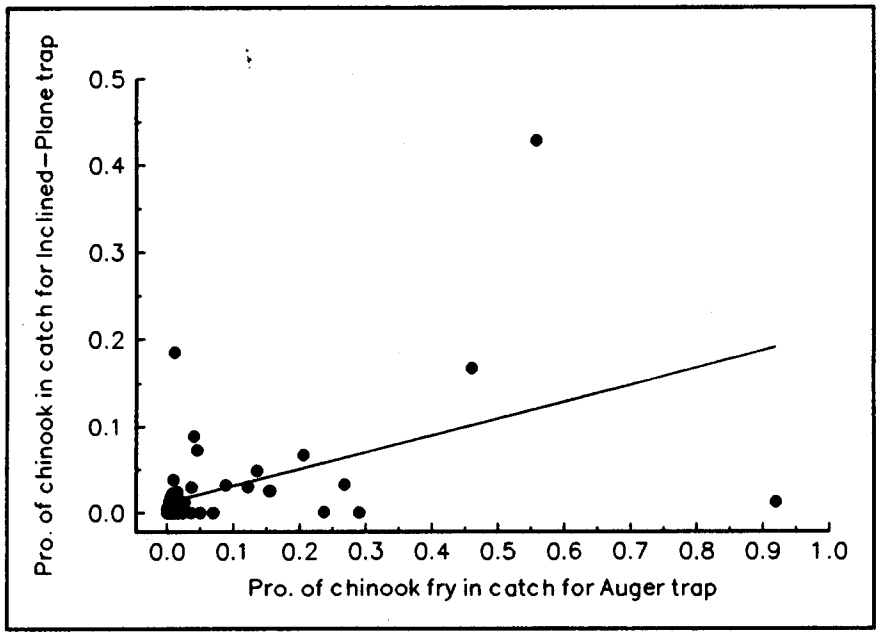

Figure 15. Comparison of the proportion of chinook in catch between 2.4 m auger trap and the Incline-plane trap for 2 h sampling intervals, Cowichan R., 1994.

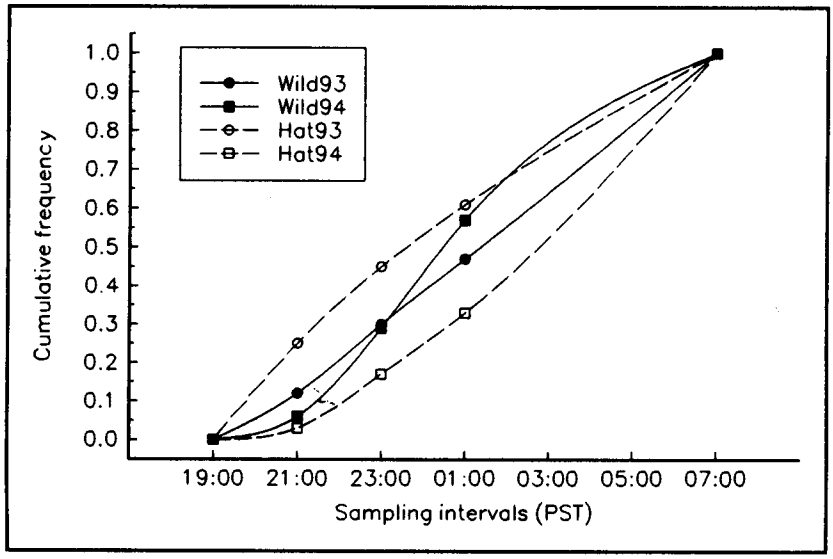

Figure 16 - Cummulative frequency of chinook migrants during over-night sampling, pumphouse site Cowichan River, 1993 and 1994.

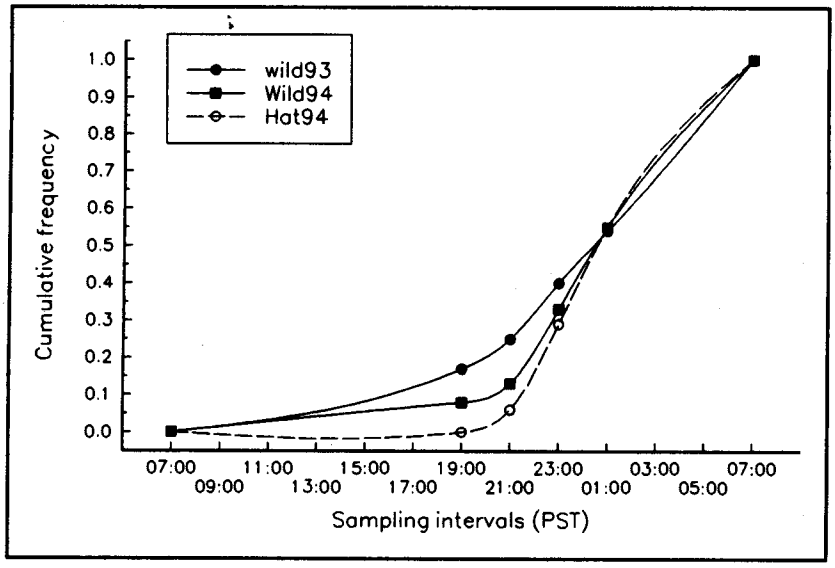

Figure 17 - Cumulative frequency of chinook migrants (solid-wild, dotted-hatchery) for daytime and night sampling interval, Pumphouse site, Cowichan R. 1993 and 1994.

Appendix table 1. Catch data for site and trap type by date for Cowichan River for 1993. T=temperature (°C), W=weather, C=water clarity, S=site, Trap=trap type, CNH=hatchery chinook, CNN=naturally spawned, CNM=chinook adipose clipped, CNF=chinook fry (naturally-spawned or hatchery), COF=coho fry, CHF=chum fry, CO1=1+ coho, CO2=2+ coho.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
010393	19:00-21:00	5	1	2	7B	IPT	0	0	0	1	0	0	
010393	19:00-21:00	5	1	2	7B	SC5	0	9	0	4	0	0	
010393	21:00-23:00	5	1	2	7B	IPT	0	1	0	0	0	0	
010393	21:00-23:00	5	1	2	7B	SC5	0	1	0	8	0	0	
010393	23:00- 1:00	5	1	2	7B	IPT	0	3	0	3	0	0	
010393	23:00- 1:00	5	1	2	7B	SC5	0	5	0	15	0	0	
030393	19:00-21:00	5	3	2	7B	IPT	0	4	0	1	0	0	
030393	19:00-21:00	5	3	2	7B	SC5	0	11	0	7	0	0	
030393	21:00-23:00	5	3	2	7B	IPT	0	2	0	3	0	0	
030393	21:00-23:00	5	3	2	7B	SC5	0	7	0	3	0	0	
030393	23:00- 1:00	5	3	2	7B	IPT	0	6	0	0	0	0	
030393	23:00- 1:00	5	3	2	7B	SC5	0	4	0	6	0	0	
050393	19:00-21:00	5	2	2	7B	SC5	0	10	0	13	0	0	
050393	19:00-21:00	5	2	2	7B	IPT	0	0	0	0	0	0	blown screen, 2100 to 2300 plugged
050393	21:00-23:00	5	2	2	7B	SC5	0	9	0	8	0	1	
050393	23:00- 1:00	5	2	2	7B	SC5	0	2	0	3	0	0	
080393	19:00-21:00	6	1	2	7B	IPT	0	0	0	0	0	0	flooding not working
080393	19:00-21:00	6	1	2	7B	SC5	0	4	0	9	0	0	
080393	21:00-23:00	6	1	2	7B	IPT	0	0	0	0	0	0	trap flooding over stern
080393	21:00-23:00	6	1	2	7B	SC5	0	11	0	57	0	0	
080393	23:00- 1:00	6	1	2	7B	IPT	0	0	0	0	0	0	
080393	23:00- 1:00	6	1	2	7B	SC5	0	15	0	35	0	0	
100393	19:00-21:00	6	1	2	7B	IPT	0	2	0	0	0	0	
100393	19:00-21:00	6	1	2	7B	SC5	0	14	0	17	0	0	
100393	21:00-23:00	6	1	2	7B	IPT	0	1	0	4	0	0	
100393	21:00-23:00	6	1	2	7B	SC5	0	16	1	71	0	0	
100393	23:00- 1:00	6	1	2	7B	IPT	0	14	0	3	0	0	
100393	23:00- 1:00	6	1	2	7B	SC5	0	8	0	58	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
110393	1:00- 3:00	6	1	2	7B	IPT	0	6	0	0	0	0	
110393	1:00- 3:00	6	1	2	7B	SC5	0	10	0	34	0	0	
110393	3:00- 5:00	6	1	2	7B	IPT	0	2	0	0	0	0	
110393	3:00- 5:00	6	1	2	7B	SC5	0	11	0	20	0	0	
110393	5:00- 7:00	6	1	2	7B	IPT	0	6	0	0	0	0	
110393	5:00- 7:00	6	1	2	7B	SC5	0	13	0	15	0	0	
110393	7:00- 8:18	6	1	2	7B	IPT	0	0	0	0	0	0	
110393	7:00- 8:18	6	1	2	7B	SC5	0	19	0	3	0	0	
120393	19:00-21:00	6	1	2	7B	IPT	0	2	0	2	0	0	
120393	19:00-21:00	6	1	2	7B	SC5	0	18	0	32	0	0	
120393	21:00-23:00	6	1	2	7B	IPT	0	3	0	6	0	0	
120393	21:00-23:00	6	1	2	7B	SC5	0	9	0	88	0	0	
120393	23:00- 1:00	6	1	2	7B	IPT	0	8	0	5	0	0	
120393	23:00- 1:00	6	1	2	7B	SC5	0	15	0	94	0	0	
150393	19:30-21:00	6	1	1	7B	IPT	0	6	0	0	0	0	
150393	19:30-21:00	6	1	1	7B	SC5	0	16	0	26	0	0	
150393	21:00-23:00	6	1	1	7B	IPT	0	1	0	1	0	0	
150393	21:00-23:00	6	1	1	7B	SC5	0	25	0	91	0	0	
150393	23:00- 1:00	6	1	1	7B	IPT	0	0	0	1	0	0	
150393	23:00- 1:00	6	1	1	7B	SC5	0	21	0	161	0	0	
170393	19:00-21:00	6	3	2	7B	IPT	0	15	2	26	0	0	
170393	19:00-21:00	6	3	2	7B	SC5	0	13	1	34	0	0	
170393	21:00-23:00	6	3	2	7B	IPT	0	21	5	49	0	0	
170393	21:00-23:00	6	3	2	7B	SC5	0	29	0	92	0	0	
170393	23:00- 1:00	6	3	2	7B	IPT	0	11	1	43	0	0	
170393	23:00- 1:00	6	3	2	7B	SC5	0	18	0	50	0	0	
190393	19:00-21:00	6	3	2	7B	IPT	0	16	0	31	0	0	
190393	19:00-21:00	6	3	2	7B	SC5	0	39	0	49	0	0	
190393	21:00-23:00	6	3	2	7B	IPT	0	20	0	169	0	0	
190393	21:00-23:00	6	3	2	7B	SC5	0	41	0	271	0	0	
190393	23:00- 1:00	6	3	2	7B	IPT	0	12	0	125	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
190393	23:00- 1:00	6	3	2	7B	SC5	0	30	0	277	0	0	high flow cable broke traps ripped out
260393	19:00-21:00	6	1	2	7B	SC5	0	1	0	7	0	0	no IPT working yet
260393	21:00-23:00	6	1	2	7B	SC5	0	3	1	3	0	0	
260393	23:00- 1:00	6	1	2	7B	SC5	0	0	0	2	0	0	
290393	19:00-21:00	7	1	2	7B	IPT	0	0	0	0	0	0	high debris flow blocking back of trap
290393	19:00-21:00	7	1	2	7B	SC5	0	2	0	39	0	0	
290393	21:00-23:00	7	1	2	7B	IPT	0	6	0	371	0	0	
290393	21:00-23:00	7	1	2	7B	SC5	0	11	1	260	0	0	
290393	23:00- 1:00	7	1	2	7B	IPT	0	0	0	0	0	0	
290393	23:00- 1:00	7	1	2	7B	SC5	0	3	0	36	0	0	
310393	19:00-21:00	7	1	2	7B	IPT	0	11	1	69	0	0	
310393	19:00-21:00	7	1	2	7B	SC5	0	28	1	186	0	0	
310393	21:00-23:00	7	1	2	7B	IPT	0	9	3	248	0	0	
310393	21:00-23:00	7	1	2	7B	SC5	0	32	1	517	0	0	
310393	23:00- 1:00	7	1	2	7B	IPT	0	2	0	106	0	0	
310393	23:00- 1:00	7	1	2	7B	SC5	0	19	0	376	0	0	
020493	19:00-21:00	8	1	2	7B	IPT	0	4	0	76	0	0	traps moved slightly further out
020493	19:00-21:00	8	1	2	7B	SC5	0	15	0	162	0	0	
020493	21:00-23:00	8	1	2	7B	IPT	0	7	0	137	0	0	
020493	21:00-23:00	8	1	2	7B	SC5	0	17	2	397	0	0	
020493	23:00- 1:00	8	1	2	7B	IPT	0	0	0	0	0	0	
020493	23:00- 1:00	8	1	2	7B	SC5	0	11	1	418	0	0	
050493	20:00-22:00	8	1	1	7B	IPT	0	5	0	92	0	0	
050493	20:00-22:00	8	1	1	7B	SC5	0	1	0	224	0	0	two trout approx 80 mm
050493	22:00-24:00	8	1	1	7B	IPT	0	8	1	385	0	0	
050493	22:00-24:00	8	1	1	7B	SC5	0	12	0	980	0	0	
060493	0:00- 2:00	8	1	1	7B	IPT	0	6	0	600	0	0	
060493	0:00- 2:00	8	1	1	7B	SC5	0	19	0	1475	0	0	
070493	20:00-22:00	8	3	2	7B	IPT	0	6	0	105	0	0	
070493	20:00-22:00	8	3	2	7B	SC5	0	23	0	270	0	0	
070493	22:00-24:00	8	3	2	7B	IPT	0	6	0	1250	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
070493	22:00-24:00	8	3	2	7B	SC5	0	22	2	4850	0	0	
080493	0:00- 2:00	8	3	2	7B	IPT	16	9	3	1300	0	0	note some hatchery release fish
080493	0:00- 2:00	8	3	2	7B	SC5	171	39	1	9300	0	0	
090493	20:00-22:00	8	1	2	7B	IPT	0	0	0	0	0	0	not working properly due to high flow
090493	20:00-22:00	8	1	2	7B	SC5	42	7	2	56	0	0	
090493	22:00-24:00	8	1	2	7B	IPT	0	0	0	0	0	0	
090493	22:00-24:00	8	1	2	7B	SC5	3	7	1	40	0	0	
100493	0:00- 2:00	8	1	2	7B	IPT	0	0	0	0	0	0	screen plugged not working
100493	0:00- 2:00	8	1	2	7B	SC5	9	9	0	40	0	1	
120493	20:00-22:00	8	1	2	7B	IPT	0	2	6	190	0	0	
120493	20:00-22:00	8	1	2	7B	SC5	0	4	3	169	0	0	
120493	22:00-24:00	8	1	2	7B	IPT	0	0	0	0	0	0	
120493	22:00-24:00	8	1	2	7B	SC5	0	24	13	4605	0	0	
130493	0:00- 2:00	8	1	2	7B	IPT	1	18	0	2100	0	0	
130493	0:00- 2:00	8	1	2	7B	SC5	1	35	8	4100	0	0	
130493	2:00- 4:00	8	1	2	7B	IPT	0	19	10	850	0	0	
130493	2:00- 4:00	8	1	2	7B	SC5	2	49	20	2050	0	0	
130493	4:00- 6:00	8	1	2	7B	IPT	0	9	5	500	0	0	
130493	4:00- 6:00	8	1	2	7B	SC5	1	34	11	2100	0	0	
130493	6:00- 8:00	8	1	2	7B	IPT	0	2	1	50	0	0	
130493	6:00- 8:00	8	1	2	7B	SC5	0	12	2	375	0	0	
130493	8:00- 9:18	8	1	2	7B	IPT	0	0	0	0	0	0	
130493	8:00- 9:18	8	1	2	7B	SC5	4	26	3	400	0	0	
140493	20:00-22:00	8	1	2	7B	IPT	0	6	3	150	0	0	
140493	20:00-22:00	8	1	2	7B	SC5	0	18	7	350	0	0	
140493	22:00-24:00	8	1	2	7B	IPT	0	20	8	2200	0	0	
140493	22:00-24:00	8	1	2	7B	SC5	1	72	12	7000	0	1	
150493	0:00- 2:00	8	1	2	7B	IPT	0	24	4	1800	0	0	
150493	0:00- 2:00	8	1	2	7B	SC5	0	60	12	5600	0	0	
160493	20:00-22:00	8	1	2	7B	IPT	0	6	9	90	0	0	
160493	20:00-22:00	8	1	2	7B	SC5	0	12	27	320	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
160493	22:00-24:00	8	1	2	7B	IPT	0	17	22	1100	0	0	
160493	22:00-24:00	8	1	2	7B	SC5	1	60	72	4150	0	1	
170493	0:00- 2:00	8	1	2	7B	IPT	1	21	12	1200	0	1	
170493	0:00- 2:00	8	1	2	7B	SC5	2	48	28	2200	0	2	
190493	20:00-22:00	8	1	2	7B	IPT	2	8	5	280	0	1	
190493	20:00-22:00	8	1	2	7B	IPT	0	3	1	20	0	0	
190493	22:00-24:00	8	1	2	7B	IPT	0	10	12	2600	0	0	
190493	22:00-24:00	8	1	2	7B	IPT	0	12	6	2900	0	0	
200493	0:00- 2:00	8	1	2	7B	IPT	0	0	0	0	0	0	inside screen ripped out
200493	0:00- 2:00	8	1	2	7B	IPT	1	18	10	3600	0	0	
210493	20:00-22:00	8	1	2	7B	IPT	0	18	8	500	0	2	
210493	20:00-22:00	8	1	2	7B	IPT	1	6	15	350	0	2	
210493	22:00-24:00	8	1	2	7B	IPT	0	26	14	4900	0	1	
210493	22:00-24:00	8	1	2	7B	IPT	0	0	0	0	0	0	
220493	0:00- 2:00	8	1	2	7B	IPT	0	5	6	1150	0	0	
220493	0:00- 2:00	8	1	2	7B	IPT	1	24	36	4600	0	1	
230493	20:00-22:00	8	1	2	7B	IPT	0	12	5	500	0	0	
230493	20:00-22:00	8	1	2	7B	IPT	0	18	17	750	0	0	
230493	22:00-24:00	8	1	2	7B	IPT	0	40	20	5500	0	1	
230493	22:00-24:00	8	1	2	7B	IPT	0	12	40	8600	0	0	
240493	0:00- 2:00	8	1	2	7B	IPT	0	25	10	4000	0	0	
240493	0:00- 2:00	8	1	2	7B	IPT	0	10	10	4750	0	0	
260493	20:00-22:00	.	1	2	7B	IPT	0	0	0	0	0	0	flow too high not fishing
260493	20:00-22:00	.	1	2	7B	IPT	0	0	0	0	0	0	
260493	22:00-24:00	.	1	2	7B	IPT	0	0	0	0	0	0	
260493	22:00-24:00	.	1	2	7B	IPT	0	0	0	0	0	0	
270493	0:00- 2:00	.	1	2	7B	IPT	0	0	0	0	0	0	
280493	20:00-21:00	.	1	2	7B	IPT	0	2	0	30	0	0	
280493	20:00-21:00	.	1	2	7B	IPT	0	0	0	0	0	0	
280493	21:00-22:30	.	1	2	7B	IPT	0	0	0	0	0	0	
280493	21:00-22:30	.	1	2	7B	IPT	0	0	0	0	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
280493	22:30-24:00	.	1	2	7B	IPT	0	0	0	0	0	0	
300493	20:00-22:00	10	1	2	7B	IPT	1	3	3	225	0	0	
300493	20:00-22:00	10	1	2	7B	IPT	1	2	2	300	0	0	
300493	22:00-24:00	10	1	2	7B	IPT	0	0	5	700	0	0	
300493	22:00-24:00	10	1	2	7B	IPT	0	1	11	1000	0	0	
010593	0:00- 2:00	10	1	2	7B	IPT	0	0	2	200	0	0	
010593	0:00- 2:00	10	1	2	7B	IPT	1	0	5	800	0	0	
030593	20:00-22:00	9	1	2	7B	IPT	0	1	1	275	0	0	
030593	20:00-22:00	9	1	2	7B	IPT	0	2	4	300	0	0	
030593	22:00-24:00	9	1	2	7B	IPT	0	3	10	2050	0	3	
030593	22:00-24:00	9	1	2	7B	IPT	0	0	0	0	0	0	
040593	0:00- 2:00	9	1	2	7B	IPT	0	2	24	1700	0	0	
040593	0:00- 2:00	9	1	2	7B	IPT	0	0	24	1700	0	2	
050593	20:00-22:00	10	3	2	7B	IPT	0	2	2	300	0	0	
050593	20:00-22:00	10	3	2	7B	IPT	0	2	5	275	0	0	
050593	23:00-24:00	10	3	2	7B	IPT	0	2	14	400	0	0	
050593	23:00-24:00	10	3	2	7B	IPT	1	1	6	550	0	0	
060593	0:00- 1:00	10	3	2	7B	IPT	0	2	17	550	0	0	
060593	0:00- 1:00	10	3	2	7B	IPT	0	3	10	550	0	1	
060593	1:00- 2:00	10	3	2	7B	IPT	1	1	15	570	0	1	
060593	1:00- 2:00	10	3	2	7B	IPT	0	0	9	450	0	0	
070593	20:00-22:00	10	1	2	7B	IPT	0	0	2	54	0	1	
070593	20:00-22:00	10	1	2	7B	IPT	0	0	1	50	0	0	
070593	22:00-23:00	10	1	2	7B	IPT	0	0	7	375	0	0	
070593	22:00-23:00	10	1	2	7B	IPT	0	0	12	460	0	0	
080593	1:00- 3:00	10	1	2	7B	IPT	0	3	32	2300	0	1	
080593	1:00- 3:00	10	1	2	7B	IPT	0	2	52	1425	0	2	
080593	2:00- 3:00	10	1	2	7B	IPT	0	0	23	775	0	0	
080593	2:00- 3:00	10	1	2	7B	IPT	0	0	9	510	0	4	
100593	20:00-22:00	11	2	2	7B	IPT	0	2	0	40	0	0	
100593	20:00-22:00	11	2	2	7B	IPT	0	2	1	40	0	0	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
100593	22:00-24:00	11	2	2	7B	IPT	0	3	14	400	0	0	
100593	22:00-24:00	11	2	2	7B	IPT	2	2	19	425	0	0	
110593	0:00- 2:00	11	2	2	7B	IPT	19	1	2	600	0	0	
110593	0:00- 2:00	11	2	2	7B	IPT	7	2	15	800	0	0	
110593	23:00- 7:00	10	2	2	7B	IPT	1000	0	50	1700	0	15	
120593	20:00-22:00	11	1	2	7B	IPT	2	0	0	2	0	0	
120593	20:00-22:00	11	1	2	7B	IPT	9	0	0	8	0	0	
120593	22:00-24:00	11	1	2	7B	IPT	6	4	4	270	0	0	
120593	22:00-24:00	11	1	2	7B	IPT	7	2	7	405	0	0	
130593	0:00- 2:00	11	1	2	7B	IPT	7	1	11	700	0	0	
130593	0:00- 2:00	11	1	2	7B	IPT	18	1	16	450	0	0	
130593	2:00- 8:00	11	1	2	7B	IPT	50	0	10	300	0	0	
140593	20:00-22:00	12	1	2	7B	IPT	4	0	0	51	0	0	
140593	20:00-22:00	12	1	2	7B	IPT	2	1	0	38	0	0	
140593	22:00-24:00	12	1	2	7B	IPT	2	2	7	200	0	0	
140593	22:00-24:00	12	1	2	7B	IPT	5	0	7	216	0	0	
150593	0:00- 2:00	12	1	2	7B	IPT	3	2	10	650	0	0	
150593	0:00- 2:00	12	1	2	7B	IPT	2	4	10	500	0	0	
170593	20:00-21:00	15	1	2	7F	IPT	47	0	0	51	0	48	
170593	20:00-21:00	15	1	2	7F	IPT	98	6	0	52	0	74	
170593	22:00-23:00	15	1	2	7F	IPT	14	2	58	309	0	46	
170593	22:00-23:00	15	1	2	7F	IPT	12	0	43	200	0	23	
180593	0:00- 1:00	15	1	2	7F	IPT	4	2	49	405	0	46	
180593	0:00- 1:00	15	1	2	7F	IPT	9	0	32	362	0	26	
180593	20:00-21:00	14	1	2	7F	IPT	520	30	10	39	0	40	
180593	20:00-21:00	14	1	2	7F	IPT	606	18	6	50	0	66	
190593	0:00- 1:00	14	1	2	7F	IPT	245	25	190	163	0	6	
190593	0:00- 1:00	14	1	2	7F	IPT	544	18	168	259	0	18	
190593	2:00- 3:00	14	1	2	7F	IPT	198	9	117	199	0	15	
190593	2:00- 3:00	14	1	2	7F	IPT	0	0	0	0	0	0	
190593	4:00- 5:00	14	1	2	7F	IPT	270	0	9	51	0	36	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
190593	4:00- 5:00	14	1	2	7F	IPT	504	9	45	61	0	72	
190593	5:00- 6:30	14	1	2	7F	IPT	20	0	0	12	0	0	
190593	5:00- 6:30	14	1	2	7F	IPT	20	0	0	12	0	0	
190593	20:00-22:00	15	3	2	7F	IPT	390	30	5	30	0	20	
190593	20:00-22:00	15	3	2	7F	IPT	330	24	0	48	0	12	
190593	22:00-24:00	15	3	2	7F	IPT	114	6	6	132	0	12	
190593	22:00-24:00	15	3	2	7F	IPT	164	0	8	187	0	8	
210593	20:00-21:00	12	1	2	7F	IPT	400	0	0	0	0	0	
210593	20:00-21:00	12	1	2	7F	IPT	350	0	0	0	0	0	
210593	21:00-22:00	12	1	2	7F	IPT	348	0	20	50	0	72	
210593	21:00-22:00	12	1	2	7F	IPT	630	0	12	30	0	24	
210593	23:00-24:00	12	1	2	7F	IPT	212	0	10	20	0	30	
210593	23:00-24:00	12	1	2	7F	IPT	280	0	10	30	0	24	
220593	0:00- 2:00	12	1	2	7F	IPT	400	0	12	50	0	8	
220593	0:00- 2:00	12	1	2	7F	IPT	160	0	60	50	0	5	
240593	20:00-22:00	14	1	1	7F	IPT	300	0	0	8	45	2	
240593	20:00-22:00	14	1	1	7F	IPT	350	0	0	10	60	4	
240593	22:00-24:00	14	1	1	7F	IPT	200	0	15	30	20	2	
240593	22:00-24:00	14	1	1	7F	IPT	200	0	20	50	20	2	
250593	0:00- 2:00	14	1	1	7F	IPT	250	0	100	250	10	2	
250593	0:00- 2:00	14	1	1	7F	IPT	300	0	150	200	20	6	
260593	20:00-21:00	16	1	1	7F	IPT	22	33	26	2	4	1	
260593	20:00-21:00	16	1	1	7F	IPT	4	20	23	0	0	0	
260593	21:00-22:00	16	1	1	7F	IPT	63	140	24	0	3	6	
260593	21:00-22:00	16	1	1	7F	IPT	100	120	32	0	0	8	
260593	22:00-23:00	16	1	1	7F	IPT	27	33	12	9	7	2	
260593	22:00-23:00	16	1	1	7F	IPT	35	37	24	5	2	1	
260593	23:00-24:00	16	1	1	7F	IPT	77	25	56	32	6	3	
260593	23:00-24:00	16	1	1	7F	IPT	66	18	50	39	5	2	
270593	0:00- 1:00	16	1	1	7F	IPT	58	30	49	33	4	7	
270593	0:00- 1:00	16	1	1	7F	IPT	61	19	78	42	0	3	

Appendix table 1 - continued.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNH	CNN	COF	CHF	CO1	CO2	COMMENTS
270593	1:00- 2:00	16	1	1	7F	IPT	50	24	74	54	3	8	
270593	1:00- 2:00	16	1	1	7F	IPT	72	23	57	58	0	1	
280593	20:00-21:00	17	3	1	7F	IPT	22	121	4	0	0	0	
280593	20:00-21:00	17	3	1	7F	IPT	6	70	2	1	0	0	
280593	21:00-22:00	17	3	1	7F	IPT	33	150	6	0	0	0	
280593	21:00-22:00	17	3	1	7F	IPT	27	66	6	0	9	3	
280593	22:00-23:00	17	3	1	7F	IPT	8	22	18	15	4	1	
280593	22:00-23:00	17	3	1	7F	IPT	2	5	6	18	1	0	
280593	23:00-24:00	17	3	1	7F	IPT	4	12	13	45	3	0	
280593	23:00-24:00	17	3	1	7F	IPT	0	5	4	22	3	0	
290593	0:00- 1:00	17	3	1	7F	IPT	3	7	21	43	3	1	
290593	0:00- 1:00	17	3	1	7F	IPT	2	3	6	31	0	1	
310593	20:00-22:00	15	2	2	7F	IPT	4	23	3	2	0	0	
310593	22:00-23:00	15	2	2	7F	IPT	5	26	7	4	1	0	
010693	20:00-21:00	15	2	2	7F	IPT	14	78	41	20	0	0	
010693	20:00-21:00	15	2	2	7F	IPT	12	75	26	10	0	0	
010693	21:00-22:00	15	2	2	7F	IPT	38	61	22	13	0	0	
010693	21:00-22:00	15	2	2	7F	IPT	22	51	15	5	0	0	
010693	22:00-23:00	15	2	2	7F	IPT	19	11	22	23	0	3	
010693	22:00-23:00	15	2	2	7F	IPT	10	11	19	30	2	1	
010693	23:00-24:00	15	2	2	7F	IPT	13	6	23	34	1	4	
010693	23:00-24:00	15	2	2	7F	IPT	7	14	18	39	0	1	
020693	0:00- 1:00	15	2	2	7F	IPT	12	4	19	42	3	2	
020693	0:00- 1:00	15	2	2	7F	IPT	6	9	22	40	1	1	
020693	1:00- 2:00	15	2	2	7F	IPT	14	10	18	91	1	2	
020693	1:00- 2:00	15	2	2	7F	IPT	12	8	23	80	1	1	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
260293	19:00-21:00	2	1	1	5B	IPT	0	0	1	0	0	0	
260293	19:00-21:00	2	1	1	5B	IPT	0	0	0	0	0	0	
260293	23:00- 1:00	2	1	1	5B	IPT	0	2	1	0	0	0	
260293	23:00- 1:00	2	1	1	5B	IPT	0	3	0	0	0	0	
270293	1:00- 3:00	2	1	1	5B	IPT	0	2	0	0	0	0	
270293	1:00- 3:00	2	1	1	5B	IPT	0	1	0	0	0	0	
010393	19:00-21:00	5	1	1	5B	IPT	0	3	1	0	0	0	
010393	19:00-21:00	5	1	1	5B	IPT	0	2	0	0	0	0	
010393	21:00-23:00	5	1	1	5B	IPT	0	3	0	1	0	0	
010393	21:00-23:00	5	1	1	5B	IPT	0	3	0	0	0	0	
010393	23:00- 1:00	5	1	1	5B	IPT	0	1	0	0	0	0	
010393	23:00- 1:00	5	1	1	5B	IPT	0	0	0	0	0	0	
030393	19:00-21:00	6	3	1	5B	IPT	0	4	0	0	0	0	
030393	19:00-21:00	6	3	1	5B	IPT	0	5	0	1	0	0	
030393	21:00-23:00	6	3	1	5B	IPT	0	6	1	0	0	0	
030393	21:00-23:00	6	3	1	5B	IPT	0	5	0	0	0	0	
030393	23:00- 1:00	6	3	1	5B	IPT	0	2	1	0	0	0	
030393	23:00- 1:00	6	3	1	5B	IPT	0	0	1	0	0	0	
050393	19:00-21:00	5	3	1	5B	IPT	0	11	0	1	0	0	5 steelhead >80 mm
050393	19:00-21:00	5	3	1	5B	IPT	0	2	0	0	0	0	
050393	21:00-23:00	5	3	1	5B	IPT	0	4	0	0	2	0	
050393	21:00-23:00	5	3	1	5B	IPT	0	1	0	0	0	0	
050393	23:00- 1:00	5	3	1	5B	IPT	0	7	0	0	0	0	
050393	23:00- 1:00	5	3	1	5B	IPT	0	2	0	0	0	0	
080393	19:00-21:00	4	1	1	5B	IPT	0	6	0	0	1	0	
080393	19:00-21:00	4	1	1	5B	IPT	0	4	0	0	0	0	
080393	21:00-23:00	4	1	1	5B	IPT	0	14	0	0	0	0	
080393	21:00-23:00	4	1	1	5B	IPT	0	9	0	0	0	0	
080393	23:00- 1:00	4	1	1	5B	IPT	0	1	0	1	0	0	
080393	23:00- 1:00	4	1	1	5B	IPT	0	2	0	0	0	0	
100393	19:00-21:00	6	1	1	5B	IPT	0	23	1	0	0	0	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
100393	19:00-21:00	6	1	1	5B	IPT	0	10	0	0	0	0	
100393	21:00-23:00	6	1	1	5B	IPT	0	17	0	0	0	0	
100393	21:00-23:00	6	1	1	5B	IPT	0	8	1	0	0	0	
100393	23:00- 1:00	6	1	1	5B	IPT	0	4	0	0	0	0	
100393	23:00- 1:00	6	1	1	5B	IPT	0	3	0	0	0	0	
110393	1:00- 3:00	6	1	1	5B	IPT	0	4	0	0	0	0	
110393	1:00- 3:00	6	1	1	5B	IPT	0	6	0	0	0	0	
110393	3:00- 5:00	6	1	1	5B	IPT	0	0	2	0	0	0	
110393	3:00- 5:00	6	1	1	5B	IPT	0	1	0	1	0	0	
110393	5:00- 7:00	6	1	1	5B	IPT	0	0	0	0	0	0	
110393	5:00- 7:00	6	1	1	5B	IPT	0	0	0	0	0	0	
120393	19:00-21:00	6	1	1	5B	IPT	0	35	2	2	0	0	
120393	19:00-21:00	6	1	1	5B	IPT	0	25	0	2	0	0	
120393	21:00-23:00	6	1	1	5B	IPT	0	19	0	1	0	0	
120393	21:00-23:00	6	1	1	5B	IPT	0	14	1	0	0	0	
120393	23:00- 1:00	6	1	1	5B	IPT	0	15	1	0	0	0	
120393	23:00- 1:00	6	1	1	5B	IPT	0	11	1	0	0	0	
150393	19:00-21:00	6	1	1	5B	IPT	0	19	0	0	0	0	
150393	19:00-21:00	6	1	1	5B	IPT	0	10	1	1	0	0	
150393	21:00-23:00	6	1	1	5B	IPT	0	19	2	2	0	0	
150393	21:00-23:00	6	1	1	5B	IPT	0	13	2	1	0	0	
150393	23:00- 1:00	6	1	1	5B	IPT	0	5	1	1	0	0	
150393	23:00- 1:00	6	1	1	5B	IPT	0	4	1	1	0	0	
170393	19:00-21:00	6	2	1	5B	IPT	0	29	3	1	1	0	
170393	19:00-21:00	6	2	1	5B	IPT	0	20	4	1	0	0	
170393	21:00-23:00	6	2	1	5B	IPT	0	28	2	0	0	0	
170393	21:00-23:00	6	2	1	5B	IPT	0	20	3	2	0	0	
170393	23:00- 1:00	6	2	1	5B	IPT	0	15	3	2	0	0	
170393	23:00- 1:00	6	2	1	5B	IPT	0	15	2	0	0	0	
190393	19:00-21:00	6	3	1	5B	IPT	0	28	0	2	0	0	
190393	19:00-21:00	6	3	1	5B	IPT	0	23	2	0	0	0	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
190393	21:00-23:00	6	3	1	5B	IPT	0	21	1	2	0	0	
190393	21:00-23:00	6	3	1	5B	IPT	0	20	2	2	0	0	
190393	23:00- 1:00	6	3	1	5B	IPT	0	19	3	0	0	0	
190393	23:00- 1:00	6	3	1	5B	IPT	0	15	1	2	0	0	
260393	19:00-21:00	7	1	1	5B	IPT	0	17	3	20	1	0	
260393	19:00-21:00	7	1	1	5B	IPT	0	20	5	24	0	0	
260393	21:00-23:00	7	1	1	5B	IPT	0	12	2	10	0	0	
260393	21:00-23:00	7	1	1	5B	IPT	0	12	0	10	0	0	
260393	23:00- 1:00	7	1	1	5B	IPT	0	7	2	5	1	0	
260393	23:00- 1:00	7	1	1	5B	IPT	0	7	0	0	0	0	
290393	19:00-21:00	7	1	1	5B	IPT	0	25	3	30	0	0	
290393	19:00-21:00	7	1	1	5B	IPT	0	25	1	12	0	0	1 cutthroat
290393	21:00-23:00	7	1	1	5B	IPT	0	30	2	50	0	0	
290393	21:00-23:00	7	1	1	5B	IPT	0	34	3	30	0	0	
290393	23:00- 1:00	7	1	1	5B	IPT	0	40	6	32	0	0	
290393	23:00- 1:00	7	1	1	5B	IPT	0	25	3	25	0	0	
310393	19:00-21:00	6	2	1	5B	IPT	0	29	5	15	0	0	
310393	19:00-21:00	6	2	1	5B	IPT	0	20	4	18	0	0	
310393	21:00-23:00	6	2	1	5B	IPT	0	20	2	13	0	0	
310393	21:00-23:00	6	2	1	5B	IPT	0	29	0	10	0	0	
310393	23:00- 1:00	6	2	1	5B	IPT	0	26	4	16	0	0	
310393	23:00- 1:00	6	2	1	5B	IPT	0	20	3	10	0	0	
020493	19:00-21:00	7	2	1	5B	IPT	0	17	3	23	0	0	
020493	19:00-21:00	7	2	1	5B	IPT	0	20	4	36	0	0	
020493	21:00-23:00	7	2	1	5B	IPT	0	12	6	30	0	0	
020493	21:00-23:00	7	2	1	5B	IPT	0	11	6	30	0	0	
020493	23:00- 1:00	7	2	1	5B	IPT	0	9	5	30	0	0	
020493	23:00- 1:00	7	2	1	5B	IPT	0	12	7	34	0	0	
050493	20:00-22:00	8	1	1	5B	IPT	0	20	9	30	0	0	
050493	20:00-22:00	8	1	1	5B	IPT	0	26	12	56	0	0	
050493	22:00-24:00	8	1	1	5B	IPT	0	6	8	15	0	0	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
050493	22:00-24:00	8	1	1	5B	IPT	0	6	10	30	0	0	
060493	0:00- 2:00	8	1	1	5B	IPT	0	5	5	10	0	0	
060493	0:00- 2:00	8	1	1	5B	IPT	0	8	5	15	0	0	
070493	20:00-22:00	8	2	1	5B	IPT	18	400	24	90	0	0	trap didn't go back out all the way
070493	20:00-22:00	8	2	1	5B	IPT	0	459	23	128	0	0	
070493	22:00-23:00	8	2	1	5B	IPT	5	75	12	57	0	0	
070493	22:00-23:00	8	2	1	5B	IPT	6	79	10	40	0	0	
080493	0:00- 2:00	8	2	1	5B	IPT	4	30	3	5	0	0	
080493	0:00- 2:00	8	2	1	5B	IPT	4	24	3	6	0	0	
090493	20:00-22:00	8	1	1	5B	IPT	30	50	25	200	0	0	hatchery fish grouped marked and unmarked
090493	20:00-22:00	8	1	1	5B	IPT	33	57	35	133	0	0	
090493	22:00-24:00	8	1	1	5B	IPT	30	37	20	76	0	0	
090493	22:00-24:00	8	1	1	5B	IPT	41	40	24	70	0	0	
100493	0:00- 2:00	8	1	1	5B	IPT	6	33	13	50	0	0	
100493	0:00- 2:00	8	1	1	5B	IPT	1	35	20	52	0	0	
120493	20:00-22:12	8	1	1	5B	IPT	4	50	20	150	0	2	
120493	20:00-22:12	8	1	1	5B	IPT	0	46	15	167	0	0	
120493	22:00- 0:12	8	1	1	5B	IPT	1	60	59	100	0	0	
120493	22:00- 0:12	8	1	1	5B	IPT	0	51	10	55	0	0	
130493	0:00- 2:12	8	1	1	5B	IPT	0	21	16	54	0	0	
130493	0:00- 2:12	8	1	1	5B	IPT	0	10	8	30	0	0	
130493	2:00- 4:12	8	1	1	5B	IPT	1	16	10	100	0	0	
130493	2:00- 4:12	8	1	1	5B	IPT	0	10	8	5	0	0	
130493	4:00- 6:12	8	1	1	5B	IPT	0	5	6	30	0	0	
130493	4:00- 6:12	8	1	1	5B	IPT	0	5	0	0	0	0	
130493	6:00- 8:12	8	1	1	5B	IPT	0	7	7	26	0	0	
130493	6:00- 8:12	8	1	1	5B	IPT	1	0	0	0	0	0	
140493	20:00-22:00	8	1	1	5B	IPT	0	75	35	210	1	0	
140493	20:00-22:00	8	1	1	5B	IPT	0	80	30	210	0	0	
140493	22:00-24:00	8	1	1	5B	IPT	0	55	45	107	2	0	
140493	22:00-24:00	8	1	1	5B	IPT	0	30	30	107	0	0	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
150493	0:00- 2:00	8	1	1	5B	IPT	0	33	14	54	1	0	
150493	0:00- 2:00	8	1	1	5B	IPT	0	20	10	54	0	0	
160493	20:00-22:00	8	3	1	5B	IPT	0	83	34	280	2	0	
160493	20:00-22:00	8	3	1	5B	IPT	0	110	36	227	1	0	
160493	22:00-24:00	8	3	1	5B	IPT	0	112	52	138	0	0	
160493	22:00-24:00	8	3	1	5B	IPT	0	80	30	220	1	0	
170493	0:00- 2:00	8	3	1	5B	IPT	0	46	45	129	1	0	
170493	0:00- 2:00	8	3	1	5B	IPT	0	26	20	70	0	0	
190493	20:00-22:00	8	1	1	5B	IPT	0	47	27	423	0	0	
190493	20:00-22:00	8	1	1	5B	IPT	0	40	20	300	0	0	
190493	22:00-24:00	8	1	1	5B	IPT	0	87	68	300	0	1	
190493	22:00-24:00	8	1	1	5B	IPT	0	70	60	418	0	0	
200493	0:00- 2:00	8	1	1	5B	IPT	0	63	62	162	1	0	
200493	0:00- 2:00	8	1	1	5B	IPT	0	60	50	200	0	0	
210493	20:00-22:00	8	2	1	5B	IPT	0	26	20	337	0	0	
210493	20:00-22:00	8	2	1	5B	IPT	0	20	15	200	0	0	
210493	22:00-24:00	8	2	1	5B	IPT	0	93	71	667	2	0	
210493	22:00-24:00	8	2	1	5B	IPT	0	90	70	500	0	0	
220493	0:00- 2:00	8	2	1	5B	IPT	0	40	60	300	0	0	
220493	0:00- 2:00	8	2	1	5B	IPT	0	52	70	475	0	0	
230493	20:00-22:00	7	1	1	5B	IPT	0	17	20	288	0	0	
230493	20:00-22:00	7	1	1	5B	IPT	0	30	32	340	2	1	
230493	22:00-24:00	7	1	1	5B	IPT	0	68	100	400	0	1	
230493	22:00-24:00	7	1	1	5B	IPT	0	99	133	625	0	0	
240493	0:00- 2:00	7	1	1	5B	IPT	0	83	110	220	0	0	
240493	0:00- 2:00	7	1	1	5B	IPT	0	98	120	284	0	0	
260493	20:00-22:00	8	2	2	5B	IPT	0	18	32	433	3	0	
260493	20:00-22:00	8	2	2	5B	IPT	0	0	0	0	0	0	
260493	22:00-24:00	8	2	2	5B	IPT	0	37	80	300	2	0	
260493	22:00-24:00	8	2	2	5B	IPT	0	30	84	325	3	0	
270493	0:00- 2:00	8	2	2	5B	IPT	1	20	30	160	1	0	

Appendix table 1 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1993

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	CO1	CO2	COMMENTS
270493	0:00- 2:00	8	2	2	5B	IPT	0	17	28	138	0	0	
280493	20:00-22:00	8	3	2	5B	IPT	0	1	10	282	0	0	
280493	20:00-22:00	8	3	2	5B	IPT	0	2	19	248	0	0	
280493	22:00-24:00	8	3	2	5B	IPT	0	13	46	510	1	0	
280493	22:00-24:00	8	3	2	5B	IPT	0	12	42	470	0	0	
290493	0:00- 2:00	8	3	2	5B	IPT	0	19	50	601	2	0	
290493	0:00- 2:00	8	3	2	5B	IPT	0	14	45	537	0	0	
100593	21:30-23:00	10	2	1	5B	IPT	0	850	0	0	0	0	

Appendix table 2. Catch data for site and trap type by date for Cowichan River for 1994. T=temperature (°C), W=weather, C=water clarity, S=site, Trap=trap type, CNH=hatchery chinook, CNN=naturally spawned, CNA=chinook adipose clipped, COF=coho fry, CHF=chum fry, CO1=1+ coho, CO2=2+ coho.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
280294	19:00-21:00	7	3	2	7A	SC8	2	0	0	7	0	0	0	flooding screen strap to shore
280294	21:00-23:00	7	3	2	7A	SC8	2	0	0	16	0	0	0	
280294	23:00- 1:00	7	3	2	7A	SC8	3	0	0	15	0	0	0	
040394	17:00-19:00	6	1	2	7A	SC8	0	0	0	8	0	0	0	
040394	19:00-21:00	6	1	2	7A	SC8	2	0	0	17	0	0	0	
040394	21:00-23:00	6	1	2	7A	SC8	0	0	0	9	0	0	0	
040394	23:00- 1:00	6	1	2	7A	SC8	1	0	0	17	0	0	0	
070394	13:00-21:00	6	1	2	7A	SC8	19	0	0	8	1	1	0	
070394	21:00-23:00	6	1	2	7A	SC8	13	0	0	10	0	0	0	
070394	23:00- 1:00	6	1	2	7A	SC8	12	0	0	4	0	0	0	
090394	19:00-21:00	6	1	2	7A	SC8	4	0	0	7	0	0	0	
090394	21:00-23:00	6	1	2	7A	SC8	13	0	0	9	3	1	0	
090394	23:00- 1:00	6	1	2	7A	SC8	6	0	0	5	2	0	0	
110394	19:00-21:00	8	1	2	7A	SC8	1	0	0	2	1	2	0	5 steelhead smolts
110394	21:00-23:00	8	1	2	7A	SC8	8	0	0	13	1	2	0	
110394	23:00- 1:00	8	1	2	7A	SC8	9	0	0	9	0	5	0	
140394	19:00-21:00	7	1	2	7B	IPT	0	0	0	0	0	0	0	IPT flooding
140394	21:00-22:00	7	1	2	7B	IPT	0	0	0	6	0	0	0	
140394	22:00-23:00	7	1	2	7B	IPT	1	0	0	0	0	0	0	
140394	23:00- 1:00	7	1	2	7B	IPT	1	0	0	3	2	0	0	
140394	19:00-21:00	7	1	2	7B	SC8	1	0	0	16	8	1	0	
140394	21:00-23:00	7	1	2	7B	SC8	9	0	0	17	4	1	0	
140394	23:00- 1:00	7	1	2	7B	SC8	29	0	0	26	5	3	0	
160394	19:00-21:00	6	1	2	7B	IPT	0	0	0	0	0	0	0	flow too fast for IPT
160394	21:00-23:00	6	1	2	7B	IPT	0	0	0	0	0	0	0	
160394	23:00- 1:00	6	1	2	7B	IPT	0	0	0	0	0	0	0	
160394	16:00-19:00	6	1	2	7B	SC8	1	0	0	4	0	1	0	
160394	19:00-21:00	6	1	2	7B	SC8	25	0	0	25	2	5	0	water 2" below adult trap box
160394	19:00-21:00	6	1	2	7B	SC8	14	0	0	20	1	1	0	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
160394	21:00-23:00	6	1	2	7B	SC8	49	0	0	30	1	1	0	
160394	21:00-23:00	6	1	2	7B	SC8	23	0	0	56	3	3	0	
160394	23:00- 1:00	6	1	2	7B	SC8	34	0	0	30	0	7	0	
160394	23:00- 1:00	6	1	2	7B	SC8	28	0	0	27	0	3	0	
170394	1:00- 3:00	6	1	2	7B	SC8	34	0	0	25	1	3	0	
170394	3:00- 5:00	6	1	2	7B	SC8	16	0	0	26	0	3	0	
170394	5:00- 7:00	6	1	2	7B	SC8	19	0	0	9	1	2	0	
210394	19:00-21:00	6	2	2	7B	SC8	13	0	0	25	3	2	0	
210394	21:00-23:00	6	2	2	7B	SC8	14	0	0	49	1	1	0	
210394	23:00- 1:00	6	2	2	7B	SC8	23	0	0	32	2	2	0	
230394	19:00-21:00	6	1	2	7B	SC8	44	0	0	116	2	5	0	
230394	21:00-23:00	6	1	2	7B	SC8	32	0	0	75	2	3	0	
230394	23:00- 1:00	6	1	2	7B	SC8	40	0	0	45	0	12	0	
250394	19:00-21:00	6	1	2	7B	SC8	4	0	0	38	0	2	0	
250394	21:00-23:00	6	1	2	7B	SC8	7	0	0	81	1	3	0	
250394	23:00- 1:00	6	1	2	7B	SC8	9	0	0	24	0	13	0	
280394	19:00-21:00	8	1	2	7B	SC8	2	0	0	73	1	8	0	
280394	21:00-23:00	8	1	2	7B	SC8	4	0	0	246	4	7	0	
280394	23:00- 1:00	8	1	2	7B	SC8	18	0	0	147	1	30	0	
300394	19:00-21:00	8	1	2	7B	SC8	9	0	0	168	5	7	0	
300394	21:00-23:00	8	1	2	7B	SC8	16	0	0	442	3	11	0	
300394	23:00- 1:00	8	1	2	7B	SC8	15	0	0	271	12	7	0	
010494	21:00-23:00	9	1	2	7B	IPT	0	0	0	0	0	0	0	
010494	23:00- 1:00	9	1	2	7B	IPT	5	0	0	62	1	1	0	
010494	21:00-23:00	9	1	2	7B	SC8	22	0	0	1065	7	3	0	
010494	23:00- 1:00	9	1	2	7B	SC8	31	0	0	640	9	4	0	
040494	20:00-22:00	9	2	1	7B	IPT	2	0	0	180	2	0	0	
040494	22:00-24:00	9	2	1	7B	IPT	5	0	0	508	7	2	0	
040494	20:00-22:00	9	2	1	7B	SC8	18	0	0	916	9	6	0	
040494	22:00-24:00	9	2	1	7B	SC8	42	0	0	2836	16	12	0	
050494	0:00- 2:00	9	2	1	7B	IPT	12	0	0	112	10	1	0	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
050494	0:00- 2:00	9	2	1	7B	SC8	66	0	0	1563	4	10	0	
050494	2:00- 8:00	9	2	1	7B	SC8	135	0	0	1300	75	23	0	
060494	20:00-22:00	8	1	2	7B	IPT	2	0	0	118	7	0	0	
060494	22:00-24:00	8	1	2	7B	IPT	3	0	0	235	5	0	0	
060494	20:00-22:00	8	1	2	7B	SC8	15	0	0	832	29	3	0	
060494	22:00-24:00	8	1	2	7B	SC8	10	0	0	2505	15	5	0	
070494	0:00- 2:00	8	1	2	7B	IPT	5	0	0	154	7	0	0	
070494	2:00- 7:00	8	1	2	7B	IPT	10	0	0	36	8	0	0	
070494	7:00-19:00	8	1	2	7B	IPT	0	0	0	0	0	0	0	flowing over screen
070494	0:00- 2:00	8	1	2	7B	SC8	60	0	0	1520	35	1	0	
070494	2:00- 7:00	8	1	2	7B	SC8	35	0	0	3414	108	12	0	
070494	7:00-19:00	8	1	2	7B	SC8	24	0	0	232	11	0	0	
080494	20:00-22:00	8	2	2	7B	IPT	2	0	0	240	13	0	0	
080494	22:00-24:00	8	2	2	7B	IPT	4	0	0	298	16	0	0	
080494	20:00-22:00	8	2	2	7B	SC8	12	0	0	1168	36	3	0	
080494	22:00-24:00	8	2	2	7B	SC8	24	0	0	4480	76	8	0	
090494	0:00- 2:00	8	2	2	7B	IPT	5	0	0	197	20	0	0	
090494	0:00- 2:00	8	2	2	7B	SC8	20	0	0	2420	60	8	0	
110494	20:00-22:00	9	2	1	7B	IPT	4	0	0	148	12	2	0	
110494	22:00-24:00	9	2	1	7B	IPT	5	0	0	340	20	2	0	
110494	20:00-22:00	9	2	1	7B	SC8	21	0	0	1282	44	12	0	
110494	22:00-24:00	9	2	1	7B	SC8	15	0	0	3744	63	20	0	
120494	0:00- 2:00	9	2	1	7B	IPT	6	0	0	286	18	2	0	
120494	0:00- 2:00	9	2	1	7B	SC8	15	0	0	2580	15	10	0	
130494	20:00-22:00	9	2	1	7B	IPT	5	0	0	110	13	1	1	
130494	22:00-24:00	9	2	1	7B	IPT	4	0	0	400	30	0	0	
130494	20:00-22:00	9	2	1	7B	SC8	18	0	0	1820	28	15	8	
130494	22:00-24:00	9	2	1	7B	SC8	20	0	0	5120	28	3	3	
140494	0:00- 2:00	9	2	1	7B	IPT	3	0	0	285	23	1	0	
140494	0:00- 2:00	9	2	1	7B	SC8	28	0	0	3864	72	2	3	
140494	2:00- 7:00	9	2	1	7B	SC8	200	0	0	6176	496	8	0	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
140494	7:00-19:00	9	2	1	7B	SC8	8	0	0	178	23	0	0	
150494	20:00-22:00	10	2	1	7B	IPT	0	0	0	8	6	0	0	
150494	22:00-24:00	10	2	1	7B	IPT	0	0	0	20	8	0	0	
150494	20:00-22:00	10	2	1	7B	SC8	6	0	0	1800	21	2	0	
150494	22:00-24:00	10	2	1	7B	SC8	5	0	0	5915	60	3	0	
160494	0:00- 2:00	10	2	1	7B	IPT	0	0	0	12	5	0	0	
160494	0:00- 2:00	10	2	1	7B	SC8	15	0	0	6875	130	4	0	
180494	20:00-22:00	10	2	1	7B	IPT	0	0	0	1	0	0	0	
180494	22:00-24:00	10	2	1	7B	IPT	0	0	0	21	1	0	0	
180494	14:00-20:00	10	2	1	7B	SC8	0	0	0	60	0	0	0	
180494	20:00-22:00	10	2	1	7B	SC8	0	0	0	1484	40	6	1	
180494	22:00-24:00	10	2	1	7B	SC8	10	1	0	9660	20	7	0	
190494	0:00- 2:00	10	2	1	7B	IPT	0	0	0	14	0	0	0	
190494	20:00-22:00	10	2	1	7B	IPT	0	2	0	57	3	0	0	
190494	22:00-24:00	10	2	1	7B	IPT	1	5	0	192	1	0	0	
190494	0:00- 2:00	10	2	1	7B	SC8	8	48	0	7992	24	3	0	
190494	2:00- 7:00	10	2	1	7B	SC8	1	2320	180	0	15	1	0	early release
190494	7:00-19:00	10	2	1	7B	SC8	2	0	0	120	3	0	0	
190494	20:00-22:00	10	2	1	7B	SC8	3	88	7	1001	7	0	1	
190494	22:00-24:00	10	2	1	7B	SC8	20	800	80	6400	90	0	0	
200494	0:00- 1:00	10	2	1	7B	IPT	1	1	0	75	3	0	0	
200494	1:00- 3:00	10	2	1	7B	IPT	1	15	2	23	1	0	0	
200494	20:00-22:00	11	1	1	7B	IPT	0	2	0	28	0	0	0	
200494	22:00-24:00	11	1	1	7B	IPT	0	9	0	262	3	0	0	
200494	0:00- 1:00	10	2	1	7B	SC8	40	410	30	2600	30	0	0	
200494	1:00- 3:00	10	2	1	7B	SC8	0	2400	270	2100	15	0	1	
200494	3:00- 7:00	10	2	1	7B	SC8	1	3960	220	8492	22	0	1	
200494	7:00-20:00	11	1	1	7B	SC8	1	23	1	155	10	0	0	
200494	20:00-22:00	11	1	1	7B	SC8	2	256	3	1000	2	6	0	
200494	22:00-24:00	11	1	1	7B	SC8	12	1284	204	4085	24	3	0	
210494	0:00- 2:00	11	1	1	7B	IPT	0	9	0	173	3	0	0	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
210494	20:00-22:00	11	1	1	7B	IPT	0	0	0	56	1	0	0	
210494	22:00-24:00	11	1	1	7B	IPT	0	5	0	393	0	0	0	
210494	0:00- 2:00	11	1	1	7B	SC8	1	700	63	4857	21	1	0	
210494	2:00- 7:00	11	1	1	7B	SC8	0	400	0	4664	0	8	0	
210494	7:00-20:00	11	1	1	7B	SC8	0	3	0	300	0	0	0	
210494	20:00-22:00	11	1	1	7B	SC8	2	37	2	1700	5	7	0	
210494	22:00-24:00	11	1	1	7B	SC8	7	175	7	7000	7	21	0	
220494	0:00- 2:00	11	1	1	7B	IPT	0	4	0	320	0	0	0	
220494	20:00-22:00	12	1	1	7B	IPT	0	0	0	84	3	0	0	
220494	22:00-24:00	12	1	1	7B	IPT	1	0	0	720	6	0	0	
220494	0:00- 2:00	11	1	1	7B	SC8	0	240	0	0	16	5	0	
220494	2:00- 7:00	11	1	1	7B	SC8	32	296	32	3896	56	16	0	
220494	7:00-20:00	12	1	1	7B	SC8	1	1	0	114	2	0	0	
220494	20:00-22:00	12	1	1	7B	SC8	0	10	0	1292	8	3	0	
220494	22:00-24:00	12	1	1	7B	SC8	1	6	0	5520	12	7	0	
230494	0:00- 2:00	12	1	1	7B	IPT	0	3	0	532	4	0	0	
230494	0:00- 2:00	12	1	1	7B	SC8	0	11	3	5850	0	3	0	
250494	20:00-22:00	12	1	1	7B	IPT	0	0	0	9	0	0	0	
250494	22:00-24:00	12	1	1	7B	IPT	0	0	0	53	1	0	0	
250494	20:00-22:00	12	1	1	7B	SC8	1	3	0	530	4	0	0	
250494	22:00-24:00	12	1	1	7B	SC8	0	5	0	5050	10	0	0	
260494	0:00- 1:00	12	1	1	7B	IPT	0	0	0	114	0	0	0	
260494	0:00- 1:00	12	1	1	7B	SC8	0	1	0	1350	1	0	0	
260494	1:00- 7:00	12	1	1	7B	SC8	0	42	0	4675	2	6	0	
280494	20:00-22:00	14	1	1	7E	IPT	1	2	0	578	2	2	1	
280494	22:00-23:00	14	1	1	7E	IPT	0	2	1	784	20	2	0	
280494	20:00-22:00	14	1	1	7E	SC8	0	8	0	6464	16	18	2	
280494	22:00-24:00	14	1	1	7E	SC8	0	0	0	5358	7	22	7	
290494	0:00- 1:00	14	1	1	7E	IPT	0	0	0	1084	20	5	0	
290494	20:00-22:00	12	1	1	7E	IPT	1	1	0	356	0	5	0	
290494	22:00-24:00	12	1	1	7E	IPT	4	2	0	1484	18	7	1	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
290494	0:00- 1:00	14	1	1	7E	SC8	0	3	0	9870	108	26	5	
290494	1:00- 7:00	14	1	1	7E	SC8	0	220	1	0	200	400	7	
290494	7:00-20:00	14	1	1	7E	SC8	3	4	0	300	5	0	0	
290494	20:00-22:00	12	1	1	7E	SC8	3	18	0	2484	12	10	8	
290494	22:00-24:00	12	1	1	7E	SC8	0	10	0	8555	35	20	40	
300494	0:00- 2:00	12	1	1	7E	IPT	0	2	0	2000	34	3	0	
300494	0:00- 2:00	12	1	1	7E	SC8	5	60	0	0	60	90	60	
020594	20:00-22:00	13	1	1	7E	IPT	0	2	0	299	4	10	0	moved trap closer to side
020594	22:00-23:00	13	1	1	7E	IPT	3	0	0	1124	28	0	0	
020594	23:30- 0:30	13	1	1	7E	IPT	1	0	0	852	14	0	0	
020594	20:00-22:00	13	1	1	7E	SC8	1	1	0	1799	0	91	1	
020594	22:00-23:00	13	1	1	7E	SC8	14	14	0	3738	28	77	6	
020594	23:30- 0:30	13	1	1	7E	SC8	14	49	0	4361	35	77	5	
030594	1:30- 7:30	13	1	1	7E	IPT	0	0	0	360	10	0	0	
030594	1:30- 7:30	13	1	1	7E	SC8	24	60	0	4884	60	60	3	
040594	20:00-22:00	12	1	1	7E	IPT	0	0	0	77	0	0	0	
040594	22:00-23:00	12	1	1	7E	IPT	0	1	1	1008	16	0	0	
040594	23:00- 1:00	12	1	1	7E	IPT	0	0	0	750	9	0	0	
040594	20:00-22:00	12	1	1	7E	SC8	2	9	0	404	3	88	3	
040594	22:00-23:00	12	1	1	7E	SC8	24	64	0	7032	48	92	6	
040594	23:00- 1:00	12	1	1	7E	SC8	16	24	0	3288	80	24	5	
050594	1:00- 7:00	12	1	1	7E	IPT	0	0	0	860	12	0	0	
050594	20:00-22:00	14	1	1	7E	IPT	0	0	0	5	0	0	0	
050594	22:00-24:00	14	1	1	7E	IPT	0	0	0	6	0	0	0	
050594	1:00- 7:00	12	1	1	7E	SC8	60	180	0	6120	48	288	12	
050594	7:00-20:00	14	1	1	7E	SC8	2	7	0	18	2	4	0	
050594	20:00-22:00	14	1	1	7E	SC8	0	6	0	24	0	54	2	
050594	22:00-24:00	14	1	1	7E	SC8	1	6	0	724	5	34	5	
060594	0:00- 7:00	14	1	1	7E	IPT	0	0	0	34	0	0	0	out of main flow not fishing well
060594	20:00- .	13	1	1	7E	IPT	0	0	0	4	0	0	0	
060594	22:00- .	13	1	1	7E	IPT	0	0	0	0	0	0	0	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
060594	0:00- 7:00	14	1	1	7E	SC8	8	264	0	4680	16	440	4	
060594	7:00-20:00	14	1	1	7E	SC8	0	42	2	5	0	1	0	
060594	20:00-22:00	13	1	1	7E	SC8	0	200	0	150	0	80	2	
060594	22:00-24:00	13	1	1	7E	SC8	6	865	45	300	22	75	3	
070594	0:00- .	13	1	1	7E	IPT	0	0	0	0	0	0	0	
070594	0:00- 2:00	13	1	1	7E	SC8	0	900	15	200	0	65	6	
090594	20:00-22:00	14	2	1	7E	SC8	0	278	12	20	0	44	2	
090594	22:00-24:00	14	2	1	7E	SC8	3	432	18	210	0	96	6	
100594	0:00- 2:00	14	2	1	7E	SC8	0	408	8	160	4	125	8	
110594	20:00-22:00	15	2	1	7E	SC8	0	308	8	0	0	140	4	
110594	22:00-24:00	15	2	1	7E	SC8	5	385	10	100	5	135	10	
120594	0:00- 2:00	15	2	1	7E	SC8	0	528	30	80	0	84	15	
130594	20:00-22:00	14	1	1	7E	SC8	0	396	24	5	0	92	10	
130594	22:00-24:00	14	1	1	7E	SC8	12	666	36	198	0	73	20	
140594	0:00- 2:00	14	1	1	7E	SC8	8	332	40	240	4	100	10	
160594	20:00-22:00	14	2	1	7E	SC8	0	330	15	15	0	200	4	
160594	22:00- 7:00	14	2	1	7E	SC8	15	1350	120	405	135	435	26	
180594	20:00- 7:00	18	1	1	7E	SC8	32	1040	48	688	0	240	27	
190594	7:00-19:00	18	1	1	7E	SC8	0	6	0	10	0	2	0	
190594	20:00-22:00	17	1	1	7E	SC8	2	150	0	3	2	48	0	
190594	22:00-24:00	17	1	1	7E	SC8	15	725	45	110	5	100	20	
200594	0:00- 7:00	17	1	1	7E	SC8	28	2366	216	14	14	308	16	
200594	7:00-19:00	17	1	1	7E	SC8	0	110	0	14	0	56	0	
200594	20:00-22:00	17	1	1	7E	SC8	0	1248	60	0	1	192	6	
200594	22:00-24:00	17	1	1	7E	SC8	0	1840	180	60	60	589	10	
210594	0:00- 7:00	17	1	1	7E	SC8	0	3168	340	280	180	420	14	
240594	18:00- 7:00	17	1	1	7E	SC8	0	969	51	0	34	153	6	
250594	20:00- 8:00	17	1	1	7E	SC8	0	1920	140	15	140	60	3	
270594	20:00- 8:00	14	2	1	7E	SC8	0	900	60	50	30	40	4	
300594	17:00- 6:00	14	1	1	7E	SC8	0	1062	36	0	300	200	2	
010694	21:00- 8:00	15	1	1	7E	SC8	0	975	30	45	950	60	2	

Appendix table 2. continued.

PUMPHOUSE SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
030694	20:00- 8:00	15	2	1	7E	SC8	0	932	16	24	720	13	0	
060694	18:00- 8:00	16	2	1	7E	SC8	0	890	20	80	720	70	1	
090694	18:00- 8:00	14	1	1	7E	SC8	0	216	5	15	496	10	0	
100694	18:00- 8:00	18	2	1	7E	SC8	0	280	5	20	960	28	0	

BLOCK 51 SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
070394	19:00-21:00	6	1	2	5B	IPT	17	0	0	0	0	1	1	water still high from floods
070394	21:00-23:00	6	1	2	5B	IPT	2	0	0	0	1	0	0	
070394	23:00- 1:00	6	1	2	5B	IPT	3	0	0	0	0	0	0	
090394	19:00-21:00	6	2	2	5B	IPT	11	0	0	0	8	2	0	
090394	21:00-23:00	6	2	2	5B	IPT	8	0	0	1	1	0	0	
090394	23:00- 1:00	6	2	2	5B	IPT	8	0	0	0	1	0	0	
110394	19:00-21:00	7	1	1	5B	IPT	15	0	0	0	5	1	0	brown trout
110394	21:00-23:00	7	1	1	5B	IPT	6	0	0	1	1	0	0	
110394	23:00- 1:00	7	1	1	5B	IPT	6	0	0	0	4	2	0	
140394	19:00-21:00	7	1	1	5B	IPT	30	0	0	2	3	4	0	three steelhead
140394	21:00-23:00	7	1	1	5B	IPT	17	0	0	1	5	1	0	
140394	23:00- 1:00	7	1	1	5B	IPT	7	0	0	1	0	1	0	
160394	19:00-21:00	6	3	1	5B	IPT	23	0	0	0	3	4	0	rainbow yearling
160394	21:00-23:00	6	3	1	5B	IPT	11	0	0	0	4	0	0	
160394	23:00- 1:00	6	3	1	5B	IPT	16	0	0	1	5	0	0	
170394	1:00- 3:00	6	3	1	5B	IPT	10	0	0	0	4	0	0	
170394	3:00- 5:00	6	3	1	5B	IPT	5	0	0	0	2	0	0	
170394	5:00- 7:00	6	3	1	5B	IPT	4	0	0	0	2	0	0	
180394	19:00-21:00	6	1	1	5B	IPT	19	0	0	0	1	4	0	
180394	21:00-23:00	6	1	1	5B	IPT	18	0	0	1	7	1	0	
180394	23:00- 1:00	6	1	1	5B	IPT	8	0	0	0	5	0	0	
210394	19:00-21:00	6	2	1	5B	IPT	18	0	0	1	5	2	0	
210394	21:00-23:00	6	2	1	5B	IPT	14	0	0	1	6	0	0	

Appendix table 2 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
210394	23:00- 1:00	6	2	1	5B	IPT	7	0	0	0	4	0	0	
230394	19:00-21:00	6	1	1	5B	IPT	24	0	0	1	3	2	0	
230394	21:00-23:00	6	1	1	5B	IPT	16	0	0	0	5	1	0	two brown trout fry
230394	23:00- 1:00	6	1	1	5B	IPT	10	0	0	0	3	2	0	
250394	19:00-21:00	7	1	1	5B	IPT	17	0	0	0	9	14	0	one steelhead, one brown trout
250394	21:00-23:00	7	1	1	5B	IPT	13	0	0	2	3	4	0	
250394	23:00- 1:00	7	1	1	5B	IPT	10	0	0	0	3	2	0	
280394	19:00-21:00	8	1	1	5B	IPT	74	0	0	2	26	11	0	
280394	21:00-23:00	8	1	1	5B	IPT	55	0	0	1	15	6	0	
280394	23:00- 1:00	8	1	1	5B	IPT	28	0	0	1	10	1	0	
300394	19:00-21:00	8	1	1	5B	IPT	77	0	0	5	31	10	0	
300394	21:00-23:00	8	1	1	5B	IPT	65	0	0	7	28	4	0	
300394	23:00- 1:00	8	1	1	5B	IPT	32	0	0	6	23	4	0	
010494	19:00-21:00	9	1	1	5B	IPT	38	0	0	7	19	0	0	one brown trout, one cutthroat
010494	21:00-23:00	9	1	1	5B	IPT	69	0	0	2	60	4	0	
010494	23:00- 1:00	9	1	1	5B	IPT	42	0	0	3	32	0	0	
040494	20:00-22:00	9	1	1	5B	IPT	40	0	0	14	30	2	0	
040494	22:00-24:00	9	1	1	5B	IPT	51	0	0	14	84	1	0	
050494	0:00- 2:00	9	1	1	5B	IPT	16	0	0	5	43	0	0	
060494	20:00-22:00	9	2	1	5B	IPT	24	0	0	5	20	2	0	one brown trout
060494	22:00-24:00	9	2	1	5B	IPT	28	0	0	6	27	1	0	
070494	0:00- 2:00	9	2	1	5B	IPT	46	0	0	25	90	1	0	
080494	20:00-22:00	9	2	1	5B	IPT	22	0	0	20	70	0	0	
080494	22:00-24:00	9	2	1	5B	IPT	27	0	0	19	70	1	0	
090494	0:00- 2:00	9	2	1	5B	IPT	35	0	0	17	136	0	0	
110494	20:00-22:00	8	2	1	5B	IPT	57	0	0	31	81	0	0	
110494	22:00-24:00	8	2	1	5B	IPT	52	0	0	62	259	1	0	
120494	0:00- 2:00	8	2	1	5B	IPT	31	0	0	31	87	0	0	
130494	20:00-22:00	9	1	1	5B	IPT	44	0	0	69	75	1	0	
130494	22:00-24:00	9	1	1	5B	IPT	50	0	0	77	239	5	0	
140494	0:00- 2:00	9	1	1	5B	IPT	22	0	0	38	210	1	0	

Appendix table 2 - continued.

BLOCK 51 SITE, COWICHAN RIVER, 1994

DATE	TIME	T	W	C	S	TRAP	CNN	CNH	CNA	CHF	COF	CO1	CO2	COMMENTS
150494	20:00-22:00	9	1	1	5B	IPT	2	0	0	82	35	0	0	
150494	22:00-24:00	9	1	1	5B	IPT	11	0	0	166	196	0	0	
160494	0:00- 2:00	9	1	1	5B	IPT	10	0	0	76	185	0	0	
190494	0:30- 0:48	9	1	1	5B	IPT	6	282	0	43	24	0	0	
190494	1:30- 1:48	9	1	1	5B	IPT	9	193	0	34	32	0	0	
190494	20:00-22:00	9	1	1	5B	IPT	16	709	0	200	11	0	0	
190494	22:30-22:48	9	1	1	5B	IPT	13	1514	0	78	23	0	0	
190494	23:30-23:48	9	1	1	5B	IPT	8	320	0	52	22	0	0	
220494	20:00-22:00	11	2	1	5B	IPT	21	19	0	528	10	1	0	
220494	22:00-24:00	11	2	1	5B	IPT	12	30	0	692	31	1	0	
230494	0:00- 2:00	11	2	1	5B	IPT	5	25	0	278	43	1	0	
250494	20:00-22:00	12	1	1	5B	IPT	9	4	0	812	44	0	0	
250494	22:00-24:00	12	1	1	5B	IPT	5	2	0	964	51	0	0	
260494	0:00- 2:00	12	1	1	5B	IPT	4	0	0	362	30	0	0	
270494	20:00-22:00	12	1	1	5B	IPT	9	5	0	605	146	5	0	
270494	22:00-24:00	12	1	1	5B	IPT	24	18	0	711	797	4	0	
280494	0:00- 2:00	12	1	1	5B	IPT	0	4	0	189	150	0	0	
290494	20:00-22:00	11	1	1	5B	IPT	6	1	0	86	62	4	0	
290494	22:00-24:00	11	1	1	5B	IPT	19	6	0	366	269	6	0	
300494	0:00- 2:00	11	1	1	5B	IPT	5	1	0	480	210	4	0	