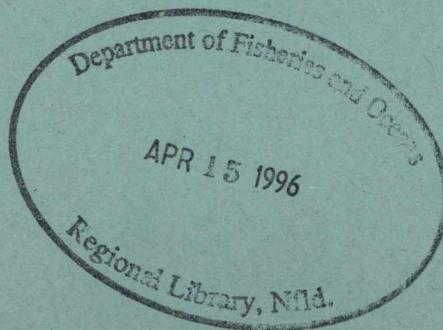


A Preliminary Report on Juvenile Chinook Production in the Cowichan River during 1991 and 1992

J.R. Candy, D.A. Nagtegaal, and B. Riddell

**Department of Fisheries and Oceans
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Nanaimo, British Columbia
V9R 5K6**

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by

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ABSTRACT

J.R. Candy, D.A. Nagtegaal, and B. Riddell. 1995. A preliminary report on juvenile chinook production in the Cowichan River during 1991 and 1992. Can. Manuscr. Fish. Aquat. Sci. 2329 64 p.

As part of an ongoing study to assess the productivity of chinook salmon (*Onchorhynchus tshawytscha*) in the Cowichan River, the Department of Fisheries and Oceans, Pacific Biological Station, began monitoring the downstream migration of chinook juveniles in 1991. The interaction between hatchery and naturally-spawned chinook juveniles was also monitored. Various techniques and equipment (minnow traps, purse seines, beach seines, incline-plane traps, and auger trap) were used on the Cowichan River in 1991 and 1992 to collect information on growth, abundance and migration timing of juvenile chinook salmon. An estimate of juvenile chinook abundance was not calculated for 1991 since we were investigating various means to collect migrant juveniles. In 1992, the production of naturally-spawned chinook juveniles was estimated to be 810,240 and hatchery releases of chinook juveniles totalled 1.9 million fish. Peak migration for naturally-spawned juveniles occurred from mid-March to mid-April. Hatchery chinook tended to move downstream in a large pulse and most fish appear to be in the estuary within a few days of release.

RÉSUMÉ

J.R. Candy, D.A. Nagtegaal, and B. Riddell. 1995. A preliminary report on juvenile chinook production in the Cowichan River during 1991 and 1992. Can Manuscr. Fish. Aquat. Sci. 2329 64 p.

En 1991, dans le cadre d'une étude concernant la productivité du saumon quinnat (*Onchorhynchus tshawytscha*) de la rivière Cowichan, la station biologique du Pacifique du ministère des Pêches et des Océans a entrepris une campagne d'observation des mouvements de migration catadrome des saumons quinnats juvéniles. Les chercheurs ont notamment observé les interactions entre les juvéniles issus d'écloserie et ceux issus de frayère naturelle. Les campagnes de 1991 et de 1992 ont fait intervenir divers procédés et engins de pêche (nasses à vairons, sennes coulissantes, sennes manoeuvrées à partir du rivage, et engins d'échantillonnage en plan incliné et à vis sans fin) pour la collecte de données concernant la croissance, l'abondance et les périodes de migration des saumons quinnats juvéniles. Le taux d'abondance du quinnat juvénile n'a pas été calculé pour l'année 1991 du fait qu'on étudiait divers moyens de capturer juvéniles en cours de migration. En 1992, on a estimé le recrutement des saumons quinnats juvéniles issus de frayère naturelle à 810 240 et le recrutement des saumons quinnats issus d'écloserie à 1,9 million. On a pu établir que la pointe de migration des stocks issus de frayère naturelle se situait entre la mi-mars et la mi-avril, alors que les stocks issus d'écloserie migraient par vagues successives. Enfin, on a constaté que la plupart des poissons arrivaient dans les eaux de l'estuaire quelques jours après avoir été mis en liberté.

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 and rearing (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 purposes of this report, naturally-spawned fish are those 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 for biological data collection on returning adult chinook (Nagtegaal et al. 1994 a,b,c). 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 and naturally-spawned juvenile populations.

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. Using an incline plane trap they estimated total chinook juvenile production to be 2.6 million in 1966 and 1.6 million in 1967. The estimate for 1967 was considered incomplete due to forced termination of trapping before the end of the smolt migration. In 1975 and 1976, chinook smolt production (fish >55 mm) 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 adipose clipped smolts marked in the river and recaptured in Cowichan Bay.

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 group and late group based on size. The "early group" (March-April), comprising a 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 may have 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 juveniles in 1980, production has been increased to between 1.5 and 3 million in recent years. The hatchery incorporates three main release strategies

(early, late, and lake-pen), but also releases some smolts from sea-pen sites in Cowichan Bay and Saanich Inlet. The early release occurs between 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 the other late release group. Since 1980 a portion of the hatchery releases were marked by coded-wire tagging (Jefferts et al. 1963), and in 1992 14% of the total released were marked (Table 1).

This report presents the results of the juvenile chinook production study, which includes migration timing, and growth of naturally-spawned and hatchery chinook juveniles in the Cowichan River for 1991 and 1992, and an abundance estimate of naturally-spawned chinook juveniles for 1992.

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 km² and carries a mean annual discharge of 55 m³/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

During the first year of the study (1991) we tried a number of different fry trapping methods at numerous sites along the Cowichan River to evaluate which method would best estimate juvenile production and allow for representative biological data to be collected. Based on this information, in 1992, we monitored migrants using IPT's (Incline plane trap) at two sites in the river (Fig. 1). The Block 51 site, just above Skutz Falls, was the only road accessible site situated just below the main chinook spawning area. The Pumphouse site provided an opportunity at the lower end of the river where we could sample juveniles from all chinook adults that had passed above the enumeration fence to spawn. The disadvantage of the Pumphouse site was that we were also trapping large numbers of chum fry. In-river residence time of hatchery fish could be obtained by observing the rate of movement of these fish past the two sites. Purse seining and beach seining in Cowichan Bay allowed us to determine differences in hatchery and wild fry/smolt estuarine utilization and residence time. Juveniles were sampled concurrently from the river and the hatchery to compare growth of hatchery and naturally-spawned fish.

GEAR DESCRIPTION

Modified Fyke net (1991)

The opening of this net was 2 x 2 m and tapered over approximately 6 m to 3.5 cm in diameter (Fig. 2A). The cod-end was strapped onto a short length of PVC Drain pipe (.7 m) which was connected to a live-trap box. The net was constructed of 5 cm nylon mesh at the mouth to 1.2 cm knotless mesh at the cod-end. The mouth opening of the net was maintained with a steel pipe frame. At each of the bottom corners of the steel frame, 22 kg lead balls were attached for stability and floatation bouys were attached to the top corners. The live-trap box was made of plywood and pieces of styrofoam were fastened to each side of the trap for added buoyancy. The Fyke net assembly was kept in position in the river by a set of polypropylene bridles which connected the top and bottom corners of the steel frame to a .9 cm galvanized cable suspended across the river approximately 18 m upstream.

Inclined plane trap (1992)

Aluminum .6 m x 1.2 m inclined plane traps were used in 1992 (Fig. 2B). 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 efficiency of the trap the aluminum flotation pontoons on either side of the trap were flooded with water and used as ballast.

Rotary auger trap (1.5 m diameter) (1992)

This trap¹, consists of a revolving stainless steel mesh cone (1.5 m opening) and enclosed auger, suspended between two 6.5 m floats. The auger paddles turn in the flow, trapping fish and forcing them back into a 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 (1991,1992)

A small beach seine (30 m in length and 2.3 m deep) was used to collect juveniles. 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.

Minnow traps (1991)

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

Aluminum minnow traps² (.3 cm mesh) were baited using cured salmon roe. Traps were placed in deep pools and in shallow protected areas along the shoreline at various locations along the river.

Purse Seine (1991,1992)

A small purse seine (220 m long and 27 m deep) which fished an area approximately 3851 m² was used to examine the distribution of fry/smolts in Cowichan Bay (Fig. 3). The seine net had a marquisette webbing that would retain fish greater than 3 cm. The net was fished from the FRV Tahlok (1991) and the FRV Caligus (1992).

TRAPPING/SAMPLING PROCEDURES

River and Estuary trapping and sampling

During the first year of the study (1991) fry trapping was accomplished using a variety of techniques; 1) Modified Fyke nets, 2) Minnow traps, 3) Beach seines, 4) Inclined plane traps (IPT), and 5) Purse seine. Aluminum minnow traps were used at two main sites (Road Pool, Block 51) in the upper end of the river in May and June (Fig. 1). Beach seining occurred in early May at Road Pool and during May and June in the estuary. Purse seining in the estuary was carried out along the north and south mouth of the Cowichan River and along the north shore of Cowichan Bay towards Separation Pt using sampling sites established by Lister et al., (1971) (Fig. 3). Purse seining occurred on 13 June 1991 and 13 May 1992.

Fish were enumerated three nights a week (Monday, Wednesday, Friday) at the Pumphouse site in 1991 and at both Pumphouse and Block 51 sites in 1992. We used a standard sampling interval from 20:00-02:00 until early April. This sampling interval was shifted one h later to 21:00-03:00 in both 1991 and 1992 to coincide with the change from Pacific Standard time to Daylight Savings time. Traps were checked at 2 h intervals and approximately 50 chinook migrants were kept for samples each evening. If catches were low, the trap was sometimes left to fish overnight and checked again in the morning. During high flow conditions, the traps were checked more frequently to remove debris and prevent fish mortality. If catches were extremely large (>1000 fish) we often sub-sampled the total catch.

In 1991, a side-by-side pair of fyke traps was used at the Pumphouse (site 7a-b, March 6-April 27). In 1992, a side-by-side pair of IPT's was used at both the Pumphouse (site 7a-b, March 2-April 7 and site 7e-f April 10-May 20) and Block 51 (site 5a, March 3-April 9 and site 5b, April 10-May 22). At both Pumphouse and Block 51 sites, traps were moved upstream to a narrower faster section of the river during low flow conditions later in the spring (Fig 4). From May 20 until the end of sampling (June 3), one IPT at the Pumphouse was replaced with the 5

²Cuba Specialty Manufacture, PO Box 377, Ridgeway, Ont., L0S 1N0.

May 20 until the end of sampling (June 3), one IPT at the Pumphouse was replaced with the 5 foot auger trap.

Flow meter (General Oceanic 2030R)³ measurements were taken for each sampling evening at the Pumphouse (1991) and both the Pumphouse and Block 51 in 1992. Flow rates were calculated by the number of rotor revolutions in a five minute interval, multiplied by a rotor constant to give flow values in m/s. In addition, water temperature (°C), water clarity (1-clear, 2-cloudy), and atmospheric conditions (1-clear, 2-cloudy, 3-raining) were recorded.

On several occasions at both the Pumphouse and Block 51 site, trapping was continuous over a 24 hr period to monitor diel patterns of fry movement.

Hatchery sampling

Approximately 30 hatchery juveniles were randomly netted from the holding facilities at Cowichan hatchery on a weekly basis (Tuesday) from March 26 to May 21, 1991 and April 4 to May 5, 1992. These fish were representative of the three main release groups; early, late, and lake pen. Once moved to Cowichan Lake, the lake pen release group were sampled from the netpens. All juveniles were weighed and measured for fork length.

Trap catch comparisons

To determine the difference in trapping efficiency between the IPT and auger trap, we fished both traps simultaneous side-by-side and compared catch data from 2 h sampling intervals. The proportion of chinook juveniles to total catch was compared using a chi-square test and the differences in trapping efficiency was tested using a T-test (Zar 1984).

BIOLOGICAL SAMPLING

Regardless of the technique used to capture the migrants, all fish were examined and the numbers recorded by species, gear type or release strategy, date, and time of day. Fish that were kept for biosampling were anaesthetized using MS-222 or carbon dioxide and measured to the nearest millimetre. In 1991, fish were measured for length then frozen and thawed before weights were taken. In 1992, only fresh lengths and weights were taken. We also sampled a portion of the adipose-clipped fish caught in the trap. These were used to recover CWT information on hatchery release strategies. On a weekly basis approx. 30 chinook migrants were frozen for future analysis.

³General Oceanic, 1295 NW 163rd St., Miami, Florida, USA

Using the catch data from IPT and auger trap (1992) collected at the Pumphouse site, estimates of total chinook migration were expanded using a ratio of trap cross-sectional area compared to the river cross-sectional area. Most evenings we sampled a portion of the migration during a standard 6 h interval. The numbers were expanded by an estimate of the percentage sampled determined by our overnight and daytime sampling. Nightly estimates of juvenile numbers were summed over the duration of the run to obtain a total estimate of juvenile abundance.

Daily total juvenile numbers were determined by expanding the proportion of the catch (R_t) by the ratio of cross-sectional area of the trap mouth (O_t) to the total cross-sectional area of the river (K_d) for sampling interval t . Trap mouth cross-sectional area values of 0.542 m^2 and 0.91 m^2 were used for the IPT and auger trap respectively. River cross-sectional area values were 48.1 m^2 for sites 7A-C and 30.1 m^2 for sites 7E-F. The effective fish area (O_t) was adjusted when the entire cross-sectional area of the trap mouth was not fishing. The sampling interval t (usually 20:00 - 02:00 or 21:00 - 03:00) 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).

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

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 (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 nightly 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 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 days sampling.

RESULTS

RIVER CONDITIONS

Cowichan River discharge rates in 1991 and 1992 followed a pattern of extremely high winter flows which started to abate by the end of February. Flows greater than the 30 year average occurred in November-December 1990 and early February in 1992 (Fig 5 and 6). Water

winter flows which started to abate by the end of February. Flows greater than the 30 year average occurred in November-December 1990 and early February in 1992 (Fig 5 and 6). Water temperatures rose from 5°C in early March to 11°C by the end of April 1991 (Fig 7). In 1992, water temperatures were already at 7°C in early March and rose to 20°C by early June (Fig. 8). Flow meter readings ranged from 1.75 m/s to .29 m/s in 1991 with greater flow at site 7B (Table 2). In 1992, flow meter readings were taken at both the Pumphouse and Block 51 (Table 3). Once flow meter readings dropped to around 0.5 m/s in 1992, the traps were moved upstream to faster flows to reduce the effects of trap avoidance.

CHINOOK JUVENILE ABUNDANCE ESTIMATE

An estimate of juvenile abundance was not calculated for 1991 since we were investigating various means to collect migrants (Appendix table 1). For 1992 the estimate was calculated based on the data collected using the IPT's at the lower site (7b) and the IPT and auger trap at the upper site (7e) at the Pumphouse location (Appendix table 2). 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 low flows. The proportion of fish trapped during a sampling interval was determined from overnight sampling. It was estimated that approximately 35% of the catch could be expected from the 6 hr sampling period (20:00 to 02:00 or 21:00 to 03:00) based on diel movement information collected (Fig. 9). For sampling durations longer than 9 h (usually 12 h or 24 h), we assumed 100% of nightly catch. From daytime sampling it was estimated that very few naturally-spawned juveniles and approximately 10% of the hatchery fish moved during daylight hours (Fig. 10).

In 1992, the early hatchery release occurred below the Pumphouse site. Therefore, the first hatchery release to be trapped at the Pumphouse site was the May 17 (Lake Pen) release followed by the May 21 (Late) release. By the time these hatchery releases had occurred, numbers of naturally-spawned juveniles collected at the trap site were negligible. Based on fish size differences and adipose clips, the large pulses of hatchery fish could be separated from the naturally-spawned juveniles. However, due to our inability to separate some of the smaller hatchery fish from naturally-reared fish, we assumed all chinook migrants after May 17 were of hatchery origin. Peak migration of naturally-spawned juveniles occurred from mid-March to mid-April in both 1991 and 1992 (Fig 11 and 12).

Based on our calculations an estimated 810,240 naturally-spawned chinook and 737,694 hatchery chinook juveniles passed the Pumphouse site in 1992. Known hatchery releases which were upstream of and could pass the Pumphouse site totalled 1,839,785 chinook juveniles (Table 1).

TRAP CATCH EFFICIENCY COMPARISON

The auger trap was found to be considerably more efficient at sampling than the IPT regardless of the discharge (T-test, $P < 0.05$). Approximately five times as many fish were caught in the auger trap compared to the IPT for a 2 h sampling interval (Fig. 13), although the cross-sectional sampling area of the auger trap was only 40% greater (0.543 m^2 vs 0.91 m^2). The proportion of chinook trapped compared to the total catch of all species remained the same for both trap types (chi-square, $P > 0.05$) (Fig. 14).

JUVENILE CHINOOK GROWTH

Mean length and weight was compiled by date, trap site, and trap type for the naturally spawned juveniles and by date, and release strategy for the hatchery fish in 1991 (Table 4) and 1992 (Table 5). In 1991, we did not detect a change in naturally-spawned chinook fry size from early March to late April (40-42 mm) with the exception of the last sampling night where we caught some larger fish thought to be part of the first early hatchery release. Our results led us to suggest that many of the larger juveniles were likely able to avoid the fyke trap. This is based on the observation that at low flows this equipment cannot successfully trap and hold fish, and is only effective at higher flow conditions. In addition, we did not move the trap to an upstream site, in April in 1991 as was the case in 1992, to take advantage of higher flow conditions.

In 1992, naturally-spawned juveniles mean size changed from 40 mm in early March to 59 mm in late May. Hatchery juveniles were significantly larger (length and weight) for a given sampling week up to the time of release in both 1991 (Fig. 15) and 1992 (Fig. 16 and 17).

Chinook caught in Cowichan Bay in May and June ranged in size from 61-82 mm (beach seining) in 1991 and 84-86 mm (purse seining) in 1991 and 1992. Most of the juveniles caught in the beach seining were smaller, assumed to be naturally-spawned fish or small hatchery fish whereas, the fry caught purse seining in deeper water tended to be larger naturally-spawned fish or hatchery fish.

HATCHERY RELEASE STRATEGY AND CWT RECOVERY

A random sample from each release group, just prior to release, was measured for length and weight and is summarized with CWT release codes for 1991 (Table 6) and 1992 (Table 7). In 1991, the Cowichan hatchery released 650,815 juveniles of which 289,211 (44%) were coded-wire tagged (Table 1). In 1992, the Cowichan hatchery released 1,894,653 fry of which 270,682 (15%) were coded-wire tagged. In 1991, more marked fry were recovered in Cowichan Bay by beach seining and purse seining than in the river (Table 8). In 1992, an extended sampling period and more efficient trapping (use of IPT's and upstream narrower site) meant our in-river recovery of CWT tagged fish was much higher than the previous year (Table 9). Most hatchery fry were recovered in-river usually within several days of release. In both years, very few of the lake pen fish were recovered at the Pumphouse site or in Cowichan Bay even though substantial numbers were released.

DISCUSSION

JUVENILE CHINOOK ABUNDANCE AND TIMING

It was estimated that approximately 810,000 naturally-spawned chinook juveniles migrated from the Cowichan River in 1992. Downstream movement was protracted over several months although peak migration occurred in the beginning of April. This was assumed to be a minimum estimate because migration was already underway when trapping started on March 2. In addition, we assumed that all migrants after May 17 were hatchery fish. This was likely not the case since Lister et al. (1971) and Armstrong and Argue (1977) recorded naturally-spawned juveniles movement well into June, although more than 90% were observed prior to the end of May.

Lister et al. 1971 divided the chinook migrants into an early group and late group based on size. The early group, comprising a majority of the migrants, consisted of primarily emergent fry averaging approximately 42 mm in length. The late migrants were defined as fingerlings averaging over 55 mm. The late group commenced on May 19 and May 14 in 1966 and 1967 respectively. In 1992, the first fry over 55 mm was trapped on April 6 and the average chinook size had exceeded 55 mm by April 13. This suggests that either we were more efficient at trapping the larger juveniles or the start of the late group has advanced by one month.

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). The fry abundance estimates were very sensitive to small 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 in the river. This is not the case for many species (Thedinga et al. 1994; McDonald 1960). 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 , in formula) was not measured during our study. For the purposes of the abundance estimate calculation, it was assumed that the full cross-section of the trap mouth was fishing at all times. This assumption was valid under most circumstances because we made substantial effort to ensure the traps were fishing to their maximum. The only possible exception was under conditions of extremely low flows when no amount of adjustment would improve the ability of the IPT's to trap fish. Based on the variability in the expansion factors associated with cross-sectional areas and day/night movement, we expect the confidence limits of the estimate to be approximately $\pm 15\%$.

Our estimate of hatchery chinook abundance was compared with the known numbers of hatchery fish released above the trapping site. The comparison is primarily based on the late release group in 1992 (May 17-20), when approximately 1,168,887 juveniles were expected to pass by the Pumphouse. An additional 725,766 juveniles were released below the trap site or were sea-pen releases (Table 1). Based on trap catch expansions from May 17 to June 3, we estimated 737,694 hatchery fish or approximately 63% of the number released above the trap site. No explanation is offered as to why only 63% of the hatchery fish were trapped, but we do know

from beach seine sampling in late May in the upper river that virtually all hatchery juveniles have moved downstream.

Calculation of egg to fry survival is dependent on good escapement and fry enumeration data. According to Nagtegaal et al. (1994a), chinook escapement in 1991 was determined to range between 3200 and 7000, based on a combination of fence count and swim survey data. The number of female spawners was calculated to range between 1728 and 3780. Based on these estimates of female spawner abundance, and an average fecundity of 4013 eggs/female (Millerd pers. comm.), egg to fry survival for the 1991 brood year was estimated to range between 8.5 and 18.7%. 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 1991 brood year was estimated to range between 7.4% and 16.1%. Lister et al. (1971) calculated egg to fry survival to be 3.2%, although this was based on questionable female spawner enumeration data. Healey (1991) reported from several sources that egg to fry survival of chinook ranged from approximately 8% to 16%.

HATCHERY VS NATURALLY-SPAWNED JUVENILE GROWTH

In 1991, daily mean length and weight data collected for naturally-spawned juveniles migrating past the Pumphouse showed little change over the period of trapping from early March to late April. Uniform fry size over the sampling period and the inability to successfully trap hatchery fish with the fyke-nets suggests that net avoidance probably occurred especially during the lower flows in late spring.

In 1992, a steady increase in average naturally-spawned juvenile size over the period of the migration (March-May) indicated that a proportion of the population spend some time rearing in the river before moving to the estuary. The fish caught in the trap were 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 small newly emerged fry (30-40 mm) in samples taken from March and April, but by May the larger fish (>70 mm) were caught. This suggest that emergence occurred between late February and late April. Understandably, the hatchery juveniles grew substantially faster than the naturally-reared juveniles and were considerably larger and heavier.

HATCHERY/NATURALLY-SPAWNED JUVENILE INTERACTION

Preliminary observations indicate that the hatchery chinook released in the river move very quickly to the estuary. Although some stragglers were captured in the river up to two weeks after being released, the majority of the fish moved downstream in a large pulse over a few days. It is worthwhile to note that very few fish from the lake pen hatchery release group were recovered even though substantial numbers were released (1991 - 282,780; 1992 - 671,914). This release strategy accounted for 43% of total chinook releases in 1991 and 36% in 1992.

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 in the Campbell River 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-reared 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 the river and likely in the estuary as well.

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LITERATURE CITED

- Argue, A.W., L.M. Patterson and R.W. Armstrong. 1979. Trapping and coded-wire tagging of wild coho, chinook and steelhead juveniles from the Cowichan-Koksilah River system, 1976. Can. Dept. Fisheries and Marine Service, Tech. Rept. No. 850 117 p.
- Armstrong, R.W. and A.W. Argue. 1977. Trapping and coded-wire tagging of wild coho and chinook juveniles from the Cowichan River system, 1975. Canada Dept. Fisheries and Environ., Fisheries Service, Pacific Region. Tech. Rept. Series PAC/T-77-14. 58 p.
- Cross, C.L., L. Lapi, E.A. Perry. 1991. Production of chinook and coho salmon from British Columbia hatcheries, 1971 through 1989. Can. Tech. Rep. Fish. Aquat. Sci:1816. 48 p.
- Healey, M.C. 1980. Utilization of the Nanaimo River estuary by juvenile chinook, *Oncorhynchus tshawytscha*. Fish. Bull. 77:653-668.
- Healey, M.C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*), p. 313-393. In C. Groot and L. Margolis (eds.) Pacific Salmon Life Histories. UBC Press, Vancouver.
- Healey, M.C. and F.P. Jordan. 1982. Observations on juvenile chum and chinook and spawning chinook in the Nanaimo River, British Columbia, during 1975-1981. Can. Manuscr. Rep. Fish. Aquat. Sci: 1659 31 p.
- Inland Waters Directorate. 1988. Historical stream flow summary, British Columbia, 1988. Water Survey of Canada, Ottawa.
- Jefferts, K.B., P.K. Bergman, and H.F. Fiscus. 1963. A coded wire identification system for macro-organisms. Nature (London) 198:460-462.
- Kuhn, B.R. 1988. The MRP-REPORTER PROGRAM: A data extraction and reporting tool for the mark recovery program database. Can. Tech. Rep. Fish. Aquat. Sci. 145 p.
- Levings, C.D. 1982. Short term use of a low tide refuge in a sandflat by juvenile chinook (*Oncorhynchus tshawytscha*), Fraser River estuary. Can. Tech. Rep. Fish. Aquat. Sci: 1111 33 p.
- Levings, C. D., C. D. McAllister, and B. D. Chang. 1986. Differential use of the Campbell River estuary, British Columbia, by wild and hatchery-reared juvenile chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 43:1386-1397.
- Lister, D.B., C.E. Walker and M.A. Giles 1971. Cowichan River chinook salmon escapements and juvenile production, 1965-1967. Department of Fisheries and Forestry, Tech. Rep. 1971-3.

- McDonald, J. 1960. The behaviour of Pacific salmon fry during their downstream migration to freshwater and saltwater nursery areas. *J. Fish. Res. Bd. Can.* 17(5), 1960.
- Millerd, D. 1992. Personal communication. Cowichan River Community Economic Development hatchery manager. P.O. Box 880, Duncan B.C. V9L 3Y2.
- Nagtegaal, D.A., P.J. Starr, and B. Riddell. 1994. A preliminary report on the chinook productivity study conducted on the Cowichan River, 1988 and 1989. *Can MS Rep. Fish. Aquat. Sci.*:2233 53 p.
- Nagtegaal, D.A., J. Candy, and B. Riddell. 1994. A preliminary report on the chinook productivity study conducted on the Cowichan River, 1990 and 1991. *Can. MS. Rep. Fish. Aquat. Sci.*:2265 71 p.
- Nagtegaal, D.A., J. Candy, and B. Riddell: 1994. A preliminary report on the chinook productivity study conducted on the Cowichan River, 1992. *Can. MS. Rep. Fish. Aquat. Sci.*:2268 73 p.
- Neave, F. 1949. Game fish populations of the Cowichan River. *Fish. Res. Bd. Can. Bull* LXXXIV. 32 p.
- Thedinga, J.F., M.L. Murphy, S.W. Johnson, J.M. Lorenz and K.V. Koski. 1994. Determination of salmonid smolt yield with rotary-screw traps in the Situk River, Alaska, to predict effects of glacial flooding. *N. Am. J. Fish. Man.* 14:837-851.
- Zar, J. 1984. *Biostatistical analysis*. Prent-Hall Inc., Englewood Cliffs, New Jersey. 718 p.

Table 1. Juvenile chinook release information by tag code¹, Cowichan hatchery 1985-92

Tag Code	BY	Number Tagged	% Tag Loss	Number Released	CWT % Mark	Weigh (gm)	Release Date	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 ddmmyy:ddmmyy	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

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

Table 2. Flowmeter reading by site, Cowichan River, 1991

Date ddmmyy	7A (m/s)	7B (m/s)
200391	0.51	0.95
220391	0.57	0.93
250391	0.52	0.84
270391	0.52	0.91
290391	0.48	0.83
010491	0.44	0.80
030491	0.62	1.23
040491	1.38	1.75
050491	0.85	1.22
080491	0.72	1.09
100491	0.76	1.31
120491	0.50	0.91
150491	0.46	0.87
170491	0.42	0.63
190491	0.43	0.83
220491	0.44	0.79
240491	0.43	0.64
260491	0.29	0.74

Table 3. Flowmeter readings by site, Cowichan River, 1992.

Date ddmmyy	7A-B-C (m/s)	7E-F (m/s)	5A (m/s)	5B (m/s)
020392	1.81			
030392			1.23	
040392	1.89			
060392	1.78		1.68	
090392	1.44		1.82	
110392	1.20		1.29	
130392	1.16		1.21	
160392	1.05		1.21	
180392	1.00		0.91	
200392	1.03		1.01	
230392	0.94		1.07	
250392	1.02		1.01	
270392	0.88		1.04	
300392	0.61		0.86	
010492	0.59		0.71	
030492	0.71		0.58	
060492	3.11		0.52	
080492		1.24	0.41	
100492		1.41		0.75
130492		1.17		0.87
150492		1.23		0.95
170492		0.99		1.11
200492		1.64		1.03
220492		1.13		1.16
240492		1.34		1.20
270492		1.34		1.21
290492		1.73		1.21
010592		1.43		
040592	0.87	1.33		
060592	0.81	1.54		
080592	0.97	1.74		
110592	0.24	1.33		
130592	0.08	1.57		
150592	0.70	1.46		
180592		1.13		
200592		1.20		
220592		0.96		
250592		1.13		
270592		1.24		
290592		0.64		
010692		0.60		

Table 4 - Mean length and mean weight (standard deviation), maximum /minimum values and sample size for chinook by catch location or hatchery release strategy, 1991.

CHINOOK BIOSAMPLING PUMPHOUSE LOCATION, COWICHAN RIVER, 1991

Date ddmmyy	Length (mm)			N	Weight (gm)			N
	Mean(SD)	Min	Max		Mean(SD)	Min	Max	
060391	42(2)	36	45	30	. (.)	.	.	0
070391	40(2)	36	44	28	. (.)	.	.	0
080391	40(2)	37	44	20	. (.)	.	.	0
110391	40(2)	35	44	51	0.98(1.19)	0.40	6.94	51
130391	40(2)	36	46	41	0.50(0.07)	0.37	0.65	41
150391	41(2)	35	45	40	. (.)	.	.	0
180391	41(2)	38	46	36	0.52(0.08)	0.35	0.69	36
200391	41(2)	37	45	75	0.49(0.08)	0.32	0.69	75
220391	40(1)	38	43	33	0.53(0.08)	0.38	0.69	33
250391	41(2)	35	45	74	0.54(0.09)	0.29	0.71	74
270391	41(2)	36	45	59	0.58(0.10)	0.33	0.84	59
290391	41(1)	40	43	13	0.56(0.07)	0.48	0.73	13
010491	41(2)	37	44	86	0.54(0.08)	0.33	0.75	86
030491	41(2)	36	46	57	0.55(0.10)	0.32	0.80	57
050491	41(2)	37	44	62	0.60(0.10)	0.42	0.84	62
080491	41(3)	36	56	45	0.58(0.17)	0.39	1.55	45
100491	41(2)	35	46	70	0.59(0.08)	0.39	0.91	70
120491	43(3)	39	51	11	0.67(0.21)	0.47	1.23	11
150491	40(2)	34	45	139	. (.)	.	.	0
170491	42(2)	39	44	12	0.60(0.05)	0.49	0.69	12
190491	40(3)	35	45	31	0.49(0.12)	0.31	0.92	31
220491	43(3)	40	48	6	. (.)	.	.	0
240491	43(4)	38	52	11	. (.)	.	.	0
260491	54(20)	28	123	42	. (.)	.	.	0

Table 4. - continued.

CHINOOK BIOSAMPLING, OTHER SITES, COWICHAN RIVER, 1991

Date ddmmyy	Gear ¹	Site ²	Length (mm)			N
			Mean(SD)	Min	Max	
020591	BEA	ROADPO	58 (6)	52	64	3
070591	BEA	ROADPO	51 (8)	43	95	52
150591	FYK	ROADPO	47 (26)	28	123	12
160591	FYK	ROADPO	45 (5)	40	50	4
190591	FYK	ROADPO	63 (.)	63	63	1
200591	FYK	ROADPO	55 (.)	55	55	1
210591	FYK	ROADPO	49 (2)	47	50	2
230591	FYK	ROADPO	83 (17)	50	98	7
080591	MIN	ROADPO	55 (5)	45	69	120
210591	MIN	ROADPO	60 (10)	48	98	76
140591	MIN	BLOC51	58 (7)	45	77	78
220591	MIN	BLOC51	63 (6)	55	77	22
290591	MIN	BLOC51	63 (6)	47	72	19
050691	MIN	BLOC51	77 (2)	75	78	2
120691	BEA	PUMPHO	80 (5)	73	88	9
180691	BEA	PUMPHO	77 (6)	66	90	22
250691	BEA	FORKS	78 (7)	61	91	67
100591	BEA	ESTUAR	61 (8)	41	84	27
160591	BEA	ESTUAR	78 (19)	49	108	23
230591	BEA	ESTUAR	76 (8)	57	101	67
300591	BEA	ESTUAR	77 (6)	65	95	75
040691	BEA	ESTUAR	78 (7)	49	100	84
060691	BEA	ESTUAR	76 (8)	58	98	101
110691	BEA	ESTUAR	82 (9)	55	101	88
210691	BEA	ESTUAR	76 (11)	54	111	128
270691	BEA	ESTUAR	78 (14)	49	130	101
080791	BEA	ESTUAR	74 (7)	62	102	63
130691	PUR	ESTUAR	85 (9)	65	125	418

¹ FYK-fyke net, BEA-beach seine, MIN-minnow trap, PUR-purse seine

² ROADPO-road pool, BLOC51-block 51, PUMPHO-pumphouse, ESTUAR-estuary.

Table 4. - continued.

CHINOOK BIOSAMPLING, COWICHAN HATCHERY, 1991

Date ddmmyy	Release ¹	Length (mm)				Weight (gm)			
		Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
260391	ER	61 (5)	50	69	24	2.57 (0.81)	1.01	3.89	24
020491	ER	60 (3)	54	67	49	2.33 (0.55)	1.46	4.14	48
100491	ER	66 (5)	57	75	50	3.08 (0.78)	1.71	4.97	50
160491	ER	65 (5)	54	71	30	2.79 (0.69)	1.26	3.89	30
260391	LP	60 (4)	49	68	50	2.56 (0.71)	0.98	4.30	83
020491	LP	59 (4)	52	69	49	2.01 (0.43)	1.36	3.54	48
080491	LP	64 (3)	57	72	52	2.73 (0.55)	1.55	3.97	53
170491	LP	66 (5)	52	79	50	3.18 (1.07)	1.59	5.32	16
230491	LP	70 (5)	53	78	46	3.61 (0.90)	1.25	5.57	49
010591	LP	74 (5)	64	85	50	. (.)	.	.	0
080591	LP	78 (6)	64	90	50	. (.)	.	.	0
150591	LP	87 (6)	72	102	57	. (.)	.	.	0
260391	LR	59 (4)	49	66	50	2.15 (0.52)	1.22	3.41	50
020491	LR	57 (4)	50	64	51	1.86 (0.46)	1.02	2.93	51
100491	LR	64 (4)	55	72	50	2.00 (0.74)	0.98	3.81	87
160491	LR	56 (3)	48	62	49	. (.)	.	.	0
230491	LR	63 (6)	52	83	50	2.68 (0.95)	1.19	6.13	48
300491	LR	65 (6)	51	78	50	2.95 (0.96)	1.04	5.08	50
080591	LR	72 (7)	62	97	35	3.89 (1.25)	0.67	6.96	35
140591	LR	77 (7)	61	93	50	4.79 (1.51)	2.06	8.60	48
210591	LR	83 (6)	68	95	49	. (.)	.	.	0

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

Table 5 - Mean length and mean weight (standard deviation), maximum /minimum values and sample size for chinook by catch location or hatchery release strategy, 1992.

CHINOOK BIOSAMPLING PUMPHOUSE LOCATION, COWICHAN RIVER, 1992

Date ddmmyy	Length (mm)			N	Weight (gm)			N
	Mean(SD)	Min	Max		Mean(SD)	Min	Max	
020392	42(2)	35	46	86	0.54(0.08)	0.29	0.80	86
040392	41(2)	36	47	76	0.54(0.08)	0.35	0.78	76
060392	41(3)	36	49	51	0.51(0.12)	0.31	0.99	51
090392	42(2)	36	47	50	0.54(0.11)	0.35	0.83	50
110392	42(2)	36	50	52	0.45(0.13)	0.25	0.96	52
130392	42(2)	36	48	50	0.64(0.12)	0.35	0.93	50
160392	43(2)	38	52	50	0.55(0.13)	0.36	1.09	50
180392	42(3)	37	46	18	0.55(0.16)	0.32	0.84	18
200392	41(2)	36	51	55	0.54(0.15)	0.31	1.25	55
230392	43(3)	37	58	50	0.70(0.24)	0.40	2.01	50
250392	42(3)	37	50	50	0.67(0.12)	0.34	1.02	50
270392	46(3)	39	55	72	0.77(0.23)	0.35	1.61	72
300392	44(3)	38	53	51	0.73(0.23)	0.39	1.55	51
010492	44(3)	38	52	50	0.56(0.20)	0.18	1.31	50
060492	46(5)	39	58	34	0.83(0.37)	0.41	2.05	34
100492	55(5)	40	66	95	1.79(0.69)	0.51	4.13	95
130492	59(7)	44	70	18	2.11(0.76)	0.60	3.59	18
150492	59(11)	46	83	15	2.22(1.37)	0.97	5.82	15
170492	54(5)	43	63	13	1.61(0.55)	0.77	2.75	13
200492	56(7)	44	68	20	1.64(0.66)	0.63	3.05	20
220492	57(6)	47	73	49	(.)	.	.	0
240492	60(6)	51	73	8	2.23(0.84)	1.28	4.07	8
270492	65(6)	51	77	48	2.98(0.88)	1.31	5.04	48
290492	49(4)	44	52	4	0.91(0.29)	0.53	1.14	4
010592	61(7)	49	76	15	2.60(1.04)	1.23	4.95	15
040592	67(10)	53	78	6	3.32(1.29)	1.46	4.86	6
110592	73(6)	55	82	26	3.51(0.94)	1.43	5.44	26
130592	72(7)	59	88	23	4.03(1.18)	2.32	7.42	23
150592	70(6)	62	81	9	2.83(0.84)	1.89	4.53	9
180592	68(8)	58	87	13	3.24(1.21)	1.68	6.40	13
200592	76(8)	54	104	150	3.22(1.40)	1.19	8.90	150
220592	78(10)	60	118	87	4.11(1.43)	2.31	9.04	87
250592	75(7)	64	94	65	3.88(1.19)	2.17	8.09	65
270592	77(9)	62	100	35	3.84(1.47)	1.79	8.77	35
290592	79(6)	69	92	32	3.92(0.90)	2.64	6.28	32
010692	76(6)	64	92	92	4.11(0.95)	3.59	8.89	92
030692	76(6)	65	92	68	3.90(0.75)	2.44	6.23	68
040692	(.)	.	.	0	3.53(0.76)	2.37	5.34	28

Table 5 - continued.

CHINOOK BIOSAMPLING BLOCK 51 LOCATION, COWICHAN RIVER, 1992

Date ddmmyy	Length (mm)			N	Mean(SD)	Weight (gm)		N
	Mean(SD)	Min	Max			Min	Max	
030392	51(5)	48	59	4	0.51(0.30)	0.20	2.14	43
060392	42(2)	36	49	89	0.52(0.07)	0.37	0.78	51
090392	43(2)	38	48	44	0.57(0.10)	0.37	0.80	44
110392	41(2)	38	49	44	0.59(0.12)	0.44	1.06	44
130392	42(2)	34	45	44	0.54(0.09)	0.29	0.68	44
160392	41(4)	32	51	41	0.58(0.12)	0.31	1.03	41
180392	42(4)	33	47	22	0.60(0.15)	0.30	0.89	18
200392	41(3)	36	53	44	0.57(0.18)	0.37	1.54	44
230392	43(3)	38	55	44	0.54(0.27)	0.21	1.86	45
250392	44(4)	36	53	44	0.66(0.23)	0.20	1.36	43
270392	43(3)	36	48	23	0.41(0.15)	0.17	0.73	23
300392	43(4)	36	56	44	0.57(0.37)	0.24	2.41	44
010492	44(3)	37	49	44	0.59(0.14)	0.20	0.88	40
030492	44(3)	38	52	44	0.60(0.29)	0.28	2.25	45
060492	46(6)	40	61	20	0.84(0.39)	0.42	2.01	19
080492	46(7)	40	66	15	0.75(0.49)	0.35	2.34	15
100492	49(5)	39	66	44	1.10(0.45)	0.39	2.76	42
130492	50(5)	40	62	33	1.10(0.37)	0.49	1.98	32
150492	51(6)	42	68	44	1.09(0.41)	0.53	2.14	31
170492	54(13)	40	115	44	1.03(0.38)	0.47	2.16	33
200492	53(14)	39	117	44	0.87(0.30)	0.38	1.53	31
220492	54(6)	42	71	44	1.17(0.47)	0.54	2.98	43
240492	67(24)	42	116	44	1.23(0.61)	0.50	3.25	34
270492	65(19)	43	115	44	1.61(0.94)	0.61	5.24	30
290492	53(6)	45	70	44	1.27(0.52)	0.50	2.78	30
070592	56(6)	44	70	61	2.03(0.70)	0.88	3.92	61
080592	.(.)	.	.	0	1.74(0.66)	0.71	3.33	30
150592	.(.)	.	.	0	2.07(0.55)	1.10	2.85	10
180592	.(.)	.	.	0	2.55(1.02)	0.81	4.35	11
210592	.(.)	.	.	0	2.81(1.17)	1.98	3.64	2

Table 5 - continued.

CHINOOK BIOSAMPLING, HATCHERY, 1992

Date ddmmyy	Release ¹	Length (mm)				Weight (gm)			
		Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
070492	CO	66 (4)	58	75	30	3.30 (0.76)	1.95	5.08	30
140492	CO	67 (4)	60	80	30	3.79 (0.89)	2.53	6.48	30
210492	CO	69 (5)	57	79	30	2.70 (0.71)	1.22	4.38	30
100392	ER	48 (2)	43	52	30	0.77 (0.17)	0.51	1.17	30
170392	ER	50 (4)	40	57	30	1.19 (0.35)	0.46	1.98	30
240392	ER	55 (5)	43	67	32	1.63 (0.46)	0.58	2.49	32
100392	LP	47 (3)	37	53	30	0.47 (0.14)	0.14	0.75	30
170392	LP	51 (3)	45	55	30	1.26 (0.27)	0.71	1.77	30
240392	LP	56 (4)	46	62	33	1.64 (0.41)	0.61	2.38	33
070492	LP	62 (4)	54	70	30	1.43 (0.39)	0.73	2.36	30
150492	LP	65 (5)	49	73	30	. (.)	.	.	0
220492	LP	67 (6)	53	75	30	. (.)	.	.	0
290492	LP	70 (5)	63	79	30	2.02 (0.54)	1.16	3.07	28
100392	LR	47 (3)	40	53	30	0.70 (0.23)	0.29	1.14	30
170392	LR	51 (2)	45	56	30	0.64 (0.14)	0.36	0.86	30
240392	LR	55 (5)	46	62	32	1.55 (0.47)	0.75	2.58	32
070492	LR	56 (6)	43	66	30	1.98 (0.67)	0.72	3.5	30
140492	LR	60 (5)	51	70	29	2.37 (0.69)	1.31	3.64	29
210492	LR	62 (5)	50	70	30	1.58 (0.48)	0.67	2.43	30
280492	LR	65 (6)	51	79	60	1.49 (0.63)	0.60	3.10	30
050592	LR	67 (6)	52	76	30	3.09 (1.10)	0.63	5.77	60

¹ CO-captive brood, ER-early release, LR-late release, LP-lake pen

Table 5. - continued.

CHINOOK BIOSAMPLING, PURSE SEINE, COWICHAN BAY, 1992

Date ddmmyy	Site ¹	Length (mm)				Weight (gm)			
		Mean(SD)	Min	Max	N	Mean(SD)	Min	Max	N
130592	9A	86 (9)	68	107	27	4.13 (1.29)	2.00	7.33	27
130592	9B	85 (9)	70	100	36	4.06 (1.45)	2.06	7.93	36
130592	9C	84 (8)	63	101	38	3.95 (1.17)	1.78	6.65	38
130592	9D	84 (9)	64	106	29	3.37 (1.30)	1.48	7.71	29
130592	9E	85 (8)	69	104	39	3.63 (0.99)	1.66	6.07	39
130592	9F	86 (7)	76	100	14	4.46 (1.58)	3.00	8.32	14

¹ for site locations see figure 3.

Table 6. Juvenile chinook release data for the Cowichan hatchery, 1991.

Release ¹ strategy	Tag code	Release date	Length (mm)			Weight (gm)		
			Mean	Min	Max	Mean	Min	Max
Early	02-03-38	April 17	69	57	80	3.3	1.8	4.9
	02-03-37							
	02-03-36							
Lake pen	02-03-35	May 15	90	84	105	8.9	4.8	12.5
	02-03-34							
	02-03-33							
Late	02-03-41	May 22	91	80	105	6.9	4.2	10.8
	02-03-40							
	02-03-39							
Captive	02-03-43	June 17,18	78	59	95	4.7	2.0	8.1
	02-03-42							
Seapen	no CWT	June 3,26	81	60	115	5.4	2.3	13.3

¹ for release site see Table 1.

Table 7. Juvenile chinook release data for the Cowichan hatchery, 1992.

Release ¹ strategy	Tag code	Release date	Length (mm)			Weight (gm)		
			Mean	Min	Max	Mean	Min	Max
Early	18-05-15	April 21	n/a			3.3 ²		
	18-05-16							
Lake	18-05-13	May 17	n/a			5.0 ²		
	18-05-14							
Late	18-05-17	May 21	77	60	92	4.8	2.6	8.5
	18-05-18							
Captive	18-05-19	April 21	n/a			3.3 ²		
	18-05-20							
Seapen	18-05-21	May 29	n/a			6.3 ²		
	18-05-22							

¹ for release site see Table 1.

² mean weight values determined from hatchery bulk sampling.

Table 8. Chinook CWT data collected during fry migration in the Cowichan River and Cowichan Bay, 1991.

Release date	Recovery date	Release code	Tag code	Recovery site	Number of fry
17Apr91	13Jun91	Early	2-03-38	Cow. Bay #4	2
17Apr91	13Jun91	Early	2-03-37	Cow. Bay #6	1
17Apr91	13Jun91	Early	2-03-36	Cow. Bay #8	1
17Apr91	16May91	Early	2-03-38	Estuary	1
17Apr91	16May91	Early	2-03-36	Estuary	2
17Apr91	23May91	Early	2-03-36	Estuary	1
17Apr91	23May91	Early	2-03-38	Estuary	1
07May91	13Jun91	Chemainus	2-14-52	Cow. Bay #8	1
15May91	13Jun91	Lake Pen	2-03-33	Cow. Bay #8	1
15May91	27Jun91	Lake Pen	2-03-34	Estuary	1
22May91	13Jun91	Late	2-03-39	Cow. Bay #2	1
22May91	13Jun91	Late	2-03-39	Cow. Bay #3	1
22May91	13Jun91	Late	2-03-40	Cow. Bay #1	2
22May91	13Jun91	Late	2-03-39	Cow. Bay #1	1
22May91	13Jun91	Late	2-03-41	Cow. Bay #1	1
22May91	13Jun91	Late	2-03-40	Cow. Bay #4	2
22May91	13Jun91	Late	2-03-39	Cow. Bay #8	2
22May91	13Jun91	Late	2-03-40	Cow. Bay #8	1
22May91	13Jun91	Late	2-03-41	Cow. Bay #8	4
22May91	13Jun91	Chemainus	2-53-11	Cow. Bay #8	1
22May91	04Jun91	Late	2-03-41	Estuary	1
22May91	04Jun91	Late	2-03-41	Estuary	3
22May91	06Jun91	Late	2-03-39	Estuary	2
22May91	06Jun91	Late	2-03-40	Estuary	1
22May91	06Jun91	Late	2-03-41	Estuary	1
22May91	06Jun91	Late	2-03-41	Road Pool	1
22May91	27Jun91	Late	2-03-39	Estuary	2
22May91	21Jun91	Late	2-03-41	Estuary	1
18Jun91	21Jun91	Captive	2-03-42	Estuary	2
18Jun91	21Jun91	Captive	2-03-43	Estuary	8
18Jun91	25Jun91	Captive	2-03-42	Pumphouse	2
18Jun91	25Jun91	Captive	2-03-43	Pumphouse	1
18Jun91	25Jun91	Captive	2-03-42	Forks	9
18Jun91	25Jun91	Captive	2-03-43	Forks	4
18Jun91	27Jun91	Captive	2-03-42	Estuary	6
18Jun91	27Jun91	Captive	2-03-43	Estuary	7
18Jun91	27Jun91	Chemainus	2-53-11	Estuary	1
18Jun91	08Jul91	Captive	2-03-43	Estuary	1

note: also 8 fish with 'no-pin'.

Table 9. Chinook CWT data collected during fry migration in the Cowichan River and Cowichan Bay, 1992.

Release date	Recovery date	Release code	Tag code	Recovery site	Number of fry
21Apr92	13May92	Early	18-05-19	Cow. Bay #3	2
21Apr92	13May92	Early	18-05-20	Cow. Bay #3	1
21Apr92	13May92	Early	18-05-20	Cow. Bay #1	2
21Apr92	13May92	Early	18-05-19	Cow. Bay #5	1
21Apr92	13May92	Early	18-05-15	Cow. Bay #5	3
21Apr92	13May92	Early	18-05-16	Cow. Bay #5	1
21Apr92	13May92	Early	18-05-16	Cow. Bay #2	1
21Apr92	13May92	Early	18-05-19	Cow. Bay #2	1
21Apr92	13May92	Early	18-05-20	Cow. Bay #2	1
21Apr92	13May92	Early	18-05-15	Cow. Bay #4	1
21Apr92	26May92	Early	18-05-15	Forks	1
17May92	21May92	Lake Pen	18-05-13	Pumphouse	1
20May92	20May92	Late	18-05-17	Pumphouse	13
20May92	20May92	Late	18-05-18	Pumphouse	18
20May92	21May92	Late	18-05-17	Pumphouse	3
20May92	21May92	Late	18-05-18	Pumphouse	7
20May92	22May92	Late	18-05-17	Pumphouse	22
20May92	22May92	Late	18-05-18	Pumphouse	15
20May92	24May92	Late	18-05-17	Pumphouse	11
20May92	24May92	Late	18-05-18	Pumphouse	5
20May92	26May92	Late	18-05-17	Forks	1
20May92	26May92	Late	18-05-18	Forks	1
20May92	27May92	Late	18-05-17	Pumphouse	8
20May92	27May92	Late	18-05-18	Pumphouse	10
20May92	28May92	Late	18-05-17	Pumphouse	2
20May92	28May92	Late	18-05-18	Pumphouse	7
20May92	29May92	Late	18-05-17	Pumphouse	1
20May92	29May92	Late	18-05-17	Pumphouse	1
20May92	02Jun92	Late	18-05-18	Pumphouse	2
20May92	03Jun92	Late	18-05-17	Pumphouse	1
20May92	03Jun92	Late	18-05-18	Pumphouse	2
20May92	04Jun92	Late	18-05-17	Pumphouse	2
20May92	04Jun92	Late	18-05-18	Pumphouse	4

note: 6 fish with 'no pin'.

FIGURES

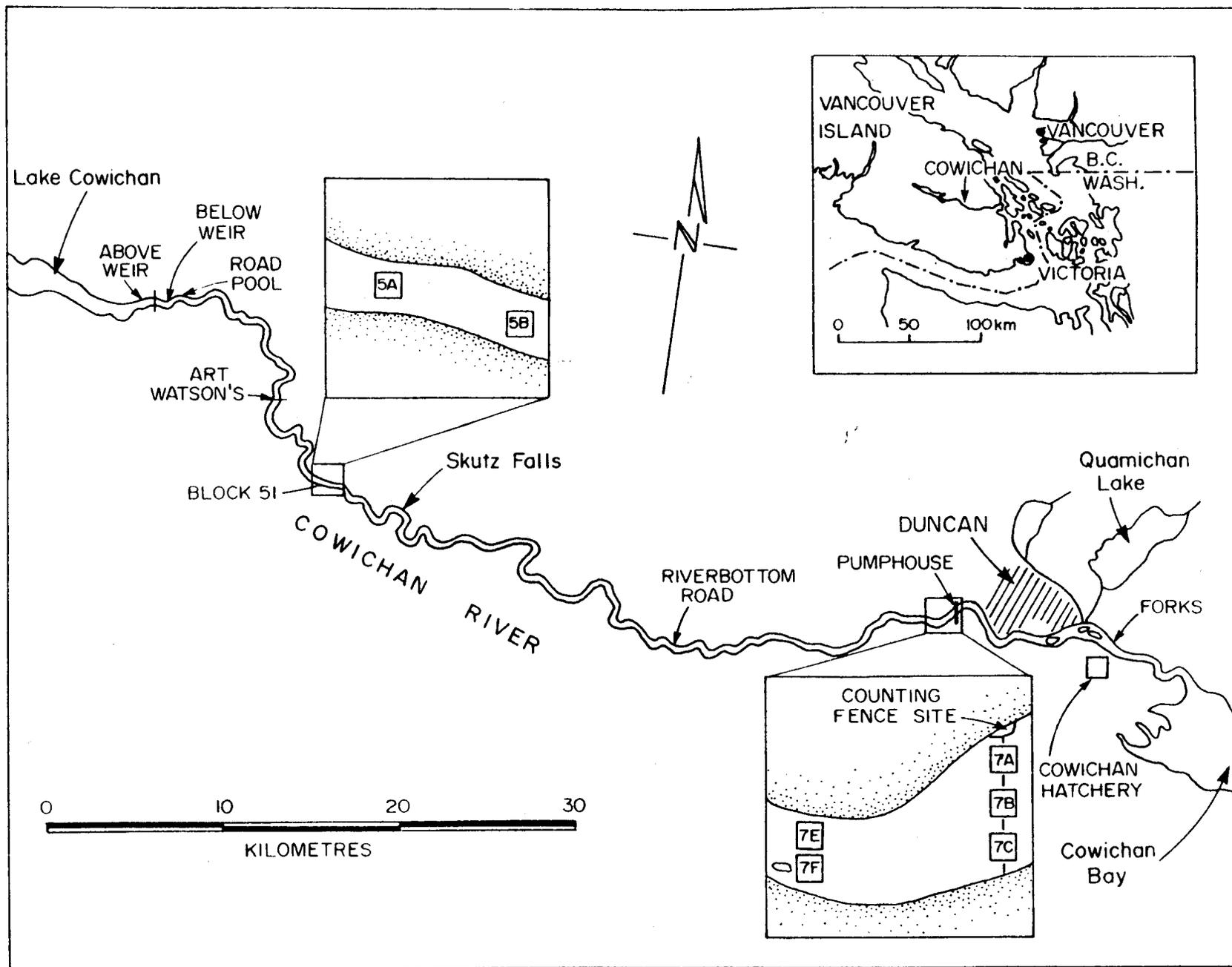


Figure 1. - Map showing sampling locations on the Cowichan River.
 (insert of Pumphouse and Block 51 trapping sites).

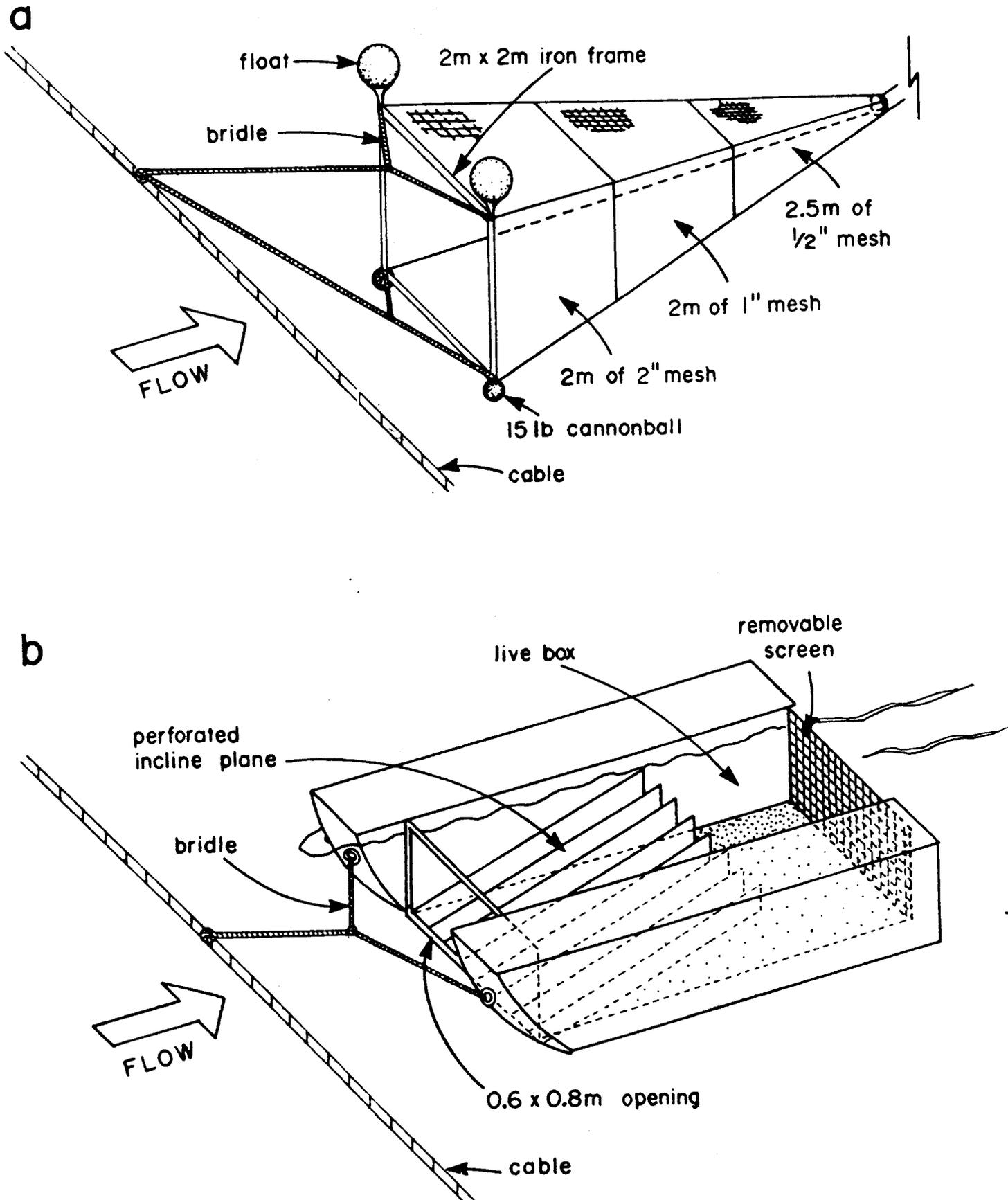


Figure 2. - Diagrams showing the Fyke net (2a) and the Inclined plane trap (2b) used for catching chinook in the Cowichan River 1991 and 1992.

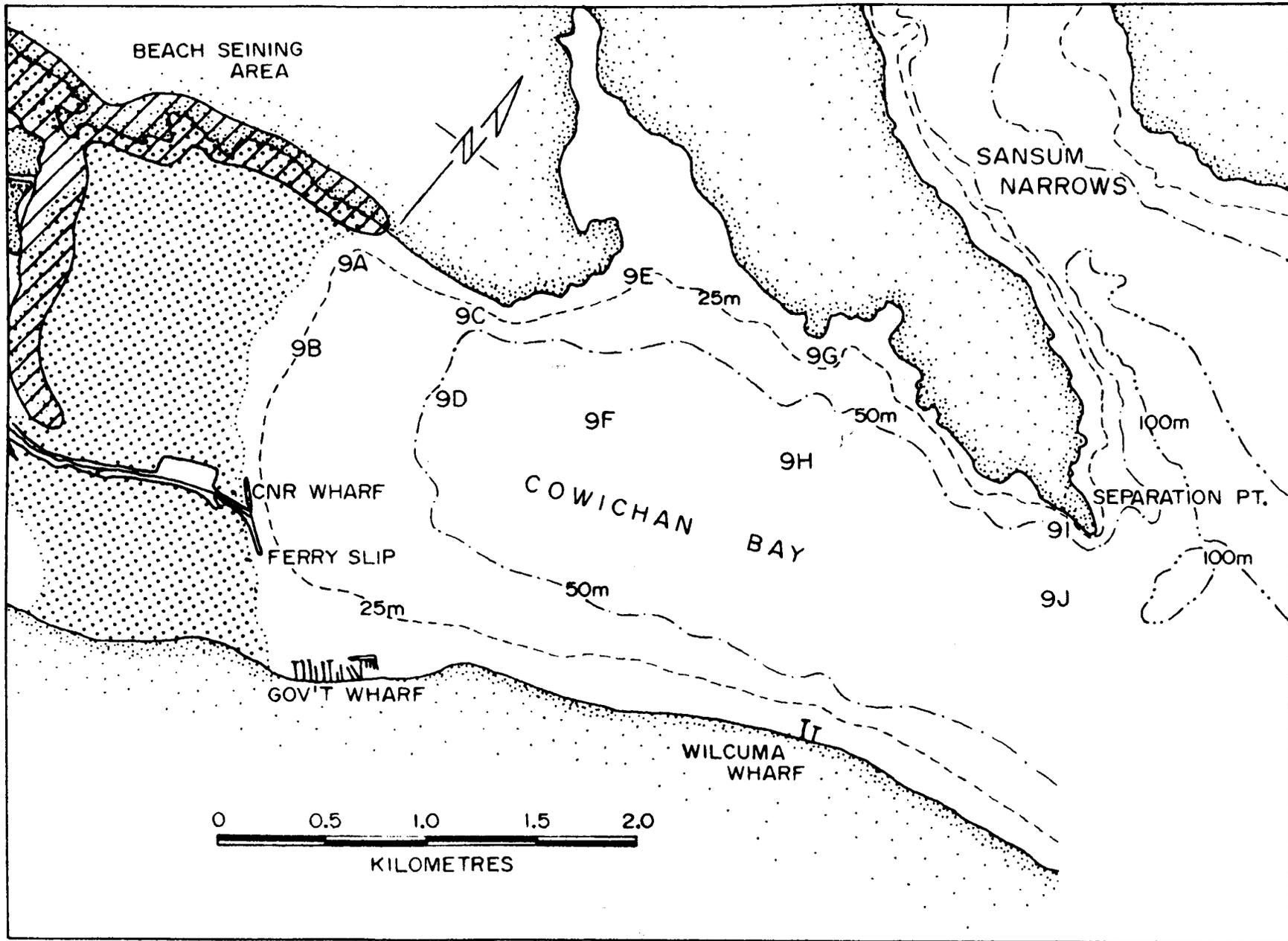


Figure 3. - Map showing Cowichan Bay beach seine and purse seine sampling sites.

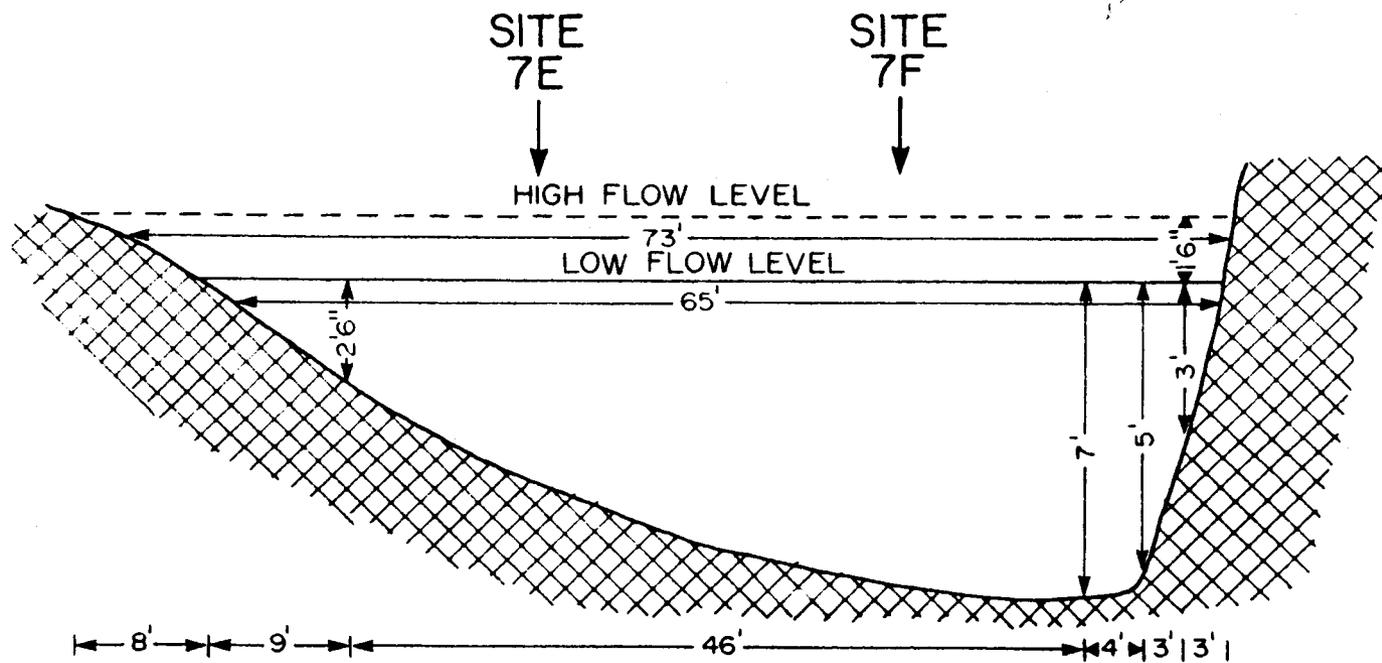
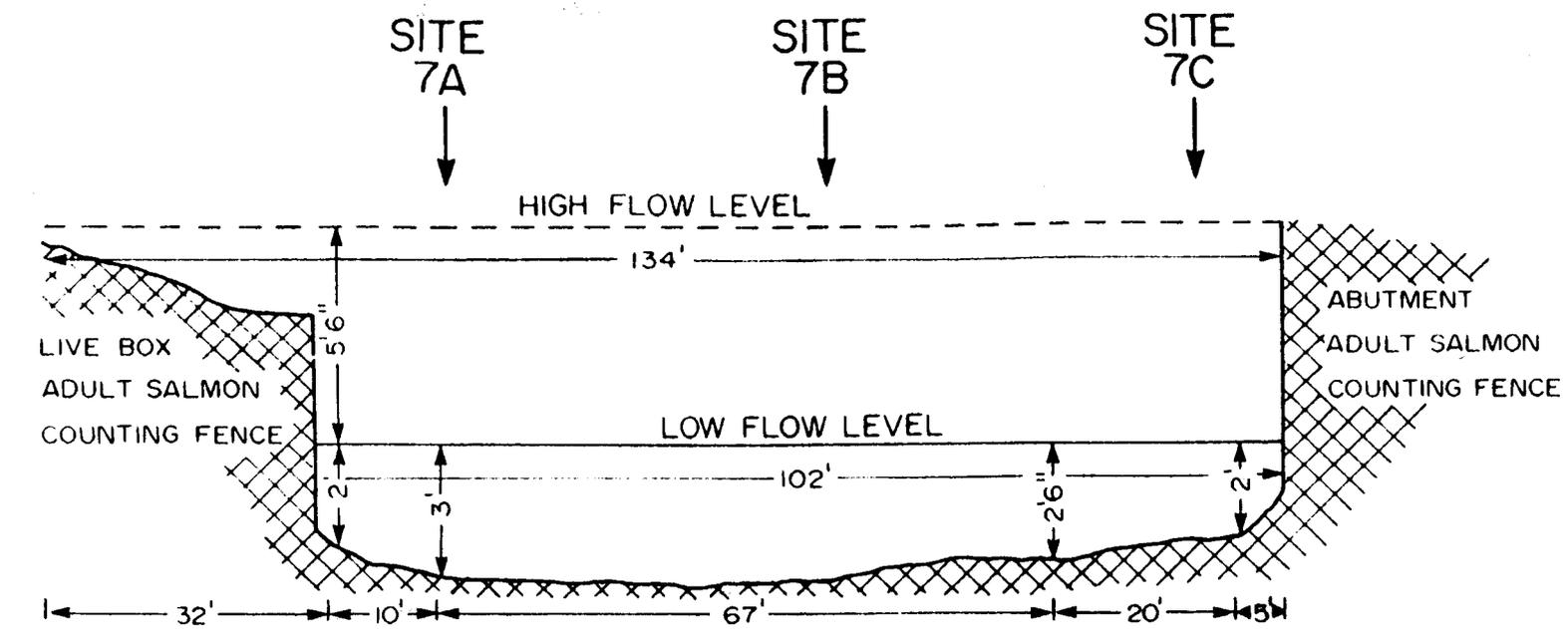


Figure 4. - Cross-section of the Cowichan River at the pumphouse sites 7a-c and 7e-f.

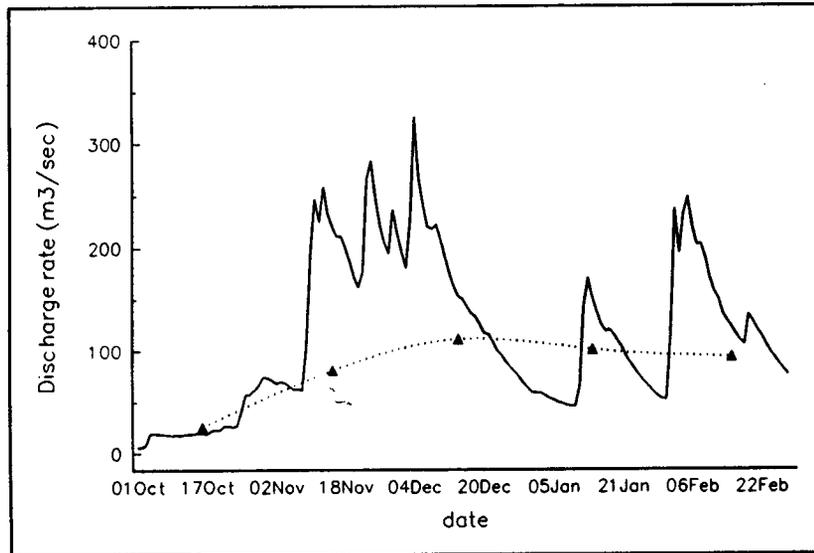


Figure 5 - Daily discharge rates for Oct-Feb 1990/91 (solid line) and the 30 year monthly average (dotted line) from the Duncan site (Water Survey of Canada).

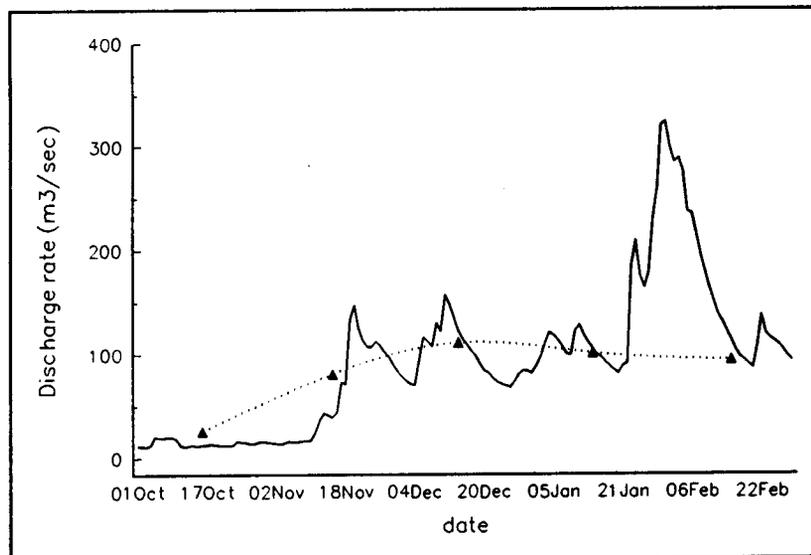


Figure 6. - Daily discharge rate from Oct-Feb 1991/92 (solid line) and the 30 year monthly average (dotted line) for the Duncan site (Water Survey of Canada).

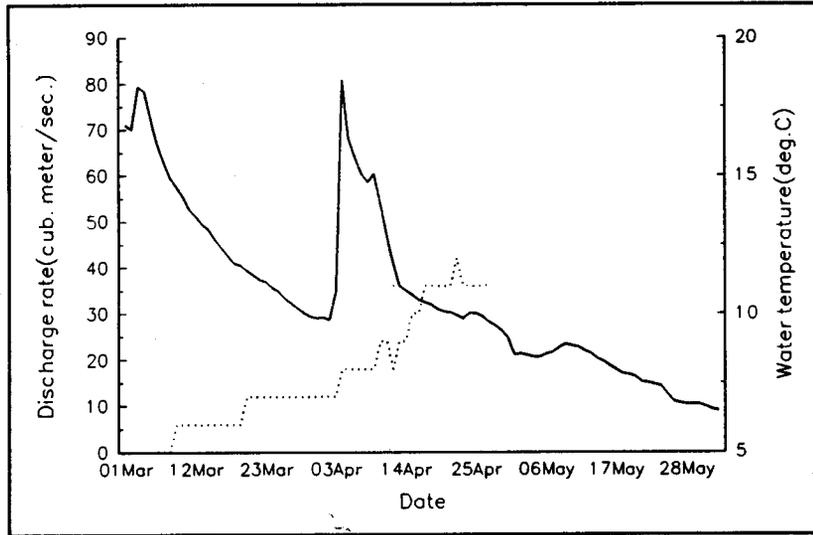


Figure 7 - Discharge rate (solid line) from Duncan site (Water Survey of Canada) and water temperature (dotted line) measured at the Pumphouse location, Cowichan River, 1991.

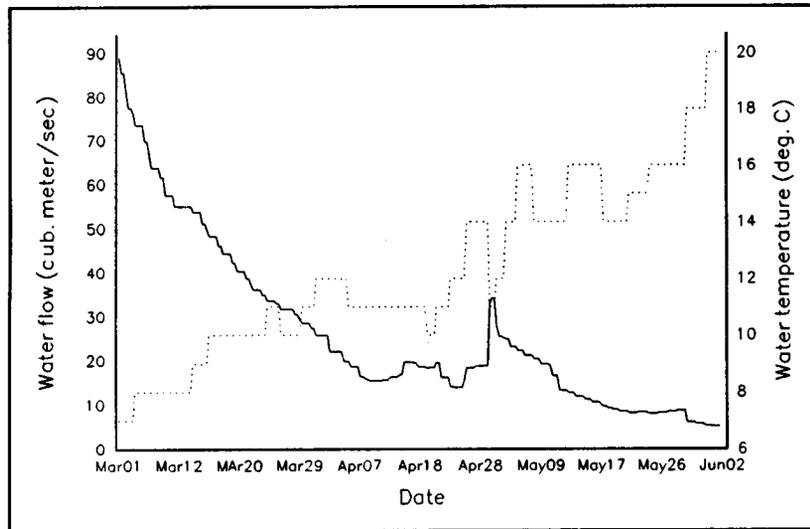


Figure 8 - Discharge rate (solid line) from Duncan site (Water Survey of Canada) and water temperature (dotted line) measured at Pumphouse location, Cowichan River, 1992.

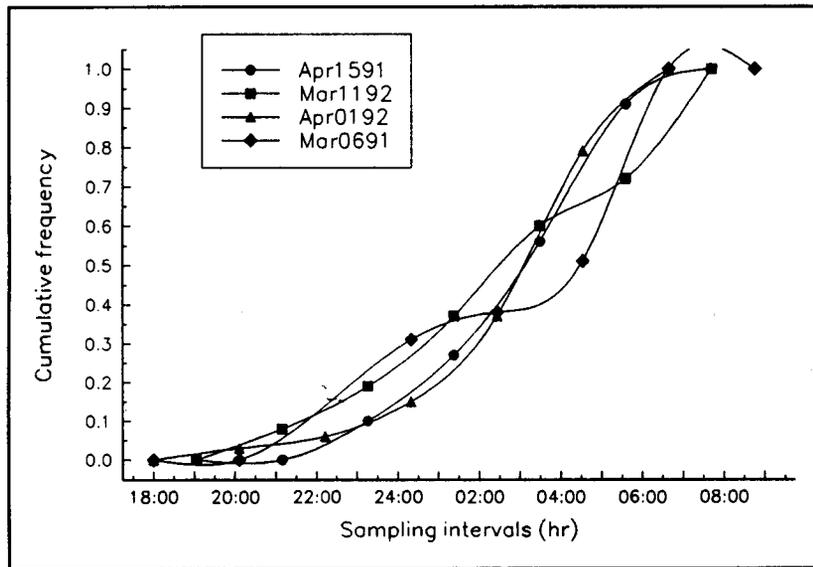


Figure 9. - Cumulative frequency of chinook migrants during 12 h night sampling interval, Pumhouse site, Cowichan River, 1991 and 1992.

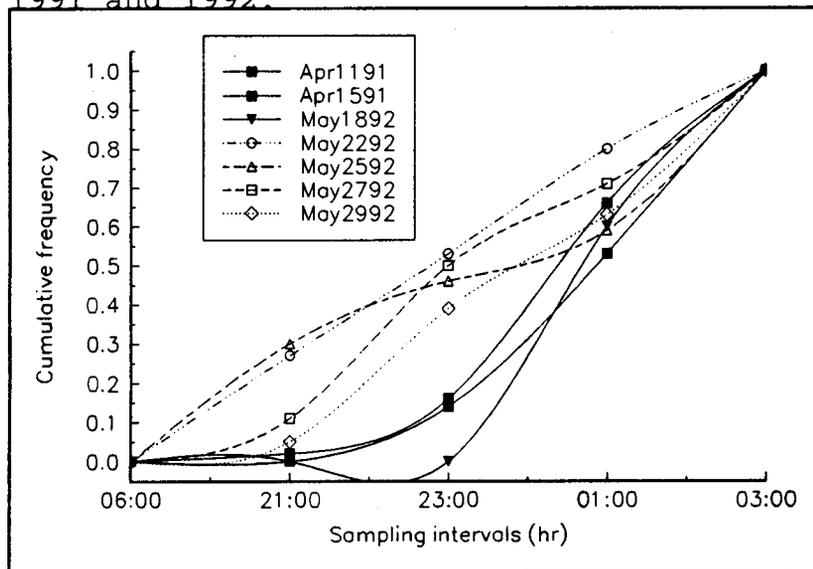


Figure 10. Cumulative frequency of chinook migrants during the daytime and standard 6 h sampling interval during the night (solid-wild, dotted-hatchery) at the Pumhouse site, Cowichan R. 1991-1992.

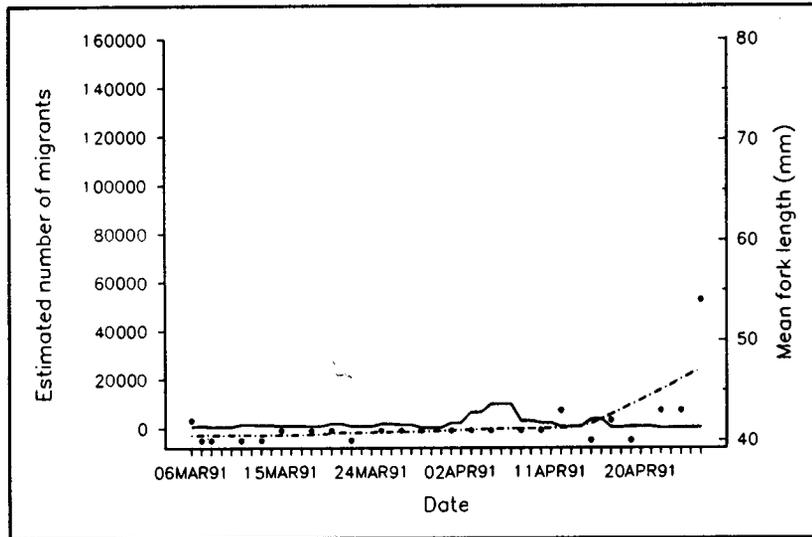


Figure 11. - Migration timing and seasonal trend in mean growth of chinook salmon migrants, Pumphouse site, Cowichan River, 1991.

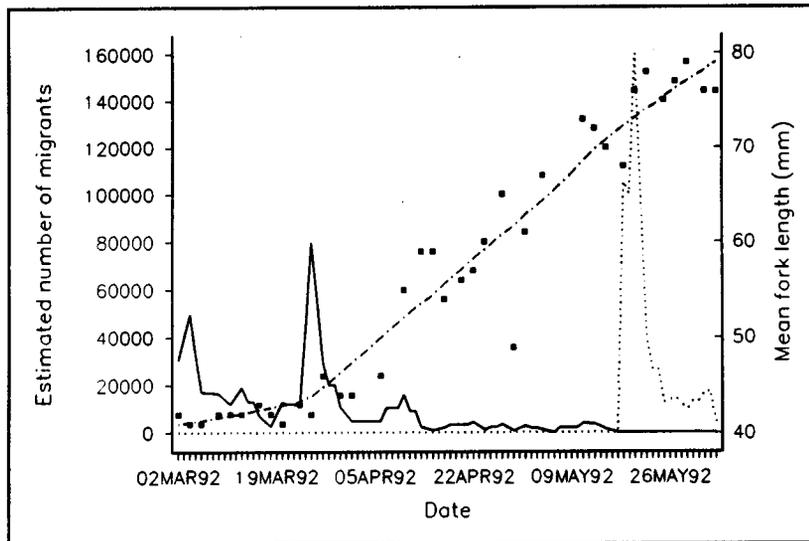


Figure 12. - Migration timing and seasonal trend in mean growth of chinook salmon migrants, Pumphouse site, Cowichan River, 1992 (solid-naturally-spawned, dotted-hatchery).

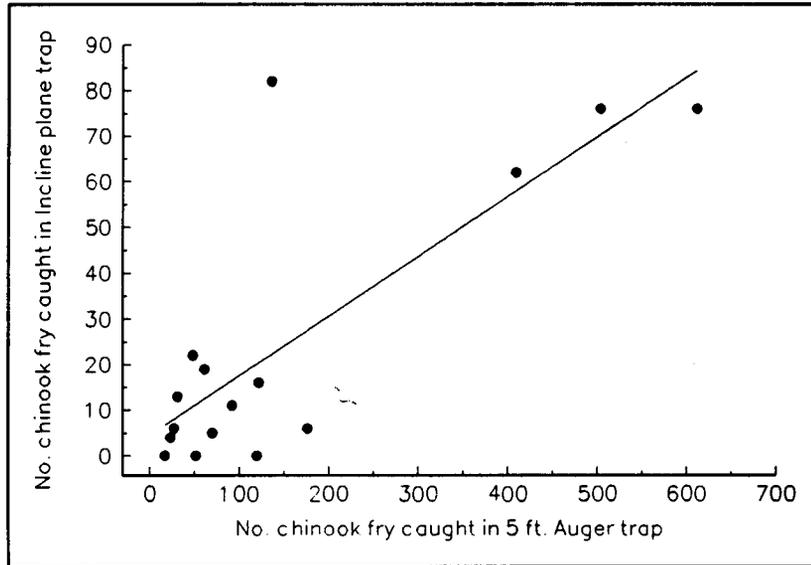


Figure 13. - Comparison of chinook catch between the Auger trap and the Incline plane trap, Cowichan River, 1992.

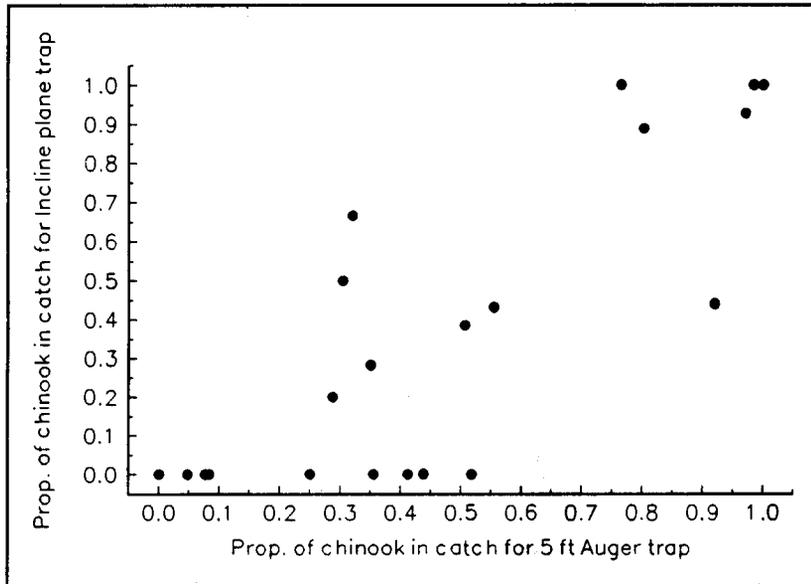


Figure 14. - Comparison of the proportion of chinook in catch between the Auger trap and the Incline plane trap, Cowichan River, 1992.

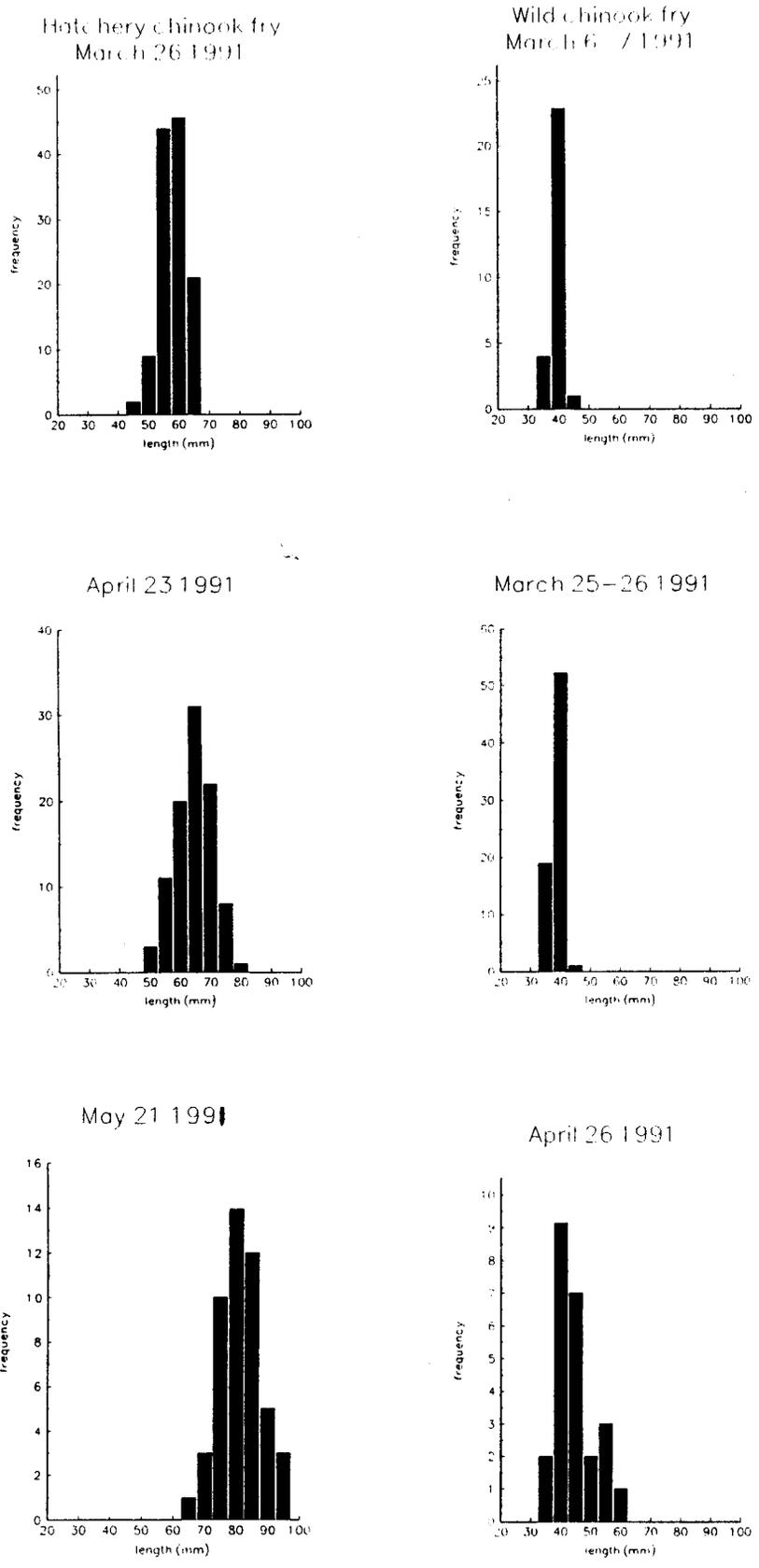


Figure 15. Frequency of fry length for naturally-reared and hatchery release chinook by date, Cowichan River, 1991.

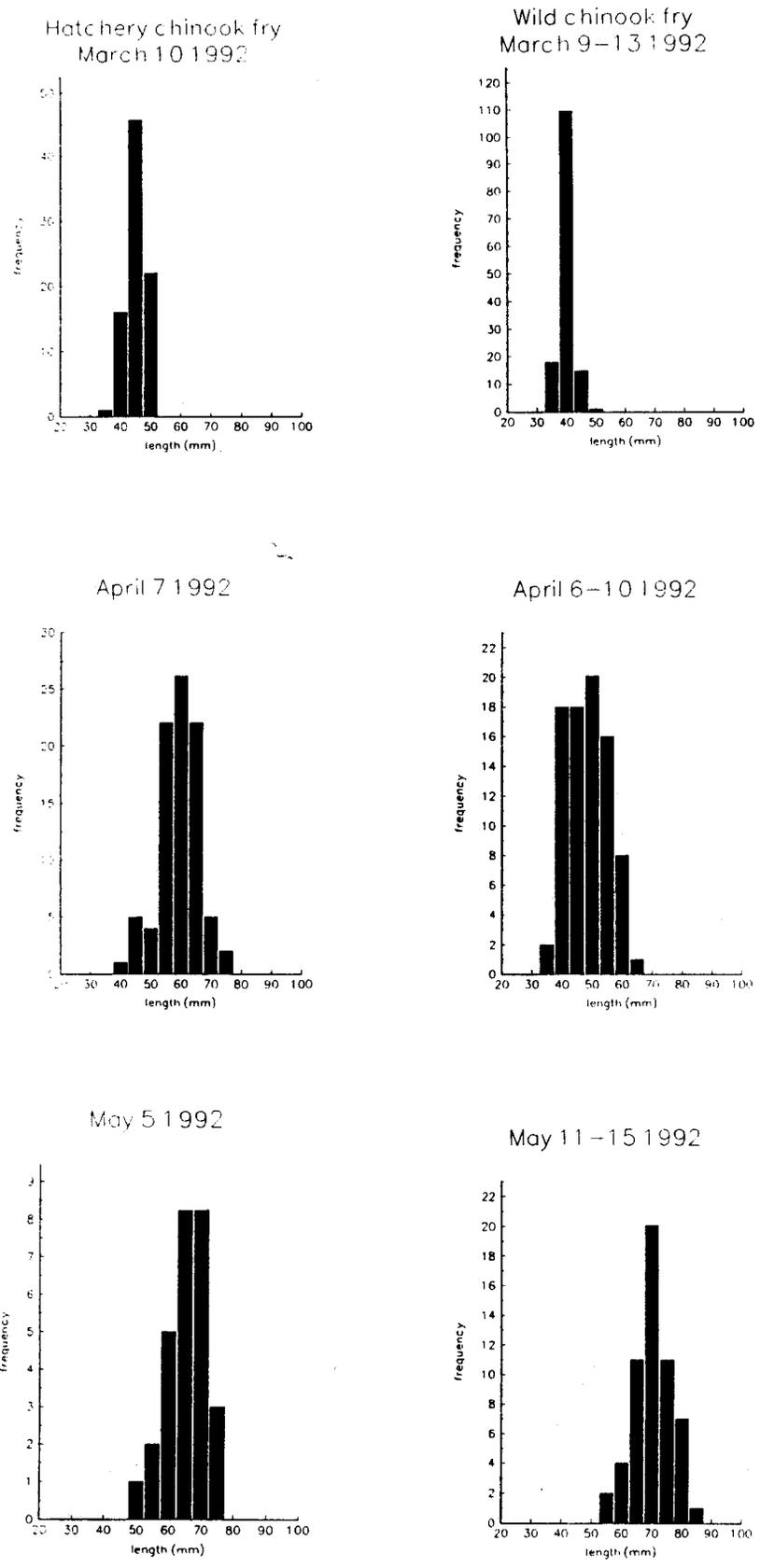


Figure 16. Frequency of fry length for naturally-reared and hatchery release chinook by date, Cowichan River, 1992.

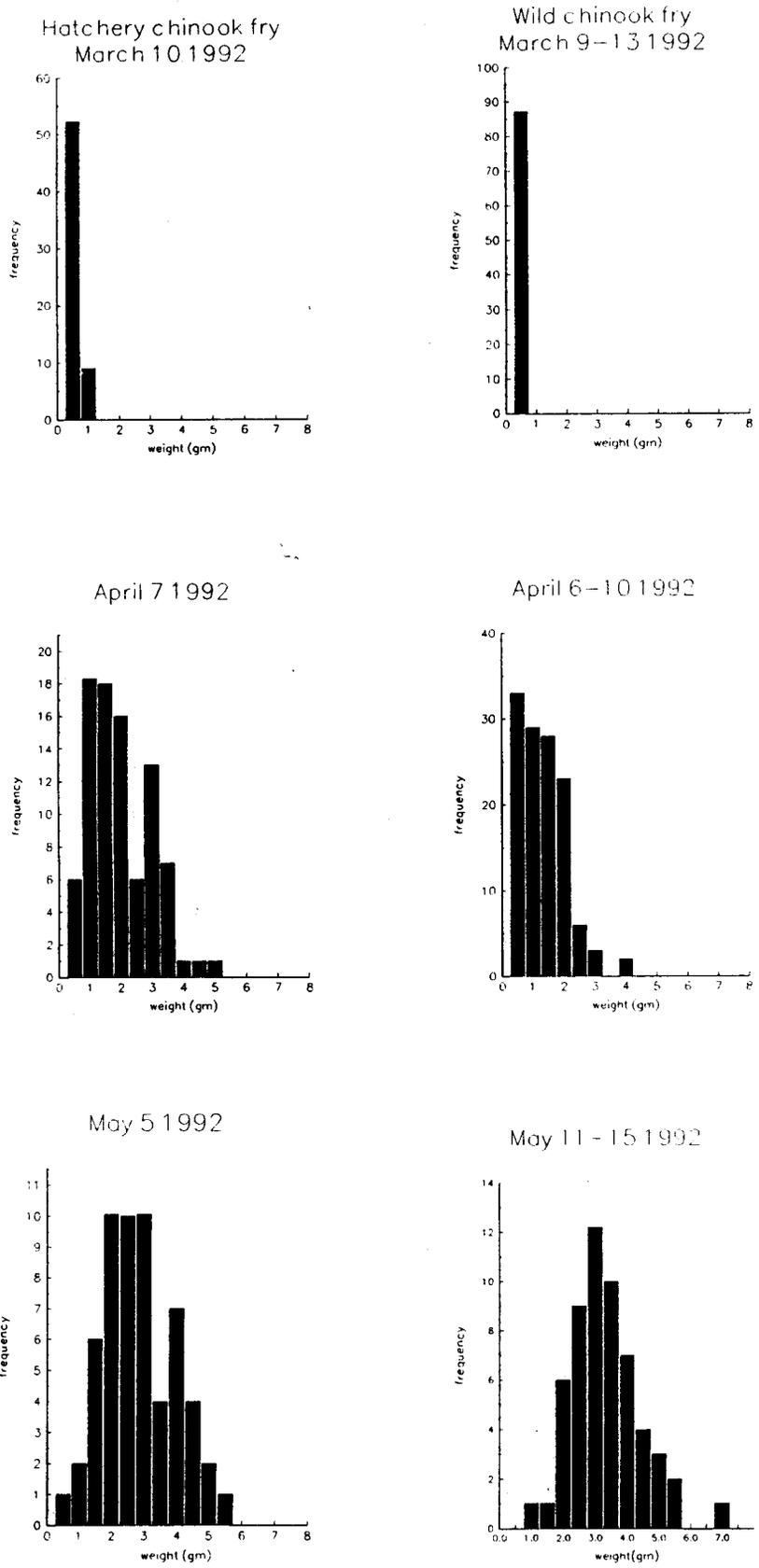


Figure 17. Frequency of fry weight for naturally-reared and hatchery release chinook by date, Cowichan River, 1992.

Appendix 1 - Catch data for site and trap type by date/time for Cowichan River, 1991.
 T=water temperature (°C), W=weather, C=water clarity, S=Site, Trap=type type, CNM=juvenile chinook marked (adipose clip), CNF=juvenile chinook (naturally-spawned or hatchery), COF=coho fry, COS=coho smolts, CHF=Chum fry.

PUMPHOUSE TRAP LOCATION, COWICHAN RIVER, 1991												COMMENTS
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS	CHF	
060391	18:00-20:00	5	3	2	7A	FYK	0	0	0	0	0	
060391	20:00-22:00	5	3	2	7A	FYK	0	9	0	1	4	
060391	22:00-24:00	5	3	2	7A	FYK	0	2	0	4	6	
070391	0:00- 2:00	5	3	2	7A	FYK	0	4	0	9	5	
070391	2:00- 4:00	5	3	2	7A	FYK	0	8	0	7	4	
070391	4:00- 6:00	5	3	2	7A	FYK	0	7	0	10	4	
070391	6:00-18:00	5	3	2	7A	FYK	0	4	0	1	1	
070391	18:00-20:00	5	3	2	7A	FYK	0	0	0	1	1	
070391	20:00-22:00	5	3	2	7A	FYK	0	3	0	0	2	
070391	22:00-24:00	5	3	2	7A	FYK	0	5	0	6	0	
080391	0:00- 2:00	5	3	2	7A	FYK	0	9	0	3	2	
080391	2:00- 4:00	5	3	2	7A	FYK	0	7	0	2	0	
080391	4:00- 6:00	5	3	2	7A	FYK	0	5	0	7	0	
080391	6:00-20:00	6	3	2	7A	FYK	0	2	0	4	0	
080391	20:00-22:00	6	3	2	7A	FYK	0	5	0	1	1	
080391	22:00-24:00	6	3	2	7A	FYK	0	5	0	3	4	
090391	0:00- 2:00	6	3	2	7A	FYK	0	8	0	3	7	
110391	18:00-20:00	6	3	2	7A	FYK	0	5	0	2	5	
110391	19:00-21:00	5	3	2	7C	FYK	0	37	0	3	48	
110391	20:00-22:00	6	3	2	7A	FYK	0	6	0	0	7	
110391	22:00-24:00	6	3	2	7A	FYK	0	5	0	3	11	
120391	0:00- 2:00	6	3	2	7A	FYK	0	5	0	3	11	
130391	20:00-22:00	6	3	2	7A	FYK	0	0	0	0	1	
130391	22:00-24:00	6	3	2	7A	FYK	0	4	0	0	2	
130391	22:00-24:00	5	3	2	7B	FYK	0	22	0	3	27	
140391	0:00- 2:00	6	3	2	7A	FYK	0	4	0	0	2	
140391	0:00- 2:00	5	3	2	7B	FYK	0	21	0	4	50	
150391	20:00-21:00	5	3	2	7B	FYK	0	3	1	2	8	
150391	20:00-22:00	6	2	2	7A	FYK	0	0	0	1	0	

Appendix 1 - cont.

DATE	PUMPHOUSE TIME	TRAP LOCATION,					COWICHAN RIVER, 1991					COMMENTS
		T	W	C	S	TRAP	CNM	CNF	COF	COS	CHF	
150391	21:00-22:00	5	3	2	7B	FYK	0	6	0	1	37	
150391	22:00-23:00	5	3	2	7B	FYK	0	14	0	1	41	
150391	22:00-24:00	6	2	2	7A	FYK	0	4	0	0	2	
150391	23:00-24:00	5	3	2	7B	FYK	0	5	1	6	24	
160391	0:00- 1:00	5	3	2	7B	FYK	0	5	0	1	26	
160391	0:00- 2:00	6	2	2	7A	FYK	0	4	0	2	2	
180391	20:00-21:00	5	3	2	7B	FYK	0	4	0	3	4	
180391	20:00-22:00	6	2	2	7A	FYK	0	3	0	0	4	
180391	21:00-22:00	5	3	2	7B	FYK	0	7	0	0	31	
180391	22:00-23:00	5	3	2	7B	FYK	0	3	0	3	49	
180391	22:00-24:00	6	2	2	7A	FYK	0	1	0	0	6	
180391	23:00-24:00	5	3	2	7B	FYK	0	5	0	1	29	
190391	0:00- 1:00	5	3	2	7B	FYK	0	10	0	0	42	
190391	0:00- 2:00	6	2	2	7A	FYK	0	3	0	0	11	
200391	20:00-21:00	5	3	2	7B	FYK	0	10	2	1	39	
200391	20:00-22:00	6	2	2	7A	FYK	0	3	0	0	8	
200391	21:00-22:00	5	3	2	7B	FYK	0	9	1	0	35	
200391	22:00-23:00	5	3	2	7B	FYK	0	11	3	2	136	
200391	22:00-24:00	6	2	2	7A	FYK	0	7	0	0	9	
200391	23:00-24:00	7	3	2	7B	FYK	0	24	1	2	132	
210391	0:00- 1:00	7	3	2	7B	FYK	0	11	1	2	101	
210391	0:00- 2:00	6	2	2	7A	FYK	0	1	0	0	8	
220391	20:00-21:00	7	3	2	7B	FYK	0	10	0	2	22	
220391	20:00-22:00	6	2	2	7A	FYK	0	1	0	0	17	
220391	21:00-22:00	7	3	2	7B	FYK	0	9	1	0	55	
220391	22:00-23:00	7	3	2	7B	FYK	0	0	0	0	64	
220391	22:00-24:00	6	2	2	7A	FYK	0	2	1	0	20	
220391	23:00-24:00	7	3	2	7B	FYK	0	3	0	0	64	
230391	0:00- 1:00	7	3	2	7B	FYK	0	6	1	0	57	
230391	0:00- 2:00	6	2	2	7A	FYK	0	2	0	1	27	
250391	20:00-21:00	7	3	2	7B	FYK	0	6	1	0	55	
250391	20:00-22:00	6	2	2	7A	FYK	0	5	0	0	6	

Appendix 1 - cont.

PUMPHOUSE TRAP LOCATION, COWICHAN RIVER, 1991												COMMENTS
DATE	TIME	T	W	C	S TRAP	CNM	CNF	COF	COS	CHF		
250391	21:00-22:00	7	3	2	7B FYK	0	8	1	0	93		
250391	22:00-23:00	7	3	2	7B FYK	0	12	0	0	119		
250391	22:00-24:00	6	2	2	7A FYK	0	0	0	0	4		
250391	23:00-24:00	7	3	2	7B FYK	0	13	0	0	76		
260391	0:00- 1:00	7	3	2	7B FYK	0	29	1	1	201		
260391	0:00- 2:00	6	2	2	7A FYK	0	1	0	0	3		
270391	20:00-21:00	7	3	2	7B FYK	0	7	0	0	61		
270391	20:00-22:00	6	2	2	7A FYK	0	6	1	0	6		
270391	21:00-22:00	7	3	2	7B FYK	0	11	1	1	116		
270391	22:00-23:00	7	3	2	7B FYK	0	8	0	0	121		
270391	22:00-24:00	6	2	2	7A FYK	0	7	0	0	18		
270391	23:00-24:00	6	3	2	7B FYK	0	9	1	0	115		
280391	0:00- 1:00	6	3	2	7B FYK	0	7	0	0	114		
280391	0:00- 2:00	6	2	2	7A FYK	0	4	1	1	36		
290391	20:00-21:00	6	3	2	7B FYK	0	1	0	0	95		
290391	20:00-22:00	6	2	2	7A FYK	0	5	0	0	45		
290391	21:00-22:00	6	3	2	7B FYK	0	5	0	0	129		
290391	22:00-23:00	6	3	2	7B FYK	0	0	0	0	52		
290391	22:00-24:00	6	2	2	7A FYK	0	0	0	0	11		
290391	23:00-24:00	6	3	2	7B FYK	0	2	0	0	73		
300391	0:00- 1:00	6	3	2	7B FYK	0	0	0	0	37		
300391	0:00- 2:00	6	2	2	7A FYK	0	0	0	0	6		
010491	20:00-21:00	6	3	2	7B FYK	0	7	0	0	188		
010491	20:00-22:00	6	2	2	7A FYK	0	23	2	0	118		
010491	21:00-22:00	6	3	2	7B FYK	0	14	1	0	436		
010491	22:00-23:00	6	3	2	7B FYK	0	5	1	0	530		
010491	22:00-24:00	6	2	2	7A FYK	0	16	1	0	155		
010491	23:00-23:30	6	3	2	7B FYK	0	6	1	1	332		
020491	0:00- 0:30	6	3	2	7B FYK	0	8	0	0	195		
020491	0:00- 2:00	6	2	2	7A FYK	0	7	2	0	73		
020491	1:00- 1:30	6	3	2	7B FYK	0	1	0	0	107		
030491	20:00-22:00	6	2	2	7A FYK	0	58	8	0	279		
030491	21:30-22:00	8	3	2	7B FYK	0	37	1	0	266		

Appendix 1 - cont.

PUMPHOUSE		TRAP LOCATION,				COWICHAN RIVER, 1991					COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
050491	20:00-22:00	6	2	2	7A	FYK	0	62	15	12	82	
050491	22:00-24:00	6	2	2	7A	FYK	0	44	44	12	98	
060491	0:00- 2:00	6	2	2	7A	FYK	0	39	46	15	56	
080491	20:00-22:00	6	2	2	7A	FYK	0	9	4	2	13	
080491	22:00-24:00	6	2	2	7A	FYK	0	14	23	4	38	
090491	0:00- 2:00	7	3	2	7A	FYK	0	20	27	0	42	
100491	21:00-23:00	7	3	2	7A	FYK	0	7	10	2	26	
100491	23:00- 1:00	7	3	2	7A	FYK	0	23	18	4	102	
110491	1:00- 3:00	7	3	2	7A	FYK	0	26	17	0	125	
110491	3:00- 5:00	7	3	2	7A	FYK	0	17	9	1	49	
110491	5:00- 7:00	7	3	2	7A	FYK	0	14	4	0	20	
110491	7:00-20:00	7	3	2	7A	FYK	0	1	2	0	2	
120491	21:00-23:00	7	3	2	7A	FYK	0	3	1	1	13	
120491	23:00-23:00	8	3	2	7B	FYK	0	0	0	0	0	
120491	23:00- 1:00	7	3	2	7A	FYK	0	5	4	0	79	
130491	1:00- 3:00	7	3	2	7A	FYK	0	2	5	0	64	
150491	21:00-22:00	8	3	2	7B	FYK	0	2	1	0	127	
150491	21:00-23:00	7	3	2	7A	FYK	0	4	14	0	33	
150491	22:00-23:00	8	3	2	7B	FYK	0	5	29	0	315	
150491	23:00-24:00	8	3	2	7B	FYK	0	11	28	1	531	
150491	23:00- 1:00	7	3	2	7A	FYK	0	7	8	0	54	
160491	0:00- 1:00	8	3	2	7B	FYK	0	14	29	0	891	
160491	1:00- 2:00	8	3	2	7B	FYK	0	4	8	0	407	
160491	1:00- 3:00	7	3	2	7A	FYK	0	13	21	1	123	
160491	2:00- 3:00	8	3	2	7B	FYK	0	27	21	11026		
160491	3:00- 4:00	8	3	2	7B	FYK	0	29	11	0	667	
160491	3:00- 5:00	7	3	2	7A	FYK	0	13	21	0	115	
160491	4:00- 5:00	8	3	2	7B	FYK	0	13	4	0	108	
160491	5:00- 6:00	8	3	2	7B	FYK	0	4	3	0	89	
160491	5:00- 7:00	7	3	2	7A	FYK	0	4	2	0	72	
160491	6:00- 7:00	8	3	2	7B	FYK	0	0	0	0	2	
160491	7:00-21:00	7	3	3	7A	FYK	0	0	1	0	2	
170491	21:00-22:00	8	3	2	7B	FYK	0	0	3	0	167	

Appendix 1 - cont.

PUMPHOUSE TRAP LOCATION, COWICHAN RIVER, 1991												COMMENTS
DATE	TIME	T	W	C	S TRAP	CNM	CNF	COF	COS	CHF		
170491	21:00-23:00	8	3	2	7B FYK	0	1	13	0	254		
170491	21:00-23:00	7	3	3	7A FYK	0	0	7	1	6		
170491	22:00-24:00	8	3	2	7B FYK	0	2	11	0	622		
170491	23:00- 1:00	11	3	2	7B FYK	0	5	18	0	1205		
170491	23:00- 1:00	7	3	3	7A FYK	0	4	19	0	51		
180491	0:00- 2:00	11	3	2	7B FYK	0	5	18	0	1205		
180491	1:00- 3:00	7	3	3	7A FYK	0	0	15	0	39		
190491	21:00-23:00	7	3	3	7A FYK	0	0	10	0	25		
190491	22:00-22:30	11	3	2	7B FYK	0	2	5	0	105		
190491	22:30-23:00	11	3	2	7B FYK	0	1	15	0	223		
190491	23:00-23:30	11	3	2	7B FYK	0	1	8	0	177		
190491	23:00- 1:00	7	3	3	7A FYK	0	7	5	0	71		
190491	23:30-24:00	11	3	2	7B FYK	0	0	3	0	200		
200491	0:00- 0:30	11	3	2	7B FYK	0	1	6	0	299		
200491	0:30- 1:00	11	3	2	7B FYK	0	0	11	0	252		
200491	1:00- 1:30	11	3	2	7B FYK	0	6	11	0	361		
200491	1:00- 3:00	7	3	3	7A FYK	0	4	12	0	94		
200491	1:30- 2:00	11	3	2	7B FYK	0	2	4	0	323		
200491	2:00- 2:30	11	3	2	7B FYK	0	4	11	0	317		
200491	2:30- 3:00	11	3	2	7B FYK	0	4	9	0	331		
220491	21:00-21:30	11	3	2	7B FYK	0	0	0	0	5		
220491	21:00-23:00	7	3	3	7A FYK	0	0	1	0	12		
220491	21:30-22:00	11	3	2	7B FYK	0	0	0	0	19		
220491	22:00-23:00	11	3	2	7B FYK	0	0	0	0	103		
220491	23:00-24:00	11	3	3	7B FYK	0	1	3	0	288		
220491	23:00- 1:00	7	3	3	7A FYK	0	1	4	0	10		
230491	0:00- 1:00	11	3	3	7B FYK	0	3	1	1	213		
230491	1:00- 2:00	11	3	3	7B FYK	0	0	1	0	236		
230491	2:00- 2:30	11	3	3	7B FYK	0	1	3	0	132		
230491	2:30- 3:00	7	3	3	7A FYK	0	0	2	0	19		
240491	21:00-21:30	11	3	3	7B FYK	0	0	0	0	16		
240491	21:00-23:00	7	3	3	7A FYK	0	0	0	0	6		
240491	21:30-22:00	11	3	3	7B FYK	0	0	1	0	48		

Appendix 1 - cont.

PUMPHOUSE		TRAP LOCATION,					COWICHAN RIVER, 1991					COMMENTS
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS	CHF	
240491	22:00-22:30	11	3	3	7B	FYK	0	0	0	0	140	
240491	22:30-23:00	11	3	3	7B	FYK	0	0	2	0	245	
240491	23:00-23:30	11	3	3	7B	FYK	0	0	1	0	296	
240491	23:00- 1:00	7	3	3	7A	FYK	0	0	0	0	4	
240491	23:30-24:00	11	3	3	7B	FYK	0	1	3	0	340	
250491	0:00- 0:30	11	3	3	7B	FYK	0	1	3	0	504	
250491	0:30- 1:00	11	3	3	7B	FYK	0	2	1	0	275	
250491	1:00- 1:30	11	3	3	7B	FYK	0	3	6	1	321	
250491	1:00- 3:00	7	3	3	7A	FYK	0	1	1	0	51	
250491	1:30- 2:00	11	3	3	7B	FYK	0	1	7	0	290	
250491	2:00- 2:30	11	3	3	7B	FYK	0	4	4	0	264	
260491	19:00-21:00	7	3	3	7A	FYK	0	0	0	0	2	
260491	20:00-21:00	11	3	3	7B	FYK	0	1	1	0	48	
260491	21:00-22:00	11	3	3	7B	FYK	0	1	6	0	201	
260491	21:00-23:00	7	3	3	7A	FYK	0	0	0	0	0	
260491	22:00-23:00	11	3	3	7B	FYK	0	2	3	0	342	
260491	23:00-24:00	11	3	3	7B	FYK	0	2	9	0	412	
260491	23:00- 1:00	11	3	3	7A	FYK	0	0	0	0	8	
270491	0:00- 1:00	11	3	3	7B	FYK	0	3	9	0	581	

Appendix 1 - cont.

SITE OTHER THAN PUMPHOUSE LOCATION, COWICHAN RIVER, 1991							
DATE	TIME	S	TRAP	CNM	CNF	COF	COMMENTS
020591	12:15	ROADPO	BEA	0	3	0	
020591	15:00	RIVERB	BEA	0	1	0	
070591	11:30	ROADPO	BEA	0	52	0	
080591	11:00	ROADPO	MIN	0	97	9	
080591	11:00	ROADPO	MIN	0	35	1	
100591	10:00	ESTUAR	BEA	0	10	0	
100591	11:00	ESTUAR	BEA	2	0	0	
100591	12:00	ESTUAR	BEA	0	4	1	
100591	13:00	ESTUAR	BEA	1	7	0	
100591	14:00	ESTUAR	BEA	0	2	0	
100591	15:00	ESTUAR	BEA	0	1	0	
140591	10:00	ROADPO	MIN	0	52	10	
140591	10:35	ROADPO	FYK	0	17	0	
140591	14:00	BLOC51	FYK	0	27	28	
150591	11:00	ROADPO	FYK	0	12	0	
160591	10:20	ROADPO	FYK	0	4	105	
160591	12:30	PUMPHO	FYK	0	0	60	
160591	9:00	ESTUAR	BEA	0	10	1	
160591	10:00	ESTUAR	BEA	0	1	0	
160591	14:00	ESTUAR	BEA	7	5	20	
170591	12:30	ROADPO	FYK	0	0	60	
170591	13:45	PUMPHO	FYK	0	0	51	
180591	10:30	ROADPO	FYK	0	0	62	
180591	11:45	PUMPHO	FYK	0	0	32	
190591	10:20	ROADPO	FYK	0	1	86	
190591	11:35	PUMPHO	FYK	0	0	32	
200591	11:00	ROADPO	FYK	0	1	58	
200591	12:00	PUMPHO	FYK	0	0	0	
210591	10:00	ROADPO	FYK	0	2	119	
210591	11:00	ROADPO	BEA	0	76	0	
210591	11:30	PUMPHO	FYK	0	0	47	
220591	11:00	ROADPO	MIN	0	9	0	
220591	11:30	ROADPO	FYK	0	0	148	

Appendix 1 - cont.

SITE OTHER THAN PUMPHOUSE LOCATION, COWICHAN RIVER, 1991							
DATE	TIME	S	TRAP	CNM	CNF	COF	COMMENTS
220591	2:00	BLOC51	MIN	0	15	11	
220591	9:15	PUMPHO	FYK	0	0	17	
230591	9:30	ROADPO	FYK	3	1	108	
230591	11:00	PUMPHO	FYK	0	0	0	
230591	9:10	ESTUAR	BEA	0	0	2	
230591	9:30	ESTUAR	BEA	0	1	0	
230591	9:50	ESTUAR	BEA	0	0	0	
230591	10:15	ESTUAR	BEA	0	0	0	
230591	10:40	ESTUAR	BEA	0	0	0	
230591	10:55	ESTUAR	BEA	0	1	0	
230591	11:15	ESTUAR	BEA	0	1	0	
230591	11:30	ESTUAR	BEA	0	9	0	
230591	12:00	ESTUAR	BEA	0	1	0	
230591	12:15	ESTUAR	BEA	0	3	0	
230591	12:33	ESTUAR	BEA	0	1	0	
230591	13:00	ESTUAR	BEA	1	11	19	
230591	13:30	ESTUAR	BEA	1	37	20	
240591	13:50	ROADPO	FYK	0	0	86	
240591	14:30	PUMPHO	FYK	0	0	8	
290591	12:00	ABOVEW	MIN	0	0	0	
290591	12:00	ROADPO	MIN	0	4	8	
290591	14:00	ROADPO	BEA	0	20	0	
290591	10:00	BLOC51	MIN	0	15	7	
300591	8:40	ESTUAR	BEA	0	1	0	
300591	8:55	ESTUAR	BEA	0	23	0	
300591	9:20	ESTUAR	BEA	0	30	0	
300591	9:55	ESTUAR	BEA	0	0	0	
300591	10:10	ESTUAR	BEA	0	3	0	
300591	10:25	ESTUAR	BEA	0	4	0	
300591	10:55	ESTUAR	BEA	0	1	0	
300591	11:15	ESTUAR	BEA	0	0	0	
300591	11:25	ESTUAR	BEA	0	1	0	
300591	11:40	ESTUAR	BEA	0	12	0	

Appendix 1 - cont.

SITE OTHER THAN PUMPHOUSE LOCATION, COWICHAN RIVER, 1991							COMMENTS
DATE	TIME	S	TRAP	CNM	CNF	COF	
300591	12:40	ESTUAR	BEA	0	20	3	
300591	13:00	ESTUAR	BEA	0	0	0	
310591	10:00	ABOVEW	MIN	0	0	2	
310591	10:00	BELOWW	MIN	0	0	2	
040691	8:45	ESTUAR	BEA	0	0	0	
040691	9:10	ESTUAR	BEA	0	1	0	
040691	9:30	ESTUAR	BEA	0	3	0	
040691	9:45	ESTUAR	BEA	0	0	0	
040691	10:00	ESTUAR	BEA	0	0	0	
040691	10:10	ESTUAR	BEA	0	0	0	
040691	10:30	ESTUAR	BEA	0	0	0	
040691	10:45	ESTUAR	BEA	0	0	0	
040691	10:55	ESTUAR	BEA	0	8	0	
040691	11:10	ESTUAR	BEA	0	8	1	
040691	11:50	ESTUAR	BEA	0	0	0	
040691	12:30	ESTUAR	BEA	0	0	0	
040691	12:40	ESTUAR	BEA	1	7	2	
040691	12:55	ESTUAR	BEA	1	11	6	
040691	13:10	ESTUAR	BEA	3	37	13	
050691	10:00	ABOVEW	BEA	0	0	6	
050691	10:00	BELOWW	BEA	0	0	4	
050691	11:00	ARTWAT	BEA	0	1	12	
050691	12:00	BLOC51	BEA	0	0	0	
060691	15:00	BLOC51	BEA	1	29	0	
060691	16:00	PUMPHO	MIN	0	0	0	
060691	8:45	ESTUAR	BEA	0	7	1	
060691	9:00	ESTUAR	BEA	0	5	1	
060691	9:10	ESTUAR	BEA	0	1	1	
060691	9:20	ESTUAR	BEA	0	1	0	
060691	9:35	ESTUAR	BEA	0	2	0	
060691	9:45	ESTUAR	BEA	0	5	1	
060691	10:00	ESTUAR	BEA	1	19	1	
060691	10:15	ESTUAR	BEA	1	18	0	

Appendix 1 - cont.

SITE OTHER THAN PUMPHOUSE LOCATION, COWICHAN RIVER, 1991							
DATE	TIME	S	TRAP	CNM	CNF	COF	COMMENTS
060691	10:35	ESTUAR	BEA	0	9	1	
060691	11:10	ESTUAR	BEA	0	2	0	
060691	11:40	ESTUAR	BEA	2	22	5	
110691	11:00	BLOC51	BEA	0	7	0	
110691	15:00	FORKS	BEA	0	11	0	
110691	8:45	ESTUAR	BEA	0	0	0	
110691	9:00	ESTUAR	BEA	0	0	0	
110691	9:10	ESTUAR	BEA	0	8	0	
110691	9:30	ESTUAR	BEA	0	7	3	
110691	9:45	ESTUAR	BEA	0	9	3	
110691	10:05	ESTUAR	BEA	0	1	0	
110691	10:20	ESTUAR	BEA	0	15	0	
110691	10:40	ESTUAR	BEA	0	0	0	
110691	10:50	ESTUAR	BEA	0	12	0	
110691	11:20	ESTUAR	BEA	0	0	0	
110691	12:20	ESTUAR	BEA	0	45	4	
120691	12:00	BLOC51	MIN	0	0	0	
120691	.	PUMPHO	BEA	0	9	0	
130691	12:08	ABOVEW	PUR	4	80	0	
130691	13:15	ABOVEW	PUR	1	109	0	
130691	14:21	ABOVEW	PUR	1	2	0	
130691	15:10	ABOVEW	PUR	4	8	0	
130691	16:10	ABOVEW	PUR	0	2	0	
130691	17:00	ABOVEW	PUR	1	5	0	
130691	17:50	ABOVEW	PUR	6	63	0	
130691	19:10	ABOVEW	PUR	12	20	.	
180691	9:00	BLOC51	BEA	0	0	0	
180691	.	PUMPHO	BEA	5	17	0	
210691	9:00	ESTUAR	BEA	0	1	0	
210691	10:00	ESTUAR	BEA	0	30	1	
210691	10:30	ESTUAR	BEA	8	62	0	
210691	11:30	ESTUAR	BEA	6	27	0	
250691	13:00	PUMPHO	BEA	3	8	0	

Appendix 1 - cont.

SITE OTHER THAN PUMPHOUSE LOCATION, COWICHAN RIVER, 1991							
DATE	TIME	S	TRAP	CNM	CNF	COF	COMMENTS
250691	10:00	FORKS	BEA	15	1	.	
270691	8:40	ESTUAR	BEA	0	2	7	
270691	9:10	ESTUAR	BEA	0	1	0	
270691	9:30	ESTUAR	BEA	0	4	0	
270691	9:45	ESTUAR	BEA	0	0	1	
270691	9:55	ESTUAR	BEA	0	0	0	
270691	10:05	ESTUAR	BEA	3	21	2	
270691	10:30	ESTUAR	BEA	1	2	5	
270691	10:45	ESTUAR	BEA	2	7	3	
270691	11:00	ESTUAR	BEA	6	23	5	
270691	11:30	ESTUAR	BEA	1	12	0	
270691	11:45	ESTUAR	BEA	9	23	1	
080791	9:00	ESTUAR	BEA	0	0	0	
080791	9:10	ESTUAR	BEA	1	1	0	
080791	9:20	ESTUAR	BEA	0	5	0	
080791	9:35	ESTUAR	BEA	1	8	0	
080791	9:45	ESTUAR	BEA	0	9	0	
080791	10:00	ESTUAR	BEA	0	2	0	
080791	10:15	ESTUAR	BEA	0	4	1	
080791	10:25	ESTUAR	BEA	0	1	0	
080791	10:35	ESTUAR	BEA	1	0	0	
080791	10:45	ESTUAR	BEA	0	1	0	
080791	10:55	ESTUAR	BEA	0	22	2	
080791	11:10	ESTUAR	BEA	0	4	2	
080791	11:25	ESTUAR	BEA	0	3	0	

Appendix 2 - Catch data for site and trap type by date/time for Cowichan River, 1992.
 T=water temperature (°C), W=weather, C=water clarity, S=Site, Trap=type type, CNM=juvenile chinook marked (adipose clip), CNF=juvenile chinook (naturally-spawned or hatchery), COF=coho fry, COS=coho smolts, CHF=Chum fry, UNK=unknown.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1992											COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
020392	20:00-22:00	7	1	2	7B	IPT	0	22	0	0	1	
020392	22:00-24:00	7	1	2	7B	IPT	0	20	1	0	5	
030392	0:00- 2:00	7	1	2	7B	IPT	0	66	1	0	2	
040392	20:00-22:00	7	2	2	7B	IPT	0	47	2	0	4	
040392	22:00-24:00	7	2	2	7B	IPT	0	56	2	0	6	
050392	0:00- 2:00	7	2	2	7B	IPT	0	73	3	1	8	
060392	20:00-22:00	8	1	2	7B	IPT	0	31	1	0	11	
060392	20:00-22:00	8	1	2	7B	IPT	0	10	0	0	4	
060392	22:00-24:00	8	1	2	7B	IPT	0	19	0	0	3	
060392	22:00-24:00	8	1	2	7B	IPT	0	13	2	0	11	
070392	0:00- 2:00	8	1	2	7B	IPT	0	30	0	0	6	
070392	0:00- 2:00	8	1	2	7B	IPT	0	19	0	0	1	
090392	20:00-22:00	8	1	2	7B	IPT	0	10	2	0	7	
090392	20:00-22:00	8	1	2	7B	IPT	0	19	2	0	12	
090392	22:00-24:00	8	1	2	7B	IPT	0	21	2	0	7	
090392	22:00-24:00	8	1	2	7B	IPT	0	16	1	0	9	
100392	0:00- 2:00	8	1	2	7B	IPT	0	30	2	0	3	
100392	0:00- 2:00	8	1	2	7B	IPT	0	21	1	0	4	
110392	19:00-21:00	8	1	2	7B	IPT	0	13	1	0	16	
110392	19:00-21:00	8	1	2	7B	IPT	0	12	1	0	16	
110392	21:00-23:00	8	1	2	7B	IPT	0	22	2	0	19	
110392	21:00-23:00	8	1	2	7B	IPT	0	9	2	1	19	
110392	23:00- 1:00	8	1	2	7B	IPT	0	30	3	0	15	
110392	23:00- 1:00	8	1	2	7B	IPT	0	26	3	0	18	
120392	1:00- 3:00	8	1	2	7B	IPT	0	41	8	0	16	
120392	1:00- 3:00	8	1	2	7B	IPT	0	30	1	0	13	
120392	3:00- 5:00	8	1	2	7B	IPT	0	34	1	0	19	
120392	3:00- 5:00	8	1	2	7B	IPT	0	22	1	0	6	
120392	5:00- 7:00	8	1	2	7B	IPT	0	43	1	1	7	

Appendix 2 - cont.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1992											COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
120392	5:00- 7:00	8	1	2	7B	IPT	0	26	0	1	7	
130392	20:00-22:00	9	1	2	7B	IPT	0	18	3	0	23	
130392	20:00-22:00	9	1	2	7B	IPT	0	13	1	0	33	
130392	22:00-24:00	9	1	2	7B	IPT	0	19	1	0	18	
130392	22:00-24:00	9	1	2	7B	IPT	0	24	0	0	24	
140392	0:00- 2:00	9	1	2	7B	IPT	0	31	3	0	11	
140392	0:00- 2:00	9	1	2	7B	IPT	0	30	1	0	19	
160392	20:00-22:00	10	2	2	7B	IPT	0	7	0	0	47	
160392	20:00-22:00	10	2	2	7B	IPT	0	13	0	0	53	
160392	22:00-24:00	10	2	2	7B	IPT	0	6	0	0	42	
160392	22:00-24:00	10	2	2	7B	IPT	0	7	0	0	32	
170392	0:00- 2:00	10	2	2	7B	IPT	0	8	0	0	28	
170392	0:00- 2:00	10	2	2	7B	IPT	0	9	0	0	28	
180392	20:00-22:00	10	1	2	7B	IPT	0	2	0	0	1	
180392	20:00-22:00	10	1	2	7B	IPT	0	7	0	0	16	
180392	22:00-24:00	10	1	2	7B	IPT	0	4	0	0	37	
180392	22:00-24:00	10	1	2	7B	IPT	0	2	1	0	24	
190392	0:00- 2:00	10	1	2	7B	IPT	0	2	0	0	19	
190392	0:00- 2:00	10	1	2	7B	IPT	0	1	0	0	16	
200392	20:00-22:00	10	1	2	7B	IPT	0	3	7	0	83	
200392	20:00-22:00	10	1	2	7B	IPT	0	4	2	0	80	
200392	22:00-24:00	10	1	2	7B	IPT	0	11	3	0	121	
200392	22:00-24:00	10	1	2	7B	IPT	0	10	6	1	142	
210392	0:00- 2:00	10	1	2	7B	IPT	0	27	3	0	87	
210392	0:00- 2:00	10	1	2	7B	IPT	0	35	4	0	134	
230392	20:00-22:00	10	1	2	7B	IPT	0	15	15	0	53	
230392	20:00-22:00	10	1	2	7B	IPT	0	3	3	0	4	
230392	22:00-24:00	10	1	2	7B	IPT	0	26	24	0	89	
230392	22:00-24:00	10	1	2	7B	IPT	0	6	12	0	5	
240392	0:00- 2:00	10	1	2	7B	IPT	0	26	19	0	108	
240392	0:00- 2:00	10	1	2	7B	IPT	0	3	5	0	4	
250392	20:00-22:00	11	1	2	7B	IPT	0	57	34	0	109	
250392	20:00-22:00	11	1	2	7B	IPT	0	51	23	0	114	

Appendix 2 - cont.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1992											COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
250392	22:00-24:00	11	1	2	7B	IPT	0	185	38	0	151	
250392	22:00-24:00	11	1	2	7B	IPT	0	137	35	0	183	
260392	0:00- 2:00	11	1	2	7B	IPT	0	88	39	0	164	
260392	0:00- 2:00	11	1	2	7B	IPT	0	47	41	0	156	
270392	8:00-19:30	10	1	2	7B	IPT	0	3	2	0	4	
270392	17:30-19:30	10	1	2	7B	IPT	0	26	4	0	14	
270392	20:00-22:00	10	1	2	7B	IPT	0	49	60	0	148	
270392	20:00-22:00	10	1	2	7B	IPT	0	38	54	0	118	
270392	22:00-24:00	10	1	2	7B	IPT	0	33	37	0	145	
270392	22:00-24:00	10	1	2	7B	IPT	0	44	40	0	232	
280392	0:00- 2:00	10	1	2	7B	IPT	0	25	26	0	164	
280392	0:00- 2:00	10	1	2	7B	IPT	0	20	26	0	152	
300392	20:00-22:00	11	1	1	7B	IPT	0	8	7	0	58	
300392	20:00-22:00	11	1	1	7B	IPT	0	17	30	0	191	
300392	22:00-24:00	11	1	1	7B	IPT	0	26	28	0	190	
300392	22:00-24:00	11	1	1	7B	IPT	0	5	8	0	76	
310392	0:00- 2:00	11	1	1	7B	IPT	0	3	14	0	60	
310392	0:00- 2:00	11	1	1	7B	IPT	0	16	23	0	191	
010492	18:00-20:00	12	1	1	7B	IPT	0	3	8	0	22	added water to front tanks (3/4 full)
010492	18:00-20:00	12	1	1	7B	IPT	0	0	4	0	8	
010492	20:00-22:00	12	1	1	7B	IPT	0	3	5	0	79	
010492	20:00-22:00	12	1	1	7B	IPT	0	1	0	0	29	
010492	22:00-24:00	12	1	1	7B	IPT	0	6	12	0	131	
010492	22:00-24:00	12	1	1	7B	IPT	0	4	7	0	76	
020492	0:00- 2:00	12	1	1	7B	IPT	0	17	10	0	301	
020492	0:00- 2:00	12	1	1	7B	IPT	0	7	8	0	199	
020492	2:00- 4:00	12	1	1	7B	IPT	0	2	3	0	120	
020492	2:00- 4:00	12	1	1	7B	IPT	0	33	18	0	463	
020492	4:00- 6:00	12	1	1	7B	IPT	0	1	8	0	69	
020492	4:00- 6:00	12	1	1	7B	IPT	0	21	8	0	242	
020492	22:00- 9:00	12	1	1	7B	IPT	0	0	0	0	1000	
060492	20:00-22:00	11	1	1	7B	IPT	0	1	4	0	56	sampling missed on Apr 3.
060492	20:00-22:00	11	1	1	7B	IPT	0	0	4	0	71	

Appendix 2 - cont.

PUMPHOUSE LOCATION, COWICHAN RIVER, 1992											COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
060492	22:00-24:00	11	1	1	7B	IPT	0	10	10	0	124	
060492	22:00-24:00	11	1	1	7B	IPT	0	6	9	0	148	
070492	0:00- 2:00	11	1	1	7B	IPT	0	9	15	0	145	
070492	0:00- 2:00	11	1	1	7B	IPT	0	8	16	0	251	
100492	21:00-23:00	11	1	1	7B	IPT	0	13	0	0	272	
100492	21:00-23:00	11	1	1	7E	IPT	0	40	2	16	751	subsampling half the catch
100492	23:00- 1:00	11	1	1	7B	IPT	0	27	2	0	312	
100492	23:00- 1:00	11	1	1	7E	IPT	0	40	3	0	754	
110492	1:00- 3:00	11	1	1	7E	IPT	0	10	0	0	90	
110492	1:00- 3:00	11	1	1	7B	IPT	0	5	0	0	66	
130492	21:00-23:00	11	2	1	7E	IPT	0	0	0	1	114	
130492	21:00-23:00	11	2	1	7B	IPT	0	1	0	2	85	
130492	23:00- 1:00	11	2	1	7E	IPT	0	7	0	6	87	
130492	23:00- 1:00	11	2	1	7B	IPT	0	2	0	1	36	
140492	1:00- 3:00	11	2	1	7E	IPT	0	6	0	1	42	
140492	1:00- 3:00	11	2	1	7B	IPT	0	2	0	1	20	
150492	21:00-23:00	11	2	1	7B	IPT	0	4	0	0	140	
150492	21:00-23:00	11	2	1	7E	IPT	0	0	0	0	26	
150492	23:00- 1:00	11	2	1	7E	IPT	0	0	0	5	33	
150492	23:00- 1:00	11	2	1	7B	IPT	0	2	0	1	70	
160492	1:00- 3:00	11	2	1	7E	IPT	0	5	0	5	38	
160492	1:00- 3:00	11	2	1	7B	IPT	0	4	0	0	117	
170492	21:00-23:00	11	1	1	7B	IPT	0	0	0	0	0	first set outside trap flooded
170492	21:00-23:00	11	1	1	7E	IPT	0	3	0	0	32	
170492	23:00- 1:00	11	1	1	7B	IPT	0	2	0	1	100	
170492	23:00- 1:00	11	1	1	7E	IPT	0	4	0	12	200	
180492	1:00- 3:00	11	1	1	7B	IPT	0	0	0	0	0	
180492	1:00- 3:00	11	1	1	7E	IPT	0	4	0	7	0	
200492	21:00-23:00	10	1	1	7B	IPT	0	5	2	7	300	inside trap not working
200492	23:00- 1:00	10	1	1	7B	IPT	0	8	0	8	300	
210492	1:00- 3:00	10	1	1	7B	IPT	0	7	3	7	200	
220492	21:00-23:00	11	1	1	7B	IPT	0	8	4	11	0	
220492	21:00-23:00	11	1	1	7E	IPT	0	10	4	67	0	

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PUMPHOUSE LOCATION, COWICHAN RIVER, 1992												
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS	CHF	COMMENTS
220492	23:00- 1:00	11	1	1	7B	IPT	0	7	3	7	0	
220492	23:00- 1:00	11	1	1	7E	IPT	0	8	2	32	0	
230492	1:00- 3:00	11	1	1	7E	IPT	0	7	2	21	0	
230492	1:00- 3:00	11	1	1	7B	IPT	0	9	1	1	0	
240492	21:00-23:00	12	1	1	7E	IPT	0	2	0	44	10	
240492	21:00-23:00	12	1	1	7B	IPT	0	2	0	5	60	
240492	23:00- 1:00	12	1	1	7B	IPT	0	0	0	1	5	
240492	23:00- 1:00	12	1	1	7E	IPT	0	2	1	39	40	
250492	1:00- 3:00	12	1	1	7B	IPT	0	0	0	7	0	
250492	1:00- 3:00	12	1	1	7E	IPT	0	2	0	28	0	
270492	19:00-21:00	14	1	1	7E	IPT	0	27	0	62	0	
270492	19:00-21:00	14	1	1	7B	IPT	0	0	0	0	0	
270492	21:00-23:00	14	1	1	7E	IPT	0	6	2	55	0	
270492	21:00-23:00	14	1	1	7B	IPT	0	0	0	0	0	
270492	23:00- 1:00	14	1	1	7E	IPT	0	14	2	36	0	
270492	23:00- 1:00	14	1	1	7B	IPT	0	0	0	0	0	
280492	1:00- 3:00	14	1	1	7B	IPT	0	0	0	0	0	
280492	1:00- 3:00	14	1	1	7E	IPT	0	5	2	19	0	
280492	3:00- 5:00	14	1	1	7E	IPT	0	3	2	32	0	
280492	3:00- 5:00	14	1	1	7B	IPT	0	0	0	0	0	
290492	21:00-23:00	11	2	2	7E	IPT	0	0	0	0	0	outside trap removed from river
290492	23:00- 1:00	11	2	2	7E	IPT	0	0	0	0	0	
300492	1:00- 3:00	11	2	2	7E	IPT	0	4	2	1	0	
010592	21:00-23:00	12	1	2	7E	IPT	0	14	1	0	0	
010592	23:00- 1:00	12	1	2	7E	IPT	0	1	0	0	0	
020592	1:00- 3:00	12	1	2	7E	IPT	0	0	0	0	0	
040592	21:00-23:00	14	1	1	7E	IPT	0	5	18	3	0	
040592	22:00-24:00	14	1	1	7B	IPT	0	0	0	0	5	
040592	23:00- 1:00	14	1	1	7E	IPT	0	0	0	0	0	
050592	0:00- 2:00	14	1	1	7B	IPT	0	0	0	0	12	
050592	1:00- 3:00	14	1	1	7E	IPT	0	1	0	0	0	
060592	21:00-23:00	16	1	1	7E	IPT	0	0	1	26	12	
060592	22:00-24:00	16	1	1	7B	IPT	0	0	1	0	0	

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		PUMPHOUSE LOCATION,					COWICHAN RIVER, 1992					COMMENTS
DATE	TIME	T	W	C	S TRAP	CNM	CNF	COF	COS	CHF		
060592	22:00-24:00	16	1	1	7B SC5	0	0	4	11	8		
060592	23:00- 1:00	16	1	1	7E IPT	0	0	3	0	9		
070592	0:00- 2:00	16	1	1	7B IPT	0	0	0	0	2		
070592	0:00- 2:00	16	1	1	7B SC5	0	0	1	14	4		
070592	1:00- 3:00	16	1	1	7E IPT	0	0	0	0	3		
080592	21:00-23:00	14	1	1	7E IPT	0	0	0	2	2	moved upstream trap over heavy flow	
080592	22:00-24:00	14	1	1	7B IPT	0	0	0	0	1		
080592	22:00-24:00	14	1	1	7B SC5	0	0	9	16	4		
080592	23:00- 1:00	14	1	1	7E IPT	0	0	2	1	0		
090592	0:00- 2:00	14	1	1	7B IPT	0	0	0	0	0		
090592	0:00- 2:00	14	1	1	7B SC5	0	0	2	3	0		
090592	1:00- 3:00	14	1	1	7E IPT	0	0	0	0	3		
110592	21:00-23:00	14	1	1	7E IPT	0	16	1	19	12		
110592	22:00-24:00	14	1	1	7B IPT	0	0	0	1	14		
110592	22:00-24:00	14	1	1	7B SC5	0	2	1	3	15		
110592	23:00- 1:00	14	1	1	7E IPT	0	0	0	0	14		
120592	0:00- 2:00	14	1	1	7B IPT	0	0	0	0	12		
120592	0:00- 2:00	14	1	1	7B SC5	0	1	0	3	14		
120592	1:00- 3:00	14	1	1	7E IPT	0	7	2	6	12		
130592	21:00-23:00	16	1	1	7E IPT	0	8	0	2	1		
130592	22:00-24:00	16	1	1	7B IPT	0	0	0	0	1		
130592	22:00-24:00	16	1	1	7B SC5	0	2	0	0	6		
130592	23:00- 1:00	16	1	1	7E IPT	0	5	0	1	9		
140592	0:00- 2:00	16	1	1	7B IPT	0	0	0	0	3		
140592	0:00- 2:00	16	1	1	7B SC5	0	1	0	2	8		
140592	1:00- 3:00	16	1	1	7E IPT	0	7	1	2	6		
150592	21:00-23:00	16	1	1	7E IPT	0	5	0	0	0		
150592	22:00-24:00	16	1	1	7B IPT	0	0	0	0	0		
150592	22:00-24:00	16	1	1	7B SC5	0	1	0	1	0		
150592	23:00- 1:00	16	1	1	7E IPT	0	0	1	2	0		
160592	0:00- 2:00	16	1	1	7B IPT	0	0	0	0	0		
160592	0:00- 2:00	16	1	1	7B SC5	0	0	0	1	12		
160592	1:00- 3:00	16	1	1	7E IPT	0	3	0	1	0		

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PUMPHOUSE LOCATION, COWICHAN RIVER, 1992											COMMENTS	
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS		CHF
170592	10:30- 9:00	.	2	1	7E	IPT	0	0	0	0	2	
170592	10:30- 9:00	.	2	1	7B	SC5	0	3	2	7	14	
180592	7:00-20:00	.	2	1	7E	IPT	0	0	0	0	0	upstream trap only
180592	23:00- 1:00	14	1	1	7E	IPT	0	6	1	11	20	
190592	1:00- 3:00	14	1	1	7E	IPT	0	4	1	10	10	
200592	3:00-15:00	14	1	1	7E	SC5	19	117	0	9	0	hatchery fry both traps
200592	21:00-23:00	14	1	1	7E	IPT	3	79	0	0	0	auger trap moved further into flow
200592	21:00-23:00	14	1	1	7E	SC5	3	500	0	4	0	sub-sampling
200592	23:00- 1:00	14	1	1	7E	IPT	1	75	0	3	0	
200592	23:00- 1:00	14	1	1	7E	SC5	11	600	0	9	0	sub-sampling
210592	1:00- 3:00	14	1	1	7E	IPT	3	59	0	0	0	
210592	1:00- 3:00	14	1	1	7E	SC5	9	400	0	0	0	sub-sampling
220592	9:00-21:00	15	1	1	7E	IPT	0	0	0	0	0	
220592	9:00-21:00	15	1	1	7E	SC5	0	119	0	2	0	sub-sampling
220592	21:00-23:00	15	1	1	7E	IPT	0	16	0	0	2	
220592	21:00-23:00	15	1	1	7E	SC5	8	114	8	8	6	
220592	23:00- 1:00	15	1	1	7E	IPT	1	5	0	0	0	
220592	23:00- 1:00	15	1	1	7E	SC5	10	166	20	17	0	
230592	1:00- 3:00	15	1	1	7E	IPT	2	9	4	5	0	
230592	1:00- 3:00	15	1	1	7E	SC5	3	89	8	0	0	
250592	9:00-21:00	16	1	1	7E	IPT	0	0	0	0	0	
250592	9:00-21:00	16	1	1	7E	SC5	0	51	1	13	2	
250592	21:00-23:00	16	1	1	7E	IPT	0	6	0	2	2	
250592	21:00-23:00	16	1	1	7E	SC5	0	27	0	28	6	
250592	23:00- 1:00	16	1	1	7E	IPT	0	4	0	1	0	
250592	23:00- 1:00	16	1	1	7E	SC5	0	23	19	13	4	
260592	1:00- 3:00	16	1	1	7E	IPT	0	5	6	1	0	
260592	1:00- 3:00	16	1	1	7E	SC5	0	70	26	17	8	
270592	9:00-21:00	16	1	1	7E	IPT	0	0	0	0	0	
270592	9:00-21:00	16	1	1	7E	SC5	0	17	0	7	1	
270592	21:00-23:00	16	1	1	7E	IPT	1	18	7	9	0	
270592	21:00-23:00	16	1	1	7E	SC5	1	60	13	18	0	
270592	23:00- 1:00	16	1	1	7E	IPT	0	13	12	20	0	

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PUMPHOUSE LOCATION, COWICHAN RIVER, 1992												
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	COS	CHF	COMMENTS
270592	23:00- 1:00	16	1	1	7E	SC5	0	31	11	33	0	
280592	1:00- 3:00	16	1	1	7E	IPT	0	22	11	22	1	
280592	1:00- 3:00	16	1	1	7E	SC5	3	45	14	37	1	
290592	9:00-21:00	18	1	1	7E	IPT	0	0	0	0	0	added water to IPT
290592	9:00-21:00	18	1	1	7E	SC5	0	5	3	5	0	
290592	21:00-23:00	18	1	1	7E	IPT	0	0	0	0	0	
290592	21:00-23:00	18	1	1	7E	SC5	1	31	14	14	0	
290592	23:00- 1:00	18	1	1	7E	IPT	0	0	3	1	0	
290592	23:00- 1:00	18	1	1	7E	SC5	0	22	20	10	0	
300592	1:00- 3:00	18	1	1	7E	IPT	0	0	4	0	3	
300592	1:00- 3:00	18	1	1	7E	SC5	1	34	28	11	0	
010692	21:00-23:00	20	1	1	7E	IPT	0	0	0	0	0	very low flow
010692	21:00-23:00	20	1	1	7E	SC5	0	28	17	3	3	
010692	23:00- 1:00	20	1	1	7E	IPT	0	0	3	0	0	
010692	23:00- 1:00	20	1	1	7E	SC5	2	62	63	8	3	
020692	1:00- 3:00	20	1	1	7E	IPT	0	0	1	0	0	
020692	1:00- 3:00	20	1	1	7E	SC5	0	73	57	3	2	
030692	9:00-21:00	.	1	1	7E	IPT	0	0	0	0	0	
030692	9:00-21:00	.	1	1	7E	SC5	0	2	4	0	0	
030692	22:00- 9:00	.	1	1	7E	IPT	0	0	5	0	0	
030692	22:00- 9:00	.	1	1	7E	SC5	4	100	90	25	6	

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BLOCK 51 TRAP LOCATION, COWICHAN RIVER, 1992														
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	UNK	CNS	COS	COMMENTS
030392	20:40-22:20	8	1	1	5A	IPT	0	132	9	0	0	0	0	
030392	22:00-24:00	8	1	1	5A	IPT	0	44	4	0	0	0	0	
040392	0:00- 2:00	8	1	1	5A	IPT	0	40	8	0	0	0	0	
060392	23:15- 1:15	8	1	1	5A	IPT	0	40	1	0	0	0	0	
060392	1:15- 3:15	8	1	1	5A	IPT	0	44	4	0	0	0	0	
060392	21:10-22:35	8	1	1	5A	IPT	0	166	9	0	0	0	0	
070392	22:05- 0:05	8	1	1	5A	IPT	0	47	10	0	0	0	0	
070392	0:05- 2:05	8	1	1	5A	IPT	0	42	5	0	2	0	0	two unidentifiable
090392	20:00-22:00	8	1	1	5A	IPT	0	125	10	0	0	0	0	rainbow trout
100392	22:00-24:00	8	1	1	5A	IPT	0	46	5	0	0	0	0	
100392	0:00- 2:00	8	1	1	5A	IPT	0	65	7	0	0	0	0	
110392	18:00-20:00	9	1	1	5A	IPT	0	81	2	0	0	0	0	
110392	20:00-22:00	9	1	1	5A	IPT	0	125	3	0	0	0	0	
120392	22:00- 0:10	9	1	1	5A	IPT	0	120	3	0	0	0	0	
120392	0:05- 2:05	9	1	1	5A	IPT	0	36	6	0	0	0	0	
120392	2:00- 4:00	9	1	1	5A	IPT	0	84	14	1	0	0	0	first chums
120392	4:00- 6:00	9	1	1	5A	IPT	0	59	8	2	0	0	0	
130392	20:00-22:00	9	1	1	5A	IPT	0	78	8	0	1	0	0	
130392	22:00-24:00	9	1	1	5A	IPT	0	19	0	0	0	0	0	
140392	0:00- 2:00	9	1	1	5A	IPT	0	18	0	0	0	0	0	
160392	20:00-22:00	9	1	1	5A	IPT	0	41	4	0	0	0	0	brown trout at 02:00
160392	22:00-24:00	9	1	1	5A	IPT	0	16	3	0	0	0	0	
170392	0:00- 2:00	9	1	1	5A	IPT	0	6	3	0	0	0	0	
180392	20:00-22:00	10	1	1	5A	IPT	0	16	5	1	0	0	0	
190392	22:45- 0:45	10	1	1	5A	IPT	0	4	1	0	0	0	0	
190392	0:00- 2:45	10	1	1	5A	IPT	0	3	4	0	0	0	0	
200392	18:00-20:00	10	1	1	5A	IPT	0	269	184	0	14	0	0	
210392	22:00-24:00	10	1	1	5A	IPT	0	12	41	5	1	0	0	
210392	0:00- 2:00	10	1	1	5A	IPT	0	6	4	0	0	0	0	
230392	20:00-22:00	10	1	1	5A	IPT	0	139	78	0	0	0	0	
230392	22:00-24:00	10	1	1	5A	IPT	0	172	158	0	0	0	0	
240392	0:00- 2:00	10	1	1	5A	IPT	0	89	60	0	0	0	0	
250392	20:00-22:00	.	1	1	5A	IPT	0	308	206	0	1	0	0	

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BLOCK 51 TRAP LOCATION, COWICHAN RIVER, 1992														
DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	UNK	CNS	COS	COMMENTS
250392	22:00-24:00	.	1	1	5A	IPT	0	154	86	0	0	0	0	
260392	0:20- 2:20	.	1	1	5A	IPT	0	112	112	0	0	0	0	
270392	8:00-20:00	.	1	1	5A	IPT	0	4	0	0	0	0	0	
270392	20:00-22:00	10	1	1	5A	IPT	0	18	2	0	0	0	0	
280392	22:00- 0:30	10	1	1	5A	IPT	0	5	0	0	0	0	0	
300392	19:30-21:30	10	1	1	5A	IPT	0	288	111	0	0	0	0	
300392	21:30-23:30	10	1	1	5A	IPT	0	231	177	0	0	0	0	
310392	0:00- 2:00	10	1	1	5A	IPT	0	139	106	4	0	2	0	
010492	18:00-20:00	10	1	1	5A	IPT	0	21	8	39	0	0	0	
010492	19:30-22:00	10	1	1	5A	IPT	0	150	240	181	0	0	0	
010492	22:00-24:00	10	1	1	5A	IPT	0	95	187	141	0	0	0	
020492	0:00- 2:00	10	1	1	5A	IPT	0	84	184	104	0	0	0	
020492	2:00- 4:00	10	1	1	5A	IPT	0	40	84	35	0	0	0	
020492	4:00- 6:00	10	1	1	5A	IPT	0	10	41	41	0	0	0	
030492	20:00-22:00	11	1	1	5A	IPT	0	12	34	44	0	0	0	
040492	22:00-24:00	11	1	1	5A	IPT	0	18	82	19	0	0	0	
040492	0:00- 2:00	11	1	1	5A	IPT	0	17	39	6	0	0	0	
060492	20:00-22:00	11	2	1	5A	IPT	0	8	12	41	0	0	0	
070492	22:00-24:00	11	2	1	5A	IPT	0	3	79	48	0	0	0	
070492	0:00- 2:00	11	2	1	5A	IPT	0	10	93	33	0	0	0	
080492	20:00-22:00	11	1	1	5A	IPT	0	4	22	58	0	0	0	
090492	22:00-24:00	11	1	1	5A	IPT	0	6	20	120	0	0	0	
090492	0:00- 2:00	11	1	1	5A	IPT	0	5	48	40	0	0	0	
100492	20:30-22:30	11	1	1	5B	IPT	0	99	26	205	0	0	0	moved upstream to new site
110492	22:30- 0:30	11	1	1	5B	IPT	0	33	2	88	0	0	0	
110492	0:30- 2:30	11	1	1	5B	IPT	0	32	11	68	0	0	0	
130492	20:00-22:00	11	2	1	5B	IPT	0	14	50	30	0	0	0	
140492	22:00-24:00	11	2	1	5B	IPT	0	2	5	8	0	0	0	
140492	0:00- 2:00	11	2	1	5B	IPT	0	17	10	18	0	0	0	
150492	20:00-22:00	11	2	1	5B	IPT	0	72	71	151	0	0	0	
150492	22:00-24:00	11	2	1	5B	IPT	0	27	26	64	0	0	0	
160492	0:00- 2:00	11	2	1	5B	IPT	0	25	30	52	1	0	0	
170492	20:00-22:00	11	1	1	5B	IPT	0	52	460	579	0	0	0	

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BLOCK 51 TRAP LOCATION, COWICHAN RIVER, 1992

DATE	TIME	T	W	C	S	TRAP	CNM	CNF	COF	CHF	UNK	CNS	COS	COMMENTS
170492	22:00-24:00	11	1	1	5B	IPT	0	31	77	429	0	0	0	
180492	0:00- 2:00	11	1	1	5B	IPT	0	11	27	73	0	0	0	
200492	18:00-20:00	11	1	1	5B	IPT	0	41	75	119	0	0	0	
200492	22:00-24:00	11	1	1	5B	IPT	0	139	330	368	2	0	0	1.2 mm steelhead set #2
210492	0:00- 2:00	11	1	1	5B	IPT	0	114	266	232	0	0	0	
220492	20:00-22:00	11	1	1	5B	IPT	0	19	18	51	0	0	0	trout and steelhead
220492	22:00-24:00	11	1	1	5B	IPT	0	120	204	327	0	0	0	
230492	0:00- 2:00	11	1	1	5B	IPT	0	94	94	96	0	0	0	
240492	20:00-22:00	11	2	1	5B	IPT	0	24	19	57	1	0	0	
240492	22:00-24:00	11	2	1	5B	IPT	0	59	52	90	0	0	0	
250492	0:00- 2:00	11	2	1	5B	IPT	0	34	42	161	0	0	0	
270492	19:00-21:00	11	1	1	5B	IPT	0	4	1	0	0	0	0	
270492	21:00-23:00	11	1	1	5B	IPT	0	53	57	108	1	0	0	4 rainbow and brown trout
280492	23:00- 1:00	11	1	1	5B	IPT	0	118	106	145	0	0	0	
280492	1:00- 3:00	11	1	1	5B	IPT	0	108	78	101	0	0	0	
280492	3:00- 5:00	11	1	1	5B	IPT	0	88	35	33	0	0	0	
280492	5:00- 7:00	11	1	1	5B	IPT	0	15	8	14	0	0	0	
290492	22:00-24:00	11	3	2	5B	IPT	0	325	231	284	0	0	0	
300492	0:00- 2:00	11	3	2	5B	IPT	0	108	113	43	0	0	0	
080592	17:30- 8:00	.	.	.	5B	IPT	0	80	50	70	30	0	6	
140592	8:00- 8:00	.	.	.	5B	IPT	0	10	0	0	0	0	0	
180592	8:00- 8:00	.	.	.	5B	IPT	0	12	0	0	0	0	0	
210592	8:00- 8:00	.	.	.	5B	IPT	0	2	0	0	0	0	0	
220592	9:20- 9:20	.	.	.	5B	IPT	0	3	0	0	0	0	0	